S. P. SHACKLETON.

SIGNALING APPARATUS.

APPLICATION FILED APR. 1, 1918.

1,411,385.

Patented Apr. 4, 1922.

2 SHEETS—SHEET 1.

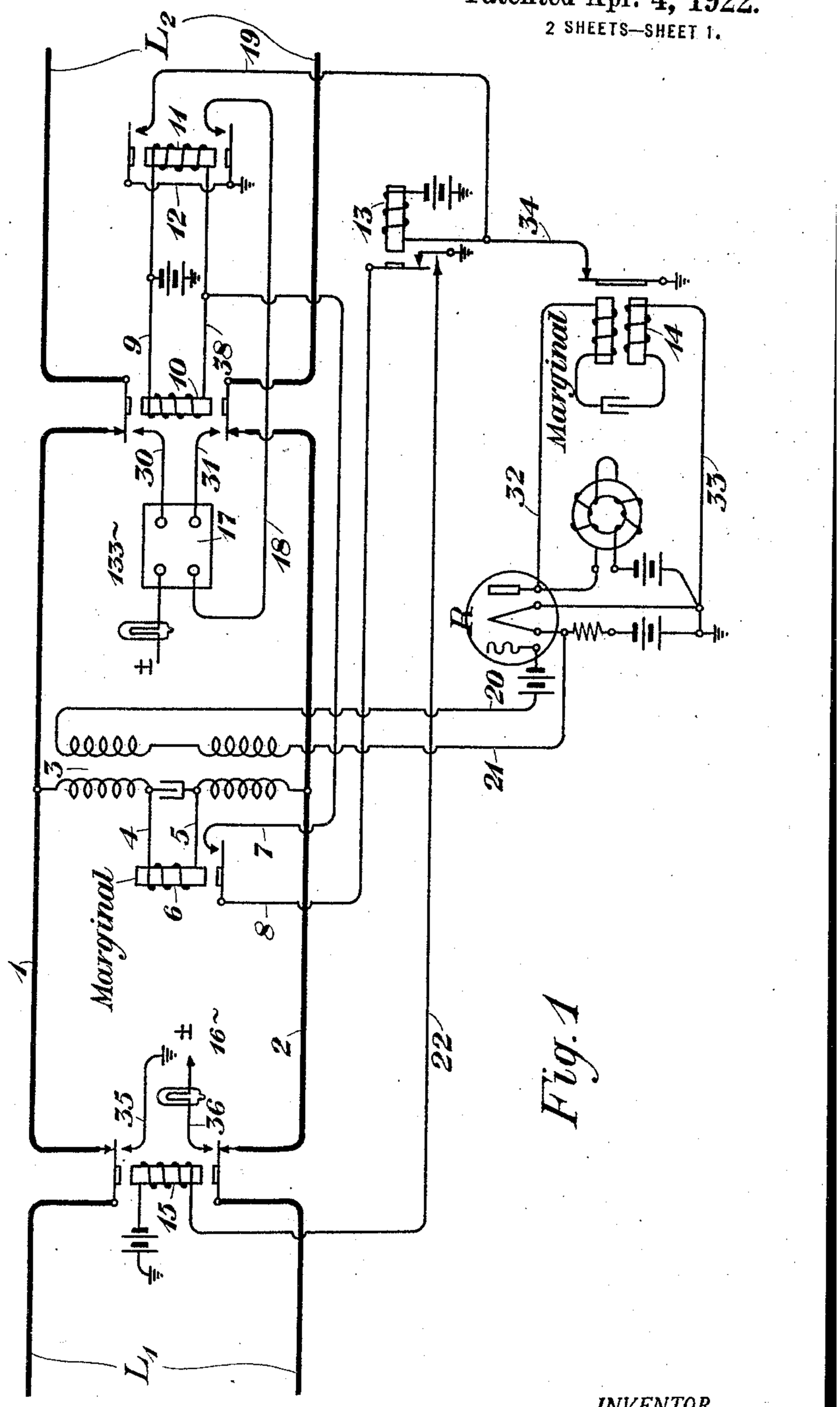


Fig. 1

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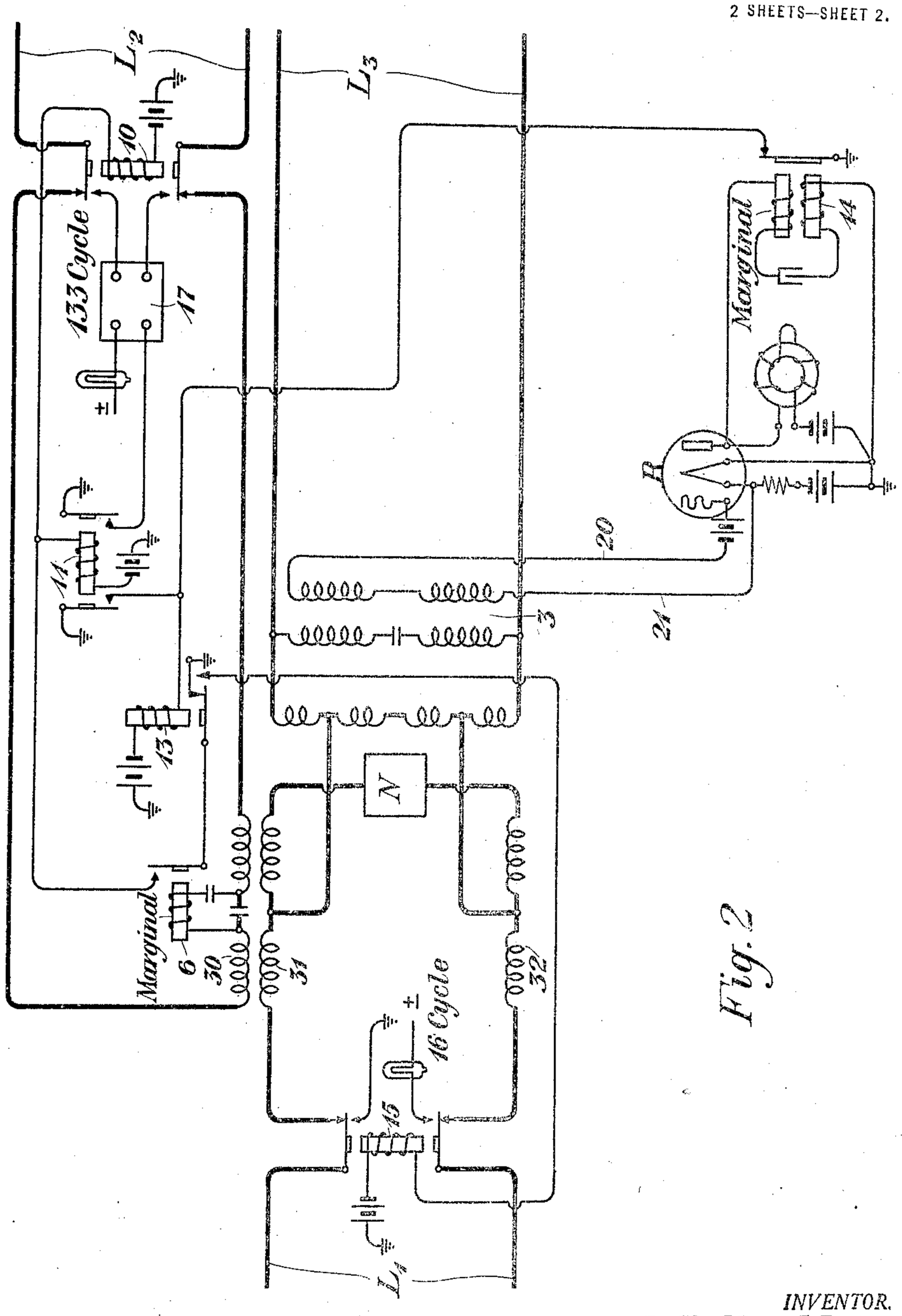


Fig. 2

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# UNITED STATES PATENT OFFICE.

SAMUEL P. SHACKLETON, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

## SIGNALING APPARATUS.

1,411,385. Specification of Letters Patent. Patented Apr. 4, 1922.

Application filed April 1, 1918. Serial No. 226,065.

*To all whom it may concern:*

Be it known that SAMUEL P. SHACKLETON, residing in New York city, in the county of Bronx and State of New York, has invented certain Improvements in Signaling Apparatus, of which the following is a specification.

This invention relates to ringing apparatus and more particularly to ringing apparatus for use in connection with composited telephone and telegraph lines.

It is one of the objects of the invention to provide a composite ringer set which will be very sensitive to ringing currents coming in over a transmission line, and which will, accordingly, increase the ringing range over a line. A further object consists in providing means for decreasing the transmission loss of telephonic currents ordinarily caused by the association of a composite ringer set with a line. Other and further objects of the invention will be more clear from the detailed description to be given later.

When a transmission line is used solely for telephone purposes the ringing current transmitted thereover may be of a frequency in the neighborhood of 16 cycles, and the ringing apparatus at the switchboard is constructed to generate and to respond to currents of approximately this frequency. When, however, the transmission line is composited and used for both telephone and telegraph purposes, it has been found that ringing currents having a frequency of the order above mentioned can not be transmitted out over such a line from the switchboard, nor can they be transmitted over such a line to the switchboard. This is because the frequency of these ringing currents is approximately the same as the frequency of the currents used for telegraphic purposes, and the discriminatory apparatus devised to keep these telegraphic currents from entering and interfering with the telephone apparatus, also serves to attenuate and practically extinguish these ringing currents of similar frequency. Accordingly, the ringing current to be well adapted for use over a composited transmission line must be of a frequency above the limit suppressed by this discriminatory apparatus, and it has been found that a ringing current having a frequency in the neighborhood of 133 cycles is well adapted for use over such a transmission line, although any frequency above the limit of this discriminatory apparatus may be satisfactory.

In order to change the low frequency ringing current generated at the switchboard into a higher frequency ringing current suitable for use over the transmission line and vice versa, arrangements are associated with the transmission line known as composite ringer sets. Such sets include a plurality of marginal relays. One of these marginal relays is adjusted to respond only to the ringing current coming in over the transmission line and its actuation serves to connect to the conductors leading to the switchboard apparatus a local source of ringing current suitable to operate such apparatus. The other marginal relay is adjusted to respond only to ringing current impressed on the line at the switchboard and its actuation serves to connect the outgoing transmission line to a source of ringing current suitable for transmission thereover.

The composite ringer set of this invention is associated with the line by means of a transformer, one winding of which is bridged across the line. The higher the impedance of this winding, the less will be the transmission loss caused thereby with respect to telephonic currents transmitted over the line, and, accordingly, this winding is constructed so as to have high impedance. Associated with the other winding of the transformer is an amplifier which amplifies the feeble ringing currents, which pass through the transformer, to a strength sufficient to cause the operation of the ringing arrangements of the composite ringer set. With such an arrangement a higher impedance bridge may be used than would otherwise be possible and the loss in transmission of telephone currents is correspondingly reduced. The sensitiveness of these arrangements, furthermore, serves to increase the ringing range over long distance lines.

This invention may now be more fully understood by reference to the accompanying drawing, in Figure 1 of which is illustrated a preferred form of the circuit arrangements of the composite ringer when associated with a transmission line. In the Figure 2 is illustrated a modification of the arrangements desirable for use with a four-wire repeater circuit. Only such portions of a four-wire repeater circuit have been shown in Figure

2 as are necessary for the purposes of illustrating this invention. However, a full illustration of a four-wire repeater circuit, with which the arrangements of this invention may be associated, may be found in Application, Serial No. 196,897, filed October 16, 1917, in the name of J. F. Toomey which has matured into Patent No. 1,295,816, issued Feb. 25, 1919.

In the Figure 1 the composite ringer is illustrated as associated with a transmission line, the section $L_1$ of which terminates at switchboard apparatus and the section $L_2$ of which extends to a distant station or central office. Associated with the talking conductors 1 and 2 of the transmission line is a transformer 3. One winding of the transformer 3 is of high impedance and is bridged across the talking conductors 1 and 2. Associated with the other winding of transformer 3 is a vacuum tube amplifier R and a marginal relay 14. The receiving circuit terminating in the relay 14 is tuned so that this relay will respond only to currents having a frequency desirable for transmission over the section $L_2$ of the transmission line and which in practice may be in the neighborhood of 133 cycles. Under the control of relay 14 is the relay 13, which in turn controls the relay 15. The operation of relay 15 serves to disconnect the talking conductors 1 and 2 from the section $L_1$ of the line and to connect to the section $L_1$ a local source of ringing current having a frequency suitable to operate the ringing apparatus located at the switchboard and which in practice may be in the neighborhood of 16 cycles. Associated with the winding of transformer 3, which is bridged across the conductors 1 and 2, is the marginal relay 6. The marginal relay 6 is tuned so that it will respond only to currents sent out by said ringing apparatus at the switchboard which in practice may have a frequency in the neighborhood of 16 cycles. Under the control of relay 6 are the relays 10 and 11. The relay 10, serves to disconnect the talking conductors 1 and 2 from the section $L_2$ of the transmission line and to connect the section $L_2$ to a generating apparatus 17. The relay 11 serves to start the generating apparatus 17 into operation. The generating apparatus 17 serves to translate currents from a local source into currents having a frequency suitable for ringing over the section $L_2$ of the line and which in practice may be in the neighborhood of 133 cycles. The operation of relay 11 also serves to lock up the relay 13 and thereby prevents the relay 15 from operating simultaneously with the relay 10.

The operation of the invention, as illustrated in Figure 1, is as follows: The ringing current, which is sent out from the switchboard and which may have a frequency in the neighborhood of 16 cycles, will be transmitted over the sides of the line $L_1$ and over conductors 1 and 2 and through the left hand winding of transformer 3 and thence over conductors 4 and 5 and through the winding of the marginal relay 6. As the marginal relay 6 is tuned to respond to the ringing current from the switchboard, it will become energized and close the following circuit: from ground, contact and armature of relay 13, conductor 8, armature and contact of relay 6, conductor 7, over conductor 38, windings of relays 10 and 11 and over conductor 9 to battery and ground. The closing of this circuit will operate the relays 10 and 11. The operation of relay 10 disconnects the sides of the line $L_2$ from the conductors 1 and 2 and connects the sides of the line $L_2$ to conductors 30 and 31, leading to the generating apparatus 17. The operation of relay 11 closes the following circuit: from ground, lower armature and contact of relay 11, conductor 18, to generating apparatus 17. The closing of this last mentioned circuit starts the generating apparatus 17 into operation. The generating apparatus 17 will, accordingly, translate current from a local source into current having a frequency suitable for ringing over the line $L_2$, which frequency as hereinbefore indicated may be in the neighborhood of 133 cycles. This ringing current will then be transmitted from the generating apparatus 17 over conductors 30 and 31, the contacts and armatures of relay 10 and out over the sides of the line $L_2$. The operation of relay 11 also closes the following circuit: from ground, conductor 12, upper armature and contact of relay 11, conductor 19, winding of relay 13, to battery and ground. The closing of this circuit locks up the relay 13. As will be described later, the relay 13 controls the operation of relay 15 and the closing of this last mentioned circuit and the locking up of the relay 13 will prevent simultaneous operation of the relays 15 and 10.

Ringing current coming in over the line $L_2$, which as stated may have a frequency in the neighborhood of 133 cycles, or thereabouts, will be transmitted over conductors 1 and 2 and through the lefthand winding of transformer 3. As the lefthand winding of transformer 3 is of high impedance, only a very feeble current will be induced in the righthand winding of transformer 3. This feeble current will be transmitted over conductors 20 and 21 to the amplifier R, where it will be amplified to a sufficient strength and transmitted over conductors 32 and 33 and through the windings of the marginal relay 14. As this part of the circuit including the marginal relay 14 has been tuned to respond to ringing currents coming in over the line $L_2$, it will become energized and, by pulling up its armature, will open the following normally closed circuit: from

ground, armature and contact of relay 14, conductor 34, winding of relay 13, to battery and ground. The opening of this circuit will deenergize the relay 13, which will allow its armature to retract and thereby close the following circuit: from ground, contact of relay 13, conductor 22, winding of relay 15, to battery and ground. The closing of this last mentioned circuit will operate the relay 15, which will disconnect the line $L_1$ from the conductors 1 and 2, connecting one side of the line $L_1$ to conductor 35 leading to ground, and the other side thereof to conductor 36 leading to a local source which supplies ringing current suitable for operating the ringing apparatus at the switchboard, and having the usual frequency of about 16 cycles.

In the Figure 2 the composite ringer arrangements are shown as associated with a four-wire repeater circuit connected to switchboard apparatus by means of the line $L_1$. The incoming and outgoing lines of the four-wire circuit are shown as $L_3$ and $L_2$ respectively. The lines $L_2$ and $L_3$ are associated with each other by means of the usual three-winding transformer, having the windings 30, 31 and 32. Associated with the windings 31 and 32 is the network N adapted to balance the section $L_1$ of the line. Associated with the line $L_3$ is the transformer 3, one winding of which is of high impedance and is bridged across the sides of the line. Associated with the other winding of transformer 3 is a vacuum tube amplifier R and the marginal relay 14. The circuit including the marginal relay 14 is tuned to respond only to current coming in over the line $L_3$ which in practice may be in the neighborhood of 133 cycles. The relay 14 controls the relay 13, which in turn controls the relay 15. The relay 15 serves to connect the line $L_1$ to a local source of ringing current which generates ringing current suitable for operating the ringing apparatus at the switchboard, and which in practice may be in the neighborhood of 16 cycles. Associated with the winding 30 is the marginal relay 6, which is tuned to respond only to ringing current sent out from the switchboard and which may in practice be in the neighborhood of 16 cycles. The relay 6 controls the relays 10 and 11. The relay 10 serves to connect the line $L_2$ to the generating apparatus 17 and the relay 11 serves to start the generating apparatus 17 into operation. The generating apparatus 17 serves to translate current from a local source into current having a frequency suitable for use over the line $L^2$ and which in practice may be in the neighborhood of 133 cycles. The relay 11 also serves to lock up the relay 13 and thereby prevents the relay 15 from operating simultaneously with the relay 10.

With the arrangements illustrated in Figure 2, ringing current coming in over the line $L_3$ will be transmitted by the transformer 3 to the amplifier R and thence to the marginal relay 14. As the relay 14 is tuned so that it will be operated by ringing current coming in over the line $L_3$, it will respond and operate the relay 13, which in turn will cause the operation of relay 15, whereby current from a local source suitable for operating the ringing apparatus at the switchboard will be impressed on the line $L_1$. The ringing current transmitted from the switchboard will flow through the transformer comprising the windings 30, 31, and 32 and will operate the marginal relay 6, which is tuned to respond to the type of ringing current generated at the switchboard. The operation of relay 6 will cause the operation of relays 10 and 11. The relay 10 will connect the generating apparatus 17, which translates current from a local source into current having a frequency suitable for ringing over the line $L_2$, to the sides of line $L_2$. The relay 11 will serve to lock up relay 13 and prevent the operation of relay 15, and will also start the generating apparatus 17 into operation, whereby current suitable for ringing over the line $L_2$ will be impressed thereon.

While the invention has been disclosed as embodied in certain specific arrangements which have been deemed desirable, it will be understood that it is capable of embodiment in many and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A transmission line, a composite ringer including amplifying means, and a transformer for associating said composite ringer with said line, one winding of said transformer being bridged across said line and having a high impedance to talking currents and a relatively lower impedance to signaling currents, said amplifying means being in circuit with the other winding of said transformer.

2. A transmission line terminating at a switchboard, ringing apparatus at said switchboard, a winding bridged across said line and having a high impedance to telephone currents and a relatively lower impedance to signaling currents, a second winding inductively related to said first mentioned winding, an amplifier associated with said second winding, a relay associated with said amplifier and responsive to signaling currents coming in over said line, and means controlled by said relay for opening the talking conductors of said line which lead to the switchboard and for impressing on said conductors a current suitable for operating the ringing apparatus at the switchboard.

3. A transmission line, a winding of high impedance to telephone currents and relatively lower impedance to signaling currents bridged across said line, a second winding inductively related to said winding, a vacuum bulb amplifier associated with said second mentioned winding, a relay coupled with the output circuit of said amplifier and responsive to signaling currents transmitted over one section of said transmission line when amplified, and means controlled by said relay for impressing on another section of said line signaling current of a different character from said first mentioned signaling current.

4. A transmission line, a winding of high impedance bridged across said line, a second winding inductively related to said winding, an amplifier associated with said second mentioned winding, a relay associated with said amplifier and responsive to signaling currents transmitted over one section of said transmission line, means controlled by said relay for impressing on another section of said line signaling current of a different character from said first mentioned signaling current, a relay associated with said first mentioned winding and responsive to signaling current transmitted over one section of the line, means controlled by said relay for impressing on another section of said line signaling current of a different character from said last mentioned signaling current, and means controlled by said last mentioned means for preventing the simultaneous operation of said first mentioned and said last mentioned means.

5. A transmission line terminating at a switchboard, signaling apparatus at said switchboard, a bridge across said line having a high impedance to telephone currents and a relatively lower impedance to signaling currents, a vacuum bulb amplifier associated with said bridge, a relay coupled with the output circuit of said amplifier and responsive to signaling currents coming in over said line when amplified, and means controlled by said relay for opening the talking conductors of said line which lead to the switchboard and for impressing on said conductors a current suitable for operating the signaling apparatus at the switchboard.

6. A transmission line, a bridge across said line having a high impedance to telephone currents and a relatively lower impedance to signaling currents, a vacuum bulb amplifier associated with said bridge, a relay coupled with the output circuit of said amplifier and responsive to signaling currents transmitted over one section of said transmission line when amplified, and means controlled by said relay for impressing on another section of said line signaling current of a different character from said first mentioned signaling current.

In testimony whereof, he has signed his name to this specification this 28 day of March, 1918.

SAMUEL P. SHACKLETON.