J. F. TOOMEY.

MEANS FOR CONTROLLING REPEATER CIRCUITS.

APPLICATION FILED OCT. 16, 1917.

1,400,189.

Patented Dec. 13, 1921.

3 SHEETS—SHEET 1.

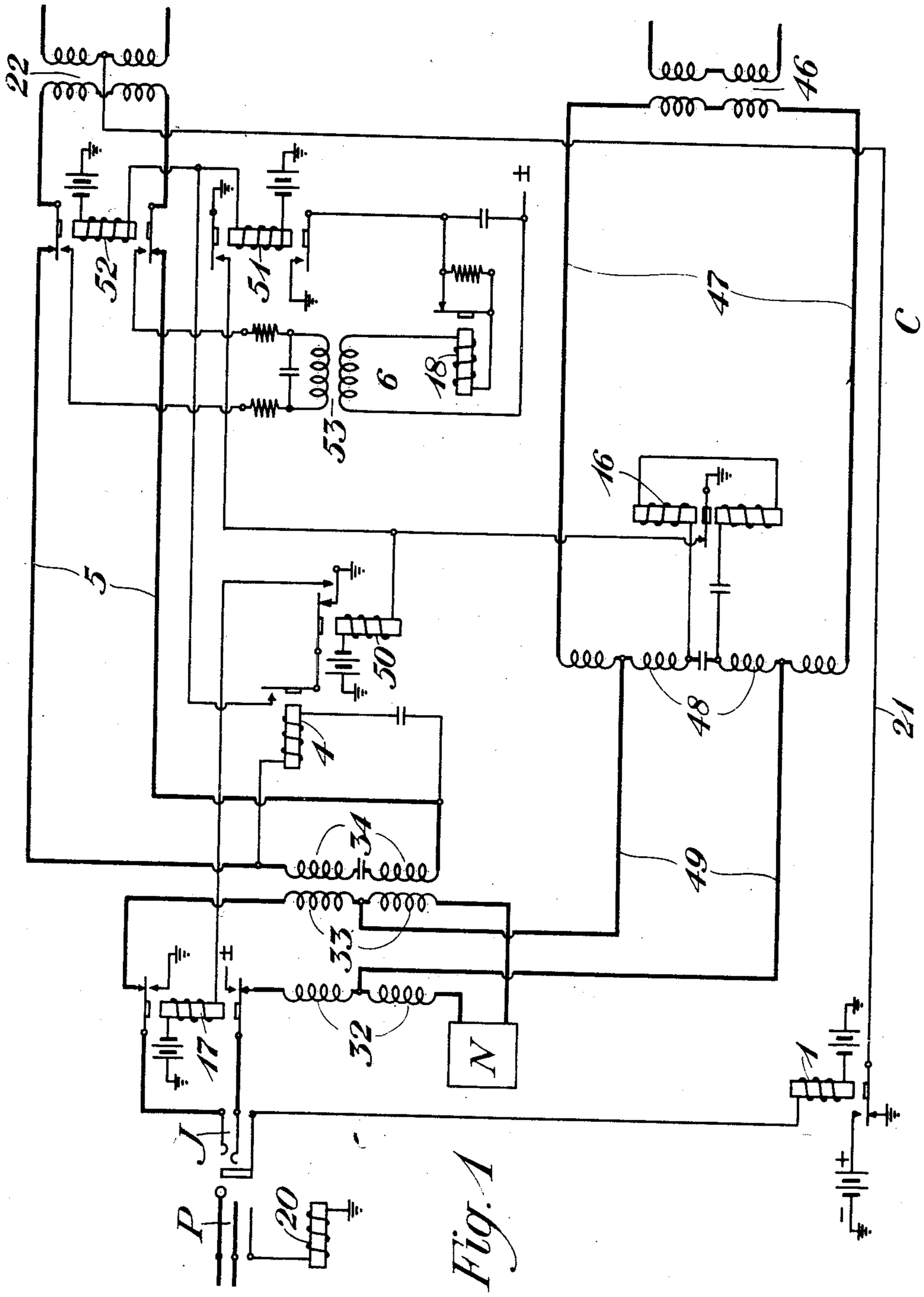


Fig. 1.

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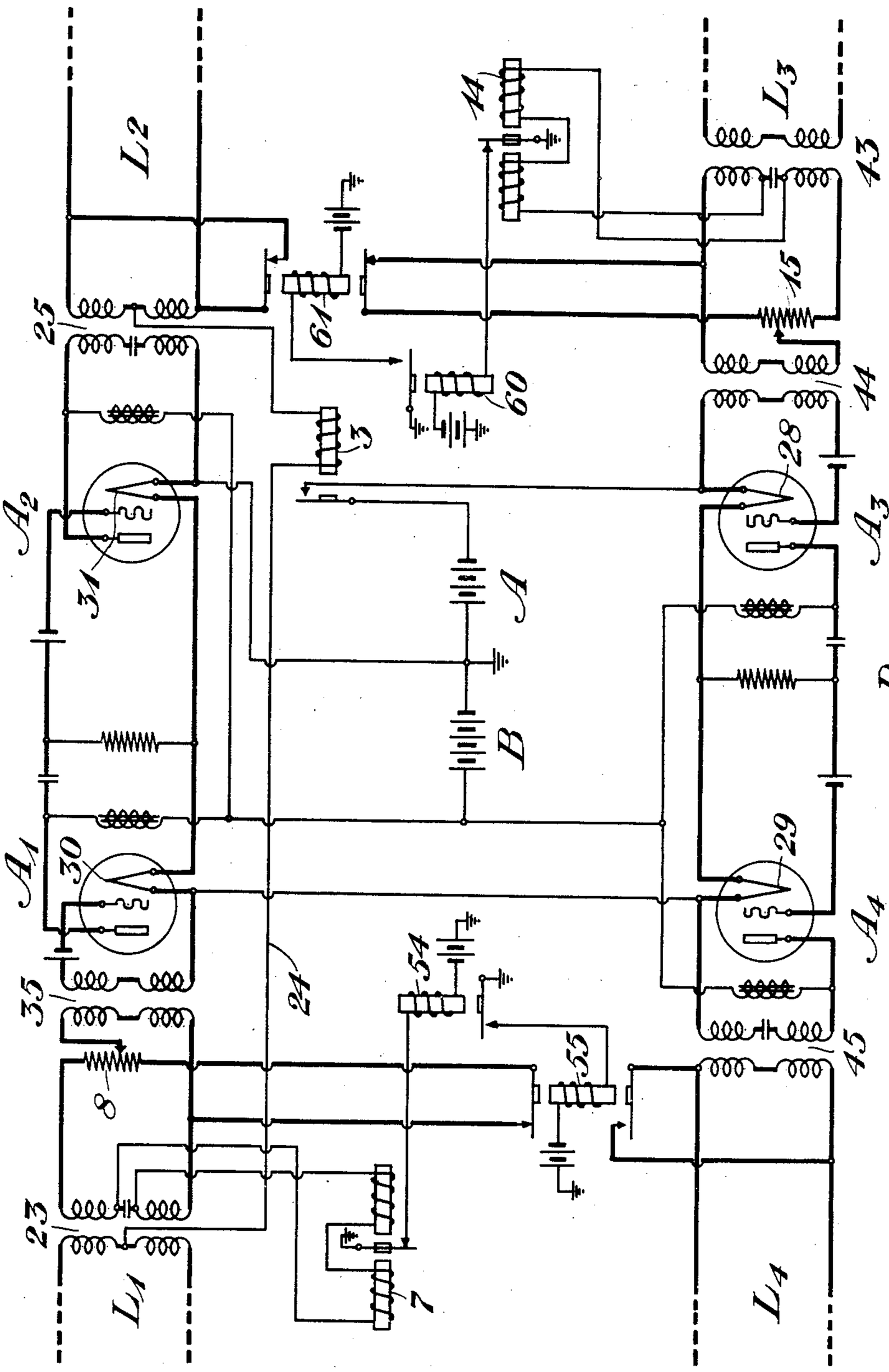


Fig. 2

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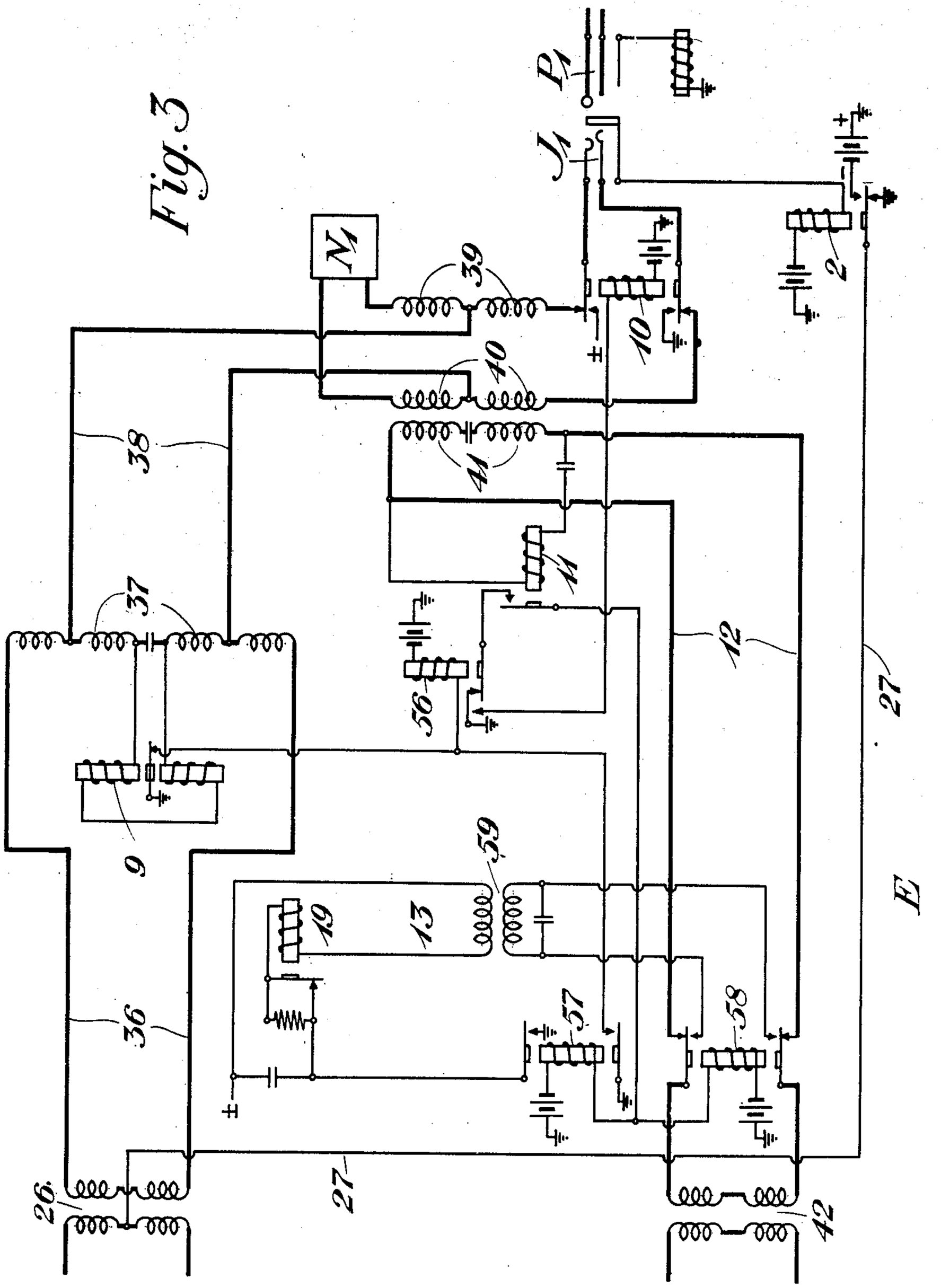
3 SHEETS—SHEET 3.

Fig. 3




INVENTOR.

J. F. Toomey

BY

ATTORNEY

# UNITED STATES PATENT OFFICE.

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## MEANS FOR CONTROLLING REPEATER-CIRCUITS.

1,400,189. Specification of Letters Patent. Patented Dec. 13, 1921.

Application filed October 16, 1917. Serial No. 196,898.

*To all whom it may concern:*

Be it known that I, JOHN F. TOOMEY, residing at 111 W. 84th street, New York city, in the county of New York and State of New York, have invented certain Improvements in Means for Controlling Repeater-Circuits, of which the following is a specification.

This invention relates to repeater circuits and more particularly to repeater circuits of the type known as four-wire repeater circuits. The invention has for one of its objects the provision of means whereby a repeater may be controlled from a distant station. Another object of the invention has reference to the provision of means whereby it is possible to transmit ringing or other auxiliary signaling current over a four-wire repeater circuit. Such means may include instrumentalities whereby the ringing or signaling current may be relayed at suitable points in the circuit, or may be amplified if desired. Further objects of the invention will be clear from the detailed description of the invention to be given later.

In the usual four-wire repeater circuit used for telephone transmission two distant stations are interconnected by a pair of transmission lines one for transmission in each direction, one way repeaters being inserted in the lines at an intermediate station or stations to amplify the voice currents transmitted over the circuit. If the one way repeaters or amplifiers are of the well known vacuum tube type, it is desirable that the amplifiers at the intermediate stations be cut out of service when the circuit is not in use. While this might be done by operators or attendants at the intermediate stations, it is preferable that the entire connection should be under the control of the operators at the terminal stations. Therefore means are provided in accordance with this invention whereby the operator at either terminal station may control the circuits of the amplifiers at intermediate stations to render them operative.

In order to provide through ringing over the four-wire circuit, which in practice is connected at the terminal stations to terminating two-wire lines, arrangements are provided whereby ringing current coming in over a two-wire line may actuate a relay apparatus at the terminating station, which relay apparatus applies ringing current from a local source at the terminal station to the outgoing line of the four-wire circuit. The ringing current thus applied may if desired be of a different frequency from that coming in over the two-wire line. This relayed ringing current is then transmitted over the line to the intermediate repeating station or stations where it actuates mechanisms to adjust the amplifiers at the intermediate stations to secure the desired amplification for ringing current. The ringing current transmitted to the intermediate station or stations is then amplified at said station or stations and the amplified ringing current transmitted to the terminal station where it actuates a relay apparatus to apply ringing current from a local source to the terminating two-wire line with which the four-wire circuit is associated at said terminal station. It will be understood, however, that in certain four-wire organizations it may not be desirable or necessary to relay the ringing current, the amplification at the repeater station being sufficient for transmission purposes. In other organizations it may be undesirable to pass the ringing current through amplifiers at the intermediate stations, in which case the ringing current may be relayed around the amplifying apparatus. Various other changes may be suggested depending on the particular conditions and service requirements met with.

The invention may now be fully understood from the following description taken in connection with the accompanying drawing, Figures 1, 2 and 3 of which when placed side by side in numerical order, constitute a circuit diagram of the arrangements of the invention. Referring to the drawing, stations C, D and E are shown, stations C and E being connected by a four-wire circuit consisting of two separate transmission lines, each line being used for transmission in one direction only. For instance, transmission from station C to E takes place over the lines $L_1$ and $L_2$ while transmission from E to C takes place over the lines $L_3$ and $L_4$. At station D, intermediate between stations C and E, an amplifying arrangement, consisting of one way repeaters for each transmission line, is provided. The amplifying arrangement between lines $L_1$ and $L_2$ consists of a pair of tandem amplifiers $A_1$ and $A_2$ of the well known vacuum tube type although it will be understood that any other well known type of amplifier may be employed. Similarly

between line $L_3$ and $L_4$ vacuum tube amplifiers $A_3$ and $A_4$ are arranged in tandem. These amplifiers are all illustrated as being arranged at intermediate station D. It will be understood, however, that if desired a plurality of intermediate stations may be arranged between the terminal stations C and E, each intermediate station being provided with amplifying arrangements similar to that illustrated in connection with station D. At each terminal station C and E the four-wire circuit is coupled through a three winding transformer to a two-wire connection terminating in jacks J and $J_1$, whereby the four-wire circuit may be connected to terminating two-wire lines outgoing from stations C and E. The terminating two-wire lines are not illustrated, however, but plugs P and $P_1$ of suitable cord circuits for connecting the four wire circuits to the terminating two-wire lines are shown coöperating with jacks J and $J_1$. Artificial lines N and and $N_1$ are provided at stations C and E respectively to balance the particular terminating two-wire line with which the four-wire circuit is connected.

In order that the operators at stations C and E may have control of the amplifying arrangement at station D, simplex circuits are provided, said simplex circuits being under the control of sleeve relays 1 and 2 of the terminating jacks of the four-wire circuit. The simplex circuit extends from the contact of relay 1 over the two sides of line $L_1$ in parallel through the winding of an amplifier controlling relay 3 at station D, over the two sides of the line $L_2$ in parallel and thence to the contact of sleeve relay 2. This circuit is so arranged that upon the energization of either relay 1 or relay 2 or both the simplex circuit is closed to energize the amplifier controlling relay 3 which operates to close the energizing circuit of the filaments of the amplifiers, thereby rendering them operative.

In order to provide for through ringing over the four-wire circuit from station C to station E a relay 4 responsive to 16 cycle ringing current coming in from a terminating two-wire line is bridged across the outgoing circuit 5 of the four-wire repeater arrangement. This ringing relay 4 operates to control an apparatus 6 whereby 133 cycle ringing current is generated and applied to the line $L_1$. 133 cycle ringing current is applied at station C instead of 16 cycle ringing current for the reason that the former frequency is better adapted to the type of transmission circuit provided by the lines $L_1$ and $L_2$. It will be understood, of course, that, subject to conditions met in practice, the frequency of the ringing current used may be varied as desired or found necessary and where conditions warrant, the frequency of the relayed ringing current applied to the outgoing line of the four-wire circuit may be the same as that received from the terminating two-wire line.

At the station D the ringing current transmitted over the line $L_1$ actuates a suitable ringing responsive relay 7 which controls mechanisms whereby the portion of a potentiometer 8 which is in shunt of the input circuit leading to the amplifier $A_1$ is opened, while at the same time the induction coil connecting the output circuit of amplifier $A_4$ with line $L_4$ is short circuited. Upon opening the shunt portion of the potentiometer 8 the ringing current transmitted over line $L_1$ is applied to the amplifiers $A_1$ and $A_2$ and thereby amplified. The ringing current is then transmitted over the line $L_2$. The opening of the circuit of the potentiometer above described is for the purpose of increasing the amplification of the amplifiers so as to secure the desired amplification for ringing current.

The ringing current transmitted over the line $L_2$ at station E operates a ringing responsive relay 9 in bridge of the input circuit of the four-wire repeater. Relay 9 controls the operation of a relay 10 whereby 16 cycle ringing current is applied to the terminating two-wire line.

Similarly in order to provide for through ringing from station E to station C a relay 11 is bridged across the output circuit 12 of the four-wire repeater at station E, said relay controlling a generating apparatus 13 whereby 133 cycle ringing current may be applied through a suitable transformer to the line $L_3$. The ringing current transmitted over the line $L_3$ to station D operates a ringing responsive relay 14 at said station which in a manner similar to that of relay 7 opens the shunt portion of potentiometer 15 and short circuits the induction coil connecting line $L_2$ to the output circuit of repeater $A_2$. The ringing current from line $L_3$ is then amplified by amplifiers $A_3$ and $A_4$ and transmitted over the line $L_4$ to station C where it actuates a relay 16 to control the application of 16 cycle ringing current to the terminating two-wire line, over the contacts of relay 17.

It will be noted that at station D when the shunt of the potentiometer is opened in one transmission line of the four-wire circuit, the other transmission line of the four-wire circuit is short circuited. This is to prevent the possibility of any ringing current being transmitted back over the return circuit due to incomplete balance at the terminal stations. It will also be noted that while in the preceding description the ringing current has been described as being of either 16 or 133 cycle frequency, any desired frequency may be used, these particular frequencies having been referred to because in practice they have been found to conform

to the requirements of the particular grade of transmission circuits used. The apparatus 6 at station C and the apparatus 13 at station E are so arranged as to translate ringing current from a 16 cycle source to 133 cycle frequency. This result is accomplished by means of buzzer relays 18 and 19 which are mechanically timed so that their armatures will vibrate at a periodicity of about 133 cycles per second to break up the 16 cycle current into the higher frequency current desired.

With this brief description of the apparatus in mind, the invention may now be fully understood from a description of the operation. Assuming that the cord circuits corresponding to plugs P and $P_1$ are connected with terminating two-wire lines at stations C and E and that said plugs are inserted in jacks J and $J_1$ respectively of the four-wire circuit, upon inserting plug P in jack J a circuit is completed from battery through the winding of relay 1, sleeve contacts of jack J and plug P, and winding of relay 20, to ground. A similar circuit is completed for the relay 2. Upon the energization of relay 1 the positive pole of the battery is connected to the conductor 21 of a simplex circuit which extends from the mid-point of the secondary winding of an induction coil 22 through the two halves of said winding in parallel, and thence in parallel over the two sides of line $L_1$, through the two halves of primary of induction coil 23 to conductor 24, through the winding of relay 3, to the mid-point of the secondary winding of induction coil 25, thence over the two sides of the line $L_2$ in parallel, over the two halves of the primary of induction coil 26, over conductor 27, and over the front contact of relay 2 to the negative pole of a battery at station E. Relay 3 at station D is thereby energized with the result to be presently described. In case the plug $P_1$ had not yet been inserted in the jack $J_1$, the circuit above traced would have passed over the back contact of relay 2 to ground, completing an energizing circuit for relay 3. In case the plug $P_1$ is inserted in jack $J_1$ before the plug P is inserted in jack J, the circuit would have extended from the negative pole of the battery at station E over the front contact of relay 2 and thence over the path previously traced through station D to conductor 21 at station C and over the back contact of relay 1 to ground, thereby energizing relay 3. It will thus be seen that if either plug P or plug $P_1$, or both, be inserted in the corresponding jacks, relay 3 will be energized.

Upon the energization of relay 3 a circuit is completed from filament heating battery A over the front contact of relay 3, through filaments 28, 29, 30 and 31 in series to the grounded side of battery A. The filaments of the four amplifiers are now caused to glow, so that under the potential due to battery B in the output circuits of the amplifiers, a discharge passes from the filament to the plate of each of the amplifiers, so that they are in operative condition. Before the filament heating circuit was closed no energy was wasted by either battery A or battery B, the circuit of battery A being opened at the contact of relay 3, and the circuits of battery B being non-conductive, due to the evacuated space between the unheated filament and the plate of each of the amplifiers. The amplifiers being now in operative condition, transmission for talking purposes may take place. Talking currents coming in from a terminating two-wire line over the contacts of plug P and jack J, are transmitted through the three limb induction coil comprising windings 32, 33 and 34 to the outgoing circuit 5 and through induction coil 22 to line $L_1$. After being transmitted over the line $L_1$ and through induction coil 23 the talking currents are applied through the potentiometer 8 and induction coil 35 to the input circuit of amplifier $A_1$. The talking currents then pass through the amplifiers $A_1$ and $A_2$ in tandem, being thereby amplified, and are transmitted through induction coil 25 to line $L_2$. From the line $L_2$ the amplified currents are transmitted through an induction coil 26 to circuit 36, over which they are transmitted through an auto transformer 37 to the incoming circuit 38 of the four-wire circuit which leads to the mid-points of windings 39 and 40 of a three limb induction coil similar to the induction coil already described at station C. The incoming currents from circuit 38 divide between the artificial line $N_1$ and the terminating two-wire line, passing over the contacts of jack $J_1$ and plug $P_1$. Due to this arrangement the circuit is balanced with respect to the third winding 41 of the induction coil so that substantially no energy is wasted over the circuit 12, the transmission taking place in one direction only. In a similar manner incoming currents from a terminating two-wire line at station E are transmitted through the three limb induction coil comprising windings 39, 40 and 41, to the outgoing circuit 12 of the four-wire organization at station E and thence through induction coil 42 to the line $L_3$, and through induction coil 43, potentiometer 15 and induction coil 44 to the input circuit of amplifier $A_3$. The talking current is then passed through amplifiers $A_3$ and $A_4$, being thereby amplified, and transmitted through induction coil 45 over line $L_4$ and through induction coil 46 to circuit 47, leading through auto transformer 48 to the input circuit 49 at station C. The energy transmitted over circuit 49 divides between the artificial line and the terminating two-wire line connected with jack J, so that a balance is produced

with respect to circuit 5 and substantially no energy is wasted in said circuit.

Assuming that ringing current is transmitted over a terminating two-wire line connected to the plug P, said ringing current is transmitted through the three limb induction coil comprising windings 32, 33 and 34 to ringing responsive relay 4 bridged across the outgoing circuit 5. Relay 4 is thereby energized and at its front contact closes a circuit from ground over the front contact of normally energized relay 50, front contact of relay 4 and in parallel through the windings of relays 51 and 52 to battery. Relays 51 and 52 are thereby energized, the former at its upper contact completing a locking circuit for normally energized relay 50 to prevent the deënergization of said relay due to the action of ringing responsive relay 16 which might respond to ringing currents transmitted into circuit 49 from the two-wire line. The deënergization of relay 50 would result as explained hereafter in the application of ringing current to the terminating two-wire line. Relay 51 at its lower contact closes a circuit from ground over the front contact of said relay, back contact and winding of buzzer relay 18, primary winding of induction coil 53, to a source of 16 cycle current, thereby setting buzzer relay 18 into operation so that the 16 cycle current is broken up into 133 cycle current and transmitted through the induction coil 53. Relay 52 upon being energized, opens the outgoing circuit 5 and connects the secondary winging of induction coil 53 to the line $L_1$, so that 133 cycle ringing current is transmitted through induction coils 53 and 22 to the line $L_1$. Said ringing current, upon being transmitted over the line $L_1$ and through the induction coil 23 actuates relay 7 which operates to open the circuit of normally energized relay 54 which relay upon deënergizing, at its back contact closes the circuit of relay 55. Relay 55 at its upper contact opens the shunt portion of the potentiometer 8, and at its lower contact closes a short circuit for secondary winding of induction coil 45. The opening of the shunt portion of the potentiometer increases the amplification of the amplifiers so that the ringing current transmitted over the line $L_1$ is transmitted through induction coil 35 to the amplifier $A_1$, and after being amplified by amplifiers $A_1$ and $A_2$ is transmitted through induction coil 25 to line $L_2$. The amplified ringing current after being transmitted over the line $L_2$ is transmitted through induction coil 26, over circuit 36, through auto transformer 37 to the winding of ringing responsive relay 9. Relay 9 is thereby energized and opens the normally closed circuit of relay 56 which upon being deënergized, at its back contact closes a circuit from ground through the winding of relay 10 to battery. Relay 10 is then energized and at its front contacts applies 16 cycle ringing current over the terminals of jack $J_1$ and plug $P_1$ to the terminating two-wire line. In a similar manner incoming ringing current from the terminal two-wire line associated with plug $P_1$, is transmitted through the induction coil comprising windings 39, 40 and 41, to the winding of ringing responsive relay 11. Said relay upon being energized, at its front contact closes a circuit from ground, front contact of normally energized relay 56, front contact of relay 11, and thence in parallel through the windings of relays 57 and 58 to battery. Relay 57 upon being energized, at its lower contact closes a locking circuit from ground, through the winding of relay 56, to maintain said relay energized so that it cannot respond to the possible actuation of relay 9 due to ringing current transmitted from the terminating two-wire line to circuit 38. Relay 57 at its upper contact closes a circuit from ground over the front contact of said relay, through the back contact and winding of buzzer relay 19, and through the primary of induction coil 59 to a source of 16 cycle current. Buzzer relay 19 is thereby actuated to break up the 16 cycle current into 133 cycle current, which is transmitted through induction coil 59 and over the front contacts of relay 58 to the primary winding of induction coil 42. The relayed ringing current is then transmitted over line $L_3$ and through the induction coil 43 to ringing responsive relay 14 which is actuated to open the circuit of normally energized relay 60, which is thereby deënergized to close a circuit through the relay 61, which in turn at its lower contact opens the shunt portion of the potentiometer 15 and at its upper front contact short circuits the secondary winding of induction coil 25. Upon the opening of the shunt portion of the potentiometer 15 the 133 cycle ringing current transmitted over line $L_3$ is transmitted through induction coil 44 to the amplifier $A_3$, and upon being amplified by amplifiers $A_3$ and $A_4$ is transmitted through induction coil 45, over line $L_4$, through induction coil 46, over circuit 47, and through auto transformer 48 to ringing responsive relay 16. Relay 16 is thereby actuated to open the circuit of normally energized relay 50, which is thereby deenergized and at its back contact closes a circuit from ground through the winding of relay 17, which is energized to connect 16 cycle ringing current to the terminating two-wire line associated with the jack J.

It will be noted that the operation of relay 61 resulted in the short circuiting of the secondary of induction coil 25 at the same time the shunt portion of the potentiometer 15 was opened. This prevents the possibility of any of the ringing current transmitted over line $L_4$ and over circuits 47 and 49 to the induc-

tion coil comprising windings 32, 33 and 34 from being transmitted over the circuit 5 and the line $L_1$, amplifiers $A_1$ and $A_2$, and back to the line $L_2$. If an exact balance was maintained between the artificial line $N_1$ and the terminating two-wire line at station B, no ringing current would be transmitted back through circuit 5 and line $L_1$ to $L_2$, but since in practice an exact balance is not ordinarily possible, it is necessary to provide means to prevent the current so transmitted from passing over the line $L_2$ and actuating the relay 9 to cause the application of ringing current to the terminating two-wire line at station E. The short circuiting of the secondary of induction coil 45 by the lower contact of relay 55 during transmission of ringing current from station C to E over lines $L_1$ and $L_2$ is for the same purpose, that is, to prevent any currents transmitted back over line $L_3$ and through amplifiers $A_3$ and $A_4$ from passing over line $L_4$ to actuate relay 16.

It will be clear of course, that upon the cessation of ringing current from the terminating line associated with plug P, the relay 4 will be deënergized to open the circuit of relays 51 and 52. Relay 51 opens the circuit of the buzzer relay 18 while relay 52 disconnects the buzzer circuit from the line. The ringing current transmitted over line $L_1$ thereby ceases, so that relay 7 is restored to normal, closing the circuit of relay 54 which opens the circuit of relay 55, thereby opening the short circuit about the secondary winding of induction coil 45 and closing the shunt portion of the potentiometer 8. Ringing current over line $L_2$ also ceases so that relay 9 is restored to normal and closes the circuit of relay 56, which opens the circuit of relay 10 to disconnect the 16 cycle ringing source from the terminating two-wire line associated with plug $P_1$. In the same manner, upon the cessation of ringing current from the two-wire terminating line associated with plug $P_1$ the relay 11 is deënergized, thereby opening the circuit of relays 57 and 58. Relay 57 opens the circuit of the buzzer 19 while relay 58 disconnects the buzzer apparatus from the line $L_3$. Ringing current over the line $L_3$ now ceases so that relay 14 is restored to normal, thereby closing the circuit of relay 60, which in turn opens the circuit of relay 61 to open the short circuit about the secondary winding of induction coil 25 and to close the potentiometer 15. Ringing current over the line $L_4$ also ceases, so that relay 16 is restored to normal, thereby closing the circuit of relay 50 which in turn opens the circuit of the relay 17 whereby the 16 cycle ringing source is disconnected from the terminating two-wire line associated with the plug P. When plugs P and $P_1$ are both withdrawn from the jacks J and $J_1$ respectively the relay 3 at station D is deënergized, thereby opening the filament heating circuit from battery A through filaments 28, 29, 30 and 31. The filaments now cease to glow and the discharge no longer passes between the filaments and the corresponding plates of the amplifiers $A_1$, $A_2$, $A_3$ and $A_4$ so that the amplifiers are now rendered inoperative and no energy is wasted by the batteries A or B.

It will be seen that by means of this invention arrangements have been provided whereby operation of the amplifiers at intermediate stations is under control of the operators at the terminating station, and while the controlling means we have employed is particularly adapted for use in connection with a four-wire transmission circuit, it is equally well adapted for use in connection with a transmission circuit of any other type, such as, for instance, the ordinary two-wire circuit. It will also be seen that by means of the organization disclosed, through ringing over each transmission line of the four-wire circuit may be obtained independently of any transmission over the other transmission line of said four-wire circuit. While the invention has been disclosed as embodied in certain forms which are considered desirable, it will be understood that it may be embodied in many widely different organizations without departing from the spirit of the invention.

What is claimed is:

1. A signaling system comprising a pair of switching stations, a transmission line interconnecting said stations, terminal lines associated with said stations adapted to be switched into connection with said transmission line, a repeater in said transmission line, and means whereby said repeater may be controlled from one of said stations independently of voice currents transmitted over said transmission line.

2. A signaling system comprising a pair of switching stations, a transmission line interconnecting said stations, terminal lines associated with said stations adapted to be switched into connection with said transmission line, a repeater in said transmission line, and means whereby the operation of said repeater may be controlled from one of said stations independently of voice currents transmitted over said transmission line.

3. A signaling system comprising a pair of switching stations, a transmission line interconnecting said stations, terminal lines associated with said stations adapted to be switched into connection with said transmission line, a repeater in said transmission line, and means whereby the operation of said repeater may be controlled from either of said stations independently of voice currents transmitted over said transmission line.

4. A signaling system comprising a plurality of switching stations, a repeater at

one of said stations, terminal lines associated with the other stations, means at said other stations for extending connections from said repeater to said terminal lines, and means whereby the operation of the repeater may be controlled from said other stations independently of voice currents.

5. A signaling system comprising a plurality of stations, a repeater at one of said stations, terminal lines associated with the other stations, means at said other stations for extending connections from said repeater to said terminal lines, and means whereby said repeater may be rendered operative or inoperative at will from said other stations, with respect to currents transmitted from said other stations.

6. A signaling system comprising a plurality of stations, a pair of transmission lines interconnecting two of said stations, each line being used for transmission in one direction only, repeaters in said lines at another station and means whereby the operation of said repeaters may be controlled from one of said first mentioned stations.

7. A signaling system comprising a plurality of stations, a pair of transmission lines interconnecting two of said stations, each line being used for transmission in one direction only, repeaters in said lines at another station and means whereby said repeaters may be rendered operative or inoperative at will from one of said first mentioned stations.

8. A signaling system comprising two stations, a repeater at one of said stations, said repeater comprising an evacuated tube containing an electrode adapted to be heated, a circuit for heating said electrode, and means to control said circuit from the other station.

9. A signaling system comprising two stations, a transmission line connecting said stations, a repeater in said line at one of said stations, said repeater comprising an evacuated tube containing an electrode adapted to be heated, a circuit for heating said electrode, and means controllable over the two sides of said line in parallel to control said circuit.

10. In a signaling system, two stations at widely separated points, a pair of transmission lines connecting said stations, each line being used for transmission in one direction only, terminating lines at said stations adapted to be connected to said transmission lines, a source of signaling current at one of said stations, means at said last mentioned station responsive to signaling current received from a terminating line at said station to apply said source of signaling current to one of said transmission lines for transmission to the other station and means to prevent the transmission of said signaling current from said other station to said first station.

11. In a signaling system, two stations at widely separated points, a pair of transmission lines connecting said stations, each line being used for transmission in one direction only, amplifiers at intermediate points in said lines, and means controllable from one of said stations whereby the amplification of said amplifiers may be varied.

12. In a signaling system, two stations at widely separated points, a pair of transmission lines connecting said stations, each line being used for transmission in one direction only, amplifiers at intermediate points in said lines, and means controllable from one of said stations for automatically adjusting the amplification of said amplifiers.

13. In a signaling station, a transmission line of one type leading from said station, a terminating line of another type leading to said station and adapted to be connected to said first line, means responsive to signaling current of one frequency incoming from a terminating line to apply signaling current of a different frequency to said transmission line, and means to prevent the signaling current thus applied from being transmitted back to said terminating line.

14. In a signaling system, two terminating stations and an intermediate station, two transmission lines connecting said terminating stations through said intermediate station, each of said lines being used for transmission in one direction only, amplifiers in said lines at said intermediate station, terminating lines at said terminating stations adapted to be connected to said transmission lines, a source of signaling current at each terminating station, means at one of said terminating stations responsive to signaling current from a terminating line at said station to apply the source of signaling current at said station to one of said transmission lines, means responsive to signaling current transmitted to the intermediate station from said source to increase the amplification of the amplifiers at said intermediate station, whereby the signaling current is amplified, means at the second terminating station responsive to amplified signaling current transmitted to said station to apply the source of signaling current at said station to a terminating line at said station.

15. In a signaling system, two terminating stations and an intermediate station, two transmission lines connecting said terminating stations through said intermediate station, each of said lines being used for transmission in one direction only, amplifiers in said lines at said intermediate station, and means responsive to signaling current transmitted from one of said terminal stations to the intermediate station to vary the amplification of the amplifier in one of said lines and to prevent transmission over the other line.

16. In a signaling system, two stations, an amplifier at one of said stations, a potentiometer for controlling the amplification of said amplifier, and means controllable from the other station to adjust the potentiometer.

17. A repeating system comprising a repeater, means for supplying current to the repeater, and means responsive to said current for controlling the transmission efficiency of the repeating system.

18. In a repeating system, the combination of a repeater, means to supply thereto a plurality of currents of different character, and means responsive to current of one character for varying the transmission efficiency of the repeater for current of that character.

In testimony whereof, I have signed my name to this specification this ninth day of October, 1917.

JOHN F. TOOMEY.