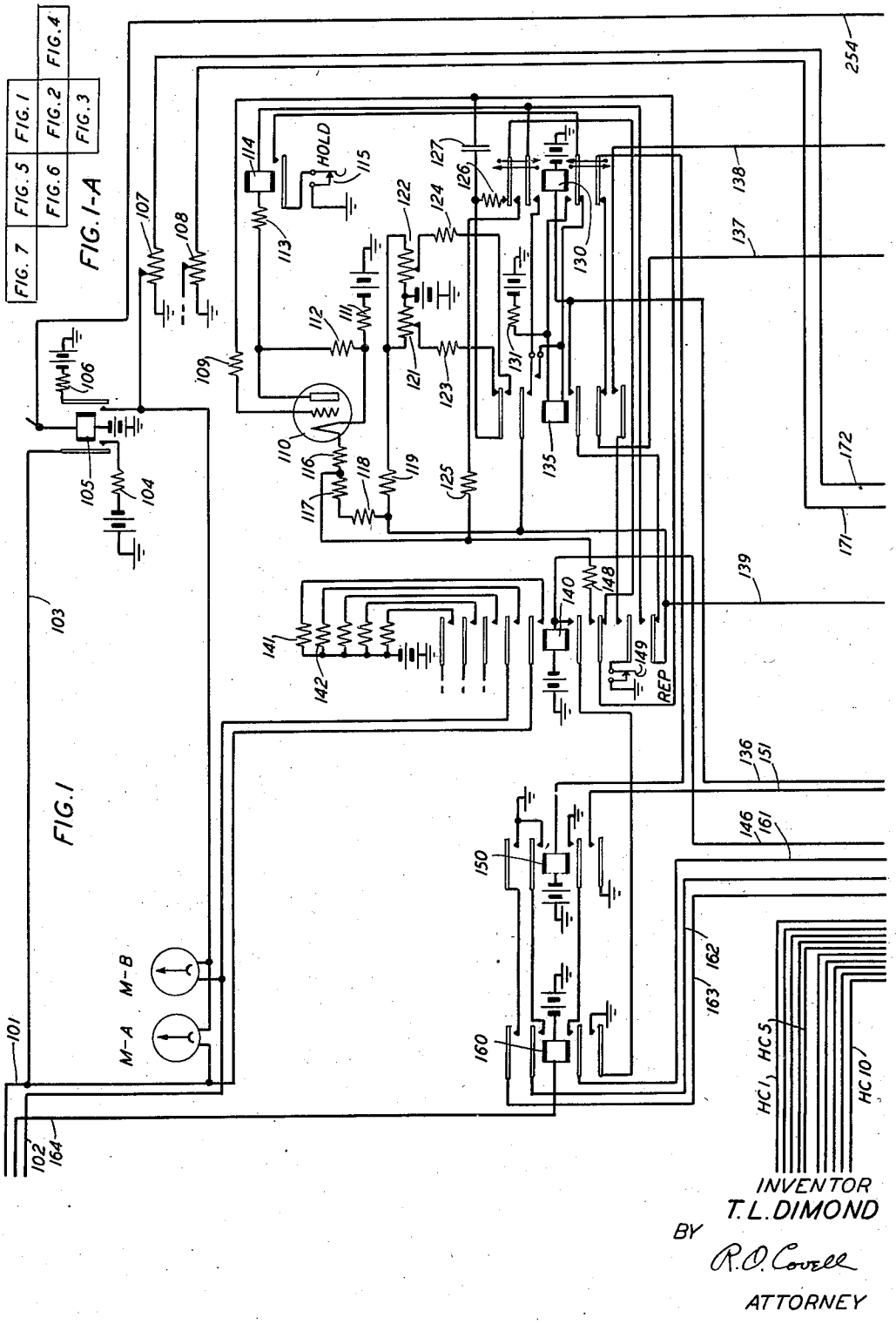
June 19, 1945. T. L. DIMOND 2,378,541

TRAFFIC OBSERVING APPARATUS

Filed Oct. 22, 1942 7 Sheets-Sheet 1



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TRAFFIC OBSERVING APPARATUS

Filed Oct. 22, 1942 7 Sheets-Sheet 2

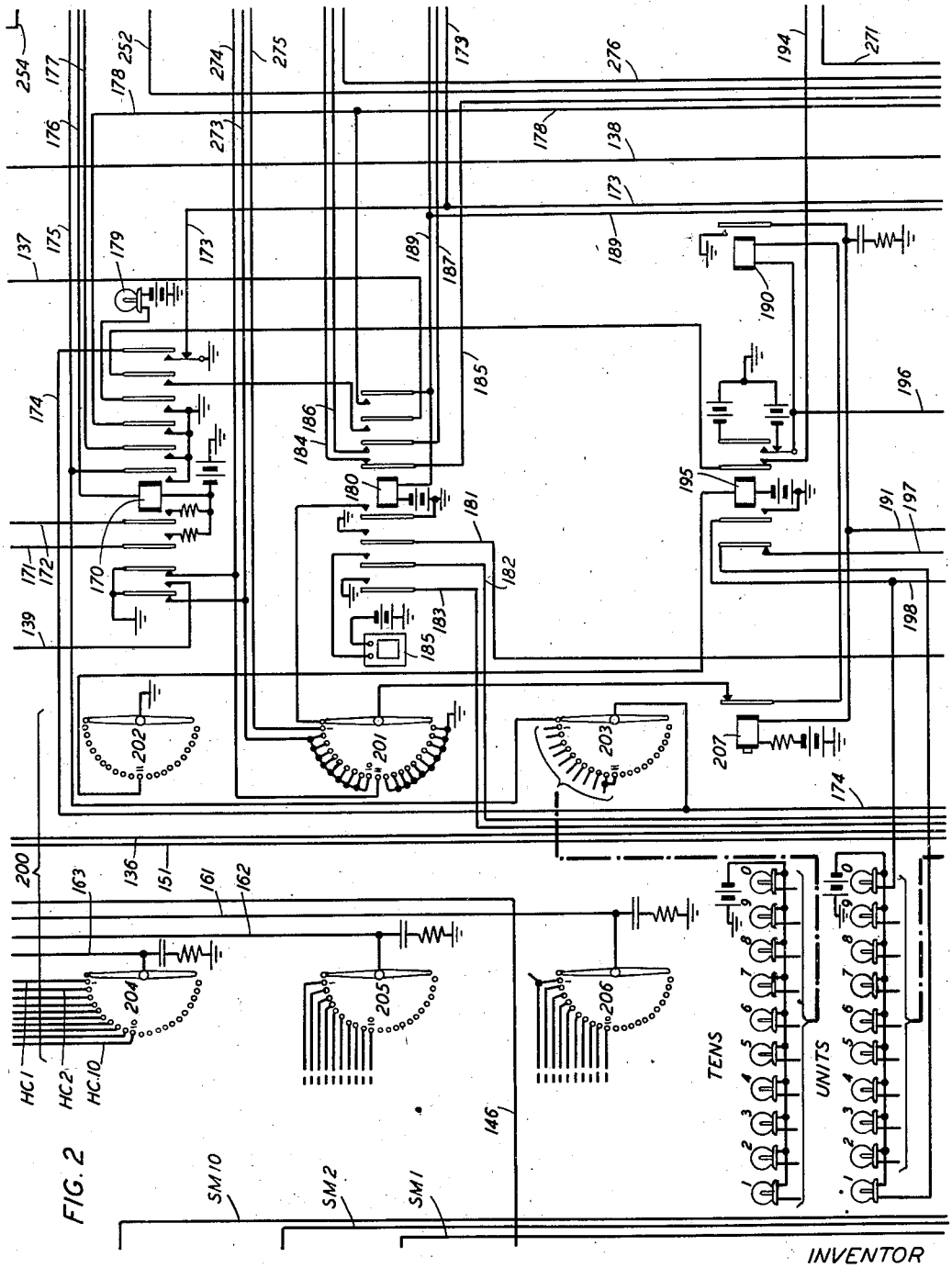

FIG. 2

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TRAFFIC OBSERVING APPARATUS

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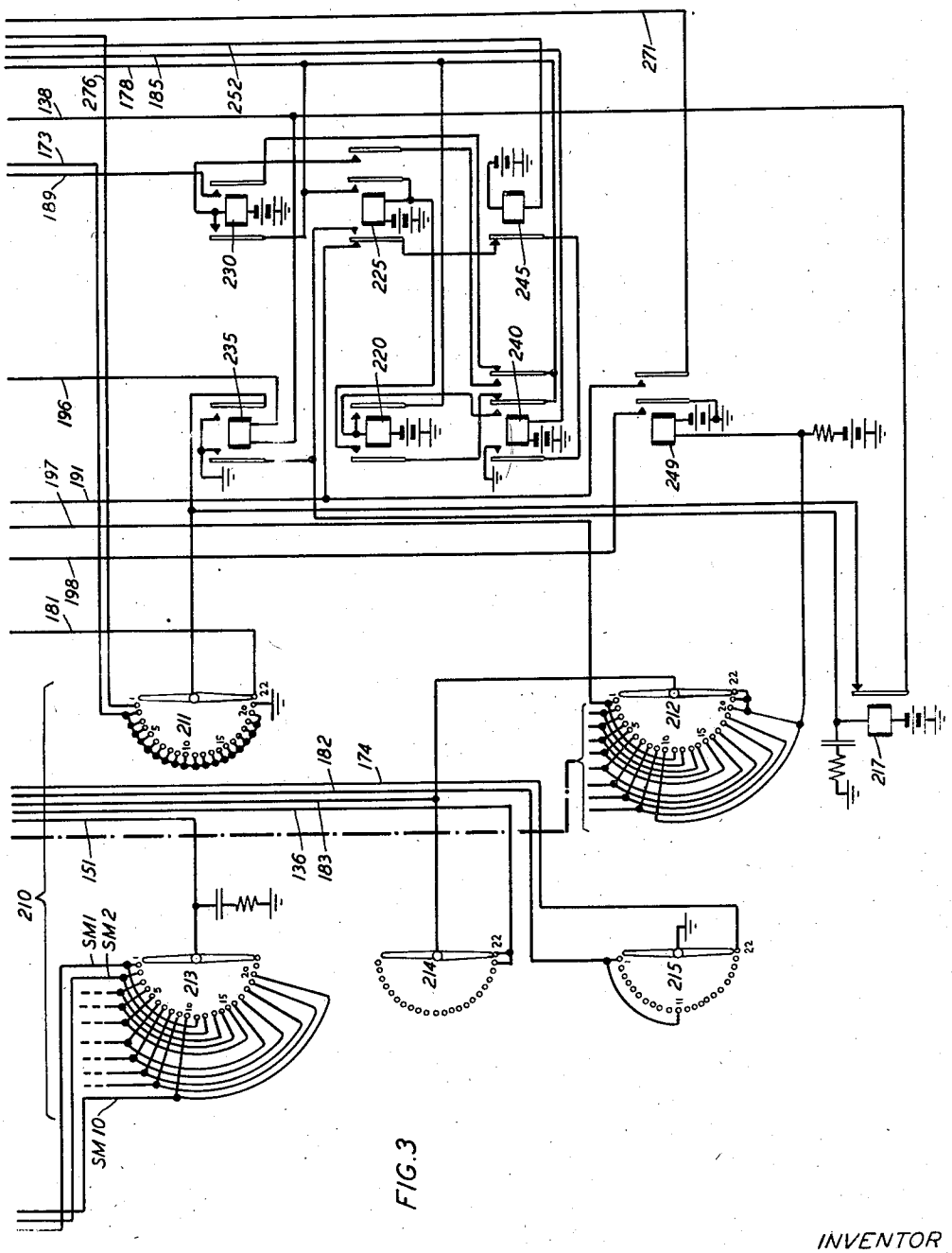

FIG. 3

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TRAFFIC OBSERVING APPARATUS

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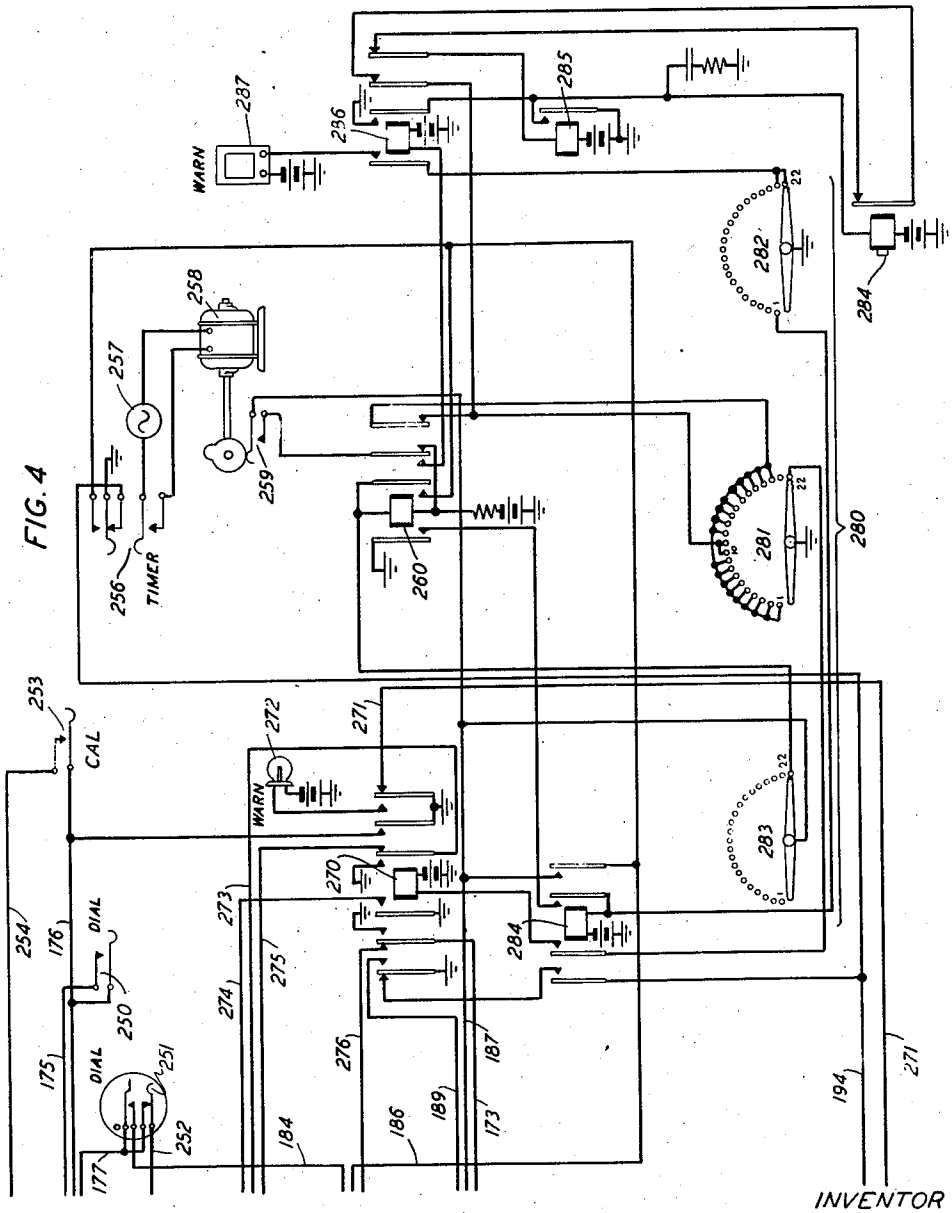

FIG. 4

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TRAFFIC OBSERVING APPARATUS

Filed Oct. 22, 1942 7 Sheets-Sheet 5

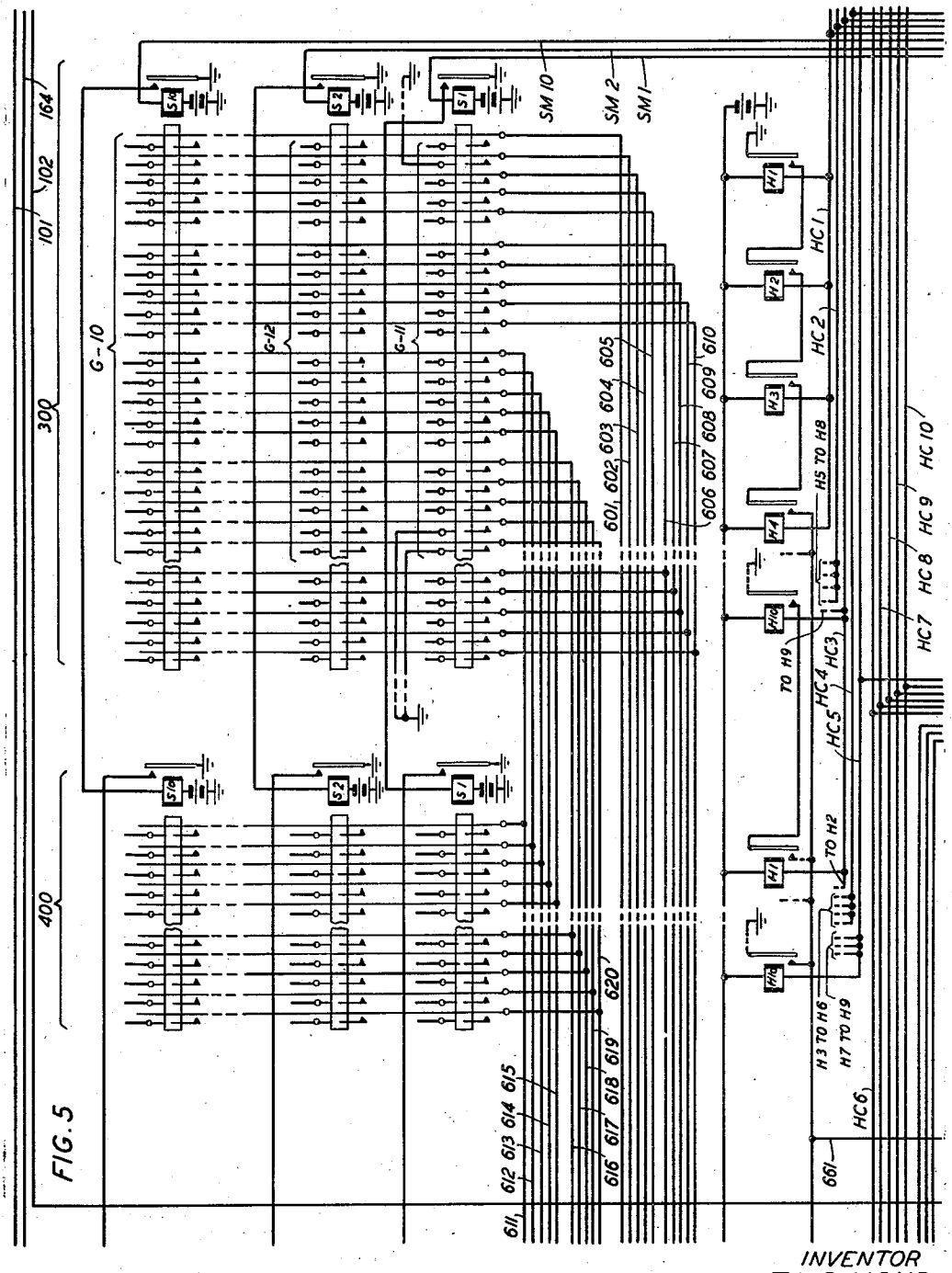

FIG. 5

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TRAFFIC OBSERVING APPARATUS

Filed Oct. 22, 1942 7 Sheets-Sheet 6

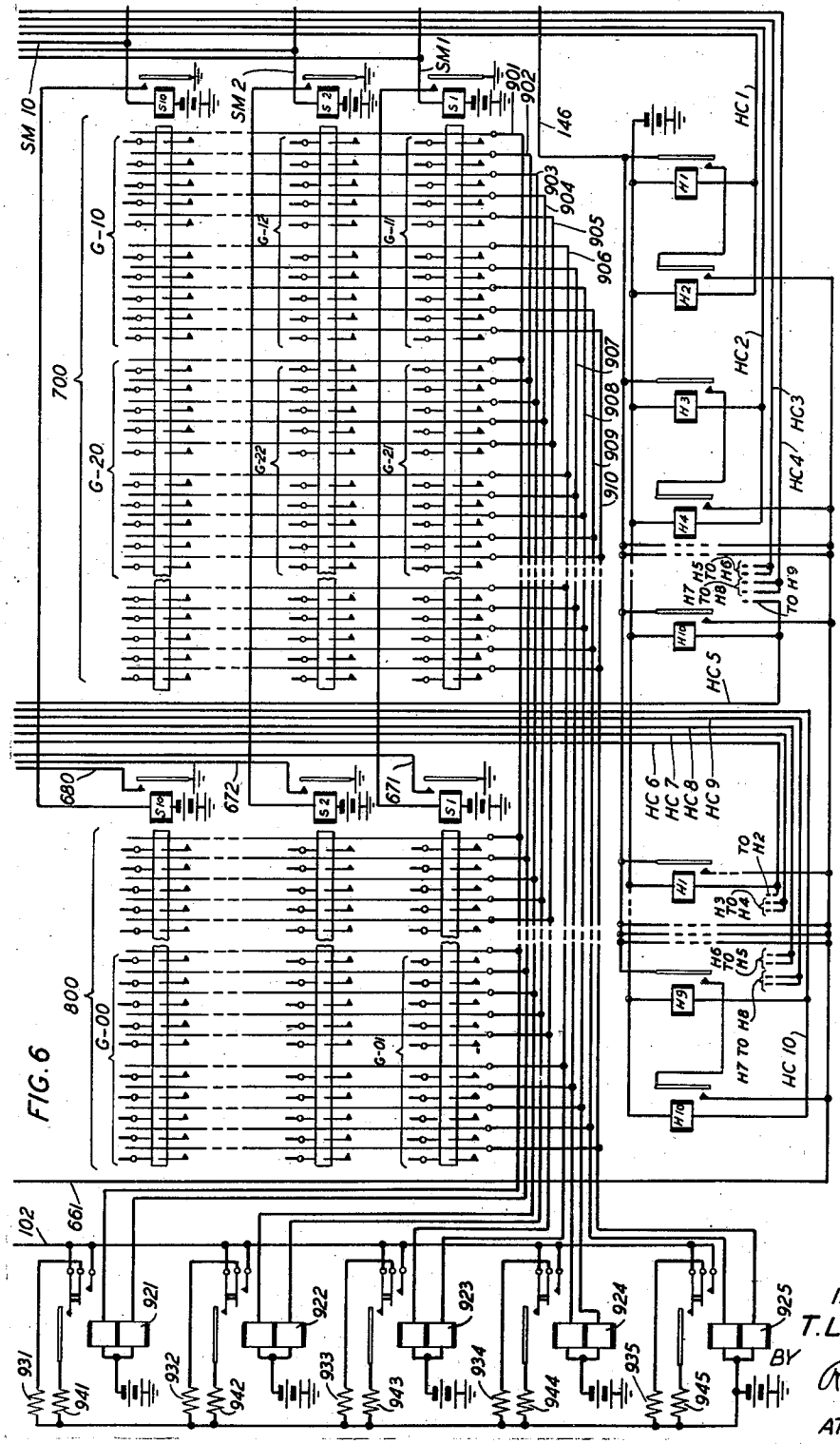

FIG. 6

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TRAFFIC OBSERVING APPARATUS

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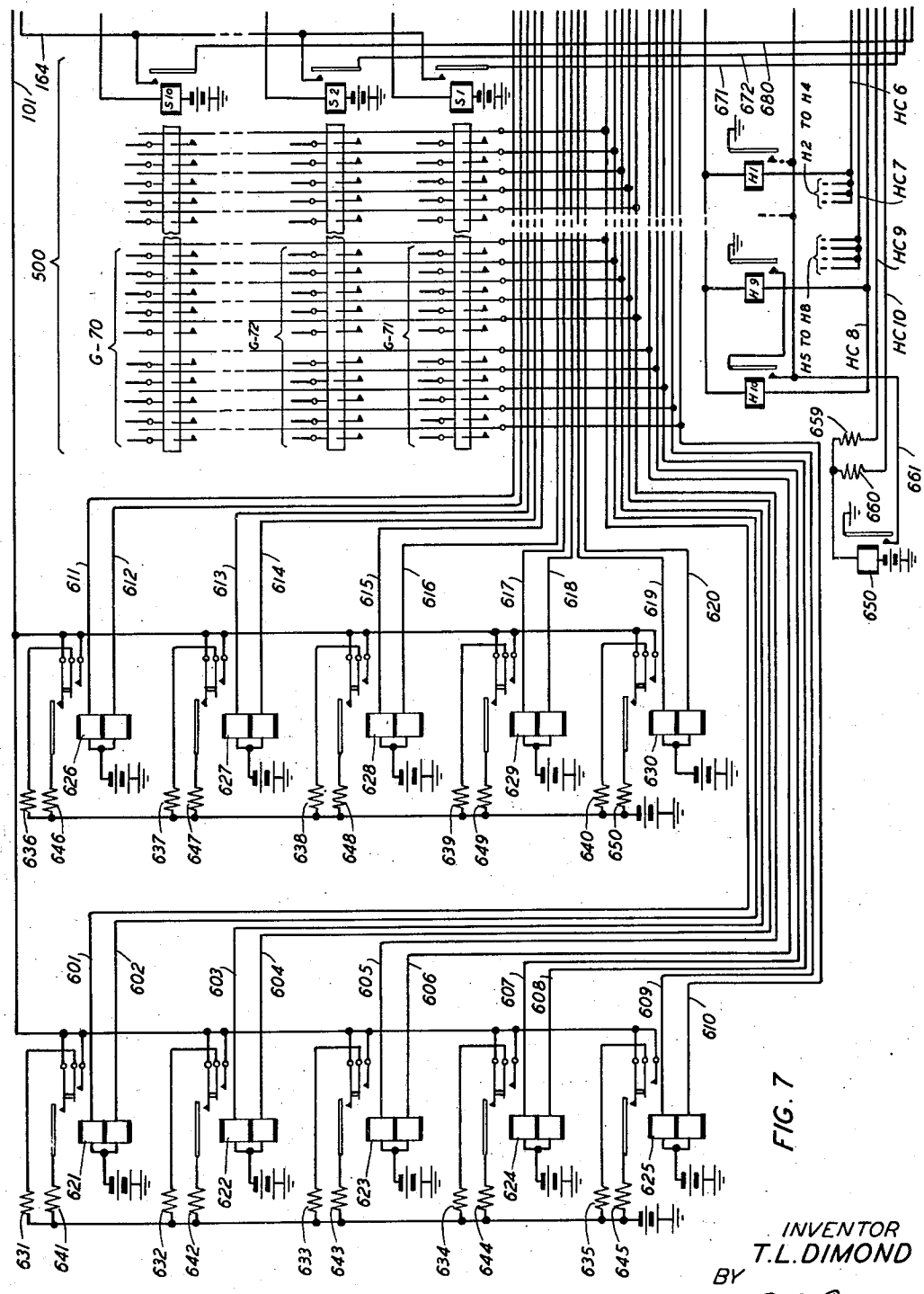

FIG. 7

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Patented June 19, 1945 2,378,541

UNITED STATES PATENT OFFICE

2,378,541

TRAFFIC OBSERVING APPARATUS

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Application October 22, 1942, Serial No. 462,930

18 Claims. (Cl. 179—8)

This invention relates to traffic registers and particularly to traffic registering apparatus in telephone systems.

Objects of the invention are an increase in the efficiency and flexibility of traffic registering apparatus and the provision of means for indicating at frequent intervals the number of trunks busy in each of the trunk groups in a telephone office having a large number of trunk groups, and particularly in an automatic telephone system.

It is known to provide apparatus for successively testing each of the trunks in a plurality of trunk groups and for registering either the number of trunks which are busy or the percentage of the trunks which are busy, in each group. Such arrangements are, however, inadequate to obtain traffic data including the number of trunks busy in each of a large number of groups at frequent intervals, such as is necessary in an automatic telephone office comprising many groups of line finders, selectors, connectors, repeaters, and other trunk circuits.

This invention is a trunk group usage apparatus arranged to successively test a different plurality of groups of trunks simultaneously and give separate indications of the number of trunks that are busy in each of the simultaneously tested groups, to indicate the particular plurality of groups being tested, to repeat the test of all trunk groups at frequent intervals, to automatically select any particular plurality of trunk groups which the observer wishes to test or on which it is desired to start the successive test of different pluralities of trunk groups, to block the further operation if the switching means for connecting the trunks for test fails to connect all of the groups which are to be tested simultaneously, and to make repeated tests of a single group. These and other features of the invention are embodied in the trunk group usage circuit shown schematically on the drawings which form a part of this specification.

Referring to the drawings which consist of seven sheets:

Figs. 1 to 4 represent traffic observing apparatus comprising two observers' stations A and B, switching means for selecting the groups to be tested, and means for indicating the groups under test;

Figs. 5, 6 and 7 show the busy register or test relays and the switches which are provided for connecting the test relays to the test conductors of groups of trunks; and

Fig. 1A shows the relative position in which Figs. 1 to 7 are to be placed to form an operative arrangement.

The apparatus shown in the drawings comprises two meters M—A and M—B calibrated to indicate the number of trunks which are busy in a trunk group under test, the trunks in two groups being tested simultaneously. Traffic observers A and B, one for each meter, record the successive indications for the various trunk groups. The number of observing meters provided depends upon the total number of trunk groups, one observer being able to record the indications of the number of trunks busy for about one hundred trunk groups in succession within a period of about four minutes. A group of busy register or test relays is provided for each traffic observer, and groups of crossbar switches are provided for connecting the test relays to the test conductors of groups of trunks, one group of switches for each group of relays. The number of test relays in the group for one observer depends on the number of trunks in the largest group to be tested simultaneously by the test relays in question; and the number of crossbar switches depends on the total number of trunks and total number of trunk groups in the office. In the arrangement shown, the group of test relays associated with meter M—A consists of ten two-step relays **621** to **630**, inclusive, arranged to simultaneously test a maximum of twenty trunks; and the group of test relays associated with meter M—B consists of five two-step relays **921** to **925**, inclusive, arranged to simultaneously test a maximum of ten trunks. Each of the test relays has two windings, each of these windings being connected to the sleeve conductor of a different one of the trunks in the particular group being tested, and successively to the sleeve conductor of a trunk in each of the groups, the busy indication for which is to be given to the observer with which the test relay in question is associated. If only one of the two trunks thus tested by one test relay is busy, one winding is energized to close one of the contacts; but if both of the trunks thus tested are busy, both windings are energized to close both contacts of the relay. The closing of each contact of a test relay connects a resistor in series with the winding of the observer's meter with which the relay is associated; so that the number of resistors connected in series with the meter upon test of each group of trunks depends upon the number of busy trunks in the group, and the meter is calibrated to indicate this number. In the arrangement shown in the drawings, the meter is calibrated to give a maximum reading of thirty so that not more than six hold magnets may be

connected in a parallel combination and a maximum of thirty trunks may be tested as a group. If the number of switches or trunks in a group exceeds thirty, the group is divided into subgroups which are separately tested and the readings for these subgroups are added to obtain the number of trunks busy in the entire group of switches or trunks.

Each of the crossbar switches 300, 400, 500, 700 and 800 provided for connecting the test conductors of the trunks to the windings of the register relays is a five-wire one-hundred point switch with ten vertical units and ten select magnets, numbered S1 to S10. Each vertical unit consists of ten contact groups of five contacts each and a hold magnet. The hold magnets, numbered H1 to H10, are connected in parallel combinations so that the operation of a select magnet of each switch associated with one observer and one parallel combination of hold magnets effects the connection of all the trunks in a group to the associated test relays. The switches 300, 400 and 500, associated with observer A, are arranged to connect eighty groups of trunks to the test relays 621 to 630. The first seventy of the eighty groups consist of twenty trunks each, and the last ten groups consist of only ten trunks each; and there are eight parallel combinations of hold magnets as follows: H1 to H4, inclusive, of switch 300; H5 to H8, inclusive, of switch 300; H9 and H10 of switch 300 together with H1 and H2 of switch 400; H3 to H6, inclusive, of switch 400; H7 to H10, inclusive, of switch 400; H1 to H4, inclusive, of switch 500; H5 to H8, inclusive, of switch 500; and H9 and H10 of switch 500. The switches 700 and 800 associated with observer B are arranged to connect one hundred groups of trunks to the register relays 921 to 925, inclusive, all groups consisting of ten trunks each; and the parallel combinations of hold magnets are as follows: H1 and H2 of switch 700, H3 and H4 of switch 700, H5 and H6 of switch 700, H7 and H8 of switch 700, H9 and H10 of switch 700, H1 and H2 of switch 800, etc. Thus one parallel combination of hold magnets for each observer is operated so as to test as many groups of trunks at one time as there are observers. The total number of hold magnets which may be thus connected in parallel is limited to fifteen hold magnets in the arrangement shown in the drawings so as to prevent excessive current through the contacts of relays 160 and 170. If the total number of trunks to be tested at one time for all observers exceeds seventy-five trunks, not more than fifteen of the hold magnets for the contacts connected to these trunks are connected to a thermal of the bank of brush 204, another fifteen may be connected to the corresponding terminal of the bank of brush 205, and another fifteen may be connected to the corresponding terminal of the bank of brush 206. Thus the group selecting arrangement provides for a maximum of two hundred and twenty-five trunks to be simultaneously tested, the number of observers depending upon the number of test relays associated with the meters of the various observers.

To control the successive operation of the select magnets and the parallel combinations of hold magnets, two rotary switches are provided. The switch 200 comprising brushes 201 to 206 and stepping magnet 207 is arranged to successively connect the parallel combinations of hold magnets for operation, one combination for each observer at a time. The switch 210 comprises brushes 211 to 215 and stepping magnet 217 is arranged to successively connect the select magnets of switches 300 and 700 for operation, the like designated select magnets of switches 400 and 800 being controlled by the select magnets of switches 300 and 700, and the like designated select magnets of switch 500 being controlled by the select magnets of switch 400. The rotary switches may be advanced under the control of the dial 251 to select any desired plurality of groups, one for each observer, for test, the number of the group which is being tested and for which a busy indication is given on each meter being indicated by the tens and units lamps which are connected to the terminals engaged by brushes 203 and 212, respectively. If the hold key 115 is operated, the test does not progress to the next group; and if the repeat key 149 is operated, the test of the selected group is repeated at intervals. If the hold key is not operated, the test begins with the group selected by dialing and the test progresses to each succeeding group; and if the timer key 256 is operated, the test of all groups is repeated once every five minutes. The order in which the trunk groups are selected by the rotary switches 200 and 210 for test is as follows: 11, 12, 13, 14, 15, 16, 17, 18, 19, 10, 21 to 20, 31 to 30, 41 to 40, 51 to 50, 61 to 60, 71 to 70, 81 to 80, 91 to 90 and 01 to 00. Various other features of this traffic observing apparatus are set forth in the following detailed description of the operations involved in obtaining desired traffic data.

Assume that the test of all trunk groups in the office is desired but that automatic repeating of the test is not desired. When the apparatus is normal, the brushes of switch 200 are in engagement with terminals 0 of the associated banks and the brushes of switch 210 are in engagement with terminals 22 of the associated banks. The operation of dial key 250 closes a circuit from ground through brush 215 and the engaged terminal 22 of switch 210, conductor 174, brush 203 and the engaged terminal 0 of switch 200, conductor 175, contact of key 250, conductor 176, and through the winding of start relay 170 to battery. Relay 170 operates and it locks under the sole control of key 250. The operation of relay 170 closes the circuit for lighting the pilot lamp 179 to indicate that the chief observer may dial the number of the first groups to be tested, disconnects ground from conductors 173, 273 and 274, connects ground to conductor 139 to energize the filament of gas-filled tube 110, connects ground to conductors 174, 175, 177 and 178, and connects battery to conductors 171 and 172. The connection of ground to conductor 177 effects the operation of the impulse relay 245 in series with the lower, impulse contact of dial 251. The chief operator now dials the digits 11 designating the first trunk group to be tested by the test relays of each observer. When the first digit 1 is dialed, a circuit is closed from grounded conductor 177, through the upper, off-normal contact of the dial 251, conductor 184, inner right back contact of relay 180, and conductor 185 for operatively energizing the winding of the dial-off-normal relay 240. The operation of relay 240 closes a circuit, including conductor 178, for operating relay 220, and relay 220 locks directly to conductor 178. As the dial 251 returns to normal, the impulse contact opens the circuit for energizing the winding of relay 245 as many times as there are units in the digit dialed. Thus the dialing of the digit 1 causes relay 245 to release and reoperate once. The release of relay 245 closes a circuit for operating stepping magnet 207 of

switch 200; and the reoperation of relay 245 causes the release of stepping magnet 207, thereby advancing the brushes 201 to 206 one step. With brush 203 in engagement with terminal 1, the tens lamp 1 is lighted since brush 203 is connected through conductor 174 to ground at a front contact of relay 170. When the dial reaches normal at the end of the first digit, relay 240 releases, thereby closing a circuit, including a front contact of relay 220, for operating relay 225. Relay 225 locks directly to grounded conductor 178. When the chief observer dials the units digit 1 of the number of the first trunk group to be tested, the closing of the off-normal contacts of the dial causes the reoperation of relay 240. The operation of relay 240 closes a circuit, including a front contact of relay 225, for operating relay 230, and relay 230 locks directly to conductor 178. When relay 245 releases in response to the impulse created by the dialing of the units digit 1, a circuit is closed from ground at the left front contact of relay 240, through the back contact of relay 245 and left front contact of relay 225 for operating stepping magnet 217 of switch 210. When relay 245 reoperates at the end of the impulse, the stepping magnet 217 releases, thereby advancing the brushes of switch 210 into engagement with terminal 1 of their respective banks of terminals. When the dial reaches normal, relay 240 releases, closing a circuit, through conductor 189 and a front contact of relay 230, for operating relay 180. Relay 180 locks to conductor 178; connects ground to conductor 183 thereby lighting the units lamp 1 in a circuit which includes brush 212 and terminal 1, conductor 197, and a back contact of relay 195; closes a circuit through brush 215 and terminal 1 and conductor 182 for operating the audible signal device 185 to indicate that test of the first group is about to begin; connects ground through conductor 181 to terminal 22 of bank 211; connects ground to terminal 0 of bank 201; disconnects the off-normal contact of the dial from the winding of relay 240; and closes a circuit from ground at the back contact of timer key 256, through conductor 194, a back contact of relay 195, a front contact of relay 170, a front contact of relay 180, conductor 137, a back contact of relay 135, a back contact of relay 130, through the winding of relay 150 to battery. Relay 150 operates thereby connecting ground, through conductor 151, to brush 213 of switch 210 to effect the operation of the select magnets S1 of crossbar switches 300, 400, 500, 700 and 800. With the S1 select magnets all operated, a check circuit is closed from ground at the front contact of select magnet S1 of switch 800, through conductor 671, the front contact of select magnet S1 of switch 500, conductor 164 and the winding of relay 160 to battery. Relay 160 operates, connecting ground, through conductors 161, 162 and 163, to brushes 204, 205 and 206 of switch 200 to effect the operation of the parallel combinations of hold magnets connected to the terminals engaged by these brushes. Thus with the brushes of switch 210 in position 1, hold magnets H1 to H4, inclusive, of switch 300 are actuated to connect the sleeve conductors of the trunks in group G11 of observer A, through conductors 601 to 620, inclusive, to the windings of test relays 621 to 630, inclusive; and hold magnets H1 and H2 of switch 700 are actuated to connect the sleeve conductors of the trunks in group G11 of observer B, through conductors 901 to 910, inclusive, to the windings of the test relays 921 to 925. The test relay windings thus connected to the sleeve conductors of busy trunks are operatively energized, both sets of contacts of each test relay being actuated if both windings are energized and only one set of contacts being actuated if only one winding is energized. If all of the hold magnets of the parallel combinations associated with the first group of trunks to be tested for each observer are operated, a check circuit is closed from ground at the front contact of hold magnet H1 of switch 300, in series with a front contact of each of hold magnets H2, H3 and H4 of switch 300, conductor 661, a front contact of each of hold magnets H2 and H1 of switch 700, conductor 146, and the winding of relay 140. Relay 140 operates, locks under the control of relay 160, connects resistor 141 in series with the winding of meter M—A so that a zero reading will be given if no trunks are busy in the group associated with observer A, and connects resistor 142 in series with meter M—B so that a zero reading will be given if no trunks are busy in the group associated with observer B. If there are busy trunks in the group connected to test relays 621 to 630, the winding of meter M—A is further energized in series with the actuated contacts of the test relays and the associated ones of resistors 631 to 650, so that meter M—A indicates the number of trunks busy in the trunk group being tested; and if there are busy trunks in the group connected to test relays 921 to 925, the winding of meter M—B is further energized in series with the actuated contacts of the test relays and the associated ones of resistors 931 to 935 and 941 to 945, so that meter M—B indicates the number of trunks busy in the group being tested. As shown in the drawings, three trunks in the group G11 associated with observer A are busy; ground being connected to conductor 602 to energize the lower winding of relay 621 and ground being connected to conductors 619 and 620 to energize both windings of relay 630. Thus resistors 641, 640 and 650 are connected in parallel with resistor 141 to energize meter M—A to give a reading of three trunks busy.

The aforementioned operation of relay 140 closes a circuit for starting the charging of condenser 127, which circuit is traced from battery through potentiometer 121 and its movable contact, resistor 123, upper back contact of relay 135, condenser 127, a front contact of relay 140, resistor 148, resistor 117, resistor 118, and conductor 139, to ground at a front contact of relay 170. The grid of tube 110 assumes the same potential as the plate of condenser 127 to which it is connected through resistor 109; and when condenser 127 starts charging, the grid is sufficiently negative with respect to the cathode to block the tube. After condenser 127 has charged to a certain percentage of the office battery voltage, the potential of the grid approaches that of the filament and the tube energizes, the current in the anode-cathode circuit being effective to operate relay 114. The operation of relay 114 closes a circuit, including the contact of key 115 and a back contact of relay 130, for operating relay 135. Relay 135 locks to conductor 139; transfers condenser 127 from potentiometer 121 to potentiometer 122; causes the release of relay 150; and closes a circuit from ground at the contact of repeat key 149, through a front contact of relay 140, a front contact of relay 135, conductor 138, winding of relay 235, conductor 196, through a back contact of relay 195, to battery. Relay 235 is thereby operatively energized, connecting ground to brush 211 and closing a circuit for operating stepping mag-

net 217. The release of relay 150 causes the release of the select magnets S1 and release of the hold magnets of switches 300 and 700 which were operated to test the first two groups of trunks, one for each observer. When these hold magnets and select magnets have released, relays 160 and 140 release, the test relays which were operated release, and the meters M—A and M—B restore to normal. The release of relay 140 causes the release of relay 235, and the release of relay 235 causes the release of stepping magnet 217 thereby advancing each of the brushes of switch 210 to terminal 2.

When brush 212 advances from terminal 1 to terminal 2, units lamp 1 is extinguished and lamp 2 is lighted. The release of relay 140 opens the anode-cathode circuit of tube 110, thereby causing the release of relay 114; effects the discharge of condenser 127 through resistor 126; and closes a circuit from ground at a front contact of relay 170, through conductor 139, lowermost back contact of relay 140, and inner lower front contact of relay 135, for operating relay 130. Relay 130 is slow in operating so that condenser 127 discharges and relay 114 releases before relay 130 operates. The operation of relay 130 again closes the anode-cathode circuit through the winding of relay 114; and closes a circuit for charging condenser 127, from battery through potentiometer 122 and its movable contact, resistor 124, a front contact of relay 135, condenser 127, a back contact of relay 140, a front contact of relay 130, resistor 125, resistor 117, resistor 118, and conductor 139 to ground at a front contact of relay 170. When the potential of the plate of condenser 127 which is connected to resistor 109 approaches that of the filament of tube 110, the tube breaks down and relay 114 reoperates. The operation of relay 114 causes the release of relay 135 by closing a short circuit, across the winding of relay 135, through the lower front contact of relay 130. The release of relay 135 opens the anode-cathode circuit releasing relay 114, transfers condenser 127 from potentiometer 122 to potentiometer 121, and opens the circuit for energizing relay 130. Relay 130 is slow in releasing, so that relay 114 releases before relay 130 releases, so as to prevent the immediate reoperation of relay 135. When relay 130 releases, condenser 127 discharges through resistor 126. With both of relays 130 and 135 normal, relay 150 reoperates, thereby reconnecting ground, through conductor 151, to brush 213 to effect the operation of select magnets S2 of the crossbar switches to which the trunk groups are connected. With all S2 select magnets operated, a check circuit is closed from ground at the front contact of select magnet S2 of switch 800, through conductor 672, front contact of select magnet S2 of switch 500, and conductor 164 for operating relay 160. Relay 160 again connects ground to brushes 204, 205 and 206 to effect the reoperation of hold magnets H1 to H4 of switch 300 and hold magnets H1 and H2 of switch 700. The twenty sleeve conductors of a trunk group G12 on switch 300 are thereby connected to test relays 621 to 630; and the ten sleeve conductors of a trunk group G12 on switch 700 are connected to test relays 921 to 925. With all of these hold magnets operated, the check circuit for operating relay 140 is again closed and meters M—A and M—B indicate the number of trunks busy in the groups tested. Relays 114, 130 and 135 and tube 110 are again effective to measure short intervals of time, the tube 110 and relay 135 controlling the length of the interval during which the meter circuits are closed and the tube 110 and relay 130 controlling the length of the interval during which the meter circuits are open before the test of the next group can begin. When relay 135 operates, relay 150 releases, relay 235 and stepping magnet 217 operate, the select and hold magnets which were operated release, relay 140 releases, the meters return to normal, relay 235 releases, and stepping magnet 217 releases, thereby advancing the brushes of switch 210 to terminal 3, all in the manner above described for advancing these brushes to terminal 2. When relay 130 operates, relay 135 releases; and when relay 130 releases, relay 150 reoperates to start another test.

It may be noted at this time that the measurement of the meter-closed and meter-open intervals by tube 110 and relays 130 and 135 is independent of the office voltage, because the potential of the filament and the potential of the grid at the end of a desired interval of time during which condenser 127 is charging are both proportional to the office battery voltage. By an adjustment of potentiometers 121 and 122, the measured intervals may be varied until the desired frequency of successive meter indications is obtained. The resistor 113 limits the anode-cathode current to prevent damage to the tube; and resistor 112 prevents the anode from attaining a potential while the anode-cathode circuit through relay 113 is open which might cause immediate operation of the tube upon reclosure of this circuit.

The above-described cycle of operations is repeated to test additional groups, switch 210 being advanced one step after each test; so that the select magnets S3, S4, S5, S6, S7, S8, S9 and S10 of all crossbar switches are successively operated simultaneously with hold magnets H1 to H4 of switch 300 and hold magnets H1 and H2 of switch 700, thereby successively connecting the sleeve conductors of groups G13 to G10 to the test relays.

When the brushes of switch 210 are advanced to terminal 10 to operate select magnets S10 for test of groups G10, relay 249 is operated. The operation of relay 249 closes a circuit for energizing stepping magnet 207 and closes a circuit for lighting the units lamp 0. After the test of groups G10 has been completed, the brushes of switch 210 are advanced to terminals 11 to again operate select magnets S1. Relay 249 releases when the brushes of switch 210 advance to terminal 11, causing the release of stepping magnet 207 and thereby advancing the brushes of switch 200 to terminal 2 to select the second group of parallel combinations of hold magnets. The operation of select magnets S1 and the operation of hold magnets H5 to H8, inclusive, of switch 300 and hold magnets H3 and H4 of switch 700 connect the test conductors of trunk groups G21 to the two sets of test relays. At the end of the test, the brushes of switch 210 are advanced to terminals 12 and select magnets S2 are operated in combination with the same parallel combinations of hold magnets to connect trunk groups G22 for test. Thus groups G21 to G20 are tested successively, switch 210 being advanced one step after test of each group. Relay 249 is again operated when the brushes of switch 210 reach position 20 and remains operated while switch 210 is being advanced to position 1; and the operation of relay 249 again closes the circuit for operating stepping magnet 207. When the brushes of switch 210 are advanced to terminals 21 after the test of groups

G20 is completed, relay 235 is operated in a circuit including the back contact of stepping magnet 217, brush 211 and terminal 21, to ground. The operation of relay 235 causes the operation of stepping magnet 217; the operation of stepping magnet 217 causes the release of relay 235; and the release of relay 235 causes the release of stepping magnet 217 to advance the brushes of switch 210 to position 22. Advance of the brushes of switch 210 from position 22 to position 1 is effected in like manner, except that the circuit for operating relay 235 is traced through terminal 22 of the bank associated with brush 211 and through conductor 181, to ground at a front contact of relay 180. When the brushes of switch 210 advance to position 1, relay 249 releases causing the release of stepping magnet 207 to advance the brushes of switch 200 to position 3, in which position the third group of parallel combinations of hold magnets is connected for operation. Thus switch 200 is advanced one step each time switch 210 is advanced to position 11 or to position 1 to connect another group of parallel combinations of hold magnets for operation. Each time the brushes of switch 210 are advanced to position 1 or position 11 to start another ten readings, the audible signal device 185 is operated to aid the observers in making a correct record of the meter readings with respect to the trunk group numbers on the recording form. During each test by the test relays of each observer, the number of the trunk groups being tested is indicated by the tens and units lamps, the corresponding tens and units lamps being lighted successively in circuits which include brushes 203 and 212, respectively. When the brushes of switch 200 are advanced to position 11, relay 195 operates preventing the further operation of relay 150 and the further advance of switches 200 and 210. While relay 195 is operated the 0 tens and 0 units lamps are energized, terminals 10 and 11 of the bank of brush 203 being strapped together.

Since one observer may have more groups to test than another, and a correct reading is given only when relay 140 is operated by the closing of the check circuit, an omitted reading relay 650 is provided and is connected through a resistor such as either of resistors 659 and 660 to take the place of a parallel combination of hold magnets which would be operated for each of a group of ten readings. In the arrangement shown, observer B observes 100 groups and observer A observes only 80 groups, and the low resistance relay 650 is operated through resistor 659 when groups G91 to G90 are being tested for observer B and is operated through resistor 660 when groups G81 to G00 are being tested for observer B. In either case the operation of relay 650 completes the check circuit for operating relay 140.

If the dial key 250 is released either before or after all groups have been tested, relay 170 releases, thereby causing the release of all operated relays and crossbar switch magnets. The release of relay 170 also closes a circuit, including brush 201, and the associated terminals, including terminal 11, for repeatedly energizing relay 190 to effect the repeated operation and release of stepping magnet 207 and thereby advance the brushes of switch 200 to normal. The release of relay 170 also closes a circuit, including brush 211 and the associated terminals, for repeatedly energizing relay 235 to effect the repeated operation and release of stepping magnet 217 and thereby advance the brushes of switch 210 to normal.

If the hold key 115 is operated before a number is dialed or any time after test has started, the meters M—A and M—B give a continuous indication of the number of trunks which are busy in the particular groups then being tested. If the hold key is restored to normal, relay 135 may operate and test of the succeeding groups proceeds. If the hold key is restored to effect advance to the next group and then reoperated, a continuous indication of the next groups tested is given by the meters.

If the repeat key 145 is operated before a number is dialed or any time after test has started, the switches 200 and 210 do not advance; and test of the same groups, one for each observer, is repeated under the control of timing relays 130 and 135. If the hold key 115 is also operated, the operation of the timing relays is stopped and the meters M—A and M—B give a continuous reading.

In case the repeated test of all groups of trunks is desired, the timer key 256 is actuated prior to operation of the dial key 250, and ground is thereby disconnected from conductor 194 to place the operation of relay 150 under the control of relays 284 and 270. The operation of key 256 connects ground to conductor 186 and closes a circuit for operating the timer motor 258 to effect the closure of interrupter contacts 259 for two seconds, at intervals of fifteen seconds. After two digits have been dialed by the chief observer and switches 200 and 210 have selected the groups of select and hold magnets which are associated with the first groups of trunks which it is desired to test, the operation of relay 180 connects ground at the front contact of timer key 256, through conductor 186, a front contact of relay 180, conductor 187, brush 283 of timer switch 280 and the normally engaged terminal 22, to the winding of relay 260. If the interrupter contact 259 is closed when relay 180 operates, the winding of relay 260 is short-circuited by this contact. If the interrupter contact 259 is open when relay 180 operates, or as soon thereafter as this contact is open, relay 260 operates. Relay 260 locks under control of key 256, and transfers the interrupter contact to the winding of relay 286. When contact 259 is next closed, relay 286 operates, closing a circuit for operating stepping magnet 284 and closing a circuit for operating the audible signal device 287, so that the observer will be prepared to take readings. When contact 259 next opens, relay 286 releases, causing the release of stepping magnet 284 to advance brushes 281, 282 and 283 to terminal 1 of their respective banks. With brush 282 in engagement with terminal 1, a circuit is closed for operating relay 284. Relay 284 locks under control of relay 260, connects the winding of relay 270 to terminal 22 of bank 281, connects ground at key 256 to conductor 187, and connects ground to conductor 194 to effect the operation of relay 150; whereupon testing and reading of the meters start as hereinbefore described. While the tests are proceeding, each closure and opening of interrupter contact 259 causes the successive operation and release of relay 286 and stepping magnet 284; whereby the brushes of switch 280 are advanced one step every fifteen seconds. When the brushes of the switch 280 reach position 10, relay 285 is operated in a circuit through terminals 10 and brush 281, the operation of relay 285 causing the operation of stepping magnet 284. The opera-

tion of stepping magnet 284 causes the release of relay 285; and the release of relay 285 causes the release of stepping magnet 284, thereby advancing the brushes to position 11. Relay 285 immediately reoperates, thereby causing the advance of the brushes to position 12 in the same manner as that in which the brushes were advanced from position 10 to position 11, without waiting for the closure of interrupter contact 259. The brushes are advanced from position 12 to position 21 under control of interrupter contact 259 and relay 286. When position 21 is reached, the operation of relay 286 also effects the operation of the audible signal device 287 to warn the observers that an interval of four and three-quarter minutes has elapsed since the test started. When the brushes are advanced to terminal 22 by the release of relay 286, relay 270 operates connecting ground to conductors 173, 273 and 274 and lighting the warning lamp 272. The connection of ground to conductor 273 causes the repeated operation and release of relay 190 and stepping magnet 207 to effect the advance of the brushes of switch 200 to terminal 11, if not already advanced to this terminal; the connection of ground to conductor 274 effects the operation of relay 190 and stepping magnet 207 to advance the brushes to terminal 12; the repeated operation of relay 190 through brush 201 and terminals 12 to 21, inclusive, effects the advance of the brushes of switch 200 to normal; and the connection of ground to conductor 173 causes the repeated operation of relay 235 to effect the advance of the brushes of switch 210 to normal. The operation of relay 270 also disconnects ground from conductor 194 to prevent further testing, holds relay 170 to render the operation of the dial ineffective to step switches 200 and 210, and disconnects ground from conductor 271 to prevent the operation of relay 249 from interfering with the advance of switch 200 to normal. If relay 270 is operated without the observer having operated the dial to select the first groups for testing, the operation of relay 270 also causes the operation of relay 180 thereby to effect the operation of relays 190 and 235 and advance switches 200 and 210 to position 1 in which groups G11 are selected for test. When relay 286 reoperates after brush 282 engages terminal 22, the audible signal device 287 is again operated, indicating that a cycle of readings is about to start. When relay 286 next releases, the brushes of switch 280 are advanced to position 1, causing the release of relay 270. The release of relay 270 closes the circuit for operating relay 150 and a cycle of tests begins. After key 256 is restored to normal, testing ends when a cycle of tests is completed.

The potentiometer 107 which is connected in series with the central office battery may be adjusted according to the office voltage before starting tests, so that the readings will be correct. To make the required adjustment, the observer operates the dial key 250 and the calibrating key 253, thereby operating relays 105 and 170. Relay 105 connects battery, through resistor 104, to meter M—A and connects resistor 106 to the potentiometer 107 to simulate an average load of meters. The potentiometer is adjusted so that the meter gives a full scale deflection. If there are more than five observers, there will be another relay similar to relay 105 connected to conductor 254 and the potentiometer 108 which is provided for those observers will be adjusted so that the meter of one of those observers gives full scale deflection. When key 253 is released, relay 105 releases and testing may proceed.

In order to adjust potentiometers 121 and 122 to obtain the desired frequency of readings, the dial key 250 and repeat key 149 are operated and the observer dials the number of an unused trunk group in which all sleeve conductors have been connected to ground. The switches 200 and 210 will not be advanced and repeated tests of the unused group will be made. Potentiometer 122 should then be adjusted until the meter associated with the artificially busied group definitely remains normal for a short period after each reading. The potentiometer 121 should then be adjusted until ten readings are made in about twenty-six seconds. With these potentiometer settings, one-hundred readings should be completed in about four minutes and fifteen seconds.

Although indicating meters are shown for giving the traffic readings to be recorded by observers, it is obvious that recording meters might be used. Individual test relays might be provided, one for each trunk of the largest group to be tested, in place of double wound two-step relays. Instead of a single indicating meter being provided for giving an indication of the number of busy trunks in a tested group, a plurality of indicating means, such as lamps, may be associated with each observer, the lamps being connected to the contacts of the test relays in such a manner as to display the number of busy trunks in the tested trunk group. These and other modifications may be made in the traffic observing apparatus, shown in the drawings, within the scope of the invention hereinafter claimed.

What is claimed is:

1. A traffic observing apparatus for testing groups of trunks and for indicating the number of busy trunks in each group, said apparatus comprising means for selecting each group in succession, test relays for individually testing each trunk in the selected group, means for simultaneously connecting all of the trunks in the selected group to said test relays, and a meter controlled by said test relays calibrated to indicate the number of busy trunks in the tested group.

2. An observing apparatus for determining the extent of use of groups of like units each of which has an individual conductor to which a busy marking potential is connected while the unit is in use, said apparatus comprising means for selecting each group in succession, test relays for individually testing each unit in a selected group, means for simultaneously connecting all of the units in a selected group to said test relays, an electrical meter, and means connecting said meter to the contacts of said test relays, whereby the meter is energized to give an indication of the number of busy units in the tested group.

3. A traffic observing apparatus for testing groups of trunks and for indicating the number of busy trunks in each group, said apparatus comprising a plurality of meters, one for each of a plurality of observers, a set of test relays for each observer, means for selecting groups of trunks for test, a group for each set of test relays, means for simultaneously connecting the trunks in the selected groups to the sets of test relays, and means including the contacts of each set of test relays for energizing the associated meter to give an indication of the number of busy trunks in the associated one of the simultaneously tested groups.

4. A traffic observing apparatus for determin-

ing the extent of use of groups of trunks, said apparatus comprising a plurality of sets of test relays, switching means for connecting each set of test relays to certain of said groups of trunks, means for selectively operating said switching means to simultaneously connect each set of test relays to a group of trunks and to successively connect each set of test relays to a different one of the groups of trunks to which it may be connected, and a plurality of indicating meters one for each of said sets of test relays, each of said meters connected and adapted to give an indication of the number of trunks which is busy in any group of trunks to which the associated set of test relays is connected.

5. A traffic observing apparatus for determining the extent of use of groups of trunks, said apparatus comprising a plurality of electrical meters, one for each of a plurality of traffic observers, sets of test relays, one set for each observer, switching means individual to each set of test relays for connecting the relays to each of certain of said groups of trunks, means common to all observers for controlling the operation of the switching means for each observer to selectively and successively connect the sets of test relays to the associated certain groups of trunks, and means including contacts of the test relays of each set for energizing the associated meter to give an indication of the number of busy trunks in the group of trunks being tested.

6. A traffic observing apparatus arranged so that a plurality of observers may record the number of trunks which is busy in each of a plurality of groups of trunks, said apparatus comprising for each observer a meter, a set of test relays and switching means for connecting the test relays to certain of said groups of trunks, and comprising means common to said observers for selectively controlling the operation of the switching means associated with each observer to connect the associated test relays successively to each of the certain groups to which the individual switching means gives access, and means including the test relays associated with each observer for energizing the associated meter to indicate the number of busy trunks in each trunk group to which the test relays are connected.

7. A traffic observing apparatus for testing groups of trunks and for indicating the number of busy trunks in each group, said apparatus comprising means for selecting each group in succession, test relays for individually testing each trunk in the selected group, means for simultaneously connecting all of the trunks in the selected group to said test relays, a meter controlled by said test relays calibrated to indicate the number of busy trunks in the tested group, and means for effecting the repeated test of the selected group at predetermined intervals.

8. A traffic observing apparatus for testing groups of trunks and for indicating the number of busy trunks in each group, said apparatus comprising means for selecting each group in succession, test relays for individually testing each trunk in the selected group, means for simultaneously connecting all of the trunks in the selected group to said test relays, a meter controlled by said test relays calibrated to indicate the number of busy trunks in the tested group, and means for maintaining the connection of the test relays to a selected group of trunks to give a continuous reading of the associated meter.

9. A traffic observing apparatus for determining the extent of use of groups of trunks, said apparatus comprising a plurality of sets of test relays, switching means for connecting each set of test relays to certain of said groups of trunks, means for selectively operating said switching means to simultaneously connect each set of test relays to a group of trunks and to successively connect each set of test relays to a different one of the groups of trunks to which it may be connected, a plurality of indicating meters one for each of said sets of test relays, each of said meters connected and adapted to give an indication of the number of trunks which is busy in any group of trunks to which the associated set of test relays is connected, and means for effecting the repeated test of all groups of trunks at predetermined intervals.

10. A traffic observing apparatus for testing groups of trunks and for indicating the number of busy trunks in each group, said apparatus comprising means for selecting each group in succession, test relays for individually testing each trunk in the selected group, means for simultaneously connecting all of the trunks in the selected group to said test relays, a meter controlled by said test relays calibrated to indicate the number of busy trunks in the tested group, means effective a predetermined interval of time after the connection of the test relays to a group of trunks to disconnect the test relays from said trunks, and means for effecting the reconnection of the test relays to the same group of trunks at predetermined intervals.

11. A traffic observing apparatus for testing groups of trunks and for indicating the number of busy trunks in each group, said apparatus comprising means for selecting each group in succession, test relays for individually testing each trunk in the selected group, means for simultaneously connecting all of the trunks in the selected group to said test relays, a meter controlled by said test relays calibrated to indicate the number of busy trunks in the tested group, and means for visually indicating the number of the group which is being tested.

12. A traffic observing apparatus for determining the extent of use of groups of trunks, said apparatus comprising a plurality of sets of test relays, switching means for connecting each set of test relays to certain of said groups of trunks, means for selectively operating said switching means to simultaneously connect each set of test relays to a group of trunks and to successively connect each set of test relays to a different one of the groups of trunks to which it may be connected, a plurality of indicating meters one for each of said sets of test relays, each of said meters connected and adapted to give an indication of the number of trunks which is busy in any group of trunks to which the associated set of test relays is connected, and means for indicating the number of the group which is being tested by each of the sets of test relays.

13. A traffic observing apparatus for testing groups of trunks and for indicating the number of busy trunks in each group, said apparatus comprising means for selecting each group in succession, test relays for individually testing each trunk in the selected group, means for simultaneously connecting all of the trunks in the selected group to said test relays, a meter controlled by said test relays calibrated to indicate the number of busy trunks in the tested group, and means effective if all units of the tested group are idle to energize the meter to give a zero reading.

14. A traffic observing apparatus for a plurality of groups of trunks, said apparatus comprising an

observer's indicating meter, a set of test relays, and a group of switches for connecting the groups of trunks to the test relays one group at a time, said switches being of the crossbar type, each having a plurality of select magnets and a plurality of hold magnets, the hold magnets being connected in a plurality of parallel combinations whereby the operation of a group of like numbered select magnets of said switches and a particular combination of hold magnets is effective to simultaneously connect said test relays to all of the trunks in one group, means for successively operating each group of like numbered select magnets with each different combination of hold magnets, thereby to successively connect the trunks of each group to said test relays, and means including the test relays for energizing the meter to indicate the number of busy trunks in each group tested.

15. A traffic observing apparatus for a plurality of groups of trunks, each group of trunks being individually allotted for observation by a particular one of a plurality of observers, said apparatus comprising a meter, a set of test relays and a group of switches for each observer, each group of switches adapted to connect the groups of trunks allotted to the associated observer to the associated test relays, said switches being of the crossbar type, each having a plurality of select magnets and a plurality of hold magnets, the hold magnets of the switches associated with each observer being connected in a plurality of parallel combinations whereby the operation of the like numbered select magnets and a particular parallel combination of hold magnets of the switches associated with each observer is effective to simultaneously connect the associated test relays to all of the trunks in one of the associated groups of trunks, switching means common to all observers for effecting the successive energization of each group of like numbered select magnets of the switches associated with each observer with each particular parallel combination of hold magnets to effect the connection of each set of test relays to each of the trunk groups allotted to the associated observer, and means including the test relays for each observer for effecting the energization of the associated meter to indicate the number of busy trunks in the group being tested.

16. A traffic observing apparatus for a plurality of groups of trunks, said apparatus comprising an observer's indicating meter, a set of test relays, and a group of switches for connecting the groups of trunks to the test relays one group at a time, said switches being of the crossbar type, each having a plurality of select magnets and a plurality of hold magnets, the hold magnets being connected in a plurality of parallel combinations whereby the operation of a group of like numbered select magnets of said switches and a particular combination of hold magnets is effective to simultaneously connect said test relays to all of the trunks in one group, means for successively operating each group of like numbered select magnets with each different combination of hold magnets, thereby to successively connect the trunks of each group to said test relays, means for preventing the testing of the next group in case any of the like numbered select magnets or any of the hold magnets in a particular parallel combination of hold magnets, the operation of which select and hold magnets is required for the testing of a selected group, fail to operate, and means including the test relays for energizing the meter to indicate the number of busy trunks in each group tested.

17. A traffic observing apparatus for a plurality of groups of trunks, each group of trunks being individually allotted for observation by a particular one of a plurality of observers, said apparatus comprising a meter, a set of test relays and a group of switches for each observer, each group of switches adapted to connect the groups of trunks allotted to the associated observer to the associated test relays, said switches being of the crossbar type each having a plurality of select magnets and a plurality of hold magnets, the hold magnets being connected in a plurality of parallel combinations whereby the operation of the like numbered select magnets of all switches and a particular parallel combination of hold magnets of the switches of each group is effective to connect the associated test relays to one of the associated groups of trunks, switching means common to all observers for effecting the successive energization of each group of like numbered select magnets of the switches associated with each observer with each parallel combination of hold magnets to effect the connection of each set of test relays to each of the trunk groups allotted to the associated observer, means for preventing the testing of the next group of trunks for each observer in case any of the like numbered select magnets or any of the hold magnets of the particular parallel combinations of hold magnets for each observer, the operation of which select and hold magnets is required for the testing of a selected group for each observer, fail to operate, and means including the test relays for each observer for effecting the energization of the associated meter to indicate the number of busy trunks in the group being tested.

18. A traffic observing apparatus arranged so that each of a plurality of observers observes the traffic carried by each group of a different plurality of groups of trunks, said apparatus comprising a meter, a set of test relays and a group of switches for each observer, said switches being of the crossbar type each having a plurality of select magnets and a plurality of hold magnets, the hold magnets being connected in a plurality of parallel combinations, whereby the operation of the like numbered select magnets of all switches and a particular parallel combination of hold magnets of the switches associated with each observer is effective to connect each set of test relays to one of the groups of trunks of the plurality associated with each observer, switching means common to all observers for operating in succession each group of like numbered select magnets of said switches in combination with each parallel combination of hold magnets whereby all groups of trunks associated with each observer are successively connected to the associated set of test relays, means operated only in case all of the select magnets and all of the hold magnets, the operation of which is required to connect a group of trunks to the associated test relays of each observer, are operated for effecting the advance from one group of trunks to the next, the last-mentioned means including an omitted reading relay in case one observer has a smaller number of trunk groups to observe than the other observers, and means including the test relays for each observer for effecting the energization of the associated meter to indicate the number of busy trunks in the tested group.

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