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C. S. DEMAREST.
THROUGH RINGING AMPLIFIER.
APPLICATION FILED OCT. 16, 1917.

Patented Oct. 8, 1918.

2 SHEETS—SHEET 1.

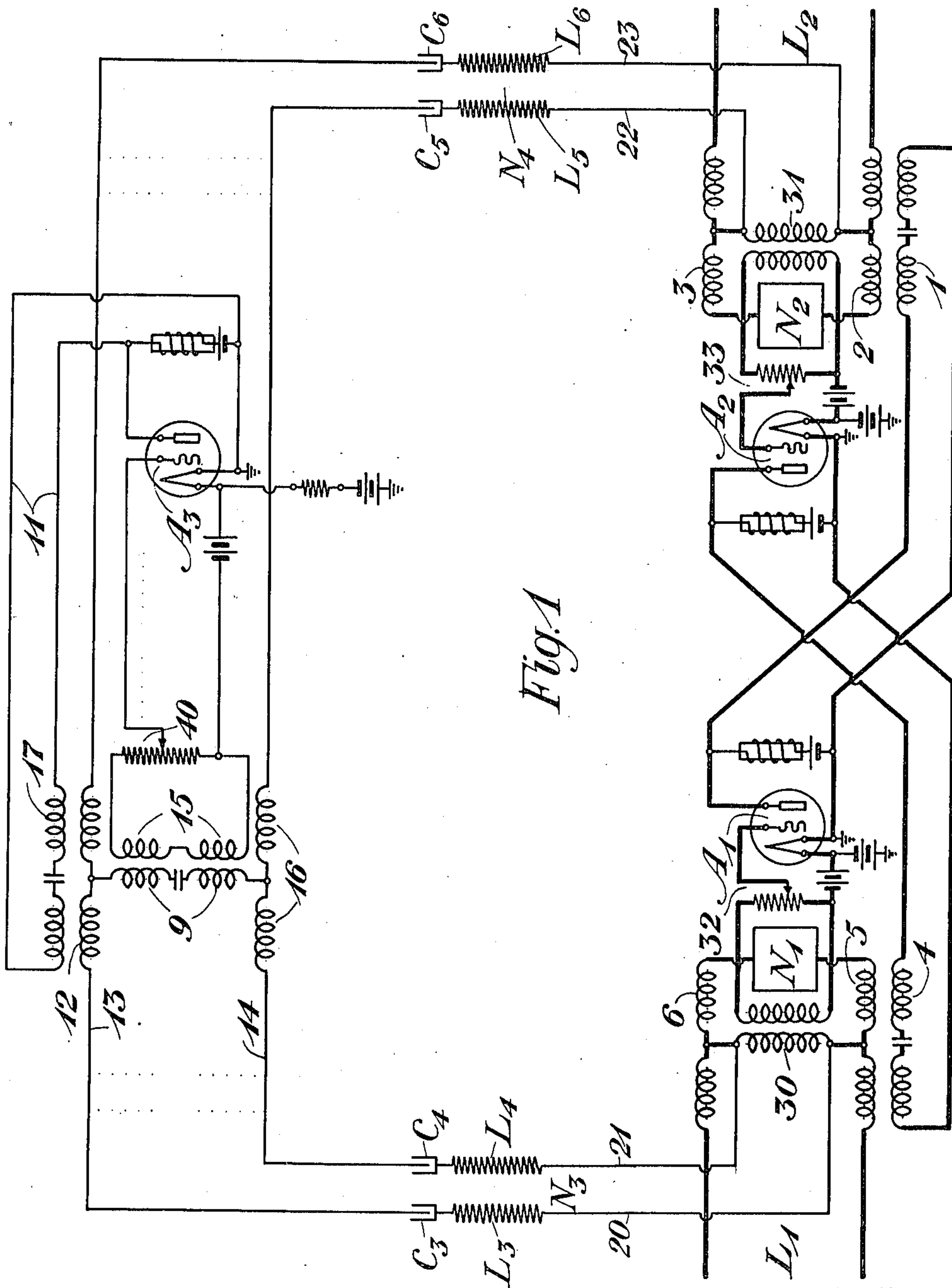


Fig. 1

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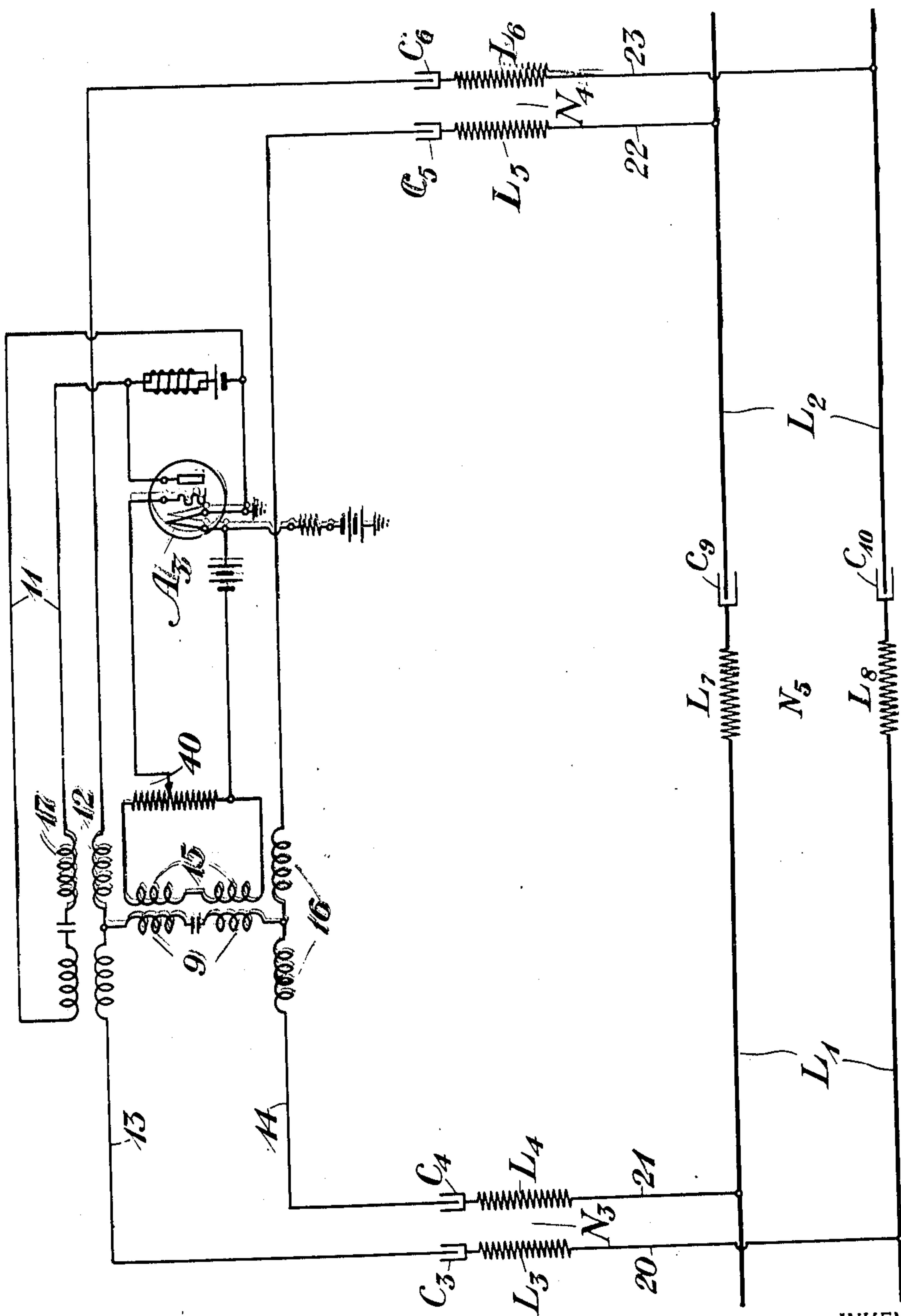


Fig. 2

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UNITED STATES PATENT OFFICE.

CHARLES S. DEMAREST, OF FLATBUSH, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

THROUGH-RINGING AMPLIFIER.

1,280,969.

Specification of Letters Patent.

Patented Oct. 8, 1918.

Application filed October 16, 1917. Serial No. 196,895.

To all whom it may concern:

Be it known that I, CHARLES S. DEMAREST, residing at Flatbush, in the county of Kings and State of New York, have invented certain Improvements in Through-Ringing Amplifiers, of which the following is a specification.

This invention relates to ringing equipment for use on transmission lines and also for use on transmission lines including repeater elements.

It is one of the objects of the invention to provide a means for amplifying ringing current in a transmission line without affecting the balance of the repeaters included therein, or interfering with the transmission. Another object of the invention is to increase the ringing range on long toll lines not equipped with telephone repeaters. A further object is to obviate the tendency for false ringing which is prevalent in former types of through line repeater equipment. Other and further objects of the invention will be clear from the detailed description to be given later.

In former types of through line repeaters many difficulties have been experienced in through ringing due to the occurrence of electrical and mechanical interference with the relays and interrupters associated with the apparatus and false ringing often results from such interference. For the purpose of eliminating the relays and interrupters from the through line repeater equipment and at the same time providing satisfactory means for through ringing, the apparatus embodied in this invention has been provided. Such apparatus includes an intermediate repeater circuit designed to be especially efficient for amplifying ringing current. When the transmission line includes repeater elements, this intermediate repeater circuit is associated therewith by means of conductors bridged from the mid-points of the input windings of the through line repeaters included in the line. When the intermediate repeater circuit is to be used with a transmission line which does not include repeater elements the conductors associating it therewith are bridged directly across the two sections of the transmission line, said sections being interconnected by an artificial line. In order that the transmission of talking currents over the line may not be affected by this intermediate repeater

circuit, there is inserted in the conductors leading thereto a pair of artificial lines so designed as to be resonant to currents having a frequency suitable for ringing purposes, such for example as 133 cycles, while at the same time offering a high impedance to currents of talking frequencies. By the above arrangements it will be possible to send amplified ringing current out over a transmission line without interfering with either the transmission or amplification of voice currents thereover, and without the occurrence of false ringing.

The arrangements of the invention may now be more fully understood from the following description taken in connection with the accompanying drawing in the Figures 1 and 2 of which are illustrated the preferred form of the circuit arrangements of the invention: In Fig. 2 the intermediate repeater circuit is shown associated with a transmission line, while in Fig. 1 the intermediate repeater circuit is shown associated with a transmission line which includes the usual type of two way two element repeater. In the Fig. 1 the incoming and outgoing sections of a transmission line are shown at L_1 or L_2 . Inserted in the transmission line is the usual type of through line repeater consisting of two amplifiers A_1 and A_2 having their output circuits coupled to the lines L_2 and L_1 respectively by means of the windings 1, 2, and 3, and 4, 5, and 6, and having their input circuits coupled to the lines L_1 and L_2 by means of the transformers 30 and 31 respectively. The transformers 30 and 31 are designed to be especially efficient for the transmission of voice currents but offer a fairly high impedance to currents of ringing frequency and hence reduce the transmission of ringing currents through the repeater. Inserted in the input circuits of the amplifiers A_1 and A_2 are the potentiometers 32 and 33 for the purpose of regulating the amplification to produce an amplitude desirable for voice currents. As the amplification desirable for voice currents may in practice be considerably lower than the amplification desirable for ringing current, it will be seen that any ringing current, which is transmitted through the transformers 30 and 31 and the potentiometers 32 and 33, arrives at the amplifiers A_1 and A_2 so attenuated that it will not be transmitted out over the lines L_2 or L_1 with the amplitude de-

sirable for practical use, and it is for the purpose of obviating this difficulty that the arrangements to be described later have been provided. For the sake of convenience the
 5 amplifiers A_1 and A_2 are shown as of the vacuum tube type although any other well known arrangement such as the mechanical repeater may be used. Associated with the amplifiers A_1 and A_2 are the artificial lines
 10 N_1 and N_2 adapted to simulate the respective sections L_1 and L_2 of the transmission line.

Bridged from the mid-points of the repeater input windings 5 and 6 are the conductors 20 and 21 leading to the artificial
 15 line N_3 which includes the retardation coils L_3 and L_4 and the condensers C_3 and C_4 . Bridged from the mid-points of the repeater input windings 2 and 3 are the conductors 22 and 23 leading to the artificial line N_4 , similar to N_3 , and including the retardation coils
 20 L_5 and L_6 and the condensers C_5 and C_6 . The artificial lines N_3 and N_4 are designed to be resonant to currents of a frequency suitable for ringing, as for example 133 cycles,
 25 while offering a high impedance to currents of talking frequencies. Accordingly the artificial lines N_3 and N_4 prevent talking currents from entering and being transmitted over the intermediate repeater circuit, but
 30 readily allow ringing currents to be transmitted thereover. Furthermore artificial lines N_3 and N_4 tend to balance lines L_1 and L_2 with respect to the intermediate repeater A_3 . The artificial lines N_3 and N_4 are inter-
 35 connected by means of the conductors 13 and 14 in which are inserted the windings 12 and 16, the neutral points of which are interconnected by the winding 9. In inductive relation to the winding 9 is the winding 15 which
 40 serves as the input winding of the intermediate repeater circuit, said input circuit being completed by the potentiometer 40 and the conductors leading to the grid and filament of amplifier A_3 . The potentiometer 40 is ad-
 45 justed to regulate the amplification of the amplifier A_3 to produce an amplitude desirable for ringing purposes. Associated with the amplifier A_3 is an output circuit formed by the conductors 11 and the winding 17,
 50 which is in inductive relation to the winding 12. By this inductive relation amplified ringing current may be transmitted to the conductors 13 and 14 and thence over the artificial line N_4 and the conductors 22 and 23
 55 to section L_2 of the transmission line. This amplified ringing current may also be transmitted from the conductors 13 and 14 to section L_1 of the transmission line by way of the artificial line N_3 and the conductors 20
 60 and 21.

In the Fig. 2 the two sections L_1 and L_2 of the transmission line are coupled together by the artificial line N_5 including the retardation coils L_7 and L_8 and the condensers C_7 and
 65 C_{10} , instead of a two way through line re-

peater. This artificial line N_5 is designed to transmit transmission currents efficiently while offering a high impedance to ringing currents. Thus the greater part of the ringing currents pass through the intermediate
 70 repeater. When such is the case the conductors 20 and 21, and 22 and 23, leading to the artificial lines N_3 and N_4 , are connected directly to the sides of the transmission line and in all other respects the intermediate re-
 75 peater circuit is similar to that shown in Fig. 1.

With this description of the apparatus in mind the arrangements of the invention may now be more fully understood from the fol-
 80 lowing description of its operation.

The ringing current coming in over the line L_1 , Fig. 1, will be transmitted from the mid-points of the windings 5 and 6 and over the conductors 20 and 21 to the artificial line
 85 N_3 . As has been formerly pointed out this artificial line is so constructed that it offers a high impedance to currents of talking frequencies, while being resonant to current having a frequency suitable for ringing
 90 such for example as 133 cycles. Accordingly any talking currents which are transmitted over the conductors 20 and 21 will be practically extinguished by the artificial line N_3 , while ringing current will be readily trans-
 95 mitted thereover. The ringing current will then be transmitted over conductors 13 and 14 and through the winding 9. An induced ringing current will then be set up in the winding 15 and will be transmitted to the
 100 potentiometer 40 and over the conductors leading to the grid and filament of the amplifier A_3 . The ringing current is accordingly amplified by the amplifier A_3 and is transmitted in amplified form out over con-
 105 ductors 11 and through the winding 17. An induced amplified current will then be set up in the windings 12 and 16 and transmitted over conductors 13 and 14 to the artificial line N_4 . As the artificial line N_4 is similar
 110 in construction to artificial line N_3 , the amplified ringing current will be readily transmitted therethrough, and thence over conductors 22 and 23 to the line L_2 over which it is transmitted in the desired amplified form.
 115 A portion of the amplified ringing current will also be transmitted through the artificial line N_3 and back over the line L_1 but this does not interfere with the operation.

In like manner ringing current coming in
 120 over the line L_2 will be transmitted over the conductors 22 and 23 and the artificial line N_4 to the circuit of the amplifier A_3 and thereby be amplified and in turn transmitted out over the line L_1 . As the operation is sub-
 125 stantially the same for ringing current coming in over the line L_2 , as in the case of ringing current coming in over the line L_1 , no detailed description of the operation is necessary.

The operation of the intermediate amplifier circuit illustrated in Fig. 2, when associated with a transmission line which does not include repeater elements, is substantially the same as described above, and the description of its operation will be omitted.

While the invention has been illustrated as embodied in certain specific forms it will be understood that it is capable of embodiment in many and widely varied arrangements without departing from the spirit of the invention.

What is claimed is:

1. In a telephone transmission system, the combination with a transmission line and means included therein for amplifying currents transmitted thereover, said means being adapted to transmit currents of all frequencies within the limits of the frequencies found in the usual voice or telephone currents; of an auxiliary circuit associated with said line for transmitting currents suitable for ringing purposes around said amplifying means, amplifying means included in said auxiliary circuit, and means in said auxiliary circuit between said transmission line and said last mentioned amplifying means for attenuating and practically extinguishing currents suitable for talking purposes.

2. In a telephone transmission system, the combination with a transmission line including a through line repeater and transformer windings located in each side of said line and on each side of said repeater; of an auxiliary circuit bridged from the mid-points of said transformer windings, said auxiliary circuit including means adapted to amplify current suitable for ringing purposes and means between the transmission line and said last mentioned amplifying means for attenuating and practically extinguishing currents suitable for talking purposes.

3. In a telephone transmission system, the combination with a through line repeater adapted to transmit currents of all frequencies within the limits of the frequencies found in the usual voice or telephone currents; of an intermediate amplifying set bridged around said repeater, artificial lines inserted between said intermediate set and said repeater, said artificial lines being so

designed as to attenuate and practically extinguish currents of certain frequencies entering said intermediate set.

4. In a telephone transmission system, the combination with a through line repeater apparatus adapted to transmit currents of all frequencies within the limits of the frequencies found in the usual voice or telephone currents; of an auxiliary circuit bridged around said apparatus, a two-way one element repeater included therein designed to amplify current suitable for ringing purposes, and means in said bridged circuit for attenuating and practically extinguishing currents suitable for talking purposes entering therein.

5. In a signaling system, the combination with a transmission line adapted to transmit currents of all frequencies within the limits of the frequencies found in the usual voice or telephone currents; of an auxiliary circuit shunted around a portion of said transmission line, amplifying means included in said auxiliary circuit, and means in said auxiliary circuit between said amplifying means and said transmission line for attenuating and practically extinguishing currents of certain frequencies.

6. In a signaling system, the combination with a telephone transmission line adapted to transmit currents of all frequencies within the limits of the frequencies found in the usual voice or telephone currents; of an auxiliary circuit shunted around a portion of said transmission line, amplifying means included in said auxiliary circuit adapted to amplify current suitable for ringing purposes, and means included therein between said amplifying means and said transmission line for attenuating and practically extinguishing currents suitable for talking purposes.

In testimony whereof, I have signed my name to this specification in the presence of two subscribing witnesses, this tenth day of October 1917.

CHARLES S. DEMAREST.

Witnesses:

MAY QUINN,
ALFRED KAUFMANN.