July 10, 1928. 1,676,301

J. F. TOOMEY

PROGRAM TRANSMISSION SYSTEM FOR APARTMENT HOUSES

Filed Sept. 20, 1924 3 Sheets-Sheet 1

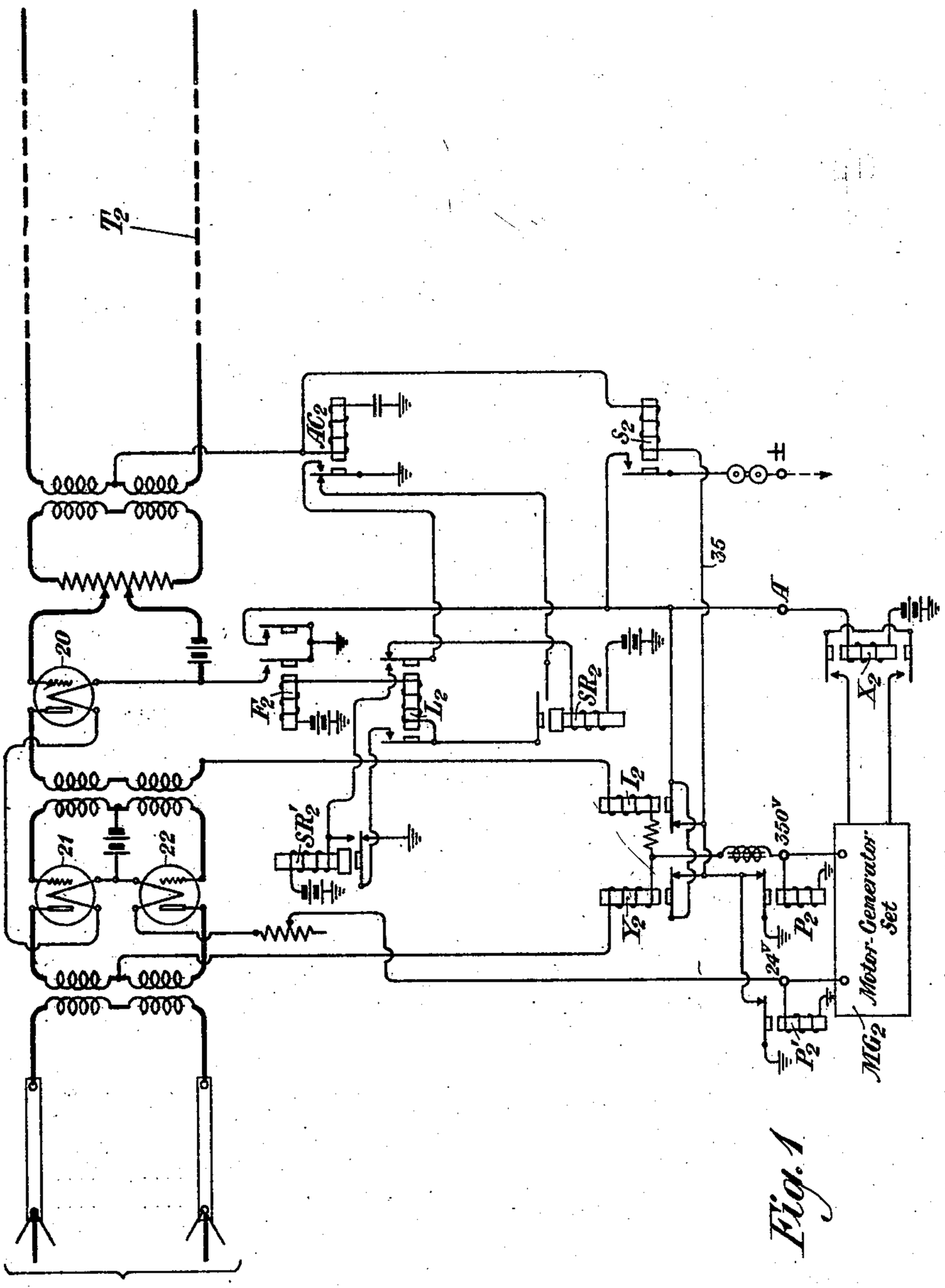

Fig. 1

INVENTOR
J. F. Toomey

BY

ATTORNEY

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J. F. TOOMEY

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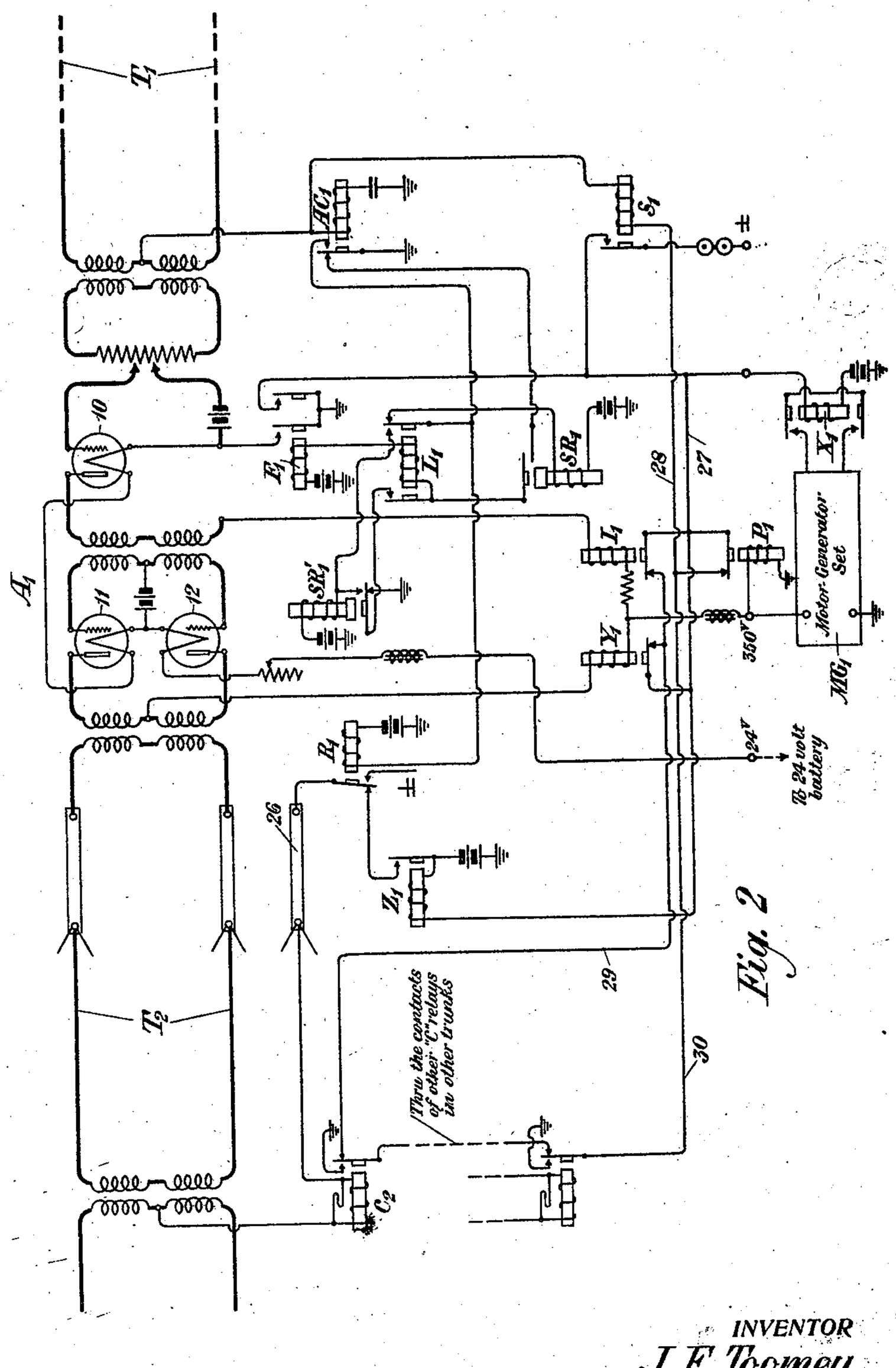

Fig. 2

INVENTOR
J. F. Toomey

BY

ATTORNEY

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J. F. TOOMEY

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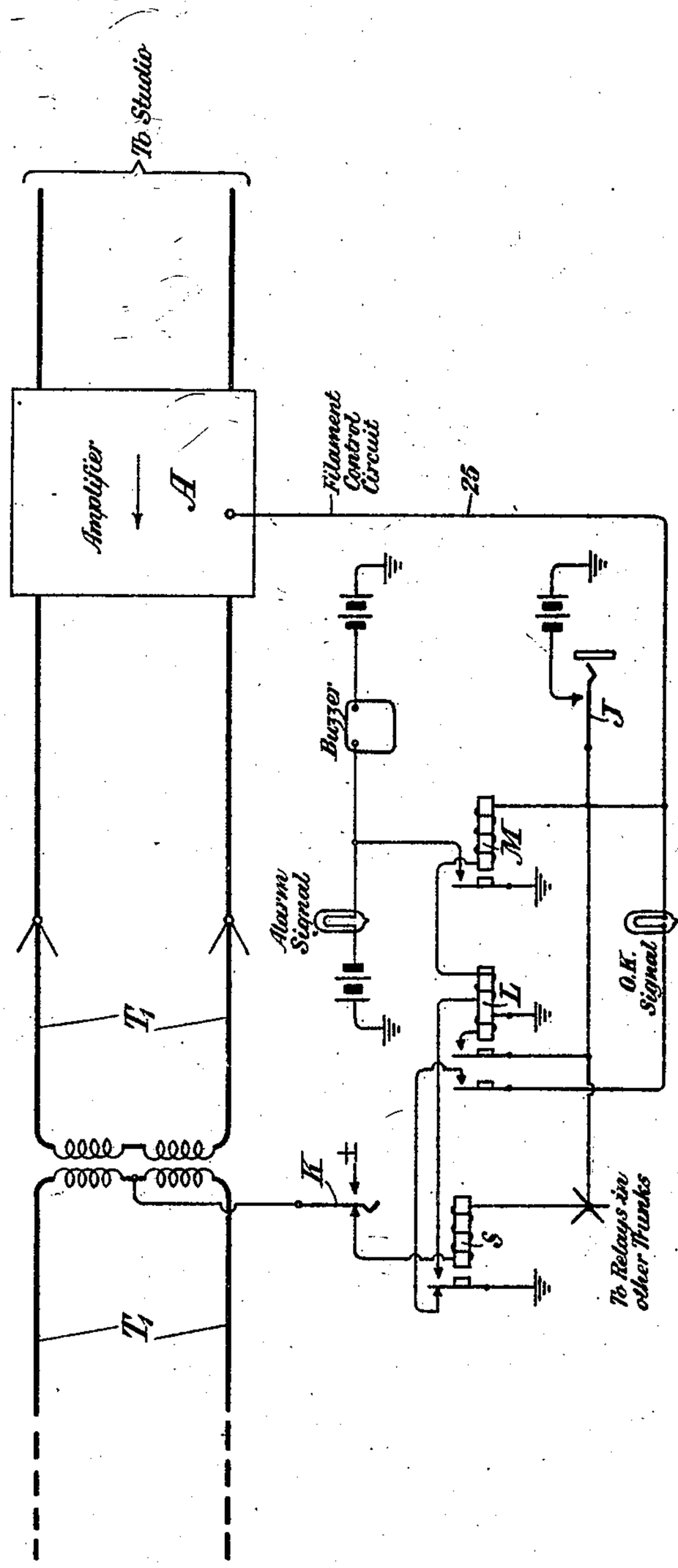

Fig. 3

INVENTOR
J. F. Toomey

BY

ATTORNEY

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UNITED STATES PATENT OFFICE.

JOHN F. TOOMEY, OF NEW YORK, N. Y., ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

PROGRAM-TRANSMISSION SYSTEM FOR APARTMENT HOUSES.

Application filed September 20, 1924. Serial No. 738,923.

This invention relates to transmission systems, and more particularly to a system for the distribution of programs, such as news, music and entertainments to apartment houses and the like.

It has been proposed to transmit entertainment programs over wires by telephony to subscribers, and in the case of a large city, where apartment houses abound, the program would be transmitted over a trunk or trunks from a studio to central offices, such as telephone exchanges. At each central office, branch trunks would extend from each central office trunk to various apartment houses in the neighborhood. At the apartment house the trunk would be again branched with new lines extending to each subscriber.

In such a system it would be desirable to have amplifiers at each branching point such as the central office and the apartment house. It is also desirable that the attendant at the studio should exercise supervisory control over the entire circuit including the branches and over the amplifying or other equipment associated with the various branching points.

In accordance with the present invention, the circuit for controlling the filament and plate circuits of the various amplifiers is controlled by means of an alternating current. The motor generators for supplying the current for the amplifiers are also started and stopped under the control of an attendant at the studio by means of alternating current. In addition, a signaling circuit is provided which indicates to the attendant at the studio whether the transmission circuit is functioning properly or whether there is any trouble at some point. This signaling circuit is preferably controlled by direct current. Another feature of the invention resides in the fact that during the time that the transmission circuit is functioning normally no signaling current flows over the circuit.

The invention may now be more fully understood from the following description, when read in connection with the accompanying drawing, the figures of which, when placed side by side in regular order with Figure 3 to the right, illustrate a preferred embodiment of the invention.

Referring to the drawing (Fig. 3), T_1 designates a trunk extending from a studio to a central office. At the studio, an amplifier schematically indicated at A is provided and the various trunks such as T_1, extending to the different central offices will be branched from the output of the amplifier A as indicated. At each central office (Fig. 2), the trunk such as T_1 is provided with an additional amplifying equipment A_1 comprising vacuum tubes 10, 11 and 12 and their associated circuits. On the output side of each amplifier such as A_1, each trunk such as T_1 is branched into branch trunks such as T_2, which lead to apartment houses. An amplifying equipment such as A_2 is associated with each trunk such as T_2, at the apartment house (Fig. 1). The amplifying equipment A_2, as illustrated, comprises vacuum tubes 20, 21 and 22, together with associated circuits.

A motor generator set, MG_2, is provided at the apartment house for supplying the plate and filament current to operate the vacuum tubes 20, 21, 22. At the central office a similar motor generator set, MG_1, is provided for supplying the plate current for operating vacuum tubes 10, 11 and 12. As the details of these sets form no part of the present invention, they are merely illustrated schematically. At the studio a controlling jack J and a controlling key K are provided to enable the attendant to render the circuit operative or inoperative at will. Signal lamps or other devices are also provided to indicate to the attendant the condition of the circuit.

Further details of the invention will now be clear from the description of the operation, which is as follows: when the attendant at the studio desires to transmit a program, a dead plug is inserted in the jack J, thereby connecting battery over the contacts of the jack J and over the filament control conductor 25 to render the amplifier at the studio operative in the well-known manner. The attendant then momentarily depresses the key K to connect alternating current over its left-hand contact to the midpoint of the transformer winding associated with the trunk T_1. The alternating current flows over the two sides of the trunk T_1 in parallel and through the winding of alternating current relay AC_1 at the central office, thereby energizing the relay during the time that the alternating current continues.

The relay AC_1, when energized, completes

a circuit from ground over its front contact and through the winding of the relay R_1. The relay R_1 is therefore energized during the time that the alternating current is transmitted from the trunk T_1 and at its front contact applies alternating current to the bus-bar 26. From the bus-bar the alternating current flows from the various third wires associated with the trunks such as T_2, leading to the apartment houses. A relay, such as C_2, is interposed in the connection between the bus-bar 26 and the midpoint of the transformer winding associated with each trunk, such as T_2. This relay is shunted by a non-inductive connection, however, so that the alternating current does not operate the relay. The alternating current now flows over the two sides of the trunks, such as T_2, in parallel and thence through an alternating current relay AC_2 at the apartment house. It will therefore be seen that the alternating current relays AC_1 at the central office and AC_2 at the apartment house are energized simultaneously during the time that the key K at the studio is depressed.

Returning to the central office, the relay AC_1, upon being energized, also completes a circuit from ground over its front contact, over the right-hand back contact of relay L_1 and through the winding of slow-release relay SR_1 to battery. The relay SR_1 is now energized and as soon as the key K is restored at the studio, relay AC_1 releases and closes a circuit from ground over its back contact, over the front contact of slow-release relay SR_1 and through the windings of relays L_1 and F_1 to battery. Relay L_1 at its right-hand front contact disconnects slow-release relay SR_1, but before the latter has become deenergized, the relay L_1 establishes a locking circuit for the relays F_1 and L_1 over the left-hand front contact of relay L_1 to the back contact of slow-release relay SR'_1.

Relay F_1, upon being energized, completes a filament circuit for tubes 10, 11 and 12 from ground over the inner front contact of relay F_1, through the filaments of tubes 10, 11 and 12 in series, and thence to the 24-volt battery so that the filaments of the amplifier tubes begin to glow. Relay F_1 also connects ground over its outer front contact to the winding of relay X_1 which starts motor generator set MG_1 into operation. At the same time a signaling circuit for the studio is established from ground over the outer front contact of relay F_1 to conductor 27 and thence over the back contact of relay P_1 to conductor 28. A connection also extends from conductor 27 to conductor 28 over the back contacts of relays I_1 and Y_1 in parallel, over conductor 29, back contacts of various trunk relays, such as C_2, in series, and thence over conductor 30 to conductor 28. From conductor 28 the signaling trunk extends through the winding of the relays S_1 to the midpoint of the winding of the transformer associated with the trunk T_1, over the two sides of the trunk in parallel, and thence over the normal contact of the key K at the studio, through the winding of relay S and over the make contact of the jack J to battery. Relays S and S_1 are energized over the circuit above traced and remain energized until the apparatus is all in operating condition, as will be described later.

Relay S, on being energized, completes a circuit from ground, over its front contact, through the right-hand winding of the relay L and through the winding of the relay M, and thence over the make contacts of the jack J to battery. Relay M temporarily closes the circuit of an alarm signal and a buzzer, while the apparatus associated with the various amplifiers is being placed in operating condition, as will be described later. Relay L completes a locking circuit from ground through its left ending, over its inner front contact to battery, over the make contacts of the jack J. The relay L will therefore remain locked up so long as the connection is established.

Returning again to the central office, as soon as the motor generator set MG_1 is set into operation and generates the necessary plate voltage, the relay P_1 is operated and opens the connection between conductors 27 and 28 at one point. At the same time the plate current of the tube 10 begins to flow through the winding of the relay I_1 and the plate current of the tubes 11 and 12 begins to flow through the winding of the relay Y_1 and these two relays are therefore energized and open connections between conductors 27 and 28 at another point.

If, at this time, all the trunk relays, such as C_2, were deenergized, the signaling circuit through S_1 and S would be open so that an O. K. signal would be given at the studio. It will be seen later, however, that the trunk relays, such as C_2, are all energized during the time that the amplifying equipment and motor generator sets at the apartment house are being put into operation. The contacts of each of these relays are so arranged as to independently place ground upon the conductor 30 so that the signaling circuit traced through conductor 28 and relays S_1 and S will be maintained independently of the deenergization of relays P_1, I_1 and Y_1 until such time as all the trunk relays are released.

Going now to the apartment house, it will be remembered that during the time that the key K was depressed to transmit alternating current, the relay R_1 at the central office was energized to transmit alternating current to the alternating current relay AC_2, so that the latter relay is energized during

the same period that the relay AC_1 at the central office is energized. When the relay AC_2 is energized, it closes a circuit from ground over its front contact, over the right-hand back contact of relay L_2, and through the winding of slow-release relay SR_2 to battery. When the alternating current ceases to flow, relay AC_2 releases and completes a circuit from ground over its back contact, over the front contact of relay SR_2, through the windings of relays L_2 and F_2 to battery. Relay L_2 at its right-hand contact releases relay SR_2 and at its left-hand contact completes a locking circuit for the relays L_2 and F_2 over the back contact of relay SR'_2. Relay F_2, upon being energized, at its outer front contact connects ground through the winding of relay X_2, which, upon being energized, sets the motor generator set MG_2 into operation to generate the plate and filament voltage.

It will be noted that ground is normally applied to the conductor 35 over the back contacts of relays P_2 and P'_2. Consequently, as soon as relay R_1 at the central office releases its armature (which occurs at the cessation of transmission of alternating current from the studio to disconnect the alternating current from the circuit through the trunk relays such as C_2), a circuit will be completed for the trunk relays such as C_2, as follows: from battery, over the front contact of relay Z_1, over the back contact of relay R_1, bus-bar 26, through the winding of trunk relay C_2, over the two sides of the trunk T_2 in parallel, through the winding of relay S_2, over conductor 35, and thence to ground over the back contacts of relays P_2 and P'_2.

Relays S_2 and C_2 are energized over the circuits above traced and in a similar manner the trunk relays corresponding to C_2, of all the other trunks leading to apartment houses, will be energized to maintain ground upon conductor 28. The direct current signal circuit through relays S_2 and C_2 is also maintained from ground over the front contact of relay FR_2 and over the back contacts of relays Y_2 and I_2 in parallel to conductor 35.

When the motor generator set MG_2 is started into operation by the relay X_2, relays P'_2 and P_2 will be energized as soon as the plate and filament voltages, respectively, attain the proper values. The energization of these relays disconnects ground from the conductor 35 at their contacts. The filament circuit is now completed from ground, over the inner front contact of relay F_2, through the filament on tubes 20, 21 and 22 to the 24-volt terminal of the motor generator set. The tubes now begin to glow and the space current flowing through the tubes from the 350-volt terminal of the motor generator set energizes relays I_2 and Y_2, thereby removing ground from conductor 32 at their contacts. All of the ground connections to conductor 35 having now been opened, the circuit previously traced through relay S_2 and trunk relay C_2 is open so that these relays are de-energized. Similar operations take place in connection with all the other trunks leading to the apartment houses and it will be observed that each of the trunk relays is energized as soon as alternating signaling current ceases and remains energized until the motor generator sets and the amplifier sets associated with each trunk are put into operative condition. It will also be noted that as soon as the apparatus associated with each trunk is placed in operative condition, the corresponding trunk relay is released.

It will be remembered that ground is applied to conductor 30 at the central office as soon as any trunk relay is energized. As soon, however, as all of the trunk relays have been released, the ground is removed from conductor 30, and in the meantime the motor generator set MG_1 and the amplifier A_1 at the central office have been placed in operative condition so that relays P_1, I_1 and Y_1 are energized. Consequently, all possible ground connections will have been removed from conductor 28 and the direct current signaling circuit through relay S_1 at the central office and relay S at the studio will be open, thereby releasing relays S and S_1. Relay S at the studio was energized during the brief period that it required to place all of the amplifiers and motor generator sets of all the circuits in operative condition, and during this brief period the circuit maintained through the relay M over the left-hand front contact of relay S caused the momentary operation of the alarm signal and buzzer at the studio. As soon as relay S is released, however, the alternating signal and buzzer ceases and a circuit is completed from ground over the left-hand back contact of relay S and over the outer front contact of locked-up relay L through the O. K. signal lamp to battery at the contacts of the jack J. All of the apparatus is now in operative condition, and this fact is indicated to the operator by the O. K. signal, so that the program transmission may now begin.

If trouble should occur in connection with any of the amplifying apparatus or motor generator sets associated with the various branch trunks, the relay S will again be energized to open the circuit of the O. K. signal and close the circuit of the relay M to continuously actuate the alarm signal and the buzzer. For example, if the motor generator set MG_1 should be disabled, the relay P_1 would be released and ground would be applied to conductor 28 over the outer front contact of relay F_1 and over the back contact of relay P_1. Similarly, if the space current should cease to flow for any reason

through the tube 10, relay I_1 would be deenergized. If space current should cease to flow through the tubes 11 and 12, relay Y_1 would be released, thereby again applying ground to conductor 28. Furthermore, if the filament of any tube should fail, the filaments of all the tubes of the amplifier would cease to flow and the space current would at once cease flowing, with the consequent deenergization of relays I_1 and Y_1. The application of ground to conductor 28 under any one or all of these conditions, immediately completes the circuits for relays S_1 and S, as previously traced, so that the alarm signal and the buzzer will be actuated and continue in operation as long as the abnormal condition remains.

In case the motor generator MG_2 at the apartment house should fail, relay P_2 or P'_2, or both, would be released, thereby connecting ground to conductor 35. If a filament of one of the amplifiers should fail, or if for any other reason the plate current of any one of the three vacuum tubes of the amplifier A_2 should cease to flow, relay I_2 or Y_2, or both, would be released and apply ground to conductor 35. Under any of these conditions the circuit for relay S_2 and the trunk relay C_2 will again be completed, thereby connecting ground from the front contact of the trunk relay to the conductor 30 and thence to the conductor 28. This would in turn complete the circuit for relay S at the studio and cause the actuation of the alarm signal and buzzer.

At the end of the program the attendant at the studio may restore the circuit to its normal condition by momentarily actuating the key K to connect alternating current over the two sides of the trunk T_1 to energize the alternating current relay AC_1. Relay AC_1, upon being energized, completes a circuit from ground over its front contact and over the right-hand front contact of locked-up relay L_1 and through the winding of slow-release relay SR'_1 to battery. Relay SR'_1, upon being energized, completes a new locking circuit from ground over the front contact of relay AC_1, over the right-hand front contact of relay L_1, over the lower front contact of relay SR'_1, over the left-hand front contact of relay L_1 and through the windings of relays L_1 and F_1 to battery. As soon as the relay AC_1 releases, however, the locking circuit above traced is opened and relays F_1 and L_1 are released. The relay SR'_1, being slow to release, does not release its armature until the relays L_1 and F_1 are restored to normal, with the consequent opening of the normal circuit of the relay SR'_1 at the right-hand contact of relay L_1.

Relay F_1, upon being released, opens a filament circuit of the tubes 10, 11 and 12 at its inner contact, and at its outer contact, and disconnects ground from relay X_1, so that the operation of the motor generator set MG_1 ceases. The relay P_1 is accordingly released and relays Y_1 and I_1 are released as soon as space current ceases to flow through the vacuum tubes. No ground is connected to the conductor 28, however, by this operation, as the ground connection over the contacts of relays P_1, Y_1 and I_1 is controlled by the outer contact of relay F_1, which is released. The apparatus at the central station is therefore restored to normal. The release of F_1 also disconnects ground at its outer contact from the conductor 27 and consequently from the winding of the relay Z_1, which is accordingly released.

Returning again to the relay AC_1, which was energized while the key K was depressed, it will be observed that a circuit was completed over the front contact of the relay AC_1 through the winding of the relay R_1. The relay R_1 is accordingly energized and connects alternating current to the bus-bar 26 so long as the key K remains depressed, consequently alternating current is transmitted over the front contact of the relay R_1, over the bus-bar 26, over the two sides of the trunk T_2 in parallel and thence to the relay AC_2, energizing the latter relay. Relay AC_2, upon being energized, completes a circuit from ground over its front contact, over the right-hand front contact of relay L_2, and through the winding of SR'_2 to battery. A new locking circuit is now established for relays F_2 and L_2 from ground over the front contact of relay AC_2, over the right-hand front contact of relay L_2, over the front contact of relay SR'_2, over the left-hand front contact of relay L_2, and through the windings of relays L_2 and F_2 to battery.

As soon as the key K is restored, with the consequent release of relay R_1, the alternating current ceases to flow through relay AC_2. The locking circuit previously traced for the relays L_2 and F_2 is now open, and these two relays are restored to normal. The circuit of the relay SR'_2 is also open at the contact of the relay AC_2, so that relay SR'_2 is restored to normal a moment later. As soon as the relay F_2 releases, the filament circuit of the tubes 20, 21 and 22 is opened at the inner contact of the relay F_2. The space current accordingly ceases to flow through the tubes and the relays Y_2 and I_2 are released. This operation does not result in applying ground to conductor 35, however, as the ground connection is open at the outer contact of relay F_2. The opening of this contact also releases the relay X_2, which causes the motor generator set MG_2 to cease functioning. The relays P_2 and P'_2 are now released and connect ground to conductor 35. This does not result in the energization of relay S_2 and the trunk relay C_2, however,

for the circuit of the trunk relay C_2 is held open at the contact of released relay Z_1. The apparatus is now all restored to normal as a consequence of a momentary transmission of alternating current by the depression of the key K, and this occurs without the establishment of any direct current signaling circuit to actuate relay S after the key K has been released. The attendant now removes the dead plug from the jack J to release the locked-up relay L and disable the amplifier A, so that all the apparatus is now in its normal condition.

It will be obvious that the general principle herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a signaling system, a trunk, a normally disabled amplifier associated with said trunk, and switching means unresponsive to voice currents but responsive to the momentary transmission of low frequency alternating current over said trunk to render said amplifier operative.

2. In a signaling system, a trunk, a normally disabled amplifier associated with said trunk, means responsive to the momentary transmission of alternating current over said trunk, to render said amplifier operative, and means responsive to the subsequent transmission of alternating current over said trunk to disable said amplifier.

3. In a signaling system, a trunk, an amplifier associated with said trunk, normally inoperative means for supplying current for said amplifier, and switching means unresponsive to voice currents but responsive to the momentary transmission of low frequency alternating current over said trunk to render said current supply means operative.

4. In a signaling system, a trunk, an amplifier associated with said trunk, normally inoperative means for supplying current for said amplifier, means responsive to the momentary transmission of alternating current over said trunk to render said current supply means operative, and means responsive to the subsequent transmission of alternating current over said trunk to render said current supply means again inoperative.

5. In a signaling system, a trunk, a normally disabled amplifier associated with said trunk, means responsive to the transmission of alternating current over said trunk to render said amplifier operative, and means responsive to the momentary transmission of a direct current over said trunk to indicate the condition of the apparatus associated with said trunk.

6. In a signaling system, a trunk, a normally disabled amplifier associated with said trunk, means responsive to the momentary transmission of alternating current over said trunk to render said amplifier operative, and means responsive to the momentary transmission of a direct current over said trunk to indicate the condition of the apparatus associated with said trunk.

7. In a signaling system, a trunk, a normally disabled amplifier associated with said truck, means responsive to the momentary transmission of alternating current over said trunk to render said amplifier operative, means responsive to the subsequent transmission of alternating current over said trunk to disable said amplifier, and means responsive to the momentary transmission of a direct current over said trunk to indicate the condition of the apparatus associated with said trunk.

8. In a signaling system, a trunk, an amplifier associated with said trunk, normally inoperative means for supplying current for said amplifier, means responsive to the transmission of alternating current over said trunk to render said current supply means operative, and means responsive to the momentary transmission of a direct current over said trunk to indicate the condition of the apparatus associated with said trunk.

9. In a signaling system, a trunk, an amplifier associated with said trunk, normally inoperative means for supplying current for said amplifier, means responsive to the momentary transmission of alternating current over said trunk to render said current supply means operative, and means responsive to the momentary transmission of a direct current over said trunk to indicate the condition of the apparatus associated with said trunk.

10 In a signaling system, a trunk, an amplifier associated with said trunk, normally inoperative means for supplying current for said amplifier, means responsive to the momentary transmission of alternating current over said trunk to render said current supply means operative, means responsive to the subsequent transmission of alternating current over said trunk to render said current supply means again inoperative, and means responsive to the momentary transmission of a direct current over said trunk to indicate the condition of the apparatus associated with said trunk.

11. In a signaling system, a trunk extending from a main station to an outlying station, a normally disabled amplifier associated with said trunk at said outlying station, branch trunks extending from said outlying stations to a plurality of local stations, normally disabled amplifiers associated with the branch trunks at each local station, and means responsive to the transmission of al-

ternating current from said main station to render the amplifiers at the other stations operative.

12. In a signaling system, a trunk extending from a main station to an outlying station, a normally disabled amplifier associated with said trunk at said outlying station, branch trunks extending from said outlying stations to a plurality of local stations, normally disabled amplifiers associated with the branch trunks at each local station, and means responsive to the momentary transmission of alternating current from said main station to render all of said amplifiers operative.

13. In a signaling system, a trunk extending from a main station to an outlying station, a normally disabled amplifier associated with said trunk at said outlying station, branch trunks extending from said outlying stations to a plurality of local stations, normally disabled amplifiers associated with the branch trunks at each local station, means responsive to the momentary transmission of alternating current from said main station to render all of said amplifiers operative, and means responsive to the subsequent transmission of alternating current from said main station to again disable all of said amplifiers.

14. In a signaling system, a trunk extending from a main station to an outlying station, an amplifier associated with said trunk, branch trunks extending from said outlying station to a plurality of local stations, amplifiers associated with said branch trunks at each local station, normally inoperative means at each station to supply current to the amplifier thereat, and means responsive to the transmission of alternating current from said main station to render the current supply means at all of said stations operative.

15. In a signaling system, a trunk extending from a main station to an outlying station, an amplifier associated with said trunk, branch trunks extending from said outlying station to a plurality of local stations, amplifiers associated with said branch trunks at each local station, normally inoperative mean at each station to supply current to the amplifier thereat, and means responsive to the momentary transmission of alternating current from said main station to render the current supply means at all of said stations operative.

16. In a signaling system, a trunk extending from a main station to an outlying station, an amplifier associated with said trunk, branch trunks extending from said outlying station to a plurality of local stations, amplifiers associated with said branch trunks at each local station, normally inoperative means at each station to supply current to the amplifier thereat, means responsive to the momentary transmission of alternating current from said main station to render the current supply means at all of said stations operative, and means responsive to the subsequent transmission of alternating current from the main station to again disable said current supply means.

In testimony whereof, I have signed my name to this specification this 19th day of September 1924.

JOHN F. TOOMEY.