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PROGRAM TRANSMISSION OVER WIRES

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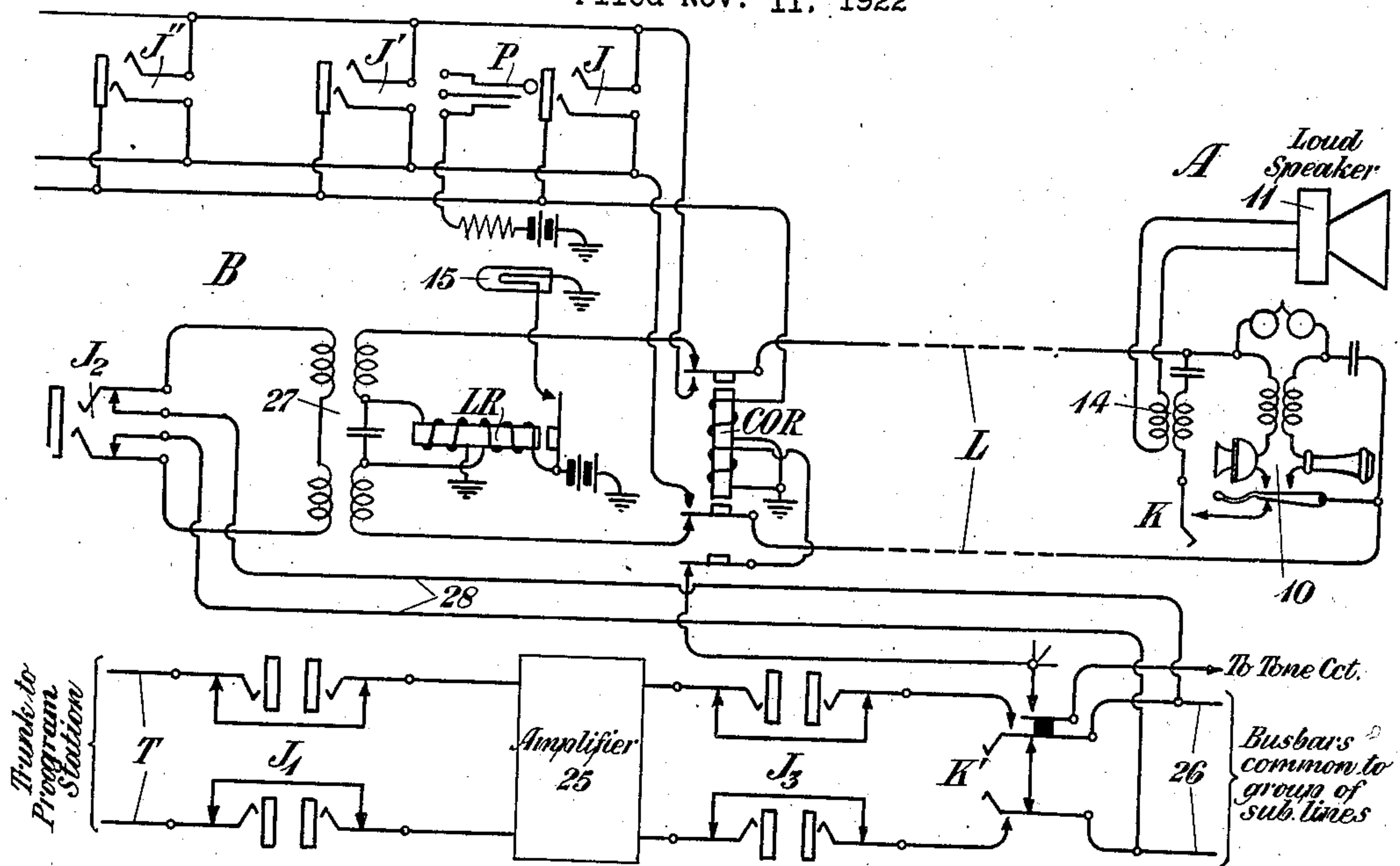


Fig. 1

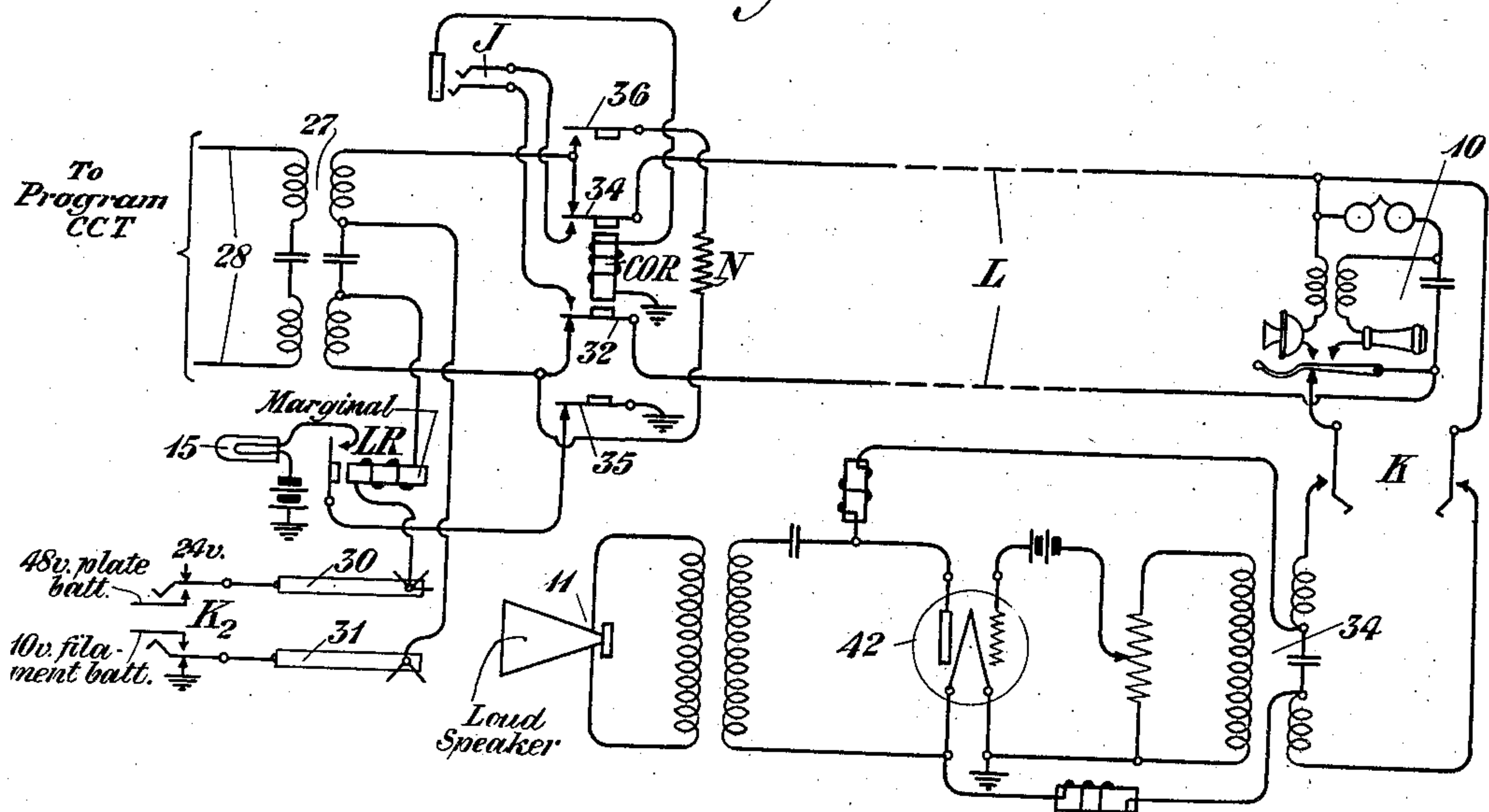


Fig. 2

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PROGRAM TRANSMISSION OVER WIRES.

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This invention relates to systems of communication and more particularly to systems for disseminating news, information, music or the like.

Various schemes have been proposed heretofore for program transmission purposes. The only one of these schemes which has been exploited to any extent is radio broadcasting, that is, the transmission of news, information or entertainment by means of radio telephone equipment so that persons provided with suitable radio receiving sets tuned to the proper wave length may receive the distributed entertainment or the like.

This method, however, has very serious objections. In the first place, numerous broadcasting stations in the same area operate on wave lengths sufficiently close together to interfere with each other. Furthermore, radio telephonic transmission necessarily involves the use of a much wider band of the frequency spectrum than is used for wireless telegraph purposes, and in view of the fact that the number of wave lengths available for radio communication are necessarily limited it is undesirable that wave lengths necessary for commercial communication should be utilized for purposes of mere entertainment. Finally, in order to avail himself of the distributed information or entertainment, each individual subscriber must provide himself with a radio receiving equipment which involves storing upon his premises expensive storage batteries which are constantly in need of re-charging, together with a considerable amount of delicate and elaborate electrical apparatus, such as coils, detectors, amplifiers, etc., all of which involve careful maintenance. Moreover, the radio receiving set as now known is, at its best, an inherently ugly thing, absolutely out of place in the home and requiring for its operation a network of unsightly wiring.

Realizing the inherent limitations of radio broadcasting, proposals have been made to use existing wire systems, such as telephone, telegraph or power networks for program transmission purposes by transmitting carrier frequencies over such existing power or communication lines. Such a method, however, would be extremely expensive as well as complicated, as it involves a very considerable reorganization of the telephone

plant or power plant, and requires the use of quite complicated and expensive apparatus.

The ordinary telephone plant, however, offers unusual facilities for program transmission purposes by the use of ordinary telephonic methods and without the employment of any high frequency or carrier methods of signaling. When it is realized that the average subscriber's telephone set is in use for telephonic purposes only during an extremely small part of the time it becomes at once apparent that if the telephone line, during its idle periods, could be used for transmitting news, information or entertainment, the plant could be used much more economically and the information or the like distributed could be transmitted to the subscriber in the simplest manner possible. It may further be observed that the average subscriber to a program service, particularly a service for transmitting entertainment, would only desire to avail himself of the service during the late afternoon or during the evening, at which times the average subscriber's telephone is only used for social purposes and is rarely or never used for business calls.

Having these circumstances in mind, it is proposed by this invention to provide simple, practical and economical arrangements by which news, information, music or other forms of entertainment may be transmitted at ordinary telephonic frequencies from a central program station over subscribers' telephone lines. It is also proposed by this invention to provide a system whereby the telephone subscriber may receive the program service without interfering in any way with the use of his line for ordinary telephone purposes. This invention also renders available a program distributing system in which the apparatus, not only at the central station but more particularly at the subscriber's station, will be extremely simple and economical and yet efficient.

The invention may now be more fully understood by reference to the following detailed description thereof when read in connection with the accompanying drawing, in which Figure 1 is a circuit arrangement illustrating one embodiment of the invention and Fig. 2 is a circuit arrangement illustrating a similar embodiment provided

with an amplifying device for the loud speaker at the receiving station.

Referring to Fig. 1, L designates an ordinary subscriber's line to which program service is normally connected through the back contacts of a cut-off relay COR. The equipment associated with the subscriber's line at the switchboard, such as the answering jack J and the multiple jacks J', J'', etc., is normally disconnected from the line at the contacts of the cut-off relay, this arrangement of the circuit operating to eliminate the cross-talk interference which might occur between adjacent circuits in the switchboard cable. A line relay LR is provided, this line relay being associated with the portion of the circuit extending from the line L to the program station instead of being associated with the part of the circuit extending to the answering jack. The cut-off relay COR is arranged to be operated over the sleeve circuit of the answering jack whenever the plug of a cord circuit is inserted in said jack. The cut-off relay, when actuated, disconnects the program equipment and hence the line relay LR from the line so that it will be apparent that incoming calls to the subscriber may be completed in the usual manner.

The program equipment comprises a trunk T, leading to a program station (not shown). An amplifier 25 is associated with the trunk T through patching jacks J₁ for amplifying the program currents to the desired amplitude for transmission over the lines of the group to which the line L belongs. In this connection, it will be noted that subscribers' lines having similar impedance characteristics may be grouped together and associated by means of jacks, such as the jack J₂, to common bus-bars connected to the output of an amplifier, such as 25. The amplifier may be so adjusted as to amplify the currents to the desired value for all of the lines of the group. For example, lines in the same cable having approximately the same length, the same gauge conductors and approximately the same capacity, would all be grouped on certain bus-bars. The amplifier, such as 25 at the central office, associated with this group of lines, would be equipped with the proper type of output coils and other apparatus so that it would work at its maximum efficiency when connected to its associated group of lines. Means may also be provided when necessary for equalizing the transmission over the various groups of subscribers' lines.

The arrangement illustrated is designed on the assumption that a fixed program will be given at certain hours and consequently a key K' is provided for switching the program station into connection with the bus-bars associated with a group of subscribers'

lines. This key will be actuated during such periods as programs are being rendered. At other periods, the key will be in its normal position and its contacts are so arranged that when the key is normal, the bus-bars 26 are short-circuited. This prevents the possibility of subscribers connected to the same bus-bars conversing with each other over the common connection when the program station is not connected. When the key K' is actuated a busy tone is applied to the sleeve of the answering jack J and its multiples through an extra winding on the cut-off relay COR to indicate to the operator that the program service is being applied to the line.

The jack J₂ is provided for the purpose of disconnecting any given line, such as L, from its normal group and patching it into connection with some other program circuit or group. For this purpose the patching cord may be connected to a multiple (not shown) of the jack J₃ of the other program circuit. The patching jacks J₁ and J₃ are provided for patching in different amplifiers or for connecting the bus-bars 26 with different program stations. By this arrangement a program of one character may be connected to one group of lines and a program of different character to another group of lines. The jacks, however, enable the programs to be switched from group to group, as the exigencies of the service may require. The jack J₂, on the other hand, permits the connection of a subscriber, normally in a given group receiving a certain program, to the bus-bars of another group receiving a different program which he may at that particular time prefer to hear.

The apparatus at the subscriber's station A is extremely simple, consisting merely of the standard substation set 10 and a loud speaker 11, the latter being connected through a transformer 14 to a circuit bridged across the line through a key K and a back contact on the switchhook of the substation set. When the receiver is on the switchhook and the contact of the key K is closed, the program applied to the bus-bars 26 will be transmitted over the line L and actuate the loud speaker 11. The program may be applied to the subscriber's line during a given period whether the subscriber desires it or not. If the subscriber does not care to hear the program he will simply maintain the contact of the key K open and if he does desire to hear the program he may do so by closing the contact of the key. During the rendition of the program, a busy tone is applied over the upper contact of the key K' at the central office, over the lower back contact of the cut-off relay and through the lower winding of the cut-off relay to the ground. The

inductive action between the two windings of the cut-off relay transmits a busy tone to the sleeve conductor of the answering jack.

If a call should come in for the line L while the program is being rendered, the operator may disregard the busy tone and insert the plug P of the usual connecting cord into the answering jack J, or one of the multiples thereof, thereby energizing the cut-off relay through its upper winding. The cut-off relay at once disconnects the line L from the circuit including the line relay LR, transformer 27, jack J₂, leads 28, key K', amplifier 25 and trunk T leading to the program station. The subscriber, upon being rung, removes his receiver from the switchhook, thereby disconnecting the loud speaker 11 and connecting the telephone set into circuit with the line L. Upon hanging up the receiver at the end of the conversation, the loud speaker will again be connected into circuit and as soon as the connection is taken down at the central office by withdrawing the plug P, the cut-off relay will be deenergized and the circuit restored to the program transmitting condition.

If, while the line is being used for program receiving, the subscriber desires to make a call, he may do so by simply removing the receiver from the switchhook, which disconnects the loud speaker 11 from the line and at the same time connects the subscriber's set into the circuit. The line relay LR, which is included in the program connection, will be energized and complete a circuit for the line lamp 15. The operator upon observing the glowing of the lamp, will insert the plug P of a cord in the answering jack, thereby energizing the cut-off relay to disconnect the line L from the program circuit and to connect it to the answering jack. Restoration of the circuit to the program transmitting condition at the end of the conversation will be as previously described.

Fig. 2 illustrates a circuit similar to that shown in Fig. 1. In this arrangement, however, the substation is equipped with a vacuum tube amplifier 32 in addition to the loud speaker 11. In order to avoid the installation of batteries at the subscriber's station, the circuit is so arranged that the current for operating the plate and filament circuits of the amplifier is furnished over the line from the central office. The plate current may be furnished from a 48-volt battery, for example, through the winding of the marginal line relay LR over the ring side of the line. The filament current, on the other hand, may be supplied from a 10-volt battery over the tip side of the line. Since the telephone line may act as an antenna and pick up transmission from a radio station, the subscriber might use the

amplifier and loud speaker to detect the radio transmission at such times as the central program equipment is not functioning. In order to prevent this, a switch K₂ is provided at the central office for disabling the current supply circuit of the amplifier, while at the same time providing the usual direct current supply for the telephone substation equipment.

In the circuit of Fig. 2, as well as in Fig. 1, the line is normally connected to the program circuit 28 over the contacts of the cut-off relay, so that the subscriber, in order to obtain the program transmission, merely throws the key K at the substation, thereby completing connection to the input transformer 34 of the amplifier 42 and at the same time completing the filament and plate circuits of the amplifier. When the central program equipment is operating, and the line L is disconnected from the program trunk and connected to the switching jack J for the purpose of establishing a telephone connection, a network N may be connected to the program trunk. The network N simulates the impedance of the line and thereby maintains constant the impedance of the network of circuits supplied from the program trunk. If this arrangement were not provided and a material number of the lines supplied from the same program circuit were simultaneously used for telephonic purposes, the program transmission to the remaining lines would be greatly increased.

Further details of the invention may be understood from the description of the operation, which is as follows: When the program service is being applied to the line L over the circuit 28 through the transformer 27 over the normal contacts of the cut-off relay COR and through the transformer 27, the switch K₂ will be actuated to connect the 48-volt battery to the bus-bar 30 and the 10-volt filament battery to the bus-bar 31. Current supply circuits for the amplifiers of all of the lines connected to the bus-bars 30 and 31 will thus be provided. The subscriber may now avail himself of this service by actuating the key K. This closes the filament circuit from the 48-volt battery over the upper make contact of the key K₂, bus-bar 30, through the winding of the line relay LR, over the armature 32 of the cut-off relay COR, over the ring conductor of the line, back contact of the switchhook of the subscriber's set 10, left-hand make contact of the key K, and through the retard coil to the plate of the amplifier 42. The line relay LR is marginal and is not actuated by the small current flowing through the high impedance of the plate circuit. The filament circuit is completed from the 10-volt battery, over the lower make contact of the key K₂, bus-bar 31, armature 34 of

the cut-off relay COR, tip side of the line L, right-hand make contact of the key K, through the retard coil to the filament of the amplifier 42 to ground. The amplifier is
 5 now energized and amplifies the program current transmitted over the line to the loud speaker 11.

If while the circuit is in this condition the subscriber wishes to initiate a call, the receiver is removed from the hook, thereby
 10 opening the bridge including the input transformer 34 of the amplifier 42 and also opening the battery supply circuit for the plate of the amplifier, so that the amplifier and loud speaker cease to function. A low impedance path is at the same time closed over the line L through the subscriber's set
 15 10 as follows: from the 48-volt battery, over the bus-bar 30, through the winding of the marginal relay LR, over the ring side of the line, over the subscriber's switchhook, through the subscriber's set 10, back over
 20 the tip side of the line L and over the bus-bar 31 to the 10-volt filament battery. The two batteries are now connected in series through the low impedance of the subscriber's set 10 and the current flow is sufficient to operate the marginal line relay LR which causes the line lamp 15 to glow. The
 30 operator is thus informed that a connection is desired and plugs into the jack J, whereby the cut-off relay COR is actuated. The cut-off relay COR, upon attracting its armatures 32 and 34, disconnects the line L
 35 from the program trunk and connects it to the tip and ring conductors of the jack J. At its armature 35, the cut-off relay opens the circuit of the line lamp 15 and at its armature 36 the cut-off relay substitutes the
 40 network or resistance N for the line L, thereby maintaining the impedance looking through the transformer 27 from the program circuit substantially the same as when the line L is connected to the transformer.

At the end of the conversation the subscriber hangs up his receiver. The operator, upon receiving the disconnect signal, withdraws the plug from the jack J, thereby de-
 50 energizing the cut-off relay COR. As a consequence, the line L is again connected to the program circuit, and if the key K has remained actuated, the subscriber will receive the program transmission as before.

If a call comes in for the line L the operator may, by inserting the plug of the connecting cord into the jack J, energize the cut-off relay, which at once disconnects the line L from the program circuit and connects it to the jack J as before. The current
 60 supply circuit for the amplifier 42 will be opened by the armatures 32 and 34 of the cut-off relay, so that the amplifier and loud speaker at the subscriber's station will be inoperative. Upon the subscriber receiving
 65 the ringing signal, he will remove the re-

ceiver from the switchhook and the telephone conversation may take place in the usual manner. At the conclusion of the conversation the circuits may be restored to the program condition as previously de-
 70 scribed.

When the program apparatus at the central station is not functioning, the key K_2 will be restored to normal, thereby disconnecting the 48-volt battery and the 10-volt
 75 battery from the ring and tip sides, respectively, of the various lines. The ring side of the lines will be connected over the normal contact of the key K_2 to the usual 24-volt battery and the tip sides of the lines
 80 will be grounded over the normal contact of the key K_2 . Under this condition the line relay LR will respond to the operation of the switchhook in the usual manner, so that telephone connections may take place.
 85 The amplifier 42, associated with the loud speaker set, will be rendered inoperative, however, and thus effectually prevent the subscriber from using the amplifier and loud speaker to receive radio transmission which
 90 might be picked up by the line L acting as an antenna.

It will be obvious that the general principles herein disclosed may be embodied in other and different organizations widely
 95 different from those illustrated without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a telephone system, a telephone line
 100 terminating at a central office at one end and a subscriber's station at the other, a telephone set at the subscriber's station, normally open conductors at the central office
 105 leading to switching means for interconnecting said line with other lines for ordinary telephonic intercommunication, a line relay used in conjunction with the establishment of such interconnections, connections normally associated with the line leading to a
 110 program transmitting station, said line relay being included in said last mentioned connections and being unactuated during the transmission of program currents to the subscriber, and means for closing said nor-
 115 mally open conductors.

2. In a telephone system, a telephone line
 120 terminating at a central office at one end and a subscriber's station at the other, a telephone set at the subscriber's station, normally open conductors at the central office leading to switching means for interconnecting said line with other lines for
 125 ordinary telephonic intercommunication, a line relay used in conjunction with the establishment of such interconnections, connections normally associated with the line leading to a program transmitting station, said line relay being included in said last
 130 mentioned connections and being unactu-

ated during the transmission of program currents to the subscriber, and means for opening the connections to the program station and closing said normally open conductors when said line is used for ordinary telephone purposes.

3. In a telephone system, a telephone line terminating at a central office at one end and a subscriber's station at the other, a jack at the central office for interconnecting said line with other telephone lines for telephonic intercommunication, connections from said line to said jack, said connections being normally disconnected from the line, connections normally associated with the line extending to a program transmitting station, a line relay included in said last mentioned connections, said line relay being unactuated during the transmission of program currents to the subscriber, and a line lamp controlled by said line relay for indicating that the subscriber is calling for the establishment of an ordinary telephone connection.

4. In a telephone system, a telephone line terminating at a central office at one end and a subscriber's station at the other, a jack at the central office for interconnecting said line with other telephone lines for telephonic intercommunication, connections from said line to said jack, said connections being normally disconnected from the line, connections normally associated with the line extending to a program transmitting station, a line relay included in said last mentioned connections, said line relay being unactuated during the transmission of program currents to the subscriber, a line lamp controlled by said line relay for indicating that the subscriber is calling for the establishment of an ordinary telephone connection, and means operating to disconnect the line relay and program connections from the line when it is used for ordinary telephone purposes.

5. In a telephone system, a telephone line terminating at a central office at one end and a subscriber's station at the other, a jack at the central office for interconnecting said line with other telephone lines for telephonic intercommunication, connections from said line to said jack, said connections being normally disconnected from the line, connections normally associated with the line extending to a program transmitting station, a line relay included in said last mentioned connections, said line relay being unactuated during the transmission of program currents to the subscriber, a line lamp controlled by said line relay for indicating that the subscriber is calling for the establishment of an ordinary telephone connection, a cut-off relay, said cut-off relay being actuated when a plug is inserted in the jack in establishing either incoming or

outgoing telephone connections, and said cut-off relay when actuated operating to disconnect the line relay and program connections from the line and connect the line to the switching jack.

6. In a telephone system, a plurality of telephone lines terminating at one end in a central office whereby any one of said lines may be connected with another line for ordinary telephonic intercommunication, a program transmitting station adapted to be connected with bus-bars common to a group of telephone lines, said group of telephone lines consisting of lines having similar impedance characteristics, and each of the lines of the group having connections whereby it may be associated with said bus-bars, and an amplifier for transmitting the program currents to said bus-bars with the amplitude required for proper transmission over said group of lines.

7. In a telephone system, a plurality of telephone lines terminating at one end in a central office, switching means at said central office whereby any one of said lines may be connected with another line for ordinary telephonic intercommunication, a plurality of program transmitting stations adapted to be connected to corresponding bus-bars, each set of bus-bars being common to a group of telephone lines and the telephone lines of each group having similar impedance characteristics, and amplifying means for amplifying the currents transmitted from each program station to a group of telephone lines.

8. In a telephone system, a plurality of telephone lines terminating at one end in a central office, switching means at said central office whereby any one of said lines may be connected with another line for ordinary telephonic intercommunication, a plurality of program transmitting stations adapted to be connected to corresponding bus-bars, each set of bus-bars being common to a group of telephone lines, the telephone lines of each group having similar impedance characteristics, amplifying means for amplifying the currents transmitted from each program station to a group of telephone lines, and means for interchanging the connections between program stations and different groups of telephone lines so that any group may be connected to any desired program station.

9. In a telephone system, a plurality of telephone lines terminating at one end in a central office, switching means at said central office whereby any one of said lines may be connected with another line for ordinary telephonic intercommunication, a plurality of program transmitting stations adapted to be connected to corresponding bus-bars, each set of bus-bars being common to a group of telephone lines, the telephone lines

of each group having similar impedance characteristics, amplifying means for amplifying the currents transmitted from each program station to a group of telephone lines, and means whereby any individual line common to a group may be disconnected from the bus-bars associated with a given program station and connected to the bus-bars associated with another program station.

10. In a telephone system, a telephone line terminating at a central office at one end and a subscriber's station at the other, a telephone set at the subscriber's station, normally open conductors at the central office leading to switching means for interconnecting said line with other lines for ordinary telephonic intercommunication, a line relay used in conjunction with the establishment of such interconnections, connections normally associated with the line leading to a program transmitting station, said line relay being included in said last mentioned connections and being unactuated during the transmission of program currents to the subscriber, means for disconnecting the connections to the program station and closing said normally open conductors when said line is used for ordinary

telephone purposes, and means for reestablishing the connection to the program station at the end of the ordinary telephone conversation.

11. In a telephone system, a telephone line terminating at a central office at one end and a subscriber's station at the other, a jack at the central office for interconnecting said line with other telephone lines for telephonic intercommunication, connections from said line to said jack, said connections being normally disconnected from the line, connections normally associated with the line extending to a program transmitting station, a line relay included in said last mentioned connections, said line relay being unactuated during the transmission of program currents to the subscriber, a line lamp controlled by said line relay for indicating that the subscriber is calling for the establishment of an ordinary telephone connection, and means to give a busy indication at said jack when the program connection is completed.

In testimony whereof, I have signed my name to this specification this 10th day of November, 1922.

JOHN F. TOOMEY.