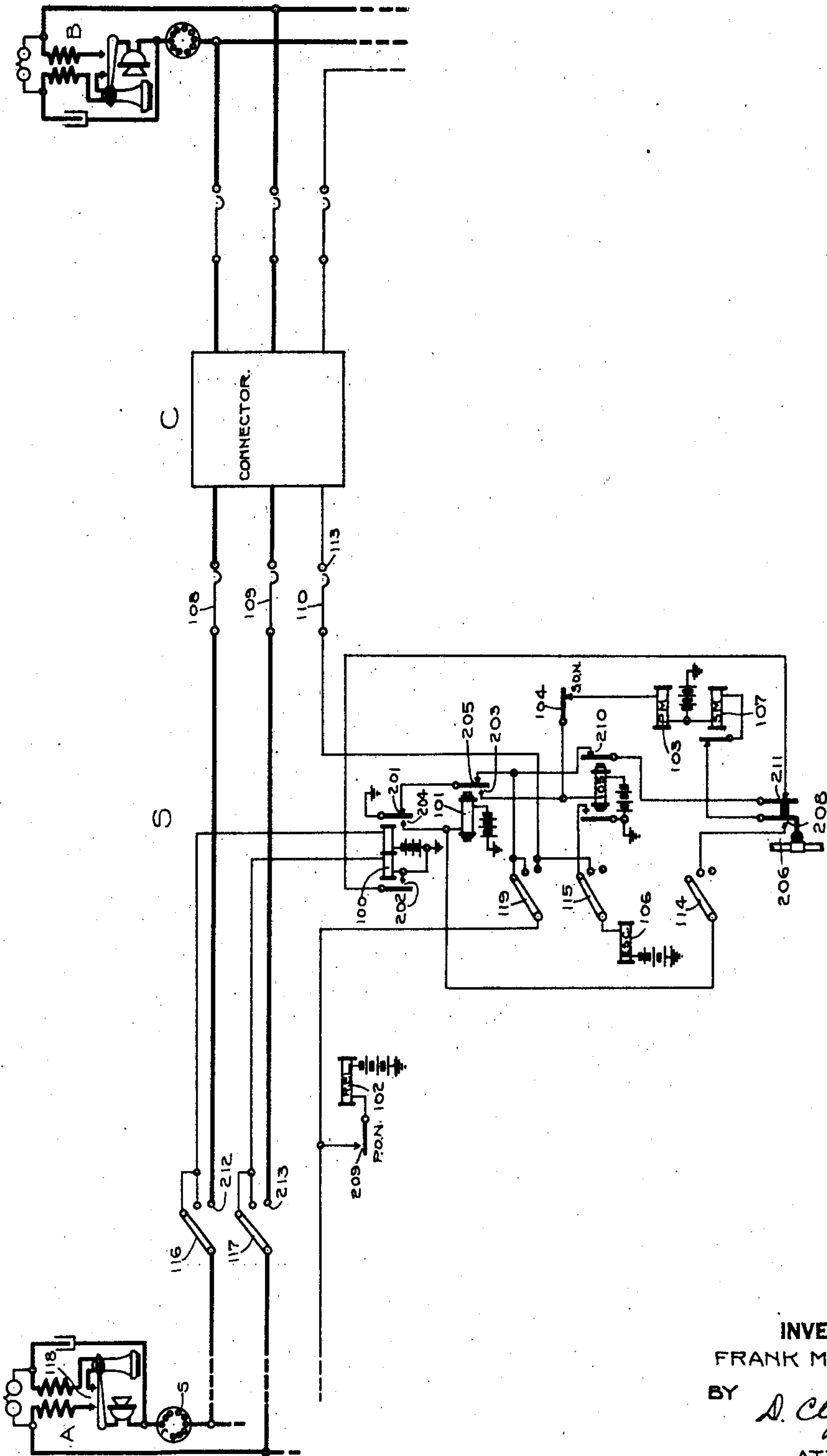


F. M. SLOUGH.
SUBSCRIBER OPERATED TELEPHONE SYSTEM.
APPLICATION FILED JAN. 28, 1918.

1,391,587.

Patented Sept. 20, 1921.



INVENTOR
FRANK M. SLOUGH
BY *D. Clyde Jones.*
ATTORNEY

UNITED STATES PATENT OFFICE.

FRANK M. SLOUGH, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

SUBSCRIBER-OPERATED TELEPHONE SYSTEM.

1,391,587.

Specification of Letters Patent. Patented Sept. 20, 1921.

Application filed January 28, 1918. Serial No. 214,057.

To all whom it may concern:

Be it known that I, FRANK M. SLOUGH, 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 Subscriber-Operated Telephone Systems, of which the following is a full, clear, and concise description.

This invention relates to telephone systems in which automatic or electrically operated switches are employed in establishing connections from calling to called lines.

The object of this invention is a provision of such a system in which the selective switch mechanisms of the central office will not be operated in such a way as to cause a calling subscriber to secure a wrong connection, if the calling subscriber in removing his receiver from the hook causes, in the act of so doing, one or more interruptions of the line circuit to be made.

It has been found that in practice such improper operation preliminary to the dialing operation by the subscriber occurs quite often, and causes the selective switches of the subscriber operated systems of the art heretofore used, to operate in other than the manner desired and causes them to make connection with other than the desired line whose number is sent by the subscriber's dial under the control of the subscriber.

It is a particular object of my invention to so arrange the apparatus at the central office of an automatic system that such improper interruptions of the line circuit occurring prior to the dialing operation and followed by the dialing operation will not operate the selective switches of the system in any but the desired way to secure connection with the desired line.

It is a further object of my invention to accomplish the aforesaid object by simple changes in the first selector switch apparatus which can be applied to existing systems or which may be installed in automatic systems with minimum expense and complication.

The invention is illustrated in connection with a fast and slow automatic system so called, that is, in which fast and slow relays are operated under the control of sub-

scriber's instrument apparatus to control the operation of the selective switches in the desired manner.

The accompanying sheet of drawings diagrammatically indicates the apparatus and circuits employed in the present embodiment of this invention. The calling device indicated at the substation of the subscriber's line may be of any desired character, in which a series of interruptions is produced in the line circuit. Many devices for accomplishing this result are well known and understood in the art.

Referring to the drawings, at A I show a calling substation having a sending dial *s* together with the usual talking and signaling apparatus connected by line conductors of the line leading to the central office equipment illustrated in the drawing. While no non-numerical switch is shown for extending the calling line to an idle first selector, it will be understood that any well-known form of line finder or line switch may be inserted at the point where the line conductors are indicated by the broken lines. In the event that a non-numerical switch is not employed the sub-station may be connected directly to the line conductors of an idle first selector switch mechanism as is illustrated at S in the drawing. The selector switch mechanism contains a line relay 100, two slow relays 101 and 105 which are constructed to release their armatures slowly, such a construction being well known in the art, an escape magnet 106 controlling the operation of side switch wipers 114, 115, 116, 117 and 119. A primary stepping magnet PM is indicated in the drawing to control the movement of the selector switch wipers 108, 109 and 110 to a group of sets of contacts, each set leading to a connector switch mechanism one of which is indicated in the drawing. A secondary switch magnet SM is illustrated in connection with the said first selector switch S, to advance the set of selector wipers from one set of contacts to another until contacts leading to an idle connector switch mechanism are located. The selector switch apparatus also includes a set of contacts 206 comprising normally opened and normally closed contacts which are shown in the drawing in their normal posi-

tion, but which are moved to their operative positions after the primary stepping magnet has moved the selector switch wipers a certain distance under the control of
5 calling line substation apparatus.

To carry out the purposes of my invention, I arrange the system of my invention so that the first digit of the number designating telephone lines to be called, is increased one or more numbers; that is, if
10 the subscriber's number would otherwise be 216, that in the system of my invention such a telephone line would be numbered 316 or 416 depending upon the judgment of the
15 person employing my invention and the construction of the substation hookswitch mechanism employed. If the first digit is increased by one numeral, provision is thereby made for the correction of one false
20 interruption of the line circuit made by the subscriber prior to operating his sender mechanism, and if the first digit is increased by two numerals provision is thereby made for the correction of one or two false inter-
25 ruptions of the line circuit by the calling subscriber in preparing to make a call. Thus, by suitably altering the numbers of called lines, and of course, suitably proportioning the apparatus 206, provision may
30 be made for the correction of the required number of false contacts made prior to the sending or dialing operation. The apparatus of the first selector switch S is so arranged that if the first train of interruptions
35 of the line circuit which is connected to the first selector switch contains less than a given predetermined number of circuit interruptions, that the selector switch mechanism will immediately restore to normal po-
40 sition and to such a condition as will permit a succeeding train of interruptions properly produced to call a called telephone line to operate the selector switch mechanism to advance, the aforesaid object, whenever the
45 number of interruptions of a continuous chain of interruptions contains more than the predetermined number, this is taken to mean that the interruptions are properly produced and the selector switch mechanism
50 after the predetermined number of interruptions have been made will disable the said apparatus shown in the drawing 206, so that it will be impotent to disable the said selector switch mechanism.

55 Although the connector switch forms no part of this invention, it will be understood that the present invention may be used in any system having connector switches of any well-known type such as that disclosed
60 on page 44 of "Automatic telephony" by Smith and Campbell.

It is believed that the invention will now be readily understood from the description of the manner in which the switches are
65 controlled in establishing a connection from

calling to called telephone lines. The subscriber desiring to make a call, will take his receiver from the hook closing a circuit, including the substation instrument and the hookswitch, and contacts 118. The closing
70 of these contacts will cause a non-numerical switch, not shown in the drawing but understood, to interconnect in any suitable way the line conductors leading to the sub-
75 station A to side switch wipers 116 and 117 of an idle first selector switch, which we will assume is the selector switch S. This will complete a circuit including the circuit
80 conductors of the said line, the said wipers 116 and 117 through the first position contacts of the side switch through the wind-
85 ings of the line relay 100 of the first selector switch, the said circuit also including the central office source of current. Current from the said source will flow over the said
90 circuit operating the relay 100, which will attract its armatures closing contacts 204 and 202, the contacts 202 being closed for a purpose later to be described, and the con-
95 tacts 204 closing a circuit for the operation of the slow relay 101. The relay 101 operating will attract its armature closing con-
100 tacts 203 for a purpose later to be described. The relays 100 and 101 will open contacts 201 and 205 respectively.

The foregoing describes the operation of certain apparatus under the condition that the subscriber will properly remove his re-
ceiver from the hook, causing no false con-
105 tacts or interruptions of the line circuit to be made.

We will now assume that the subscriber improperly in taking his receiver from the hook, causes one or two interruptions of the
110 line circuit to be made, followed by a continued closure of the line circuit preparatory for the dialing operation. At each interrup-
115 tion of the line circuit, the armatures of relay 100 will be retracted, and upon each retraction of the right-hand armature an
120 impulse is transmitted over the following circuit; to the primary stepping magnet 103 of the first selector S, from the ground pole of battery, normal contacts 201 of the relay
125 100, now closed contacts 203 of the slow releasing relay 101, which remains energized for the time, off normal contact 104, mag-
130 net 103, to the negative pole of battery. The primary magnet 103, thus steps the switch carriage carrying the brushes 108, 109 and
135 110, toward the banks of contacts connected to trunks leading to connector switches. Assuming, however, that only one or two interruptions of the line circuit are made with
140 the construction of the switch 206 during this period, and at the end of this period the contacts of this switch will remain in
145 the position shown in the drawing and will cause, at the end of the improper line in-
150 terruptions, a circuit to be completed for

the release magnet 102 of the selector switch S, as will be described.

Following the improper interruptions and the restoring of the closed condition of the line circuit, the relay 105, after an interval retracts its armature, deenergizing the escape magnet which thereupon releases the side switch into position 2. The circuit of the secondary stepping magnet 107, would now be closed, were it not for the opened contacts 208 of the switch 206, which contacts remain open at this time due to the fact that an improper, and therefore insufficient number of line interruptions have been made, to cause the closure of these contacts 208 in the stepping circuit of the secondary magnet 107 which will under these conditions remain unoperated, though the side switch wiper 114 otherwise moving into position 2, would complete an operative circuit for the said magnet. When the relay 105 deenergized, a circuit was therefore closed for the slow to operate release magnet 102 of the selector switch S, the said release circuit including a conductor from the negative pole of the source of current and the said release magnet 102, the off normal contacts 209, now closed, the side switch wiper 119, a second position contact therefor, normal contacts 210 of the relay 105, now restored, still closed contacts 211 of the switch 206, now closed contacts 202 of the first selector line relay 100 to the ground pole of the source of current. Current from the said source will flow over the said circuit, operating the release magnet 102 to restore the switch mechanism to normal position shown in the drawing, the selector switch carriage being restored to its normal position, and the side switch wipers being restored to their normal position as shown in the drawing. The line relay 100 however, may remain in its operated position, as also the relay controlled thereby, 101.

Now, the subscriber may by operating his dial in the proper manner, cause the proper operation of the selector switch as might have been done had no false or improper interruptions of the line circuit been made in preparing for the dialing operation. Upon the calling subscriber sending a proper series of impulses containing more than, say, two impulses, the armature of line relay 100 will vibrate, and upon each retraction of the armature, an impulse is transmitted over the circuit previously traced for the said primary stepping magnet 103 of the first selector S, causing the primary stepping magnet 103 to step the brushes into operative relation of the desired group of trunks. This operation being more extended than the before described improper operation, the switch 206 will be moved from its normal position to a position in which the contacts 211 for the release magnet are

opened, so that the release magnet will not be operated after the first series of impulses have been received, and the contacts 208 thereof will be closed in the circuit of the secondary stepping magnet 107. Therefore, when the sender restores and maintains the line circuit closed the relay 105, retracting its armature after an interval and thereby deenergizing the escape magnet which causes the release of the side switch to position 2, causes a circuit to be completed for the secondary magnet 107, the said circuit being traced as follows: From the ground pole of the source of current, the now closed contacts 204 of the first selector line relay 100, the side switch wiper 114 and second position contacts therefor, now closed contacts 208 of the switch 206, normal contacts of the stepping magnet 107, the winding of the said magnet, to the negative pole of the source of current; the stepping magnet operating intermittently through its own normal contact will drive the brushes 108, 109 and 110 over the level in which trunks leading to the desired group of connectors terminate. Idle trunks of the group leading to the connectors are those upon whose test multiples 113 ground is present, and the escape magnet 106 is arranged to release the side switch into position 3 upon its energization. In position 2, the escape magnet 106 is connected to the test brush 110 over side switch arm 115. When the test brush encounters a grounded multiple 113, it becomes energized to release the side switch into position 3, the side switch arm 114 in passing out of position 2 opening the circuit of the secondary stepping magnet 107, thus stopping the selector upon the seized trunk.

At the termination of a call when the subscriber at A replaces his receiver on the switchhook, the connector switch C is released in the well-known manner and again applies ground to test terminal 113. This is effective to cause the energization of the release magnet 102 in a circuit extending from grounded battery, winding of this magnet, primary off-normal contacts 209, side switch wiper 119 in its third position, test brush 110 to ground at test terminal 113. The release magnet 102 when operated accomplishes the release of the selector switch in the manner well known.

I am aware that other forms of switching apparatus may be employed to carry out my invention than that specifically illustrated in the embodiment thereof which has been described. I am also aware that the switching apparatus 206 may in suitable form be made a part of a switch operated prior to the selector switch apparatus, such as an intermediate line finding or trunk finding switch for interconnecting a calling line with a first selector switch. Other numerous and

extensive departures may be made from the embodiment illustrated without departing from the spirit thereof.

What I claim to cover by United States Letters Patent is defined in the following claims:

1. In a telephone system, the combination of an incoming line, a plurality of outgoing lines, a switch mechanism for interconnecting said incoming line with any of said outgoing lines, switch wipers for the said switch mechanism, primary moving means to move the said switch in a primary direction, secondary moving means to move the said switch wipers in a secondary direction, a sub-station sending dial for the said incoming line adapted to control the extent of movement of the said switch wipers by the primary switch wiper moving means, automatically operated means to move the said switch wipers in a secondary direction, and means responsive only to a given degree of movement of the switch wipers under the control of the said substation sending dial for conditioning said secondary switch wiper moving means for operation but effective after a predetermined primary movement of said switch wipers to prevent said secondary switch wiper moving means from operating.

2. In a telephone system, the combination of an incoming line, a plurality of outgoing lines, a switch mechanism for interconnecting said incoming line with any of said outgoing lines, switch wipers for the said switch mechanism, primary moving means to move the said switch wipers in a primary direction, secondary moving means to move the said switch wipers in a secondary direction, a sub-station sending dial for the said incoming line adapted to control the extent of movement of the said switch wipers by the primary switch wiper moving means, automatically operated means to move the said switch wipers in a secondary direction, slow operating means operative when the movement of the said switch wipers in a primary direction is discontinued under the control of said sub-station sending dial, and a release mechanism for the said switch mechanism, said release mechanism being operated under the control of the said slow operating means, only on less than a given degree of primary movement of the said switch wipers.

3. In a telephone system, the combination of an incoming line, a plurality of outgoing lines, a switch mechanism for interconnecting said incoming line with any of said outgoing lines, switch wipers for the said switch mechanism, primary moving means to move the said switch wipers in a primary manner, secondary moving means to move the said switch wipers in a secondary man-

ner, a sub-station sending dial for the said incoming line adapted to control the extent of movement of the said switch wipers by the primary switch wiper moving means, automatically operated means to move the said switch wipers in a secondary manner, and means responsive to a given degree of movement of the switch wipers under the control of the said substation sending dial for conditioning said secondary switch wiper moving means for operation, but effective after a predetermined movement of said switch wipers in a primary direction to prevent said secondary switch wiper moving means from operating.

4. In a telephone system, the combination of an incoming line, a plurality of outgoing lines, a switch mechanism for interconnecting said incoming line with any of said outgoing lines, switch wipers for the said switch mechanism, primary moving means to move the said switch wipers in a primary manner to select trunk groups, secondary moving means to move the said switch wipers in a secondary manner to select a given trunk in a group, a sub-station sending dial for the said incoming line adapted to control the extent of movement of the said switch wipers by the primary switch wiper moving means, automatically operated means to move the said switch wipers in a secondary manner to select trunk groups, and means responsive only to a given degree of movement of the said switch wipers under the control of the said substation sending dial for conditioning said secondary switch wiper moving means for operation, but effective after a predetermined movement of said switch wipers in a primary direction to prevent said secondary switch wiper moving means from operating.

5. In a telephone system, the combination of an incoming line, a plurality of outgoing lines, a switch mechanism for interconnecting said incoming line with any of said outgoing lines, switch wipers for the said switch mechanism, primary moving means to move the said switch wipers in a primary manner, secondary moving means to move the said switch wipers in a secondary direction, a sub-station sending dial for the said incoming line adapted to control the extent of movement of the said switch wipers by the primary switch wiper moving means, automatically operated means to move the said switch wipers in a secondary direction, slow operating means operative when the movement of the said switch wipers in a primary direction is discontinued under the control of said sub-station sending dial, and a release mechanism for the said switch mechanism, said release mechanism being operated under the control of the said slow operating means, only on less than a given

degree of primary movement of the said switch wipers.

6. In a telephone system, the combination of an incoming line, a plurality of outgoing lines, a switch mechanism for interconnecting said incoming line with any of said outgoing lines, switch wipers for the said switch mechanism, primary moving means to move the said switch in a primary direction, secondary moving means to move the said switch wipers in a secondary direction, a sub-station sending dial for the said incoming line adapted to control the extent of movement of the said switch wipers by the primary switch wiper moving means, automatically operated means to move the said switch wipers in a secondary direction, slow operating means operative when the movement of the said switch wipers in a primary direction is discontinued under the control of said sub-station sending dial, and a release mechanism for the said switch mechanism, said release mechanism being operated under the control of the said slow operating means, only on less than a given degree of primary movement of the said switch wipers.

7. In a telephone system, the combination of an incoming line, a plurality of outgoing lines, a switch mechanism for interconnecting said incoming line with any of said outgoing lines, switch wipers for the said switch mechanism, primary moving means to move the said switch wipers in a primary direction, secondary moving means to move the said switch wipers in a secondary direction, a sub-station sending dial for the said incoming line adapted to control the extent of movement of the said switch wipers by the primary switch wiper moving means, automatically operated means to move the said switch wipers in a secondary direction, slow operating means operative when the movement of the said switch wipers in a primary direction is discontinued under the control of said sub-station sending dial, a release mechanism for the said switch mechanism, said release mechanism being operated under the control of the said slow operating means, only on less than a given degree of primary movement of the said switch wipers, disabling means for the said secondary switch wiper moving means, and means to disable the said disabling means responsive only to a given degree of primary movement of the said switch wipers.

8. In an automatic telephone system, the combination of a first selector switch, primary stepping means for the said switch, secondary stepping means for the said switch, disabling means for the said secondary stepping means, and a secondary disabling means for the said first named disabling means, said second disabling means

being responsive to a plurality of switch steps under the control of the said primary switch stepping means.

9. In an automatic telephone system, the combination of a first selector switch, a step-by-step primary magnet for the said switch, a step-by-step secondary magnet for the said switch, a substation sending dial for controlling the primary movement of the said switch, automatic apparatus for controlling the secondary movement of the said switch, said automatic apparatus being responsive to operate the said switch to the end of a first switch operation under the control of the said substation sending dial, and disabling means for the said secondary step-by-step moving means, said disabling means being disabled under the control of means operated after a given number of switch steps under the control of said substation sending dial.

10. In a telephone system, the combination of a calling telephone line, substation apparatus for the said line, circuit closing means for the said substation apparatus, a selective switch capable of moving primarily to select trunk groups, and secondarily to select trunks of a group adapted to be operated under the control of the said substation apparatus, a primary magnet for primarily moving the said selective switch, a secondary magnet for secondarily moving the said switch, means responsive to a given number of line circuit closures by the said substation apparatus to advance the said switch to connect the calling line with a given trunk of a selected group under the control of the said primary and secondary magnets, and disabling means for the said switch responsive to the last closure of less than a predetermined number of circuit closures to restore the said switch to normal.

11. In a telephone system, the combination of a calling telephone line, substation apparatus for the said line, circuit closing means for the said substation apparatus, a selective switch capable of moving primarily to select trunk groups, and secondarily to select trunks of a group adapted to be operated under the control of the said substation apparatus, a primary magnet for primarily moving the said selective switch, a secondary magnet for secondarily moving the said switch, means responsive to a given number of line circuit closures by the said substation apparatus to advance the said switch to connect the calling line with a given trunk of a selected group under the control of the said primary and secondary magnets, and disabling means for the said switch responsive to the last closure of less than a predetermined number of circuit closures to restore the said switch to normal, said disabling means including a portion of said secondary magnet controlling means.

12. In a telephone system, the combination

of a calling telephone line, substation apparatus for the said line, circuit closing means for the said substation apparatus, a selective switch capable of moving primarily to select 5 trunk groups, and secondarily to select trunks of a group adapted to be operated under the control of the said substation apparatus, a primary magnet for primarily moving the said selective switch, a secondary 10 magnet for secondarily moving the said switch, means responsive to a given number of line circuit closures by the said substation apparatus to advance the said switch to connect the calling line with a given trunk 15 of a selected group under the control of the said primary and secondary magnets, and disabling means for the said switch responsive to the last closure of less than a predetermined number of circuit closures to re- 20 store the said switch to normal, said disabling means comprising means for preventing the operation of the said switch by the said secondary magnet.

13. In a signaling system, the combination 25 with a selective switch, of a circuit interrupter and a source of current, a magnet controlling the motion of the said selective switch, means to include the said magnet, the said source of current and the said circuit interrupter in a circuit, whereby the 30 said circuit interrupter may control the operation of the said switch, a second controlling means for the said switch, a second interrupting device in circuit with the first-named circuit interrupter, and means to 35 cause the second controlling means to restore the said selective switch to its normal position whenever the said switch is operated to less than a predetermined degree un-

der the control of the said circuit interrupter 40 or the said circuit interrupting device.

14. In an automatic telephone system, an incoming circuit, a plurality of outgoing circuits, an automatic step-by-step switch for inter-connecting said incoming circuit 45 with any of said outgoing circuits, said automatic switch having off-normal contacts arranged to be closed only after a predetermined number of steps, means for advancing said switch, an impulse relay provided with 50 contacts and operated over said incoming circuit to control said advancing means, a release magnet for said switch and a circuit for said release magnet completed through said off-normal contacts and front contacts 55 of said impulse relay.

15. In an automatic telephone system, an incoming circuit, a plurality of outgoing circuits, an automatic step-by-step switch for inter-connecting said incoming circuit with 60 any of said outgoing circuits, said automatic switch having normally open and normally closed sets of off-normal contacts, the conditions of which is reversed after a predetermined number of steps by said switch, 65 a primary motor magnet for directly controlling said switch in its primary movements, a secondary motor magnet for advancing said switch to an idle outgoing circuit, a release magnet for releasing said 70 switch and circuits for said release magnet and for said secondary motor magnet controlled through said off-normal contacts.

In witness whereof, I hereunto subscribe my name this 25th day of January, A. D. 75 1918.

FRANK M. SLOUGH.