

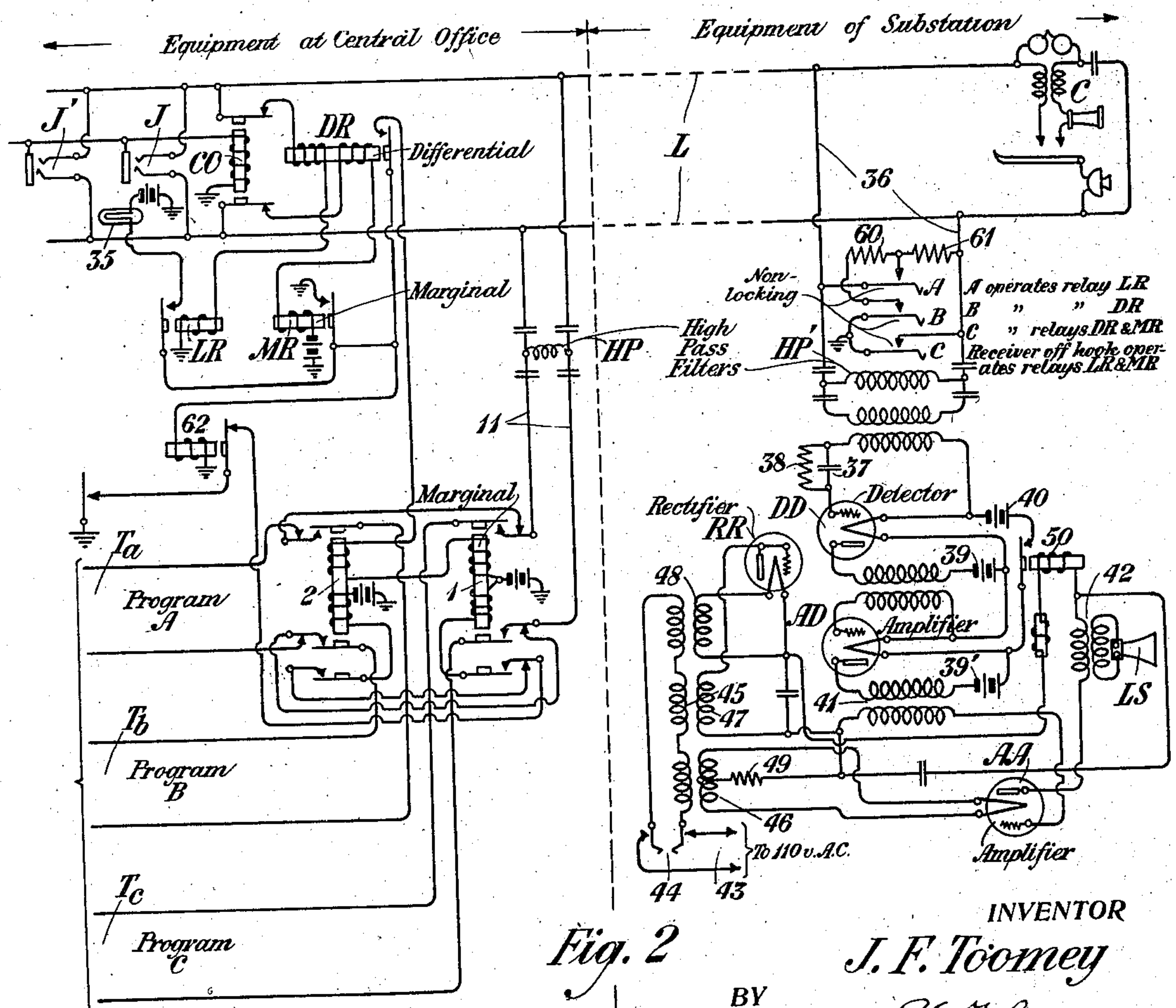
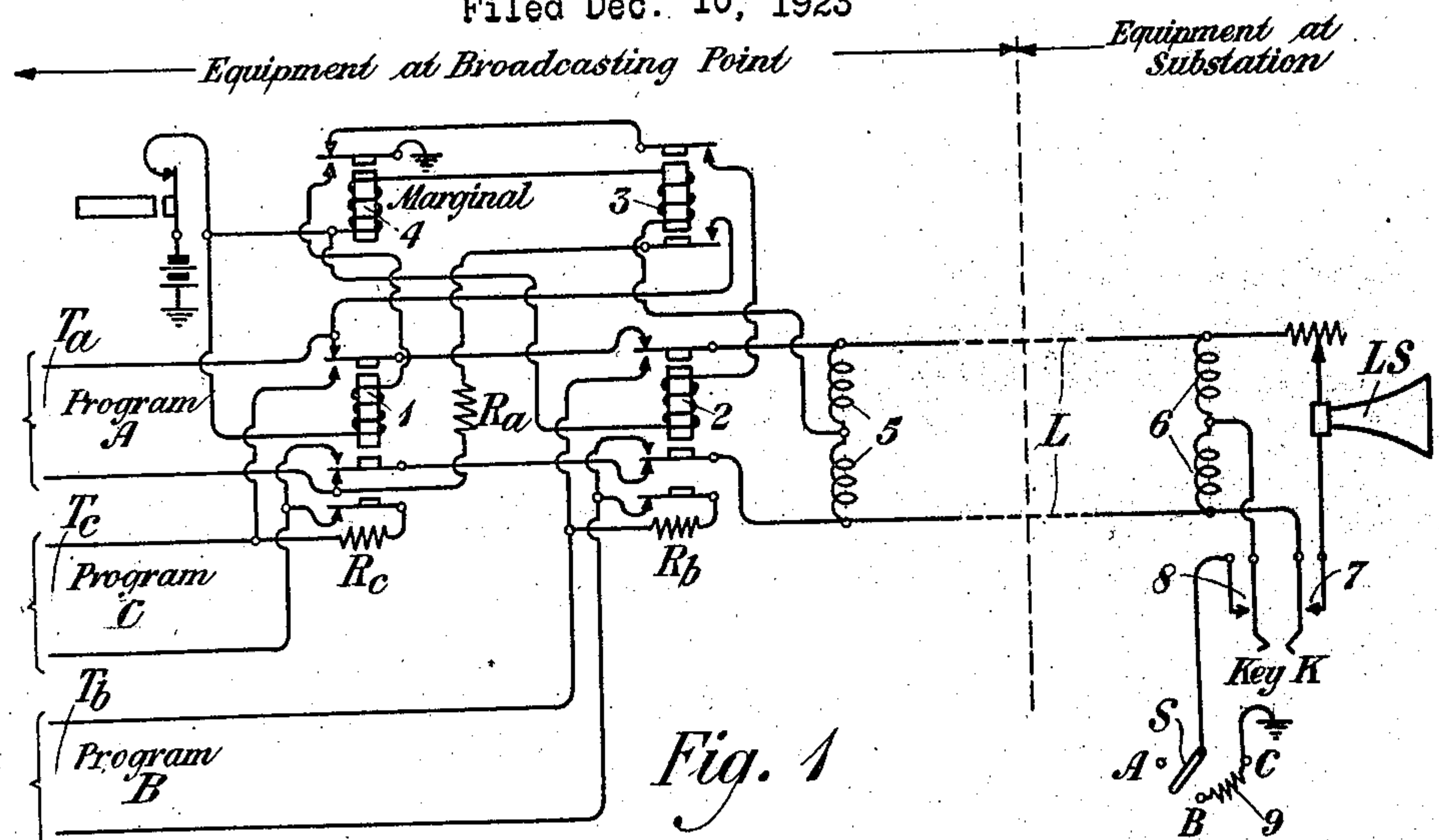
April 17, 1928.

1,666,153

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PROGRAM SELECTING CIRCUITS

Filed Dec. 10, 1923



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PROGRAM-SELECTING CIRCUITS.

Application filed December 10, 1923. Serial No. 679,736.

This invention relates to transmission systems for transmitting programs over wires and more particularly to arrangements for the selection of programs for such systems.

Where wire lines, such as ordinary telephone lines, for example, are used for the transmission of programs, such as news, lectures, concerts and the like, it is desirable that some arrangement be provided whereby the subscriber may automatically select the particular program which he desires to hear. In accordance with the present invention it is proposed to accomplish this result by providing relay arrangements at the central office which may be controlled by the subscriber at the subscriber's station to connect the terminals of the subscriber's line to the terminals of any one of a number of trunks, each leading to a different program.

By the use of selective means of the type referred to it becomes immaterial whether the program be transmitted at voice frequencies or carrier frequencies and it also becomes immaterial whether several programs be transmitted at the same frequency or whether different carrier frequencies are used for different programs. The selecting arrangement may be used either in connection with a system in which special transmission lines are provided for subscribers to the broadcasting system or it may be used in a system in which the program transmitting apparatus is superposed upon ordinary telephone lines.

The invention will now be more fully understood from the following description when read in connection with the accompanying drawing, Figure 1 of which illustrates the selective arrangement as applied to a system employing special transmission circuits for the programs and Fig. 2 of which shows a selective arrangement applied to a program system employing carrier frequency programs superposed upon ordinary telephone lines.

Referring to Fig. 1, L designates a special transmission circuit leading from a program station to a subscriber's station. At the subscriber's station a loud speaker LS is provided which may be connected to the line by the operation of the key K. At the broadcasting point a plurality of trunks T_a , T_b and T_c lead to different program sources which will be hereinafter referred to for convenience as programs A, B, and C.

Switching relays 1 and 2 are provided at the program station for determining the program connected to the line L. As illustrated, program A is normally connected to the line L over the back contacts of the relays 1 and 2. When relay 2 is operated, program B is connected to the line L over the front contacts of said relay and when relay 1 is operated program C is connected to the line L over the front contacts of said relay and the back contacts of the relay 2. These relays are controlled by a relay 3 and by a marginal relay 4, which are associated with the line L through a simplex connection to the midpoints of an impedance 5 bridged across the line at the central station. At the subscriber's station a similar bridged impedance 6 is provided and from the midpoint of this impedance a connection extends to a selecting switch S.

Further details of the apparatus will be clear from a description of the operation which is as follows: Assuming that the subscriber desires to receive a program transmitted over the trunk T_b , the subscriber closes the key K, thereby bridging the loud speaker LS across the line at contact 7 and at contact 8 closing the connection from the impedance 6 to the selecting switch S. The subscriber then moves the switch S until it rests upon contact B, whereupon a circuit is completed from ground through a resistance 9, over the switch S, contact 8 and thence in parallel through the two halves of the impedance 6 over two sides of the line in parallel and thence through the two halves of the impedance 5 to the midpoint thereof, from which point the circuit extends through the winding of the relay 3 and through the winding of marginal relay 4 to battery. Relay 4, being marginal, is not energized in series with the resistance 9 but the relay 3 is energized and upon attracting its armature completes a circuit from ground, over the back contact of relay 4, upper front contact of relay 3 and through the winding of relay 2 to battery.

It will be noted that each of the trunks leading to programs is terminated in a suitable resistance (equivalent to that of a transmission line) when the trunk is not actually connected to a transmission line. For example, the trunk T_b has a resistance R_b bridged across its terminal, the trunk T_c has a resistance R_c bridged across its terminal,

while in the case of the trunk T_a a resistance R_a is arranged to be bridged across the terminals when the trunk T_a (which is normally connected to the line L), is disconnected from the line. The relay 2, upon being operated, disconnects the resistance R_b from the trunk T_b at its lower contact and at its remaining contacts connects the line L to the trunk T_b . At the same time relay 3 at its lower contact bridges the resistance R_a across the trunk T_a in order to take the place of the resistance of the line L , which, it will be noted, was disconnected from the trunk T_a upon the operation of the relay 2.

If the subscriber should desire to select the program C he will move the switch S to the contact C , thereby completing a circuit similar to that already traced for the relays 3 and 4, except that in this instance the resistance 9 is omitted. The current now flowing through the windings of the relays 3 and 4 is sufficient to energize both relays. Accordingly, relay 4 at its upper contact opens the circuit previously traced for the relay 2 over the upper front contact of the relay 3 and closes a circuit for the relay 1 from ground, over the upper front contact of relay 4, winding of relay 1, to battery. Relay 2 is now released and at its lower contact again connects the resistance R_b across the trunk T_b . At its remaining back contacts the relay 2 connects the line L to the armatures of the relay 1. Relay 1 at its lower contact opens a circuit of the resistance R_a and at its remaining contacts disconnects the trunk T_a from the line L and connects said line to the trunk T_c . The resistance R_a is connected to the terminals of the trunk T_a over the lower front contact of the relay 3.

If the subscriber should desire to receive the program A, he moves the switch S to contact A. This opens the simplex circuit previously described for the windings of the relays 3 and 4 so that both relays will remain deenergized. Consequently, the circuit will be in the condition shown in the drawing with the line L connected to the trunk T_a over the back contacts of relays 2 and 1 in series. It will also be noted that the resistance R_a is disconnected from the trunk T_a at the lower contact of relay 3 and that resistances R_b and R_c are bridged across the trunks T_b and T_c respectively at the lower contacts of relays 2 and 1.

Fig. 2 illustrates a relay program selecting arrangement applied to a wire program system in which the programs are transmitted at carrier frequencies and superposed upon an ordinary subscriber's telephone line. In this case, the line L is an ordinary subscriber's line terminating in the usual substation set C at one end and terminating at a central office in the multiple jacks J and J' . A ground connection is established to

the tip side of the line L over the back contact of the cut-off relay CO , said ground connection including the winding of the line relay LR and one winding of a differential relay DR . A battery connection is established to the ring side of the line over the back contact of the cut-off relay CO , said connection including a winding of a marginal relay MR and one winding of the differential relay DR .

The three relays DR , LR and MR jointly control the switching of the line L to any one of three trunks T_a , T_b and T_c , leading to three programs A, B and C. This control is exercised through the relays 1 and 2. The trunk T_a is normally connected to the line L over the contacts of the relays 1 and 2 and through conductors 11, which include a high-pass filter HP . When the relay 1 is actuated the line is connected through the conductors 11 to the trunk T_c . When the relay 2 is actuated, however, the line L is connected through the conductors 11 to the trunk T_b .

At the subscriber's station the switching relays are controlled to select the desired trunk by means of non-locking keys A, B and C, which are associated with conductors 36 bridged across the line L at the subscriber's station. The conductors 36 are connected through a high pass filter HP' and suitable detecting and amplifying apparatus to the loud speaker LS .

The amplifying and detecting apparatus already referred to may comprise a detector tube DD , an amplifier detector AD , a rectifier tube RR and an amplifier tube AA . The circuits of the detector tube may be of the ordinary type including, for example, a grid condenser 37 and grid leak 38 in the input circuit. If the tube DD be a tube of the so-called peanut type, plate current may be furnished by a source consisting of dry batteries 39 and filament current may be supplied by a source consisting of dry batteries 40. The tube AD may also be a peanut tube arranged to act as an amplifier. The filament circuit of this tube may be energized by the battery 40, the filament being connected in series with the filament of the tube DD . The plate current for the tube AD may be furnished by a source consisting of dry batteries 39'.

The output circuit of the amplifier AD is connected by means of a transformer 41 with the input or grid circuit of the amplifier AA , whose output circuit is in turn connected through transformer 42 with the loud speaker LS . Since the amplifier AA is usually a power tube and therefore requires large currents for its operation, it is desirable to obtain these currents from the local power mains. In the case illustrated it is assumed that alternating current is supplied to the power mains 43 by closing a switch 44; the alternating current for the power mains may be im-

pressed upon the primary 45 of a transformer. The transformer has three secondaries. By means of secondary 46 the voltage of the power source is stepped down to the proper voltage for energizing the filament of the amplifier of the tube AA. The plate current for the amplifier AA is supplied through the rectifier RR. The secondary winding 48 of the transformer already referred to steps down the voltage of the power mains to a proper voltage for energizing the filament of the rectifier RR. The current to be rectified is impressed upon the plate of the rectifier RR through the secondary winding 47, which transforms the voltage of the power mains to the proper voltage for energizing the plate circuit of the amplifier AA. The plate circuit of the amplifier AA extends from the midpoint of the secondary winding 46 (which is connected with the filament of the tube AA) through a resistance 49, through the secondary winding 47, plate of the rectifier RR, thence through the vacuum of the tube to the filament of the rectifier RR, and from the filament of the rectifier RR the circuit extends to the winding of the relay 50 and through the primary winding of the transformer 42 to the plate of the amplifier AA. It will thus be seen that the rectifier RR is included in the plate circuit of the tube AA and rectifies the current impressed upon said tube through the secondary winding 47. This current when flowing energizes the relay 50 to close the filament circuit of the detector tube DD. Consequently, by merely closing the switch 44 the rectifier and amplifier circuits are supplied with current, thereby being rendered operative, and the current flowing in the plate of the power amplifier circuit operates the relay 50 to set the detector DD and amplifier AD in operation. Opening the switch 44 disconnects the current supply from the rectifier and the amplifier and the cessation of current flow in the plate of the amplifier causes the relay 50 to disable the detector DD and the amplifier AD.

Further details of the apparatus will be clear from the description of the operation which is as follows: Assuming that the subscriber wishes to hear the program B, he first closes the switch 44, thereby connecting the power mains to the amplifying apparatus and rendering the amplifying and detecting apparatus operative in the manner already described. The non-locking key B is then momentarily operated. This closes a circuit from ground, through resistances 60 and 61 in series, over the ring side of the line L, over the lower back contact of the cut-off relay CO, through the right-hand winding of the differential relay DR and through the winding of the marginal relay MR to battery. The relay MR is marginal

and is not energized in series with the resistances 60 and 61. The differential relay DR, however, is energized and closes a circuit from battery, through the upper winding of marginal relay 1, upper winding of marginal relay 2, over the front contact of the relay DR and through the high resistance winding of the relay 62 to ground. Relays 2 and 62 are energized by the closing of this circuit but relay 1, which is a marginal relay, will not operate in series with the high resistance winding of the relay 62 and the upper winding of the relay 2.

Relay 2 disconnects the trunk T_a leading to the program A from the conductors 11 and connects the conductors 11 to the trunk T_b leading to the program B. Relay 2 also closes a locking circuit from battery, through its lower winding and over its lower front contact, over the lower back contact of relay 1 and over the back contact of relay 62 to ground. This circuit is not closed, however, until the subscriber releases the key B, thereby deenergizing the differential relay DR and opening the circuit previously traced for the relay 62 and the relay 2. As the relay 62 is quicker to release than the relay 2, this locking circuit is established before the initial energizing circuit of the relay 2 is opened. It will be clear, therefore, that once the relay 2 has been actuated to connect the line over conductors 11 to trunk T_b , it will remain thus connected until some other key is actuated. The operation of the relay 62 when the key B is actuated, of course, holds open the locking connection and therefore releases the locking circuit of the relay 1, in case said relay had been previously energized and locked up in a manner to be described later.

If, now, the subscriber desires to hear the program C, he will momentarily actuate the non-locking key C. This completes a circuit from ground, over the key C, over the ring conductor of the line L, over the lower back contact of the cut-off relay CO, right-hand winding of differential relay DR and through the winding of marginal relay MR to battery. As resistances 60 and 61 are not included in this circuit both differential relay DR and marginal relay MR are energized. Marginal relay MR completes a circuit from ground, over its front contact, over the front contact of differential relay DR, through the upper windings of relays 2 and 1, to battery. Both relays 2 and 1 are operated as the circuit just traced did not include the high resistance winding of relay 62. Relay 1 disconnects the conductors 11 from the conductors leading to the contacts of the relay 2 and connects conductors 11 to the trunk T_a . The fact that the relay 2 is energized at this time is without effect to connect the trunk T_b to the line as the connection of the trunk T_b must ex-

tend over the normal back contacts of the relay 1, which is operative. Relay 1 at its lower front contact establishes a locking circuit through its lower winding, over its lower front contact and over the back contact of relay 62 to ground. This locking circuit is established immediately without awaiting the release of the key C as the relay 62 at this time is not operative. The lower contact of the relay 1, on the other hand, opens the locking connection through the lower winding of the relay 2 so that as soon as the key C is restored relay 2 is deenergized and only the relay 1 remain locked up to maintain the connection between the trunk T_c and the line L.

If, under the conditions above described, the subscriber should desire to shift his connection to the program A, he will momentarily actuate the non-locking key A. This completes a circuit from battery, through the winding of the marginal relay MR, through the right-hand winding of the differential relay DR, over the lower back contact of the cut-off relay CO, over the ring conductor of the line L, through the high resistance 61, over the contact of key A, over the tip conductor of the line L, over the upper back contact of the cut-off relay CO, through the left-hand winding of the differential relay DR and through the line relay LR. The differential relay DR will not be operated over this circuit as current is flowing through both of its windings. The marginal relay MR will also not be operated for the reason that the current flowing through the high resistance 61 is not sufficient to energize its winding. Relay LR will be actuated, however, and will complete a circuit from battery, through the line lamp 35, over the front contact of the line relay LR and through the high resistance winding of relay 62 to ground.

The resistance of the winding of relay 62 is sufficiently great to prevent actuation of the lamp 35 so the line lamp does not glow. The relay 62 is energized, however, and opens the locking circuit for the relay 1, restoring the contacts of said relay to normal so that the line L_c is connected with the trunk T_a over the conductors 11 and over the back contacts of relays 1 and 2. The connection to the trunk T_c is, of course, opened by means of the relay 1 at the same time. Had the connection previously established been over the contacts of the relay 2 to the trunk T_b , the relay 62 would open the locking circuit of the relay 2 and restore this relay to normal, thereby opening the connection to the trunk T_b and connecting the trunk T_a to the line L. As soon as the key A is restored the relay LR is released and the circuit of the relay 62 is opened. This does not, however, produce any change in the setting of the circuit. If

neither relay 1 nor relay 2 has been previously actuated to connect the line to a program other than the program A it would, of course, be unnecessary to actuate the key A as the trunk T_a is normally connected to the line L over the back contacts of the relays 1 and 2. The operation of the key A would not do any harm, however, in this instance, as its only purpose is to energize the relay 62 to open the locking circuit of relays 1 and 2, as the case may be, if they have been previously operated.

If, while the subscriber is receiving any one of the programs above referred to, a telephone call should come in for the subscriber the operator will insert a plug in the multiple jack J' , thereby operating the cut-off relay. The cut-off relay disconnects the windings of the differential relay DR and the line relay LR and marginal relay MR from the line L but in so doing it does not cause any circuit change so far as the connection to any given program is concerned for the reason that these relays are only momentarily operated over the line by the non-locking key at the subscriber's station and their continued energization is not necessary to maintain the connection of the line to a given program. The subscriber may then be rung in the usual manner and upon removing his receiver from the switchhook may carry on a conversation with the calling subscriber. This may be done without any interference with the program transmitted as the high pass filter HP' prevents the ordinary voice frequencies from entering the receiving program circuit. The program being broadcasted at carrier frequencies will be inaudible and will therefore not interfere with the conversation. It will also be understood that several programs hereinbefore referred to, may be transmitted either at the same carrier frequency or a different carrier frequency may be used for each program. In either case, the high pass filters segregate the program from the telephonic range and the selecting relays connect one program only to the line at a time.

In case the subscriber should desire to make a telephone call while a program is being received, he removes his receiver from the switchhook, thereby completing a low resistance circuit from battery, through the marginal relay MR, through the right-hand winding of the differential relay DR, over the lower back contact of the cut-off relay CO, over the ring conductor of the line L, over the switchhook, back over the tip conductor of the line L, over the upper back contact of the cut-off relay CO, through the left-hand winding of the differential relay DR and through the winding of the line relay LR. The differential relay DR will not be actuated if the current flows through both of these windings. Owing to the low resist-

ance path established, however, both marginal relay MR and the line relay LR will be actuated. A circuit will therefore be completed from ground, over the front contact of the relay MR, over the front contact of relay LR, through the line lamp 35, causing the line lamp to glow. No circuit will be completed for relays 1 and 2 as the circuit of these relays will be opened at the contact of the differential relay DR, which is not energized. No circuit is established for the relay 62 for the reason that the winding of said relay is short-circuited at the front contact of the relay MR. Consequently, no change will be made in the program connection previously established.

The operator, upon observing the line lamp 35, will insert the plug of her cord in the answering jack J, thereby energizing the cut-off relay. The cut-off relay disconnects the differential relay DR, the line relay LR and the marginal relay MR from the line, as previously described. This effaces the line lamp 35 but for reasons already stated does not produce any change in the connection previously established. The conversation will now take place as in the manner already described.

Whenever the subscriber desires to cease receiving a given program all that is necessary is to open the switch 44, which disables the amplifying and detecting apparatus. It is unnecessary to manipulate any of the keys A, B and C. It will be understood, of course, that the various resistance values, etc., assigned to certain of the elements upon the drawing are for purposes of illustrations merely and these particular values are not essential to the proper operation of the circuits.

It will be obvious that the general principles 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 appended claims.

What is claimed is:

1. In a program transmission system, a line extending from a central office to a program subscriber's station, a plurality of trunks at said central office upon which programs may be impressed, relay operated switching means for establishing connections between any one of said trunks and said line to the exclusion of the others, and means at the subscriber's station to transmit over the line selective currents to selectively actuate said switching means to select the desired program trunk, said current so transmitted being maintained uninterrupted both during the operation of trunk selection and during the continuance of the established program connection.

2. In a program transmission system, a line extending from a central office to a pro-

gram subscriber's station, a plurality of trunks at said central office upon which programs may be impressed, selectively operated relay means for establishing connections between any one of said trunks and said line to the exclusion of the others, and means at the subscriber's station to transmit over the line selective currents to selectively actuate said relay means to select the desired program trunk, said current so transmitted being maintained uninterrupted both during the operation of trunk selection and during the continuance of the established program connection.

3. In a program transmission system, a line extending from a central office to a program subscriber's station, a plurality of trunks at said central office upon which programs may be impressed at carrier frequencies, relay operated switching means for establishing connections between any one of said trunks and said line to the exclusion of the others, and means at the subscriber's station to transmit over the line selective currents to selectively actuate said switching means to select the desired program trunk, said current so transmitted being maintained uninterrupted both during the operation of trunk selection and during the continuance of the established program connection.

4. In a program transmission system, a line extending from a central office to a program subscriber's station, a plurality of trunks at said central office upon which programs may be impressed at carrier frequencies, selectively operated relay means for establishing connections between any one of said trunks and said line to the exclusion of the others, and means at the subscriber's station to transmit over the line selective currents to selectively actuate said relay means to select the desired program trunk, said current so transmitted being maintained uninterrupted both during the operation of trunk selection and during the continuance of the established program connection.

5. In a program transmission system, a subscriber's telephone line terminating in a subscriber's telephone apparatus at the subscriber's station, switching means at the central office whereby connections may be established between said subscriber's line and another subscriber's line, a plurality of trunks at the central office upon which programs may be impressed, relay operated switching means independent of said first mentioned switching means at the central office for establishing connections between any one of said trunks and said line to the exclusion of the others, and means at the subscriber's station for controlling the switching operation of said relay means while the receiver is on the switch hook.

6. In a program transmission system, a

subscriber's telephone line terminating in a subscriber's telephone apparatus at the subscriber's station, switching means at the central office whereby connections may be established between said subscriber's line and another subscriber's line, a plurality of trunks at the central office upon which programs may be impressed, relay operated switching means independent of said first mentioned switching means for establishing connections between any one of said trunks and said line to the exclusion of the others, and means at the subscriber's station for controlling said relay operated switching means while the receiver is on the switch hook.

7. In a program transmission system, a subscriber's telephone line terminating in a subscriber's telephone apparatus at the subscriber's station, switching means at the central office whereby connections may be established between said subscriber's line and another subscriber's line, a plurality of trunks at the central office upon which programs may be impressed, relay operated switching means independent of said first mentioned switching means for establishing connections between any one of said trunks and said line to the exclusion of the others, and means at the subscriber's station for selectively actuating said relay means while the receiver is on the switch hook.

8. In a program transmission system, an ordinary telephone subscriber's line terminating in a subscriber's telephone apparatus at the subscriber's station, switching means at the central office for establishing connections between said line and other lines so

that telephone conversations may take place at ordinary telephonic frequencies, a plurality of trunks at the central office upon which different programs may be impressed at carrier frequencies, relay operated switching means independent of said first mentioned switching means for establishing connections between any one of said trunks and said line to the exclusion of the others, and means at the subscriber's station for controlling said relay operated switching means while the receiver is on the switch hook.

9. In a program transmission system, an ordinary telephone subscriber's line terminating in a subscriber's telephone apparatus at the subscriber's station, switching means at the central office for establishing connections between said line and other lines so that telephone conversations may take place at ordinary telephonic frequencies, a plurality of trunks at the central office upon which different programs may be impressed at carrier frequencies, selectively operated relay means independent of said first mentioned switching means for establishing connections between any one of said trunks and said line to the exclusion of the others, and means at the subscriber's station for selectively actuating said relay means while the receiver is on the switch hook.

In testimony whereof I have signed my name to this specification this 7th day of December 1923.

JOHN F. TOOMEY.