

June 14, 1927.

J. F. TOOMEY

1,632,012

PROGRAM SELECTING CIRCUITS

Filed Dec. 10, 1923

2 Sheets-Sheet 1

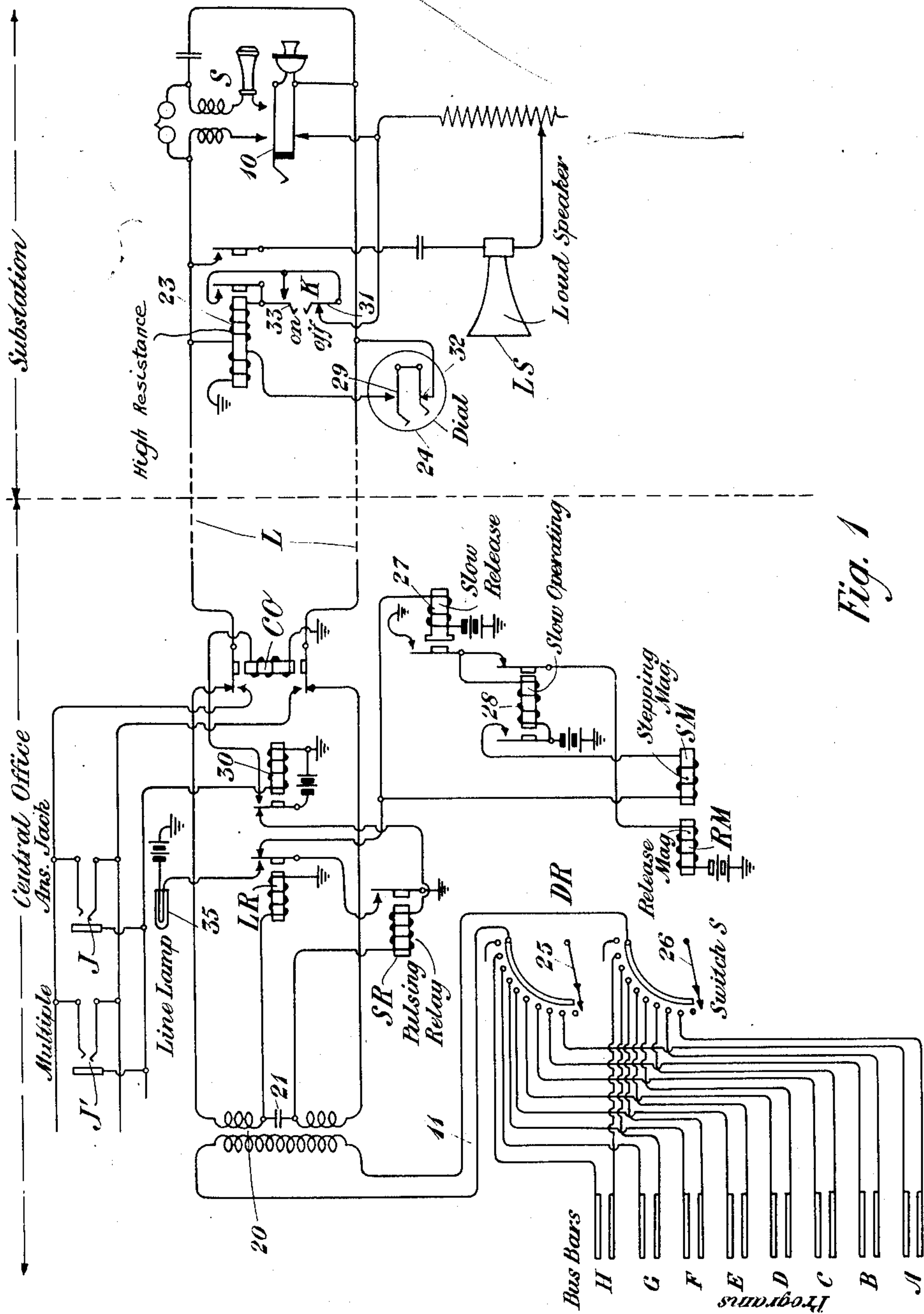


Fig. 1

INVENTOR

J. F. Toomey

BY

ATTORNEY

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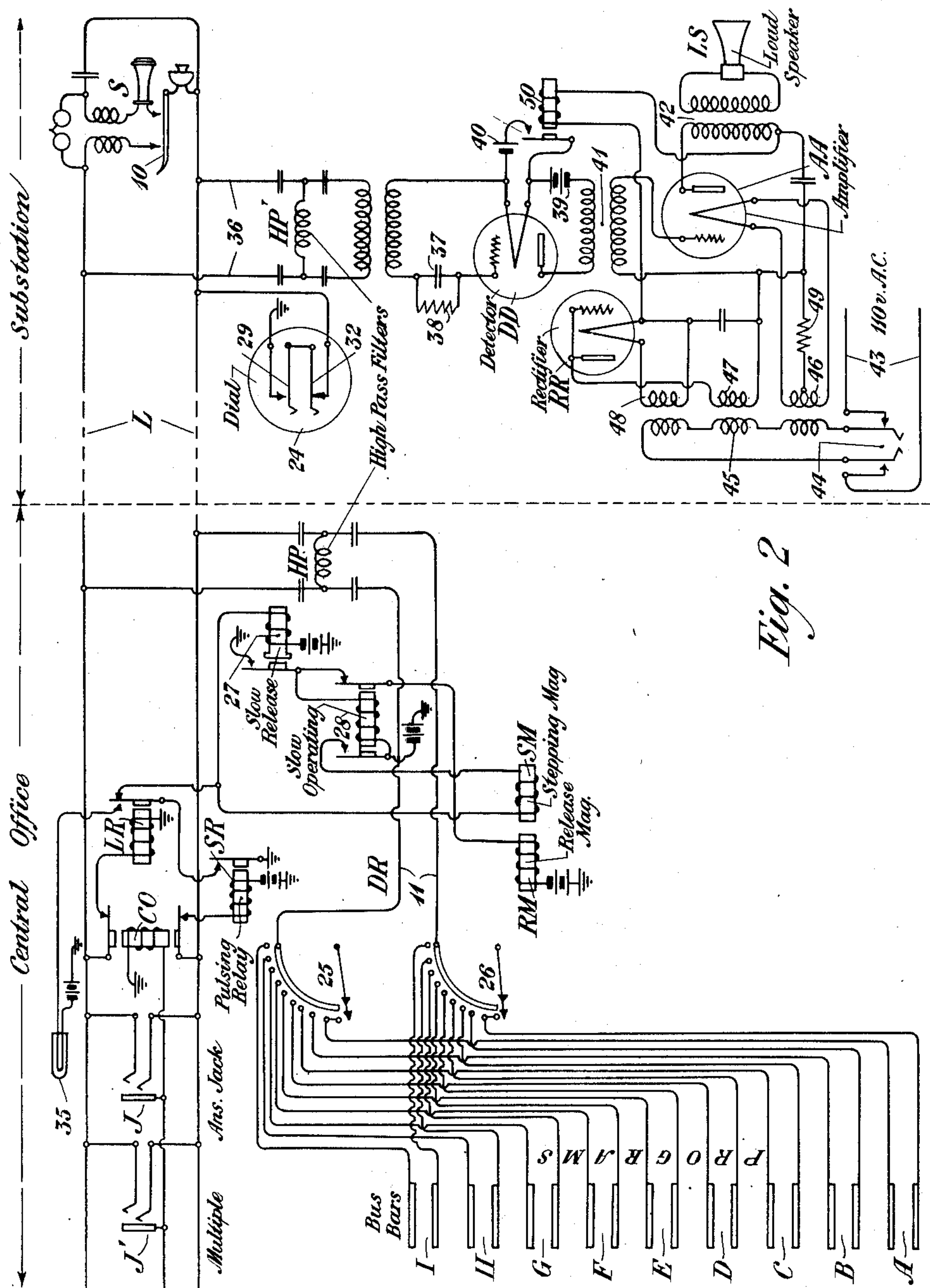


Fig. 2

BY

INVENTOR
J. F. Toomey

494 702
ATTORNEY

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1,632,012

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-SELECTING CIRCUITS.

Application filed December 10, 1923. Serial No. 879,735.

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 a selective switch at the central office which may be directly controlled by the subscriber 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 a directly controlled selective switch for selecting a program, it becomes immaterial whether the program be transmitted at voice frequencies or carrier frequencies, and it also becomes immaterial whether the several programs be transmitted at the same frequency or whether different carrier frequencies are used for different programs. The directive switch may be preferably controlled by means of a dial transmitting impulses from the subscriber's station and preferably the switch is so arranged that it will be automatically released at the beginning of the dialing operation to disconnect the line from a program previously selected and permit the switch to properly select a new program in accordance with the pulses transmitted.

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 a circuit arrangement whereby a directive switch may be used to select programs transmitted at ordinary telephonic frequencies and Fig. 2 of which shows a circuit arrangement enabling the automatic selection of carrier frequency programs.

Referring to Fig. 1, L designates an ordinary telephone transmission line terminating in the usual subscriber's set S at one end and terminating at the central office in the multiple jacks J and J'. Normally, the telephone line L is connected over the contacts of a cut-off relay CO to a transformer 20

whereby the line is associated with conductors 11 leading to a directive switch DR for connecting the line with the desired program. The line relay LR is connected between ground and one side of condenser 21 intermediate between the two halves of the primary winding of the transformer 20. A stepping or pulsing relay SR is connected between battery and the other side of the condenser 21. A cut-off relay CO is so arranged that when it is operated the line L is disconnected from the transformer 20 and hence from the line relay LR and the stepping relay SR, and is connected directly to the tip and ring terminals of the multiple jacks.

In order that the line may be used for program purposes during such time as it is not being used for ordinary telephone purposes, a program receiver such as the loud speaker LS is provided at the subscriber's station, said receiving device being bridged across the line through the back contact of the switchhook 10 and through the contact of relay 23. A dial 24 is provided at the subscriber's station and is arranged to transmit pulses over the ring conductor of the line to the pulsing or stepping relay SR to operate the directive switch DR to select a program. The relay 23, which controls the circuit of the loud speaker LS is so arranged that it will be operated to connect the loud speaker either upon the initial operation of the dial 24 or upon the momentary actuation of a non-locking key K. On the other hand, the relay 23 is so arranged that it will be released to disconnect the loud speaker upon taking the receiver from the switchhook to make a call or upon the operator inserting a plug into one of the multiple jacks to call the subscriber. It may also be released by the subscriber when he no longer desires to hear a program by means of a contact of the key K.

At the central office the wipers 25 and 26 of the directive switch DR are arranged to connect the conductors 11 to any one of a plurality of trunks A, B, C, D, E, etc., leading to different voice frequency programs. In order to operate the switch DR a stepping magnet SM is provided, said magnet being controlled by the stepping relay SR. A release magnet RM is also provided for restoring the switch to normal under cer-

tain conditions, said release relay being under the joint control of relays 27 and 28, as will be described hereinafter. The switch is so arranged that it will be operated step-by-step by the stepping magnet and will be released and restored to normal by the momentary operation of the release magnet.

Further details of the apparatus will be clear from the description of the operation which is as follows: When the line L is not in use for telephonic purposes and the subscriber desires to hear a program such, for example, as the program C, the subscriber will merely operate the dial 24 in the same manner as is customary in the operation of machine switching dials. For example, the dial may have each of its holes provided with a letter corresponding to each of the programs. The subscriber in the case assumed will insert his finger in the hole marked C and rotate the dial until his finger comes against the stop, when the dial is released. As soon as he begins to rotate the dial the off normal contact 29 of the dial is closed and remains closed until the dial is restored to normal after being released. The closing of the off normal contact completes a circuit from ground through the low resistance winding of relay 23, over contact 29, ring conductor of the line L, lower back contact of cut-off relay CO, through the lower half of the primary winding of transformer 20, through the pulsing or stepping relay SR and over the back contact of the relay 30 to battery. Relays 23 and SR are both energized over this circuit and the relay 23 at its inner front contact completes a locking circuit through its high resistance winding from ground, through the line relay LR, through the upper half of the primary winding of transformer 20, upper back contact of cut-off relay CO, tip conductor of the line L, high resistance winding of relay 23, inner make contact of said relay, contact 31 of key K, back contact of the switchhook 10, ring conductor of the line L, lower back contact of cut-off relay CO, winding of relay SR and back contact of relay 30 to battery. The relay SR is not energized in series with the high resistance winding of the relay 23 but the relay 23 will remain locked up through its high resistance winding to close the circuit of the loud speaker LS at its outer front contact. The relay 23 will remain energized over the circuit described notwithstanding the pulsing interruptions of the circuit through its low resistance winding during the operation of the dial 24.

Relay SR, upon being energized, closes a circuit from ground, over its front contact, back contact of relay LR and through the winding of slow release relay 27 to battery. Relay 27 is at once energized and is sufficiently slow in releasing its armature so that its armature will not be released through mo-

mentary interruptions of the circuit of the relay 27, due to the dialing operation. Relay 27, at its front contact, completes a circuit over the right-hand back contact of relay 28 for the release magnet RM. Relay 27 at the same time closes a circuit for the slow operating relay 28 so that after a moment the relay 28 opens a circuit of the release magnet RM. The momentary energization of the release magnet RM, however, causes the directive switch DR to be released and restored to normal before any impulses are being transmitted from the dial 24, the operations which have just been described taking place while the dial is being advanced. As is well understood, the impulses sent from the dial are transmitted after it has been released. Relay 28, upon being energized, closes a circuit from battery, over its left-hand front contact, through the winding of the stepping magnet SM, over the back contact of the line relay LR, over the front contact of the pulsing relay SR, to ground.

The circuit is now ready for the transmission of dialing impulses and as soon as the dial is released the circuit previously traced through the low resistance winding of the relay 23 and through the winding of the pulsing relay SR is intermittently opened by the contact 32 of the dial 24. Each time this circuit is interrupted the relay SR is released to open the circuit previously traced through the stepping magnet SM. Each time the stepping magnet is deenergized it advances the wipers of the directive switch DR one step. When the dial has been completely restored to normal and all of the impulses have been transmitted the wipers 25 and 26 will have been advanced to the contacts connecting the conductors 11 to the desired program which, in the case assumed, was the program C. Upon the dial being restored to normal the off normal contact 29 is opened and consequently the pulsing relay SR is released. This opens a circuit of the relay 27, which in turn opens a circuit of the relay 28. The relay 28 closes a circuit of the release magnet RM at one point but the circuit of said magnet has been previously opened at the contact of the relay 27 so that the release magnet is not energized at this time.

The relay 23 remains energized over a circuit previously traced through its high resistance winding, thereby maintaining the loud speaker LS bridged across the line. As a consequence, the program which is being transmitted may be transmitted over the trunk C, wipers 25 and 26 of the directive switch DR, conductors 11, through the transformer 20 over the back contacts of the cut-off relay CO and over the line L to the loud speaker LS.

If a call should come in for the subscriber while the circuit is being used for program reception the operator inserts the plug of her

cord circuit in one of the multiple jacks, for example, the jack J', thereby energizing the relay 30. The relay 30 thereupon opens its back contact and disconnects battery from the circuit previously traced through the winding of the relay SR, through the high resistance winding of the relay 23 and through the winding of the relay LR. Neither the relay LR nor the pulsing relay SR is energized at this time as a sufficient amount of current to energize these relays does not flow through the high resistance winding of the relay 23. The energization of the relay 30, however, by disconnecting battery from the circuit of these relays, causes the relay 23 to be deenergized, thereby opening its locking circuit and at the same time disconnecting the loud speaker LS from the line. As the relay 23 depended upon its locking circuit for its energization it will remain deenergized even if battery is again connected to the line over the front contacts of the cut-off relay, as will be described later.

The relay 30, upon being energized, at its front contact, completes a circuit for the cut-off relay CO. The cut-off relay CO disconnects the line L from the connections through the transformer 20 to the program terminals. The relays LR and SR are disconnected from the line L at the same time. At its front contacts the cut-off relay CO connects the line L to the multiple jacks J and J' and a telephonic connection is now established with the cord circuit. The battery current supplied to the line from the cord circuit does not energize the relay 23 through its high resistance winding as the circuit of said relay depended upon a locking contact, as already stated. The operations above referred to do not disturb the setting of the switch DR. The subscriber, upon being rung, removes his receiver from the switchhook and carries on the telephone conversation in the usual manner.

At the end of the conversation the subscriber hangs up his receiver and when the operator withdraws the plug of her cord from the multiple jack the relay 30 is released, opening the circuit of the cut-off relay CO. The cut-off relay in turn disconnects the line L from the multiple jacks and again connects it through the transformer 20 to the conductors 11, which are now connected to the program C. If the subscriber now wishes to again hear the program he momentarily actuates the key K to close the contact 33, thereby establishing a circuit from battery, over the back contact of relay 30, through the winding of the pulsing relay SR, back contact of the cut-off relay CO, back contact of the switchhook 10, contact 31 of key K, contact 33 of key K, high resistance winding of the relay 23, back contact of the cut-off relay CO and through the wind-

ing of relay LR to ground. Relays LR and SR are not energized by the small current flowing through the high resistance winding of the relay 23 but the latter relay is energized and locked up as previously described, thereby again bridging the loud speaker LS across the line so that the subscriber may continue to listen to the program.

If, while the program is being received, the subscriber should desire to make a call, he merely removes the receiver from the switchhook 10. This opens the locking circuit of the relay 23 and causes said relay to be released and disconnect the loud speaker LS from the line in the manner already described. At its upper contact the switchhook 10 completes a low resistance circuit for the line relay LR from ground, through the winding of the line relay, over the upper back contact of the cut-off relay CO, over the subscriber's switchhook, over the back contact of the cut-off relay CO, through the winding of the relay SR, back contact of relay 30, to battery. Relays LR and SR are both energized and complete a circuit for the line lamp 35, thereby notifying the operator that the subscriber is calling. The line relay, upon being deenergized, opens the circuit of the relay 27 at the same instant that said circuit is being closed at the front contact of the relay SR so that the derective switch DR is not disturbed by the subscriber making the call.

In response to the line lamp the operator inserts the plug of her cord into the answering jack J, thereby energizing relay 30, which in turn operates the cut-off relay CO. The cut-off relay CO disconnects the line L from the broadcasting apparatus at the central station, as already described, and connects it to the multiple jacks. This occurs without any change in the setting of the switch DR and in the meantime the operator completes the telephone connection in the usual manner.

At the end of the conversation the subscriber hangs up his receiver and upon the operator withdrawing the plug from the answering jack the cut-off relay CO is deenergized and the line L is again connected through the transformer 20 to the broadcasting equipment at the central office. The subscriber may now momentarily actuate the key K to close its contact 33, thereby causing the relay 23 to be energized and locked up, as already described. The relay 23 connects the loud speaker LS across the line and the subscriber may receive the same program as before.

When the subscriber desires to discontinue the program connection he operates the key K to momentarily open the contact 31. This releases and unlocks the relay 23, thereby disconnecting the loud speaker from the subscriber's line. The opening of the

key 31, of course, produces no effect upon the relays LR and SR as these relays are not energized at this time because of the high resistance of the relay 23. Consequently, the switch DR remains connected to the program previously selected. If the subscriber should thereafter desire to change the program he does so by manipulating the dial 24 in the manner previously described, with the result that the initial actuation of the dial before it transmits impulses causes the release relay RM to be momentarily energized in the manner already described, thereby restoring the switch to its normal position ready to be again set in accordance with the impulses transmitted.

A similar circuit arrangement may be used for selecting any one of a number of carrier programs, as illustrated in Fig. 2. In this case, where the programs are transmitted at carrier frequencies it is to be observed that the line may be used simultaneously for receiving program transmission and for ordinary telephonic purposes. Consequently, the connections 11 extending to the wipers 25 and 26 of the directive switch DR are connected directly through a high pass filter HP to the tip and ring sides of the line L so that the operation of the cut-off relay CO does not disconnect the line L from the program connections 11. The cut-off relay in this instance merely serves to disconnect the line relay LR and the stepping or pulsing relay SR from the line L.

At the subscriber's station the loud speaker LS is bridged across the line through a high pass filter HP' by means of conductors 36, this connection being independent of the switchhook 10 so that the removal of the receiver from the switchhook does not disconnect the loud speaker. Owing to the disconnection of the pulsing relay SR from the line when the cut-off relay is operated it is impossible to change the program during the time that the subscriber is using his set for talking, it being undesirable to change the program at this time because the subscriber might hear the noise due to the pulses transmitted by the dial 24.

The carrier frequency programs may be transmitted each at a different frequency but by the use of the directive switch DR it is possible to use the same carrier frequency for all of the programs since but one program will be transmitted over a line at a time. At the subscriber's station it will, of course, be necessary to provide suitable amplifying and detecting apparatus, as will be described later. No selecting apparatus is necessary at the subscriber's station, even in the case of carrier transmission, except a single high pass filter indicated at HP', this filter being provided to prevent the voice frequency currents transmitted over the line from actuating the loud speaker LS. The

high pass filter HP' will, of course, pass the carrier frequencies used for program transmission regardless of whether the same carrier frequency is used for all of the programs or whether a different carrier frequency is used for each program. A similar high pass filter HP is included in the program connection 11 at the central office for preventing the voice currents from being diverted to the program circuits.

The amplifying and detecting apparatus already referred to may comprise a detector tube DD, 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 the plate current may be furnished by a source consisting of dry batteries 39 and the filament current may be supplied by a source consisting of dry batteries 40.

The output circuit of the detector is connected by means of a transformer 41 with the input 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 and by closing a switch 44 the alternating current from the power mains may be impressed 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 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 through the winding of a 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 amplifier circuit operates the relay 50 to set the detector 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.

Further details of the apparatus will be clear from the description of the operation which is as follows: When the subscriber desires to receive the program which is transmitted over the trunk C, for example, he first closes the switch 44 to render the detecting and amplifying apparatus operative in the manner already described. The subscriber next operates the dial 24 and as soon as the dial is moved off normal the contact 29 is closed, completing a circuit from ground, over contacts 29 and 32 of the dial 24, over the ring conductor of the line L, over the lower back contact of the cut-off relay CO and through the winding of the pulsing or stepping relay SR to battery. The pulsing relay SR closes a circuit from ground, over its front contact, over the back contact of the line relay LR and through the winding of the slow release relay 27. Relay 27 completes a momentary circuit through the winding of the release magnet RM, said momentary circuit being interrupted by the slow operating relay 28, whose circuit is closed at the same time. The release magnet RM restores the switches 25 and 26 to normal (if they have previously been advanced to connection with some other program) so that the switch wipers 25 and 26 are now ready to be operated in response to impulses from the dial to advance and rest upon the contact corresponding to the desired program. The stepping magnet SM is energized over a circuit from ground, front contact of the relay SR, back contact of the relay LR, through the winding of the stepping magnet SM and over the front contact of the slow operating relay 28 to battery.

As soon as the dial 24 is released and begins to rotate to normal the circuit of the pulsing relay SR is intermittently interrupted at the contact 32 of the dial and each time it is interrupted it releases the stepping magnet SM to advance the wipers of the switch one step, the slow release relay 27 remaining energized during the rapidly succeeding pulses. At the end of the last pulse

the off normal contact 29 is opened and the relay SR remains deenergized. The wipers 25 and 26 have now been advanced to the contact corresponding to the desired program. When the pulsing relay SR releases its armature for the last time the slow release relay 27 is deenergized after a moment and opens the circuit of the relay 28, which in turn opens a circuit of the stepping magnet SM. The circuit of the release magnet RM is opened by the relay 27 before it is closed by the relay 28 and consequently the release magnet is not actuated. The switch therefore remains in the position to which it has been advanced and the program is now transmitted over the wipers 25 and 26 of the switch, over the conductors 11, through the high pass filter HP, over the line L, through the high pass filter HP' and through the detecting and amplifying apparatus at the subscriber's station to the loud speaker LS.

If a call should come in for the subscriber while the line is being used for program transmission the operator inserts a plug in one of the multiple jacks, for example, J', thereby operating the cut-off relay CO. This disconnects the line relay LR and the pulsing relay SR without interrupting the connection of the line L to the program trunk. Since the pulsing relay is disconnected from the line L it is not now possible to change the program by operating the dial 24, it being undesirable that the program be changed while the subscriber is telephoning because the pulses transmitted over the line might be heard in the receiver. The subscriber, upon being rung, removes the receiver from the switchhook in the usual manner and the conversation may proceed.

At the end of the conversation the plug is withdrawn from the jack J', thereby deenergizing the cut-off relay which again connects the line relay LR and the stepping or pulsing relay SR to the line. As no circuits are completed through either the line relay LR or the pulsing relay SR at this time the position of the switch DR is not changed. The program, being transmitted will, of course, be received over the circuit already described to operate the loud speaker LS during the operations above referred to.

If, while the transmitted program is being received the subscriber desires to initiate a telephone call, he merely removes the receiver from the switchhook, thereby completing a circuit from battery, through the pulsing relay SR, back contact of cut-off relay CO, ring side of the line L, over the switchhook 10, back over the tip side of the line L, over the upper back contact of the cut-off relay CO and through the line relay LR to ground. The line relay opens the circuit leading to the slow release relay 27 to prevent said relay from being operated by the

pulsing relay SR and a circuit is then completed over the line lamp 35, over the front contact of the pulsing relay and over the front contact of the line relay LR. The operator, upon observing the signal of the line lamp, inserts a plug in the answering jack J, thereby operating the cut-off relay CO with the same results as have been previously described. The telephone connection is then completed and the conversation proceeds without interrupting the program. As before, however, the program cannot be changed until the telephone connection is taken down by withdrawing the plug from the jack J to release the cut-off relay CO at the end of the conversation.

When the subscriber desires to discontinue the connection he merely opens the switch 44, thereby disconnecting the current supply for the amplifier AA, which in turn causes the relay 50 to be released and open the filament circuit of the detector DD. The subscriber's apparatus is now restored to normal. The program already selected will remain connected to the line L over the conductors 11, however, but will be restored as soon as the dial is moved off normal, when the subscriber makes the next program selection.

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 following claims.

What is claimed is:

1. In a program transmitting system, a subscriber's telephone line terminating in a subscriber's telephone apparatus at the subscriber's station, means at the central office whereby a connection 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, a directive switch at the central office for establishing a connection between said line and any desired trunk to the exclusion of other trunks, controlling means at the subscriber's station for controlling the operation of said directive switch to select a program, and means for restoring said switch to normal at the beginning of the operation of selecting a new program.

2. In a program transmitting system, a subscriber's telephone line terminating in a subscriber's telephone apparatus at the subscriber's station, means at the central office whereby a connection 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, a step-by-step switch at the central office operated from the subscriber's station to switch said subscriber's line to a desired trunk to the exclusion of other trunks,

and means to restore said switch to normal at the beginning of the operation of selecting another trunk.

3. In a program transmitting system, a subscriber's telephone line terminating in a subscriber's telephone apparatus at a subscriber's station, means at the central office whereby a connection 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, an impulse operated selecting switch at the central office, an impulse sender at the subscriber's station, means to transmit impulses from said impulse sender to said switch to operate the same to establish a connection between said subscriber's line and any desired trunk, to the exclusion of other trunks, and means to restore said switch to normal at the beginning of the operation of establishing a connection to another trunk.

4. In a program transmitting system, an ordinary telephone subscriber's line terminating in a subscriber's telephone apparatus at the subscriber's station, 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, a directive switch at the central office controllable at the subscriber's station for switching said subscriber's line to the trunk upon which a desired carrier program is impressed to the exclusion of other trunks, and means to restore said switch to normal at the beginning of the operation of selecting another trunk.

5. In a program transmitting system, an ordinary telephone subscriber's line terminating in a subscriber's telephone apparatus at a subscriber's station, 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, a step-by-step switch at the central office operated from the subscriber's station to switch said subscriber's line to a trunk upon which a desired carrier program is impressed to the exclusion of other trunks, and means to restore said switch to normal at the beginning of the operation of selecting another trunk.

6. In a program transmitting system, an ordinary telephone subscriber's line terminating in a subscriber's telephone apparatus at the subscriber's station, means at the central office for establishing connections between said line and other lines so that telephone conversations may take place at ordi-

nary telephonic frequencies, a plurality of trunks at the central office upon which different programs may be impressed at carrier frequencies, an impulse operated switch at the central office, an impulse sender at the subscriber's station, means for transmitting impulses from said sender to said switch to switch said subscriber's line into connection with the trunk upon which a desired pro-

gram is impressed to the exclusion of other trunks, and means to restore said switch to normal at the beginning of the operation of selecting another program. 10

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

JOHN F. TOOMEY.