

2,409,586

3 Sheets-Sheet 1



Oct. 15, 1946.

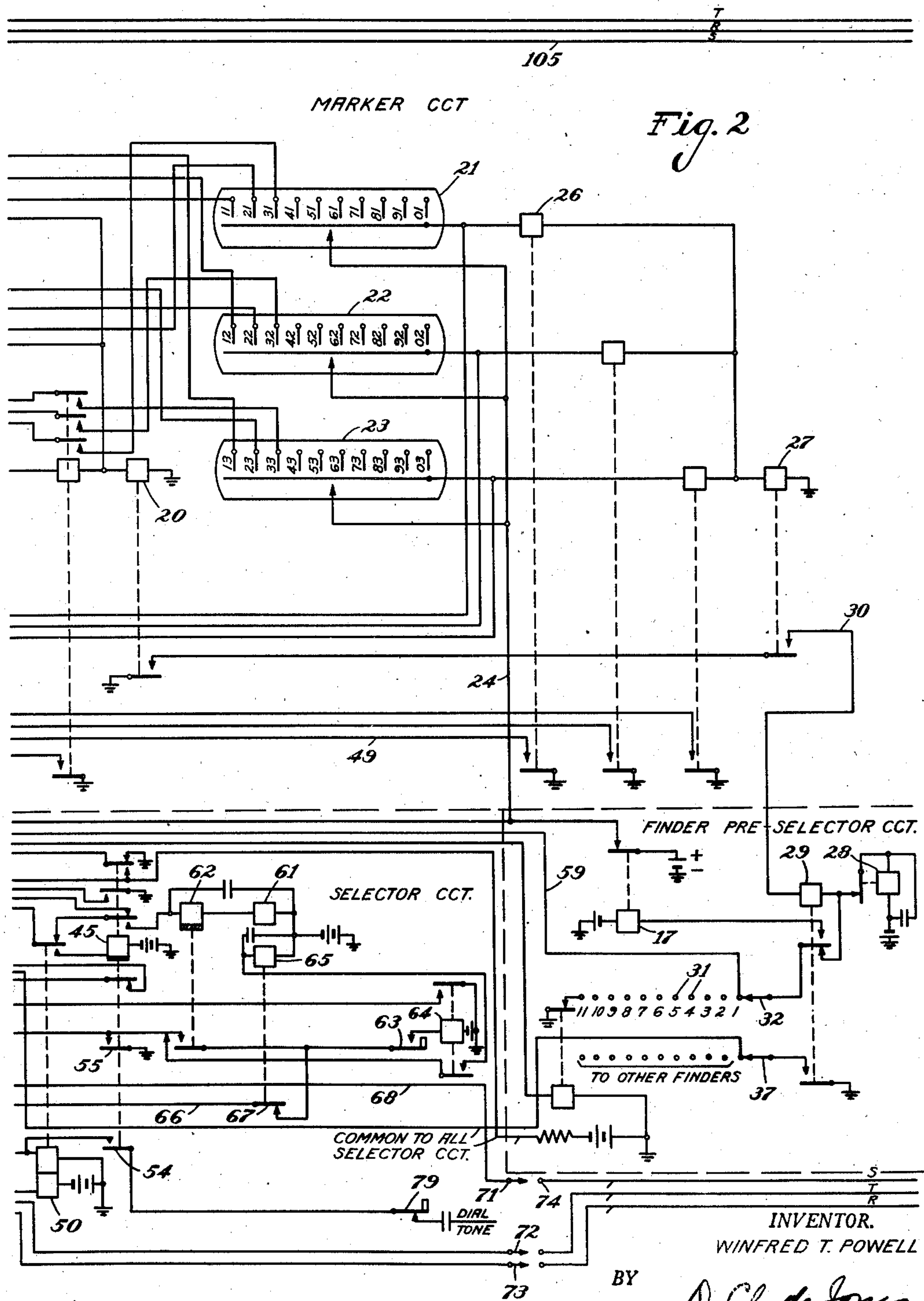
W. T. POWELL

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AUTOMATIC TELEPHONE SYSTEM

Filed Aug. 24, 1944

3 Sheets-Sheet 2



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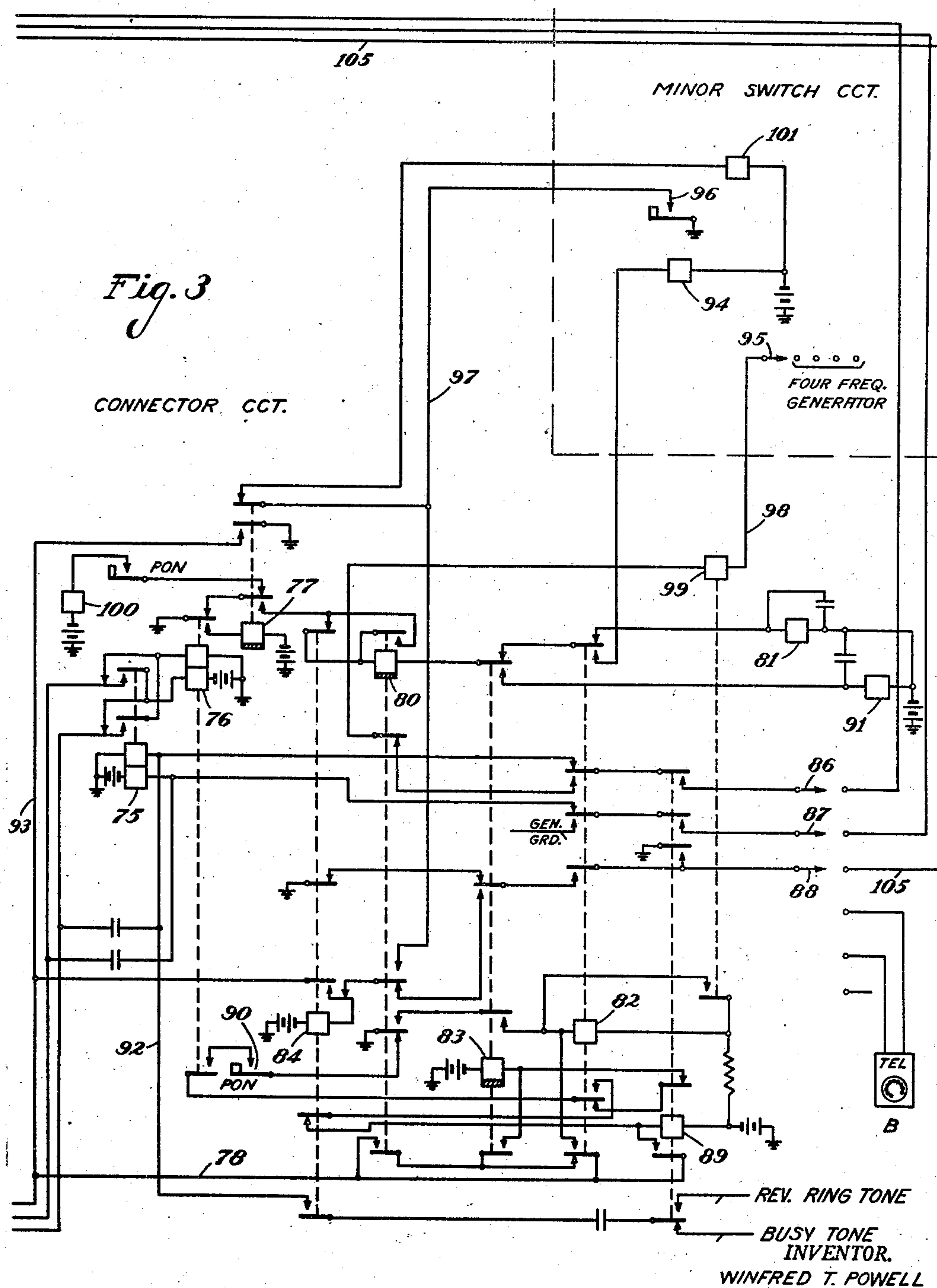
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3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,409,586

AUTOMATIC TELEPHONE SYSTEM

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Application August 24, 1944, Serial No. 551,003

12 Claims. (Cl. 179—18)

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This invention relates to automatic switching systems and more particularly to automatic telephone systems.

The present switching system provides a novel method of marking a given incoming line in the bank of a finder switch by common tens and units relays in cooperation with electric discharge devices, instead of the usual individual line relay marking arrangement. In addition, this system discloses the use of a common tens marking electric discharge device and a common units marking electric discharge device to provide improved lockout operation to insure that substantially simultaneously originated calls will be completed in sequence. Also a two-relay incoming line is used which provides the usual lockout operation in connection with revertive calls. Furthermore, this invention provides an automatic telephone system wherein the finder switches and connector switches utilize only a markedly small number of controlling relays.

Other features and advantages of the invention will appear from the detailed description and claims when taken with the drawings in which:

Figs. 1, 2 and 3, when arranged side by side in the order named, disclose an automatic telephone system of the present invention. Fig. 1 illustrates in the upper left hand corner thereof, an incoming telephone line and in the lower left hand corner thereof, a finder switch circuit. The upper right hand portion of Fig. 1 and the upper part of Fig. 2 discloses a marker circuit with its common tens relays and with its common units marker relays, together with the controlling electronic discharge devices. The lower right hand corner of Fig. 1 and the lower left hand part of Fig. 2 illustrate a selector circuit while the lower right hand corner of Fig. 2 shows a finder preselector circuit. Fig. 3 illustrates a connector switch circuit of this invention with a related minor switch circuit to select the proper ringing frequency.

The present system illustrates a thousand line system but by the addition of a second selector between the first selector and the connector, here shown, the system can be increased to ten thousand line capacity. The switches herein disclosed are of the two motion type.

The arrangement for controlling the electric discharge devices, herein illustrated, may be generally of the type disclosed in the patent to Holden 2,252,766, granted August 19, 1941, and in the patent to Mohr 2,309,525, granted January 26, 1943.

With this brief explanation of the equipment, it

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is believed that the invention will be best understood by describing the extension of a call from a calling subscriber's station A to a called subscriber's station B. For purposes of this description, it is assumed that the calling line is designated #11. When the subscriber at substation A removes his receiver from its switchhook, a circuit is completed over the tip and ring conductors of the calling line, back contacts and armatures of the cut-off relay 5, as well as the back contacts and armatures of the lockout relay 6 through the resistor 7, to the respective sides of the battery. This circuit establishes direct current flow through the resistor 7 in a direction indicated by the arrow. In this way, a positive potential is applied to the #11 start electrode in the tens marking tube 9. A negative pulser delivers a negative pulse over the #1 phase circuit 15, to the cathode 16 of the tens marking tube 9. The voltage produced across the gap in this tube, as a result of applying the negative pulse to the cathode of this tube, causes the gas in the tube to ionize and current flows from the positive side of the direct current supply, armature and back contact of the marking release relay 17 (Fig. 2), conductor 18, through the anode and cathode of tube 9, winding of the #1 tens marker relay 19 and tens lockout relay 20, to ground. This circuit operates the relays 19 and 20 and the current flow through the winding of relay 20 produces a voltage drop across this relay which results in the immediate application of a positive potential to the cathodes of other tens marker tubes, such as 9, for preventing the firing of another tens marker tube in the event of simultaneous calls in different groups. The operation of relay 19 extends the start circuits of all lines in the #1 tens group to corresponding start electrodes in all units marker tubes, such as 21, 22 and 23. Since line #11 is calling, the next impulse from the #1 phase of the negative pulser fires the units marker tube 21. The firing of the tube 21 completes a circuit from the positive pole of battery, armature and back contact of relay 17, conductor 24, anode and cathode of tube 21, winding of the units marker relay 26 and the units lockout relay 27 to ground, in the same manner as resulted from the operation of the tens marker tube 9. The voltage drop across the units lockout relay 27 results in the immediate application of a positive potential to the cathodes of the other units marker tubes for preventing the firing of a units marker tube in the event of simultaneous calling.

The tens marker relay 19 marks the #1 level in the finder banks as being the level in which

the calling line is located and the units marker relay 26 marks the terminal in the level corresponding to the calling line. The operation of the tens lockout relay 20 and the units lockout relay 27 close a circuit for operating the start relay of the finder preselector. This circuit extends from the grounded battery, winding, armature and back contact of the stepper magnet 28 of the preselector, winding of start relay 29, conductor 30, front contacts and armatures of relays 27 and 20 to ground. Start relay 29 operates in the circuit but the stepping magnet 28 does not operate since insufficient current flows there-through. It should be pointed out that the finder preselector is automatically stepped away from a terminal associated with a busy finder. This results from the fact that ground potential on the contacts 31 of busy finders is applied through the brush 32 of the finder preselector, armature and back contact of relay 29, back contact, armature and winding of the stepper magnet 28 to grounded battery. This circuit arrangement prevents the operation of the start relay 29 at all times except when the brush 32 of the finder preselector is standing on an idle terminal associated with an idle finder.

Let it be assumed that the brushes of the finder preselector are resting on the terminals illustrated, which terminals are associated with the finder illustrated in Fig. 1. Under these conditions, the operation of the relay 29 closes a circuit for operating the relay 34 associated with this finder. The circuit for operating the relay 34 extends from grounded battery upper winding of this relay, back contact and armature of the test relay 35, conductor 36 through the terminal of the finder preselector associated with this finder, brush 37 of this preselector, front contact and armature of the relay 29, to ground. When the relay 34 operates, the primary stepping magnet 38 of the finder is energized from grounded battery, winding of this magnet, its back contact and armature, front contact and armature of relay 34, back contact and armature of test relay 35 and thence to ground over conductor 36, as previously described. Under the control of this circuit, the primary stepping magnet, by self-interrupting this circuit, steps the brushes 39 to 43 inclusive of the finder, in a primary direction until the level brush 43 of this finder encounters the level marked by the calling line.

It will be remembered that it was assumed that the calling line was #11 and, therefore, this line will appear in the first level of contacts in the finder switch illustrated, as well as in other finders in the same group. Consequently, the finder switch will advance its brushes to the first level of contacts and as a result of this operation, a circuit will be closed from ground at the lower armature and front contact of the tens marker relay 19, conductor 44, the first level contact of the finder, level test brush 43, armature and back contacts of relays 45 and 46, conductor 47 through the make before break contacts of test relay 35 to grounded battery. The test relay operates in this circuit and closes a locking circuit for itself through its front contact and armature, conductor 36 and thence to ground at the front contact and armature of relay 29, associated with the finder preselector. The operation of the test relay 35 effects the release of relay 34 and also opens the self-interrupting circuit of the primary magnet 38, thereby stopping the finder switch brushes opposite the first level of contacts in its bank. With the relay 34 released and with

the test relay 35 operated, a circuit is extended for the secondary stepping magnet 48 of the finder, traceable from grounded battery, winding of this magnet, its back contact and armature, back contact and armature of relay 34, front contact and armature of relay 35, conductor 36, preselector brush 37, front contact and armature of relay 29, to ground. Under the control of this self-interrupting circuit, the secondary magnet 48 steps the finder brushes in their secondary direction, until the terminals corresponding to the calling line in the selected level are reached. Since it has been assumed that the calling line bears the designation #11, the secondary stepping magnet 48 will advance the finder brushes one step, at which time a circuit will be closed from ground at the front contact and armature of the units market relay 26, conductor 49, test brush 42, front contact and lower armature of test relay 35, lower winding of relay 34 to grounded battery. Relay 34 is again operated and the brushes 39, 40 and 41 of the finder are now in contact with the terminals of the calling line. This line is extended through the brushes 40 and 41 and the make contacts of the relay 34 as well as the back contacts of relay 45 through both windings of the relay 50 to ground and grounded battery respectively. The relay 50 operates and thereby closes an obvious circuit for operating the slow-release relay 45. When relay 45 operates it closes a circuit for holding the cut-through relay 34 operated. This circuit extends from grounded battery, lower winding of relay 34, conductor 52, front contact and armature of relay 34, conductor 57, front contact and armature of relay 45 to ground. At the lower armature 54 of the relay 45, a circuit is completed for applying a dial tone through to the calling subscriber. The slow release relay 45 at its armature 55 and front contact, extends ground potential over the conductors 53 and 59, lowermost armature and front contact of relay 34, finder brush 39, sleeve conductor 53, upper winding of the cut-off relay 5, to grounded battery. Cut-off relay 5 is thus operated and at its innermost armature and front contact extends its operating circuit through the lower winding of the lockout relay 6 to grounded battery. Thus, both relays 5 and 6 are operated. The mentioned ground at the armature 55 and front contact of the slow releasing relay 45, is extended over conductors 56 and 59, finder preselector brush 32 through the armature and front contact of the relay 29, winding of the marker release relay 17, to grounded battery. When the relay 17 operates, it interrupts at its upper armature and back contact, the operating circuits of all the marker tubes and marker relays associated therewith which were operated in response to the call on the calling line #11.

The release of the tens lockout relay 20 and the units lockout relay 27, opens the circuit that has been holding the relay 29 of the preselector operated. This relay releases and extends the conductor 59 characterized by ground potential at the armature and front contact of the relay 45, thence through the back contact, armature and winding of the stepping magnet 28, to grounded battery. Under the control of this circuit, the finder preselector stepping magnet 28 advances this preselector away from the trunk circuit which it has just assigned, to the next idle trunk to be used. The release of the start relay 29 also opens the circuit and effects the release of the marker release relay 17 which re-

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stores positive potential on the marker tube circuits. The release of the relay 29 also effects the release of the test relay 35 of the finder.

Since the calling party hears the dial tone, he operates the dial at his substation to generate the several series of impulses corresponding to the designation of the called subscriber's line. Let it be assumed that #2 corresponds to the hundreds digit of the desired number. In response to the mentioned two impulses corresponding to the hundreds digit, the relay 50 will be intermittently released twice and will then remain energized. On the first release of the relay 50, an operating circuit is completed for the primary motor magnet 61 of the selector, which circuit extends from grounded battery, winding of this magnet and winding of the slow releasing relay 62 in series, front contact and armature of relay 45, back contact and armature of relay 50, to ground at the armature and back contact of relay 45. As soon as the selector switch takes its first step in the primary direction, it closes its primary off-normal contacts 63 and opens its primary off-normal contacts 79. A circuit is now completed for operating the stepping relay 64 from grounded battery, winding of this relay, off-normal contacts 63, armature and front contact of relay 62, front contact and armature 55 of relay 45, to ground. Stepping relay 64, on operation, closes a locking circuit for itself from grounded battery through its winding, off-normal contact 63, back contact and armature of the secondary motor magnet 65, conductor 66, back contact and armature of the cut-through relay 46, front contact and armature of relay 64 to ground. At the end of the first impulse, the relay 50 energizes, as a result of which, the change-over relay 65 and the primary magnet 61 have their operating circuits interrupted, causing the primary magnet to release but the change-over relay 62 remains operated due to its slow releasing characteristic. The action of the primary motor magnet, of course, steps the selector switch in its primary direction. In response to the second and last impulse of the hundred series, the impulse relay 50 again releases so that the primary magnet 61 operates again for advancing the brushes of the selector switch to the second level of this switch. At the close of the second impulse, the relay 50 remains energized for a period long enough to permit the release of the change-over relay 62. In response to the release of relay 62, a circuit is closed for the secondary motor magnet 65 from grounded battery, winding of this magnet, front contact and armature of the stepping relay 64, back contact and continuity spring of relay 62, front contact and armature 55 of relay 45, to ground. As soon as the secondary magnet 65 operates, it interrupts at its armature 67 and back contact, the locking circuit of stepping relay 64, previously described. Relay 64 releases, whereupon at its lower armature and front contact it interrupts the operating circuit of the secondary magnet 65. The release of magnet 65 again closes a circuit for the stepping relay 64. This circuit now extends from grounded battery, winding of relay 64, off-normal contact 63, back contact and armature 67 of the secondary magnet, back contact and armature of relay 46, conductor 68, test brush 71, to ground on the test terminal 74, if the first trunk in the second level of the selector happens to be busy. With the stepping relay 64 again operated, the secondary magnet 65 again operates to advance the brushes of the selector to the second set of

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terminals corresponding to the second trunk in the selected group. As long as the selector test brush 71 encounters busy terminals, such as 74, of trunks in use, the ground potential on these terminals will prevent the operation of the cut-through relay 46 since this cut-through relay will be short-circuited under that condition. When the selector test brush 71 encounters the test terminal 74 of an idle trunk, a condition indicated by the absence of ground potential on its test terminal, then the cut-through relay 46 is operated.

When the cut-through relay 46 operates, it disconnects the calling line from the relay 50 of the selector and extends this calling line through the selector brushes 72 and 73, back contacts and continuity springs of relay 75, windings of the impulse relay 76, to ground and grounded battery respectively. This circuit operates the relay 76 which in turn causes the slow-releasing relay 77 to operate. The release of the relay 50 of the selector as well as the operation of the cut-through relay 46 associated therewith, releases slow-releasing relay 45 of the selector. However, before this relay releases, ground potential applied at the connector that has been seized is applied over the conductor 78 for locking the cut-through relay 46 operated. This ground potential is also applied over the conductors 56 and 59, brush 39 of the finder, windings of the cut-off relay 5 and lockout relay 6 for holding them operated. This ground potential is also extended over conductor 59 to the finder preselector for "keeping busy" at this point the trunk that is in use. Since the dial tone is applied through the primary off-normal contacts 79, this tone will be disconnected from the calling line as soon as this selector has taken its first step.

After the connector is seized in the manner already described, a series of impulses corresponding respectively to the tens, units and station digits are dialed by the calling subscriber. In response to the first tens digit, the impulse relay 76 of the connector releases. This closes a circuit for operating the change-over relay 80 and the primary stepping magnet 81 in series. This circuit extends from grounded battery, winding of magnet 81, back contacts and armatures of relays 82 and 83, winding of the change-over relay 80, armature and back contact of the busy relay 84, front contact and armature of relay 77, back contact and armature of the impulse relay 76, to ground. The change-over relay 80 remains operated during the tens series of impulses but the primary magnet 81 responds to each impulse to advance the connector switch brushes 86, 87 and 88 in their primary direction.

At the close of the tens series of impulses, the change-over relay 80 releases and thereby closes a circuit for operating the transfer relay 83. This circuit extends from grounded battery, winding of relay 83, back contact and armature of the cut-in relay 89, back contact and armature of the ringing relay 82, front contact of impulse relay 76, primary off-normal contacts 90, now closed, back contact and armature of the change-over relay 80, to ground. Transfer relay 83 on operating closes a locking circuit for itself through its lower front contact and armature, lowermost back contact and armature of the ringing relay 82, conductors 78 and 93, front contact and armature of relay 77, to ground.

The connector is now in condition to receive the units series of impulses, and when the calling subscriber dials the units series of impulses,

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the impulse relay 76 will be intermittently energized and deenergized, as described in connection with the tens series of impulses. In this instance, however, the change-over relay 80 and the secondary motor magnet 91 now operate in series, inasmuch as transfer relay 83 has transferred the control of the impulse relay 76 from the primary motor magnet 81 to the secondary motor magnet 91.

In response to the first impulse of the units digit, the change-over relay 80 operates as before. This in turn operates the ringing relay 82 from grounded battery, resistance, winding of this relay, front contact and armature of the transfer relay 83, front contact and armature of change-over relay 80. The ringing relay on operating closes a locking circuit for itself through its lowermost front contact and armature, to ground over conductor 78. The operation of the relay 82 interrupts the previous circuit for the transfer relay 83, but this relay is now locked operated through its lower front contact and armature, armature and front contact of the change-over relay to ground over conductor 78.

At the close of the units series of impulses, the change-over relay 80 releases and this in turn opens the locking circuit of the transfer relay 83 which also releases.

At the close of the units series of impulses, the connector brushes 86, 87 and 88 are in contact with the terminals of the called line. It is, therefore, in order to test this called line to determine its busy or idle condition. If the called line is busy, ground potential is extended through the connector test brush 88, armature and front contact of the ringing relay 82, armature and front contact of the transfer relay 83, back contact and armature of the change-over relay 80, back contact, continuity spring and winding of the busy relay 84, to grounded battery. Busy relay 84 locks itself operated. When the busy relay is operated, in the case of a call to a busy line as just indicated, the characteristic ground potential applied to the test brush 88 is opened and the cut-in relay 89 is not operated because the operating circuit of this relay is opened at a back contact of the busy relay 84. When the busy relay is operated in the manner described, the busy tone is applied over conductor 92 to the calling line. The busy relay 84 at its uppermost armature and back contact interrupts the circuits to the primary and secondary motor magnets so that future impulses will not operate the connector switch.

If the called line is not busy, no ground potential will be applied to its test terminal and no ground potential is applied to the test brush 88 for operating the busy relay 84. Thus, when the transfer relay 83 eventually releases, ground is extended through the back contacts and armatures of relays 84 and 83, front contact of the ringing relay 82 to the test brush 88 for the purpose of making the called line busy and for operating the cut-off relay of that line.

It is now in order to dial the series of impulses corresponding to the designation of the desired station on the called line. Impulses corresponding to this digit operate the impulse relay 76 as before. However, in response to these impulses, the motor magnet 94 of the minor or frequency selecting switch, is operated. The circuit for effecting this operation extends from grounded battery, winding of the magnet 94, front contact and armature of ringing relay 82, back contact and armature of transfer relay 83, change-over relay 75

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80, armature and back contact of busy relay 84, front contact and armature of relay 77, to ground, at the back contact and armature of the relay 76. The change-over relay 80 operates in series with magnet 94 and relay 80 at its upper front contact and armature closes a circuit around the back contact and armature of the busy relay 84. This is necessary because relay 84 is going to be operated as the station digit is dialed. In this distance, the circuit for operating the busy relay 84 extends from ground at the off-normal contacts 96 of the minor switch, conductor 97, front contact and armature of change-over relay 80, back contact, continuity spring and winding of busy relay 84, to grounded battery. The cut-in relay 89 is operated before the busy relay 84 is operated during the station selection on a call to an idle line thereby distinguishing between the idle and the busy condition, since the relay 84 is operated in both cases. At the conclusion of the units impulses, the change-over relay 80 releases and thus completes a circuit for operating the cut-in relay 89. This circuit is traceable from grounded battery, winding of this relay, back contact and armature of relay 84, front contact and armature of relay 82, front contact of impulse relay 76, off-normal contacts 90, back contact and armature of the change-over relay 80, to ground. The cut-in relay 89, on operating, closes a locking circuit for itself over the conductor 78. With the cut-in relay 89 and the busy relay 84 operated, reverting ringing tone is connected to the calling line while ringing current of the proper frequency is extended through the brush 95 of the minor or frequency selecting switch, conductor 98, winding of the trip relay 99 and thence through the tip and ring brushes of the connector and over the tip and the ring sides of the called line and through the ringer of the wanted station on this line. When the called party answers, the trip relay 99 energizes and at its armature and front contact short-circuits the ringing relay 82, which releases. With the cut-in relay 89 operated as previously described and with the ringing relay 82 released, the connection is completed between the calling and the called stations.

Talking battery is supplied to the called line through the windings of the relay 75. This relay is maintained energized by this talking current and it reverses the battery supply to the calling line through the windings of the relay 76 for purposes of supervision or metering.

When the calling party replaces his receiver on its switch hook to terminate the connection, the relay 76 and the slow releasing relay 77 of the connector are released in turn for operating the release magnet 100 of the connector through an obvious circuit. The relay 77 at its upper back contact and armature, also closes a circuit for the release magnet 101 of the minor or frequency selecting switch. The operation of these release magnets restores the connector and frequency selecting switches to their normal positions. The release of relay 77 also disconnects ground potential from the conductor 93. This is effective to release the cut-in relay 89, and busy relay 84 of the connector. In addition, the release of relay 77 is effective to release the cut-through relay 46 of the selector. The release of the cut-in relay 89 as well as the release of the connector switch, disconnects ground from the test brush 88 of the connector for clearing the called line circuit. The release of the cut-through relay 46 of the selector closes an obvious circuit

for operating the release magnet 102 of the selector to effect release of this switch. The removal of ground potential from the brush 38 effects the release of the cut-off relay and the lockout relay of the called line, which relays correspond to the relays 5 and 6 of the calling line. The release of the cut-through relay 46 of the selector removes ground from the lower winding of the cut-through relay 34 of the finder. This releases the relay 34 and closes a circuit for operating the release magnet 104 of the finder for restoring this switch to its normal position.

In the event that the calling subscriber at substation A desires to communicate with a substation on his own line, commonly referred to as a revertive call, the subscriber at A dials the number of the wanted substation which in the case of a revertive call is prefixed by a special digit. The special digit selects a revertive call circuit of the type disclosed in the patent to Powell 2,325,877, granted August 3, 1943. Under the control of the revertive call circuit, called multiple contacts of the calling line A will be seized. In the course of extending the calling line to the revertive call circuit, ground is applied to the sleeve conductor 58 of this line by way of a finder brush, such as 39 (Fig. 1). With ground on sleeve conductor 58, the cut-off relay 5, is energized through its upper winding to grounded battery. The slow-releasing lockout relay 6 is thereupon operated from grounded battery, lower winding of this relay, front contact and inner armature of relay 5, to the grounded sleeve conductor 58. In accordance with the usual practice, the calling party replaces his receiver on its switch hook whereupon the calling and called stations have ringing current alternately applied thereto. When the subscriber at one of these stations answers, the ringing current is tripped and the selector and finder are released in the manner indicated in the mentioned patent. This removes ground from conductor 58 causing relay 5 to release. However, lockout relay 6 is slow releasing and, therefore, does not release, but is held operated from grounded battery, lower winding of this relay, its inner front contact and armature, back contact and armature of cut-off relay 5, thence over the two sides of the line in series, armature and back contact of relay 5, middle armature and front contact of the relay 6, and through the upper, winding of this relay to ground. The talking battery is supplied to both subscribers over the circuit last described. When both parties to the revertive call replace their receivers on their respective switch hooks, the lockout relay 5 releases to restore the line circuit to its original condition.

What I claim is:

1. In a telephone system, a plurality of incoming lines, a plurality of outgoing lines, automatic switching means for interconnecting said lines, said incoming lines being arranged in primary sets according to one grouping, said incoming lines being arranged in secondary sets according to another grouping with only one incoming line common to a given primary set and to a given secondary set, a primary relay individual to each primary set of lines and a secondary relay individual to each secondary set of lines, and electrical discharge means actuated under the control of any given one of said incoming lines for operating the primary relay and the secondary relay individual to the two sets of lines including said given incoming line, said last-mentioned primary relay and secondary relay governing the op-

eration of said switching means to interconnect said given incoming line to an outgoing line.

2. In a telephone system, a plurality of incoming lines, a plurality of outgoing lines, automatic switching means for interconnecting said lines, said incoming lines terminating in contacts arranged in primary groups along one direction and arranged in secondary groups along another direction, each incoming line being common to only one primary group and one secondary group, a primary relay common to each primary group and a secondary relay common to each secondary group, means including an electric discharge path individual to and controlled over a given incoming line for actuating the primary relay common thereto, means including another electric discharge path individual to and also controlled over said given incoming line for actuating the secondary relay common to the given line, and switching means governed by the actuated primary and secondary relays operating to engage the contacts of said given incoming line.

3. In a telephone system, a plurality of incoming lines arranged in primary sets according to one grouping, said lines being arranged in secondary sets according to another grouping with only one incoming line common to a given primary set and to a given secondary set, a primary relay and a primary electric discharge device individual to each primary set of lines, a secondary relay and a secondary electric discharge device individual to each secondary set of lines, each discharge device comprising a cathode and an anode common to its set of lines and a control electrode individual to each incoming line, means including any given one of said incoming lines and a control electrode in the primary discharge device as well as a control electrode in the secondary discharge device and said given incoming line for operating the primary relay and the secondary relay individual to the two sets of incoming lines including said given incoming line, said last-mentioned primary relay and secondary relay governing the operation of said switching means to interconnect said given incoming line to an outgoing line.

4. In a telephone system, a plurality of incoming lines, a plurality of outgoing lines, automatic switching means for interconnecting said lines, said incoming lines terminating in contacts arranged in primary groups along one direction and arranged in secondary groups along another direction, each incoming line being common to only one primary group and one secondary group, a primary electric discharge path and a secondary electric discharge path individual to each incoming line, the primary electric paths and the secondary electric paths having the same grouping as said incoming lines, a primary relay common to each primary group and a secondary relay common to each secondary group, means including an electric discharge path individual to and controlled over a given incoming line for actuating the primary relay common thereto, means including another electric discharge path individual to and also controlled over said given incoming line for actuating the secondary relay common to the given line, and switching means governed by the actuated primary and secondary relays operating to engage the contacts of said given incoming line.

5. In a telephone system, a plurality of incoming lines, a plurality of outgoing lines, automatic switching means for interconnecting said lines, said incoming lines terminating in contacts ar-

ranged in primary groups along one direction and arranged in secondary groups along another direction, each incoming line being common to only one primary group and one secondary group, a primary electric discharge path and a secondary electric discharge path individual to each incoming line, the primary electric paths and the secondary electric paths having the same grouping as said incoming lines, a primary relay common to each primary group and a secondary relay common to each secondary group, means including an electric discharge path individual to and controlled over a given incoming line for actuating the primary relay common thereto, means including another electric discharge path individual to and also controlled over said given incoming line for actuating the secondary relay common to the given line, means insuring the completion of only one primary electric discharge path and only one secondary electric discharge path at a time in the respective groups, and switching means governed by the actuated primary and secondary relays operating to engage the contacts of said given incoming line.

6. In a telephone system, a plurality of incoming lines, a plurality of outgoing lines, automatic switching means for interconnecting said lines, said incoming lines terminating in contacts arranged in primary groups along one direction and arranged in secondary groups along another direction, each incoming line being common to only one primary group and one secondary group, a primary electric discharge path and a secondary electric discharge path individual to each incoming line, the primary electric paths and the secondary electric paths having the same grouping as said incoming lines, a primary relay common to each primary group and a secondary relay common to each secondary group, means including an electric discharge path individual to and controlled over a given incoming line for actuating the primary relay common thereto, means including another electric discharge path individual to and also controlled over said given incoming line for actuating the secondary relay common to the given line, means rendering the electric discharge paths of each group effective in sequence, and switching means governed by the actuated primary and secondary relays operating to engage the contacts of said given incoming line.

7. In a telephone system, a plurality of incoming lines, a plurality of outgoing lines, said incoming lines terminating in contacts coordinately arranged in primary rows extending in one direction and also arranged in secondary rows extending at right angles to said first rows, a primary electric discharge path for each incoming line in each primary row, a secondary discharge path for each incoming line in each secondary row, means responsive to the initiation of a call over a given incoming line for completing the primary discharge path and the secondary discharge path individual to the given incoming line, and switching means governed by the completed primary discharge path and by the completed secondary discharge path for interconnecting the contacts of the given incoming line with one of said outgoing lines.

8. In a telephone system, a plurality of incoming lines, a plurality of outgoing lines, automatic switching means for interconnecting said lines, said incoming lines being arranged in primary groups and in secondary groups, each incoming line being common to only one primary group and

one secondary group, a primary electric discharge path and a secondary electric discharge path individual to each incoming line, the primary discharge paths and the secondary discharge paths having the same grouping as said incoming lines, means including an electric discharge path individual to and controlled over a given incoming line for marking the primary group of said given incoming line, means including the secondary electric discharge path individual to and also controlled over said given incoming line for marking the same in said secondary group, said switching means being governed by said markings for interconnecting said given incoming line with an outgoing line.

9. In a telephone system, a plurality of incoming lines, a plurality of outgoing lines, said incoming lines terminating in contacts coordinately arranged in primary rows extending in one direction and also arranged in secondary rows extending at right angles to said first rows, a primary electric discharge path for each incoming line in each primary row, a secondary discharge path for each incoming line in each secondary row, means responsive to the initiation of a call over a given incoming line for completing the primary discharge path and the secondary discharge path individual to the given incoming line, switching means governed by the completed primary discharge path and by the completed secondary discharge path for interconnecting the contacts of the given incoming line with one of said outgoing lines, and means for temporarily disabling the other primary discharge paths and the other secondary discharge paths related to primary and secondary rows including the given incoming line, while the discharge paths of this line are completed.

10. In a telephone system, a plurality of incoming lines, a plurality of outgoing lines, automatic switching means for interconnecting said lines, said incoming lines being arranged in primary groups and in secondary groups, each incoming line being common to only one primary group and one secondary group, a primary electric discharge path and a secondary electric discharge path individual to each incoming line, the primary discharge paths and the secondary discharge paths having the same grouping as said incoming lines, means including an electric discharge path individual to and controlled over a given incoming line for marking the primary group of said given incoming line, means including the secondary electric discharge path individual to and also controlled over said given incoming line for marking the same in said secondary group, and means for rendering said groups of primary and secondary electric discharge paths effective in sequence, said switching means being governed by said markings for interconnecting said given incoming line with an outgoing line.

11. In a telephone system, a plurality of incoming lines arranged in primary groups according to one grouping, said incoming lines being arranged in secondary groups according to another grouping with only one line common to a given primary group and to a given secondary group, a primary electric discharge device individual to each primary group of lines, a secondary electric discharge device individual to each secondary group of lines, each discharge device comprising a cathode and an anode common to its group of lines and a control electrode individual to each incoming line in its group, means

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responsive to the initiation of a call on said incoming line for causing current to flow through the resistor individual thereto whereby a difference in potential is established across said resistor for marking the primary group of the given incoming line as well as for marking said given incoming line in the group, and switching means responsive to said markings for seizing said incoming line.

12. In a telephone system, a plurality of incoming lines arranged in primary groups according to one grouping, said incoming lines being arranged in secondary groups according to another grouping with only one line common to a given primary group and to a given secondary group, a primary electric discharge device individual to each primary group of lines, a secondary electric dis-

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charge device individual to each secondary group of lines, each discharge device comprising a cathode and an anode common to its group of lines and a control electrode individual to each incoming line in its group, means responsive to the initiation of a call on said incoming line for causing current to flow through the resistor individual thereto whereby a difference in potential is established across said resistor for marking the primary group of the given incoming line as well as for marking said given incoming line in the group, switching means responsive to said markings for seizing said incoming line, and means for rendering the primary and secondary electric discharges effective in sequence.

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