

July 3, 1945.

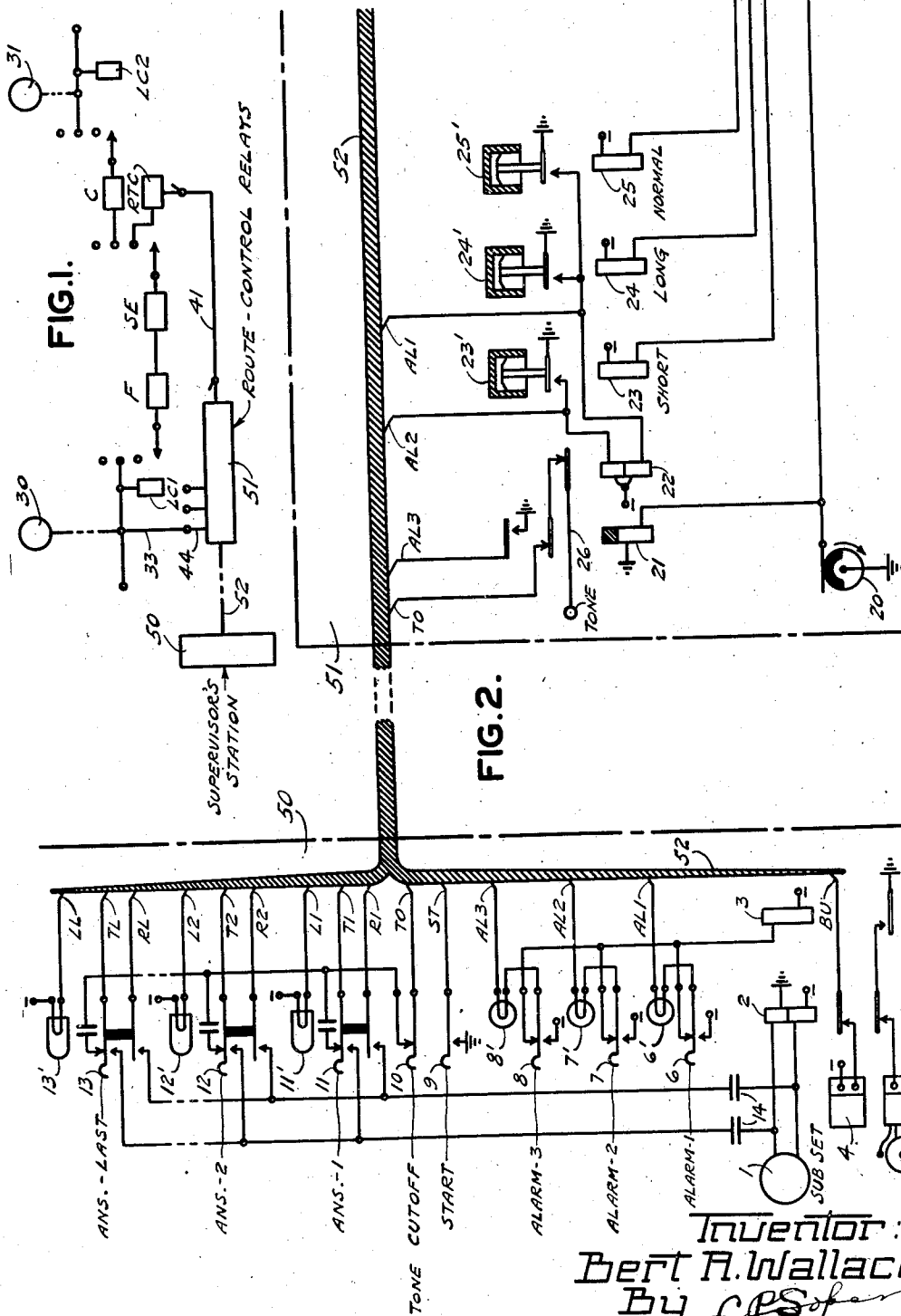
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WATCHMAN SUPERVISORY AUTOMATIC TELEPHONE SYSTEM

Filed June 12, 1943

2 Sheets-Sheet 1



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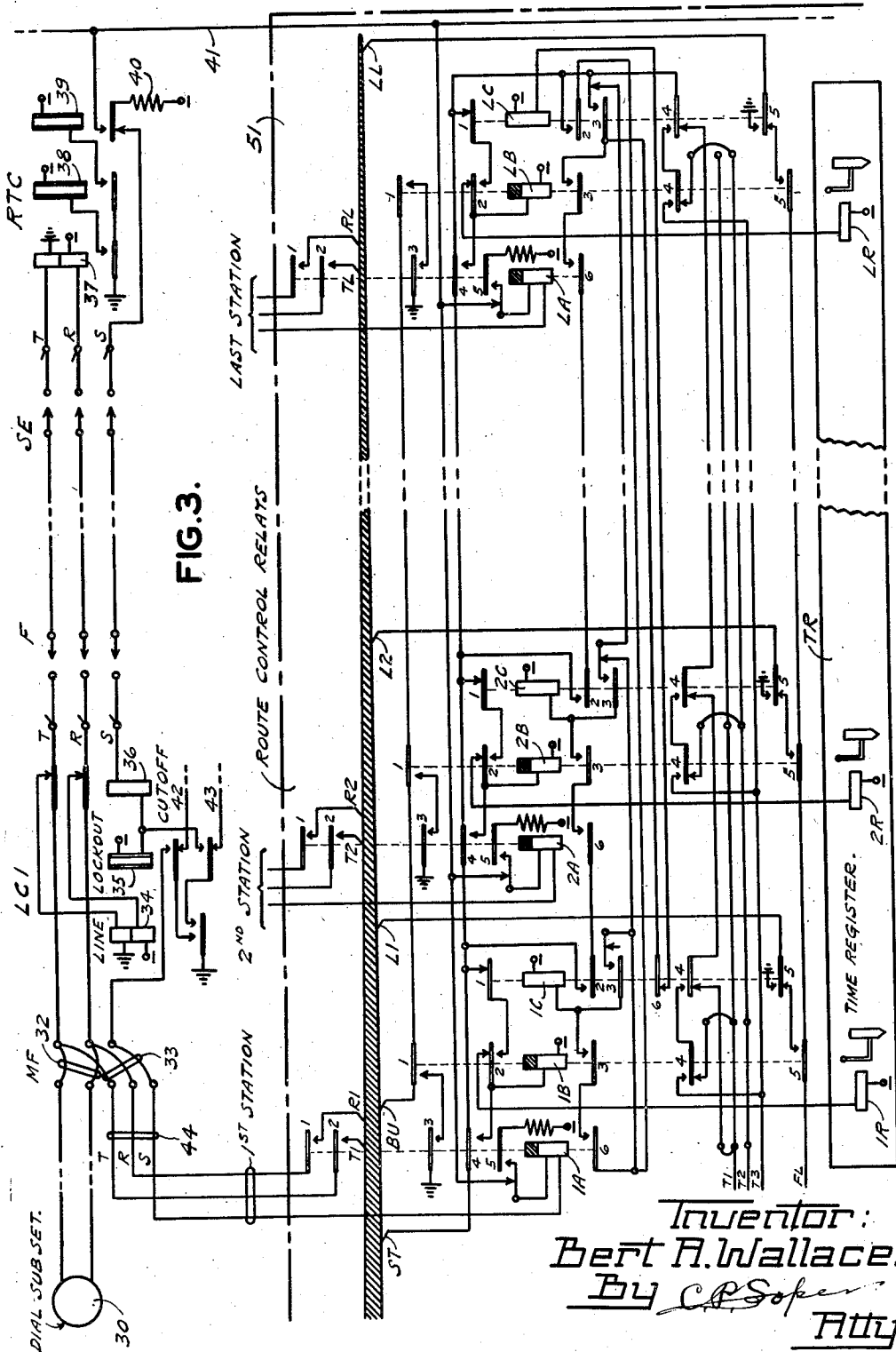
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WATCHMAN SUPERVISORY AUTOMATIC TELEPHONE SYSTEM

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,379,556

WATCHMAN SUPERVISORY AUTOMATIC
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Application June 12, 1943, Serial No. 490,691

20 Claims. (Cl. 179-2)

This invention relates to watchman supervisory automatic telephone systems. The object is to provide an automatic telephone system containing improved provisions for supervising the activities of a watchman as indicated by his successive reports from stations located along his route.

GENERAL DESCRIPTION

The automatic telephone system disclosed herein is arranged to serve the intercommunication needs of a private establishment, such as a department store, factory, warehouse, and the like. It is customary for such an establishment to employ a watchman to make periodic inspection tours of the premises during the night, on holidays, and the like.

It is also customary to provide stations along the watchman's route from which the watchman can call and report to the supervisor.

In a private establishment of the kind under consideration, local automatic-telephone substations, attached to lines served by the private automatic exchange, are usually available at each of the assigned report stations along the route of the watchman, making it convenient for the watchman to use the private automatic telephone system for making his reports. For this purpose, a report number is assigned which the watchman can call from any telephone substation designated for the purpose, and thereby secure telephonic communication with the supervisor. Provisions are made for automatically making a permanent record of the station from which any report call is made and of the time of the call.

The object of the invention may now be restated to be to provide desirable features of improvement in watchman supervisory systems as above outlined.

According to one feature of improvement, identification of the station from which the watchman makes a call is accomplished through the agency of what is termed a lockout relay, added to the individual line circuit of each of the telephone lines intended to be used as a watchman-report line. In the disclosed system, the connection established by the dialing of the report number is broken down responsive to a temporary open-circuit condition encountered whenever the report number is dialed, and a new connection is thereupon set up, under the control of the individual lockout relay, directly from the concerned line to the station of the watchman.

According to a related feature, the accidental simulation of the above noted open-circuit condition does not ordinarily result in the extension

of the concerned line to the supervisor station, because such connection depends jointly upon the operation of the lockout relay of a line and the operation of equipment to which connection is extended responsive to the calling of the report number.

According to a further feature of the invention, a group of control relays is provided containing a separate relay set for each of the report stations, and these sets of station relays are arranged for a sequential interlocking operation secured only if the watchman reports from the stations in a preassigned order of sequence. Provisions are made for signalling the supervisor in the normal manner responsive to a call from any station in its assigned order of sequence, and for signaling the supervisor in a distinctly different manner and for sounding a distinctive alarm in the event that the watchman reports from a station other than the next one in the order of sequence.

According to a further feature, delayed-action timing devices are provided for sounding an alarm in the event that the watchman fails to replace the receiver at a station following a report call, or fails to report from the next station within a preassigned time interval. According to a related feature, a plurality of differently timed devices are provided, enabling a suitable time interval to be assigned between any station and the next, according to the distance which the watchman must traverse.

According to a further feature, the sequence with which the watchman is to visit the reporting stations may be varied as desired by a suitable change in the disposition of jumper connections between the terminals of the sets of relays and the terminals of the concerned telephone lines.

A further feature concerns the automatic transmission of an all-clear tone signal to the watchman responsive to his calling of the report number from any station in its preassigned order of sequence and within the preassigned time interval, and for automatically withholding this tone signal otherwise. Arrangements are provided to enable the supervisor to withhold the all-clear signal at any time when he desires to converse with the watchman on the next report call.

THE DRAWINGS

In the accompanying drawings comprising Figs. 1 to 3, Fig. 1 is a schematic showing of the private automatic telephone system and the relation to it of the added portions which provide the watchman service;

Fig. 2 is a circuit diagram of the equipment at

the supervising station, together with a portion of the route-control relay equipment; and

Fig. 3 is a circuit diagram of the remaining portion of the route-control relay equipment and of certain portions of the automatic switching equipment.

Figure 1

Referring now to Fig. 1, the automatic telephone system exemplified therein has a nominal capacity of 1,000 lines, the subscriber lines of the system comprising a number of hundreds groups, each hundreds group being served by a separate group of connectors, one such connector being indicated at C.

A number of selectors, such as that indicated at SE, are provided for interconnecting the lines of calling subscribers with an idle connector in any desired hundreds group. Each of the selectors has a finder such as F linked thereto, the finders usually being of 100 line capacity, a desired number of them being provided for each hundreds group of lines. These finders are controlled in the well-known manner, through the line circuits (such as LC1 and LC2) of calling lines.

Telephone systems of this type are well known, but as a matter of review the general operation thereof is here stated.

When the subscriber at substation 30 desires to converse with the subscriber at station 31, for example, he removes his receiver, whereupon the line relay included in the line circuit LC1 (relay 34, Fig. 3) operates to mark the position of the calling line and to cause an idle finder, such as F, to make connection with the calling line, thereby extending the calling line to a selector such as SE.

The calling subscriber thereupon calls the hundreds digit in the desired number, whereupon the selector SE associates itself with the corresponding level of contacts, and then extends connection to an idle connector (such as the connector C) reached through the dialed level.

Responsive to the dialing of the tens and units digits in the desired number, the seized connector such as C makes connection with the desired one of the 100 lines in the concerned group, such as the line of substation 31, following which ringing current is applied to the called line. Conversation may take place as soon as the called subscriber answers, talking current for the two lines being supplied from the concerned connector.

In the arrangement illustrated in Fig. 1, the report trunk circuit RTC is accessible from an otherwise unused level of the selectors. The digit representing this level constitutes the report number to be called by the watchman.

The route-control relays are indicated at 51. They are interconnected by common conductor 41 with the trunk circuit RTC. Each of the sets of station relays in the route-control group is connected with the terminals of a report-station line by a jumper such as 33.

The operation (to be detailed hereinafter) is that, when a report call is made by the watchman from a line such as 30, through a finder such as F and a selector such as SE, to the report trunk circuit RTC, a temporary condition is imposed on conductor 41, and the finder and selector are cleared out, causing the line circuit LC1 to go into lockout condition and extending a connection over jumper 33 to the concerned set of station relays, and thence to the supervising station.

Figure 2

Referring now to Fig. 2, the equipment shown

therein includes a subset 1 for the use of the supervisor in answering calls from the watchman. Talking current is supplied to this subset through the windings of relay 2, which disconnects the call buzzer 4 and alarm bell 5, when the receiver is removed at the associated subset.

The supervisor is provided with key equipment including alarm-control keys 6 to 8, with which alarm-supervisory lamps 6' to 8' are respectively associated; start key 9; and answer keys 11 to 13, with which line lamps 11' to 13' are respectively associated.

Cable 52 contains a number of conductors interconnecting the equipment at the supervising station with the route-control equipment 51.

The portion of the route-control equipment shown in Fig. 2 includes control relays 21 and 22 and time-delay relays 23 to 25. Relay 23, by its timing device 23', may be adjusted for a relatively short delay period (of perhaps half a minute), and is employed to time the length of a report call; relay 24, by its timing device 24', may be adjusted for a relatively long delay period (of perhaps ten minutes) sufficient to enable the watchman to travel readily from one report station to the next, where the intervening distance is great; and relay 25, by its timing device 25', is adjusted for a normal delay interval (of perhaps five minutes) to permit time for travel between report stations which are not more than a normal distance apart.

Figure 3

The portion of the equipment 51 illustrated in Fig. 3 includes the several sets of station relays, each set including three relays. Relays 1A to 1C comprise the set assigned to the first station on the watchman's route; relays 2A to 2C are assigned to the second station; and relays LA to LC are assigned to the last station.

The time register TR, associated with equipment 51, includes register devices 1R, 2R, and LR, assigned respectively to the first, second, and last stations. This time register may be of the usual moving-tape, multiple-punch type, with each of the register magnets such as 1R, 2R, and LR controlling a separate punch.

Fig. 3 shows also a circuit diagram of a portion of the automatic switching equipment indicated in Fig. 1. This includes the dial subset 30 of the usual construction, interconnected by the usual two-conductor telephone line with the switchboard equipment by way of a two-conductor jumper 32 at the main frame MF.

The line circuit LC1, assigned to the line of subset 30 comprises line, lockout, and cutoff relays 34, 35, and 36. The switchboard multiple (tip, ring, and sleeve conductors T, R, and S) of the line of substation 30 is accessible to finders such as F and to the connectors assigned to the concerned hundreds group of lines.

Substation 30 is illustrated as being the first report station on the route of the watchman. Accordingly, tip, ring, and sleeve conductors associated with the line of substation 30 are cross-connected, by the three-conductor jumper 33 on the main frame MF, to the three-conductor group 44 associated with the first set of station relays (1A, 1B, and 1C).

The finder F is interconnected with the selector SE by a three-conductor link, including tip, ring, and sleeve conductors. The relay equipment and operating structure for the finder F and the selector SE have not been shown, as they may take any well-known or desired form. The operation

of the finder F is controlled in the usual manner over conductors 42 and 43 of the line circuit LCI when a call is originated at substation 30.

The report trunk circuit RTC is accessible to all of the selectors on a certain level thereof. This trunk circuit includes line relay 37 and a pair of successively operable release relays 38 and 39.

DETAILED DESCRIPTION

A detailed description of the operation of the disclosed equipment will now be given.

A. Starting the watch period

Normally, the equipment in Figs. 2 and 3 is in its illustrated condition. At the beginning of a watch period, the supervisor actuates start key 9, thereby applying ground potential to the associated start conductor ST in cable 52, preparing operating and locking circuits for certain of the relay equipment of Fig. 3.

A1. Station-one timing

The grounding of conductor ST in cable 52 also closes a circuit through armature 4 and its back contact of each of the C relays of Fig. 3, through the illustrated jumper connection associated with the back contact of armature 4 of relay 1C, and over time conductor T1, for the winding of normal interval time-delay relay 25. Relay 24 starts to attract its illustrated armature against the retarding influence of timing device 25. Ordinarily, the watchman reaches and reports from the concerned station before the assigned time interval expires.

B. Reporting from the first station

When the watchman reaches the first station, he is expected to report from this station by removing the receiver (not shown) at substation 30 and dialing the single-digit report number corresponding to the selector level through which the trunk circuit RTC is reached.

B1. Seizing selector SE

When the receiver is removed, line relay 34 operates responsive to the closure of the usual direct-current bridge across the associated line. Upon so doing, it grounds the associated finder-control conductors 42 and 43 through back contacts of lockout relay 35.

Responsive to the grounding of conductors 42 and 43, an idle finder, which may be assumed to be the finder F, is caused to make connection with the calling line by way of the associated conductors T, R, and S. When this connection is made, ground potential is applied to the sleeve conductor S associated with cutoff relay 36. The circuit connections for applying this ground potential have not been illustrated, as they are well understood. The grounding of this conductor closes an effective operating circuit for relays 36 and 35 in series.

Cutoff relay 36 operates substantially before slow-acting lockout relay 35 operates. Upon so doing, it disconnects line relay 34, which promptly restores before relay 35 has had time to operate. The operation of lockout relay 35 at this time is accordingly merely preparatory. Conductors 42 and 43 are now ungrounded to remove the marking condition previously imposed thereon.

The calling line is now connected, through the tip and ring conductors of the finder F, to the usual relay equipment (not shown) of the selector SE, whereby the selector is prepared for operation in the usual manner.

B2. Seizing the report trunk circuit RTC

Responsive to the dialing of the preassigned single-digit report number, the selector SE associates itself with the level thereof to which the report trunk circuit RTC is connected, and then performs its usual searching operation. The trunk circuit RTC is normally maintained in a selectable condition by the connection of an idle-indicating battery potential to the associated sleeve conductor S through resistor 40 and the back contact of relay 39. The trunk circuit RTC is accordingly seized by the selector SE. Such selector thereupon applies a guarding ground potential to the sleeve conductor of the seized trunk line to guard such trunk line from seizure by any subsequently searching selector. At the same time, line relay 37 of the trunk circuit RTC is operated over the calling line, whereupon release relays 38 and 39 are operated successively. Relay 39 disconnects resistor 40 from the associated sleeve conductor and transfers it into connection with conductor 41, extending from the trunk circuit RTC to the group-control relays shown at 51.

B3. Imposing the lockout condition

It is to be noted that no holding ground potential is applied to the associated sleeve conductor S by the trunk circuit RTC. As a result, when the slow-restoring release relay (not shown) of the selector SE restores a short time later, and removes the ground potential initially applied to the sleeve conductor of the established connection, the finder F and the selector SE return to normal condition, and the series circuit for relays 35 and 36 of the line circuit LCI is opened. Cutoff relay 36 restores immediately, but lockout relay 35 remains operated for an interval, being rendered slow-acting, as by the indicated copper sleeve surrounding its core beneath the winding thereof. Upon the restoration of cutoff relay 36, line relay 34 reoperates, because the receiver has not been replaced at substation 30. Upon reoperating, line relay 34 again applies ground potential to the armatures of the still-operated lockout relay 35. Ground potential on the lower armature of relay 35 closes a holding circuit for the lockout relay through the front contact of such armature, whereby relay 35 is maintained operated until the receiver is subsequently replaced at the calling substation. Conductors 42 and 43 are maintained disconnected at this time by relay 35, and are consequently not affected during the now-established lockout condition of the line circuit LCI.

B4. Relay 1A operates

The grounding of the inner armature of relay 35 by line relay 34 results in the extension of ground potential over the sleeve conductor in jumper 33 and the sleeve conductor S of group 44 to the lower winding terminal of relay 1A. A circuit is thereby closed for the winding of relay 1A through the normally closed contacts controlled by armature 5 thereof, conductor 41, the front contact of the operated relay 39 of the trunk circuit RTC, and through resistor 40 to battery. Relay 1A thereupon operates and closes a local locking circuit for itself by way of its armature 5 and the associated resistor, at the same time disconnecting its winding from the common conductor 41.

B5. Trunk circuit RTC clears out

In the report trunk circuit RTC, line relay 37

restores responsive to the clearing-out operation of the switches F and SE, following which release relays 38 and 39 restore successively. Each of these relays is slow-restoring, as indicated. As a result, the previously described operation of relay 1A occurs over conductor 41 before relay 39 has restored. Shortly thereafter, relay 39 restores completing the return of the trunk circuit RTC to its illustrated normal condition.

B6. Recording the time and the reporting station

A further result of the operation of relay 1A is the closure of a circuit, from ground on start conductor ST in cable 52 (applied by key 9, Fig. 1), through armature 4 of relay 1A and its front contact, armature 2 of relay 1B and its back contact, to battery through the winding of register magnet 1R. The magnet 1R accordingly energizes to operate its associated punch to record the time of the making of the report call from the first report station.

B7. Relay 1B operates

The winding of relay 1B is energized by virtue of its connection between the front contact of armature 3 of relay 4 and battery. The operation of relay 1B is preferably retarded, as by a copper collar surrounding the core at the armature end thereof, as indicated by the shaded upper portion. Accordingly, the operation of relay 1B is delayed for a sufficient time to secure an effective energization of the magnet of register 1R, following which relay 1B is operated.

Upon operating, relay 1B disconnects the magnet of register 1R at the back contact of armature 2 to release the associated punching mechanism, the overall result being the punching of a "dot" in the recording paper.

At the front contact of its armature 2, relay 1B closes a self-locking circuit to conductor ST, through contacts of relay 1C, so as to remain operated thereafter independent of the front contact of armature 3 of relay 1A.

B8. Call buzzer 4 sounds

At armature 1 of relay 1B, ground potential (through the front contact of armature 3 of relay 1A) is applied to conductor BU in cable 52, thereby operating the call buzzer 4 at the supervising station, through contacts of relay 2, to give the supervisor an audible indication of the report call.

At armature 5 of relay 1B, a circuit path is established from the flasher lead FL, through the back contact of armature 5 of relay 1C, and over conductor L1 of cable 52, to line lamp 11' at the supervising station. Accordingly, this lamp starts to flash because ground potential is applied intermittently to the flasher lead FL by the flasher 20. It is to be noted that ground potential is normally connected to flasher lead FL through the winding of control relay 52, this winding being shunted across the flasher. The winding of relay 21 is preferably of sufficiently high resistance that a lamp such as 13 is not effectively lighted in series with the winding. Relay 22, however, is capable of operation in series with a line lamp. Relay 22, being slow-operating as indicated, does not at this time respond to the closure of this flasher circuit, because such circuit remains closed only momentarily, and is opened by relay 1C.

B9. Relay 1C operates

As a further result of the operation of relay

1B, a circuit is closed, at the front contact of armature 3 thereof, for relay 1C. This circuit includes the contact of armature 6 of relay 1A, normally closed contacts controlled by armature 3 of each succeeding C relay, such as 2C and LC, and the grounded conductor ST in cable 52. Relay 1C operates promptly responsive to the closure of this circuit. Upon so doing, it closes a self-locking circuit at the front contact of its armature 3, independent of the contacts of relays 1A and 1B.

B10. Call lamp 11' lights

At its armature 5, relay 1C transfers conductor L1 from the flasher lead FL to ground, thereby preventing operation of slow-acting control relay 22; terminating the momentary flashing operation; and lighting the line lamp 11' steadily to indicate to the supervisor that a call is being received from a report station in its regular order of sequence.

B11. Timer relay 25 restores

At the back contact of its armature 4, relay 1C opens the previously traced circuit for the normal-interval timing relay 25, whereupon this relay restores to normal condition. Ordinarily, this timer-cutoff operation occurs before the timer relay has had time to fully operate its armature and bring in an alarm.

At the front contact of its armature 2, relay 1C extends ground potential from conductor ST to armature 3 of relay 2B to prepare for the operation of relay 2C associated with the second watchman report station.

At its armature 1, relay 1C opens the self-locking circuit of relay 1B, again placing relay 1B under the direct control of the associated relay 1A and permitting relay 1B to restore along with relay 1A when the watchman replaces his receiver.

B12. Connection extended to supervising station

As a further result of the described operation of relay 1A, armatures 1 and 2 thereof extend the conductors of the line associated with substation 30, over conductors T1 and R1 in cable 52, to the lever contacts of the #1 answer key 11 at the supervisor station.

If the supervisor has decided to converse with the watchman upon his report from substation 30, he will have actuated the key 11 to disconnect the local branch of the tone lead TO, and to extend conductors T1 and R1 to the talking conductors associated with the supervisor's subset 1. Otherwise, the supervisor will not have operated key 11.

B13. The all-clear signal

If the supervisor has not acted to prevent it, an all-clear tone signal is transmitted back to substation 30 from the tone conductor 26, through back contacts of control relays 21 and 22, tone conductor TO in cable 52, contacts of tone-cutoff key 10, the small-capacity condenser associated with answer key 11, back contact of the answer key, and thence over conductor T1 to substation 30.

Upon hearing this all-clear tone signal, the watchman may replace the receiver at substation 30 and proceed toward the next reporting station.

It may be noted that tone-cutoff key 10 permits the supervisor to disconnect the tone source from all answer keys and thus insure a verbal report from the watchman on his report call

from the next station, irrespective of from which station such call may be made.

B14. Call-duration timing

With relays 1B and 1C operated, the winding of the short-interval timer 26 is energized over lead T3, through the front contacts of armature 4 of relays 1B and 1C, the back contacts of armature 4 of relays 2C and LC, and start conductor ST. Relay 23 does not have time to complete its operation except when the receiver is left off the hook at the reporting station for a longer interval than is normally required for a report call.

When the receiver is replaced at substation 30, line relay 34 restores and open-circuits lockout relay 35 and relay 1A, which restore a moment later. Relay 1A disconnects the talking conductors of the associated line from conductors T1 and R1 in cable 52, and at its armature 3 it open-circuits buzzer 4. Relay 1A also open-circuits relay 1B at its armature 4. Relay 1B restores a moment later.

B15. Timing for station two

At the back contact of its armature 4, relay 1B closes a new circuit for the normal-interval timing relay 25, which includes the front contact of armature 4 of relay 1C. Relay 24, which has restored in the interval during which relays 1B and 1C were both operated, is reenergized to start a new operation to time the interval between the watchman's visit to the first report station and his visit to the second report station.

C. Reporting from the second station

When the watchman reaches the second station (not shown) and makes his report call therefrom, the operation of relay 2A occurs as described for relay 1A. This operation results in the momentary energization of register magnet 2R; in the extension of the talking conductors of the second report station to conductors T2 and R2 in cable 52; and in the operation of relay 2B. The operation of relay 2B results in the closure of a circuit for the call buzzer 4, and in the closure of a momentary flashing circuit over conductor L2 for line lamp 12'.

With relay 1C of the first-station group operated and locked, the operation of relay 2B results in the closure of a circuit for relay 2C, from the grounded start conductor ST, through contacts 2, 6, and 3 of relays 1C, 2A, and 2B. Relay 2C thereupon operates to light the second-station line lamp 12' steadily; opens the self-locking circuit of relay 2B; again restores the normal interval timer 25 and starts the short-interval timer 23; and, at its armature 2, prepares for the operation of the C relay at the next report station in the prearranged order of sequence.

At its armature 3, relay 2C closes a self-locking circuit, at the same time opening the self-locking circuit of relay 1C. Relay 1C accordingly restores, opening the initial operating circuit of relay 2C and its armature 2, leaving relay 2C energized in its self-locking circuit. At the same time, relay 1C, at the front contact of its armature 5, disconnects ground potential from conductor L1, thereby extinguishing line lamp 13 of the preceding station, which lamp has been held lighted steadily to indicate to the supervisor the last station from which the watchman reported.

Relays 1A to 1C of the first group are all in restored condition, and relays 2A to 2C of the second group are all in operated condition; line

lamp 12' is lighted steadily; and the call buzzer 4 is sounding.

When the watchman replaces the receiver at the second report station and thereby causes relays 2A and 2B to restore sequentially as described in connection with relays 1A and 1B, relay 2C is left locked operated alone. Relay 2B open-circuits buzzer 4 and timer relay 24.

A circuit is now closed, through the front contact of armature 4 of relay 2C and the back contact of armature 4 of relay 2B, for timing the travel of the watchman from the second reporting station to the third reporting station. It may be assumed that the distance from the second reporting station to the third reporting station is longer than the normal travel distance, in which event the back contact of armature 4 of relay 2B is jumper-connected to the associated terminal of timer conductor T2 instead of to the terminal of timer conductor T1. Accordingly, the winding of timer relay 24 is now energized, and this relay is set for a longer delay period as previously noted.

With relay 2C maintained locked operated, the second-station line lamp 14 is maintained lighted steadily at the front contact of armature 5 of relay 2C to show the supervisor the last station from which a report call was made.

D. Reporting from the last station

When the watchman makes his report from the last station on the route, relays 1A, 1B, and 1C are operated sequentially in the manner described for the similar preceding relays. The last station line lamp 13' is lighted steadily over conductor LL in cable 52, from the front contact of armature 5 of relay 1C. At its armature 3, relay 1C locks itself to the start conductor ST in cable 52, through the back contact of armature 6 of relay 1C. At the normally closed contacts controlled by its armature 3, relay 1C unlocks and restores the C relay of the next preceding relay group.

When the receiver is replaced at the last report station, relays 1A and 1B restore as previously described. With relay 1C locked operated, a timing circuit is closed through contacts of armature 4 of relays 1C and 1B. The back contact of armature 4 of relay 1B is illustrated as jumpered to the associated terminal of time conductor T2 to provide a longer than normal interval for the return of the watchman from the last station to the first.

E. Subsequent reports

When the watchman again reaches the first report station, the second call from subset 30 results in the sequential operation of relays 1A to 1C as previously described.

The chain circuit over which relay 1C was initially operated on the first call is not available at this time, being held open at the normally closed contacts of armature 3 of the operated relay 1C. The circuit over which relay 1C operates on any subsequent first-station report is from ground on start conductor ST through the front contact of armature 2 of relay 1C, and the front contact of armature 3 of relay 1B, to the winding of relay 1C.

Upon the reoperation of relay 1C, the opening of contacts 6 unlocks and restores relay 1C. The restoration of relay 1C recloses the chain circuit through the contacts controlled by armatures 3 of the C relays to establish a locking circuit for relay 1C, through the front contact of its armature 3. Otherwise, the operations attending the

subsequent reports from the first station are similar to those attending the first report from such station.

As the watchman continues to visit the stations in the established order of sequence, and to make his reports and replace the receivers within the respective time intervals allotted, the system continues to function sequentially in cycles similar to the one described.

F. Terminating the watch period

When the watchman makes his final report call at the end of the watch period, the supervisor may restore the start key 9, thereby open-circuiting and restoring any operated ones of the B and C relays in the route-control equipment 51 and otherwise returning the circuit conditions to normal.

G. Abnormal operations

Certain abnormal operations and conditions which may occur during the watch period will now be discussed.

G1. Receiver not replaced at report station

If the watchman, after having made a report call from a station, fails to replace the receiver thereat until after the elapse of an interval longer than that for which the short-interval timer 23 is set, such timer completes its operation to sound an alarm indicative of the fact. For example, when the report is being made in regular sequence at the first station, with relays 1B and 1C operated, ground potential from start conductor ST over the armature-4 chain of the C and B relays is extended, through the front contacts of armature 4 of relays 1C and 1B, to the timer lead T3, energizing the winding of relay 23. Ordinarily, this circuit is opened when relays 1B and 1C restore responsive to the receiver being replaced at subset 30. But, if the watchman forgets to replace the receiver at the concerned substation when he leaves to go to the next station, relay 23 operates fully at the end of a comparatively short interval ($\frac{1}{2}$ a minute, for example). It thereupon places ground potential on the associated alarm conductor AL2, thereby energizing relay 22 to disconnect the tone lead 26 from the tone conductor TO in cable 52, whereby the watchman will not receive the all-clear signal when he calls in from the next station but will be required to wait until he converses with the supervisor.

The placing of ground potential on alarm conductor AL3 in cable 52 results in the closure of an illuminating circuit for the alarm-signal lamp 7', through the winding of the low-resistance pilot relay 3. Lamp 7' becomes lighted to inform the supervisor of the specific alarm condition, while relay 3 closes a circuit, through contacts of relay 2, for the alarm bell 5 to sound an audible alarm.

Upon noting the alarm-2 condition, the supervisor may terminate the sounding of the audible alarm by actuating the alarm-2 cutoff key 7. Alarm-control relay 3 is thereby restored, but alarm-signal lamp 7' remains lighted through the alternate contact of key 7 until the receiver is replaced at the concerned substation.

When the watchman reports from the next substation, the supervisor can inform him that the receiver has not been replaced at the preceding substation and request him to return to that station and replace the receiver. When this has been done, the circuit of timer relay 23 is opened, whereupon this relay restores and permits relay

22 to restore. Tone lead 26 is thereby reconnected to tone lead TO, and lamp 7' is extinguished. The supervisor may now restore key 7.

If the watchman has in fact replaced his receiver at the concerned substation from which the alarm was given as above described, and the condition results from a faulty condition of the concerned subscriber line, the B relay of the concerned relay set remains operated and timer relay 23 remains energized, along with relay 22. In this event, the supervisor may maintain key 7 operated, keeping lamp 7' lighted while relay 3 is permitted to be restored to keep the audible alarm from sounding. So long as this abnormal condition obtains, the system will have to be operated by close cooperation between the supervisor and the watchman without the benefit of the all-clear tone, which is maintained disconnected at the contacts of relay 22.

Also, when the watchman has completed the current round and returned to the station associated with the out-of-order line, he will be unable to call in over the line if it is still out of order. If he desires, the supervisor may summon an investigator to determine the source of the trouble on the line in question.

G2. Delay in reporting

In the event that the watchman delays unduly long in reporting from the next station along his prescribed route, the concerned one of the two timers 24 and 25 is given time to complete its operation and close its contacts, thereby grounding alarm conductor AL1, and operating relay 22 to disconnect the tone lead 26. Alarm lamp 6' is lighted through the normal contact of key 6, and through the winding of pilot relay 3. Alarm bell 5 is sounded responsive to the operation of relay 3.

By the operation of key 6 to its alternate position, relay 3 is restored to disconnect the audible alarm, while lamp 6' remains lighted so long as the alarm condition endures.

The supervisor is expected to actuate tone-cutoff key 10 to maintain the all-clear tone source disconnected after the watchman finally reports from the next station. When this report is made and the concerned A and B relays operate, the operated one of the timer relays 24 and 25 is restored, whereupon relay 22 restores and lamp 6' becomes extinguished. The supervisor may then restore the key 6 to transfer the associated alarm conductor back to the audible alarm circuit.

The supervisor may now actuate the concerned one of the answer keys, such as 11 to 13, to converse with the watchman. Upon the removal of the receiver (not shown) at the supervisor's subset 1, relay 27 is operated to disconnect the call buzzer 4 and the alarm bell 5. The supervisor may then receive the report from the watchman and ascertain why he was late in making the report.

G3. Reporting out of sequence

In the event that the watchman reports from a station out of its proper sequence, a flashing line-lamp signal is given to the supervisor informing him of the station from which the watchman is reporting; the audible alarm bell 5 is sounded; alarm lamp 8' is lighted to indicate that an out-of-sequence report is being received, as distinct from some other alarm condition; and the clear tone is disconnected. For example, if the watchman reports from the second station at a time (either on the initial round or on some other round of

his watch period) when the first station is the one next in the order of sequence, relays 2A and 2B operate in succession as described, but relay 2C does not operate because its circuit is maintained open at the front contact of armature 2 of the unoperated relay 1C associated with the first station. With relay 2C being prevented from operating, the initially closed flashing circuit for lamp 12' remains closed and the lamp 12' flashes. The flashing circuit of this lamp is through the back contact of armature 5 of relay 2C, the front contact of armature 5 of relay 2B, flash lead FL, to ground through the flash interrupter 20. Relay 21, connected in shunt of the flasher 20, becomes operated in series with the lamp 12' during an open period of the flasher 20. Relay 21 remains operated during the closed period of the flasher 20, as it is short-circuited during such closed period, rendering it slow-restoring.

Additionally, the relay is slow-restoring by virtue of the same shading coil which renders it slow-operating. At the back contact of its first armature, relay 21 disconnects the tone lead 26 to prevent an all-clear signal from being given to the watchman, while it grounds alarm conductor AL3 at its upper armature to light the associated alarm lamp 8' through the winding of pilot relay 3. The audible alarm bell 5 is operated, through contacts of relay 3, along with the call buzzer 4 which is operated over lead BU in cable 52, through contacts of relays 2A and 2B.

Upon noting the flashing condition of line lamp 12', the lighted condition of alarm-signal lamp 8', and hearing the alarm bell 5, the supervisor removes the receiver at his subset 1, whereupon relay 2 operates to disconnect buzzer 4 and bell 5. Upon actuating answer key 12, the supervisor is placed in telephonic communication with the watchman and is able to ascertain why he called from a station other than the one next in the order of sequence.

If, for example, the last station on the route is the one from which the watchman last reported, this fact will be indicated to the supervisor by the steadily lighted condition of lamp 13', its circuit being through the front contact of armature 5 of relay 1C. The supervisor may inform the watchman that the next station from which he should report is station 1.

When the watchman replaces the receiver at the station from which he reported out of sequence, the resulting restoration of the associated A relay (relay 2A in the assumed example) leaves the associated relay 2B locked operated through the back contact of armature 1 of the unoperated relay 2C. The alarm-3 condition, and the flashing of line lamp 12' are thereby continued for the time being.

When the watchman has suitably corrected his error, and has reported from the station in question in its proper sequence, relay 2C (in the assumed example) is operated through the front contacts of armature 2 of relay 1C, armature 6 of relay 2A, and armature 3 of relay 2B. The flashing of lamp 12' is thereby terminated, and relay 21 restores a moment later. Ground potential is thereby removed from alarm conductor AL3 extinguishing alarm lamp 8' at the supervising station.

In the event that the watchman called from a station out of its normal sequence because a trouble condition at the next station in the order of sequence prevented a successful report call therefrom, he may so report to the supervisor who may thereupon actuate the key 8 to its alternate

position to transfer the circuit of lamp 8' away from the pilot relay 3 to restore this relay, while alarm conductor AL3 remains grounded and lamp 8' remains lighted through the alternate contact of key 8. In this event, the supervisor may instruct the watchman to continue on his prescribed course. However, no C relay will be able to operate as a result of reports from stations subsequently visited. As a result, all of the B relays at the stations from which the out-of-sequence reports are made remain locked operated, and a flashing circuit is closed for each newly lighted line lamp.

When the watchman has made his report from the last station along the route, the supervisor may temporarily restore the start key 9, thereby restoring all operated B and C relays and releasing any operated ones of the alarm control relays 21 to 25. The route relay equipment is thereby brought to normal condition. A new cycle of operations is started when the supervisor again actuates the start key 9. Such cycle of operations proceeds in the described manner, as an initial cycle, until the station with which the defective report equipment is located is reached by the watchman.

If the watchman is again unable to make a successful report call from the station in question, an out-of-sequence alarm is again sounded when he reaches the next succeeding station in the route and makes his report call. The special operations described may then be repeated until the current round of operations results in a report call from the final station. The start key 9 may again be temporarily restored to start the following round as an initial round of operations.

H. Normal telephone service during the watch period

Any one of the substations of the system may be used for normal telephone service by persons happening to be on the premises during the watch period. For example, between reports of the watchman at the first watchman station, the dial subset 30 may be used for initiating and receiving normal telephone calls.

As an incident to calls from subset 30 by persons other than the watchman, an open-circuit condition may occasionally be encountered, resulting, for example, from a defective holding circuit at a connector seized by a selector such as SE. Such a condition may cause the line circuit LCI to be placed in a lockout condition as previously described (relays 34 and 35 operated; relay 36 restored). Such a condition is rarely encountered in a properly maintained installation. Moreover, since the common conductor 41 is energized only momentarily, incident to a report call as described, an open-circuit-induced lockout condition of line circuit LCI rarely causes relay 1A to operate, particularly if the calling subscriber replaces the receiver with reasonable promptness after the accidental lockout condition occurs.

I. Supervising a plurality of watchmen

If a plurality of watchmen are employed, each may be assigned to a separate route. A separate route-control relay equipment 51 is provided for each watchman's route. Each such equipment may be connected by its own cable such as 52 to its own supervisory equipment at the same, or another, supervising station.

Conductor 41 is multiply connected, as indi-

cated, to each of the route-control relay equipments 51.

To provide for the rare intervals when two watchmen initiate report calls at about the same instant, one or more additional report trunk circuits RTC may be provided. The conductor 41 is multiply connected to each, as indicated. This provision permits all the watchmen to use the same report number.

J. Using a 100-line telephone system

A 100-line automatic telephone system (one lacking selectors, and employing a single group of connectors) may be used in connection with the disclosed watchman supervisory equipment. The only change necessary is to render the report trunk circuit accessible to the connectors, and to arrange the connectors to "switch through," when the report number is dialed. Switching-through connectors are well known.

I claim:

1. In a watchman supervisory automatic telephone system, a subscriber line arranged to serve as a watchman report line, said line having a line circuit individual thereto including a line relay, a cutoff relay, and a lockout relay; call-extending automatic switching devices common to said subscriber line and to other subscriber lines; said line relay being operable responsive to removal of the receiver on the associated line to cause an idle one of said switching devices to become connected with such line, said cutoff and lockout relays operating responsive to said connection, said cutoff relay being thereupon effective to disconnect and restore said line relay, means responsive to the calling of a preassigned report number over the connected subscriber line for correspondingly operating the connected automatic switching device, means responsive to such operation for open-circuiting said cutoff and lockout relays while the receiver on the calling line is still unreplaced, means for delaying the restoration of the lockout relay until after the cutoff relay has restored, the line relay reoperating upon being reconnected by the cutoff relay, a supervisory station, and means controlled jointly by said line and lockout relays in operated condition for maintaining the lockout relay in operated condition, and for extending a connection from the associated line to said supervisory station.

2. In a watchman supervisory automatic telephone system as set forth in claim 1, the means for extending connection from the concerned subscriber line to the supervisory station including an extending relay individual to such line, relay equipment accessible through any of said automatic switching devices responsive to the calling of said report number, said relay equipment being effective, when seized, to assume a temporary extending condition coincidental with the said open-circuiting of the cutoff and lockout relays, and an operating circuit for said extending relay effective depending upon the associated line and lockout relays being both in operated condition during the existence of said temporary extending condition.

3. In a watchman supervisory system wherein report stations are provided along the watchman's route, relays corresponding respectively to said stations and arranged to be operated in a predetermined order of sequence, and means for operating a relay responsive to a report call from the corresponding station depending upon the next preceding relay in the predetermined order of sequence being in operated condition.

4. In a watchman supervisory system as set forth in claim 3, a supervisory station including signal-display devices corresponding respectively to said relays, and means for causing any one of said devices to display a signal depending upon the corresponding relay being in operated condition.

5. In a watchman supervisory system wherein report stations are provided along the watchman's route, relays corresponding respectively to said stations and arranged to be operated in a predetermined order of sequence, means for operating a given relay responsive to a report call from the corresponding station depending upon the next preceding relay in the predetermined order of sequence being in operated condition, and means responsive to the operation of said given relay for restoring the said next preceding relay.

6. In a watchman supervisory system wherein report stations are provided along the watchman's route, relays corresponding respectively to said stations, and arranged to be operated in a predetermined order of sequence from first to last, means for operating the first relay responsive to a report call from the corresponding station at a time when all other ones of said relays are in unoperated condition, means for operating any succeeding one of said relays responsive to a report call from the corresponding station, depending upon the next preceding relay in the predetermined order of sequence being in operated condition, and means responsive to the operation of any one of said relays after the first for restoring the next preceding relay.

7. In a watchman supervisory system as set forth in claim 6, means for reoperating the first relay in the order of sequence depending upon the last relay in the order of sequence being in operated condition, and means responsive to the reoperation of the first relay for restoring the last relay.

8. In a watchman supervisory system wherein report stations are provided along the watchman's route, relay sets corresponding respectively to said station, said relay sets being arranged to receive report calls from said stations in a predetermined order of sequence, means for operating a first portion of the relays of a set responsive to any report call from the corresponding station, and means for operating the remaining portion of the relays of such set responsive to any such report call, depending upon the corresponding portion of the next preceding relay set in the predetermined order of sequence having been operated.

9. In a watchman supervisory system wherein report stations are provided along the watchman's route, route-control equipment arranged to receive report calls from said stations in a predetermined order of sequence, a supervisory station containing signal-display means, means in said route-control equipment responsive to a report call from one of said stations for causing said display means to display the identity of the concerned station by one or another of two distinctive signals depending upon whether the concerned station is or is not the next station in the predetermined order of sequence.

10. In a watchman supervisory system wherein report stations are provided along the watchman's route, route-control equipment arranged to receive report calls from said stations in a predetermined order of sequence, a supervisory station containing signal-display means, means

in said route-control equipment responsive to a report call from any one of said stations for causing said display means to display the identity of the concerned station, and means responsive to such report call for terminating the display of the identity of the station next preceding in the said order of sequence, depending upon reports having been received in the said order of sequence from all preceding stations.

11. In a watchman supervisory system wherein report stations are provided along the watchman's route, route-control equipment arranged to receive report calls from said stations in a predetermined order of sequence, a supervisory station containing signal-display means, means in said route-control equipment responsive to a report call from any one of said stations for causing said display means to display the identity of the concerned station by one or another of two distinctive signals depending upon whether the concerned station is or is not the next one in the said order of sequence, and means responsive to such report call for terminating the display of the identity of the station next preceding in the said order of sequence, depending upon reports having been received in the said order of sequence from all preceding stations, whereby the identity of the last station from which a report call was received in the said order of sequence is distinctively displayed, and the identity of each station from which a report call has been received subsequently is distinctively displayed.

12. In a watchman supervisory system wherein report stations are provided along the watchman's route, control equipment arranged to receive report calls from said stations in a predetermined order of sequence, a supervisory station containing display signals assigned respectively to said stations, a pair of energizing conductors, means in said control equipment responsive to a report call from any one of said report stations for energizing the corresponding display signal over one or the other of said energizing conductors, one energizing conductor being used provided the concerned station is the next one in the said order of preference, the other energizing conductor being used otherwise, and an alarm device and means for energizing it responsive to the energization of any display signal over said other energizing conductor.

13. In a watchman supervisory system wherein report stations are provided along the watchman's route, control equipment arranged to receive report calls from said stations in a predetermined order of sequence, a supervisory station containing display signals assigned respectively to said stations, a pair of energizing conductors, means in said control equipment responsive to a report call from any one of said report stations for energizing the corresponding display signal over one or the other of said energizing conductors, depending upon whether the concerned station is or is not the next one in the said order of preference, and a flashing device interconnected with one of said energizing conductors to effect a distinctive energization of any display signal energized over such conductor.

14. In a watchman supervisory system wherein report stations are provided along the watchman's route, control equipment arranged to receive report calls from said stations in succession, a timing device arranged to be operated from a normal position to an alarm position responsive to the elapse of a time interval of sufficient length to permit the watchman to travel from one sta-

tion to the next and to make a report call from the latter, means responsive to the making of a report call from a station for restoring said timing device to its normal position and for preventing it from proceeding toward its alarm position so long as the report call endures, said timing device being again started from its normal position toward its alarm position responsive to the termination of such report call, and means responsive to the arrival of said timing device in its alarm position for sounding an alarm indicative of the fact that the watchman is late in making the next report call.

15. In a watchman supervisory system wherein report stations are provided along the watchman's route, control equipment arranged to receive report calls from said stations successively, a pair of timing devices, each arranged to be operated from a normal position to an alarm position responsive to the elapse of a predetermined time interval, means for operating the first of said timing devices from its normal position toward its alarm position in the interval between report calls, means for operating the second of said timing devices from its normal position toward its alarm position during any report call, means responsive to the beginning of a report call from any station for restoring the first timing device to its normal position and for starting the second, means responsive to the termination of such report call for restoring the second timing device to its normal position and for starting the first, and means responsive to the arrival of either of said timing devices in its alarm position for sounding an audible alarm indicative of a prolonged delay in terminating a report call or in making the next one.

16. In a watchman supervisory system wherein report stations are provided along the watchman's route, control equipment arranged to receive report calls from said stations in a given sequence, said control equipment comprising separate portions assigned respectively to said stations, means responsive to the receipt of a report call from any one of said stations for actuating the corresponding portion of said control equipment, a normal-interval timing device and a longer-interval timing device, means responsive to the actuation of one of said portions for closing an operating circuit for one or the other of said timing devices to time the interval elapsing between the current report call and the report call from the next succeeding station, means for permitting either timing device to be started responsive to the actuation of any of said portions, the one started depending upon the required travel time of the watchman from the concerned station to the next succeeding station, and means responsive to either timer completing its operation for sounding an audible alarm indicative of an unpermitted delay in the making of the next report call.

17. In a watchman supervisory system wherein report stations are provided along the watchman's route, route-control equipment arranged to receive report calls from said stations in a given order of sequence, a supervisory station, circuit connections for placing the watchman in telephonic communication with such supervisory station incidental to the making of any report call, means normally effective incidental to the making of a report call for telephonically transmitting an all-clear signal to the concerned station, such signal indicating to the watchman that he may thereupon terminate such call and pro-

ceed to the next station, and means effective incidental to the making of a report call from a station out of said given order of sequence for preventing the transmission of said all-clear signal.

18. In a watchman supervisory system as set forth in claim 17, means for specially calling to the attention of the supervisor at said supervisory station the fact that a report call has been received from a station out of said given order of sequence.

19. In a watchman supervisory system wherein report stations are provided along the watchman's route, route-control equipment arranged to receive report calls from said stations in a predetermined order of sequence, a supervisory station containing display signals assigned respectively to said stations, said route-control equipment including a separate relay set for each of the report stations, each such set including

three relays, the first relay of a set being responsive to a report call to extend a telephone connection from the reporting station to the supervisory station, the second relay of a set being responsive to the first relay to transmit a common signal to the supervisory station indicative of the fact that a report call is being received, and the third relay being responsive to the second relay to transmit a signal to the supervisory station indicative of the specific report station from which the report call is being received.

20. In a watchman supervisory system as set forth in claim 19, time register devices corresponding respectively to said report stations, and means controlled jointly by a pair of the relays assigned to any report station for causing the corresponding time register device to record the time of the receipt of a report call from the concerned station.

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