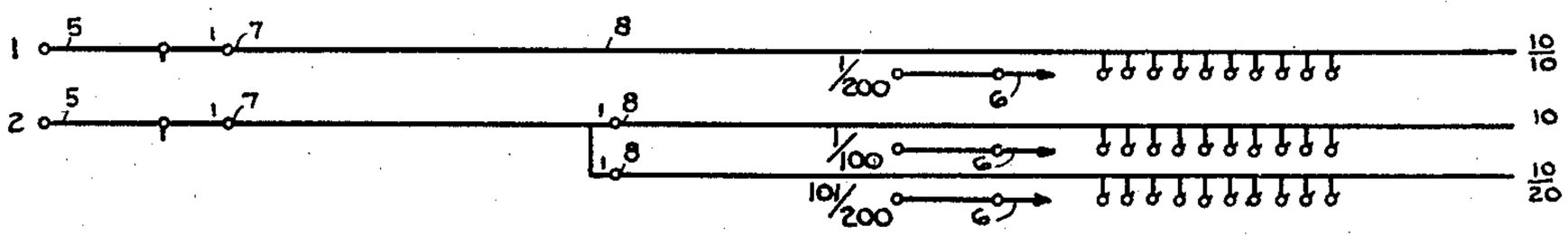
June 30, 1931. W. T. POWELL 1,812,169

SELECTIVE PROGRAM SERVICE SYSTEM

Filed Feb. 19, 1929



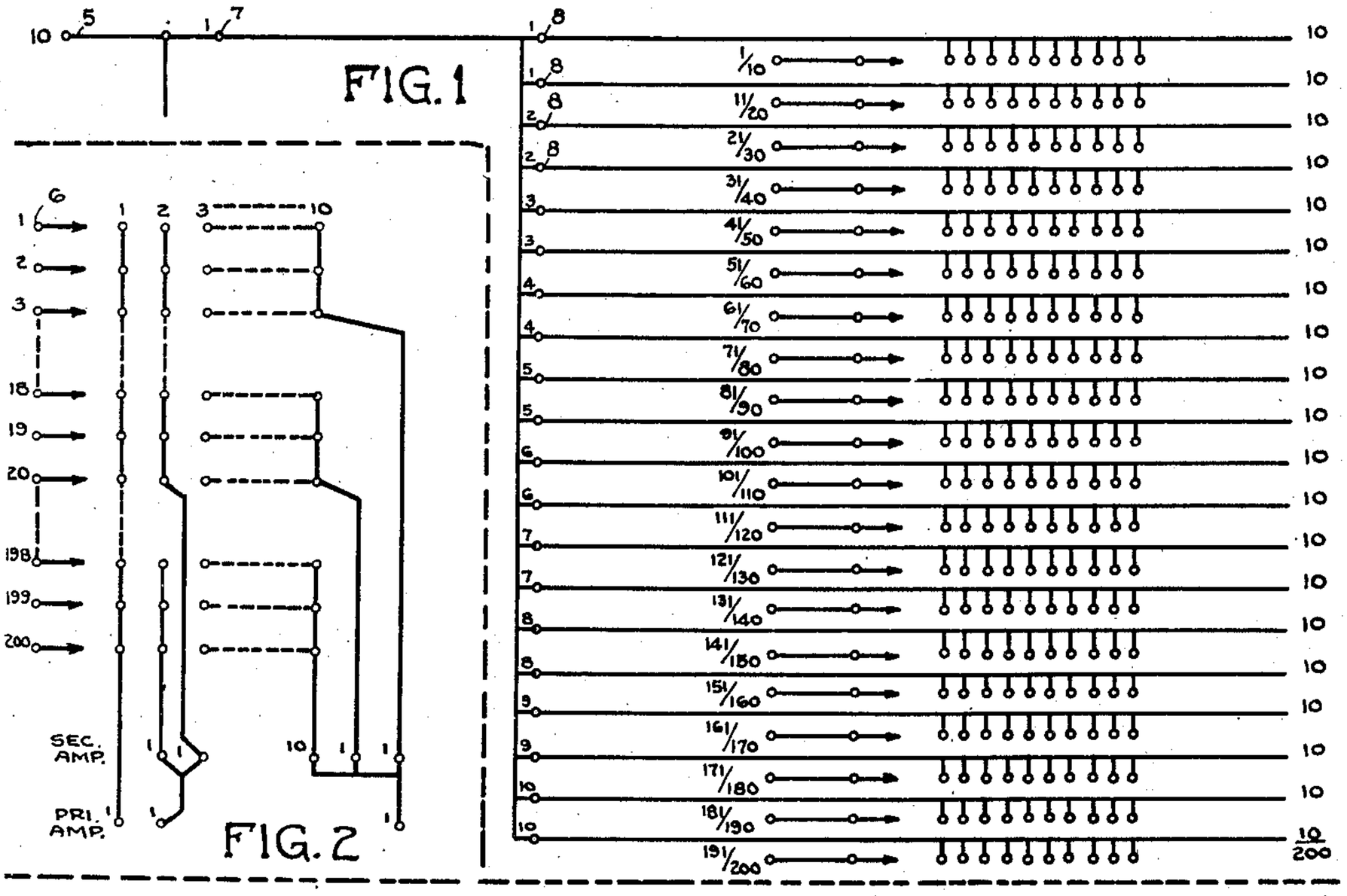


FIG. 1

FIG. 2

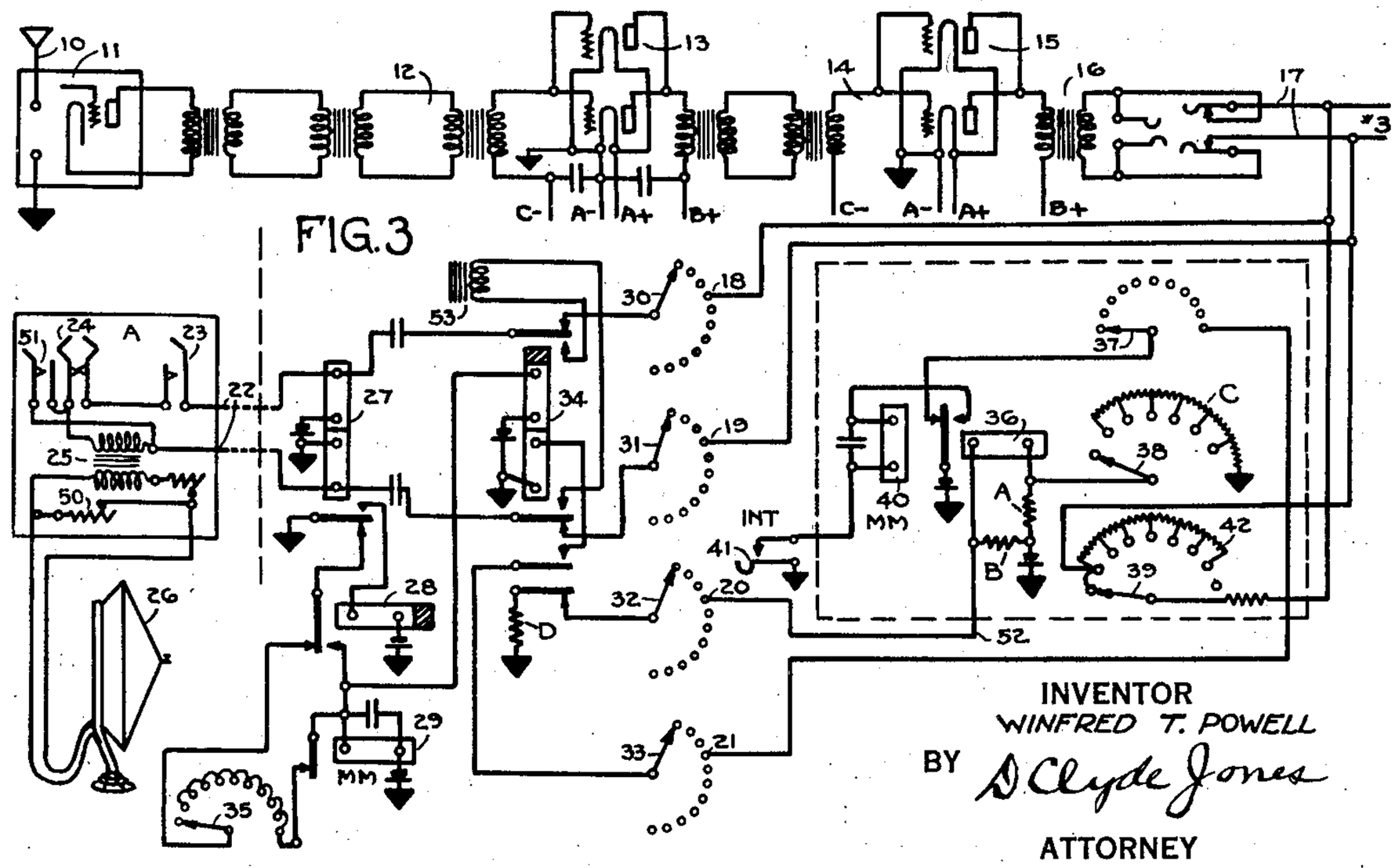


FIG. 3

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UNITED STATES PATENT OFFICE

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SELECTIVE PROGRAM SERVICE SYSTEM

Application filed February 19, 1929. Serial No. 341,091.

The present invention relates to an arrangement for transmitting programs over telephone lines commonly known in the art as program service systems.

It is now the practice to originate a program at a central point such as by intercepting a radio broadcast program on a radio receiver or else developing a program at a central point and then transmitting it over telephone lines to subscribers who are provided with loud speakers. In certain of these systems the subscribers are limited to a single program while in other systems they are limited to a choice of three programs. In the latter arrangement it is necessary to provide three sets of conductors for bringing the program to the subscriber who makes his choice by connecting his loud speaker to the set of conductors bearing the program which he desires. All program service systems are designed to operate most efficiently when predetermined numbers of loud speakers are connected to their respective amplifiers and in the systems previously referred to, it has been necessary to provide some manually controlled means to compensate for the varying numbers of loud speakers connected in circuit which tend to unbalance the load.

In accordance with the present invention, an arrangement is provided whereby a subscriber may select any one of a plurality of programs over a single pair of conductors and means are also provided to compensate for the varying numbers of loud speakers connected to the output of any program supplying means. Furthermore, the system is installed on a percentage basis whereby equipment proportional in amount to the popularity of any program supplied, is provided and the installation is so arranged that if the popularity of any program increases the system may be expanded readily to take care of the additional demand.

In the drawings, Fig. 1 is a schematic showing of one possible layout of the system of the present invention. Fig. 2 is likewise a schematic showing of the multiplying of contacts in the automatic switches which are utilized to extend calling subscribers to desired program equipment. Fig. 3 is a diagrammatic showing of this invention in which the equipment at the left of the broken line is that provided at the subscriber's station while the remainder of this figure represents equipment located at a remote central point, which equipment includes a directively operated stepping switch for connecting the subscriber's line to any one of a plurality of programs supplied from a radio receiver or its equivalent, a pick-up microphone, together with primary and secondary signal amplifiers while within the broken line rectangle there is represented equipment operating automatically to compensate for varying numbers of subscribers' loud speakers connected to the program equipment represented in this figure.

Referring especially to the layout of Fig. 1, it has been assumed for the purpose of making a concrete explanation that a series of ten program sources designated 5, are provided. Only three of these program sources are herein shown but it will be understood that seven more are to be provided. It will be recognized, of course, that more or less programs may be provided to satisfy commercial operating requirements. It has further been assumed in this disclosure that the present layout is to supply program service to two hundred subscribers although this number is also flexible. Each subscriber's line is provided with a line switch 6 of the type now commonly used in automatic telephone systems, equipped with a set of movable brushes to engage a series of contacts arranged in a bank and connected to different programs.

Programs vary in popularity so that they are not all in equal demand. For this reason it is not economical to provide equal equipment for the less popular and more popular programs but this system is operated on a percentage basis, that is only sufficient equipment is provided to take care of the maximum number of simultaneous connections to any program. In the layout of Fig. 1 it has been assumed that program #1 is the least popular and it is therefore provided with but one primary amplifier to supply this program to all of the two hundred subscribers. Program #2 is assumed to be more popular and it is therefore provided

with one primary amplifier 7 and two secondary amplifiers 8 to supply service for all of the subscribers, one secondary amplifier being arranged to supply this program to the first group of one hundred subscribers and the other secondary amplifier being arranged to supply the program to the remaining one hundred subscribers. Program #10, which is assumed to be the most in demand, is provided with one primary amplifier 7 and ten pairs of secondary amplifiers 8 so that each secondary amplifier provides this program to only ten subscribers.

Referring now to Fig. 2 it is there shown how the different programs from 1 to 10 are multiplied to the terminals of the line switches so that any one of the two hundred lines have access to a desired program over a single path including a pair of conductors. In this layout it has been assumed that no more than ten subscribers' lines are to be connected to the output of any amplifier at any one time although, of course, the amplifiers may be designed to accommodate a greater or lesser number of lines as becomes expedient. As shown in this figure program #1 is accessible to each of the line switches 6 individual to the two hundred subscribers' lines. This figure also shows that program #2 is accessible to two groups of lines with one secondary amplifier of this program multiplied to the terminals of the line switches of one hundred subscribers and the other secondary amplifier of this program multiplied to the terminals of the line switches of the remaining one hundred subscribers. This figure also shows that program #10 is distributed through ten secondary amplifiers and that each amplifier is multiplied to the line switches of a group of ten subscribers. From Fig. 2 it will be understood how the other secondary amplifiers may be multiplied to distribute the several programs through other line switches.

Referring especially to Fig. 3 wherein the detailed circuits of a portion of the system are disclosed, the operation of the arrangement to bring a program to a subscriber such as A will be explained. 10 designates an antenna for intercepting a broadcast signal which may be amplified and translated to audio frequency currents in a radio receiver 11. The output of this circuit is linked to a primary amplifier 12 including two vacuum tubes such as 13 connected in multiple, the output of which is linked to a secondary amplifier 14 having two vacuum tubes such as 15 connected in multiple. It is unnecessary to explain in detail this arrangement for developing and amplifying programs since it may be of a form now well known. The output of the secondary amplifier is linked by means of a transformer 16 to program distributing conductors multiplied as indicated in Fig. 2 to the bank terminals such as 18, 19, 20 and 21 of a group of line switches. Each subscriber is provided with a pair of conductors 22 terminating at the central point in an individual rotary line switch, the brushes of which are designated 30, 31, 32 and 33. This line terminates at the subscriber's station in a locking dial key 23, an impulse sender 24 of the type used in automatic telephone systems and a transformer 25 which inductively links the subscriber's line to a load speaker 26 across which a volume control rheostat 50 is connected.

Let it be assumed that the subscriber whose equipment is herein disclosed, desires to select the #3 program which is the program being supplied by the amplifier shown in this figure. The subscriber closes the contacts of the key 23 to energize the impulse relay 27 through both windings of this relay and the two sides of the subscriber's line and the station equipment in series. The energization of the relay 27 causes the operation of the slow releasing relay 28 to close a break point in the operating circuit of the stepping magnet 29 of the subscriber's line switch. The subscriber now operates his dial sender 24 to transmit three impulses corresponding to the #3 program. In response to each of these impulses the relay 27 deenergizes and thereby completes an operating circuit for the stepping magnet 29, from grounded battery, its winding, front contact of relay 28, back contact of relay 27 to ground. On each energization of the stepping magnet 29 the brushes 30 to 33 inclusive are moved into engagement with the contacts 18 to 21 inclusive. During the operation of the stepping magnet 29 the slow releasing switching relay 34 is operated from grounded battery, its winding, front contact and armature of relay 28, back contact and armature of relay 27 to ground, so that the brushes 30 to 33 are disconnected during their advance over the other program circuits to prevent undesirable noises being developed in the lines connected to the terminals over which these brushes are passing. Also when the impulse sender 24 is being operated, the primary winding of the transformer 25 at the substation is short circuited by the springs 51 to eliminate the noise of the dialing impulses which would otherwise be heard in the loud speaker 26. When, however, the impulse sender 24 ceases its operation, the switching relay 34 deenergizes and connects the brushes of the line switch in circuit, the brushes 30 and 31 being connected to the subscriber's line.

It will be noted that the impulse relay 27 is maintained energized during the connection and when the subscriber desires to release the connection, he opens the contacts of the key 23 whereupon the relay 27 deenergizes and shortly thereafter the slow releasing relay 28 deenergizes to close a release circuit from grounded battery, winding of the step-

ping magnet 29, its armature and back contact, line switch brush 35 in any of its off-normal positions, back contacts and armatures of relays 28 and 27 to ground, which circuit advances the brushes of the line switch to their normal position.

In accordance with one of the features of the present invention, means are provided to compensate automatically for the varying load on the output of the secondary amplifier 15 so that the secondary amplifier always operates into a uniform load. This automatic compensating arrangement is shown within the broken line rectangle of Fig. 3 and operates as follows: Let it be assumed that the connection just described is the first one to be connected to program #3. Under this assumption when the line switch brush 32 engages the terminal 20 associated with the #3 program, the relay 36 is connected from grounded battery through resistance A, winding of this relay, terminal 20, brush 32, back contact and armature of switching relay 34, resistance D, to ground. With the relay 36 operated, a driving circuit is completed from grounded battery, armature and front contact of this relay, winding of the stepping magnet 40 and common interrupter 41, to ground. The stepping magnet advances the brushes 37, 38, and 39 into position 1. It should be pointed out that the relay 36 is connected across conjugate points of a Wheatstone bridge arrangement having the resistance coils A and B, which may be 100 ohms each in value, as two of the arms and the variable resistance element C, the total value of which may be 1000 ohms and the resistance unit D, the value of which may be 1000 ohms, as the other two arms. It will thus be seen that under the present assumption the Wheatstone bridge is balanced and the relay 36 deenergized to stop the operation of the stepping magnet 40.

When now a second subscriber establishes a connection to program #3, relay 36 will be connected over conductor 52 in multiple with another resistance D, through a brush similar to 32 at the switch which has made the second connection, and the lower back contact and armature of a relay similar to 34 also associated with that switch. The second connection to program #3 unbalances the Wheatstone bridge so that the relay 36 is energized to cause the operation of the stepping magnet 40 which in turn advances the brushes 37, 38 and 39 of the control switch another step. In this position of the control switch, the brush 38 reduces the resistance of arm C of the bridge to a value where it equals the resistance of the other arm of the bridge which includes the two resistance units D in multiple. This, of course, again balances the bridge and the relay 36 deenergizes to stop the control switch in its second position. In this position the brush 39, by removing one of the resistance units 42 from the network which is equivalent to the load of the added subscriber's connection, will therefore compensate for the second connection just completed. It will be understood that other connections to program #3 are effective in the same manner to unbalance the Wheatstone bridge arrangement and thereby cause the control switch to advance its brushes including brush 39 to compensate for the load on the secondary amplifier 14. When, however, any connections are released, the Wheatstone bridge is again unbalanced and the relay 36 is effective to operate the control switch until the balance of the Wheatstone bridge is restored, at which time brush 39 of this switch properly compensates for the number of subscribers' connections retained.

When all connections to program #3 have been released, the Wheatstone bridge arrangement is also unbalanced during the time that brush 38 is in an off-normal position and therefore relay 36 is energized to operate the stepping magnet 40 which advances the brushes 37, 38 and 39 to their normal position where the relay 36 deenergizes.

If desired, means may be provided to indicate when ten connections have been established to the secondary amplifier of any program so that when all the secondary amplifiers of a program are carrying their maximum load, a busy indication is transmitted to the subscriber, which is effected in the following manner. With ten connections to a secondary amplifier, the control switch thereof will be in position 11 which results in the closure of a circuit from grounded battery, at the armature and back contact and relay 36, brush 37, terminal 21 of the subscriber's line switch, the brush 33 thereof, armature and front contact of relay 34 (now energized), lower winding of switching relay 34 to ground. This locks the relay 34 operated and prevents the subscriber's line from being connected to the desired program through the brushes 30 and 31 of the line switch. Also at the front contacts and armatures of relay 34, a source of busy tone current 53 is transmitted to the subscriber's station. Each subscriber is instructed to release the connection on hearing this busy tone and is asked to report this busy condition to the operating company in order that there may be a check on those programs which have insufficient equipment for proper distribution.

What I claim is:

1. The method of transmitting programs from program sources to subscribers which comprises automatically selectively extending channels to any desired program source under subscribers' remote control, and automatically compensating for the varying number of channels connected to any program.

2. In a system for the transmission of programs, a plurality of subscribers' lines, a plurality of program sources, means including automatic switches directively controlled over subscribers' lines for connecting said lines to wanted program sources, and means automatically compensating for the varying number of connections to any program source.

3. In a program transmitting system, a plurality of subscribers' lines, a plurality of program sources, means including automatic switches directively controlled over subscribers' lines for connecting said subscribers' lines to wanted program sources, and means including a balancing network for automatically compensating for the varying number of connections to any program source whereby the load on any program source is always uniform.

4. In a program transmitting system, a plurality of subscribers' lines, each provided with a loud speaker and an impulse transmitter, a plurality of program sources each including an amplifier, means including an automatic switch directively controlled by impulses from the impulse transmitter of a subscriber's line for connecting said line to the amplifier of a wanted program, and automatic means to compensate for the varying numbers of connections to said amplifier.

5. In a program transmitting system, a plurality of subscribers' lines, each provided with an impulse transmitter, a plurality of program sources each including an amplifier, automatic switches provided with movable brushes and fixed terminals, the amplifiers of the various program sources terminating by multiple connection in corresponding fixed terminals of said switches, the brushes of one of said switches being connectible to a subscriber's line, means controlled by impulses over a subscriber's line for directively advancing the movable brushes of said automatic switch over the fixed terminals thereof, means for disconnecting said brushes from any electrical energy during their movement and for connecting said subscriber's line to said brushes on termination of said movement, and means for compensating for varying numbers of said connections to program sources.

6. In a program transmitting system, a plurality of subscribers' lines, a plurality of program sources, means including directively operated automatic switches for connecting said subscribers' lines to any desired program source, and automatic means common to each program source for equalizing the load on each source.

7. In a program transmitting system, a plurality of subscribers' lines, a program source, a plurality of automatic switches for connecting subscribers' lines to said program source which predetermined number is less than the maximum number of possible connections, and means permitting only a predetermined number of connections to be completed simultaneously to said program source.

8. In a program transmitting system, a plurality of subscribers' lines, a program source, a plurality of automatic switches for connecting a predetermined number of subscribers' lines to said program source, and means for sending a busy tone to a subscriber's line over which an attempted connection to said source is made in excess of said predetermined number.

9. In a program transmitting system, a program source provided with an amplifier designed to operate most efficiently with a predetermined load, means including automatic switches for simultaneously connecting subscribers' lines to said amplifier whereby said load is varied, and means for compensating for said varying load on said amplifier including a Wheatstone bridge arrangement and an automatic switch controlled thereby for connecting compensating units to said amplifier.

10. In a program transmitting system, a plurality of subscribers' lines, each provided with a loud speaker, a plurality of program sources, each including an amplifier arranged to operate most efficiently when connected to a predetermined number of loud speakers or their equivalent load, automatic switches directively controlled over subscribers' lines for connecting their loud speakers to the amplifiers of desired programs, and means to compensate for the varying loads on said amplifiers due to the varying number of loud speakers connected thereto, said compensating means including a compensating switch with equalizing units and a Wheatstone bridge arrangement provided with two fixed arms and two variable arms, the variation of one of said variable arms being controlled by the change in the number of connections to an amplifier to unbalance said bridge whereby the operation of said compensating switch is started, the other variable arm being changed by the operation of said compensating switch to restore the balance of said bridge and to equalize the load on said amplifier, said second variable arm when varied to restore the balance of said bridge, causing the compensating switch to maintain the equalization of the load on said amplifier.

11. In a program transmitting system, a plurality of subscribers' lines, each provided with a loud speaker, a plurality of program sources each provided with an amplifier, means including automatic switches directively controlled over subscribers' lines to connect the loud speaker thereof to the amplifiers of desired programs, and compensating means associated with each amplifier to equalize the load thereon, each compensating means including a compensating stepping

switch provided with compensating units and a Wheatstone bridge network for controlling said stepping switch, said network having two arms, each including a fixed resistance therein and two variable resistance arms, the resistance of one of said variable arms being changed by the change in the number of subscribers' lines connected to its amplifier and the resistance of the other variable arm being changed by the movement of the compensating switch, said bridge network being so arranged that in its unbalanced condition it causes movement of said switch, said compensating switch in its movement serving to connect varying numbers of compensating units to said amplifier to equalize the load thereon due to the number of varying loud speakers connected thereto.

12. In a program transmitting system, a plurality of subscribers' lines, each provided with a loud speaker, a plurality of program sources, each provided with an amplifier, automatic switches directively controlled over subscribers' lines for connecting the loud speaker thereof to the amplifiers of desired programs, and compensating means to equalize the load on said amplifiers due to the varying number of connections extending thereto, said compensating means including a compensating stepping switch and a Wheatstone bridge network for controlling the operation of said stepping switch, said Wheatstone bridge network including two fixed resistances and two variable resistances, a relay connected to two conjugate points of said bridge network to control the operation of said stepping switch, one of said variable resistances being changed in response to the change in the number of connections to an amplifier to unbalance said network and cause the operation of said relay which in turn starts the operation of the compensating switch until the balance of the bridge network is restored and said relay deenergizes to stop the movement of said compensating switch, and compensating units connected to said amplifier by the movement of said compensating switch.

In witness whereof, I hereunto subscribe my name this 14th day of February, A. D. 1929.

WINFRED T. POWELL.

CERTIFICATE OF CORRECTION.

Patent No. 1,812,169. Granted June 30, 1931, to

WINFRED T. POWELL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 2, line 76, for the word "load" read loud; page 4, lines 65 to 67, claim 7, strike out the words "which predetermined number is less than the maximum number of possible connections" and insert the same to follow after the word "source" in line 69, same claim; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 1st day of September, A. D. 1931.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)