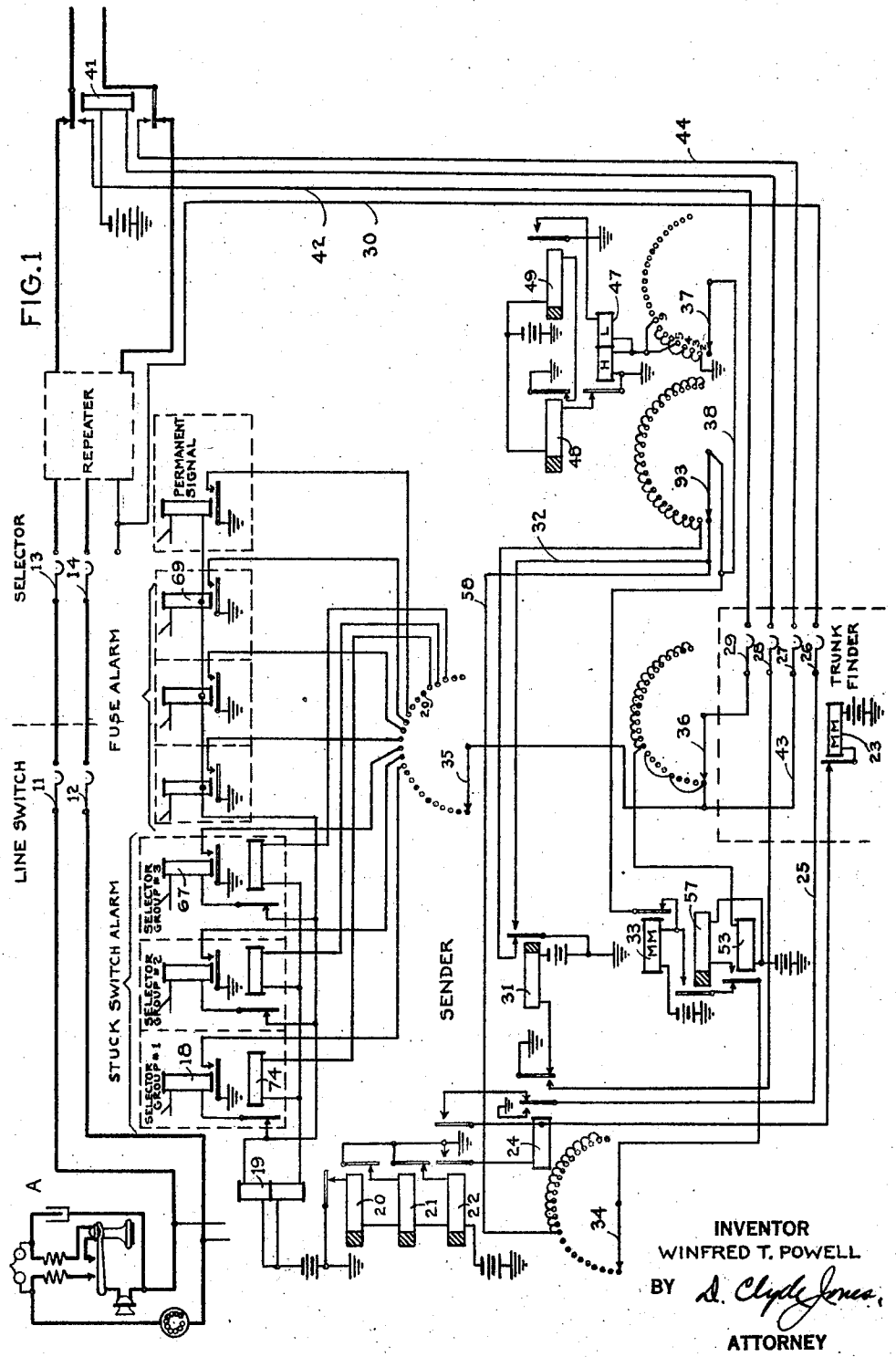
Jan. 12, 1926. 1,569,678

W. T. POWELL

AUTOMATIC TELEPHONE SYSTEM

Filed Sept. 4, 1923 2 Sheets-Sheet 1

FIG. 1



INVENTOR
WINFRED T. POWELL
BY A. Clyde Jones.
ATTORNEY

Jan. 12, 1926. 1,569,678

W. T. POWELL

AUTOMATIC TELEPHONE SYSTEM

Filed Sept. 4, 1923 2 Sheets-Sheet 2

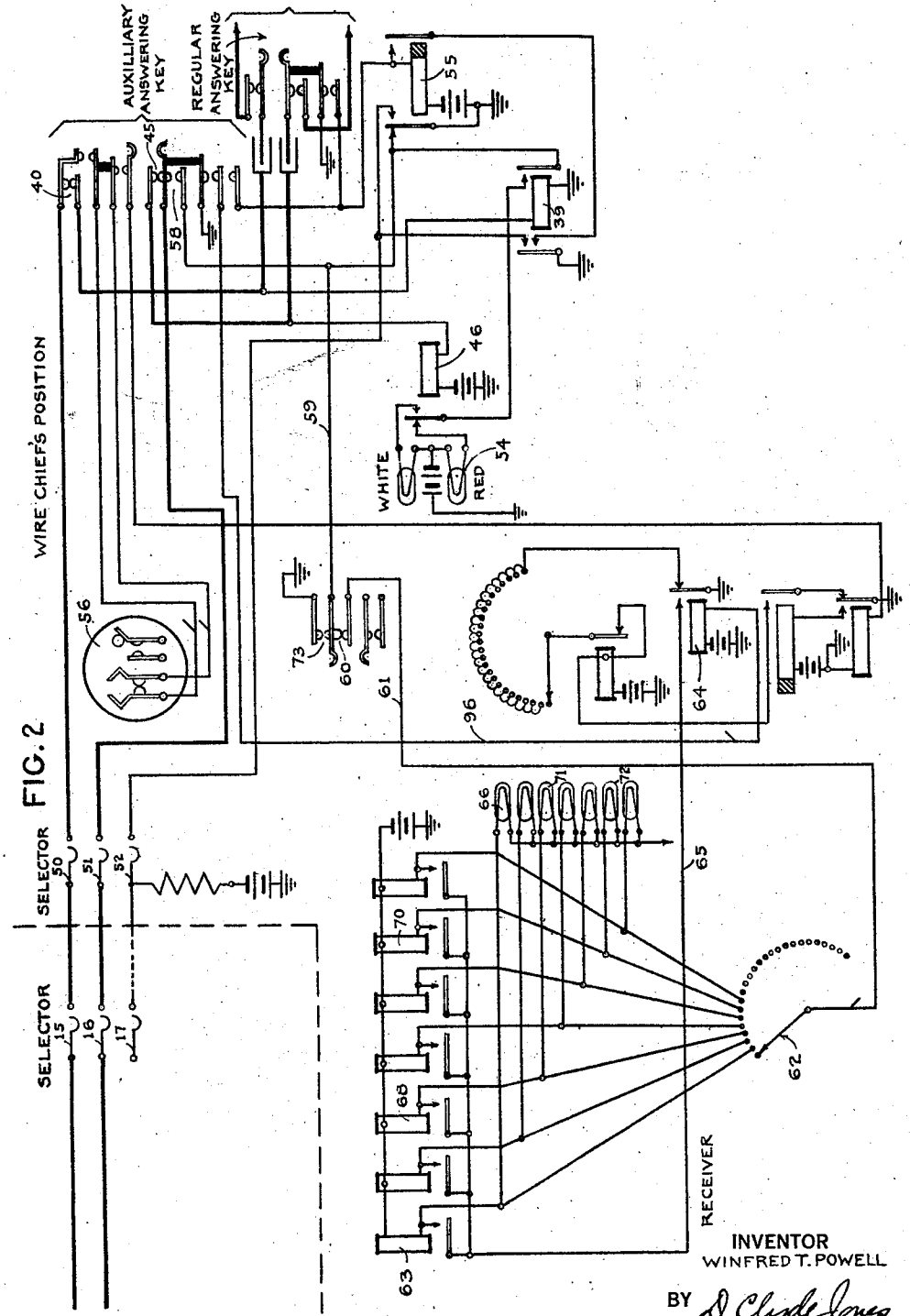


FIG. 2

INVENTOR
WINFRED T. POWELL

BY D. Clyde Jones.

ATTORNEY

Patented Jan. 12, 1926. 1,569,678

UNITED STATES PATENT OFFICE.

WINFRED T. POWELL, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

AUTOMATIC TELEPHONE SYSTEM.

Application filed September 4, 1923. Serial No. 660,761.

To all whom it may concern:

Be it known that I, WINFRED T. POWELL, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone systems and more particularly to telephone systems employing automatic switches in completing a connection between telephone lines.

In systems where automatic switches are employed, it becomes necessary to provide indicating devices to indicate the failure of certain portions of the apparatus and circuits. Some of the difficulties or troubles for which indicating devices are provided arise from the so-called "sticking" of an automatic switch which prevents the advancing or releasing of said switch. Other troubles for which indicators are provided, are fuse failures and permanent signals arising from the failure of a subscriber to replace his receiver on his switch-hook on the termination of a call.

In large exchanges the difficulties shown by the indicating device are corrected by one or more switchboard attendants who are always present, but in certain of the branch exchanges the number of switches are so few that a trouble man or switchboard attendant is not employed and such offices are known as unattended offices. When troubles of the character above mentioned arise in such an unattended office, means must be provided to indicate at the main exchange the location and the character of the trouble.

One of the main features of this invention, therefore, resides in the provision of means for signaling at a main exchange the location and character of the trouble that exists at the unattended office or exchange.

Another feature of the present invention resides in the provision of means whereby an attendant at the main office can correct certain of the difficulties that exist at an unattended office, by operating automatic equipment at the main exchange.

The drawings with Figs. 1 and 2 placed side by side diagrammatically represent a portion of the telephone system incorporating the present invention.

At the upper left hand corner of Fig. 1 there is represented an automatic telephone line which terminates in the brushes of a line switch shown at the top of Fig. 1. This line switch as well as a selector switch and a repeater located at the unattended office, are shown.

Just below the pair of conductors of the telephone line there are shown "stuck switch alarm relays". In an automatic telephone system, it is the practice to provide a common relay for each group of selector switches, which relay is energized when any of the selector switches of its group are operated. The relays of three such selector switch groups are indicated.

In connection with each selector group there is also provided a fuse alarm relay, such a relay is actuated when any of the fuses of a group of switches has failed. Three such fuse alarm relays are shown. One permanent signal relay is also shown. In a commercial automatic telephone system such a permanent signal relay is actuated whenever any of the first selector switches of a group has been seized by the line switch and the seized selector is not subsequently operated by the dial impulse sender, indicating that the subscriber has failed to hang up his receiver.

At the lower portion of Fig. 1 there is represented a so-called sender which is arranged to send directive impulses automatically to the distant station such as a wire chief's position and a trunk finder which operates to connect such a sender to an idle trunk leading to the distant office. At the top of Fig. 2 there is shown a trunk circuit leading from the unattended office to the main exchange; two selector switches are also shown at the top of this figure, which switches are arranged to be directively operated to extend the mentioned trunk to the wire chief's position, or in the case of regular calls, serve to complete links in the conversational circuit. It will be understood that in a commercial exchange, instead of having two selectors in a connection as indicated in Fig. 2, a line switch as well as

first and second selectors and connectors with their associated circuits may be substituted for the selectors of this figure.

At the right of Fig. 2 there is represented a wire chief's position which is provided with answering keys and with a dial sender such as that provided at the subscriber's station. A receiver switch is shown in the lower part of Fig. 2 which functions to record the impulses transmitted by the sender of Fig. 1.

The dial sender may be of any well known construction which functions to transmit impulses in accordance with a code determined by the subscriber.

The selector switches oif the system may be of substantially the same character as that shown in the patent to Keith Erickson & Erickson #815,321, granted March 13, 1906, while the line switches as well as the sender, trunk finder, and receiver switches may be of substantially the same character as that shown in the patent to Clement #1,107,153 granted August 11, 1914. The general arrangement of line switches, selectors and repeaters at one office and the other selectors and connector switches at a distant office are shown in the patent to Martin #1,314,454 except that in the present system rotary line switches are employed instead of the plunger type swichtes as shown in the mentioned patent.

In the operation of the telephone system of this invention, when the subscriber at A initiates a call, the line switch whose brushes are designated 11 and 12 seizes an idle trunk leading to a selector switch whose brushes are designated 13 and 14. The subscriber at A now dials one or more series of impulses. The first series of impulses is effective to cause the selector to connect with the repeater after which the remaining series of impulses are repeated by the repeater to selectively operate a series of switches, such as a selector with brushes 15, 16 and 17 represented as being located at a distant office. These switches, only one of which is represented, operate successively to complete a connection to a wanted subscriber's line (not shown). At the unattended office, whenever any of the selector switches are operated, the group relay associated with this group of selectors is momentarily operated. However, when one of these switches fails to release, a group relay which it will be assumed is that designated 18 remains operated for a relatively long interval. The relay 19 is also operated for a long period in series with the last mentioned relay. As a result of the operation of the relay 19, the chain of slow releasing relays 20, 21, and 22 which are normally held operated, release their armatures successively and when relay 22 deenergizes, the trunk finder immediately begins its operation to seize an idle trunk leading to the main office such as represented in Fig. 2.

The operation of the trunk finder is effected by a circuit closed from grounded battery, winding, armature and back contact of the motor magnet 23, outer armature and back contact of relay 22, inner back contact and armature of relay 24, conductor 25, test brush 26 and its conductor 30 to ground, since it is assumed that the trunk associated with the conductor 30 is busy. Under the control of this and similar circuits the trunk finder advances its brushes 26 to 29 inclusive until test brush 26 encounters a test conductor of an idle trunk which is characterized by the absence of ground potential. During the time that the trunk finder is operating, a circuit is closed in multiple with the operating circuit of the motor magnet, extending through the winding of relay 24, inner armature and back contact of relay 22 to ground. The operating circuit of the motor magnet, however, shunts the relay 24 while busy trunks are being tested, but when an idle trunk is located, relay 24 is operated through the mentioned circuit completed at the inner armature and back contact of relay 22. Relay 24 at its inner front contact and armature applies ground over conductor 25, test brush 26 and conductor 30 to render the seized trunk unselectable and at its outer front contact and armature closes a circuit through brush 28, winding of relay 41 to grounded battery. The operation of switching relay 41, completes an impulse circuit through brush 36 and conductors 42 and 44 to the first selector switch of Fig. 2. This impulse circuit is similar to that completed when an automatic subscriber's line is extended to a selector switch. Also the operation of the relay 24 at its outer back contact and armature interrupts the operating circuit of the normally actuated slow releasing relay 31. As soon as relay 31 releases, a circuit is closed from ground, armature and back contact of this relay, conductor 32, brush 93, of the sender switch in its normal condition, armature, back contact and winding of the motor magnet 33 to grounded battery. This magnet advances its brushes 93, 34, 35, 36 and 37 one step, where it has its operating circuit closed from grounded battery, winding of the motor magnet its back contact and armature, conductor 38, brush 37 in its second, third and fourth positions to ground. Under the control of this circuit, the sender switch is advanced into position 5. While the brush 36 is passing through positions 2, 3 and 4, the impulse circuit is opened and if the sender switch is adjusted to advance its brushes at the rate of fifty steps per second, the mentioned impulse circuit is opened at approximately the same length of time as occurs when a dial sender interrupts the impulse circuit. This opera-

tion of the sender transmits one directive impulse to mechanism (not shown) of the selector whose brushes are indicated at 15, 16 and 17. In accordance with the well known operation, these brushes advance one step in their primary direction. Thereafter the selector operates automatically to select a trunk leading to a second selector whose brushes, located at the distant office, are designated 50, 51 and 52. The brushes of the sender switch remain in position 5 for a short interval during which a circuit is closed from grounded battery, winding, back contact and armature of the motor magnet 33, conductor 38, brush 37 in its fifth position through the high resistance winding of relay 47 to ground. The motor magnet is not operated owing to the high resistance of relay 47 but this relay is actuated and at its back contact and armature opens the circuit which normally holds the relay 48 energized. This relay is slow to release but shortly after the opening of its circuit it deenergizes and in turn effects the release of the normally operated slow releasing relay 49. These two slow relays measure an interval sufficient to permit the trunk hunting operation of the first selector switch at the distant office. This time interval corresponds to the interval between successive series of impulses transmitted by the ordinary dial impulse sender. When however, the relay 49 deenergizes it closes a circuit from ground, through its armature and back contact, left hand winding of relay 47, brush 37, conductor 38, armature and back contact of motor magnet 33 to grounded battery. The right hand winding of relay 47 is of sufficiently low resistance to permit the operation of the motor magnet 33 which advances the brushes of the sender into their sixth position, where the conductor 38 is grounded through brush 37 to complete the operating circuit for the motor magnet 33. This magnet advances the sender into position 9.

The passing of the brush 36 from position 5 to position 9 sends another impulse corresponding to the second series of impulses; this impulse effects the operation of the second selector switch whose brushes are designated 50, 51 and 52. In position 9, the relay 47 is energized through its high resistance winding in series with the motor magnet 33 and again effects the deenergization of relays 48 and 49. On the release of relay 49, the motor magnet 33 is operated in series with the low resistance winding of relay 47 to advance the sender into position 10. At this time the second selector at the distant office hunts automatically for a trunk leading to the wire chief's position and since the sender is standing with its brushes in position 10, a circuit is closed from grounded battery, winding of relay 53, sender brush 36, finder brush 29, conductor 42, selector brushes 15 and 50, contacts 40 of the auxiliary answering key, winding of relay 39 to ground.

The red lamp 54, which is a trouble lamp located at the wire chief's position is now lighted in a circuit from grounded battery, lamp 54, back contact and armature of relay 46, right hand front contact and armature of relay 39, back contact and armature of slow releasing relay 55 to ground. Since the trouble lamp 54 is thus lighted, the wire chief knows that he should operate the auxiliary answering key, which opens the circuit of relay 39 to disconnect the relays 39 and 46 from the signaling circuit. It should be stated that the auxiliary answering key is of such design that it first connects ground to one impulse spring of the dial generally designated 56 and then connects the other impulse spring thereof to the lower side of the signaling circuit before this conductor is disconnected from the relay 46. This arrangement insures that the relay 53 at the sender will not be prematurely released to advance the sender switch of Fig. 1.

The wire chief is then instructed to operate the dial sender 56 at his position to transmit a large number of impulses, preferably ten, which operate the relay 53 of Fig. 1. As the relay 53 vibrates its armature, it operates the slow releasing relay 57 and then closes an actuating circuit from grounded battery, winding of the motor magnet 33, front contact and armature of relay 57, back contact and armature of relay 53, brush 34, conductors 58 and 32 back contact and armature of relay 31 to ground.

In response to each of the impulses transmitted by the dial sender 56, the motor magnet 33 advances the brushes of the sender so that the test brush 35 can successively test the group of alarm relays shown near the top of Fig. 1. It has been assumed that the relay 18 associated with the first group of circuits is operated so that while test brush 35 is advancing through position 11, a circuit is closed from ground, armature and front contact of relay 18, brush 35, conductor 43, finder brush 27, conductor 44, lower front contact and armature of relay 41, selector brushes 16 and 51, contacts 58, conductor 59, contacts 60, conductor 61, brush 62, winding of relay 63 to grounded battery. The relay 63 is thus operated and is locked in this condition from grounded battery, winding of relay 63, its front contact and armature, conductor 65, front contact and armature of relay 64, which relay is operated over conductor 96 when the auxiliary answering key is closed. In response to the remaining impulses of this series, the brushes of the sender are advanced until the brush 35 is standing in position 20.

It will be understood that, if certain of

the other trouble indicating relays such as 67 or 69 of Fig. 1 are actuated to indicate an abnormal condition, when the sender switch of Fig. 1 and the receiver switch of Fig. 2 are advanced, corresponding relays 68 and 70 are actuated to light lamps 71 and 72 in the wire chief's position. From the operation of the lamps 66, 71 or 72 the wire chief can tell the character of the trouble that exists at the unattended office indicated in Fig. 1 and he is also able to tell in what group the trouble is located and in certain cases he can remedy the trouble without sending a "trouble man" out to the unattended office.

Since the lamp 66 is operated it indicates that one of the switches in the first group is "stuck" and it is often possible to release such a "stuck" switch by momentarily opening its battery circuit. In order to do this it is only necessary for the wire chief to operate the dial sender 56 to send one, two or three impulses, depending upon whether it is the first, second or third group of switches in which the "stuck" switch is located. Since it has been assumed that the "stuck" switch is in the first group, the wire chief operates his dial sender 56 to transmit one impulse. This is effective in the manner already indicated to operate the relay 53 of Fig. 1 which in turn advances the sender switch now standing in position 20 into position 21.

The wire chief now closes the contacts 73 of the key located at his position and thereby completes a circuit from ground, contacts 73, conductor 59, contact 58, selector brushes 51 and 16, lower armature and front contact of relay 41, conductor 44, trunk finder brush 27, conductor 43, brush 35 in its twenty-first position, winding of relay 74, lower winding of relay 19 to grounded battery. The relay 74 is thus operated and opens the battery lead extending through group relay 18 to the various magnets associated with the "stuck" switch. This momentary operation of relay 74 and the consequent removal of battery from the "stuck" switch usually effects its release.

In case some other kind of trouble exists at the unattended office such as a fuse alarm arising from the failure of a fuse, or a permanent signal alarm in which cases it is necessary to send a "trouble man" to the unattended office, the wire chief again operates his dial sender 56 to transmit a series of impulses, preferably 10 which advance the sender switch of Fig. 1 into position 25. It does not require 10 impulses to accomplish this last operation, but this number of impulses, irrespective of the position in which the sender was standing will step it to position 25 and no farther because in this position the impulse circuit for relay 53 is open at brush 34.

The wire chief may now leave the key contact 73 closed and restore the auxiliary answering key to its normal position, which is an indication that the service observing operation of this trunk has been taken care of. Relay 39 is now operated in series with the relay 53 and the red lamp 54 is now lighted in a circuit traceable from grounded battery, through the lamp 54, right hand front contact and armature of relay 39, conductor 59, contacts 73 to ground. This lamp remains lighted until the trouble at the distant office has been corrected when it will be extinguished and all the circuits will be restored to their normal condition.

In the present disclosure the sender of Fig. 1 is arranged to send code impulses corresponding to #11 to actuate the selectors leading to the wire chief's position. If it were desired to send impulses corresponding to #21, the conductor leading from relay 47 to point 5 would be removed and a similar conductor is connected to point 13 of the switch bank engaged by brush 37. The first thirteen terminals of the various banks of the sender switch are also changed in a manner obvious from the present arrangement of the first ten sets of terminals of the sender.

What is claimed is:

1. In a telephone system, a primary office, a second office, means including several kinds of apparatus at said primary office, one or more trunk circuits extending between said offices, an attendant's position at said second office, means including directively operable switches and link circuits for extending a trunk to said attendant's position, an impulse sender, means responsive to the faulty operation of any of said apparatus for connecting said sender to one of said trunk circuits, means directively controlled from said impulse sender for operating said switches to extend said trunk circuit through said link circuits to said attendant's position, and means for signaling the kind of faulty apparatus over said established connection.

2. In a telephone system, a primary office, a second office, means including several kinds of apparatus at said primary office, one or more trunk circuits extending between said offices, an attendant's position at said second office, means including directively operable switches and link circuits for extending a trunk to said position, an impulse sender, means responsive to the faulty operation of any of said apparatus for connecting said sender to one of said trunk circuits, means directively controlled from said impulse sender for operating said switches to establish a connection from said trunk circuit through said link circuits to said attendant's position, and means for signaling the kind of faulty apparatus and the location of the same over said established connection.

3. In a telephone system, a primary office, connecting apparatus arranged in groups which apparatus may become faulty, an indicating device for each group of apparatus, a second office, an attendant's position and signaling means located at said second office, means including automatic switches and link circuits for interconnecting said primary office and said attendant's position, means including a sender switch arranged to send a predetermined code of impulses for directively operating said automatic switches, a receiver switch also located at said second office, means including a dial sender for causing the sender switch at the primary office and the receiver switch at the second office to advance progressively until the group of faulty apparatus is located, and means responsive to such operation of said receiver switch for variably operating said signaling means.

4. In a telephone system, a primary office, a second office means including several kinds of apparatus at said primary office, one or more trunk circuits extending between said offices, an attendant's position at said second office, means including directively operable switches and link circuits for extending a trunk circuit to said position, an impulse sender, means responsive to the faulty operation of any of said apparatus for connecting said impulse sender to one of said trunk circuits and for initiating the operation of said impulse sender, means directively controlled from said impulse sender for operating said switches to extend said trunk circuit through said link circuits to said attendant's position, means for signaling the kind of faulty apparatus and the location of the same over said established connection, and variably controlled means at said attendant's position for correcting certain of said faulty apparatus located at said first office.

5. In a telephone system, a primary office, a second office, means including several kinds of apparatus at said primary office, one or more trunk circuits extending between said offices, an attendant's position at said second office, means including directively operable switches and link circuits for extending a trunk circuit to said position, an impulse sender, means responsive to the faulty operation of any of said apparatus for connecting said sender to one of said trunk circuits, means directively controlled from said impulse sender for operating said switches to establish a connection from said trunk circuit through said link circuits to said attendant's position, means for signaling the kind of faulty apparatus and the location of the same over said established connection, and means controlled over said connection from said operator's position for correcting certain of said faulty apparatus.

6. In a system of the class described, several different kinds of apparatus, an operator's position, a plurality of trunks, means including directively operable switches and link circuits for extending a trunk circuit to said position, an impulse sender, means responsive to the faulty operation of any of said apparatus for connecting said impulse sender to one of said trunk circuits and for initiating the operation of said impulse sender, means directively controlled from said impulse sender for operating said switches to extend said trunk circuit through said link circuits to said operator's position, means at said position for signaling the kind of faulty apparatus and the location of the same over said established connection, and variably controlled means at said operator's position for correcting certain of said faulty apparatus.

In witness whereof, I hereunto subscribe my name this 31st day of August A. D. 1923.

WINFRED T. POWELL.