

Sept. 28, 1943.

T. H. MOTE

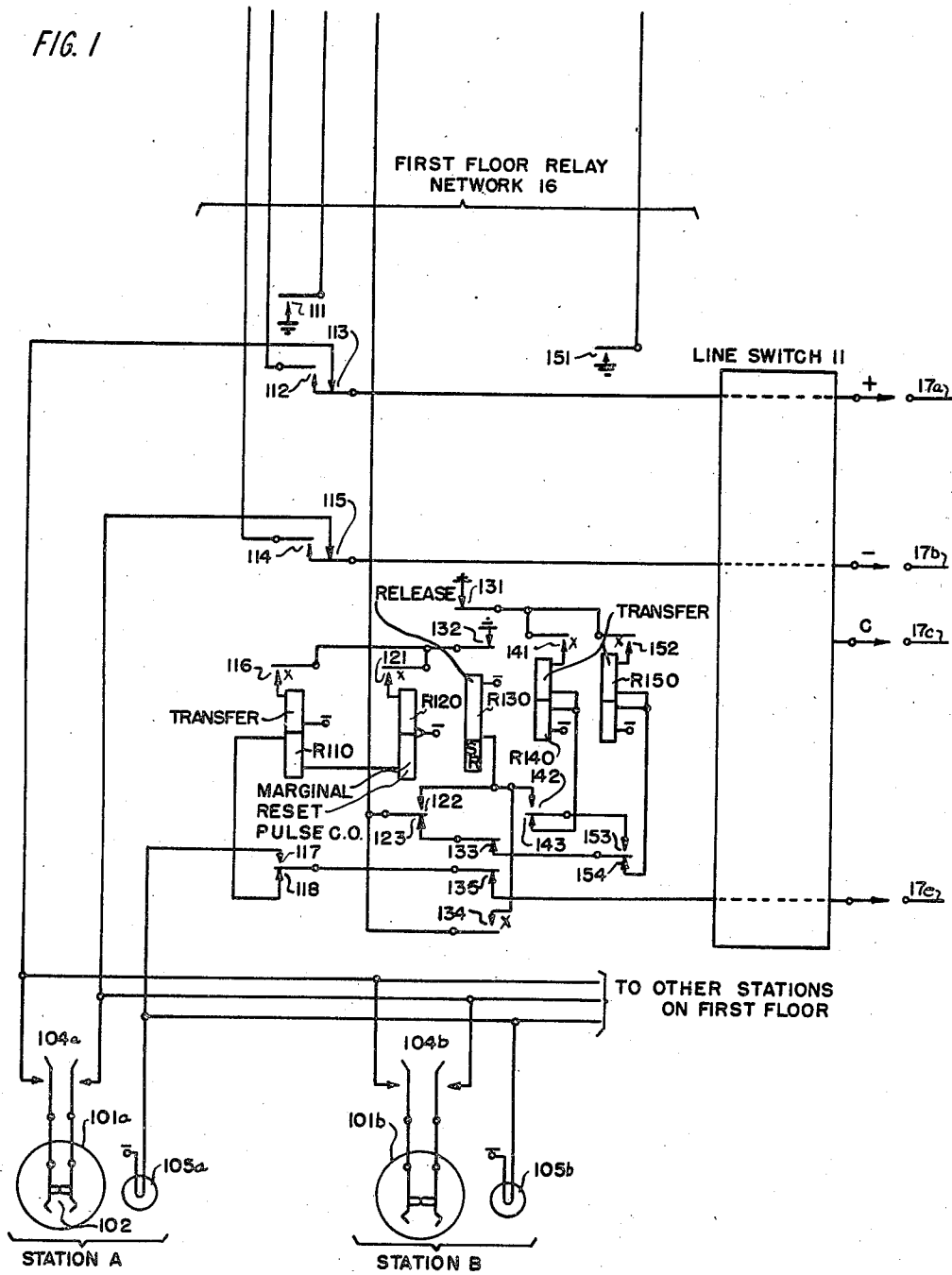
2,330,357

SIGNALING SYSTEM

Filed April 26, 1941

5 Sheets-Sheet 1

FIG. 1



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2,330,357

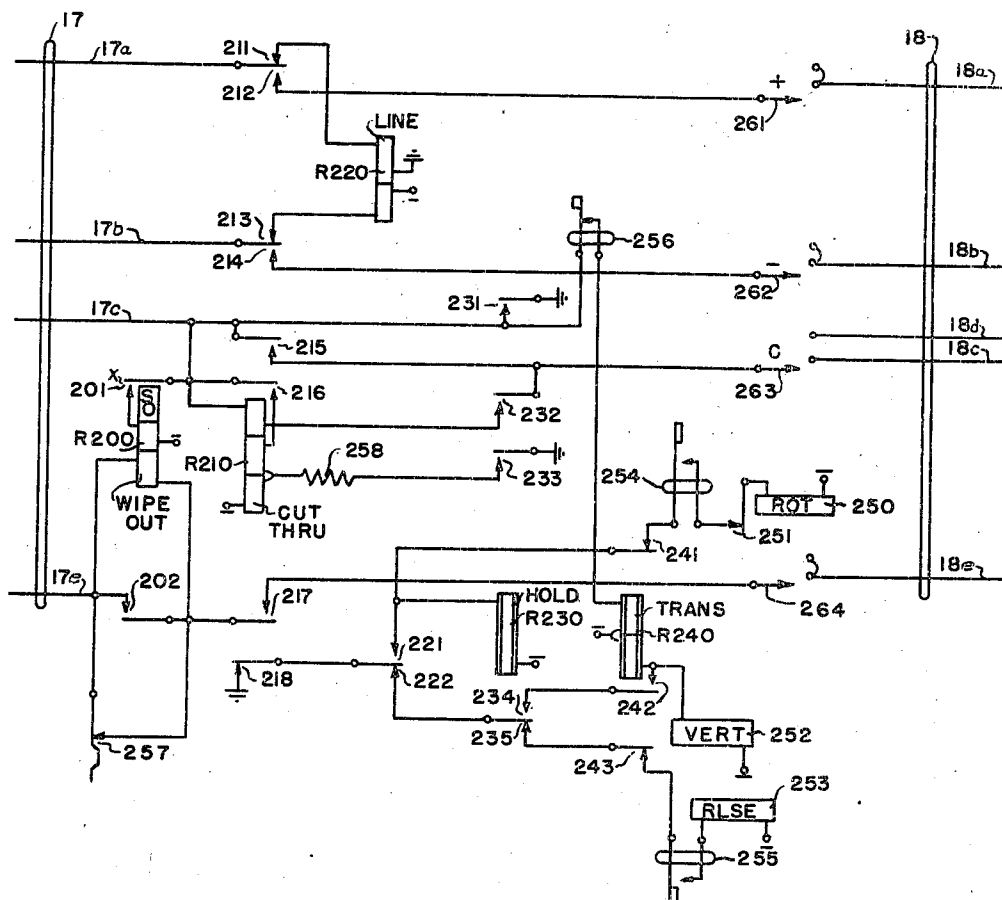
SIGNALING SYSTEM

Filed April 26, 1941

5 Sheets-Sheet 2

FIG. 2

SELECTOR SWITCH 12



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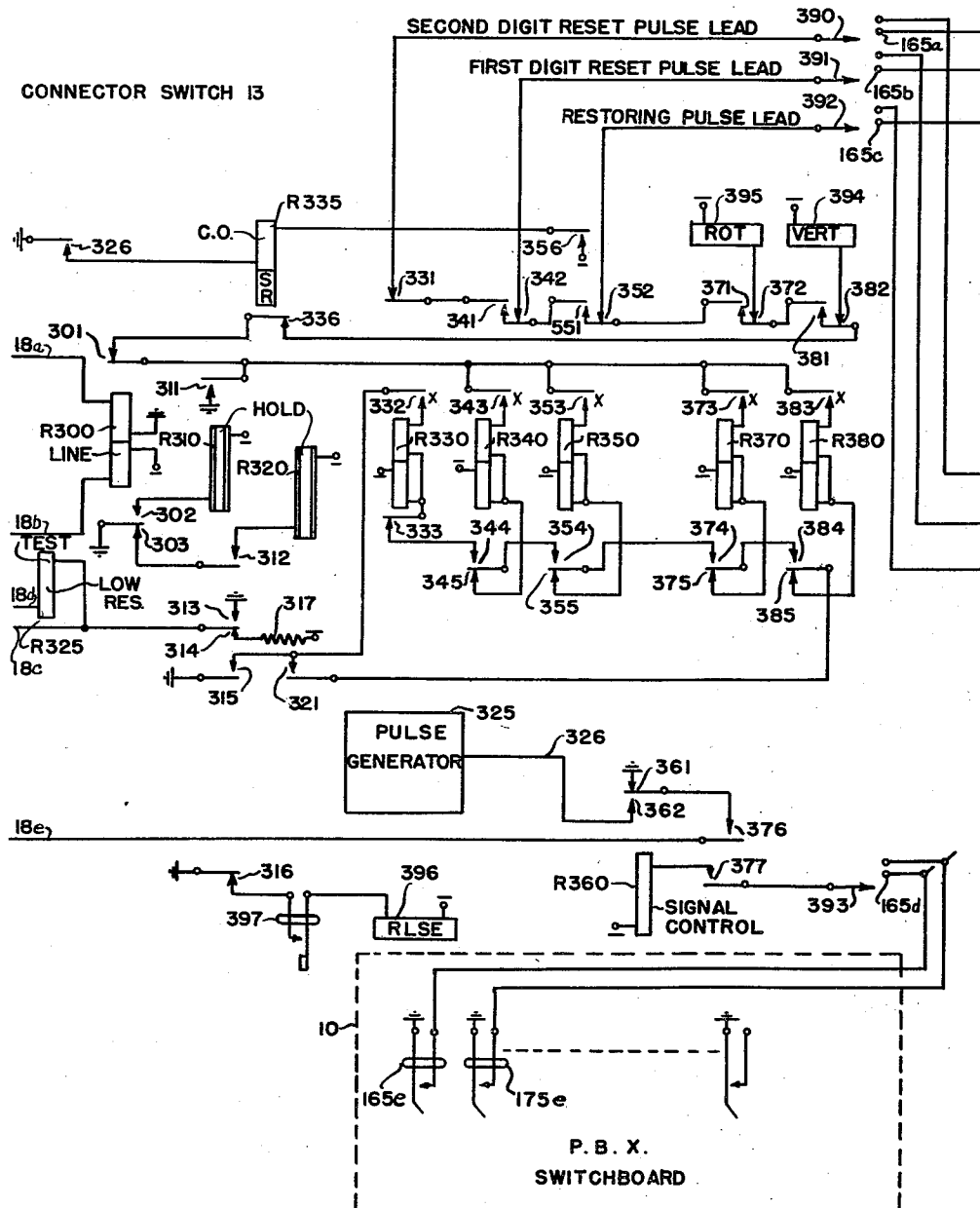
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SIGNALING SYSTEM

Filed April 26, 1941

5 Sheets-Sheet 3

FIG. 3



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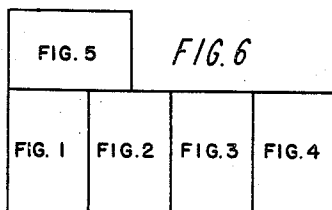
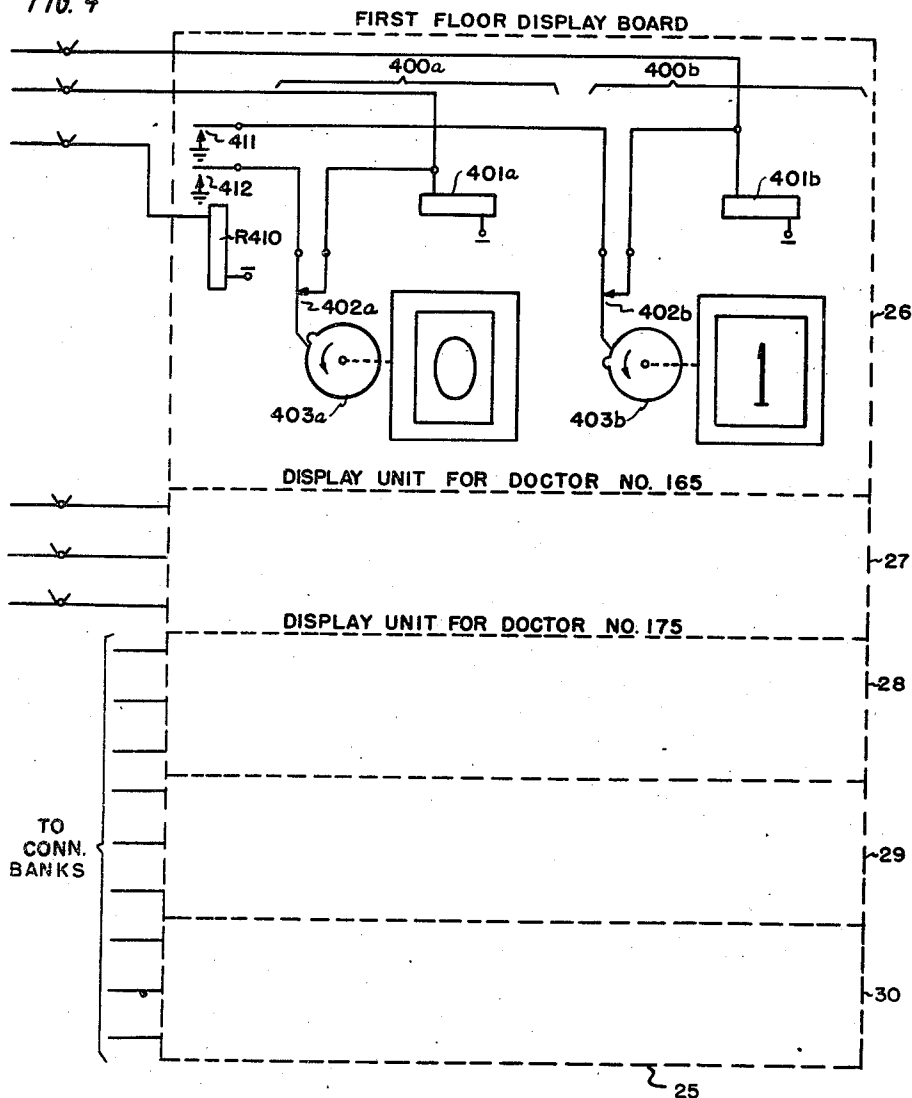
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SIGNALING SYSTEM

Filed April 26, 1941

5 Sheets-Sheet 4

FIG. 4



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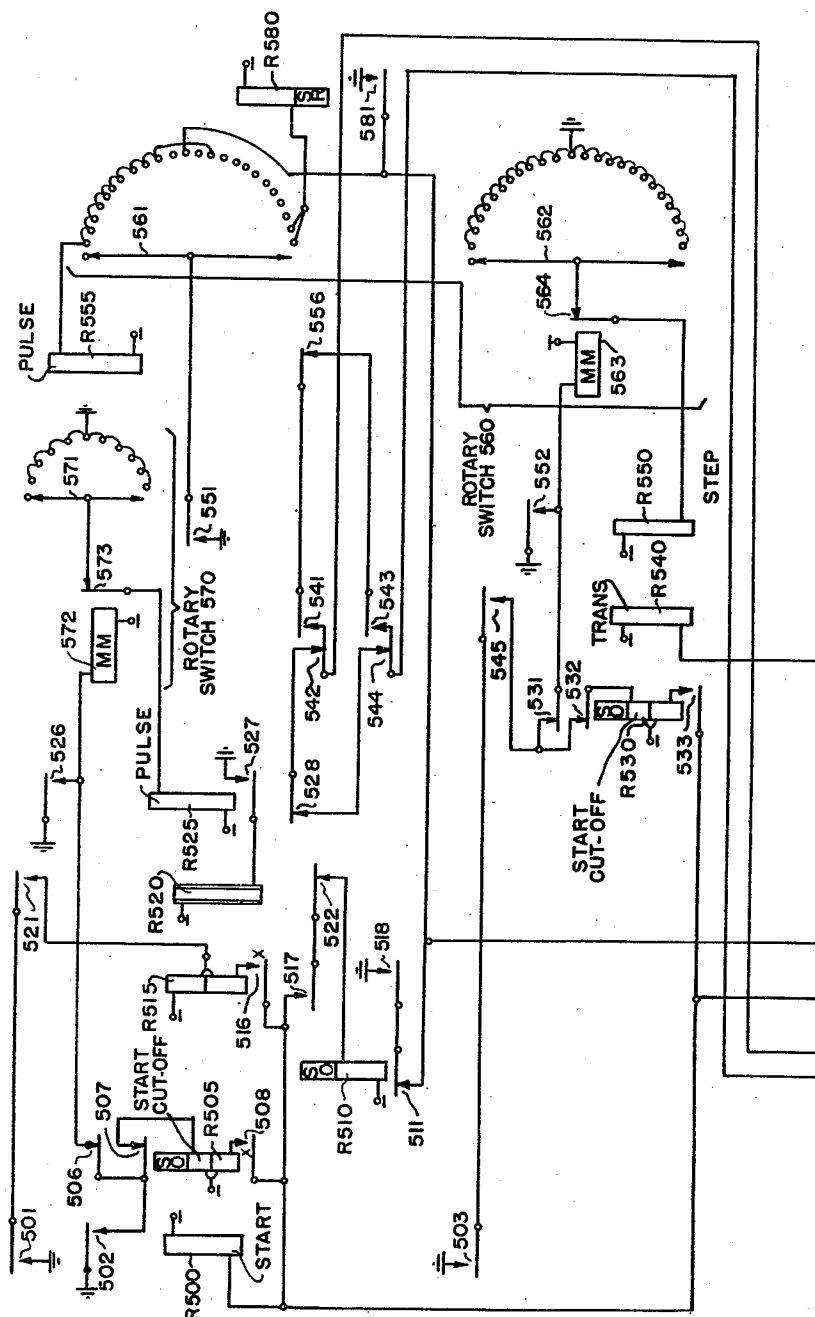
SIGNALING SYSTEM

Filed April 26, 1941

5 Sheets-Sheet 5

FIG. 5

PULSE SENDER 15



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UNITED STATES PATENT OFFICE

2,330,357

SIGNALING SYSTEM

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Application April 26, 1941, Serial No. 390,557

8 Claims. (Cl. 177-353)

The present invention relates to systems for indicating the location of one or more persons or objects which may be located in different zones of a plural zone area, and more particularly to improvements in systems for providing accurate information as to the whereabouts of a large number of doctors who may be working on the different floors of a large hospital. An improved system of this character is disclosed and claimed in the co-pending application, Serial No. 390,624, filed April 26, 1941, Alfred H. Belliveau, which is assigned to the same assignee as the present invention, and the present invention relates to improvements thereover. In the system disclosed in the Belliveau application, a display board is provided on each floor of the hospital and each board includes display registers or indicators of the pulse controlled rotatable drum type. The indicators are divided into sets which are individual to the various doctors and are selectively controllable through automatic switching equipment from control stations conveniently located on the floors of the hospital to indicate the floors where the doctors may be located. Control of the automatic switching equipment and the selected indicators is effected through operation of signal transmitting devices of the conventional dial operated type which are individually provided at the various control stations. Although the system is simple in arrangement, fully satisfactory in operation, and includes several improved and novel operating features, it requires an automatic switch for each floor, the capacity of the system is limited to the provision of indicators for a maximum of two hundred doctors, and upwards of three indicators or display registers are required for each doctor in each display board when the system is installed in a building having more than twenty floors or zones.

Accordingly, it is an object of the present invention to provide an improved system of the character described which has a large posting capacity and in which the display units may be selected and controlled by the dialing of identification numbers having only a few digits.

It is a further object of the invention to provide an improved system of the character described, wherein the dialing operations required at the various control stations, in order to select a set of indicators and effect a change in the setting thereof, are minimized by providing auxiliary pulse sending equipment which is automatically seized from the various control stations.

It is another object of the invention to provide an improved system of the character described, wherein the indicators of the display boards are selectively controlled through automatic concentration switches which are common to the various control stations.

It is a further object of the invention to pro-

vide an improved system of the character described, in which the number of indicators individual to each person or object posted on the display boards and required to indicate the zone locations of such persons or objects is minimized.

It is still another object of the invention to provide an improved arrangement, whereby the switching facilities of the system may be utilized automatically to signal the doctors who may be located in the various zones to call a specified telephone operator located in the area.

It is a further and more specific object of the invention to provide such an arrangement, wherein each doctor who is wanted by the telephone operator is automatically signaled to that effect when he calls in from one of the control stations to effect a change in the setting of the indicators provided for his use on the display board.

In the illustrated embodiment of the invention each display unit is comprised of two pulse controlled electro-magnetically operated display registers or indicators. Each indicator includes an element having a normal or blank position and ten off-normal positions wherein the numerals from one to nine are displayed thereby. In order to select and control the operating magnets of the indicators, automatic switching equipment is provided which includes connector switches having access to the pulsing circuits which extend to the operating magnets of the indicators. These circuits are so arranged that one of the two indicators in each unit is used as a tens indicator and functions to display the tens digit of two-digit numbers identifying the various floors of the hospital, and the other indicator is used as a units indicator to display the units floor numbers. The pulsing circuits are further arranged to permit the indicators of a selected unit to be restored to their normal or blank positions in unison through the transmission of restoring pulses thereto over a common restoring pulse circuit. The resetting of the indicators of a selected unit is effected through the transmission of successive trains of reset pulses to the two indicators of the unit over separate reset pulse circuits. In accordance with another feature of the invention, the transmission of the restoring and reset pulses is effected through operation of automatic plural digit pulse senders which are individual to the control stations of each floor. The operation of each sender is effected in response to the selection of a set of indicators from one of the control stations located on the associated floor.

In accordance with another feature of the invention, the indicator control facilities are coordinated with the telephone communication facilities of the hospital to permit the paging of doctors who may be occupied with various duties

on the several floors of the building. To this end, marking paths individual to the various doctors and extending to the outlet contacts of the connector switches are provided. These paths may be selectively controlled from the branch exchange switchboard of the hospital so that when a doctor calls in from a control station to effect a change in the setting of the indicators provided for his use on the display boards, a signal is automatically transmitted to the control station in use. This signal informs the calling doctor that he should get in touch with the operator attending the branch exchange switchboard over the regular telephone facilities.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the specification taken in connection with the accompanying drawings in which Figs. 1, 2, 3, 4 and 5, when combined in the manner shown in Fig. 6, illustrate a portion of the equipment provided in a system which includes the features of the invention briefly outlined above.

Referring now more particularly to the drawings, the system there illustrated comprises a plurality of display boards which are individual to the various floors of the hospital, and each of which is conveniently located for easy observation from any point in the corridor of the floor on which it is located. One such display board is indicated at 25 as being provided on the first floor of the hospital. This display board comprises a plurality of display units 26, 27, 28, 29, 30, etc., which individually correspond to the doctors whose locations are to be posted thereon. For example, the display unit 26 may be utilized to indicate the location of the doctor who is assigned the identification number 165, and the display unit 27 may be utilized to indicate the location of the doctor who is assigned the identification number 175. The various display boards are of identical arrangement and, as will appear more fully hereinafter, are so arranged that the units of each set which correspond to a particular doctor are controlled in unison. The individual display units of the display boards are also identical in arrangement, the illustrated unit 26 comprising a restoring relay R410 and a pair of floor indicating display registers or indicators 400a and 400b. These registers are of the well-known electro-mechanical type, as shown, for example, in Figure 22 of Patent No. 2,234,684, granted March 11, 1941, to Harold C. Robinson and Martin L. Nelson, and each thereof is provided with a display drum which may be rotated from a normal or blank position to any one of ten off-normal positions wherein the numerals one to nine and zero are respectively displayed thereby. More specifically, the register 400a is provided to display the tens digit of any floor number from ten to ninety-nine, and the register 400b is provided to display the units digit of such floor numbers. The indicating drum of each display register 400 is mounted on a drive shaft to which rotary movement is imparted in one direction only by an associated pulse controlled operating magnet 401 through an associated ratchet and pawl or Geneva gear mechanism, not shown. The drive shaft of each register also carries a cam 403 which is arranged to control an associated set of commutating con-

tacts 402 in the manner more fully explained hereinafter.

The control of the various display boards is effected from control stations which are conveniently located on each floor of the hospital. Thus the first floor of the building is provided with two control stations A and B, each of which includes a signal transmitting device 101, a connect key 104, and a pilot lamp 105. The connect keys 104 are of the well-known locking type. Each signal transmitting device 101 is of the dial-operated type conventionally used in substations of automatic telephone systems, and comprises a set of pulsing springs 102.

The selection and selective control of the indicators included in the various display units of the display boards is effected through the provision of automatic switching equipment, the major portion of which is common to all of the control stations in the hospital. More specifically, this equipment includes line switches individual to the various floors of the hospital and having access to a group of selector switches which, in turn, have access to five groups of connector switches through which the various display units may selectively be seized for control purposes. In the drawings, only a single line switch 11, individual to the control stations on the first floor, a single selector switch 12 and a single connector switch 13, are illustrated. The various connector switches of each group each have access to the display units individual to one hundred doctors and, since five groups are provided, the total posting capacity of the illustrated system is five hundred doctors. It will be understood, however, that by providing additional switching stages the capacity of the system may be expanded as desired. For example, if second selectors are interposed between the first selectors and the connectors, and additional groups of connectors are provided, the system capacity may be increased to five thousand doctors. The various line switches individual to the several floors are of conventional construction and arrangement and, accordingly, the line switch 11 has been only schematically illustrated in the drawings. This line switch, as well as the line switches individual to the other floors, may be of the well-known plunger type or the well-known rotary type, as desired.

Each of the selector and connector switches includes a two-motion switching mechanism of the well-known Strowger type which is equipped with four banks of contacts each including one hundred contact points. The contacts making up each contact field are divided into ten levels of ten contact sets each, and each of the four banks has associated therewith a wiper which is carried by an associated wiper carriage structure of well-known construction and arrangement. Thus the selector switch 12 is illustrated in Fig. 2 of the drawings as comprising a contact field divided into four banks having the wipers 261, 262, 263 and 264 individually associated therewith. The trunks extending to the connector switches accessible to the selector switch 12, are each terminated at two sets of contacts in adjacent levels of the selector switch. Thus the trunk 18 extending to the connector switch 13, is multiplied to the corresponding contact sets of the first and second levels of the contact field embodied in the selector switch 12. The purpose of this arrangement is to permit the doctors selectively to wipe out indications displayed by the indicators provided for their use, or to reset these

indicators to display new indications, by dialing either of two identification numbers at any one of the control stations. The manner in which this is accomplished is more fully considered in the following detailed description of the operation of the system. For the purpose of elevating the enumerated wipers to a position opposite a desired level of bank contacts, and then rotating the same into engagement with a selected set of contacts of a selected level, vertical and rotary magnets 252 and 250 are included in the switching mechanism. The mechanism further comprises a release magnet 253 which, when energized, permits the wiper carriage structure to be returned to rotary and vertical normal; three sets of off-normal springs 254, 255 and 256 which are operated when the wiper carriage structure is moved to any vertical off-normal position, and a set of normal post springs 257 which are normally engaged and which are moved out of engagement when the wipers 261 to 264, inclusive, are elevated to a position opposite any odd-numbered level of bank contacts. The operation of the magnets 250, 252 and 253 is controlled by providing in the selector switch 12 a set of control relays which includes a line relay R220, a hold relay R230, a transfer relay R240, a cut-through relay R210 and a wipe out relay R230. It will be recognized that the two relays R230 and R240 are of the well-known slow-acting type, and that the wipe out relay R200 is of the conventional slow-to-operate type.

The Strowger switching mechanism incorporated in the connector switch 13 includes wipers 390, 391, 392 and 393 individual to the four banks of the associated contact field, a vertical magnet 394, a rotary magnet 395, a release magnet 396, and vertical off-normal springs 397. The control network of this switch includes a line relay R300, a pair of slow-acting hold relays R310 and R320, a level test relay R325 having a low resistance winding, a slow-to-release pulse circuit cut-off relay R335, a signal control relay R360 and five transfer relays R330, R340, R350, R370 and R380. Each of the five transfer relays is of the well-known double-wound, two-step type.

As indicated by the above description, the selector and connector switches of the system are directly controlled through operation of the signal transmitting devices provided at the various control stations to select the indicators individual to the various doctors. The actual control of the selected indicators to effect a change in the indications displayed thereby, is effected through the operation of automatic plural digit pulse senders which are individual to the various floors. One such pulse sender 15 is illustrated in Fig. 5 of the drawings as being associated with the first floor control stations A, B, etc. Briefly described, this sender comprises a pair of rotary switches 560 and 570, and a plurality of control relays R500, R505, R510, R515, R520, R525, R530, R540, R550, R555 and R580. Of the enumerated relays, it will be recognized that the relays R505, R510 and R530 are of the well-known slow-to-operate type, the relay R515 is of the conventional double-wound, two-step type, the relay R520 is of the well-known slow-acting type, and the relay R580 is of the slow-to-release type. The rotary switch 570 includes a single set of contacts having eleven points, a contact wiper 571, and an operating magnet 572 for driving this wiper over the contacts of the associated contact set. The rotary switch 560, on the other hand, comprises two banks of contacts, each in-

cluding twenty-five contact points, wipers 561 and 562 individual to the contact banks, and an operating magnet 563 for driving the two wipers 561 and 562 over the contacts of their associated contact banks.

For the purpose of operatively associating the pulse sender 15 with the pulsing circuits extending to a selected set of indicators, and the additional purpose of controlling the pilot lamps 105 provided at the first floor control stations A, B, etc., a relay network 16 individual to the first floor control stations is provided. Similar networks are provided to operate in conjunction with the pulse senders and the control stations of the other floors. Briefly described, the network 16 comprises a transfer relay R110, a marginal reset pulse cut-off relay R120, a release relay R130 of the slow-to-release type, and a pair of digit transfer relays R140 and R150 which are of the two-step type.

As indicated above, provisions are made in the system whereby the automatic switching equipment just described may be utilized to page the various doctors attached to the hospital staff. To this end, the private branch exchange switchboard 10 of the hospital is equipped with marking keys 165a, 175a, etc., which are individual to the doctors whose names are posted on the display boards. These keys control marking paths which extend to the outlet contacts of the various connector switches so that flashing signals may be produced by the lamps 105, for example, when a doctor who is wanted at the switchboard dials his identification number at one of the first floor stations A, B, etc. The intermittent energization of the signal lamps is controlled through the provision of a pulse generator, schematically indicated at 325, which operates intermittently to connect the pulsing lead 326 to ground. Preferably, the pulse generator 325 is constructed to transmit ground pulses over the lead 326 at a rate of one hundred and twenty pulses per minute.

Current for energizing the indicator operating magnets, the control relays, the pilot lamps, the operating magnets of the rotary switches, and the operating magnets of the Strowger switching mechanisms is supplied from a common direct current source, the positive terminal of which is connected to a common bus conductor and to ground. The negative terminal of the source is connected to a common negative bus conductor which terminates the various relay, magnet and lamp terminals identified in the drawings by the negative polarity sign. For convenience in describing the circuits involved, this source of current, which may conventionally comprise a storage battery floated across the terminals of a charging rectifier, has not been shown.

In considering the operation of the system, it may be assumed that the doctor who is assigned the identification number 165 enters the hospital and remains on the first floor where he will be occupied for a considerable period of time. If this doctor desires to place himself on call he may do so by actuating the transmitting device provided at one of the control stations on the first floor to transmit the digits of his identification number to the automatic switching equipment. Assuming that the station A is selected for this purpose, the doctor, before starting the dialing operation, actuates the connect key 104a to its off-normal position, thereby to complete a circuit including the contacts 113 and 115, and the pulsing contacts 102 of the transmitting de-

vice 101a, for energizing the line relay conventionally embodied in the line switch 11. When a loop circuit is thus completed between the station A and the line switch 11, this line switch operates in a well-known manner to extend the loop circuit to an idle one of the selector switches. Assuming that the selector switch 12 is the first idle selector switch available, the wipers of the line switch 11 are either plunged or rotated to engage the contacts terminating the conductors of the trunk 17, in response to the operation of the line relay embodied in the line switch. After the trunk 17 is thus selected, the calling loop circuit is extended to include the windings of the line relay R220. As thus extended, this circuit may be traced as extending from ground by way of the upper winding of R220, the contacts 211, the conductor 17a, the positive wiper of the line switch 11, the contacts 113, the left contacts of the key 104a, the pulsing springs 102, the right contacts of the key 104a, the contacts 115, the negative wiper of the line switch 11, the conductor 17b, the contacts 213, and the lower winding of R220 to battery. Upon operating, the relay R220 closes its contacts 221 to complete a circuit including the contacts 218 for energizing the slow-acting hold relay R230. The relay R230 now operates and closes its contacts 231 to complete an obvious path for impressing ground potential upon the release conductor 17c, thereby to mark the selector switch 12 as busy in the outlet contacts of the various line switches, and to provide a holding circuit for the operated cut-off relay conventionally embodied in the line switch 11. At its contacts 231, the relay R230 also completes a circuit, including the engaged off-normal springs 256, for energizing the upper winding of the slow-acting transfer relay R240. At its contacts 232, the relay R230 prepares a circuit for energizing the upper winding of the relay R210. At its contacts 233, the relay R230 completes a circuit including the resistor 253 for energizing the lower or priming winding of the cut-through relay R210. The energization of the relay R210 over the last-mentioned circuit is insufficient to cause the operation of this relay, but serves to render the relay exceedingly fast to operate when its upper winding is subsequently energized. At its contacts 235, the relay R230 opens a point in the operating circuit for the release magnet 253. At its contacts 234, the relay R230 prepares a circuit for energizing the vertical magnet 252 in parallel with the lower winding of the transfer relay R240. The transfer relay R240, upon operating, opens its contacts 241 to prevent current pulses from being delivered to the rotary magnet 250 during the dialing of the first digit at the calling control station A. At its contacts 242, the relay R240 further prepares the above-mentioned circuit for energizing its lower winding in parallel with the vertical magnet 252. At its contacts 243, the relay R240 opens another point in the operating circuit for the release magnet 253. Following the operation of the transfer relay R240 to perform the functions just described, the selector switch 12 is conditioned to respond to the impulses of the first digit dialed at the station A.

When the first digit "1" is dialed at the station A, the pulsing springs 102 are opened and closed to transmit an impulse over the above-traced loop circuit to the line relay R220. This relay, upon restoring at the beginning of the open-circuit period of the impulse, opens its contacts 221 to interrupt the operating circuit for the hold relay

R230, and closes its contacts 222 to complete the prepared circuit for energizing the vertical magnet 252 in parallel with the lower winding of the transfer relay R240. The latter circuit extends from ground by way of the contacts 218, 222, 234 and 242, and the parallel-connected windings of the relay R240 and the vertical magnet 252 to battery. When energized over this circuit, the vertical magnet 252, operating in conjunction with its associated ratchet and pawl mechanism, functions to actuate the wipers 261 to 264, inclusive, one step in the vertical direction to a position opposite the first level of contacts in the associated contact field. When the wipers of the selector switch 12 are thus elevated to a position opposite an odd-numbered level of bank contacts the normal post springs 257 are disengaged to interrupt the path normally short-circuiting the lower or operating winding of the wiper out relay R260. Incident to this movement of the wiper carriage structure the vertical off-normal springs 254 are moved into engagement to prepare the operating circuit for the rotary magnet 250; the vertical off-normal springs 255 are engaged to prepare the operating circuit for the release magnet 253; and the vertical off-normal springs 253 are disengaged to deenergize the upper winding of the transfer relay R240. The purpose of energizing the lower winding of this transfer relay in parallel with the winding of the vertical magnet 252, during the dialing of the first digit, now becomes apparent. Thus this parallel circuit provides a vehicle whereby the transfer relay is intermittently energized and thereby maintained in its operated position throughout the series of impulses transmitted to the selector switch 12. In this regard, it will be understood that a first digit comprising any number of impulses from one to ten may be dialed at a calling control station from which the selector switch 12 is seized. Due to the slow-to-release characteristics thereof, the relays R230 and R240 remain operated during the operation of the line relay R220 to repeat the dialed impulse or impulses to the vertical magnet 252.

Shortly following the end of the first digit, the transfer relay R240 restores. In releasing, this relay opens its contacts 242 to prevent further impulses from being transmitted to its lower winding and the winding of the vertical magnet 252 in parallel, and closes its contacts 243 further to prepare the operating circuit for the release magnet 253. At its contacts 241, the relay R240 completes a circuit for energizing the rotary magnet 250, this circuit extending from ground by way of the contacts 218, 221 and 241, the off-normal springs 254, the contacts 251, and the winding of the rotary magnet 250 to battery. When thus energized, the magnet 250 operating in conjunction with its associated ratchet and pawl mechanism functions to rotate the wipers 261 to 264, inclusive, into engagement with the contacts forming the first contact set of the selected level. At its contacts 251, the magnet 250 opens its own operating circuit. Further operation of the magnet 250 depends upon the idle or busy condition of the first trunk in the selected group, i. e. the trunk terminated at the first set of contacts in the selected level and extending to the first connector switch of the selected group. If this trunk is busy, the private conductor thereof is marked with ground potential and, accordingly, the upper winding of the cut-through relay R210 is short-circuited over a path which extends by way of the grounded wiper 263, the contacts 232,

the upper winding of R210 and the contacts 231 back to ground. On the other hand, if the first trunk of the group is idle the private conductor thereof is marked with negative battery potential, so that a circuit is completed for energizing the upper winding of the cut-through relay R210. Assuming that the first trunk is busy, the magnet 252 restores and closes its contacts 251 to recomplete its operating circuit. When this circuit is recompleted the magnet 250 reoperates and advances the wipers 261 to 264, inclusive, a second step wherein they engage the contacts terminating the conductors of the trunk extending to the second connector switch of the selected group. If this connector switch is also busy the magnet 250 advances the wipers 261 to 264, inclusive, a third step, thereby to select the third switch of the group. This stepping operation on the part of the selector switch wipers 261 to 264, inclusive, continues until an idle connector switch of the group is found. Assuming that the connector switch 13 is the first idle switch in the group, the rotary movement of the wipers 261 to 264, inclusive, is arrested when these wipers are positioned to engage the contacts terminating the conductors of the trunk 18. Thus when the wiper 263 engages the contact terminating the conductor 18c, the upper or operating winding of the cut-through relay R210 is energized in a circuit which extends from ground by way of the contacts 231, the upper winding of R210, the contacts 232, the wiper 263, the conductor 18c, the contacts 314, and the resistor 317 to battery. Immediately this circuit is established, the relay R210 operates and opens its contacts 218 to interrupt the above-traced operating circuit for the rotary magnet 250. Thus further rotary movement of the wipers 261 to 264, inclusive, is prevented. At its contacts 218, the relay R210 also opens a point in the operating circuit for the release magnet 253. At its contacts 216, the relay R210 completes a circuit for energizing its middle and lower windings in series, this circuit extending from ground by way of the contacts 231 and 216, and the series-connected middle and lower windings of R210 to battery. At its contacts 215, the relay R210 completes an obvious path for short-circuiting its upper winding. Incident to the closure of the contacts 215 a path, including the contacts 231 and the wiper 263, is completed for impressing ground potential upon the release conductor 18c of the trunk 18, thereby to mark the connector switch 13 against seizure by another of the selector switches. At its contacts 217, the relay R210 prepares a circuit for energizing the relays R110, R120 and R230, and the pilot lamp 105. At its contacts 212 and 214, the relay R210 extends the calling loop circuit to include the wipers 261 and 262, the trunk conductors 18a and 18b, and the two windings of the line relay R300. At its contacts 211 and 213, the relay R210 excludes the windings of the line relay R220 from the calling loop circuit.

When energized in the calling loop circuit, the line relay R300 closes its contacts 302 to complete an obvious circuit for energizing the relay R310. At its contacts 303, the relay R300 opens a point in the operating circuit for the relay R320. At its contacts 301, the relay R300 opens a point in the circuit for transmitting current pulses to the magnets 390, 394 and 395 and the pulsing leads associated with the wipers 391 and 392. The hold relay R310, in operating, closes its contacts 311 to prepare the pulsing circuits just mentioned and to prepare locking circuits for the

transfer relays R340, R350, R370 and R380. At its contacts 312, the relay R310 prepares the operating circuit for the transfer control relay R320. At its contacts 314, the relay R310 opens the path over which negative battery potential is normally impressed upon the release conductor 18c. At its contacts 313, the relay R310 connects the release conductor 18c to ground, thereby to complete a multiple locking circuit for the cut-through relay R210 and the operated cut-off relay of the line switch 11. At its contacts 315, the relay R310 prepares a locking circuit for the relay R330 and the common portion of the operating circuits for the relay R330, R340, R350, R370 and R380. At its contacts 316, the relay R310 opens a point in the operating circuit for the release magnet 396.

As explained above, incident to the operation of the cut-through relay R210, the relay R220 restores to open the operating circuit for the hold relay R230 and to prepare the operating circuit for the release magnet 253. Due to the slow-to-release characteristic, the relay R230 remains operated until the hold relay R310 of the connector switch 13 operates. Thereafter the relay R230 restores and opens its contacts 231 to interrupt the initially completed path for impressing ground potential upon the release conductor 17c, whereby the operating and locking circuits for the relay R210 and the initially completed locking circuit for the cut-off relay of the line switch 11 are opened. At its contacts 232, the relay R230 opens another point in the operating circuit for the relay R210. At its contacts 233, the relay R230 opens the initially completed circuit for energizing the lower winding of the relay R210. At its contacts 235, the relay R230 further prepares the operating circuit for the release magnet 253. Following the operations just described, the calling device 101a provided at the control station A is operatively associated with the line relay R300 of the connector switch 13, and this connector switch is conditioned to respond to the impulses of the second digit of the identification number 165 assigned to the calling doctor.

When the second digit "6" of the doctor's identification number 165 is dialed at the station A, the pulsing springs 102 are opened and closed six times so that six impulses are transmitted to the relay R300. This relay functions to repeat the pulses to the transfer control relay R320 and the vertical magnet 394. Thus each time the relay R300 restores, it closes its contacts 303 to energize the relay R320 over an obvious circuit. At its contacts 302, the relay R300 opens the circuit for energizing the hold relay R310. At its contacts 301, the relay R300 completes a circuit including the contacts 311 and 312 for energizing the vertical magnet 394. From the above explanation, it will be understood that the relay R320 operates at the beginning of the open-circuit period of the first impulse transmitted to the relay R300. Due to its slow-to-release characteristic, this relay remains operated until shortly after the train of six impulses is ended. Similarly, the slow-acting hold relay R310 does not restore in response to the intermittent de-energization of its winding. In operating, the relay R320 closes its contacts 321 to complete a circuit for energizing the lower winding of the transfer relay R380, this circuit extending from ground by way of the contacts 315, 321 and 395, and the lower winding of R380 to battery. When its lower winding is thus energized, the relay

R380 only partially operates to close its preliminary make contacts 383. At these contacts a path is completed for short-circuiting the upper winding of the relay R380, this path extending from ground by way of the contacts 315, 321 and 335, the upper winding of R380 and the contacts 383 and 311 back to ground.

Each time the vertical magnet 394 is energized in the above-traced pulsing circuit it operates in conjunction with its associated ratchet and pawl mechanism to elevate the wiper carriage structure one step, so that at the end of the second digit dialed at the calling station A the wipers 390 to 392, inclusive, are left standing opposite the sixth level of bank contacts. Incident to the first vertical step of the wiper carriage structure, the off-normal springs 397 are moved into engagement to prepare the operating circuit for the release magnet 396. Shortly following the end of the second digit, and during the inter-digit pause between this digit and the third or final digit, the transfer control relay R320 restores. In releasing, this relay opens its contacts 321 to interrupt the above-traced path short-circuiting the upper winding of the transfer relay R380. When this path is opened, the two windings of the relay R380 are energized in series over a circuit which includes the contacts 383 and 311. The relay R380 now completes its operation, and in so doing opens its contacts 385 to interrupt its operating circuit as traced above. At its contacts 384, the relay R380 prepares a circuit for energizing the lower winding of the transfer relay R370. At its contacts 381, the relay R380 prepares a circuit for energizing the rotary magnet 395. At its contacts 382, the relay R380 opens another point in the above-traced circuit for transmitting current pulses to the vertical magnet 394.

When the third digit "5" of the doctor's identification number is dialed at the station A, the pulsing springs 102 are opened and closed five times so that five impulses are transmitted to the relay R300. This relay, in following the impulses, functions to transmit a corresponding number of current pulses to the transfer control relay R320 and the rotary magnet 395. The circuit for energizing the rotary magnet 395 may now be traced as extending from ground by way of the contacts 311, 381, 381 and 372, and the winding of the magnet 395 to battery. Upon re-operating at the beginning of the third digit, the relay R320 closes its contacts 321 to complete the prepared circuit for energizing the lower winding of the transfer relay R370, this circuit extending from ground by way of the contacts 315, 321, 384 and 375, and the lower winding of R370 to battery. When its lower winding is thus energized, the relay R370 only partially operates to close its preliminary make contacts 373. At these contacts a path is completed for short-circuiting the upper winding of the relay R370, this path extending from ground by way of the contacts 315, 321, 384 and 375, the upper winding of R370, and the contacts 373 and 311 back to ground.

Each time the rotary magnet is energized in the above-traced pulsing circuit it operates, in conjunction with its associated ratchet and pawl mechanism, to rotate the wiper carriage structure one step, so that at the end of the third digit the wipers 390 to 393, inclusive, are left standing in engagement with the fifth contacts of the sixth level in the associated contact bank.

In this position of the wiper carriage structure, the indicated wipers respectively engage the contacts 165a, 165b, 165c and 165d. At the end of the third digit dialed at the calling station A, the relay R300 remains in its operated position so that the transfer control relay R320 and the rotary magnet 395 are deenergized. Shortly after the digit is ended, the relay R320 restores and opens its contacts 321 to interrupt the path short-circuiting the upper winding of the relay R370. When this path is opened the two windings of the relay R370 are energized in series over a circuit which includes the contacts 373 and 311. The relay R370 now completes its operation, and in so doing opens its contacts 375 further to interrupt its own operating circuit. At its contacts 374, the relay R370 prepares a circuit for energizing the lower winding of the transfer relay R350. At its contacts 371, the relay R370 prepares a circuit for energizing the restoring relay R410 of the selected display unit 26 and the parallel-connected restoring relays of the corresponding display units provided on the other display boards. At its contacts 372, the relay R370 opens the above-traced circuit for transmitting current pulses to the rotary magnet 395. At its contacts 377, the relay R370 prepares the operating circuit for the signal control relay R360. At its contacts 376, the relay R370 completes the prepared circuit for energizing the lower winding of the transfer relay R110 in series with the lower winding of the wipe out relay R200 and the lower winding of the reset pulse cut-off relay R120. This circuit extends from ground by way of the contacts 361 and 376, the conductor 18e, the wiper 264, the contacts 217, the lower winding of R200, the conductor 17e, the control path through the line switch 11, the contacts 135 and 118, the lower winding of R110, and the lower winding of R120 to battery. Due to the resistance of the lower winding of the relay R200, the current traversing this circuit is insufficient to cause the operation of the reset pulse cut-off relay R120. The relay R110, however, is sufficiently energized to operate.

In operating, the relay R110 locks to ground over a path including its preliminary make contacts 116 and the contacts 132. At its contacts 118, the relay R110 opens the above-traced series-operating circuit. At its contacts 117, the relay R110 completes a circuit for energizing the parallel-connected pilot lamps 105 in series with the lower winding of the wipe out relay R200. This circuit extends from ground by way of the contacts 361 and 376, the conductor 18e, the wiper 264, the contacts 217, the lower winding of R200, the conductor 17e, the control path through the line switch 11, the contacts 135 and 117 and the parallel-connected lamps 105 to battery. The energization of these lamps serves to provide an indication that the relay and pulse sending equipment individual to the first floor stations is busy. When its lower winding is energized, first in series with the windings of the relays R110 and R120 and later in series with the parallel-connected pilot lamps 105, the wipe out relay R200 operates and locks to the grounded release conductor 17c over a path including its preliminary make contacts 201. After this path is completed the relay R200 closes its contacts 202 to short-circuit its lower winding and thus increase the energization of the pilot lamps 105.

The transfer relay R110, upon operating, also

closes its contacts 112 and 114 to complete an alternative loop circuit which extends from the pulse sender 15 to the windings of the line relay R300 in the operated connector switch 13. This loop circuit may be traced as extending from ground by way of the upper winding of R300, the conductor 18a, the wiper 261, the contacts 212, the conductor 17a, the positive wiper of the line switch 11, the contacts 112, 542, 520, 544 and 114, the negative wiper of the line switch 11, the conductor 17b, the contacts 214, the wiper 262, the conductor 18b, and the lower winding of R300 to battery. After this circuit is completed, the relay R110 opens its contacts 113 and 115 to exclude the pulsing springs 102 of the transmitting device 101a from the loop circuit. At its contacts 111, the relay R110 completes an obvious circuit for energizing the start relay R500 of the pulse sender 15. From the above explanation, it will be understood that after the transfer relay R110 operates, the control of the switching equipment is transferred from the calling control station A to the pulse sender 15. It will further be apparent that no additional operations are required on the part of the calling doctor in order to cause the selected display units to be reset to display a numerical indication of the floor on which the doctor No. 165 is located. Accordingly, the connect key 164a may be restored to normal immediately after the dialing operation is completed, thereby to condition the operated switch train to be automatically released when the restoring and reset pulse transmission of the sender 15 is completed. In this regard, it will be noted that the pilot lamps 165 individual to the first floor stations are held energized to indicate the busy condition of the relay network 16 and the pulse sender 15, until the operated switching equipment is released.

The pulse sender 15 first operates to transmit ten restoring pulses to the line relay R300 of the operated connector switch 13. Thus, when the start relay R500 operates, it closes its contacts 502 to complete a circuit including the contacts 506 and 507 for energizing the upper winding of the relay R505 in parallel with the operating magnet 572 of the rotary switch 570. At its contacts 501, the relay R500 prepares a circuit for energizing the upper winding of the relay R515. At its contacts 503, the relay R500 prepares a circuit for energizing the upper winding of the relay R530 in parallel with the operating magnet 563 of the rotary switch 560. When the magnet 572 is thus energized it opens its contacts 573 to interrupt the prepared operating circuit for the pulsing relay R525, and conditions its associated ratchet and pawl mechanism to step the wiper 571 into engagement with its associated second contact. Shortly after the magnet 572 is energized, the slow-to-operate relay R505 operates and locks to ground over a circuit including its preliminary make contacts 503 and the contacts 111. After this locking circuit is completed, the relay R505 opens its contacts 507 to interrupt its operating circuit as traced above. At its contacts 566, the relay R505 opens the circuit for energizing the magnet 572. When this magnet is thus deenergized its associated operating pawl is retracted to advance the wiper 571 one step. At its contacts 573, the magnet 572 completes the prepared operating circuit for the pulsing relay R525, this circuit extending from ground by way of the wiper 571 and its engaged second contact, the contacts 573, and the winding of R525 to

battery. When thus energized, the relay R525 closes its contacts 527 to energize the slow-acting relay R520. At its contacts 526, the relay R525 completes an obvious circuit for again energizing the magnet 572. The relay R520, upon operating, closes its contacts 521 to complete a circuit including the contacts 501 for energizing the upper winding of the relay R515. At its contacts 522, the relay R520 opens the incomplete operating circuit for the relay R510. When its upper winding is energized, the relay R515 partially operates to close only its preliminary make contacts 516 and thus completes an obvious path for short-circuiting its lower winding. When the magnet 572 is energized through the contacts of the pulsing relay R525, it reoperates and opens its contacts 573 to deenergize the pulsing relay. The relay R525, in restoring, opens its contacts 523 to deenergize the magnet 572. Since the second to eleventh contacts of the contact set associated with the wiper 571 are multiplied together and connected to ground, the interrelated operation of the pulsing relay R525 continues until the lower end of the double-ended wiper 571 is operated to engage the first contact of the associated contact bank, at which time the operating circuit for the pulsing relay R525 is obviously opened to prevent further operation of this relay and the magnet 572. As indicated by the foregoing explanation, a current pulse is transmitted to the relay R520 each time the pulsing relay R525 operates. Due to its slow-to-release characteristic, the relay R520 remains operated throughout the described cycle of operation of the rotary switch 570.

Incident to the operation of the switch 570, ten restoring pulses are transmitted to the operating magnets 401a and 401b of the indicators 400a and 400b and to the operating magnets of the corresponding indicators of the other display boards. Thus each time the pulsing relay R525 operates, it opens the above-traced loop circuit extending through the windings of the relay R300. It will be understood, therefore, that the relay R300 follows the impulses and functions to repeat the same over the restoring pulse circuit extending to the selected indicators. When the relay R300 first restores at the beginning of the restoring pulse train, it closes its contacts 303 to again energize the transfer control relay R320. This relay now operates and remains in its operated position until shortly after the impulse train ends. In reoperating, the relay R320 closes its contacts 321 to complete a circuit including the contacts 315, 324, 374 and 355 for energizing the lower winding of the transfer relay R350. The relay R350 now partially operates to close only its preliminary make contacts 353. At these contacts, a path is completed for short-circuiting the upper winding of the relay R350, this path extending from ground by way of the contacts 311 and 353, the upper winding of R350, and the contacts 355, 374, 384, 321 and 315 back to ground.

The ten restoring pulses are repeated by the relay R300 to the restoring relay R410 of the display unit 26 over a circuit which extends from ground by way of the contacts 311, 301, 336, 381, 371 and 352, the restoring pulse lead, the wiper 382 and its engaged contact 165c, and the winding of R410 to battery. Branches of this circuit extend to the restoring relays respectively embodied in the display units that correspond to the unit 26 and are provided on the other display boards. Each time the restoring relay R410 oper-

ates, it closes its contacts 411 and 412 to prepare or complete circuits for energizing the magnets 401b and 401a, respectively, of the registers 400b and 400a. In this regard it is pointed out that when the indicating drum of any register 400 occupies its normal or blank position, the associated cam 403 occupies a position such that the commutating springs 402 are disengaged. In all other positions of the indicating drum the commutating springs 402 are engaged. Accordingly, if the indicating drum of the register 400a, for example, is assumed to occupy its second off-normal position at the time the operation of the restoring relay R410 is initiated, nine of the ten restoring pulses will be transmitted to the magnet 401a. Each time this magnet is energized the indicating drum of the register 400a is advanced one step nearer its normal or blank position. At the end of the ninth step, the cam 403a operates to open the commutating contacts 402a, thereby to prevent the remaining restoring pulse of the train from producing further operation of the magnet 401a. In a manner similar to that just described, a portion or all of the restoring pulses transmitted by the relay R410 to the magnet 401b may be utilized for the purpose of driving the indicator drum of the register 400b back to its normal or blank position. Thus if the indicating drum of the register 400 occupies its fifth off-normal position, for example, at the time operation of the relay R410 is initiated, six of the restoring pulses will be utilized to advance this drum to its normal or blank position. It will be understood, from the above explanation, that after a maximum of ten restoring pulses have been transmitted through operation of the relay R300 to the restoring relays of the selected display units, all of the indicator drums of the indicators in these units are restored to their normal or blank positions.

After the train of ten restoring pulses has been counted through operation of the rotary switch 570, the relay R525 remains in its restored position and the relay R520 is deenergized and restores. In releasing, the relay R520 closes its contacts 522 to prepare the operating circuit for the slow-to-operate relay R510. At its contacts 521, the relay R520 interrupts the path short-circuiting the lower winding of the relay R515, permitting the two windings of the latter relay to be energized in series over a circuit which includes the contacts 516 and 111. The relay R515 now completes its operation, and in so doing closes its contacts 517 to energize the relay R510 in a circuit which includes the contacts 522 and 111. At its contacts 518, the relay R515 completes a circuit for energizing the lower winding of the transfer relay R150, this circuit extending from ground by way of the contacts 518, 511, 123, 133 and 154, and the lower winding of R150 to battery. When its lower winding is thus energized, the relay R150 partially operates to close only its preliminary make contacts 152. At these contacts, a path including the additional contacts 131, 154, 133, 123, 511 and 518 is completed for short-circuiting the upper winding of the relay R150. Shortly after the relay R150 partially operates, the relay R510 operates and opens its contacts to interrupt the short-circuiting path just traced. When this path is opened, the two windings of the relay R150 are energized in series over a circuit which includes the contacts 131 and 152. The relay R150 now fully operates, and in so doing opens its contacts 154 further to interrupt its operating circuit. At its contacts 153, the relay

R150 prepares the operating circuit for the relay R140. At its contacts 151, the relay R150 completes an obvious circuit for energizing the transfer relay R540.

The relay R540, in operating, closes its contacts 541 and 543 to include the contacts 556 of the pulsing relay R555 in the loop circuit extending to the windings of the line relay R300. Thereafter the relay R540 opens its contacts 542 and 544 to exclude the contacts 528 of the pulsing relay R525 from the established loop circuit. Thus, control of the relay R300 is transferred from the pulsing relay R525 to the pulsing relay R555. At its contacts 545, the relay R540 completes a circuit for energizing the operating magnet 563 of the rotary switch 560, this circuit extending from ground by way of the contacts 503, 545 and 531, and the winding of the magnet 563 to battery. When thus energized, the magnet 563 opens its contacts 564 to interrupt the incomplete operating circuit for the stepping relay R550, and conditions its associated ratchet and pawl mechanism to step the wipers 561 and 562 from their illustrated normal position into engagement with their respective associated second contacts. In operating, the transfer relay R540 also completes a circuit including the contacts 503, 545 and 532 for energizing the upper winding of the slow-to-operate start cut-off relay R530. The relay R530, in operating, locks to ground over a path including the contacts 533 and 111. After this locking circuit is completed, the relay R530 opens its contacts 532 to interrupt its operating circuit. At its contacts 531, the relay R530 opens the operating circuit for the magnet 563. When thus deenergized, the magnet 563 retracts its associated operating pawl to advance the wipers 561 and 562 into engagement with their respective associated second contacts. At its contacts 564, the magnet 563 completes the prepared operating circuit for the stepping relay R550, this circuit extending from ground by way of the wiper 562 and its engaged second contact, the contacts 564 and the winding of R550 to battery. When thus energized, the relay R550 closes its contacts 552 to again energize the magnet 563. The magnet 563 now reoperates, and opens its contacts 564 to deenergize the stepping relay R550. The relay R550, in restoring, opens its contacts 552 to deenergize the magnet 563. Since the second to twenty-fifth contacts of the contact set associated with the wiper 562 are connected to ground, the interrelated operation of the stepping relay R550 and the magnet 563 continues until the lower ends of the double-ended wipers 561 and 562 are operated to engage the respective first contacts of the associated contact banks. When this occurs the operating circuit for the stepping relay R550 is obviously opened to prevent further operation of this relay and the magnet 563.

Immediately after the train of ten restoring pulses is transmitted over the restoring pulse lead and the wiper 392 to the restoring relays of the selected display units, and before the stepping operation of the rotary switch 560 is initiated in the manner explained above, the transfer relays of the connector switch 13 operate to transfer the pulsing circuit from the restoring relays to the operating magnets of the tens indicators in the selected display units. Thus when the relay R320 restores shortly after the end of the restoring pulse train, the path short-circuiting the upper winding of the transfer relay R350 is opened at the contacts 321. When this path is opened the two windings of the relay R350 are energized in

series over a circuit which includes the contacts 311 and 353. The relay R350 now completes its operation, and in so doing opens its contacts 355 further to interrupt its operating circuit. At its contacts 354, the relay R350 prepares the operating circuit for the transfer relay R340. At its contacts 351, the relay R350 prepares a circuit for transmitting reset pulses over the first digit reset pulse lead to the operating magnets of the tens indicators in each of the selected display units. At its contacts 352, the relay R350 opens the above-traced circuit traversed by the restoring pulses.

After the transfer relays R150 and R350 operate, and during the operation of the rotary switch 560, ten reset pulses are transmitted to the tens indicator 400a of the display unit 26 and to the tens indicators of the corresponding display units in the other display boards. Thus each time the stepping relay R550 operates to energize the magnet 553 of the rotary switch 560, it closes its contacts 551 to complete a circuit extending through the wiper 561 for energizing the pulsing relay R555, this circuit also including the multiplied second to eleventh contacts of the contact set associated with the wiper 561. Each time the pulsing relay R555 operates it opens its contacts 556 to interrupt the loop circuit extending through the windings of the line relay R300. Thus the relay R300 is caused to follow the impulses, and functions to repeat the impulses to the operating magnet 401a of the tens indicator 400a. The circuit over which these impulses are transmitted to this magnet extends from ground by way of the contacts 311, 301, 336, 381, 371, 351 and 342, the first digit reset pulse lead, the wiper 391 and its engaged contact 165b, and the winding of the magnet 401a to battery. Corresponding parallel circuits are completed for energizing the operating magnets of the tens indicators of the other selected display units. Each time the magnet 401a is energized and deenergized, the display drum of the indicator 400a is advanced one step, so that after the ten reset pulses of the first digit are counted through operation of the rotary switch 560, this display drum is positioned to display the numeral "0."

During the transmission of the first digit of reset pulses in the manner just explained, the relay R320 is operated to complete a circuit for energizing the transfer relay R340, this circuit extending from ground by way of the contacts 315, 321, 354, 374, 354 and 345, and the lower winding of R340 to battery. When energized over this circuit at the beginning of the digit, the relay R340 partially operates and closes only its preliminary make contacts 343 to complete a path for short-circuiting its upper winding, this path extending from ground by way of the contacts 311 and 343, the upper winding of R340, and the contacts 345, 354, 374, 384, 321 and 315 back to ground.

After the ten reset pulses of the first reset digit are counted by the rotary switch 560, the wipers of this switch are operated successively to engage their respective associated twelfth, thirteenth and fourteenth contacts. During such movement of the wipers 561 and 562 the circuit for energizing the pulsing relay R555 is held open. Accordingly, the relay R555 remains in its restored position and the relay R300 holds its operated position for a measured time interval which comprises an inter-digit pause between the two reset pulse digits. During this interval and when the wiper 561 is stepped to engage its as-

sociated thirteenth contact, the circuit for energizing the transfer relay R140 is further prepared. This circuit is completed at the contacts 551 when the stepping relay R550 next operates, and extends from ground by way of the contacts 551, the wiper 561 and its engaged thirteenth contact, the contacts 123, 133, 153 and 143, and the lower winding of R140 to battery. When its lower winding is thus energized, the relay R140 partially operates to short-circuit its upper winding over a path including the contacts 131, 141, 143, 153, 133, 123 and 151, and the wiper 561. When the wiper 561 is thereafter stepped out of engagement with its associated thirteenth contact, this short-circuiting path is broken, permitting the two windings of the transfer relay R140 to be energized in series over a circuit which includes the contacts 131 and 141. The relay R140 now completes its operation, and in so doing opens its contacts 143 further to interrupt its operating circuit as traced above. At its contacts 142, the relay R140 prepares the operating circuit for the release relay R130.

During the inter-digit pause measured by the rotary switch 560 between the two reset pulse digits, the relay R320 restores and opens its contacts 321 to interrupt the path short-circuiting the upper winding of the transfer relay R340. The two windings of the latter relay are now energized in series over a circuit including the contacts 311 and 343. When its two windings are thus energized, the relay R340 completes its operation, and in so doing opens its contacts 345 further to interrupt its operating circuit as traced above. At its contacts 344, the relay R340 prepares the operating circuit for the relay R330. At its contacts 341, the relay R340 prepares a circuit for transmitting the pulses of the second reset pulse digit to the operating magnet of the units indicator 400b and the units indicators of the corresponding display units of the other display boards. At its contacts 342, the relay R340 opens the above-traced circuit over which the pulses of the first reset digit were transmitted to the operated magnets of the tens indicators in the selected display units.

Following the operations just described, and during continued movement of the rotary switch 560, the single impulse of the second reset pulse digit is transmitted to the operating magnets of the units indicators in the selected display units. Thus during the period when the wipers 561 and 562 engage their associated fifteenth contacts, the stepping relay R550 again closes the operating circuit for the pulsing relay R555 so that an impulse is transmitted to the relay R300. The relay R300, in restoring and reoperating, closes its contacts 303 momentarily to complete the operating circuit for the transfer control relay R320. At its contacts 301, the relay R300 transmits a current pulse to the operating magnet 401b of the units indicator 400b over a circuit which extends from ground by way of the contacts 311, 301, 336, 381, 371, 351, 341 and 331, the second digit reset pulse lead, the wiper 390 and its engaged contacts 165a, and the winding of the magnet 401b to battery. Branches of this circuit extend through the windings of the operating magnets of the other units indicators in the selected display units. The relay R320, upon reoperating, closes its contacts 321 to complete the prepared circuit for energizing the lower winding of the transfer relay R330, this circuit extending from ground by way of the contacts 315, 321, 384, 374, 354, 344 and 333, and the lower

winding of R330 to battery. When its lower winding is thus energized, the relay R330 partially operates to close only its preliminary make contacts 332, and thus complete a path including these contacts and the contacts 321, 384, 374, 356, 344 and 333, for short-circuiting its upper winding. When the operating magnets of the units indicators in the selected display units are energized over the circuit traced above, the associated display drums are advanced one step wherein each drum is positioned to display the numeral "1" through its associated display window.

Following the operations just described, the indicators 400a and 400b are reset to display the number "01" which indicates that the corresponding doctor No. 165 may be located on the first floor of the hospital. In this regard, it will be noted that the second reset pulse digit comprises only a single reset pulse. It is to this end that the fifteenth to the twenty-third contacts of the contact set associated with the wiper 561 are not wired. Accordingly, when this wiper is moved out of engagement with its associated fifteenth contact, no further circuit is available for transmitting pulses to the pulsing relay R555. It will be noted, however, that the wiring of the contact set associated with the wiper 561 in the pulse sender individual to each floor determines the number of reset pulses which are transmitted during each cycle of operation thereof. Thus, had the pulse sender 15 been provided on the twenty-fifth floor, for example, only the second, third and fifteenth to nineteenth contacts of the contact set associated with the wiper 561 would have been multipled together to provide a circuit for transmitting a first reset digit of two pulses and a second reset digit of five pulses. It will thus be apparent that by varying the wiring of the contact set associated with the wiper 561 the pulse sender 15 may be adapted to transmit first and second reset pulse digits comprising any desired number of pulses.

At the end of the second reset digit, the relay R300 remains in its operated position. Accordingly, the transfer control relay R320 is deenergized and restores. In releasing, this relay opens its contacts 321 to interrupt the path short-circuiting the upper winding of the transfer relay R330. The two windings of the transfer relay R330 are now energized in series over a circuit which extends from ground by way of the contacts 315 and 332, the upper winding of R330 and the lower winding of R330 to battery. When this circuit is completed the relay R330 completes its operation. At its contacts 331, the relay R330 cuts off the pulsing circuit so that further operation of the line relay R300 is of no effect. At its contacts 333, the relay R330 opens a point in its operating circuit as traced above, thus rendering the relay R330 inoperative to effect further control of the five transfer relays.

After the selected indicators are reset in the manner explained above, and during continued operation of the rotary switch 560, the wipers 561 and 562 are positioned to engage their associated twenty-fourth and twenty-fifth contacts. During this period the relay R520 twice operates to complete an obvious circuit for energizing the slow-to-release relay R580. Following the operation of the relay R580, the wipers 561 and 562 of the rotary switch 560 are returned to normal and the operation of this switch is arrested in the manner explained above. When the wiper 561 is moved to disengage its associated twenty-fifth contact, the circuit for energizing the relay R580

is broken. During the period when the relay R580 is operated, a circuit including the contacts 581, 123, 133, 153 and 142 is completed for energizing the release relay R130. In operating, the relay R130 first locks to ground over a path including its preliminary make contacts 134 and the contacts 581. After this locking circuit is completed, the relay R130 opens its contacts 133 to interrupt the operating circuits for itself and the two transfer relays R140 and R150. At its contacts 131, the relay R130 opens the locking circuits for the relays R140 and R150 to cause the deenergization and release thereof. The relay R150, upon restoring, opens its contacts 151 to deenergize the transfer relay R540. At its contacts 135, the relay R130 opens the previously traced circuit for energizing the pilot lamps 105 in parallel, and a point in the previously traced operating circuit for the transfer relay R116. When the pilot lamps 105 are thus deenergized the pulse sender 15 and the relay network 16 are identified as being idle. At its contacts 132, the relay R130 opens the locking circuit for the transfer relay R110, to cause the deenergization and release of the latter relay.

The relay R110, upon restoring, opens its contacts 112 and 114 to interrupt the loop circuit extending to the connector switch 13, and opens its contacts 111 to deenergize the relays R590, R505, R510, R515 and R530 of the pulse sender 15. Shortly after these relays restore, the wipers of the rotary switch 560 are returned to normal, in the manner explained above, to cause the deenergization and release of the relay R580. This relay, in restoring, opens its contacts 581 to interrupt the locking circuit for the relay R130. Following the release of the relay R130, the pulse sender 15 and the relays of the network 16 are fully restored to normal.

When the loop circuit extending to the connector switch 13 is opened, in the manner pointed out above, the relay R300 is deenergized and restores to recomplete the operating circuit for the relay R320, and to open the operating circuit for the hold relay R310. Shortly thereafter, the relay R310 restores and opens its contacts 312 to deenergize the relay R320. The momentary operation of the latter relay is without effect. In releasing, the relay R310 also opens its contacts 311 and 315 to cause the deenergization and release of the five transfer relays R330, R340, R350, R370 and R380. At its contacts 316, the relay R310 completes the prepared operating circuit for the release magnet 396. When this magnet operates, the wiper carriage structure of the Strowger switching mechanism is restored to rotary and vertical normal in a manner well understood in the art. Incident to the restoration of the wipers 390 to 393, inclusive, to their respective normal positions, the vertical off-normal springs 397 are opened to deenergize the release magnet 396. Following the release of the Strowger switching mechanism the connector switch 13 is fully restored to normal.

Incident to the release of the hold relay R310, the contacts 313 are disengaged to disconnect the release conductors 18c and 17c from ground, whereby the cut-through relay R210, the wipe out relay R290, and the cut-off relay of the line switch 11 are all deenergized and restore. At its contacts 314, the relay R310, in releasing, connects the release conductor 18c through the resistor 317 to the negative terminal of the current source, whereby the connector switch 13 is

marked as idle in the bank contacts of the selector switches having access thereto.

When the cut-through relay R210 restores, it closes its contacts 212 to complete a circuit including the contacts 222, 235 and 243, and the vertical off-normal springs 255 for energizing the release magnet 253. When this magnet is energized, the wipers 261 to 264, inclusive, are restored to their respective normal positions in the usual manner. Incident to release of the wiper carriage structure, the vertical off-normal springs 254 are disengaged further to interrupt the operating circuit for the rotary magnet 250; the vertical off-normal springs 255 are disengaged to deenergize the release magnet 253; the vertical off-normal springs 256 are operated into engagement to reprepare the operating circuit for the transfer relay R240; and the normal post springs 257 are moved into engagement to recomplete the path for short-circuiting the lower winding of the wipe out relay R200. Following the operations just described, the selector switch 12 is fully restored to normal and the release conductor 17c is connected through the upper winding of the transfer relay R240 to the negative terminal of the current source, whereby this switch is marked as idle in the bank contacts of the various line switches. When the cut-off relay embodied in the line switch 11 restores this switch is released, in a manner well understood in the art. Following the release of the line switch 11 and the selector switch 12, all of the equipment utilized in resetting the selected indicators individual to the doctor No. 165 is fully restored to normal.

From the above explanation it will be apparent that as the doctor No. 165 proceeds from floor to floor, he may, by repeatedly dialing his identification number at one of the control stations on each floor, reset the display units assigned for his use to display numbers which accurately indicate his location. If this doctor proceeds to a ward or floor where he will be occupied with duties from which he does not wish to be disturbed, he may wipe out the indications displayed by the display units provided for his use, without resetting these units to provide a new floor indication. For example, the doctor may be occupied with duties in "surgery," in which case he will not wish to be disturbed. In order to wipe out the existing indications displayed by the units provided for his use, the doctor No. 165 may dial the number "265" at any one of the control stations provided in the hospital. Assuming that this number is dialed at the control station A, for example, and that the selector and connector switches 12 and 13 are utilized in selecting the display unit 26 and the corresponding display units of the other boards, the wipers of the selector switch 12 are positioned opposite the second level of contacts in the associated contact bank at the end of the first digit. Thus the trunk 18 is seized through the contacts of an even-numbered contact level. Incident to the movement of the wipers 261 to 264, inclusive, to a position opposite the second level of contacts in the associated contact field, the normal post springs 257 are opened and then reclosed. These normal post springs remain closed until the selector switch 12 is released. When the trunk 18 is seized through the second or an even-numbered contact level of the selector switch 12 or any other selector switch, low-resistance relay R325 is energized in the trunk test circuit which now includes the test or release conduc-

tor 18d. This relay remains energized until the hold relay R310 restores during the release of the connector switch 13. In operating, the relay R325 closes its contacts 326 to prepare the operating circuit for the slow-to-release pulse circuit cut-off relay R335. Thereafter, and when the wipers 390 to 393, inclusive, of the connector switch 13, are positioned to engage the contacts 165 at the end of the third digit dialed at the calling station A, the relay R370 operates in the manner previously explained to complete an alternative circuit for energizing the lower windings of the two relays R110 and R120 in series. This circuit extends from ground by way of the contacts 361 and 378, the conductor 18e, the wiper 264, the contacts 217, the normal post springs 257, the conductor 17e, the control path through the line switch 11, the contacts 135 and 118, the lower winding of R110, and the lower winding of R120 to battery. It will be noted that the lower winding of the wipe out relay R200 is excluded from this circuit. Accordingly, the current traversing the lower winding of the marginal relay R120 is sufficient to cause the operation of this relay. In operating, the relay R120 locks to ground over a path including the contacts 121 and 132. At its contacts 123, the relay R120 opens a point in the common portion of the previously traced operating circuits for the relays R150, R140 and R130. At its contacts 122, the relay R120 prepares an alternative operating circuit for the release relay R130.

The transfer relay R110, in operating, initiates the operation of the pulse sender 15 to transmit a train of ten restoring pulses to the operating magnets of the selected indicators in the exact manner described above. Incident to the transmission of this train of restoring pulses, the display drums of the selected indicators are restored to their respective normal or blank positions. From the preceding explanation it will also be recalled that after the train of restoring pulses is transmitted from the pulse sender 15, the relay R520 restores to cause the sequential operation of the two relays R515 and R510, the relay R320 restores, and the relay R350 completes its operation. Upon fully operating, the relay R350 closes its contacts 356 to complete the prepared operating circuit for the relay R335. The relay R335, in operating, opens its contacts 336 to prevent a current pulse from being transmitted to the operating magnets of the units indicators in the selected display units during the release of the connector switch 13. During the period separating the operation of the relay R515 and the operation of the relay R510, a circuit including the contacts 518, 511 and 122 is completed for energizing the release relay R130. Thus it will be apparent now that, with the reset pulse cut-off relay R120 operated, the three transfer relays R150, R140 and R540 are prevented from operating incident to the operation of the pulse sender 15. With the relay R540 restored, the relay R530 is prevented from operating, to initiate the operation of the rotary switch 560 in the manner previously described.

In operating, the relay R130 locks to ground over a path including the contacts 134, 511 and 518. At its contacts 132 and 135, the relay R130 opens the operating and locking circuits for the relays R110 and R120, and the circuit for energizing the pilot lamps 105. At its contacts 133, the relay R130 opens another point in the common portion of the initially traced operating circuits for itself and the two relays R140 and R150.

The transfer relay R110, upon restoring, opens its contacts 112 and 114 to interrupt the loop circuit extending to the line relay R300 of the connector switch 13. When this loop circuit is opened the connector switch 13, the selector switch 12 and the line switch 11 are caused to release, in the exact manner explained above. In this regard it will be apparent that the two relays R325 and R335 are deenergized and restore in response to the release of the hold relay R310. Upon restoring, the relay R110 also opens its contacts 111 to deenergize the relays R500, R505, R515 and R510. When these four relays restore the pulse sender 15 is fully released. Incident to the operation of the relay R510 and the release of the relay R515, the previously traced locking circuit for the relay R130 is opened to deenergize the last-mentioned relay. When the relay R130 restores, all of the equipment utilized in wiping out the indications displayed by the indicators of the display unit 25, and the corresponding units of the other boards, is released. From the above explanation it will be apparent that in order for any doctor to wipe out the indications displayed by the indicators provided for his use, he may dial, at any control station of the system, a number which is one hundred greater than his assigned directory number. More specifically, the wipe out number for any doctor differs from his reset number only in the first digit, the first digit of the wipe out number being one greater than the first digit of the assigned reset number.

In considering the operation of the doctor paging facilities provided in the system, it may be assumed that while the doctor No. 165 is occupied with duties on a particular floor of the hospital a call for this doctor is received by the operator attending the P. B. X. switchboard 10. In order to transmit this information to the doctor No. 165, the operator at the switchboard 10 actuates the key 165e to its off-normal position wherein a marking path is completed for impressing ground potential upon the contact 165d of the contact field embodied in the illustrated connector switch 13 and the corresponding contacts of the other connector switches having access to the indicators provided for the use of this doctor. With the apparatus in this condition if the doctor No. 165 proceeds to the first floor, for example, and operates the transmitting device 101a to set up a connection through the line switch 11, the selector switch 12 and the connector switch 13 to the display unit 25 and the corresponding display units of the other boards, a circuit is completed for energizing the signal control relay R360 immediately after the third digit of the doctor's identification number is dialed at the station A. More specifically, this circuit is completed by way of the contacts 377, the wiper 393 and the contacts of the key 165e, when the transfer relay R370 operates at the end of the dialing operation. In operating, the relay R360 opens its contacts 351 to interrupt the previously traced circuit over which the pilot lamps 105 are energized. At its contacts 362, the relay R360 completes a circuit including the pulsing lead 325 for intermittently energizing the pilot lamps 105. It will be noted that this circuit is completed each time the pulse generator 325 operates to transmit a ground pulse over the pulsing lead 325. Aside from the intermittent energization of the pilot lamps 105 to produce a flashing signal at the first floor stations A and B, the

control of the selected indicators to wipe out the existing display, and possibly reset the indicators to display new indications, and the release of the switching equipment, are accomplished in the exact manner described above. In this regard, it will be noted that the signal control relay R360 is deenergized in response to the release of the transfer relay R370 at the end of the cycle of operation of the pulse sender 15. During the period when the pulse sender is operating to transmit restoring and reset pulses to the operating magnets of the selected indicators, the intermittent energization of the pilot lamps 105 continues. The flashing signal which results, serves to inform the calling doctor No. 165 that he is wanted by the operator attending the P. B. X. switchboard 10. Upon receiving this information the doctor No. 165 may proceed to the nearest telephone and call the switchboard operator for instructions or information.

Although the invention has been explained with reference to a system for indicating the location of doctors attached to the staff of a large hospital, it will be understood that the system may also be used in industrial and other organizations to indicate the location of other objects, both animate and inanimate, which may be in zoned areas that are not necessarily different floors of a building. For example, the system may be utilized for indicating at one or more points the different locations of the executives and department heads of a large industrial organization having buildings disposed at random within a confined area. As a further example, the system may be used to indicate the location of loaded inter-departmental trucks which are used in an industrial organization and are moved from place to place to meet production or other manufacturing requirements. In order generically to designate the persons or movable objects, the locations of which are to be indicated, such persons or objects have been termed "subjects" in certain parts of the following portions of the specification.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is contemplated to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a system for indicating the location of a plurality of subjects which may be located in different zones of a plural zone area, a display board including display units individually corresponding to said subjects, an automatic selector switch having access to said units for control purposes and including outlet contacts individually corresponding to said subjects, marking paths extending to said outlet contacts, a control station including a signal device and means for directly controlling said automatic switch to select one of said display units, means operative in response to the selection of said one unit for resetting said one unit to display an indication of the zone in which the corresponding subject may be located or for wiping out an indication previously displayed by said one unit, and means selectively controlled over one of said marking paths from said signaling station for energizing said signal device.

2. In a system for indicating the location of a plurality of subjects which may be located in different zones of a plural zone area, a plurality of

pulse controlled indicators arranged in sets which are individual to said subjects, the different indicators of each set each having a blank position and indicating positions for displaying the different digits of plural digit numbers identifying said zones, restoring pulse circuits individual to the sets of indicators, resetting pulse circuits individual to said indicators, a control station in said area, automatic switching equipment directly controllable from said station to select a set of said indicators, an automatic plural digit pulse sending device associated with said station and operative successively to transmit a train of restoring pulses and a plurality of trains of reset pulses, means operative in response to the selection of said one set of indicators for connecting said sender to control the pulsing circuits individual to the selected indicators, transfer means for directing the restoring pulses to the restoring pulse circuit individual to the indicators of the selected set and for directing the pulses of the successively transmitted reset trains to the reset pulse circuits individual to different indicators of the selected indicator set, and means selectively controllable from said control station for preventing reset pulses from being transmitted to the indicators of the selected set.

3. In a system for indicating the location of a plurality of subjects which may be located in different zones of a plural zone area, a display board including display units individual to said subjects and each including an indicator for displaying an indication of the zone in which the corresponding subject may be located, a control station in said area, tandem related selector and connector switches each having a plurality of different settings, means at said control station for directly controlling said switches to select one of said display units for control purposes, and means selectively controlled in accordance with the setting of said selector switch after said one display unit is selected for either resetting the indicator of the selected unit to display a new indication or for operating the indicator of the selected unit to wipe out the indication displayed thereby.

4. In a system for indicating the location of a plurality of subjects which may be located in different zones of a plural zone area, a plurality of pulse controlled indicators arranged in sets which are individual to said subjects, a control station in said area, tandem related selector and connector switches each having a plurality of different settings, means at said control station for directly controlling said switches to select one set of said indicators and to set up restoring and reset pulsing circuits to the indicators of the selected set, an automatic plural digit sending device associated with said station and including means for transmitting successively a train of restoring pulses and a plurality of trains of reset pulses, means operative in response to the selection of said one set of indicators for connecting said sender to control said restoring and reset pulse circuits, and means selectively controlled in accordance with the setting of said selector switch after said one set of indicators is selected for preventing reset pulses from being transmitted from said sender over said reset pulsing circuits to said indicators.

5. In a system for indicating the location of a plurality of subjects which may be located in different zones of a plural zone area, indicating units individual to said subjects, a control sta-

tion, an automatic selector switch directly controllable from said station to select any one of said units and including outlet contacts individual to said units, means including circuits individually including different ones of said outlet contacts for selectively controlling selected ones of said units to wipe out indications displayed thereby or to set up new indications therein which indicate the zones in which the corresponding subjects may be located, a signaling station, a signaling circuit extending between said stations and having branches individual to said subjects which respectively include different ones of said outlet contacts, and means at said signaling station for selectively completing the branches of said circuit.

6. In a system for indicating the location of a plurality of persons who may be located in different zones of a plural zone area, a display board including display units individual to said persons and each controllable to provide an indication of the zone in which the corresponding persons may be located, a control station, an automatic selector switch having settings individually corresponding to said persons and directly controllable by a person at said control station to select and control any one of said display units, a signal at said station, and means included in said selector switch for controlling said signal to provide an indication that the particular person controlling said switch is wanted in a pre-determined zone of said area in response to operation of said selector switch to the setting corresponding to said particular person.

7. In a system for indicating the location of a plurality of persons who may be located in different zones of a plural zone area, a display board including display units individual to said persons and each controllable to provide an indication of the zone in which the corresponding persons may be located, a control station, an automatic selector switch having settings individually corresponding to said persons and directly controllable by a person at said control station to select and control any one of said display units, a signal at said station, means included in said selector switch for controlling said signal to provide an indication that the particular person controlling said switch is wanted in a predetermined zone of said area in response to operation of said selector switch to the setting corresponding to said particular person, a signaling station, and means at said signaling station for selectively rendering said last-named means effective to control said signal.

8. In an indicating system, a plurality of display units, an automatic selector switch having different settings individually corresponding to different persons who may use said system and including means for controlling different ones of said units when operated to the different settings thereof, a pair of stations, a signal at one of said stations, means controllable by a person at said one station for directing said selector switch to any one of the settings thereof, means included in said one switch for controlling said signal to provide a predetermined indication to a given person at said one station when said given person effects the operation of said selector switch to the setting individual to said one person, and means at the other of said stations for selectively rendering said last-named means effective to control said signal.

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