

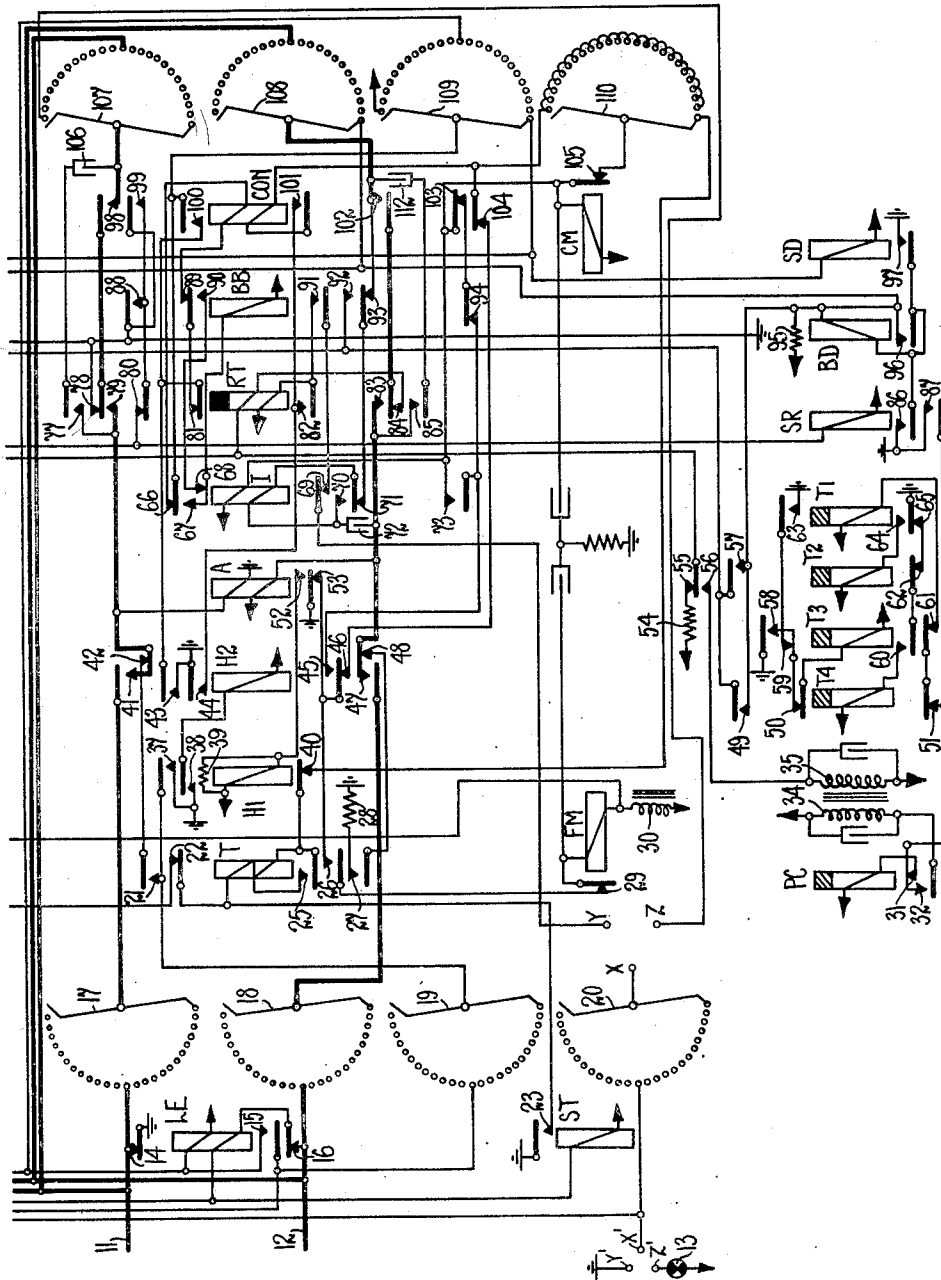
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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The present invention relates to telephone systems and is more particularly concerned with improved finder switches which can be employed with advantage in small private automatic exchanges.

The chief object of the invention is to provide simplified circuit and mechanical arrangements whereby the cost of the exchange may be reduced without rendering it in any way less reliable.

According to one feature of the invention a group of finder switches are arranged to be allotted for use one at a time from a start circuit which normally extends through all the finders in the group and is opened only when a finder in the group is hunting.

According to another feature of the invention, the lines of privileged parties are marked in a characteristic manner in the finder switch banks to cause the privilege facilities to be provided automatically. In this way the lines of privileged parties are automatically extended to line of the called party even if the called line is busy, or in response to the dialling of a special digit circuits are completed to effect the operation of a signal at the attendant's board to attract the attention of an attendant so that connections can be extended to subscribers at a public exchange.

The circuit connections of a preferred method of carrying the invention into effect employing link circuits comprising rotary switches as finder switches and connector switches are shown in the accompanying drawing and the operations involved will now be described.

It will be assumed that the subscriber at the substation connected to conductors 11 and 12 originates a call by lifting his handset. Relay LE thereupon operates partially over its lower winding in the following circuit: battery, winding of start relay ST, lower winding of relay LE, contact 16, conductor 12, loop at the calling substation, conductor 11, contact 14 to earth. Relay LE operates contact 15 only and thereby connects battery through its upper winding to private bank contact of the calling line. The start relay ST, which is common to all the line relays, operates in series with relay LE and connects earth at contact 23 to the relay T of all the link circuits. The link circuit shown in the drawing is the first link circuit and it will be assumed that this link circuit is idle; relay T thereupon operates over the following circuit: earth, contact 23, upper and lower windings of relay T in series, contact 40, home contact and wiper 110, interrupter contact 105, winding of connector magnet

CM to battery. It will be noted that a link circuit cannot be taken into use as long as the connector switch is off-normal as the circuit of relay T will be held open due to the wiper 110 of the connector switch being out of its home position. The T relays of all the idle link circuits are connected in parallel to the start lead, the T relay of the first idle link circuit operates when earth is connected to the start lead and disconnects the T relays of succeeding link circuits until the finder taken into use has completed its operation.

Relay T at contact 27 connects earth through resistance 28 to the lower winding of relay A, so as to partially energize relay A to make it quick to operate, and at contacts 21 connects the upper winding of relay A to the test wiper 19. At contact 22 relay T opens a point in the start lead to prevent succeeding finders being started in operation until the finder shown has found the calling line, at contact 25 short-circuits its lower winding to make itself slow-to-release and at contact 26 completes a circuit for the magnet of the finder switch as follows:—battery, retard 30, winding of magnet FM, interrupter contacts 29, contacts 26 and 53 to earth. Magnet FM thereupon intermittently energizes and de-energizes in a self-interrupting circuit and steps the wipers of the finder switch until wiper 19 engages the test contact of the calling line. This test wiper will be marked by the presence of battery connected through the upper winding of relay LE. Relay A thereupon energizes, opens the circuit of the finder switch magnet FM at contact 53, and at contact 52 completes a circuit for relay H1. Relay H1 in turn operates and completes a circuit for relay H2 at contact 38, at contact 37 connects earth over wiper 19 to operate relay LE completely over its upper winding, whereupon relay LE disconnects the normal battery and earth connections from the calling line at contacts 14 and 16. Relay H1 at contact 40 opens the circuit of relay T which releases after its slow period. Relay H2 upon operating disconnects the upper winding of relay A from the test wiper at contact 42 and at contacts 41 and 47 connects relay A across the speaking conductors so that relay A is maintained operated over the calling loop.

At contact 43 relay H2 completes a circuit for the dial tone start relay SD as follows:—earth, contacts 43, 81 and 89, upper winding of relay CON, contact 66, wiper 109 in its home position, winding of relay SD to battery—relay CON does not operate in this circuit owing to its comparatively low resistance. At contact 97 relay SD completes a circuit for relay BD in series with re-

sistance 95. Relay BD operates and short-circuits its winding at contact 96 whereupon it again releases, relay BD consequently operates intermittently and dial tone is fed to the calling subscriber over wiper 108, contacts 93 and 71, lower winding of relay I, condenser 72, contact 47 and thence over lower speaking conductor to the calling substation. The calling subscriber upon hearing the dial tone will dial the number of the wanted subscriber. This number may comprise either one, two or three digits. In the case of a one digit number the digits range from 1-8; in the case of a two digit number the first digit is 9 and in response to the dialling of this digit the wipers of the connector switch are stepped to a dead position and are again stepped in response to the second digit to the line of the wanted subscriber, this second digit may be any of digits 1-9; in the case of a three digit number the wipers of the connector switch are stepped to a dead position in response to the first digit 9, and are stepped to a second dead position in response to the second digit which is 0, the wipers are then stepped in response to the third digit to the line of the wanted subscriber, this third digit may be any of digits 1-5. It will be seen therefore that the range of numbers available is 1-8, 91-99, and 901-905; the home position and position 9 and 19 are left dead, so that on a 25 point rotary switch 23 lines are available.

It will be assumed that the number dialled in the present instance is a single-digit number. In response to the train of impulses transmitted by the calling subscriber relay A de-energizes intermittently, and a circuit is thereby completed from earth over contacts 53, 45, 94 and 103 to the connector magnet CM. The connector magnet is thereby energized intermittently and steps the wipers on to the line of the wanted subscriber. Relay H1 which is made slow to release by resistance 39 shunted across its winding remains energized throughout the impulse series and maintains relay H2 energized. Relay I energizes on the first impulse in parallel with the magnet CM, and short-circuits its lower winding at contact 70 thus rendering itself slow to release so that it remains energized throughout the impulse train. At contact 67 relay BB is connected to the test wiper 109.

If the wanted line is busy, relay BB energizes in series with earth encountered by the test wiper and when relay I releases shortly after the end of the impulse train, relay BB locks energized in the following circuit: battery, winding of relay BB, contacts 68, 90, 81 and 43 to earth. Relay BB completes a circuit for the ring and busy tone start relay SR as follows:—battery, winding of relay SR, contacts 80 and 88 to earth; relay SR in turn completes a circuit for relay BD which thereupon operates intermittently to feed busy tone current over contacts 49 and 57. At contact 87 relay SR completes a circuit for relay T1 over contacts 51 and 61. Relay T1 operates, at contact 64 completes a circuit for relay T2 and at contact 63 completes a circuit for the relay T3 extending over contacts 59 and 50. Relays T2 and T3 thereupon operate and relay T3 completes a locking circuit for itself at contact 58, at contact 60 prepares a circuit for relay T4 and at contact 61 opens the initial energizing circuit of relay T1. After its slow period relay T1 releases, opens the circuit of relay T2 at contact 64 and prepares a circuit for relay T4 at contact 65. After its slow period relay T2 releases and at contact 62 completes the circuit for relay T4. Relay T4 operates

and at contact 50 opens the locking circuit of relay T3 which after its slow period releases and at contact 60 opens the circuit of relay T4. After its slow period relay T4 releases and at armature 51 again completes the original circuit of relay T1, whereupon the cycle of the interrupter relays is again started. The cycle is made up as follows:—

(1) The operation of relays T1, T2 and T3 in turn, whereupon contact 57 is closed.

(2) The slow release of relays T1 and T2 in turn, whereupon contact 57 is opened.

(3) The operation of relay T4 whereupon contact 49 is closed.

(4) The slow release of relays T3 and T4 in turn, whereupon contact 49 is opened.

When contact 49 or contact 57 is closed busy tone is fed over contacts 92 and 71, lower winding of relay I, condenser 72, contact 47, and thence over the lower speaking conductor to the calling subscriber.

The calling subscriber hearing the busy tone will replace his handset whereupon the calling loop is broken and relay A releases. The circuit of relay H1 is thereupon opened at contact 52 and relay H1 releases, at contact 38 opens the circuit of relay H2 which in turn releases and at contact 43 opens the locking circuit of relay BB; upon the release of relay H2 a homing circuit is completed for the connector switch magnet as follows:—earth, contacts 53, 46, 104, commoned bank contacts and wiper 110, interrupter contact 105, winding of magnet CM to battery. Magnet CM thereupon energizes and steps the wipers until they reach the home position whereupon wiper 110 leaves the commoned bank contacts and thereby opens the homing circuit. Relay BB upon releasing opens the circuit of relay SR at contact 88 and the tone equipment restores.

If, however, the wanted line is idle, wiper 109 will encounter battery through the upper winding of line relay of the called subscriber, and relay CON will operate over its upper winding in the following circuit: earth, contacts 43, 81 and 89, upper winding of relay CON, contact 68, wiper 109, test contact of called line to battery through the upper winding of called subscriber's line relay. Relay CON upon operating locks up over its lower winding in the following circuit:—earth, contacts 44 and 101, lower winding of relay CON, bank commoning, wiper 110, contact 105, winding of magnet CM to battery. Magnet CM will not operate in this circuit owing to the relatively high resistance of the lower winding of the relay CON. At contact 99 relay CON completes a circuit for the start relay SR which causes the interrupter relays T1, T2, T3 and T4 to operate in a manner previously described. At the same time a circuit is completed over contact 87 for the pole changing relay PC over contact 31. Relay PC on operating disconnects its energizing circuit and connects earth to the lower terminal of the left-hand winding of the ringing transformer. A circuit is thereby closed through the winding 34 and a current is induced in the secondary winding 35. After its slow period relay PC releases and the initial circuit is again completed; in this way the current in the primary winding 34 is intermittently interrupted and alternating current is thereby induced in the secondary winding 35. Once in every cycle of the interrupter relays T1—T4, contact 55 is opened and contact 56 is closed, the upper winding of relay RT is thereby transferred periodically from battery fed through resistance 54 to battery fed through the second-

any winding 35 in which alternating current is being induced. Ringing current is thereby fed through the upper winding of relay RT, contacts 84 and 102, wiper 108, over the called line through the called subscriber's condenser and bell and thence back over the upper speaking conductor, wiper 107, contacts 98 and 78 to earth.

It will be noted that contact 56 is closed once in every cycle of the interrupter relays and consequently the interval between each connection of ringing current is twice that of the interval between each connection of busy tone.

When the called subscriber replies a direct current loop is placed across the called line and relay RT thereupon operates in the following circuit: battery, resistance 54, contact 55, upper winding of relay RT, contacts 84 and 102, wiper 108 and bank contact, called loop, bank contact and wiper 107, contacts 98 and 78 to earth. Relay RT locks up over its lower winding and contacts 82 and 44 to earth, at contact 80 it disconnects relay SR to cause the tone circuit to restore to normal, at contacts 79 and 83 the speaking circuit between the calling and called lines is completed and conversation can now take place, talking battery being supplied to the substations of both subscribers through the windings of relay A. Relay A is maintained operated as long as either subscriber maintains his receiver off the cradle switch, but when both subscribers have hung up relay A releases and the connector switch restores to normal in the manner previously described; in addition, contact 44 is opened upon the release of relay H2 whereupon relays RT and CON also release.

When a subscriber is to be provided with priority service, so that he can extend connections to lines even if they are busy, the contact associated with his line in the bank engaged by wiper 20 of the finder switch is connected to earth by connecting together terminals X' and Y' and at the same time terminals X and Y in the link circuit are connected together. When the subscriber in question makes a call and the called line tests busy, relay BB operates in a manner previously described. In the present case however a circuit is completed from earth connected over terminals Y' and X', wiper 20, terminals X and Y, contacts 69 and 91, and lower winding of relay RT to battery. Relay RT thereupon operates, locks operated over contact 82 and at contacts 77 and 85 completes a speaking circuit from calling line through the speaking condensers 106 and 112 to the busy line so that the calling subscriber can attract the attention of the wanted subscriber.

If the automatic exchange is to be used in conjunction with a manual board for establishing connection with a public exchange the lines of subscribers to be provided with the facility of obtaining calls to the public exchange are connected to the private automatic exchange over cut-off jacks on the manual board. Associated with each cut-off jack is a call lamp such as the lamp 13 shown in the drawing which is connected to the bank engaged by wiper 20 of the finder switch by connecting terminals X' and Z' together, whilst in the link circuits contacts X and Z are connected together. To obtain connection with a subscriber at the public exchange the subscriber at the private automatic exchange dials the digit 1 whereupon the wipers of the connector switch are stepped into engagement with the first set of bank contacts. The first contact engaged by wiper 109 is connected to battery so as to cause relay CON to operate in the manner described for

an idle line. When relay CON operates, a circuit is completed over contact 98 as follows: earth, contacts 78, 98, wiper 107 and first bank contact, terminals Z and X, wiper 20 and bank contact, terminals X' and Z', called lamp 13 to battery. The attendant at the manual board perceiving the lighted lamp will plug into the associated cut-off jack to disconnect the line of the calling subscriber from the private automatic exchange; the desired connection can then be completed over the cord circuit at the manual board.

The relays and switches employed are preferably mounted on an iron framework so that the switchboard can be assembled and tested before fixing it in the wooden cabinet. In addition to facilitating assembly and testing this has the advantage that the framework is fitted into the wooden cabinet as a final operation so that any unnecessary handling and possible scratching of the finely finished cabinet is avoided.

What I claim as new and desire to secure by Letters Patent is:—

1. In a telephone system, a group of finder switches, a start circuit normally extending to all of said finder switches, and means for opening said start circuit during the time when one of said finder switches is in hunting condition.

2. In a telephone system, a group of finder switches having access to a plurality of lines, a start circuit normally extending through all of said finder switches in series, a relay in each finder switch operated during the hunting movement of the associated finder, and normally closed contacts on each relay included in said start circuit.

3. In a telephone system, a group of finder switches having access to a plurality of lines, a start circuit, a relay in each finder switch normally connected to said start circuit, and means for disconnecting the relays in idle finder switches from said start circuit while a finder switch in the group is hunting for a calling line.

4. In a telephone system, subscribers' lines, a link circuit comprising a finder and a connector for establishing telephone connections between said lines, and means including a circuit extending through an off normal contact of said connector for preventing the operation of said finder during the time that said connector is off-normal.

5. In a telephone system, subscribers' lines, a link circuit comprising a finder and a connector for establishing telephone connections between said lines, a start relay in said finder for initiating the operation of said finder, and a circuit for said relay including a wiper and normal bank contact of said connector whereby said finder is rendered inoperative while said connector is off-normal.

6. In a telephone system having special service facilities, subscribers' lines part of which are entitled to special services, finder switches having access to all of said lines, means for marking the lines entitled to special services in the banks of said finders, and means for automatically preparing the special service facilities when one of said finders connects with a line entitled to such special services.

7. In a telephone system, two classes of subscribers' lines, finder switches having access to all of said lines, means including one of said finders and other switching apparatus controlled by a calling subscriber for extending a connection to a desired called line, and means effective only if the calling line is of a particular class for

automatically completing a talking connection to the called line in case it is found busy.

8. In a telephone system, subscribers' lines, a finder switch having access to said lines, means responsive to the initiation of a call over one of said lines for starting said finder switch to hunt for the calling line, a relay in said finder operated when the calling line is connected with to stop the switch, and means for thereafter controlling said relay over the calling line by digit impulses to complete the desired connection.

9. In a telephone system, subscribers' lines, automatic switching apparatus for establishing telephone connections between said lines, means for signalling an idle line when connected with, a relay operated when the called party answers to complete a talking connection between the calling and called lines, and means for operating said relay to disable said signalling means and to complete a talking connection to the called line in case the line is busy when connected with.

10. In a telephone system, two classes of subscribers' lines, automatic switching apparatus controlled over a calling line for extending a connection to a desired called line and to signal said line if idle, a ring-cut-off relay operated to

complete the connection when the called party answers, and means for automatically operating said relay to complete an auxiliary talking connection to a busy line in case the calling line is of a particular class.

11. In a telephone system, two classes of subscribers' lines, a finder-connector link for establishing telephone connections between said lines, a relay in said link circuit, a circuit for said relay completed over a wiper of said finder switch in case the calling line is of a particular one of said classes and the called line is busy, and means controlled by said relay for completing a talking connection to the busy called line.

12. In a telephone system, an exchange in which telephone connections are established between subscribers' lines by means of a finder-connector link, an attendant's cabinet associated therewith for extending connections to other exchanges, a signal at said attendant's cabinet for each line entitled to outgoing calls, and a circuit for the signal of a calling line completed over a wiper of said finder switch engaging the calling line and a wiper of the connector switch when operated to a particular position.

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