Aug. 15, 1944. F. E. BLOUNT 2,355,903

SIGNALING SYSTEM

Filed June 27, 1942 6 Sheets-Sheet 1

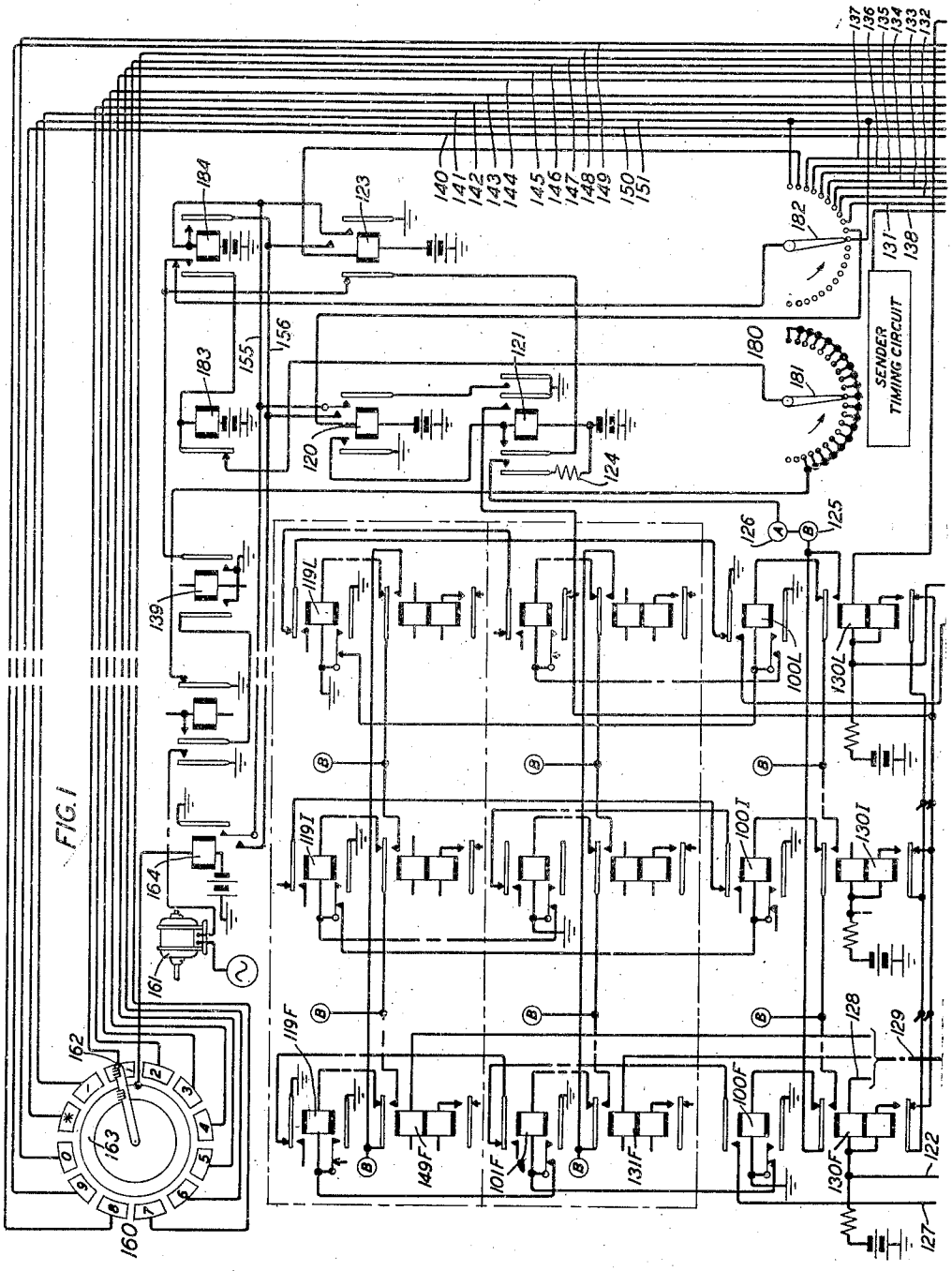

FIG. 1

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Aug. 15, 1944. F. E. BLOUNT 2,355,903

SIGNALING SYSTEM

Filed June 27, 1942 6 Sheets-Sheet 2

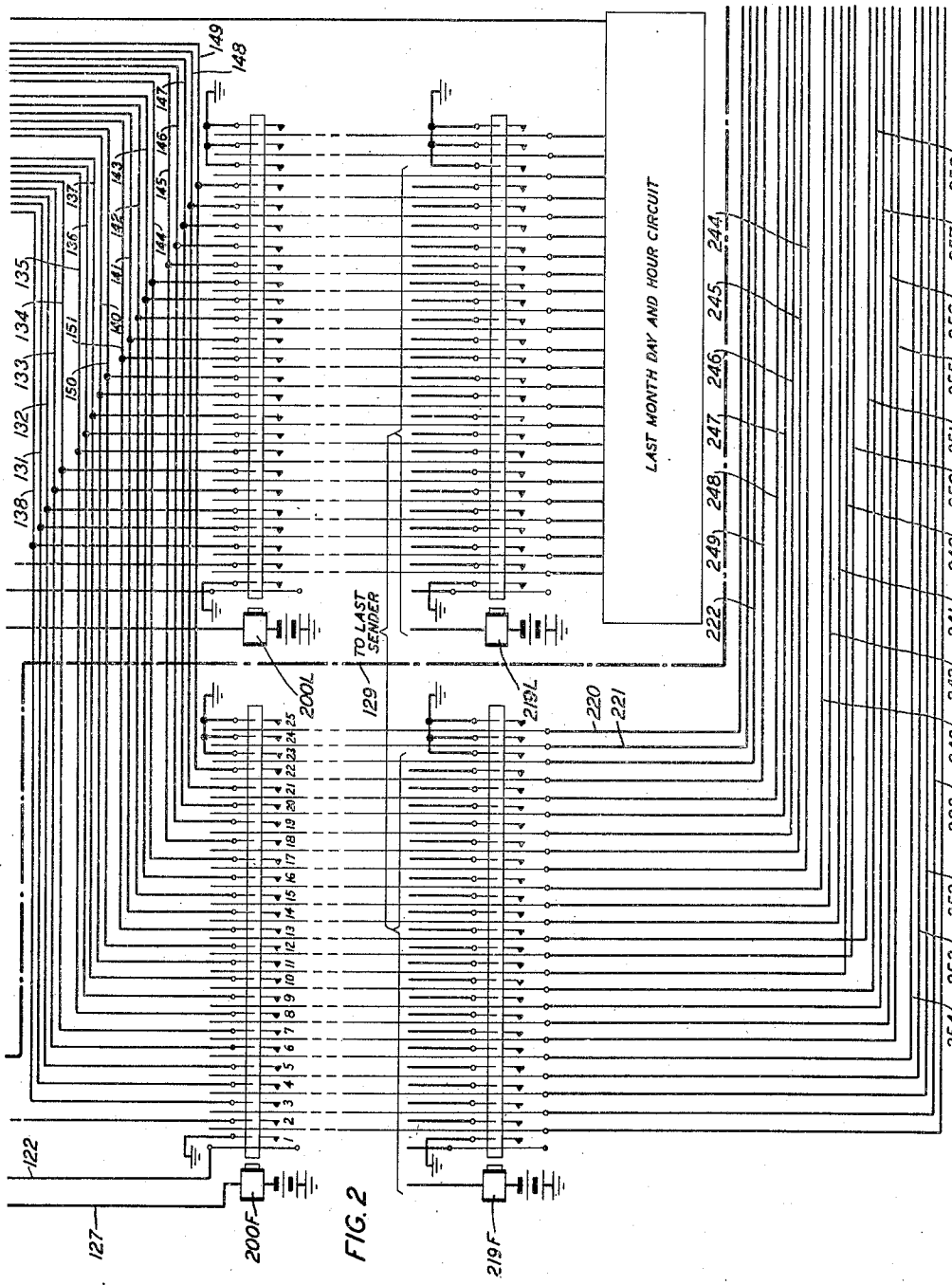

FIG. 2

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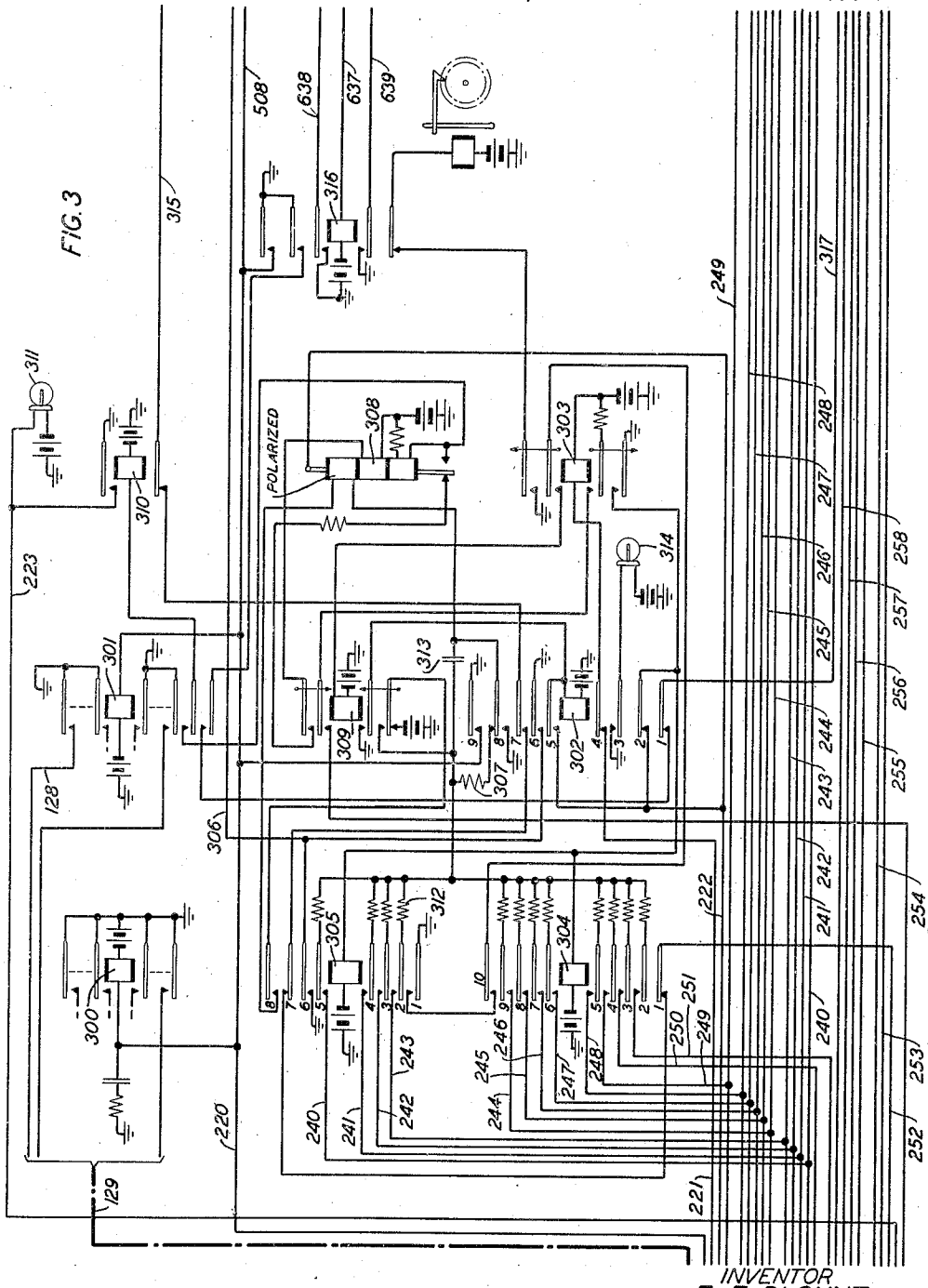
SIGNALING SYSTEM

Filed June 27, 1942 6 Sheets-Sheet 3

FIG. 3



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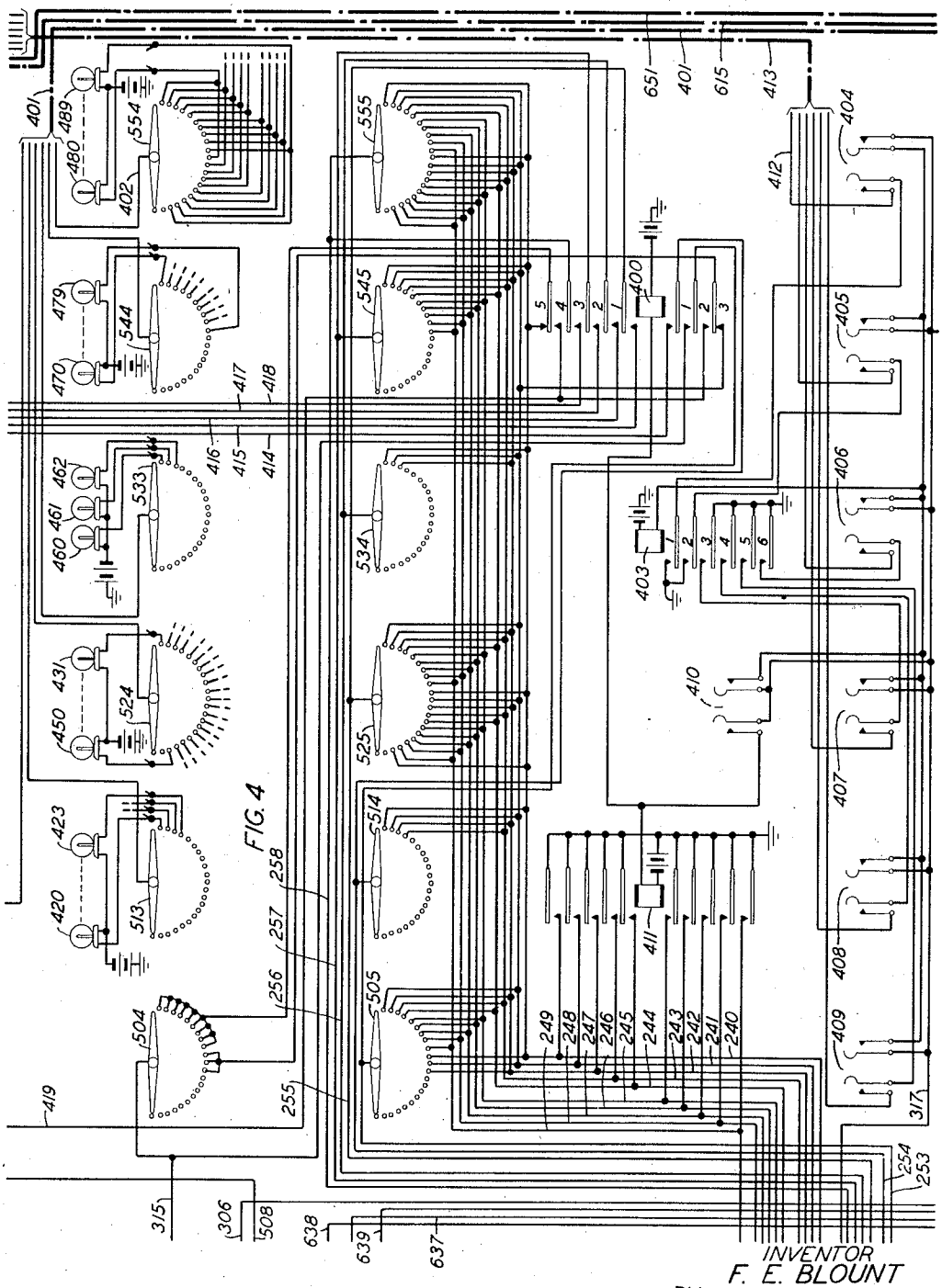
Aug. 15, 1944. F. E. BLOUNT 2,355,903

SIGNALING SYSTEM

Filed June 27, 1942 6 Sheets-Sheet 4



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SIGNALING SYSTEM

Filed June 27, 1942 6 Sheets-Sheet 5

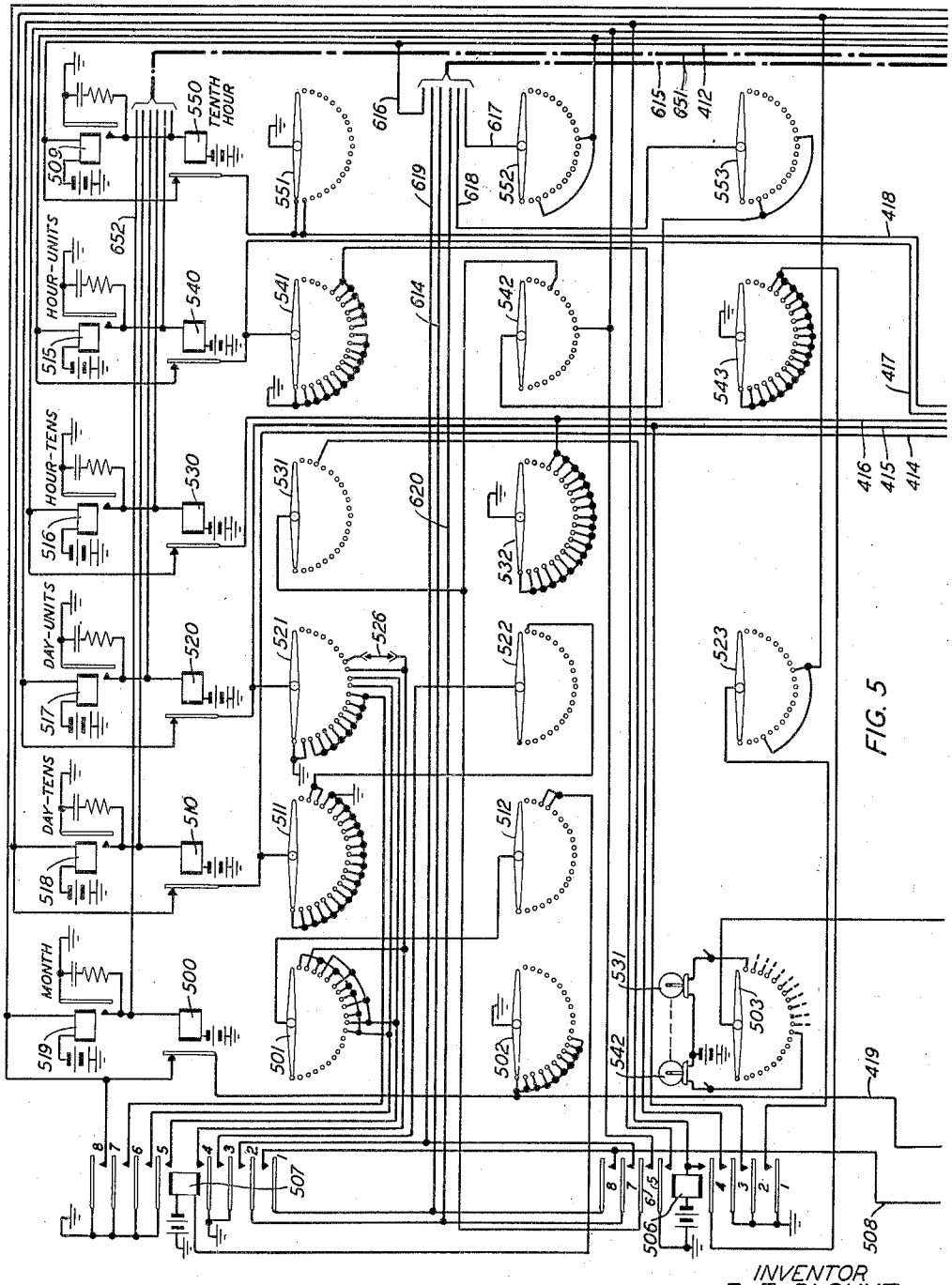

FIG. 5

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SIGNALING SYSTEM

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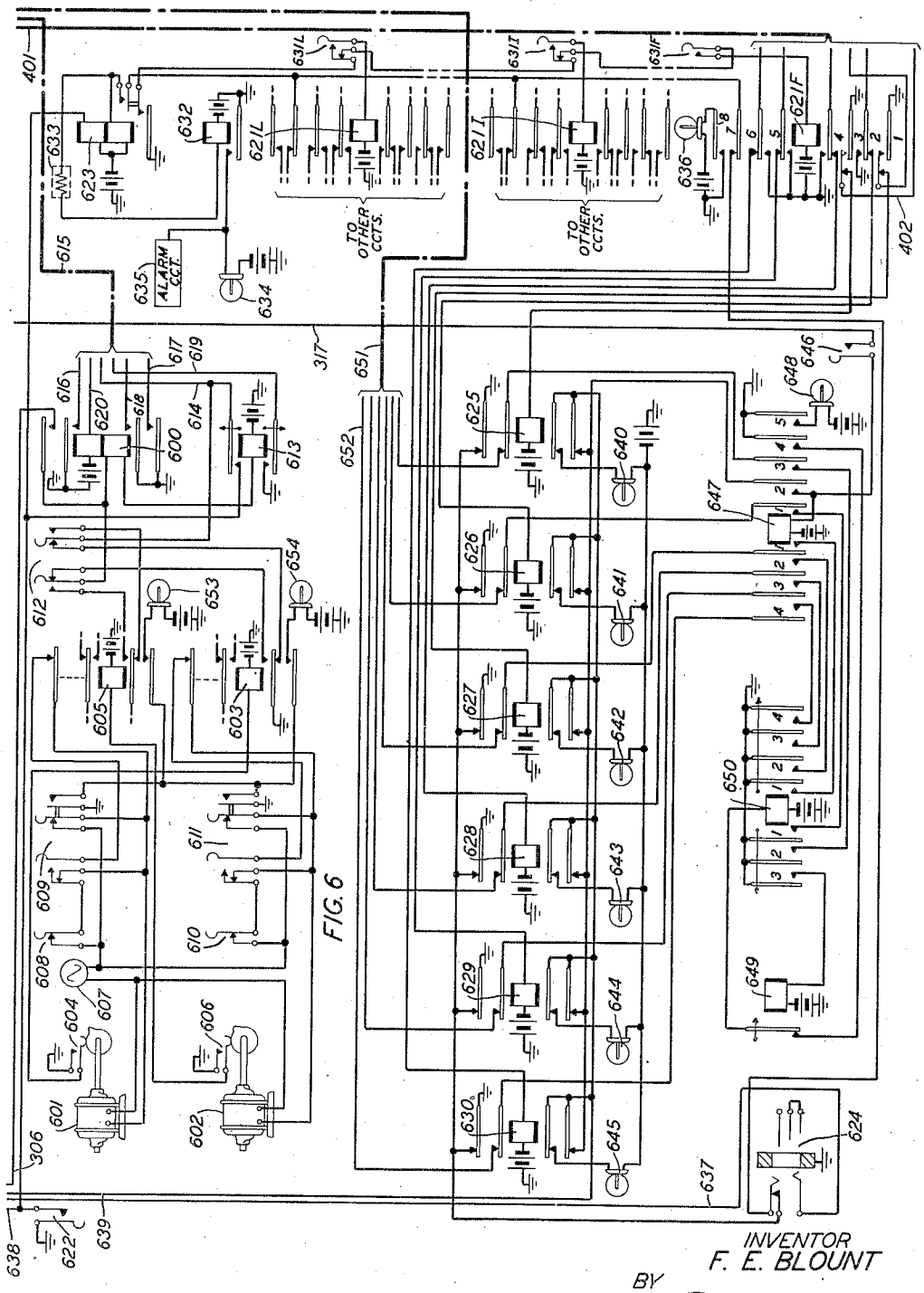

FIG. 6

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Patented Aug. 15, 1944 2,355,903

UNITED STATES PATENT OFFICE

2,355,903

SIGNALING SYSTEM

Frank E. Blount, Cedar Grove, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application June 27, 1942, Serial No. 448,754

24 Claims. (Cl. 234—36.5)

This invention relates to telephone exchange systems and more particularly to apparatus for providing data relating to the date and time of day for enabling such data to be printed on a toll ticket.

As fully disclosed and described in the application of J. W. Gooderham, Serial No. 448,782, filed concurrently herewith, a subscriber, desiring a connection to a line terminating in an office in the nearby toll area, dials the office code and numerical digits of the wanted line number and in response to the dialing of one or more of the office code digits a connection is extended to an idle one of a plurality of ticketing trunks which has access to the office in which the wanted line terminates. Immediately following the seizure of the trunk, an idle sender common to the ticketing trunks is associated with the seized trunk over a trunk-finder switch. The first digit dialed after the seizure of the trunk is registered in the trunk and the remaining digits of the called line number are registered in the sender. Since the trunk may be seized by a first selector in response to the dialing of the first office code digit of certain called office designations, by a second selector in response to the dialing of the first two office code digits of other office designations and by a third selector in response to the dialing of all three office code digits of still other office designations, the register in the trunk may register either the second or third office code digits or the thousands numerical digit. As soon as the first digit has been registered in the sender, which digit may be either the third office code digit, the thousands digit or the hundreds digit, an idle identifier is associated with the sender over an identifier-connector and the identifier is associated directly with the trunk over a trunk-identifier-connector. Thereupon the identifier proceeds to reconstruct the office code dialed by the calling subscriber, which information may be derived from the trunk or from the trunk and the sender, and transmits this information to the sender where it becomes registered. The identifier also proceeds to identify the calling line and to transmit information concerning the identification digits, the class of the calling line and the rate at which the call should be charged to the sender where it becomes registered.

The sender after registering the office code digits of the wanted line transmitted to it from the identifier and the numerical digits of the wanted line dialed into the sender from the calling line proceeds to direct the setting of selector switches to extend a connection from the ticketing trunk to the wanted subscriber's line. At a later time when the sender has received all of the information concerning the calling and called lines it proceeds to connect itself to the calling trunk over a trunk-sender-connector to control a ticket printer over such connector to print on a toll ticket information required to render a bill to the calling subscriber for the toll connection. This information includes the calling and called line numbers, the class of the calling line, the rate to be charged, the month, day of the month, the hour of the day and the tenth division of the hour of the day of the time when the call was made and, for maintenance purposes, the number of the identifier and the number of the sender used in the establishment of the connection. The trunk is also provided with registers which are effective to register the elapsed time of the conversation and to control the ticket printer to print such elapsed time information on the toll ticket.

It is the object of the present invention to provide a month, day and hour circuit for chronologically varying the registrations of the various elements of the date and time of day for the use of a sender in controlling the ticket printer of an associated trunk to print such data on a toll ticket.

A further object of the invention is to check for crosses between and grounds connected to the control conductors used by the sender for controlling the printer.

A further object of the invention is to check the setting of the registers and relays involved in the control of one month, day and hour circuit against similar registers and relays in other month, day and hour circuits and to establish an alarm circuit if the settings do not agree and to provide means for synchronizing one month, day and hour circuit with another.

To attain these objects, two or more month, day and hour circuits are made available to all of the senders of an office building an idle one of which becomes associated with a sender over a connector circuit upon the seizure of a sender. Each month, day and hour circuit comprises a plurality of rotary step-by-step switches which serve as registers. The first of these registers is advanced step-by-step by a Telechron motor-driven timer which closes a single make contact at six minute intervals. Two of these timers are used in an office with a part of the month, day and hour circuits under the control of each in order that a check may be obtained if for some reason one of the timers should stop. The first register serves to register tenth divisions of the hour of

the time of day. At the end of each hour a second switch is advanced progressively to register the units digit of the hour and at the end of the ninth and nineteenth hours causes the advance of a third register to register the tens digit of the hour of the day. At the end of each twenty-four hour period or day, a fourth switch is advanced progressively to register the units digit of the day of the month. This switch in turn causes the advance of a fifth switch to register the tens digit of the day of the month. At the end of each month a sixth switch is advanced to register the month of the year. Provision is made for advancing the month switch a step at the actual end of a month depending upon whether the month has 28, 29, 30 or 31 days. Thus at any sixth minute interval the settings of the six registers are indicative of the actual month, day of the month, hour of the day and tenth division of an hour. When therefore the month, day and hour circuit is seized by any sender, the settings of these registers are rendered effective to control the ticket printer of the trunk at the time associated with the sender to print the date and time on the toll ticket.

To insure that the control conductors extending from the month, day and hour circuit to the ticket printer are in condition to control the ticket printer, these control conductors are connected to test relays immediately following the seizure of the circuit and before the circuit is conditioned to transmit information to the ticket printer whereby such conductors are tested for false grounds and crosses.

Provision is also made for exercising the register switches of each month, day and hour circuit since certain of the registers such, for example, as the month register are operated infrequently and their brushes and terminals might become poorly conductive through the accumulation of dust or corrosion. Provision is also made for correcting the settings of any registers of a circuit after they have been exercised or should they fail to progress properly, whereby the corresponding registers of all circuits are placed in synchronism to correspond to the correct calendar date and clock time.

The invention having been described in a general manner, reference may now be had to the following detailed description thereof taken in connection with the accompanying drawings in which:

Fig. 1 shows in the upper left portion thereof a schematic representation of the distributor, driving motor and print magnet of the ticket printer of a trunk; in the right and lower portions thereof certain of the apparatus of a sender including the printer control progress switch thereof and the preference relays allocated to a plurality of month, day and hour circuits and in the dot and dash rectangles the preference relays of other senders allocated to the month, day and hour circuits;

Fig. 2 shows the multicontact relays of the connector circuit for associating any sender with any month, day and hour circuit and a box schematically representing one of the month, day and hour circuits; and

Figs. 3 to 6, inclusive, show the complete circuits of another month, day and hous circuit, Fig. 3 showing control relays, Figs. 4 and 5 showing the register switches and Fig. 6 showing the motor-driven timers, checking and alarm circuits.

To completely disclose the invention Fig. 2 should be placed beneath Fig. 1, Fig. 3 should be placed to the right of Fig. 2, Fig. 4 should be placed to the right of Fig. 3, Fig. 5 should be placed above Fig. 4 and Fig. 6 should be placed beneath Fig. 4.

The ticket printing mechanism **160** of Fig. 1 may be of the type disclosed in the Patent 2,309,688, granted to W. J. Zenner, February 2, 1943.

The control conductors extending from the distributor segments of the printing mechanism to the sender are established over the contacts of multicontact relays of a sender-trunk-connector not shown but fully disclosed and described in the application of Gooderham hereinbefore referred to. Only so much of one of the senders is disclosed in Fig. 1 as is deemed necessary for a complete understanding of the invention. The sender is provided with a progress switch **180** which progressively controls the printing mechanism **160** to print digits and characters relating to the required information to be printed on the toll ticket. The brushes of this switch, of which two only **181** and **182** are disclosed, are advanced step-by-step in response to the operation of stepping magnet **183** and stepping relay **184** and are advanced to their normal positions by the further operation of stepping magnet **183**.

The register switches of the month, day and hour circuits disclosed in Figs. 4 and 5 are of the rotary step-by-step type and each is advanced by the operation of its stepping magnet, and the release hereof. The stepping magnets are all disclosed in a horizontal row near the top of Fig. 5 and the switch brushes and terminal arcs appertaining to each switch are disclosed in Figs. 4 and 5 vertically beneath the stepping magnet appertaining to such switch.

To more clearly set forth the novel features of the invention, it will be assumed that in response to the initiation of a call and to the dialing of code digits of a called line number, an idle ticketing trunk with which the ticket printing mechanism **160** of Fig. 1 is associated is seized, that an idle sender becomes associated with such trunk over a trunk-finder, that an idle identifier becomes associated with such sender and that the identifier becomes associated over a trunk-identifier-connector with the calling trunk in a manner fully described in the Gooderham application hereinbefore referred to. The identifier then proceeds to reconstruct the called office code dialed by the calling subscriber, to identify the calling line and to transmit to the sender for registration therein the digits of the calling office code, the digits of the calling line number, the digits of the called office code, the class of the calling line and the charge rate to be used for the call. The identifier having then completed all of its functions is dismissed and the sender is signaled to proceed to establish control paths from the sender to the ticket printer **160** of the trunk, over the contacts of a sender-trunk-connector and to proceed with the control of the ticket printer.

To accomplish this, progress switch **180** of the sender is progressively advanced to associate the calling office code and calling line numerical registers of the sender with the control conductors extending to the ticket printer whereby the complete directory number of the calling line is first printed on the toll ticket. Following the printing of the last or units numerical digit of the calling line number on the toll ticket, the brushes of progress switch **180** will have been advanced to the position disclosed in which position they will

be in engagement with the No. 12 terminals of their arcs.

With brush 162 in engagement with the No. 12 terminal of its arc, ground is connected over the contacts of off-normal relay 139 of the sender, over the normal contacts of stepping relay 184, over brush 182 and the No. 12 terminal of its arc, control conductor 151, to the dash segment of the commutator of the ticket printer. When the distributor arm 162 of the ticket printer which is rotated with the type wheel by the motor 161, engages such segment, a circuit is completed from ground applied to the dash segment over brush 162, ring 163 and thence to battery through the winding of print magnet 164. The armature of magnet 164 carries a stabber which enters a slot in the distributor when the selected character has been positioned for printing thereby arresting the rotation of the printer shaft and pressing the ticket tape against the type wheel to print the selected character, in this case, a dash. When the stabber enters the slot the contacts shown associated with the magnet 164 are closed whereupon ground is connected over conductors 155 and 156 and over contacts of the sender-trunk-connector to the sender. With ground connected to conductor 155, the circuit of stepping relay 184 is completed and relay 184 operates, locks over its right contacts to ground on conductor 156, establishes a circuit for stepping magnet 183 of the progress switch 180 which may be traced from ground over contacts of off-normal relay 139 and the left alternate contacts of relay 184 to battery through the winding of magnet 183 and opens at its left normal contacts the previously traced circuit of print magnet 164. Magnet 164 thereupon releases and when the stabber is entirely removed from the slot in the distributor, the locking circuit of relay 184 is opened and relay 184 releases in turn releasing stepping magnet 183 to advance the brushes 181 and 182 to the No. 13 terminals of their arcs. The shaft of the ticket printer is now freed and the motor 161 again advances the brush arm 162 over the distributor segments and rotates the type wheel.

Seizure of the month, day, and hour circuit

With brush 162 engaged with the No. 13 terminal of its arc, a circuit is established from ground thereover, to battery through the winding of relay 120 whereupon relay 120 operates to establish an obvious circuit for relay 121 which also operates and locks over its inner left contacts, the back contact of relay 123 to ground at the contacts of off-normal relay 139 and closes a circuit for the preference relay of the first available month, day and hour circuit. It will be assumed that the first month, day and hour circuit disclosed in full in Figs. 3 to 6, inclusive, has been constituted the first preference to the sender disclosed in the lower and right portions of Fig. 1 by the cross connection of terminal 125 to terminal 126 and that this month, day and hour circuit is at the time available. A circuit is therefore effective from ground through the winding of the preference relay 100F, allocated to this month, day and hour circuit and to the No. 0 sender, over the upper back contact of the busy relay 130F, allocated to this month, day and hour circuit and to the No. 0 sender, over the strapped terminals 125 and 126 and the outer left contacts of relay 121 and through resistance 124 to battery. Relay 100F thereupon operates, locks to ground over its lower alternate contacts, removes operating ground from preference relays 101F to 119F allocated to the same month, day and hour circuit and to all other senders so that no other sender may cause the seizure of this month, day and hour circuit and establishes a circuit from ground over the upper normal contacts of preference relay 119F, thence in series over the upper normal contacts of other preference relays allocated to the same month, day and hour circuit, over the upper front contact of relay 100F and conductor 127 through the winding of connector relay 200F allocated to the first month, day and hour circuit to battery and ground. Relay 200F then operates to extend control conductors from the sender to the first month, day and hour circuit.

Had the first month, day and hour circuit been busy, then its busy relay 130F would have been operated and the circuit previously traced over terminal 125 would have been extended over the upper front contact of relay 130F and the upper front contacts of the busy relays of succeeding busy month, day and hour circuits, thence over the upper back contact of the busy relay of the first idle month, day and hour circuit to ground through the winding of the preference relay of such circuit. If it should be assumed that all month, day and hour circuits except the last are busy, then this circuit will be extended over the upper back contact of relay 130L through the winding of the preference relay 100L of such month, day and hour circuit to ground over the normal contacts of preference relay 119L of such month, day and hour circuit allocated to the last sender. It should be noted that the last month, day and hour circuit is the first choice for the last sender and the last choice preference for the first sender.

With connector relay 200F operated, a circuit is established from ground over its No. 25 contacts, conductor 220 to battery through the windings of busy relays 300 and 301 in parallel which operate and connect ground to conductors such as 128 of cable 129 extending to the upper windings of all busy relays 130F to 149F allocated to the first month, day and hour circuit and thence through such relays to battery as illustrated in connection with relay 130F and all such busy relays therefore operate with the exception of relay 130F whose upper winding is shunted over conductor 122 and the No. 1 contacts of relay 200F to ground. Relay 200F upon operating also connects ground over its No. 24 contacts to conductor 221 and over the No. 4 back contacts of relay 302 to battery through the winding of relay 303 which thereupon operates and connects ground over its lower contacts and the No. 2 back contacts of relay 302 to conductor 222 and to battery through the windings of relays 304 and 305. Relay 305 when operated establishes a circuit from ground over its No. 6 contacts, conductor 306 and over the upper contacts and through the lower winding of relay 600 to battery to prevent relay 600 from releasing if at the time operated to cause the switches of the month, day and hour circuit to advance during the time that the circuit is in use with a sender. Relays 304 and 305 also extend the control conductors 140 to 151, inclusive, extending from the segments of the ticket printer over contacts of connector relay 200F, conductors 240 to 251, inclusive, over contacts of relays 304 and 305, through associated resistances, through the common resistance 307 over the No. 8 back contact of relay 302, through the upper winding of polarized relay 308, the No. 8 contacts of relay 305

and the back contact of relay 309 to battery. A circuit is also established from ground over the No. 1 contact of relay 305, the No. 10 contacts of relay 304, the inner upper contacts of relay 303 to battery through the winding of start relay 309. Relay 309 operates over this circuit and after an interval, as determined by its slow-to-operate characteristic, removes battery at its lower back contact from the circuit traced through the upper winding of relay 308, and over the control conductors extending to the segments of the ticket printer. If a ground does exist on any control conductor, relay 308 will operate prior to the operation of relay 309 and will in turn cause the operation of relay 310 over a circuit extending from ground on conductor 222 over the right contacts of relay 308, over the next to bottom contacts of relay 301, to battery through the winding of relay 310 which will operate to light the alarm lamp 311 and to establish a circuit from ground over its upper contacts, conductor 223, the No. 3 contacts of connector relay 220F, conductor 138 to the sender timing circuit as a signal that trouble exists on a control conductor.

It will be assumed, however, that no ground condition is found and that relay 309 operates in turn operating relay 302. Relay 302 then locks over its No. 5 contacts to ground on conductor 222, lights lamp 314 over its No. 3 contacts, connects ground over its No. 6 contacts and conductor 306 for holding relay 600 operated, establishes a holding circuit for relays 300 and 301 and over its No. 9 contacts and opens the operating circuit of relay 303 at its No. 4 contacts. With relays 302 and 309 both operated, the control conductors are connected over the lower front contacts of relay 309, the No. 8 contacts of relay 305 through the upper winding of relay 308 to ground over the No. 8 front contacts of relay 302 in order to check for crosses between control conductors. During the time that the winding of relay 308 is thus connected to the control conductors, the printer distributor brush 162 is rotated and successively connects battery through the print magnet 164 to each of the control conductors for approximately .013 second. If a cross occurs between two of these conductors, this battery current will be closed through two of the resistances shown at the right of relays 304 and 305 such as 312, thereby increasing the current through the upper winding of relay 308 to a value required for its operation. To render relay 308 slightly slow to operate to prevent its operation by the momentary short-circuit established between adjacent control conductors as the distributor brush 162 advances from one segment to the next, condenser 313 is connected in parallel with the upper winding of relay 308 by the opening of the No. 8 back contact of relay 302. If a cross is found, relay 308 upon operating causes the operation of relay 310 to light alarm lamp 311 and to return a trouble signal to the sender timing circuit.

It will be assumed that no cross is found and that therefore relays 308 and 310 do not operate and that therefore with relays 302 and 309 operated and relay 303 released, relays 304 and 305 are released whereby the month, day and hour circuit is prepared for the transfer of information concerning the month, the day, the hour and the fractional part of the hour to the ticket printer. In the present case, it will be assumed that when the month, day and hour circuit is associated with the sender, its register switches have been positioned to record the month, day and time as December 25, 9:36 a. m.

Printing the month

It will be recalled that when switch 180 of the sender advanced brush 182 into engagement with the No. 13 terminal of its arc, relays 120 and 121 were operated. When these relays are operated, ground is applied over the right contacts of relays 121 and 120 to conductors 155 and 156 whereby stepping relay 184 of the sender is controlled in the manner previously described in connection with the operation of print magnet 164 to cause the operation and release of stepping magnet 183 to advance the brushes 181 and 182 of switch 180 to the No. 14 terminals of their arcs. When brush 182 is in engagement with the No. 14 terminal of its arc, a circuit is established from ground thereover, over conductor 131, the No. 4 contacts of relay 200F, conductor 252, the No. 1 back contact of relay 304, the No. 7 back contact of relay 305, the No. 7 contacts of relay 302, the back contacts of relay 310, conductor 315, brush 504 of the month register, the brushes 501 to 505 of which are assumed to be engaging the No. 12 terminals of their arcs to register the month as December, thence over the lower No. 3 back contact of relay 400, conductor 241, the No. 14 contacts of relay 200F and conductor 141, to the No. 1 distributor segment of the printer. In the manner previously described the rotation of the printer type wheel is arrested by the operation of the print magnet 164 when the brush 162 engages the No 1 segment, the numeral 1 is printed on the ticket and switch 180 of the sender is controlled to advance its brushes 181 and 182 to the No. 15 terminals of their arcs.

With brush 182 engaged with the No. 15 terminal of its arc, a circuit is established from ground thereover, over conductor 132, the No. 5 contacts of relay 200F, conductor 253, brush 505 of the month register engaged with the No. 12 terminal of its arc, conductor 242, the No. 15 contacts of relay 200F and conductor 142, to the No. 2 distributor segment of the printer. In the manner previously described the rotation of the printer type wheel is arrested by the operation of print magnet 164 when the brush 162 engages the No. 2 segment, the numeral 2 is printed on the ticket and switch 180 of the sender is controlled to advance its brushes 181 and 182 to the No. 16 terminals of their arcs.

Printing the day of the month

With brush 182 engaged with the No. 16 terminal of its arc, a circuit is established from ground thereover, over conductor 133, the No. 6 contacts of relay 200F, conductor 254, brush 514 of the day-tens register, the brushes 511 to 514 of which are assumed to be engaging the No. 3 terminals of their arcs to register the tens digit 2 of the 25th day of the month, thence over conductor 242 and as previously traced to the No. 2 distributor segment of the printer. In the manner previously described the rotation of the printer type wheel is arrested by the operation of the print magnet 164 when the brush 162 engages the No. 2 segment, the numeral 2 is printed on the ticket and switch 180 of the sender is controlled to advance its brushes 181 and 182 to the No. 17 terminals of their arcs.

With brush 182 engaged with the No. 17 terminal of its arc, a circuit is established from

ground thereover, over conductor 134, the No. 7 contacts of relay 200F, conductor 255, brush 525 of the day-units register, the brushes 521 to 525 of which are assumed to be engaging the No. 5 terminals of their arcs to register the units digit 5 of the 25th day of the month, thence over conductor 245, the No. 18 contacts of relay 200F and conductor 145 to the No. 5 distributor segment of the printer. In the manner previously described the rotation of the printer type wheel is arrested by the operation of the print magnet 164, when the brush 162 engages the No. 5 segment, the numeral 5 is printed on the ticket and switch 180 of the sender is controlled to advance its brushes 181 and 182 to the No. 18 terminals of their arcs.

Printing the hour of the day

The hours of the day are numbered 00 to 23, hour 00 being the hour between 12 midnight and 1 o'clock a. m. With brush 182 engaged with the No. 18 terminal of its arc, a circuit is established from ground thereover, over conductor 135, the No. 8 contacts of relay 200F, conductor 256, brush 534 of the hour-tens register, the brushes 531 to 534 of which are assumed to be engaging the No. 1 terminals of their arc to register the tens digit zero of the hour of the day, conductor 240, the No. 11 contacts of relay 200F and conductor 140 to the No. 0 distributor segment of the printer. In the manner previously described, the rotation of the printer type wheel is arrested by the operation of the print magnet 164 when the brush 162 engages the No. 0 segment, the numeral 0 is printed on the ticket and switch 180 of the sender is controlled to advance its brushes 181 and 182 to the No. 19 terminals of their arcs.

With brush 182 engaged with the No. 19 terminal of its arc, a circuit is established from ground thereover, over conductor 136, the No. 9 contacts of relay 200F, conductor 257, brush 545 of the hour-units register, the brushes 541 to 545 of which are assumed to be engaging the No. 10 terminals of their arcs to register the units digit 9 of the hour of the day, conductor 249, the No. 22 contacts of relay 200F and conductor 149, to the No. 9 distributor segment of the printer. In the manner previously described, the rotation of the printer type wheel is arrested by the operation of print magnet 164 when the brush 162 engages the No. 9 segment, the numeral 9 is printed on the ticket and switch 180 of the sender is controlled to advance its brushes 181 and 182 to the No. 20 terminals of their arcs.

With brush 182 engaged with the No. 20 terminal of its arc, a circuit is established from ground thereover, over conductor 137, the No. 10 contacts of relay 200F, conductor 258, brush 555 of the tenth of an hour register, the brushes 551 to 555 of which are assumed to be engaging the No. 7 terminals of their arcs to register the sixth-tenth of an hour division or the thirty-sixth minute of the hour, conductor 246, the No. 19 contacts of relay 200F and conductor 146 to the No. 6 distributor segment of the printer. In the manner previously described the rotation of the printer type wheel is arrested by the operation of the print magnet 164 when the brush 162 engages the No. 6 segment, the numeral 6 is printed on the ticket and switch 180 of the sender is controlled to advance its brushes 181 and 182 to the No. 21 terminals of their arcs.

With brush 182 engaged with the No. 21 terminal of its arc, a circuit is established from ground thereover, to battery through the winding of relay 123. Relay 123 upon operating releases relay 121 which in turn releases preference relay 100F followed by the release of connector relay 200F. Relay 200F upon releasing disassociates the month, day and hour circuit from the sender, whereupon the operated relays 300, 301, 302 and 309 thereof release. The operated busy relays 131F, etc., are now released and the first month, day and hour circuit is again made available to other senders. Relay 123 upon operating also connects ground to conductors 155 and 156 whereby stepping relay 184 of the sender is operated and then released to advance the brushes 181 and 182 of switch 180 to the No. 22 terminals of their arcs. When brush 182 engages the No. 22 terminal of its arc, ground is connected thereover to conductor 151 whereby the printer is controlled to print a dash on the ticket and the switch 180 is controlled to advance other brushes (not shown) into engagement with the No. 1 terminals of their arcs.

The sender now proceeds to progressively advance the brushes of progress switch 180 to control the ticket printer to print the sender number, the identifier number, the called office digits, the called line number, the calling class and the charge rate. Since the present invention is concerned only with the functions of the month, day and hour circuit, the apparatus by which the sender controls the ticket printer to print this other data on the toll ticket has not been disclosed. For a full disclosure and description thereof, reference may be had to the aforementioned application of J. W. Gooderham.

Setting the registers of the month, day, and hour circuit

The settings of the registers and relays are controlled by a Telechron motor-driven timer which closes a single make contact at six minute intervals. Two of these timing motors 601 and 602 are used in an office building, one of which controls a pulsing relay 603 over its cam-operated contacts 604 and the other of which controls the pulsing relay 605 over its cam-operated contacts 606. The motor 601 is normally driven from the frequency regulated source 607 of commercial alternating current over normal contacts of keys 608 and 609 and the motor 602 is normally driven from the source 607 over normal contacts of keys 610 and 611. Each month, day and hour circuit is provided with a transfer key 612 and with associated control relays 600 and 613. With all keys 612 in their normal positions, the operating windings of all relays 600 and 613 are connected over the left normal contacts of such keys to front contacts of pulsing relay 603 whereby the relays 600 and 613 of such month, day and hour circuits are operated at six minute intervals under the control of timing motor 601. With the keys 612 all in their alternate positions, the operating windings of all relays 600 and 613 are connected over the left alternate contacts of such keys to the front contacts of pulsing relay 605 whereby the relays 600 and 613 of such month, day and hour circuits are operated at six minute intervals under the control of motor 602. In order that a check may be obtained if for some reason one of the motors should stop, the keys 612 of some of the month, day and hour circuits are maintained in their normal positions so that the relays 600 and 613 of such circuits are normally operated under the control of motor 601

and the keys 612 of the other month, day and hour circuits are maintained in their operated positions so that the relays 600 and 613 of such circuits are normally operated under the control of the motor 602.

When relay 603 for example operates in response to the closure of the contacts 604 of timing motor 601, it establishes a circuit from ground over its inner lower front contacts, over the left normal contacts of key 612 of the month, day and hour circuit disclosed in full in Figs. 3 to 6, inclusive, thence in series through the winding of relay 600 and the winding of relay 613 to battery, whereupon relays 600 and 613 both operate. Upon the opening of the contacts 604 of the timing motor 601, relay 603 releases and closes a circuit from ground over its inner lower back contact, the right normal contacts of key 612, conductor 614 of cable 615, over the No. 8 contacts of relay 506, or the No. 1 contacts of relay 507 to battery through the winding of make busy relays 300 and 301 for holding the circuit busy during the time that the registers are being advanced at the end of any day. If the month, day and hour circuit, however, is in use at this time with a sender, the previously traced circuit from ground over conductor 306 will be extended over the upper contacts of relay 600, through the lower winding of relay 600 and through the winding of relay 613 to hold these relays operated until the sender has released the circuit.

It will be assumed that the registers have been set as previously stated to register the date and time as December 25, 9:36 a. m. and that at the time relays 600 and 613 operated, the circuits have been released from a sender. A circuit is therefore established upon the operation of relay 600 from ground over its inner upper contacts and conductor 616 of cable 615 to battery through the winding of relay 509 which operates in turn operating stepping magnet 550 of the tenth-hour register. When relay 600 releases, relay 509 releases in turn releasing magnet 550 which thereupon advances brushes 551 to 555, inclusive, of the tenth-hour register one step or in the case assumed into engagement with the No. 8 terminals of their arcs to register the elapse of six additional minutes. This register now registers the elapse of the forty-second minute of the registered ninth hour of the day. After the elapse of two additional six minute intervals the tenth-hour register will in a similar manner, under the control of relay 600, be advanced two additional steps to position its brushes on the No. 10 terminals of their arcs.

With brush 552 in engagement with the No. 10 terminal of its arc, when relay 600 again operates at the end of the next six minute interval or at exactly 10 o'clock, a circuit is established from ground over the lower contacts of relay 600, conductor 617 of cable 615, over brush 552 and No. 10 terminal of its arc to battery through the winding of stepping relay 515. At the same time relay 600 establishes the previously traced circuit for relay 509. Relays 509 and 515 upon operating establish obvious circuits for stepping magnets 550 and 540, respectively, and upon the release of relay 600, relays 509 and 515 release to release magnets 550 and 540, whereupon the brushes of the tenth-hour register are advanced to the No. 11 terminals of their arcs and the brushes of the hour-units register are advanced from the No. 10 terminals of their arcs on which they have been assumed to be standing to the No. 11 terminals of their arcs. With brush 541 now engaged in the No. 11 terminal of its arc, a circuit is established from ground over brush 541, the interrupter contacts of stepping magnet 540 to battery through the winding of stepping relay 515, whereupon relay 515 operates in turn operating magnet 540. Magnet 540 upon operating opens the circuit of relay 515 which in turn releases magnet 540 to advance the brushes of the hour-units register one step to the No. 12 terminals of their arcs. Since the Nos. 11 to 22 terminals of the arc associated with brush 541 are strapped together, stepping relay 515 and magnet 540 reciprocally control each other in the manner just described to advance the brushes of the hour-units register into engagement with the No. 1 terminals of their arcs whereupon the hour-units register is now positioned to register the zero units digit of the hour of the day. Since the tenth-hour register has now been advanced to engage its brushes with the No. 11 terminals of their arcs, this register is now positioned to register the zero tenth-hour digit.

It will be recalled that the brushes of the hour-tens register were assumed to be standing upon the No. 1 terminals of their arcs to register the tens digit zero of the hour of the day since it was assumed that the time was 9:36 a. m. when the month, day and hour circuit was seized by the sender. At the end of the ninth hour, at which time the brushes of the hour-units register are standing on the No. 10 terminals of their arcs, a circuit is established by the operation of relay 600 extending from ground over its inner lower contacts, conductor 618 of cable 615, brush 553 engaged with the No. 10 terminal of its arc, brush 542 engaged with the No. 10 terminal of its arc to battery through the winding of stepping relay 516 which thereupon operates and closes an abvious circuit for the stepping magnet 530 of the hour-tens register. When relay 600 thereafter releases, relays 516 and magnet 530 release, whereby magnet 530 causes the advance of the brushes of the hour-tens register into engagement with the No. 2 terminals of their arcs to register the tens digit 1 for the hour of the day which is now 10 o'clock.

Upon the elapse of subsequent six minute intervals, the brushes of the tenth-hour register are advanced step-by-step over the Nos. 12 to 20 terminals of their arcs, the previously traced circuit over brush 552 being controlled by the operation and release of relay 600 when brush 552 engages the No. 20 terminal of its arc to advance the hour-units register one step to register the units digit 1 of the eleventh hour. When the brush 551 of the tenth-hour register engages the No. 21 terminal of its arc, after the end of the tenth hour, a circuit is established from ground over brush 551 over the interrupter contacts of stepping magnet 550 to battery through the winding of stepping relay 509 which operates in turn operating magnet 550. Magnet 550 upon operating releases relay 509 which in turn releases magnet 550 to advance the brushes of the tenth-hour register to the No. 22 terminals of their arcs, whereupon relays 509 and magnet 550 again reciprocally control each other to advance the brushes to the No. 1 terminals of their arcs. In a similar manner at the end of the subsequent hours 11 to 19, inclusive, when the brush 552 engages the Nos. 10 and 20 terminals of its arc, the hour-units register is ad-

vanced step-by-step until at the end of the nineteenth hour, at which time the brushes of the hour-units register are in engagement with the No. 10 terminals of their arcs to register the units digit 9 of the nineteenth hour of the day or 7 o'clock p. m., the circuit previously traced over brush 542 is established for relay 516 under the control of relay 600 to cause the advance of the brushes of the register 530 into engagement with the No. 3 terminals of their arcs. At this time the brushes of the tenth-hour register and the brushes of the hour-units register will be so positioned as to register the tenth-hour and units digits of the hour as zero.

In a similar manner when brush 552 of the tenth-hour register engages either the No. 10 or 20 terminal of its arc at the end of the twentieth to twenty-third hour, the hour-units register is advanced step-by-step to successively register the units digits 1, 2, 3 and 4 of the twenty-first, twenty-second, twenty-third and twenty-fourth hours. The brushes of the hour-tens register remain in a position during this time to register the tens digit 2 of these hours. When, however, the brush 542 is advanced to the No. 4 terminal of its arc at the end of the twenty-third hour of the day or midnight, relay 600 upon operating establishes a circuit from ground over its inner lower contacts, conductor 618 of cable 615, brush 553 and terminal of the tenth-hour register, brush 542 and the No. 4 terminal of its arc, brush 531 of the hour-tens register and the No. 3 terminal of its arc, to battery through the winding of relay 505. Relay 506 now operates; locks over its No. 4 contacts and the strapped terminals of the arc associated with brush 543 of the hour-units register to ground over brush 543 to insure that relay 506 will remain operated until this register is restored to normal; establishes a circuit from battery through the winding of relay 516, over its No. 6 contacts, the No. 4 terminal of the arc associated with brush 542, of the hour-units register, brush 553 of the tenth-hour register, and conductor 618 of cable 615 to a front contact of relay 600 preparatory to advancing the hour-tens register; establishes a circuit from ground over its No. 5 contacts to battery through the winding of relay 517 which operates to cause the operation of the stepping magnet 520 of the day-units register; closes over its No. 8 contacts the previously traced circuit for make busy relays 300 and 301 upon the subsequent release of relay 603 for making the circuit busy to senders during the time that the registers are advancing and closes a circuit from ground over the lower contacts of relay 613, conductor 619 of cable 615, over its No. 7 contacts and conductor 620 of cable 615 to battery through the upper winding of relay 600 for holding relay 600 operated during the time that is required for slow-to-release relay 613 to release following the opening of the operating circuit of relays 600 and 613 by the release of relay 603 in order to prevent the registers from advancing if at this time a sender is starting to seize the month, day and hour circuit. If a sender does seize the circuit before the operation of relays 300 and 301 becomes effective, relays 304 and 305 will be operated as previously described and connect holding ground over conductor 303 to hold relays 600 and 613 operated.

Relay 506 upon releasing controls the advance of the brushes of the hour-units register into engagement with the No. 5 terminals of their arcs whereupon a circuit is established from ground over the No. 3 contacts of relays 506, the No. 5 terminal of the arc associated with brush 541, brush 541, over the interrupter contacts of stepping magnet 540 of the hour-units register to battery through the winding of stepping relay 515. Relay 515 thereupon operates in turn operating magnet 540 which releases relay 515. Relay 515 upon releasing releases magnet 540 to advance the brushes of the hour-units register one step. Since the Nos. 5 to 10 terminals of the arc associated with brush 541 are strapped together, the previously traced circuit for relay 515 is effective until brush 541 advances beyond the No. 10 terminal of its arc whereby relay 515 and magnet 540 reciprocally control each other to advance the brushes of the register step-by-step. When brush 541 engages the No. 11 terminal of its arc, the circuit for relay 515 is established from ground over brush 541 engaged therewith whereby relay 515 and magnet 540 reciprocally control each other to advance the brushes of the hour-units register into engagement with the No. 1 terminals of their arcs to register the hour-units digit as zero.

When relay 600 releases, the circuits for relays 506 and 516 are opened and relay 516 upon releasing releases magnet 530 to advance the brushes of the hour-tens register into engagement with the No. 4 terminals of their arcs whereupon a circuit is established from battery through the winding of stepping relay 516, over the interrupter contacts of stepping magnet 530 and the strapped terminals of the arc associated with brush 532 to ground over brush 532. Relay 516 now operates in turn operating magnet 530 which in turn releases relay 516. Relay 516 upon releasing releases magnet 530 to advance the brushes of the hour-tens register one step. In this manner relay 516 and magnet 530 reciprocally control each other to advance the brushes of the hour-tens register into engagement with the No. 1 terminals of their arcs to register the hour-tens digit as zero. Relay 600 also releases relay 509, which was operated over conductor 616 of cable 615, to advance the brushes of the tenth-hour register to the No. 1 terminals of their arcs to register the digit 0 indicating the first six minute division of the hour. The three hour registers now register the time as 000 or just past midnight.

Relay 506 upon releasing opens the circuit of stepping relay 517 which releases in turn releasing stepping magnet 520 to advance the brushes of the day-units register one step from their assumed engagement with the No. 5 terminals of their arcs into engagement with the No. 6 terminals thereof, whereby the day-tens and day-units registers now register the day of the month as the twenty-sixth. In the manner previously described, the tenth hour, hour-units and hour-tens registers are advanced during each subsequent twenty-four hour period in turn causing the advance of the day-units register step-by-step until after the end of the twenty-ninth day of December its brushes will be positioned on the No. 9 terminals of their arcs. When relay 506 is operated in response to the operation of relay 600 at the end of the last six minute interval of the twenty-ninth day of December, a circuit is established from ground over the No. 1 contacts of relay 506, brush 523 and the No. 9 terminal of its arc to battery through the winding of stepping relay 518 which operates in turn operating stepping magnet 510 of the day-tens register. When relay 506 releases relay 518 re-

leases in turn releasing magnet 510 to advance the brushes of the day-tens register into engagement with the No. 4 terminals of their arcs to register the digit 3. Relay 506 also releases relay 516 which in turn releases magnet 520 to advance the brushes of the day-units register into engagement with the No. 10 terminals of their arcs. The day-tens and day-units registers are now set to register the thirtieth day of the month.

At the end of the next twenty-four hour period, relay 506 is again operated and released, the day-units register is again advanced a step to engage its brushes with the No. 11 terminals of their arcs whereby the thirty-first day of the month is registered. At the end of the next twenty-four hour period when relay 506 is again operated a circuit is established from ground over its No. 2 contacts, brush 521 and the No. 11 terminal of its arc, brush 501 and the No. 12 terminal of its arc, since the month register has been assumed to register the twelfth month or December, brush 512 and the No. 4 terminal of this arc, to battery through the winding of relay 507 and the circuit of relay 517 associated with the day-units register is established to thereby cause the operation of stepping magnet 520. Relay 507 upon operating locks in a circuit from battery through its winding, over brush 512 and the No. 4 terminal of its arc, brush 501 and the No. 12 terminal of its arc to ground over the No. 6 contacts of relay 507 and connects ground over its No. 6 contacts, over the No. 11 terminal of the arc associated with brush 521 and brush 521 engaged therewith, over the interrupter contacts of stepping magnet 520 to battery through the winding of relay 517, whereupon relay 517 operates in turn operating magnet 520. Magnet 520 upon operating releases relay 517 which in turn releases magnet 520 to advance the brushes of the day-units register to the No. 12 terminals of their arcs. A circuit is now established from ground over the No. 7 contacts of relay 507 and the Nos. 12 to 20 terminals of the arcs associated with brush 521 whereby relay 517 and magnet 520 reciprocally control each other to advance the brushes of the day-units register into engagement with the No. 21 terminals of their arcs. With brush 521 engaged with the No. 21 terminal of its arc, strapped to the No. 22 terminal, relay 517 and magnet 520 reciprocally control each other to further advance the brushes to the No. 1 terminals of their arcs.

When the day-units register has reached its No. 1 terminal position, a circuit is established from ground over the No. 3 contacts of relay 507, the No. 1 terminal of the arc with which brush 522 is now engaged, the No. 4 terminal of the arcs with which brush 511 is engaged over the interrupter contacts of stepping magnet 510 to battery through the winding of relay 518, whereupon relay 518 operates in turn operating magnet 510. Magnet 510 upon operating releases relay 518 whereupon magnet 510 is released to advance the brushes of the day-tens register into engagement with the No. 5 terminals of their arcs. With brush 511 engaged with the No. 5 terminal of its arc, which is strapped to terminals 6 to 22, inclusive, a circuit is established from ground thereover, over the interrupter contacts of magnet 510 to battery through the winding of relay 518 whereupon relay 518 operates in turn operating magnet 510 which in turn releases relay 518 followed by the release of magnet 510 to advance the brushes of the register one step. Thus relay 518 and magnet 510 reciprocally control each other to advance the brushes of the day-tens register into engagement with the No. 1 terminals of their arcs. Over its No. 8 contacts, relay 507 establishes the circuit of stepping relay 519 preparatory to advancing the month register. Over its No. 2 contacts it closes the previously traced holding circuit for relay 600, until relay 613 releases and over its No. 1 contacts closes the previously traced circuit for make-busy relays 300 and 301 to make the month, day and hour circuit busy until the registers thereof have taken their new settings. As soon as brush 512 of the day-tens register leaves the No. 4 terminal of its arc, relay 507 releases and following the release of relay 613 relay 600 releases followed by the release of relay 506. When relay 507 releases, relay 519 releases in turn releasing magnet 500 which advances the brushes of the month register into engagement with the No. 13 terminals of their arcs. A circuit is now established from ground over brush 502 and the strapped terminals of its arc, over the interrupter contacts of stepping magnet 500 to battery through the winding of relay 519 whereupon relay 519 operates in turn operating magnet 500 which in turn releases relay 519 followed by its own release whereby relay 519 and magnet 500 reciprocally control each other to advance the brushes of the month register into engagement with the No. 1 terminals of their arcs. At this time the registers of the month, day and hour circuit are set to register the month, day and hour as 0101000 or just after midnight on January 1.

The circuits function as just described during the month of January to register the days and hours and at the end of the month or at midnight on January 31 up the release of relays 506 and 507, the registers are set to register the month, day and hour digits as 0201000. It will be assumed that the year is not a leap year and that therefore February has but twenty-eight days. When therefore, relay 506 operates at midnight on the twenty-eighth day of February, brush 521 of the day-units register will be in engagement with the No. 8 terminal of its arc and brush 512 of the day-tens register will be in engagement with the No. 3 terminal of its arc and a circuit will be established from ground over the No. 2 contacts of relay 506, brush 521 and the No. 8 terminal of its arc, brush 501 and the No. 2 terminal of its arc, brush 512 and the No. 3 terminal of its arc to battery through the winding of relay 507. Relay 507 will thereupon operate to establish a circuit for stepping relay 519 of the month register and to establish circuits over its Nos. 4, 5, 6 and 7 contacts to cause the advance of the brushes of the day-units register into engagement with the No. 21 terminals of their arcs, whereupon they are advanced into engagement with the No. 1 terminals of their arcs. When brush 522 engages the No. 1 terminal of its arc, relay 507 establishes the previously traced circuit for advancing the brushes of the day-tens register into engagement with the No. 5 terminals of their arcs whereupon they are advanced into engagement with the No. 1 terminals of their arcs. When relays 506 and 507 release, stepping relays 516 and 519 release whereupon the brushes of the hour-tens register are advanced into engagement with the No. 4 terminals of their arcs and are thereupon advanced into engagement with the No. 1 terminals of their arcs under control of brush 532 and the brushes of the month register are advanced one

step into engagement with the No. 3 terminals of their arcs. The registers are now set to register the month, day and hour as 0301001 or just after midnight on March 1.

Had the year been leap year, then the strapping shown at **526** in the conductor connected to the No. 8 terminal of the arc associated with brush **521** of the day-units register would have been omitted and the previously traced circuit for relay **507** would not have been established until midnight on the 29th day of February at which time brush **521** would then engage the No. 9 terminal of its arc.

During the months of March, May, July, August and October during which months brush **501** of the month register is in engagement with the Nos. 3, 5, 7, 8 and 10 terminals of its arc, respectively, the circuit for relay **507** is established by the operation of relay **506** on midnight of the 31st day of such months at which time brush **521** of the day-units register will be in engagement with the No. 11 terminal of its arc and brush **512** of the day-tens register will be in engagement with the No. 4 terminal of its arc. During the months of April, June, September and November, during which months brush **501** of the month register is in engagement with the Nos. 4, 6, 9 and 11 terminals of its arc, the circuit of relay **507** is established by the operation of relay **506** at midnight on the 30th day of such month at which time brush **531** of the day-units register will be in engagement with the No. 10 terminal of its arc and brush **512** of the day-tens register will be in engagement with the No. 4 terminal of its arc.

Checking and setting registers and relays

In order to check the settings of the registers and the relays of the month, day and hour circuit, circuit paths are provided through arcs on the different registers and which are equivalent to those used in controlling the ticket printer to print the digits of the month, day and hour characters. The terminals in the arcs associated with brushes **503**, **513**, **524**, **533**, **544** and **554** of each month, day and hour circuit which correspond to the terminals of the corresponding arcs associated with the brushes **505**, **514**, **525**, **534**, **545** and **555** which are connected to the ten printer control conductors **240** to **249**, inclusive, are multipled together and connected through indicating lamps to battery. The brushes **503**, **513**, **524**, **533**, **544** and **554** are connected over conductors of cable **401** corresponding to the control conductors **258**, **257**, **256**, **255**, **254** and **253**, respectively, to armatures of a relay **621** individual to the same month, day and hour circuit and are connected over front contacts of such relay to ground if the relay is operated or over back contacts of such relay if it is not operated to the windings of checking relays **625** to **630**, inclusive of such month, day and hour circuit to battery. For example, corresponding terminals of the arcs associated with brushes **553** of the tenth hour registers of all of the day and hour circuits are multipled together and connected through the checking lamps **480** to **489**, inclusive, to battery and the brush **554** of the month, day and hour circuit is connected over conductor **402** of cable **401** to ground over the No. 3 alternate contacts of relay **621F** if such relay is operated or over the No. 3 normal contacts of relay **621F** to battery through the winding of relay **625** if relay **621F** is not operated.

It will be assumed that it is desired to check another month, day and hour circuit using the circuit shown as the master circuit. To accomplish this, key **622** is operated, thereby closing an obvious circuit through the upper winding of relay **623** which thereupon operates and locks from battery through its lower winding and inner contacts, over the No. 7 back contacts of the unoperated relays **621** of all circuits over the normal contacts of the make-busy jacks **624** of such circuits and to ground over the upper back contacts of checking relays **625** to **630**, inclusive, of such circuits and closes the circuit of relay **632** through the thermistor **633**. Relay **623** also closes a circuit over its lower contacts and in series over the normal contacts of keys **631L** to **631I** of all other month, day and hour circuits and over the alternate contacts of key **631F**, assumed to be operated, to battery through the winding of relay **621F** of the month, day and hour circuit shown in full which is to be used as a master circuit. Relay **621F** upon operating lights lamp **636** and connects ground to all of the conductors of cable **401** whereupon a lamp in each group associated with brushes **503**, **513**, **524**, **533**, **544** and **554** will be lighted to indicate the settings of the registers of the circuit being used as a master circuit. If it be assumed that the registers of the circuit disclosed have been set to register the date and time as December 25, 9:36 a. m., then lamp **542** of the group **531** to **542** associated with brush **503** of the month register, lamp **422** of the group **420** to **423** associated with brush **513** of the day-tens register, lamp **435** of the group of twenty lamps associated with brush **524** of the day-units register, lamp **460** associated with brush **533** of the hour-tens register, lamp **479** of the group associated with brush **544** of the hour-units register, and lamp **486** associated with brush **554** of the tenth hour register are lighted. The grounds applied by the operated relay **621F** to the conductors of cable **401** will also be extended over the brushes **503**, **513**, **524**, **533**, **544**, and **554**, the terminals of their associated arcs and over the multipled terminals of the corresponding arcs of all other month, day and hour circuits and thence over the brushes associated therewith and conductors of cables such as cable **401** of all other month, day and hour circuits and over back contacts of relays **621** of such circuits to battery through the windings of checking relays **625** to **630**, inclusive, of such circuits.

As an example when brush **554** of the month, day and hour circuit disclosed is in engagement with the No. 7 terminal of its arc to light the No. 6 lamp **486**, the corresponding brushes of all other month, day and hour circuits should also be engaged with the No. 7 terminals of their arcs and consequently ground applied over the No. 3 alternate contacts of relay **621F**, over conductor **402** of cable **401**, brush **554** and the No. 7 terminal of its arc should be connected over the No. 7 terminals of the arcs associated with brushes **554** of all other circuits and over conductors **402** of cable **401** extending from such brushes, over the No. 3 normal contacts of relays **621** of the other month, day and hour circuits to battery through the windings of relay **625** of such other circuits thereby operating such relays. Similarly if all corresponding registers of all circuits have taken settings similar to the settings of the registers of the circuit being used as a master, all relays **625** to **630** of such circuits will be operated thereby opening at their upper back contacts the locking circuit of relay **623** which will thereupon open the circuit of relay **632**. If any

circuit should for any reason fail to progress at the end of a time period, the relay of the group 625 and 630 associated with the register which did not advance will remain normal during the checking operation.

If it be assumed that the tenth hour register of one of the circuits fails to advance so that its brush 554 is not engaged with the No. 7 terminal of its arc, then relay 625 of such circuit will not operate during the checking operation and relay 623 will not therefore release after the release of key 622, relay 623 being held over its holding circuit extending to ground at the upper back contact of the non-operated relay 625. Relay 623 is therefore maintained operated for a sufficient interval to permit alarm relay 632 to be energized through the thermistor 633 and over the locking circuit of relay 623 to thereby light alarm lamp 634 and to cause the operation of the audible alarm device 635.

If some circuit is found to be out of synchronism as indicated by the operation of the visual and audible alarms, the maintenance man will then proceed to determine which circuit is out of synchronism. It will be assumed that the circuit disclosed in full is correct as indicated by the correct lighting of the lamps associated with its registers to correspond to the calendar date and correct clock time and is therefore being used as a master circuit as hereinbefore described. The maintenance man, with relay 623 locked operated due to the trouble condition, now successively operates the checking keys 631 of all of the circuits thereby causing the successive operation of the associated relays 621. When the relay 621 of each circuit operates, the conductors of the cables 401 of such circuit will be grounded to thereby cause lamps associated with the registers of such circuit to light to indicate the settings of its registers. The lamps associated with the registers of each circuit should light when each circuit is checked in correspondence with the lighting of the lamps of the master circuit, but when the circuit is checked in which some register or registers are out of synchronism, the lamps associated with such registers will not be lighted to correspond with the lamps which were lighted in the master circuit, thus informing the maintenance man that such circuit is in trouble. If it be assumed that the tenth hour register of this circuit is out of synchronism, then checking relay 625 will have failed to operate as previously described. The maintenance man then makes such circuit busy by the insertion of a plug in the make-busy jack 624 thereby opening the circuit of relay 632 to discontinue the alarms and establishing a circuit from ground over the sleeve and ring contacts of jack 624, conductor 637 to battery through the winding of make-busy relay 316.

Relay 316 upon operating connects ground over its inner upper front contacts to conductor 638 to hold relay 623 operated, connects ground over its lower front contacts to conductor 639 and over the inner lower back contacts of unoperated relay 625 through lamp 640 to battery to light lamp 640 as a signal that the tenth hour register of the particular circuit is out of synchronism, over its upper contacts, causes the operation of relays 300 and 301 to render the particular circuit busy to all senders and establishes a circuit from ground over its upper middle contacts, over the lower contacts of relay 301, the No. 1 back contact of relay 302 and conductor 317 preparatory to operating relay 403.

The maintenance man now momentarily operates key 404 of the month, day and hour circuit found to be in trouble corresponding to the register thereof found to be out of synchronism, in the case assumed the tenth hour register indicated by the lighted lamp 640. Keys 405 to 409, inclusive, are similarly allotted to the hour-units, hour-tens, day-units, day-tens and month registers and may be operated if any of such registers are found to be out of synchronism as indicated by the lighted condition of any of the lamps 641 to 645 allocated to the checking relays 626 to 630, inclusive. When any one of these keys is operated, the circuit of relay 403 is completed over the right contacts thereof whereby relay 403 is operated to connect ground to the left contacts of all of the keys. With key 404 operated as assumed, a circuit is completed from ground over the lower No. 1 contacts of relay 403, over the left contacts of key 404, conductor 412 of cable 413 to battery through the winding of stepping relay 509 of the tenth hour register. Relay 509 thereupon operates and establishes the circuit of stepping magnet 550. When the key 404 is released, relay 509 releases followed by the release of the stepping magnet 550 whereby the brushes of the tenth hour register are advanced one step. The key 404 is thus operated and released one or more times until the tenth hour register is brought into a position corresponding to the position of the tenth hour register in the master circuit at which time a circuit for relay 625 of the defective circuit will be established from ground over the No. 3 alternate contacts of relay 621F of the master circuit, conductor 402 of cable 401, brush 554 and the terminal of its arc with which it is engaged, cross-connected to the terminal of the arc of the corresponding register of the defective circuit, brush 554 engaged therewith, conductor 402 of the cable 401 of such defective circuit, over the No. 3 normal contacts of relay 621 of such circuit to battery through the winding of checking relay 625 thereof. Checking relay 625 thereupon operates to extinguish the associated lighted lamp 640 to indicate that the register has been brought into synchronism. Keys 404 to 409, inclusive, are made effective by relay 403 only when the circuit is made busy and is not in use by a sender in order that registers thereof may not be advanced by accidental operation of such keys.

Exercising the registers

Since the month register operates only once a month and some of the other registers operate infrequently, it is desirable at times to advance the brushes of the registers over the terminals of their associated arcs to free the terminals of dust and corrosion. To accomplish this the month, day and hour circuit is taken out of service by inserting a plug into the make-busy jack 624 as previously described, resulting in the operation of relay 316. With relay 316 operated and if the circuit is not at the time in use with a sender, the circuit of relay 403 is prepared as before described. The maintenance man then operates the exercise key 410 thereby completing the circuit of relay 403 over its right contacts and establishing the circuits of relays 400 and 411 over its left contacts. Relay 411 upon operating connects ground to all of the printer control conductors 240 to 249, inclusive. Relay 400 upon operating, over its lower No. 2 contacts connects brushes 504 and 505 of the month register together and connects brushes 514, 525, 534, 545 and 555 of the day-tens, day-units, hour-tens, hour-unit and tenth hour registers over its lower

No. 1 and upper Nos. 1 to 4 contacts, inclusive, over conductors 414 to 418, inclusive and over the interrupter contacts of the stepping magnets 510, 520, 530, 540 and 550, respectively, of the registers to battery through the windings of the respective stepping relays 518, 517, 516, 515 and 509. Relay 400 upon operating disconnects the printer control conductors from the arc with which brush 504 of the month register is associated and connects these conductors over conductor 419 and the interrupter contacts of magnet 500 of the month register to battery through the winding of stepping relay 519.

With these connections established, stepping relay 519 of the month circuit is now operated in a circuit from battery through its winding over the interrupter contacts of magnet 500, conductor 419, the upper No. 5 and lower No. 3 front contacts of relay 403, over any terminal of the arc engaged by brush 504, brush 504, the lower No. 2 contacts of relay 400, brush 505, the terminal of its arc with which it is engaged, over that one of the printer control conductors 240 to 249, inclusive, connected to such terminal to ground over a contact of relay 411. Relay 519 upon operating causes the operation of stepping magnet 500 which in turn releases relay 519 which in turn releases magnet 500 to step the brushes of the month register one step, whereupon the circuit of relay 519 is reestablished over other terminals engaged by brushes 504 ad 505. The month register is in this manner advanced step-by-step until brush 502 engages the strapped terminals of its arc, whereupon the brushes are advanced to the No. 1 terminals of their arcs and the further advance of its brushes is continued under the control of brushes 504 and 505.

Stepping relay 518 is operated over a circuit extending from battery through its winding, over the interrupter contacts of stepping magnet 510, conductor 414, the lower No. 1 contacts of relay 400, brush 514 of the day-tens register and the terminal of its arc with which it is engaged over the printer control conductor of the group 240 to 243, inclusive, connected thereto, to ground over a contact of relay 411. Relay 518 upon operating causes the operation of stepping magnet 510 which in turn releases relay 518 which in turn releases magnet 510 to step the brushes of the day-tens register one step whereupon the circuit of relay 518 is reestablished over another terminal now engaged by brush 514 and connected to a conductor of the group 240 to 243 grounded through the operation of relay 411. The day-tens register is in this manner advanced step-by-step until brush 511 thereof engages the strapped terminals of its arc, whereupon the brushes are advanced to the No. 1 terminals of their arcs and the further advance of the brushes is continued under the control of brush 514. The other registers are similarly advanced step-by-step under the control of their brushes 525, 534, 545 and 555. All of the registers are thus exercised so long as the exercise key 410 is maintained operated and relays 400, 403 and 411 are thus operated. Since the control paths for exercising each register are dependent upon the application of ground to the printer control conductors 240 to 249, inclusive, by the operation of relay 411 and extend over the arcs or arc used in controlling printing, the exercise test also checks the continuity of these paths, an open circuit over any path being effective to cause the register controlled thereby to stop.

Synchronizing the circuit

After the exercising has been completed, the registers may be resynchronized by the operation of synchronizing key 646 which establishes a circuit from ground over conductor 317 over its contacts to battery through the winding of relay 647. Relay 647 upon operating locks over its No. 2 right contact and over the lower back contacts of such relays of the group 625 to 630 as are at the time unoperated to indicate an unsynchronized condition of the registers corresponding thereto and thence to ground over conductor 639 and the contacts of busy relay 316; causes the lighting of lamp 648 over its No. 5 right contacts and establishes a circuit from ground over its No. 4 right contacts and over the back contact of relay 649 to battery through the winding of relay 650 whereupon relay 650 operates. Relay 650 upon operating establishes an obvious circuit for relay 649 which after an interval determined by its slow-to-operate characteristic operates to open the circuit of relay 650. Relay 650 being slow to release does not release immediately. Thus during the interval measured by the slow-to-operate characteristic of relay 649, and the slow-to-release characteristic of relay 650, relay 650 maintains ground connected over its contacts, front contacts of relay 647 and the inner upper back contacts of the unoperated relays of the group 625 to 630, inclusive, to conductors of cable 651 and thence to battery through the windings of the stepping magnets of such registers as are not in synchronism with the corresponding registers of the master month, day and hour circuit. As soon as relay 649 becomes fully released, it again closes the circuit of relay 650 which again operates to reestablish the circuit of relay 649, thus relays 649 and 650 reciprocally control each other whereby relay 650 is intermittently operated to repeatedly close and open the circuits of the stepping magnets of the registers whereby the registers are all advanced step-by-step.

For example, if it be assumed that the month register is out of synchronism, the repeated operations and releases of relay 650, repeatedly operates and releases stepping magnet 500 to advance the brushes of the month register step-by-step over a circuit which may be traced from ground over the No. 4 right contacts of relay 650, the No. 4 left contacts of relay 647, the inner upper back contact of relay 630, conductor 652 of cable 651 to battery through the winding of stepping magnet 500. When brush 503 of this register has been advanced to a terminal position corresponding to the terminal position of brush 503 of the month register of the master circuit, relay 630 becomes energized in the manner previously described to open the stepping circuit of magnet 500 and to extinguish lamp 645 which has been lighted to indicate the unsynchroniized condition of the month register. The other registers are brought into synchronism in a similar manner and when all registers have been synchronized and all of the relays 625 to 630 have been operated, all the lamps 640 to 645 will become extinguished and relay 647 will be released to arrest the operation of relays 649 and 650. Any of the month, day and hour circuits can be made the master circuit by the operation of its relay 621 thus making it possible to put the registers and relays of such circuits in the proper positions corresponding to date and hour settings obtained from a calendar and a clock, by means of the manual control keys 404 and 409 as before explained and then to synchronize all other cir-

cuits with this preset circuit. This expedites returning the circuits to service when power failure causes the circuits to fail to progress.

As previously described, checking paths are provided through the corresponding register arcs associated with brushes **503**, **513**, **524**, **533**, **544** and **554** of the several circuits to check the synchronism of the registers of such circuits. These checking paths are prepared automatically every six minutes upon the release of either relays **603** or **605** and while relay **613** is still operated by the operation of relay **623**, in a circuit from ground over a back contact of either relay **603** or **605**, the right normal or alternate contacts of key **612**, the upper contacts of relay **613** to battery through the winding of relay **623**. Relay **623** then functions to operate relay **621** of any circuit whose individual checking key **631** has been operated to lock itself operated and to establish the circuit for alarm relay **632** as previously described. Checking then proceeds in a manner previously described.

Synchronizing the timers

If it be assumed that the timer **601** is operating in service, the timer **602** is then allowed to run until the circuit controlled thereby for operating relay **605** has been closed and is just on the point of releasing or has just released as is indicated by the extinguishing of lamp **653**. The keys **610** and **611** are then operated to open the circuit for timer **602**, until relay **603** is operated by the timer **601** as indicated by the lighting of lamp **654**. Key **610** is then released while key **611** is maintained operated, whereupon the circuit for timer **602** is reestablished through the source **607**, over the contacts of key **610** and the left alternate contacts of key **611**. The key **611** is then released. If the timer **602** is assumed to be operating, the timer **601** may be synchronized with it in a similar manner by the operation of keys **608** and **609**.

What is claimed is:

1. In a signaling system, a clock, a fractional hour register operable step-by-step in response to impulses transmitted by said clock, a register for registering the units digits of the hours of the day operable step-by-step at the end of each hour, a register for registering the tens digits of the hours of a day operable step-by-step at the end of the ninth, nineteenth and twenty-fourth hours of each day, a register for registering the units digits of the days of each month operable step-by-step at the end of each day, a register for registering the tens digits of the days of each month operable step-by-step at the end of the ninth and nineteenth days of each month and at the end of the twenty-ninth day or at the end of each month, a register for registering the months of the year and means controlled jointly by the setting of the month, day-tens and day-units registers for determining whether said month register shall be advanced at the elapse of twenty-eight, thirty or thirty-one days.

2. In a signaling system, a clock, a relay operable periodically by said clock, a fractional hour register operable step-by-step in response to said relay, a register for registering the units digits of the hours of a day operable step-by-step at the end of each hour under the joint control of said relay and said fractional hour register, a register for registering the tens digits of the hours of the day operable step-by-step at the end of the ninth, nineteenth and twenty-fourth hours of each day under the joint control of said relay and said hour-units register, a second relay operable under the joint control of said first relay and said hour-tens and hour-units registers at the end of each day, a register for registering the units digits of the days of each month operable step-by-step under the control of said second relay at the end of each day, a register for registering the tens digits of the days of each month operable step-by-step under the joint control of said second relay and said day-units register at the end of the ninth and nineteenth days of each month and at the end of the twenty-ninth day or at the end of each month, a register for registering the months of the year, a third relay operable under the joint control of said second relay and said month, day-tens and day-units registers at the end of each month, and means controlled by said third relay for controlling the step-by-step advance of said month register.

3. In a signaling system, a clock, a relay operable periodically by said clock, a fractional hour register operable step-by-step in response to said relay, a register for registering the units digits of the hours of the day operable step-by-step at the end of each hour under the joint control of said relay and said fractional hour register, a register for registering the tens digits of the hours of the day operable step-by-step at the end of the ninth, nineteenth and twenty-fourth hours of each day under the joint control of said relay and said hour-units register, a second relay operable under the joint control of said first relay and said hour-tens and hour-units registers at the end of each day and means controlled by said second relay for causing the restoration of said hour-tens and hour-units registers to normal at the end of each day.

4. In a signaling system, a clock, a relay operable periodically by said clock, a fractional hour register operable step-by-step in response to said relay, a register for registering the units digits of the hours of the day operable step-by-step at the end of each hour under the joint control of said relay and said fractional hour register, a register for registering the tens digits of the hours of a day operable step-by-step at the end of the ninth, nineteenth and twenty-fourth hours of each day under the joint control of said relay and said hour-units register, a second relay operable under the joint control of said first relay and said hour-tens and hour-units registers at the end of each day, a register for registering the units digits of the days of each month operable step-by-step under the control of said second relay at the end of each day, a register for registering the tens digits of the days of each month operable step-by-step under the joint control of said second relay and said day-units register at the end of the ninth and nineteenth days of each month, a register for registering the months of the year, a third relay operable under the joint control of said second relay and said month, day-tens and day-units registers at the end of each month, means controlled by said third relay for controlling the step-by-step advance of said month register, means controlled by said second relay for causing the restoration of said hour-tens and hour-units registers to normal at the end of each day, means controlled by said third relay for causing the restoration of said day-tens and day-units registers at the end of each month, and means for restoring said month register to normal at the end of each year.

5. In a signaling system, a plurality of recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, each of said circuits having a clock, a plurality of registers for registering the fractional hour and the tens and units digits of the hour of the day, the tens and units digits of the day of the month and the month of the year, a relay operable periodically by said clock for controlling the step-by-step advance of said registers, and means for rendering said circuit busy to all recorders during the time that registers thereof are being advanced in response to said relay.

6. In a signaling system, a plurality of recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, each of said circuits having a clock, a relay operable periodically by said clock, a fractional hour register operable step-by-step in response to said relay, a register for registering the units digits of the hours of the day operable step-by-step at the end of each hour under the joint control of said relay and said fractional hour register, a register for registering the tens digits of the hours of the day operable step-by-step at the end of the ninth and nineteenth hours of each day under the joint control of said relay and said hour-units register, a second relay operable under the joint control of said first relay and said hour-tens and hour-units registers at the end of each day, and means controlled by said second relay for holding said first relay operated for a predetermined interval to prevent the advance of said registers if said circuit is about to be operatively associated with a recorder.

7. In a signaling system, a plurality of recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, each of said circuits having a clock, a first relay operable periodically by said clock, a second relay operable by said first relay at the end of each day, a register for registering the units digits of the days of each month operable step-by-step under control of said second relay at the end of each day, a register for registering the tens digits of the days of each month operable step-by-step under the joint control of said second relay and said day-units register at the end of the ninth and nineteenth days of each month, a register for registering the month of the year, a third relay operable under the joint control of said second relay and said month, day-tens and day-units registers at the end of each month, means controlled by said third relay for controlling the step-by-step advance of said month register, and means controlled by either said second or third relays for holding said first relay operated for a predetermined interval to prevent the advance of said registers if said circuit is about to be operatively associated with a recorder.

8. In a signaling system, a plurality or recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, a plurality of registers in said circuit for registering the fractional hour and the tens and units digits of the hour of the day, the tens and units digits of the day of the month and the digits of the month of the year, a plurality of control conductors terminating in said registers and extensible by said means to said associated recorder, means operative upon the seizure of said circuit for testing said control conductors for false grounds, and means thereafter effective if no false ground condition is found for progressively rendering said registers effective to selectively establish circuits over said control conductors to control said associated recorder in accordance with said registrations.

9. In a signaling system, a plurality of recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, a plurality of registers in said circuit for registering the fractional hour and the tens and units digits of the hour of the day, the tens and units digits of the day of the month and the digits of the month of the year, a plurality of control conductors terminating in said registers and extensible by said means to said associated recorder, means operative upon the seizure of said circuit for testing said control conductors for false grounds and crosses with each other, and means thereafter effective if no false ground or crossed condition is found for progressively rendering said registers effective to selectively establish circuits over said control conductors to control said associated recorder in accordance with said registrations.

10. In a signaling system, a plurality of recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, a plurality of registers in said circuit for registering the fractional hour and the tens and units digits of the hour of the day, the tens and units digits of the day of the month and the digits of the month of the year, a plurality of control conductors terminating in said registers and extensible by said means to said associated recorder, means operative upon the seizure of said circuits for testing said control conductors for false grounds and crosses with each other, and alarm means operable in the event that a false ground or crossed condition is found.

11. In a signaling system, a plurality of recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, a plurality of registers in said circuit for registering the fractional hour and the tens and units digits of the hour of the day, the tens and units digits of the day of the month and the digits of the month of the year, a clock-operated relay for controlling the advance of said registers, a plurality of control conductors terminating in said registers and extensible by said means to said associated recorder, means operative upon the seizure of said circuits for testing said control conductors for false grounds and crosses with each other, means thereafter effective for progressively rendering said registers effective to selectively establish circuits over said control conductors to control said associated recorder in accordance with said registrations, and means operative during said tests and during the control of said recorder to hold said relay operated to prevent the advance of said registers.

12. In a signaling system, a plurality of recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, a plurality of registers in said circuit for registering the fractional hour and the tens and units digits of the hour of the day, the tens and units digits of the day of the month and the digits of the month of the year, a plurality of control conductors terminating in said registers and extensible by said means to said associated recorder, a polarized test relay, means effective upon the seizure of said circuit for as-

sociating all of said control conductors with a winding of said relay and for so poling said relay as to render it responsive only to a false ground on any one of said conductors, and alarm means operable in the event said relay responds to a false ground condition.

13. In a signaling system, a plurality of recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, a plurality of registers in said circuit for registering the fractional hour and the tens and units digits of the hour of the day, the tens and units digits of the day of the month and the digits of the month of the year, a plurality of control conductors terminating in said registers and extensible by said means to said associated recorder, a polarized test relay, means effective upon the seizure of said circuit for associating all of said control conductors with a winding of said relay and for so poling said relay as to render it responsive only to a false ground on any one of said conductors, means for thereafter so poling said relay and for rendering it marginal in operation as to render it responsive only to battery applied simultaneously to two or more of said conductors because of crosses therebetween, and alarm means operable in the event said relay responds to either a false ground or a crossed conductor condition.

14. In a signaling system, a plurality of recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, a plurality of step-by-step registers in said circuit for registering the fractional hour and the tens and units digits of the hour of the day, the tens and units digits of the day of the month and the digits of the month of the year, means for rendering said circuits busy to all recorders, an exercise key, and means controlled by the operation of said key if said circuit is not associated with any recorder at the time it is made busy for establishing a self-interrupting stepping circuit for each of said registers whereby the brushes thereof are rapidly advanced over the terminals of their arcs so long as said key is maintained operated whereby said terminals and brushes are burnished for better conductivity.

15. In a signaling system, a plurality of recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, a plurality of step-by-step registers in said circuit for registering the fractional hour and the tens and units digits of the hour of the day, the tens and units digits of the day of the month and the digits of the month of the year, a plurality of control conductors terminating in the terminals of an arc of each of said registers and extensible by said means to an associated recorder, means for rendering said circuit busy to all recorders, an exercise key, a first and a second relay operable by said key, said first relay operative to connect ground to all of said control conductors and said second relay operative to complete a self-interrupting stepping circuit for each of said registers over the brush and the terminals of the arc associated therewith to which said grounded control conductors are connected whereby the brushes thereof are rapidly advanced over the terminals of their arcs to burnish them for better conductivity and whereby the continuity of the circuit paths over said control conductors are tested.

16. In a signaling system, a plurality of recorders, a plurality of month, day and hour circuits, means for associating any recorder with an idle one of said circuits, a plurality of step-by-step registers in said circuit for registering the fractional hour and the tens and units digits of the hours of the day, the tens and units digits of the days of the month and the digits of the month of the year, a plurality of control conductors terminating in the terminals of an arc of each of said registers and extensible by said means to an associated recorder, means for rendering said circuit busy to all recorders, an exercise key, a first and a second relay operable by said key, said first relay operative to connect ground to all of said control conductors and said second relay operative to complete a self-interrupting stepping circuit for each of said registers over the brush and the terminals of the arc associated hterewith to which said grounded control conductors are connected whereby the brushes thereof are rapidly advanced, and a further self-interrupting stepping circuit for each of said registers for insuring the continued advance thereof so long as said key is maintained operated.

17. In a signaling system, a clock, and a plurality of signal transmitting circuits each comprising a plurality of registers operable from said clock to register various calendar and time periods including the hour and fraction thereof, the day and the month, and means for synchronizing the settings of the registers of any one of said circuits with the settings of the corresponding registers of another of said circuits used as a master circuit.

18. In a signaling system, a clock, and a plurality of signal transmitting circuits each comprising a plurality of step-by-step registers operable from said clock to register various calendar and time periods including the hour and fraction thereof, the day and the month, a plurality of groups of lamps common to said signal transmitting circuits, each group of lamps associable with one of said registers and a relay individual to each signal transmitting circuit operable to cause one lamp of each group to be lighted to indicate the settings of the registers of the corresponding transmitting circuit for comparison with the correct calendar date and clock time.

19. In a signaling system, a clock, a plurality of signal transmitting circuits each comprising a plurality of step-by-step registers operable from said clock to register various calendar and time periods including the hour and fraction thereof, the day and the month, each of said registers having a plurality of arcs of contacts, a group of indicating lamps associable with each register, each lamp being connected in multiple to corresponding terminals of corresponding arcs of corresponding registers of all of said circuits, a master checking relay, means for operating the master checking relay of any one of said circuits and means controlled by said relay for establishing circuits for one lamp of each group to indicate the settings of the registers of the circuit whose master relay is operated for comparison with the correct calendar date and clock time.

20. In a signaling system, a clock, a plurality of signal transmitting circuits each comprising a plurality by step-by-step registers operable from said clock to register various calendar and time periods including the hour and fraction thereof, the day and the month, each of said registers having a plurality of arcs of contacts, a checking relay for each register, a group of indicating lamps associable with each register, multiple connections extending between corresponding

terminals of corresponding arcs of corresponding registers of all of said circuits to which said lamps are connected, a master checking relay and means for operating the master relay of any circuit to cause one lamp associated with each of its registers to light to indicate the settings of its registers and to cause the operation of the register checking relays of all the other circuits whose registers have settings corresponding to the register settings of the circuit selected as a master circuit by the operation of its master checking relay, an alarm device and means for operating said alarm device in the event that any checking relay fails to operate to thereby indicate an unsynchronized condition of a register.

21. In a signaling system, a clock, a plurality of signal transmitting circuits each comprising a plurality of step-by-step registers operable from said clock to register various calender and time periods including the hour and fraction thereof, the day and the month, each of said registers having a plurality of arcs of contacts, a checking relay for each register, a checking lamp for each register, a master checking relay and means for operating said master checking relay, a group of indicating lamps associable with each register, multiple connections extending between corresponding terminals of corresponding arcs of corresponding registers of all of said circuits, circuits controlled over said multiple connections by the successive operation of the master checking relays of said circuits to light lamps of said groups to indicate the settings of the registers of each circuit for comparison with the correct calendar date and clock time and to operate the register checking relays of other circuits whose corresponding registers are correctly positioned, means for removing any circuit from service whose registers are indicated by said indicating lamps to be incorrectly set, and circuits controlled by said latter means and the unoperated register checking relays of such circuits for lighting the associated checking lamps to indicate which registers require synchronizing.

22. In a signaling system, a clock, a plurality of signal transmitting circuits each comprising a plurality of step-by-step registers operable from said clock to register various calendar and time periods including the hour and fraction thereof, the day and the month, means for indicating when registers of any one of said circuits are incorrectly set, means for removing said circuit from service, means thereupon controlled to indicate which one or ones of said registers require resetting, a setting key for each of said registers operable to advance it step-by-step, and means operable when each register has been advanced to its correct position to restore said latter indicating means.

23. In a signaling system, a clock, a plurality of signal transmitting circuits each comprising a plurality of step-by-step registers operable from said clock to register various calendar and time periods including the hour and fraction thereof, the day and the month, each of said registers having a plurality of arcs of contacts, a checking relay for each register, a checking lamp for each register, a setting key for each register, a master checking relay and means for opertating said master checking relay, a group of indicating lamps associable with each register, multiple connections extending between the corresponding terminals of corresponding arcs of corresponding registers of all of said circuits, circuits controlled over said multiple connections by the successive operation of the master checking relays of said circuits to light lamps of said groups to indicate the settings of the registers of each circuit for comparison with the correct calendar date and clock time and to operate the register checking relays of other circuits whose corresponding registers are correctly positioned, means for removing any circuit from service whose registers are indicated by said indicating lamps to be incorrectly set, circuits controlled by said latter means and the unoperated register checking relays of such circuits for lighting the associated checking lamps to indicate which registers thereof require synchronizing, and means controlled by the operation of the setting key of any register indicated to be out of synchronism for advancing said register step-by-step, the lighted checking lamps being all extinguished when the registers have all been correctly set.

24. In a signaling system, a clock, a plurality of signal transmitting circuits each comprising a plurality of step-by-step registers operable from said clock to register various calendar and time periods including the hour and fraction thereof, the day and the month, a checking relay for each register, a checking lamp for each register, and a synchronizing key, means for indicating when registers of any one of said circuits are incorrectly set, means for removing said circuit from service, means controlled thereby to light the checking lamps of all registers which require resetting, means controlled by said key for transmitting stepping impulses to advance such registers as require resetting, and means for operating each of said register checking relays when its associated register becomes correctly set whereby all lighted checking lamps become extinguished and the transmission of impulses to said registers is arrested.

FRANK E. BLOUNT.

Disclaimer

2,355,903.—*Frank E. Blount*, Cedar Grove, N. J. SIGNALING SYSTEM. Patent dated Aug. 15, 1944. Disclaimer filed Oct. 31, 1947, by the assignee, *Bell Telephone Laboratories, Incorporated.*

Hereby enters this disclaimer to the subject-matter of claim 1.

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