May 3, 1955 G. ELLIOTT ET AL 2,707,725

REVERTING CALL SYSTEM

Filed Feb. 13, 1952 6 Sheets-Sheet 1

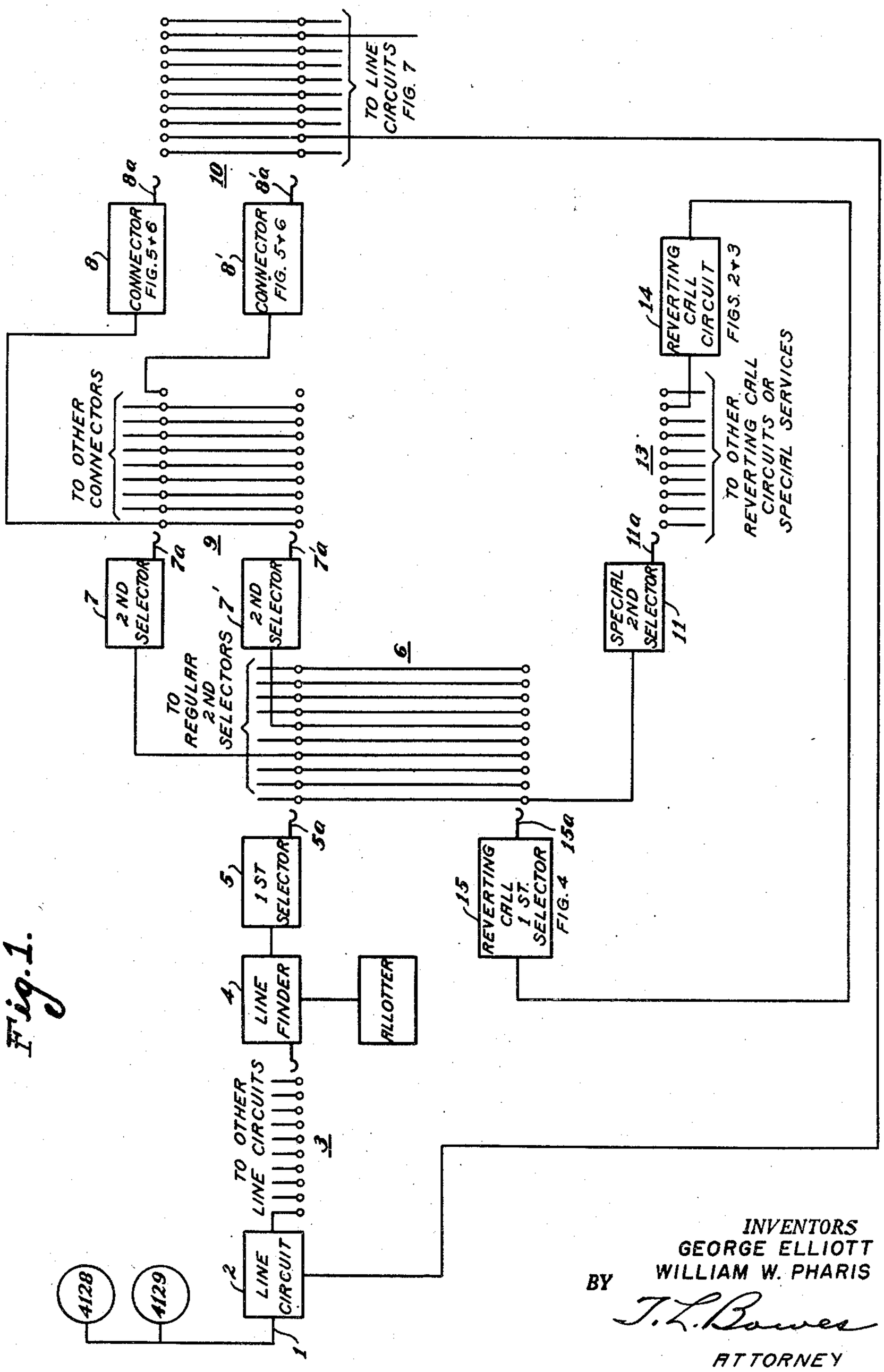

Fig. 1.

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6 Sheets-Sheet 2

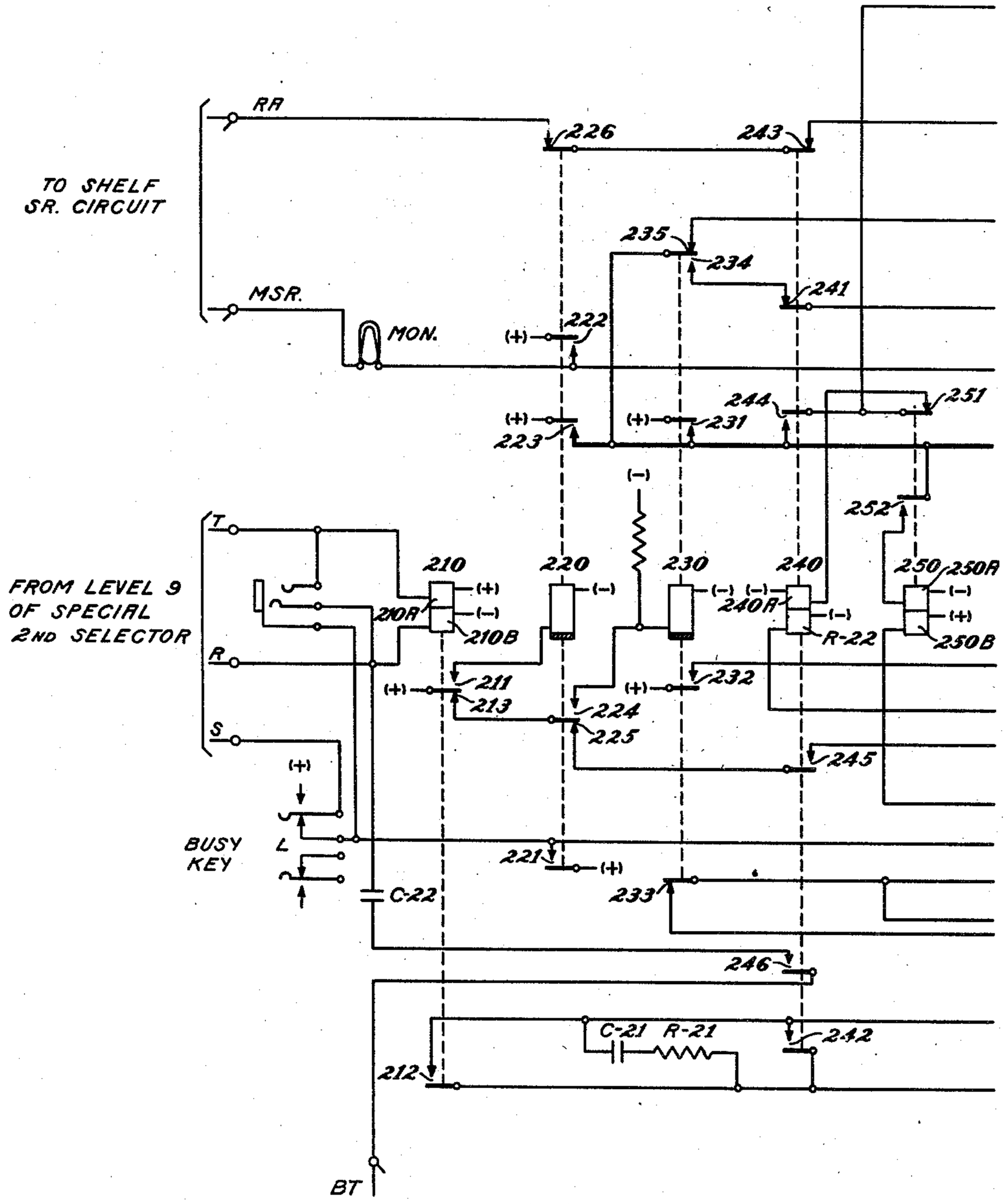

Fig. 2

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6 Sheets-Sheet 3

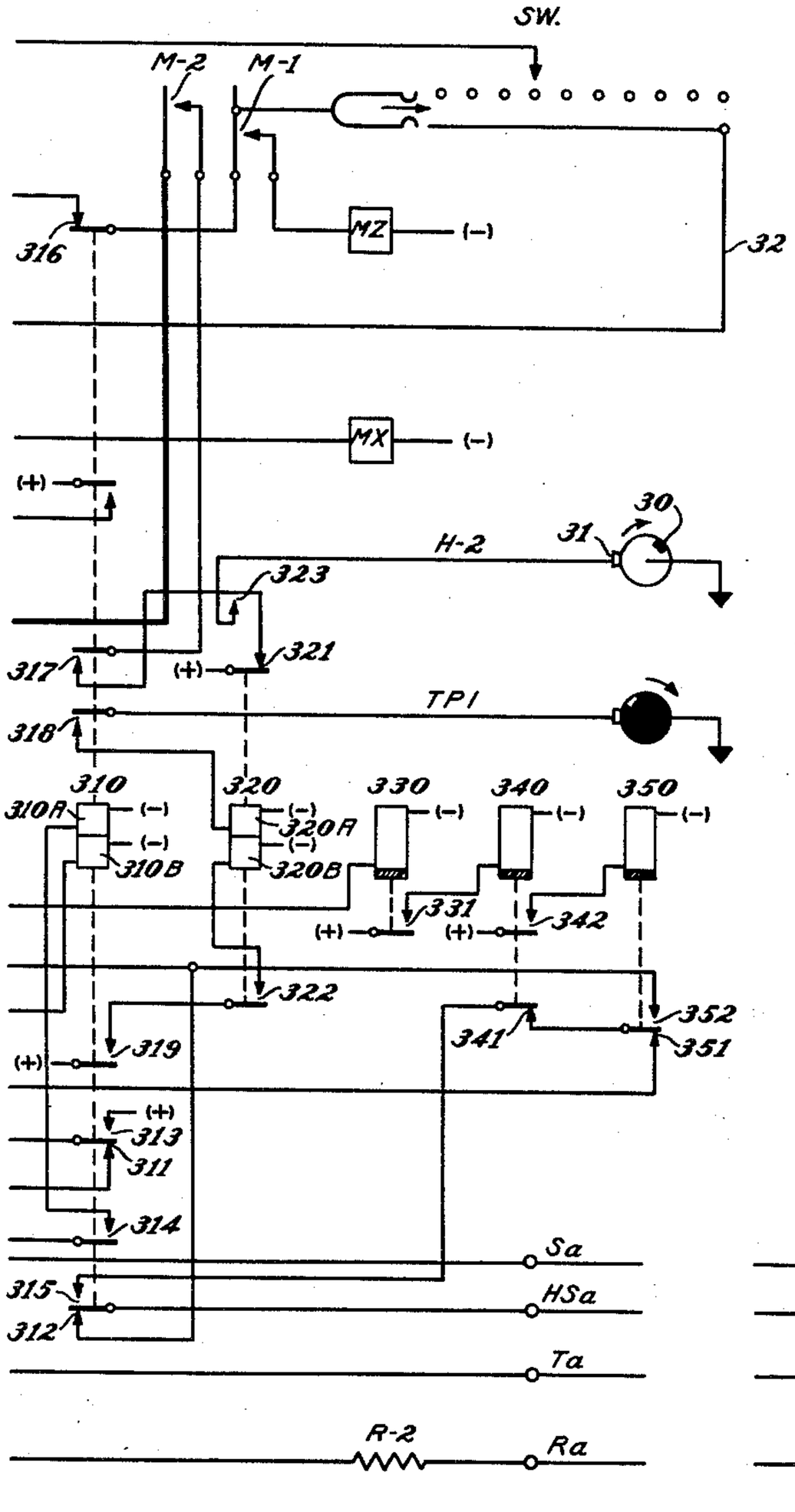

Fig. 3

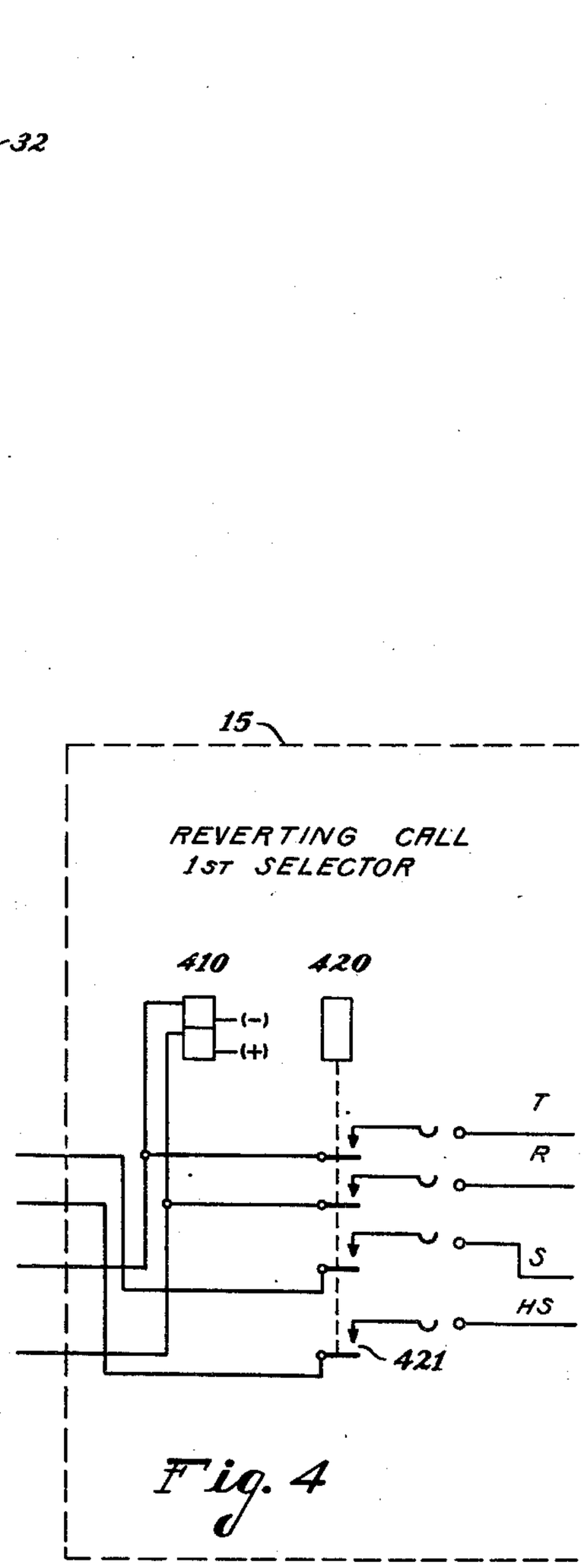

Fig. 4

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6 Sheets-Sheet 4

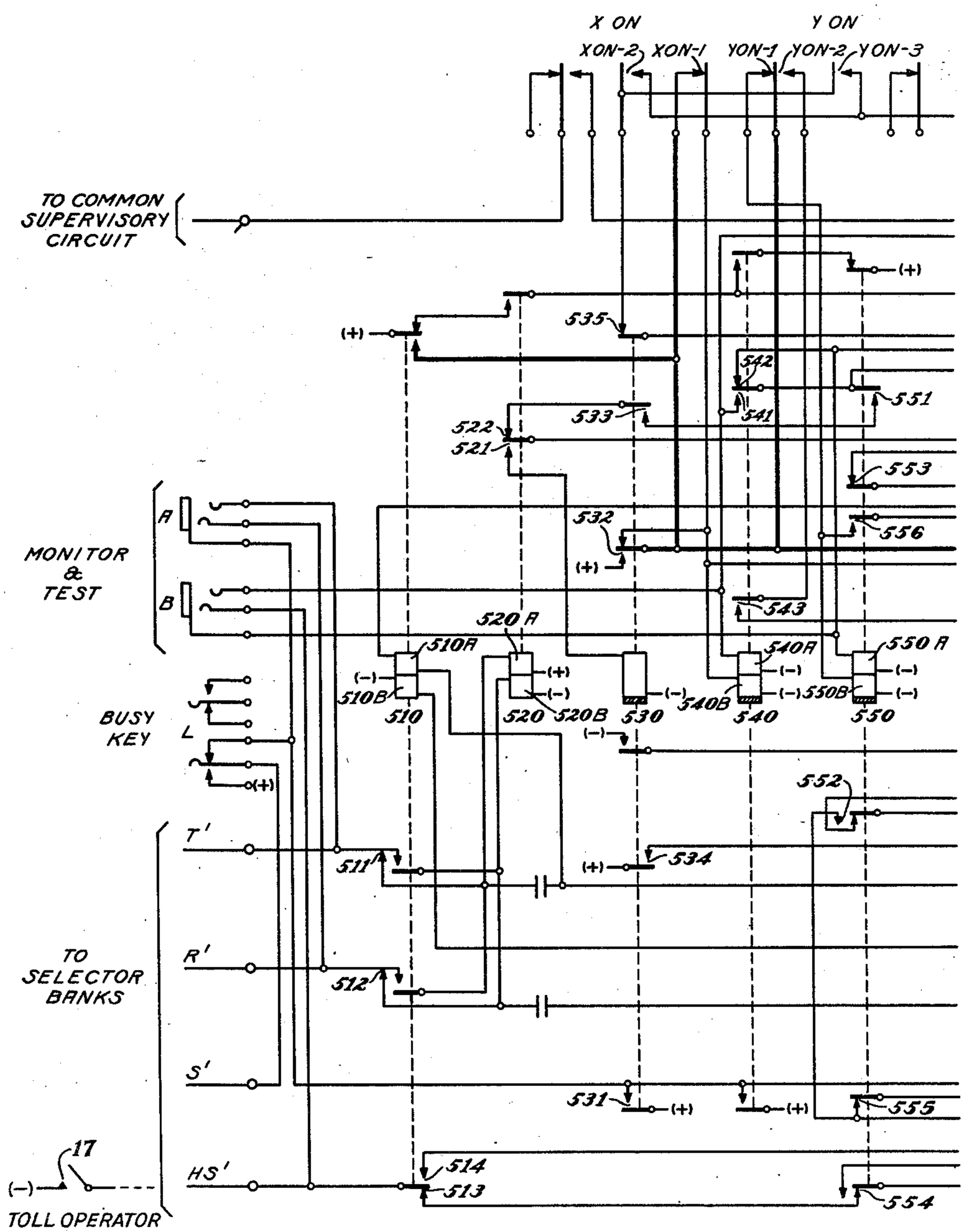

Fig. 5

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REVERTING CALL SYSTEM

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6 Sheets-Sheet 5

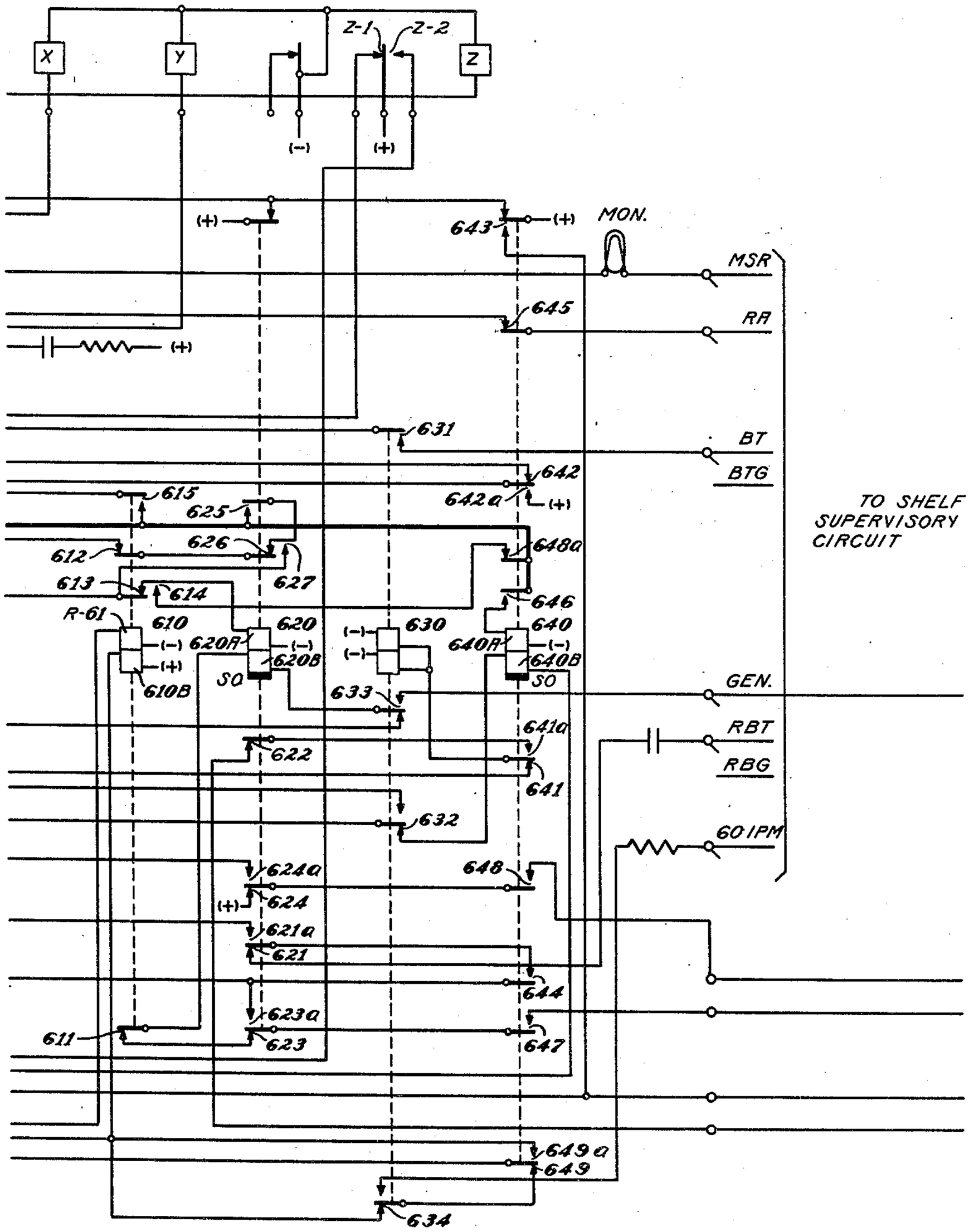

Fig. 6

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6 Sheets-Sheet 6

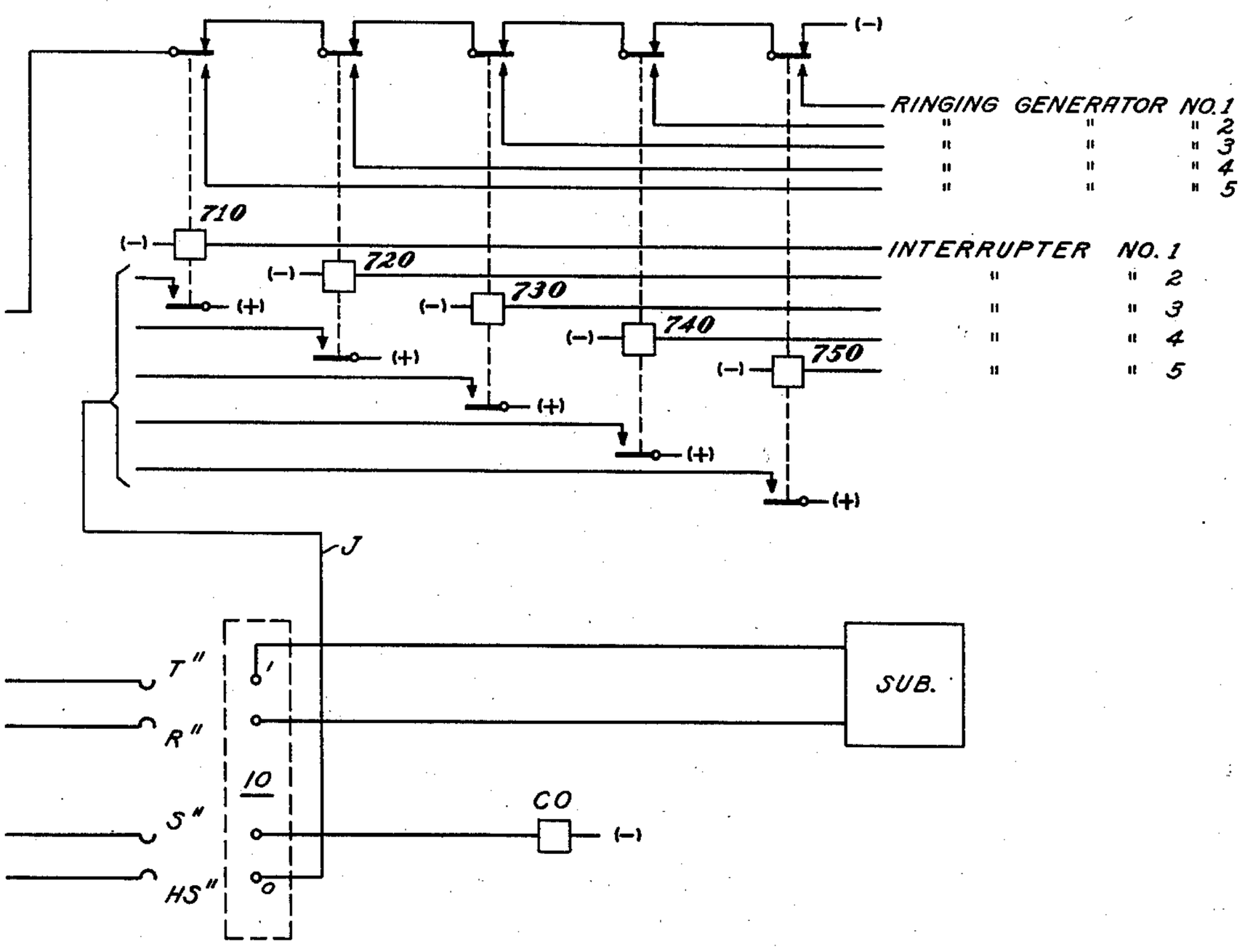

Fig. 7

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United States Patent Office

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REVERTING CALL SYSTEM

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Application February 13, 1952, Serial No. 271,408

9 Claims. (Cl. 179—17)

This invention relates to automatic telephone systems and more particularly to reverting call systems for use in automatic telephone systems.

Two methods of handling reverting calls have been extensively used in telephone systems of the automatic type. In accordance with one of these methods, commonly known as the directory number method, the calling subscriber, after dialling the directory number of the called subscriber or substation, restores the receiver to its supporting hook or cradle and, after waiting a reasonable time, again removes the receiver to complete or prepare the desired connection, depending upon whether or not the call has been answered at the called substation. The other method commonly used in handling reverting calls in automatic telephone systems comprises the provision of special reverting call switches or circuits for selective ringing purposes. In practicing this method, the substations associated with the various party lines are provided with special directory number listings. These special directory numbers must be dialled by the calling subscriber in order to set up the reverting call connection.

It is an object of this invention to provide a new and improved reverting call system.

It is another object of this invention to provide a new and improved reverting call system having particular utility with connectors of the terminal per station type.

It is still another object of this invention to provide a reverting call system of the directory number type in which the directory number is prefixed by a special digit or digits.

A further object of our invention is to provide new and improved ringing control means in connection with reverting calls.

In carrying out the principles of the present invention, there is transmitted a prefix digit or digits, as by means of a dialling mechanism, followed by the directory number of the called subscriber. Following the dialling of the above described digits, the calling party hangs up. The reverting call circuit provided in accordance with our invention repeats all of the dialled digits of the directory number to the succeeding switch train. After the last digit is repeated by the reverting call circuit, a busy tone is returned to the calling subscriber who then hangs up or replaces his receiver. The succeeding switch train includes a connector which is conventional for the most part. However, the connector is arranged so that upon the receipt of the last digit and disconnect by the calling party, means is provided to effect the release of the busy test relay and the seizure of the line by the connector. After a brief time interval, ringing is established.

The features of the invention which are believed to be novel are set forth with particularity in the appended claims. The invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection

with the accompanying drawings in which Fig. 1 is a skeletonized representation of an automatic telephone system embodying the principles of the invention, Figs. 2 and 3 represent the circuit connections of the reverting call circuit identified in Fig. 1, Fig. 4 illustrates partial circuit connections of a suitable reverting call first selector as identified in Fig. 1, Figs. 5 and 6 disclose circuit connections for the connectors outlined in Fig. 1, and Fig. 7 represents suitable line circuits and interrupted ringing supply for the system shown in Fig. 1.

GENERAL DESCRIPTION

Referring to the system layout indicated in Fig. 1, there is illustrated a party line **1** terminating in a suitable line circuit **2**, the line circuit being connected to terminals in the bank **3** of line finders **4**, one of which is illustrated. Each finder is permanently associated with a first selector **5** as indicated. Each selector is provided with a suitable step-by-step switch comprising a plurality of brushes, one of which is indicated by the numeral **5***a*, which may be advanced to engage contacts or terminals in selector bank **6**. In the arrangement shown in Fig. 1, all levels of the first selectors except the first level are extended to suitable second selectors, such as indicated by numerals **7** and **7′**, in order to extend calls between different lines or trunks through connectors such as indicated by numerals **8** and **8′**. Each of the second selectors is provided with a suitable step-by-step switch having brushes, one of which is indicated by the numeral **7***a* for engagement with terminals or contacts within selector bank **9**. Selectors **7** and **7′** are thus operated to extend calls to connectors **8** and **8′** which, through the agency of suitable step-by-step switches and connector bank **10**, in turn, extend the call to line circuits in conventional fashion. By way of example, connector **8** is connected to contacts in the first level of the selector bank **9** and connector **8′** is connected into the tenth level of bank **9**.

In order to provide reverting call service and other special services in the system illustrated in Fig. 1, there are provided special second selectors, one of which is indicated by the numeral **11** connected into the first level of selector bank **6**. Selectors **11** are special only in the sense that they are assigned solely to special services such as reverting calls, calls to information, wire chief, and so forth, as distinguished from call forwarding services. The special second selectors may employ conventional circuits and may be identical to the other second selectors **7** and **7′**. Each special second selector **11** is connected into the first level of bank **6** and is provided with a suitable step-by-step switch, one wiper or brush of which is represented by the numeral **11***a* and arranged for engagement with suitably disposed contacts in bank **13**. In the arrangement shown in Fig. 1, the reverting call circuit **14** is connected into the ninth level of bank **13** and the detailed circuit is shown in Figs. 2 and 3.

Each reverting call circuit **14** is permanently connected to a reverting call first selector **15** which includes a suitable step-by-step switch having wipers or brushes, one of which is indicated by the numeral **15***a*. The reverting call first selectors **15** are disposed for cooperation with selector bank **6** in order to extend reverting calls through second selectors **7** and **7′** and connectors **8** and **8′**.

In setting up a reverting call connection, the calling line **1** is extended through the line circuit **2** and line finder **4** to a first selector **5** upon the initiation of the call by lifting the receiver at one of the substations connected to line **1**. The calling subscriber then dials the prefix number, assumed in the present application to be "19." Responsive to the dialling of the digit "1," the regular first selector **5** selects an idle special second se-

lector 11 in the first level of selector bank 6. In turn, in response to the dialling of the digit "9," the seized special selector 11 selects an idle reverting call circuit 14 in the ninth level of bank 13.

Let it be assumed that the directory numbers comprise four digits. When the first or thousands digit is next dialled by the calling subscriber, certain circuit operations are effective in reverting call circuit 14 to repeat the digit to the reverting call first selector 15. Let it be assumed that the called subscriber is represented by the number 4129. Responsive to the receipt of the four impulses in the thousands digit, the reverting call first selector 15 is advanced to the fourth selector level and then hunts within that level for an idle second selector such as selector 7, for example.

When the second or hundreds digit 1 is dialled the wipers of selector switch 7 advance into the first level of bank 9 and then hunt through that level for an idle connector such as connector 8.

When the third or tens digit 2 is dialled, connector 8 is caused to advance to the second level of bank 10 and in response to the fourth or units digit 9, the wipers of connector switch 8 advance to the ninth position within the second level.

Busy tone is then returned from the reverting call circuit 14 to the calling party who thereupon replaces his receiver on the switch hook or cradle at his substation. As will be more fully described hereinafter, the busy test relay, which operated upon the testing busy of the called line inasmuch as the calling and called line are the same, is released. Upon the release of the busy test relay, the connector switches through and seizes the called line. A battery pulse is forwarded from the reverting call switch which causes the connector to apply a suitable ringing signal to the seized line. Thereafter, removal of the receiver at either the called or the calling station sets up circuits to provide a talking connection through the connector 8. Responsive to the answering of the call, the reverting call first selector 15 and reverting call circuit 14 are released, the line finder 4 and first selector 5 having previously been released.

In the present embodiment of the invention, connectors 8 are preferably of the type in which release is controlled by the last station to hang up, i. e., the connector is not released as long as there is a closed circuit across the line conductors to which the connector is connected. Consequently the connector remains in connection with the line circuit for supplying talking battery to the connector until both calling and called subscribers hang up or replace their receivers, at which time all of the circuits restore to normal.

Means is also provided for releasing the switch train if the calling party fails to complete dialling of the directory number or if the call is not answered within a predetermined interval of time.

Call between subscribers on different lines

Before describing the detailed operation of the circuits involved in reverting calls, it is believed desirable to describe a non-reverting call, i. e., a call between subscribers on different lines, in order to make clear the normal operation of the system, and in particular connectors 8 and 8'. Let it be assumed that a finder-selector link including finder 4 and selector 5 has responded to a calling condition on line 1 to complete an extension of the call through second selector 7 to connector 8'. Referring to Figs. 5 and 6 upon the seizure of connector 8' there is completed a loop to operate calling bridge relay 520 over a circuit extending from ground, represented herein by (+), through relay winding 520A, normal contacts 511, calling loop including tip and ring conductors T' and R', respectively, normal contacts 512 and relay winding 520B to battery, indicated by (—). Responsive to the operation of relay 520, there is completed a circuit for energizing slow-to-release delay relay 530 over a circuit extending from battery through the winding of relay 530, operated contacts 521, and release magnet contacts Z–1 to ground.

Relay 530 operates and grounds the sleeve lead S' at operated contacts 531, and closes a circuit to operate X delay relay 540 and Y delay relay 550 in parallel. Relay 540 is operated from ground on operated contacts 532 through the X off normal contacts XON–1 and winding 540B to battery. Relay 550 is energized from ground through operated contacts 532, Y off normal contacts YON–1 and relay winding 550B to battery.

As is well known in the art, the calling bridge relay 520 follows the station selecting digits (in this case digits 03). During the dialling of the first of these digits, upon restoring at each impulse, the circuit for energizing relay 530 is opened at contacts 521. However, relay 530 is provided with a slow-to-release characteristic such that relay 530 remains operated during impulsing. Upon each restoration of relay 520, there is completed a circuit for operating the primary stepping magnet X of the step-by-step switch associated with connector 8' over a circuit extending from battery through the stepping magnet X, operated contacts 541, operated contacts 551, operated contacts 533, normal contacts 522, and release magnet contacts Z–1 to ground, thus stepping the switch in the primary direction. Any suitable step-by-step switch may be used but there is herein illustrated an arrangement employing the so-called "XY" switch in which the primary and secondary movements are designated as X and Y, respectively. When the connector switch moves off normal, the X off normal springs operate to open the circuit to winding 540B at contacts or springs XON–1. Relay 540, having a slow release characteristic does not release, however, during the impulsing.

Relay 520, upon reoperating after the last impulse of the tens digit, again opens the circuit for energizing the stepping magnet X and recloses the circuit for energizing relay 530 at operated contacts 521. Upon the restoration of relay 540 following the termination of the tens digit, the impulsing path is transferred to the Y magnet at normal contacts 542.

During the dialling of the second station selecting digit, i. e., the units digit 3, relay 520 again follows the dial pulses and upon restoring each time again opens the circuit for energizing relay 530 and closes the impulsing circuit for the secondary motion magnet Y at normal contacts 522. Winding 550A is energized in parallel with the Y magnet impulsing circuit. The Y magnet is operated to cause the connector switch to step in the secondary or Y direction. When the switch moves off normal in the Y direction the off normal springs YON operate and open the circuit to relay winding 550B at contacts YON–1. Relays 550 and 530 remain operated during impulsing due to their slow release characteristics. Upon the reoperation of relay 520 after the last impulse of the units digit, the circuit for energizing relay 530 is again completed at operated contacts 521.

At this point the busy test is made by connecting the busy test relay 630 to the sleeve wiper S'' (Fig. 7) in conventional fashion. The presence of ground on the sleeve wiper S'' is indicative of a busy connection and operates busy test relay 630 from ground on the sleeve through still operated contacts 552, normal contacts 641 and both windings of relay 630 in parallel to battery. If the line tests busy, busy tone on busy tone lead BT is returned to the calling line by way of operated contacts 631, normal contacts 553, normal contacts 642, winding 510A of relay 510, normal contacts 511 and capacitor to tip lead T' so that busy tone is applied as soon as relay 550 restores. Absence of ground on the sleeve bank terminal, signifying an idle line, prevents the operation busy test relay 630 so that when relay 550 restores there is completed a circuit for operating the switch-through relay 640 over a circuit extending from cut-off relay battery in the line circuit (Fig. 7) by way of the sleeve

bank and sleeve wiper S'', normal contacts **555**, lower winding **640**B, normal contacts **632** and operated contacts **534** to ground. Responsive to the operation of switch-through relay **640**, the sleeve lead S'' is grounded at operated contacts **642**; ring back tone is applied to the ring lead R' through operated contacts **644** and normal contacts **621**; relay **630** is connected to the HS'' lead through operated contacts **641***a* and normal contacts **622**; a holding circuit is completed from battery through winding **640***a*, operated contacts **646** and **532** to ground; and a circuit is prepared for operating the answering bridge relay **510** at operated contacts **642**A and **648**.

Ringing of the called station is effected over the following circuit. With relay **640** operated, ground is applied from one of the common ringing interrupter relays **710** to **750** by means of a suitable jumper connection J, ring control terminal and wiper HS'' of the connector switch, normal contacts **622**, operated contacts **641***a* and windings of busy test relay **630** to battery. Relay **630** is thereupon reoperated as a ringing relay during any one of the five ringing intervals determined by the jumper connection J. Therefore, the generator marking (HS) terminal of the individual line selected by the connector can be cross-connected to effect the operation of relay **630** at any one of five ringing intervals for selecting any one of the five ringing generator sources by extending the circuit from the generator source through contacts of ringing interrupter relays **710** to **750** and common generator conductor GEN, operated contacts **633**, winding **620**B of ring trip relay **620**, normal contacts **611**, normal contacts **623**, operated contacts **647**, ring wiper R'' and corresponding contact in connector bank **10**, called line and substation in series, tip terminal and wiper T'', operated contacts **648** and normal contacts **624** to ground. By means of the foregoing arrangement, terminal-per-station operation is provided so that a station may be moved from one line to another without changing the station number if there is a vacancy on the line to which the station is moved having the same ringing frequency or ringing code as the station to be moved. (If the vacancy is for a different frequency, it is necessary to change the station ringer to that frequency.) This results from the fact that the tip, ring and sleeve terminals of the connector bank associated with any station number can be cross-connected to any line and the marking (HS) terminal can be cross-connected to any frequency or code.

When the called party answers, a metallic path is closed for the direct current operation of ring trip relay **620** due to superimposed or tripping battery, not shown, on the common generator lead GEN. The ring trip relay **620** is provided with a preliminary make contact **625** which recloses a circuit for operating relay **540** over a circuit from ground through operated contacts **532** and **625**, normal contacts **626** and **612** to the winding **540**B. The following reoperation of relay **540** closes a circuit to winding **620**A over a circuit extending from ground at operated contacts **532** by way of off normal springs YON–**2**, operated contacts **543**, normal contacts **613**, and winding **620**A to battery. Ring trip relay **620** now fully operates and opens the circuit through relay winding **540**B at normal contacts **626**; closes a holding circuit for winding **620**A through operated contacts **627**, **625**, and **532** to ground; disconnects the busy test relay **630** from wiper HS'' at contact **622**; disconnects ring back tone at contacts **621**; switches the tip lead T'' through to relay **510** at operated contacts **624***a*; and switches the ring lead R'' through to winding **510**B of relay **510** through operated contacts **647**, **623**A, **644** and **621**A. Relay **540** restores and relay **510** operates on ground furnished at operated contacts **642**A and the previously described circuit.

When the calling party disconnects first, the loop to calling bridge relay **520** is opened whereupon relay **520**

restores and de-energizes relay **530**. The restoration of relay **530** removes ground from the sleeve at contacts **531** in order to allow the preceding equipment to restore, and recloses the circuit for energizing relay **540**, relay **540** reoperates and grounds the sleeve lead to hold this circuit busy. When the called party disconnects, the loop to answering bridge relay **510** is opened and upon its restoration ground is removed from the sleeve lead and the remaining operated relays restore. Upon the restoration of switch-through relay **640**, a circuit is completed for energizing release magnet Z from ground on lead RA through normal contacts **645**, normal contacts **535**, off normal contacts XON–**2** and YON–**3** in parallel and release magnet Z to battery. The release magnet operates, allowing the switch to return to normal, and operates its associated contact Z–**2** which places ground on the sleeve lead to guard the connector circuit during release. When the switch returns to normal the off-normal springs open the circuit to the release magnet Z which thereupon restores. The return of the off-normal springs Z–**2** to normal removes ground from the sleeve lead.

If the called party disconnects first, the loop to answering bridge relay **510** is opened. When the calling party disconnects, the loop to calling bridge relay **520** is opened and that relay thereupon restores and opens the circuit to relay **530**. When relay **530** restores, ground is removed from the sleeve lead to allow the release of the preceding equipment and opens the circuit to relays **620** and **640** whereupon these relays restore and the circuit continues to release as described in connection with calling party disconnect in the preceding paragraph.

Toll access

Inasmuch as toll relay **610** is utilized when the connector is seized during the extension of a reverting call, as well as during the extension of toll calls, toll access is next described.

On a call from toll operator position **16**, Fig. 5, the connector circuit disclosed in Figs. 5 and 6 functions in the same manner as on a local call with the following exceptions. During the dialling of each digit, the associated trunk circuit forwards battery in any suitable manner, as by a suitable dial or key represented by numeral **17**, under the control of a toll operator, for example, on the HS' lead to operate relay **610** over a circuit extending from battery on lead HS' through normal contacts **513**, **554**, **649**, **634** and the lower winding of relay **610** to ground. In response to the resulting operation of relay **610**, ring trip relay **620** operates from master ground at contacts **532** through normal contacts **648***a*, operated contacts **614** and winding **620**A to battery, thereby preventing the application of ringing.

Assuming the use of a dial by the toll operator, relay **610** operates during the dialling of each digit to close the circuit to ring trip relay **620** by way of operated contacts **614**, and normal contacts **648***a*, and relay **620** remains operated from master ground by way of operated contacts **625** and **627** and transfer contacts **613** and **614**. Relay **610** also provides holding ground for relay **550** by connection through contacts **556**, **615** and **532**.

When the operator has completed dialling, relay **610** is released and the called line, if idle, is seized without ringing by the operation of relay **640** as previously described. Should a party on the line attempt to place a call while the toll operator is holding the line, answering bridge relay **510** operates to give supervision to the toll operator.

When the toll operator wishes to ring, battery is forwarded on the HS' lead to re-operate relay **610**. The re-operation of relay **610** opens the above traced holding circuit for relay **620** at now open contacts **613** (the alternate holding circuit through contacts **614** and **648***a* being open at contacts **648***a*) and, at contacts **611**, opens part of the circuit from the common generator lead GEN to the ring side of the line in order to prevent application

of the ringing current until relay **610** restores because, with relay **610** operated, there exists no possibility of tripping ringing. When relay **620** restores, a ringing circuit is prepared at normal contacts **623**. Toll relay **610** restores when battery is removed from the HS' lead and the ringing circuit is now completed from lead GEN through operated contacts **633**, winding **620B**, normal contacts **611** and **623** and operated contacts **647** to the ring lead R".

Reverting call

In connection with the following description it is assumed that the prefix required to reach a reverting call circuit is "19" and that the directory number of the called subscriber is 4129.

In response to the dialling of the digit "1," the first selector enters the first level of bank **6** and hunts for an idle special selector **11**. In response to the receipt of the digit "9" selector **11** advances to the ninth level of bank **13** and selects an available reverting call circuit **14**.

Upon seizure of reverting call circuit **14**, see Figs. 2 and 3, a loop is completed for operating calling bridge relay **210** by way of the extended calling loop including conductors T and R of Fig. 2 and windings **210**A and **210**B of relay **210**.

The resulting operation of relay **210** effects the energization of slow-to-release relay **220** in an obvious circuit including operated contacts **211**, and bridges the outgoing tip and ring leads T*a* and R*a*, respectively, to the reverting call first selector **15** through operated contacts **212**, thereby providing circuit means for seizing the reverting call first selector **15** and repeating dial pulses to the reverting call selector.

The operation of relay **220** grounds the back sleeve lead S at operated contacts **221** in order to hold the preceding equipment; grounds the front lead S*a* through operated contacts **221**, normal contacts **311** and normal contacts **233**; grounds the monitor supervisory lead MSR through operated contacts **222** and monitor lamp MON; establishes master ground at operated contacts **223**; and prepares a circuit for operating relay **230** at operated contacts **224**.

The calling subscriber proceeds to dial the directory number of the called subscriber. On the previously stated assumption that the directory number is 4129, in response to the receipt of the digit "4," relay **210** follows the impulses whereby contacts **212** and **213** pulse. On the first release of relay **210**, relay **230** operates from ground through normal contacts **213**, operated contacts **224** and the winding of relay **230** to battery. It is noted that both relays **220** and **230** are provided with slow-to-release characteristics so that these relays hold up between the pulses of each digit.

The operation of relay **230** completes a second connection for master ground through contacts **231**; disconnects the front sleeve lead S*a* from the back sleeve lead S at contacts **233**; and completes a circuit for energizing the stepping magnet MX of the minor switch SW from ground through the magnet MX, normal contacts **241** and operated contacts **234** to master ground. The minor switch SW advances one step. Off normal springs M–**1** and M–**2** operate as soon as the switch SW moves away from its normal or home position. The closure of contacts M–**1** prepares a circuit for operating release magnet MZ through normal contacts **316**, **243** and **226** to ground on lead RA. The release circuit is not energized at present because of the energization of relay **220** and the consequent open condition of contacts **226**. Switch contacts M–**2** extend master ground to contacts **317** of relay **310**.

Since relay **230** remains energized during pulsing because of its slow-to-release nature, the minor switch advances only one step for each digit received in the reverting call circuit; hence the continued pulsing of contacts **213** in response to the dialling of the thousands digit

"4" has no further effect but the pulsing of repeating contacts **212** causes selector **15** to advance to a level corresponding to the dialled digit, i. e. the fourth level and then to hunt in the fourth level for an idle second selector. The tip and ring conductors T*a* and R*a* are bridged by the series connection of capacitor G**21** and resistor R–**21** in order to minimize sparking at the impulsing contacts **212**.

At the end of the first digit of the directory number, relay **210** is re-operated over the calling loop which effects the re-operation of relay **220** and permits the restoration of relay **230**.

Upon the receipt of the second digit "1" of the directory number, relay **210** again releases to re-energize relay **230** and the foregoing sequence of operations again follows to advance minor switch SW to its second position and to forward a single pulse to advance the second selector **7** to the first level and initiate its hunting through that level for an idle connector **8**.

Upon receipt of the third digit, in a manner similar to that heretofore described, the minor switch SW advances to its third step and the pulses repeated by contacts **212** result in the stepping of the connector switch **8** to the second level. Upon the receipt of the last digit, the minor switch advances to its fourth position and the connector advances its brushes to engage the contacts or terminals representing the ninth position in the second level. The stepping of minor switch SW to its fourth position prepares a circuit for operating relay **240** through winding **240**A, normal contacts **251**, fourth contact of switch SW, brush of switch SW, conductor **32** and normal contacts **235** to master ground. As soon as relay **230** releases following the reoperation of relay **210**, relay **240** operates.

The operation of relay **240** shunts the tip and ring leads T*a* and R*a*, respectively, at operated contacts **242** in order to hold the succeeding equipment after the release of relays **210** and **220** when the calling subscriber hangs up; opens the release circuit for release magnet MZ at contacts **243** in order to prevent the premature release of minor switch SW; opens the stepping circuit for magnet MX at contacts **241** to prevent the further advance of the minor switch; completes a locking circuit for itself from master ground through operated contacts **244**, normal contacts **251**, and winding **240**A; prepares a circuit for the energization of winding **310**B of relay **310** at operated contact **245**; and applies busy tone to the calling loop from busy tone lead BT through operated contacts **246**, capacitor C–**22** and ring lead R.

Referring to the connector as illustrated in Figs. 5 and 6, it is assumed that the connector wipers or brushes shown in Fig. 7, stand on the contacts representing the called line. Assuming that the calling subscriber has not yet hung up his receiver in response to the receipt of the busy tone, toll access relay **610** (now to be employed as a ring control relay) stands operated from resistance battery (the lower winding of relay **240** acting as a resistor, indicated by the designation R–**22**) by way of normal contacts **312**, the HS*a* lead, operated contacts **421** and brush of selector **15**, lead HS, second selector **7**, lead HS' of connector **8**, normal contacts **513**, **554**, **649** and **634** to winding **610**B and ground. While resistor R–**22** is shown as one winding of relay **240**, it will be understood that a separate resistor may be employed if desired. Relay **550** is locked operated from master ground provided through operated contacts **532**, operated contacts **615** and operated contacts **556** through winding **550**B to battery; ring trip relay **620** is operated from master ground through normal contacts **648**A, operated contacts **614** and winding **620**A to battery; and the application of ringing current to the called subscriber's line is prevented by the operation of normal contacts **611**.

Now, when the connector switch engages the terminals corresponding to the called subscriber, ground is applied to operate busy test relay **630**, the circuit extending from

battery through the windings of relay **630** in parallel, normal contacts **641**, operated contacts **552**, sleeve brush S'' and through the multipled connector-finder banks, line finder **4** and selectors **5** and **11** to ground at contacts **221** of the reverting call circuit.

Referring back to the operation of the reverting call circuit, attention is called to the fact that busy tone has been extended to the calling subscriber. As soon as the calling subscriber hangs up or replaces his receiver thereafter, relay **210** releases because of the opening of the extended calling loop. After a short delay, relay **220** releases. However, during the period between the release of relay **210** and the release of relay **220**, relay **230** is reoperated over a circuit extending from ground through normal contacts **213**, operated contacts **224** and winding of relay **230** to battery. In response to the re-operation of relay **230**, slow-to-release relays **330**, **340** and **350** operate successively by way of obvious circuits. At this point it may be noted that these relays also operated during the stepping of minor switch SW but the operation of these relays at that time was without effect. Now when relay **220** releases, ground is removed from the back sleeve lead S at contacts **221** so that the finder **4** and selectors **5** and **11** are released; and relay **310** operates over a circuit extending from ground through normal contacts **213** and **225** and operated contacts **245** through relay winding **310B** to battery; and relay **230** is de-energized by the opening of contacts **224**. Also, when ground is removed from the sleeve lead S, because of the opening of contacts **221**, ground is also removed at sleeve brush S'' of the connector thereby releasing busy test relay **630** in the connector.

Referring again to the connector, the release of busy test relay **630** prepares at contacts **632** a circuit for operating switch-through relay **640**.

Referring again to the reverting call circuit, the operation of relay **310** restores ground on the sleeve lead S for making the reverting call switch busy at contacts **313** (the operating time of relay **310** being made long enough to assure the release of the finder and selector); removes resistance battery from the HS*a* lead at now open contacts **312** in order to release ring control relay **610**; completes another source of master ground from normal contacts **321** through operated contacts **317** and M–**2**; and completes a locking circuit for itself through its upper winding **310A**, operated contacts **314** and normal or back contacts **233** to sleeve S*a*. In the connector, the release of relay **610** effects the de-energization of relay **550** at now open contacts **615**. When relay **550** releases after a time delay, a circuit is completed for operating switch-through relay **640** from ground by way of operated contacts **534**, normal contacts **632**, winding **640B**, normal contacts **555**, sleeve brush S'' and sleeve bank contact to cut off battery in the line circuit. The switch through relay **640** is preferably a two-step relay in which the contacts **646** engage on the first step thereby applying master ground through relay winding **640A** in order to complete the operation of relay **640**. Upon the full operation of switch-through relay **640**, the connector is switched through and seizes the called line. At this point in the operation of the system the called subscriber cannot be rung because ring trip relay **620** remains operated from its previous energization so that the ringing circuit is open at normal contacts **623**.

Referring back to the de-energization of relay **230**, upon the release of that relay, relay **330** is de-energized by the opening of contacts **232**. After a delay corresponding to the release time of slow-to-release relay **330**, relay **340** is de-energized at contacts **331**. After another time interval corresponding to the release time of slow-to-release relay **340**, relay **350** is de-energized by the opening of contacts **341**. During the interval between the release of relay **340** and the release of slow-to-release relay **350**, resistance battery is again applied to the HS*a* lead through resistor R–**22**, operated contacts **352**, normal contacts **341**, operated contacts **315**, lead HS*a*, selector

15, selector **7**, lead HS', normal contacts **513**, normal contacts **554**, operated contacts **649***a* and winding **610B** to ground.

The reoperation of relay **610** effects the release of ring trip relay **620** at contacts **613**. The release of relay **620** prepares a circuit for reoperating busy test relay **630** from ground on the appropriate make contact of relays **710**–**750**, brush HS'' and contacts **622** and **641***a* to the winding of relay **630**. The closure of contacts **633** completes the ringing circuit so that the selected ringing generator is applied to the line circuit by way of common generator lead GEN, operated contacts **633**, winding **620B**, normal contacts **611** and **623**, operated contacts **647**, ring brush R'' and ring bank contact, line circuit, tip bank contact and tip wiper T'', operated contacts **648** and normal contacts **624** to ground.

Referring back to the reverting call circuit, upon the release of relay **350**, resistance battery is removed from the HS*a* lead at contacts **352**.

Upon the answering of the call by the called subscriber, the ring trip relay **620** is reoperated by the closure of the loop across tip and ring leads T'' and R'', respectively, thereby closing contacts **623***a* and **624***a* respectively to effect the operation of answering bridge relay **510** as described in connection with an ordinary non-reverting call. Upon the operation of relay **510** the connector returns resistance battery to the reverting call circuit through resistor **R61** which in the illustrated embodiment of this invention takes the form of one winding of relay **610**, operated contacts **514**, lead HS', selector **7**, selector **15**, lead HS*a* operated contacts **315** and normal contacts **341** and **351** to ground through relay winding **250B**. Upon operation, relay **250** locks to master ground through its winding **250A** and operated contacts **252**.

In response to the operation of relay **250**, relay **240** is released by the opening of contacts **251**. Responsive to the release of relay **240**, the circuit for relay winding **310B** is opened at contacts **245**, relay **310** holding through winding **310A**. The release of relay **240** also opens the shunt across leads T' and R'. at contacts **242**, thereby causing the connector to remove ground momentarily from lead S*a* which releases the reverting call selector **15**.

The removal of ground from lead S*a*, also effects the de-energization of relay winding **310A** so that relay **310** releases and removes the master ground connection at normal contacts **321** because of the opening of contacts **317**. Inasmuch as relays **220** and **230** were previously released, master ground disappears and relay **250** is released. The release of relay **310** also completes the circuit for energizing release magnet MZ over an obvious circuit through normal contacts **316** and the minor switch SW restores to its normal or home position at which time the release circuit is opened at contacts M–**1**. Winding **250B** is de-energized upon the release of relay **310** by the opening of contacts **315**. At this stage the switch train except for connector **8** is released, and connector **8** being held operated by the last party release feature.

Means is provided for releasing the reverting call circuit if the calling subscriber fails to dial all the required digits of the directory number. In such a case, the minor switch SW stands at one of the first three positions and there will be no connection through the wiper of the minor switch to operate relay **240**. Hence, when the calling subscriber hangs up, relay **210** releases and relay **220** releases thereafter to complete, at contacts **226**, a circuit for energizing release magnet MZ.

Means is also provided for releasing the reverting call circuit if either calling or called party fails to answer the call within a predetermined time after ringing commences.

There is provided, as indicated in Fig. 3, conventional timing pulse lead **TP1** and holding ground lead **H2**. The appearance of a pulse on conductor **TP1** at the beginning of the time-out period is extended through operated contacts **318** of relay **310** to energize permanent timing relay **320**. Relay **320** locks up through winding **320B**,

operated contacts 322 and 319 to ground. The operation of relay 320 also switches holding or master ground through normal contacts 321 and operated contacts 317 to holding ground on hold conductor H2 through operated contacts 323, conductor H2 being connected to ground for a comparatively long interval after the appearance of the pulse on conductor TP1, as two minutes for example. If the circuits are not released within this time interval, ground is removed from conductor H2, as for example by the breaking of the circuit when insulating segment 30 engages brush 31, thereby removing holding ground from the master ground conductor which in turn effects the release of relay 310 for releasing the connection as previously described. Since the permanent timing feature is not part of the present invention but is only incident thereto, the common apparatus for controlling the energization of conductors TP1 and H2 is not illustrated in detail.

What we claim is:

1. In an automatic telephone system, a plurality of lines including a party line having a plurality of stations associated therewith; a connector; said connector including a switch controlled from any one of said lines to extend a call from said party line to the same or another line; a ring trip relay; a ring control relay; means responsive to the seizure of said connector on reverting calls for operating said relays; means responsive thereafter to replacement of the receiver for releasing said ring control relay; means for thereafter reoperating said ring control relay to extend a connection through said connector to said party line; means responsive to the reoperation of said ring control relay for effecting the release of said ring trip relay; a source of ringing signal; and means responsive to the release of said ring trip relay for applying a ringing signal to said party line.

2. In an automatic telephone system, a plurality of lines including a party line having a plurality of stations associated therewith; a connector; said connector including a switch controlled from any one of said lines to extend a call from said party line to the same or another line, a ring trip relay, and a ring control relay; means responsive to the seizure of said connector on reverting calls for operating both of said relays; directively controlled means for causing said switch to move to a position corresponding to said party line; means responsive thereafter to replacement of the receiver at the calling station for releasing said ring control relay; means responsive to the release of said ring control relay for seizing said party line; means thereafter effective to reoperate said ring control relay; means responsive to the reoperation of said ring control relay for effecting the release of said ring trip relay; a source of ringing signal; and means responsive to the release of said ring trip relay for applying said ringing signal to said party line.

3. In an automatic telephone system, a plurality of lines including a party line having a plurality of stations associated therewith; a connector; said connector including a switch controlled from any one of said lines to extend a call from said party line to the same or another line, a ring trip relay, and a ring control relay; means responsive to the seizure of said connector on reverting calls for operating said relays; a reverting call circuit included in the extended connection when the call is between stations on the same line, said reverting call circuit including a slow-to-release relay; means effective at a predetermined time after the replacement of the receiver at the calling station on a reverting call for operating said slow-to-release relay; means responsive to said replacement of the receiver for releasing said ring control relay; means responsive to the release of said ring control relay for extending a call through said connector to said party line; means for thereafter de-energizing said slow-to-release relay and reoperating said ring control relay; means responsive to the reoperation of said ring control relay for effecting the release of said ring trip relay; a source of ringing signal; means responsive to the release of said ring trip relay for applying a ringing signal to said party line; means responsive to the release of said slow-to-release relay after a predetermined time interval for again releasing said ring control relay.

4. In an automatic telephone system, a plurality of lines including a party line having a plurality of stations associated therewith; a connector; said connector including a switch controlled from any of said lines to extend a call from said party line to the same or another line, a ring trip relay, a busy test relay, and a ring control relay; means responsive to the seizure of said connector on a reverting call between stations on said party line for operating said ring control and ring trip relays; directively-controlled means for causing said switch to move to a position corresponding to the party line on said reverting call; means responsive to said positioning of said switch for operating said busy test relay; a source of busy signal; means responsive to the operation of said busy test relay for transmitting said busy signal to the calling station; means effective upon the replacing of the receiver at said calling station thereafter for releasing said busy test relay and said ring control relay; means responsive to the release of said ring control relay for causing the seizing of the called line by said switch; means for thereafter reoperating said ring control relay; means responsive to the reoperation of said ring control relay for releasing said ring trip relay; a source of ringing signal; and means responsive to the release of said ring trip relay for applying a ringing signal to said party line.

5. In an automatic telephone system, a plurality of lines including a party line having a plurality of stations connected thereto; a connector; said connector including a switch controlled from any of said lines to extend a call from said party line to the same or another line, a ring trip relay, a slow-to-release relay, a busy test relay, a ring control relay, and a switching relay; means responsive to the seizure of said connector on a reverting call between stations on said party line for operating said ring control, ring trip, and slow-to-release relays; means responsive to the operation of said ring control relay for holding operated said slow-to-release relay; directively controlled means for causing said switch to move to a position corresponding to said party line on said reverting call; means responsive to said positioning of said switch for operating said busy test relay; a source of busy tone, means responsive to the operation of said busy test relay for transmitting said busy tone to the calling station; means effective upon the replacing of the receiver at said calling station thereafter for releasing said busy test relay and said ring control relay; means responsive to the release of said ring control relay for releasing said slow-to-release relay; means responsive to the release of said slow-to-release relay for causing the operation of said switching relay thereby to seize the called line; means for thereafter reoperating said ring control relay; means responsive to the reoperation of said ring control relay for releasing said ring trip relay; a source of ringing signal; and means responsive to the release of said ring trip relay for applying said ringing signal to said party line.

6. In an automatic telephone system, a plurality of local lines including a party line having a plurality of stations associated therewith; a toll line; a connector; a reverting call circuit; said connector having a ring trip relay and a ring control relay; means for extending a connection from any of said lines to said connector; means for operating said ring control relay from said toll line following the extension of a connection from said toll line to said connector; means responsive to a call between different stations on said party line for causing the extension of a connection from said party line to said connector through said reverting call circuit; means for operating said ring control relay from said reverting call circuit following the extension of a call from said party line to said connector on a call between said different

stations; means responsive to the operation of said ring control relay for operating said ring cut-off relay; means for thereafter re-operating said ring control relay; and means responsive to the re-operation of said ring control relay for releasing said ring trip relay.

7. In an automatic telephone system, a plurality of local lines including a party line having a plurality of stations associated therewith; a toll line; a connector; a reverting call circuit; said connector having a ring trip relay and a ring control relay; means for extending a connection from any of said lines to said connector; means for operating said ring control relay from said toll line following the extension of a connection from said toll line to said connector; means responsive to a call between different stations on said party line for causing the extension of a connection from said party line to said connector through said reverting call circuit; means for operating said ring control relay from said reverting call circuit following the extension of a call from said party line to said connector on a call between said different stations; means responsive to the operation of said ring control relay for operating said ring cut-off relay; means for thereafter releasing said ring control relay while maintaining the operation of said ring trip relay; means for thereafter re-operating said ring control relay; and means responsive to the re-operation of said ring control relay for releasing said ring trip relay.

8. In an automatic telephone system, a plurality of local lines including a party line having a plurality of stations associated therewith; a toll line; a connector; a reverting call circuit; said connector having a ring trip relay and a ring control relay; means for extending a connection from any of said lines to said connector; means for operating said ring control relay from said toll line following the extension of a connection from said toll line to said connector; means responsive to a call between different stations on said party line for causing the extension of a connection from said party line to said connector through said reverting call circuit; means for operating said ring control relay from said reverting call circuit

following the extension of a call from said party line to said connector on a call between said different stations; means responsive to the operation of said ring control relay for operating said ring cut-off relay; means for thereafter releasing said ring control relay from said toll line on toll calls and responsive to hang up at the calling station on calls between said different stations while maintaining the operation of said ring trip relay; means for thereafter re-operating said ring control relay; and means responsive to the re-operation of said ring control relay for releasing said ring trip relay.

9. In an automatic telephone system, a plurality of local lines including a party line having a plurality of stations associated therewith; a toll line; a connector; a reverting call circuit; said connector having a ring trip relay and a ring control relay; means for extending a connection from any of said lines to said connector; means for operating said ring control relay from said toll line following the extension of a connection from said toll line to said connector; means responsive to a call between different stations on said party line for causing the extension of a connection from said party line to said connector through said reverting call circuit; means for operating said ring control relay from said reverting call circuit following the extension of a call from said party line to said connector on a call between said different stations; means responsive to the operation of said ring control relay for operating said ring cut-off relay; means for thereafter re-operating said ring control relay; means responsive to the re-operation of said ring control relay for effecting the release of said ring trip relay; a source of ringing signal; and means responsive to the release of said ring trip relay for applying said ringing signal to the called line.

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