Jan. 12, 1943. M. W. MUEHTER 2,308,198

SIGNALING SYSTEM

Filed July 25, 1939 5 Sheets-Sheet 1

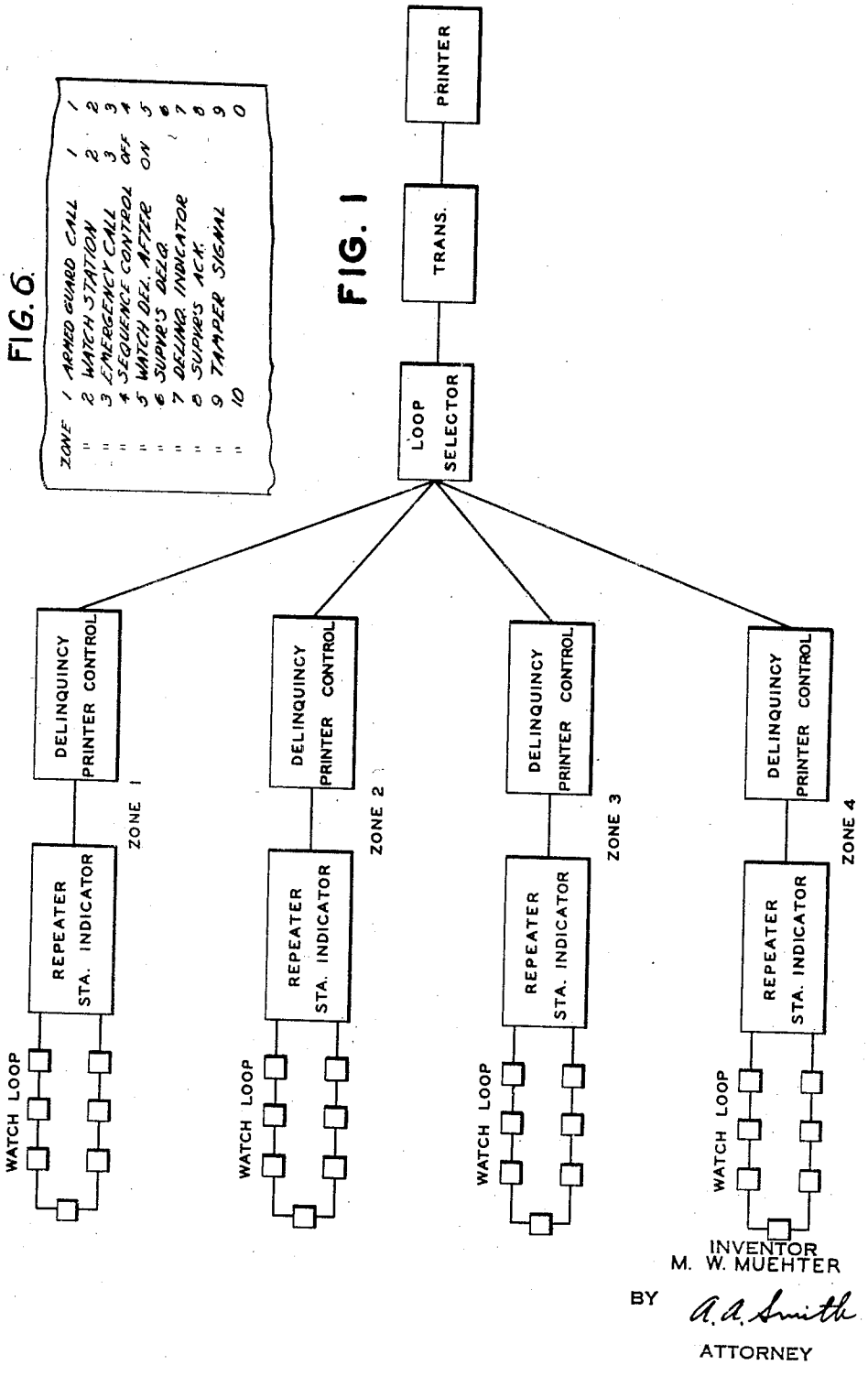


FIG. 1

FIG. 6.

ZONE			
1	ARMED GUARD CALL	1	1
2	WATCH STATION	2	2
3	EMERGENCY CALL	3	3
4	SEQUENCE CONTROL	OFF	4
5	WATCH DEL. AFTER	ON	5
6	SUPVS DELA		6
7	DELINQ. INDICATOR		7
8	SUPVS ACK.		8
9	TAMPER SIGNAL		9
10			0

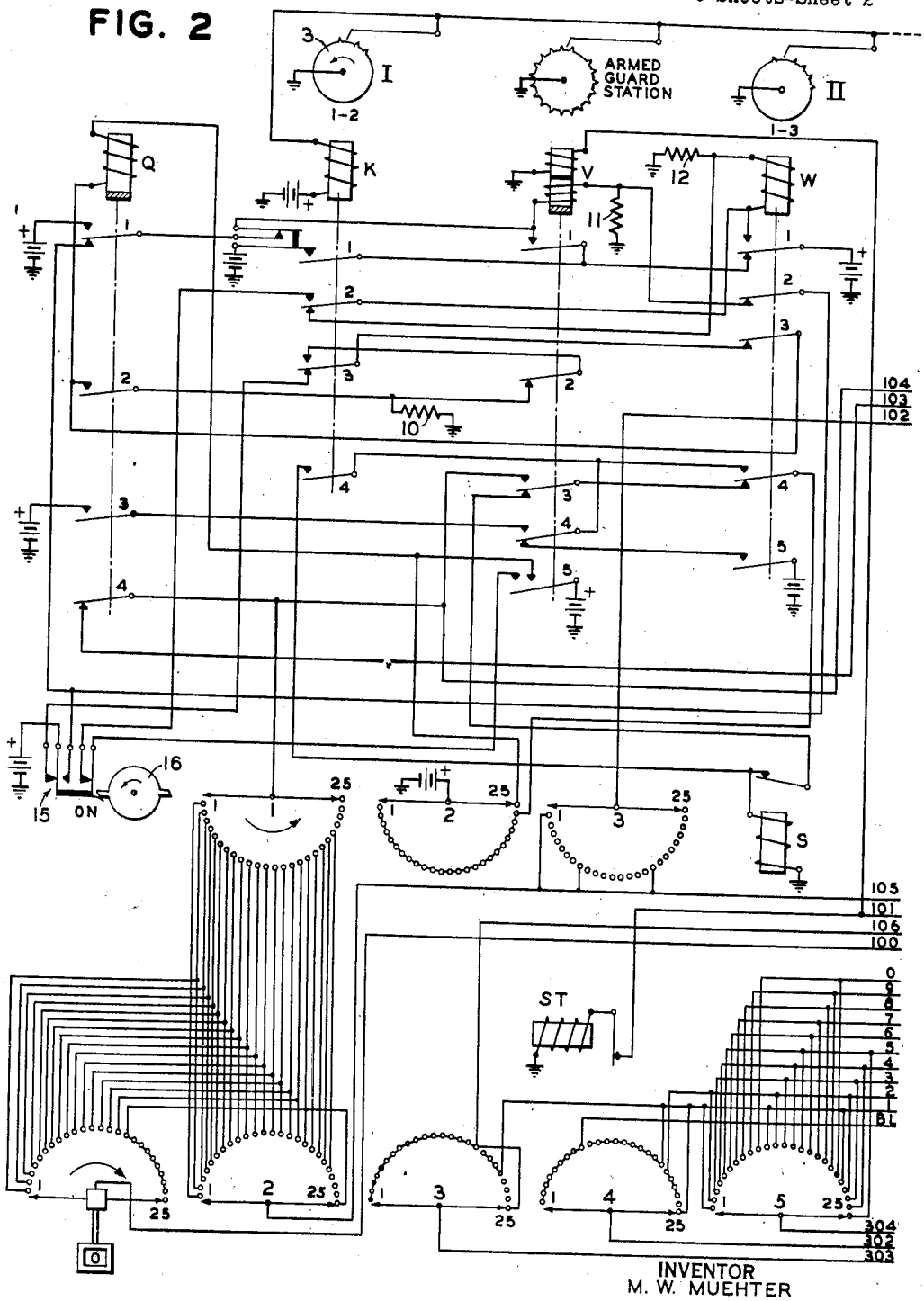
INVENTOR
M. W. MUEHTER
BY A. A. Smith
ATTORNEY

Jan. 12, 1943. M. W. MUEHTER 2,308,198

SIGNALING SYSTEM

Filed July 25, 1939 5 Sheets-Sheet 2

FIG. 2



INVENTOR
M. W. MUEHTER

BY A. A. Smith

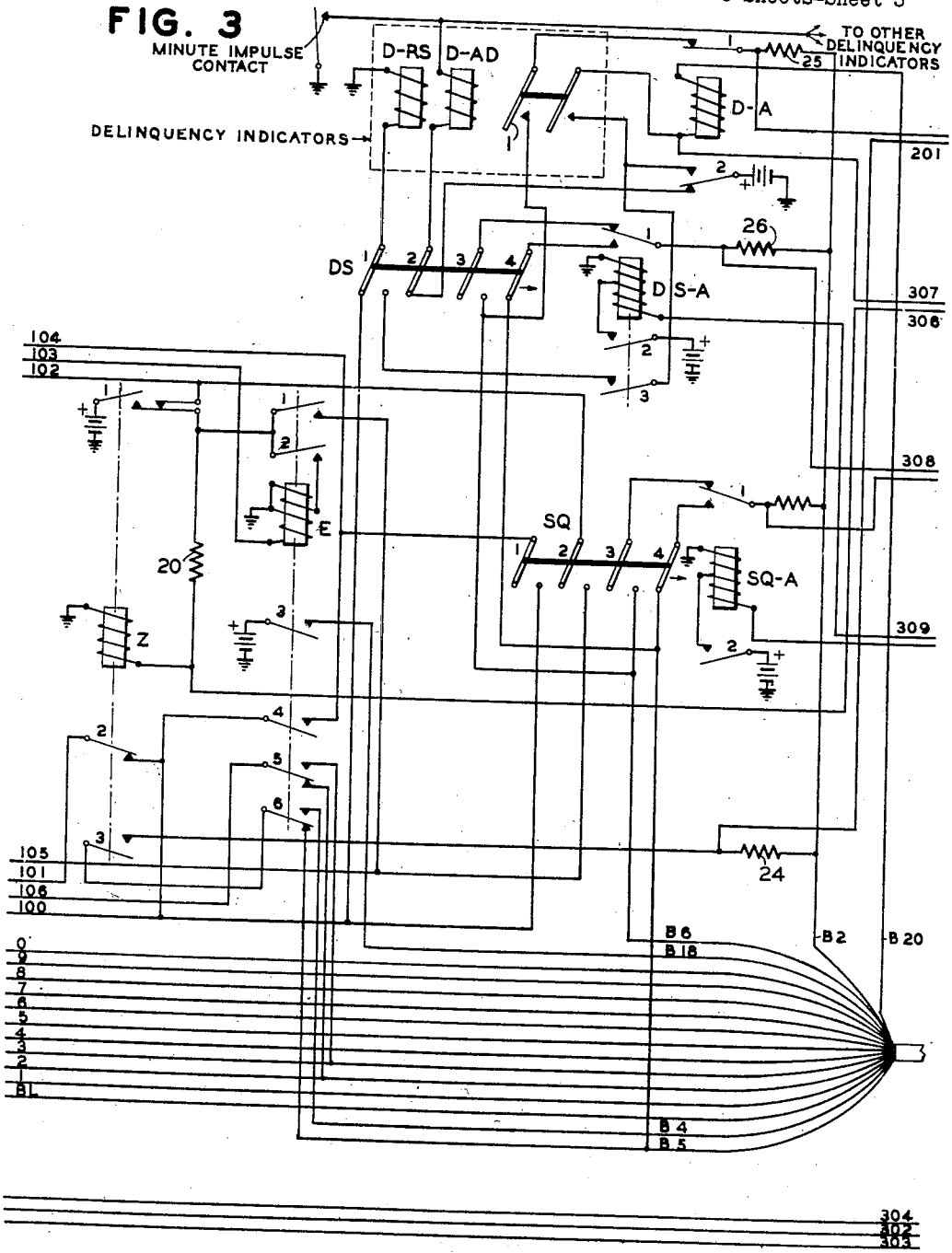
ATTORNEY

Jan. 12, 1943. M. W. MUEHTER 2,308,198

SIGNALING SYSTEM

Filed July 25, 1939 5 Sheets-Sheet 3

FIG. 3



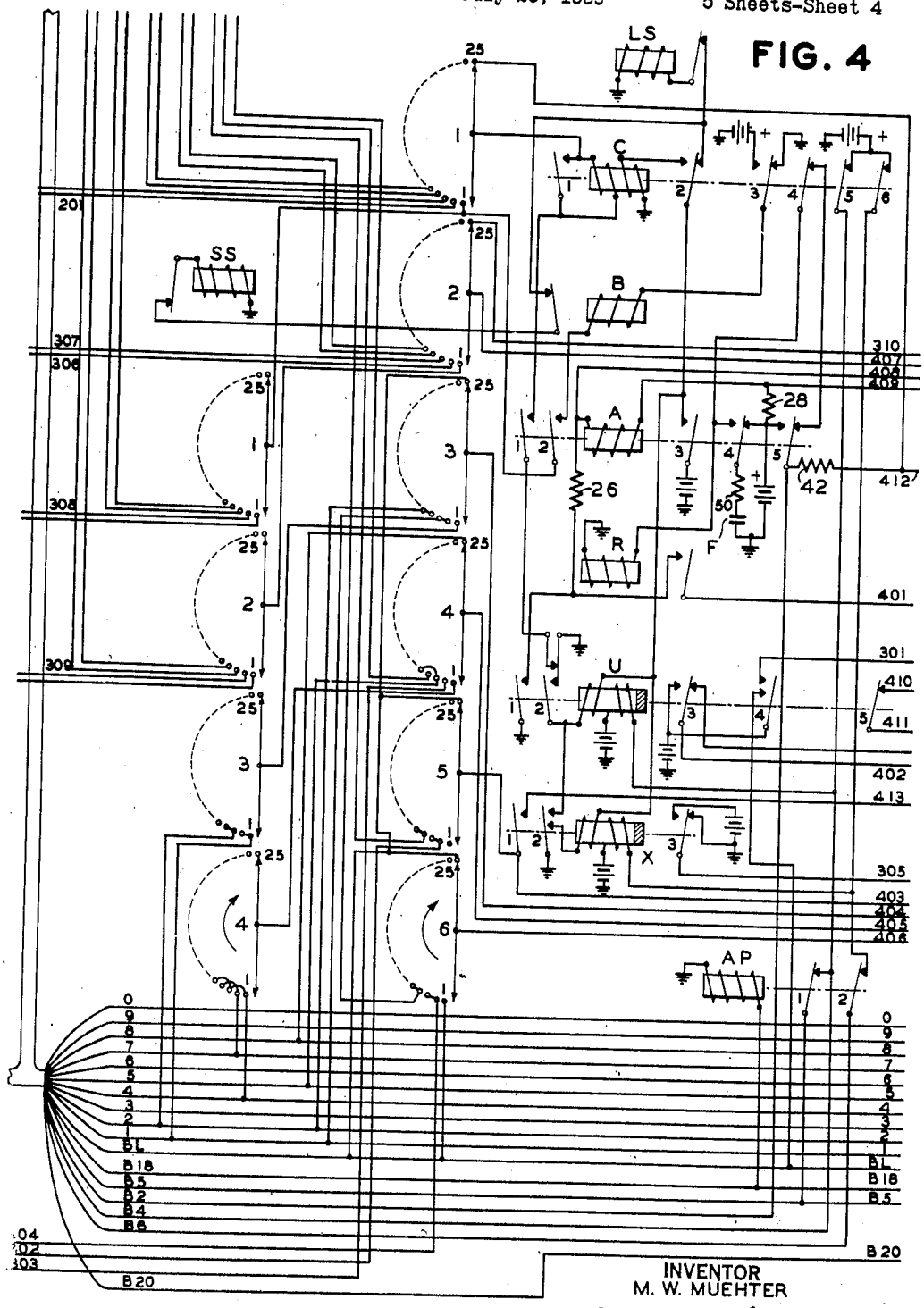
INVENTOR
M. W. MUEHTER
BY A. A. Smith
ATTORNEY

Jan. 12, 1943. M. W. MUEHTER 2,308,198

SIGNALING SYSTEM

Filed July 25, 1939 5 Sheets-Sheet 4

FIG. 4



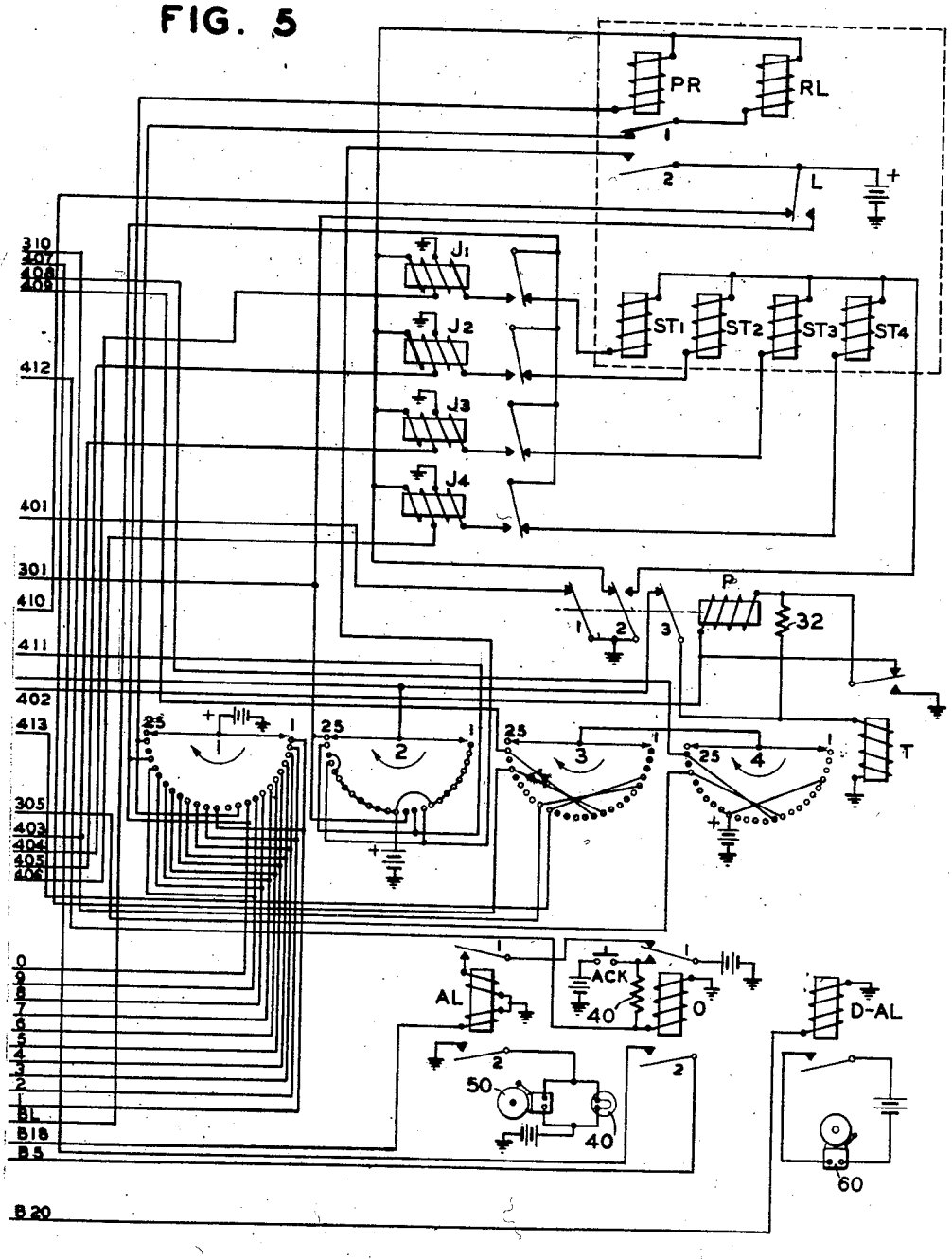
INVENTOR
M. W. MUEHTER
BY A. A. Smith
ATTORNEY

Jan. 12, 1943. M. W. MUEHTER 2,308,198

SIGNALING SYSTEM

Filed July 25, 1939 5 Sheets-Sheet 5

FIG. 5



INVENTOR
M. W. MUEHTER
BY A. A. Smith
ATTORNEY

Patented Jan. 12, 1943

2,308,198

UNITED STATES PATENT OFFICE

2,308,198

SIGNALING SYSTEM

Manfred W. Muehter, Nutley, N. J., assignor to American District Telegraph Company, Jersey City, N. J., a corporation of New Jersey

Application July 25, 1939, Serial No. 286,371

21 Claims. (Cl. 177—360)

This invention relates in general to signaling systems, but more particularly to a watchman's supervisory and signaling system wherein a number of watchmen are supervised by means of a plurality of box routes arranged either in one building or in several buildings. The boxes are operated at regular intervals and in a given order to transmit signals over a line extending to the central supervising office and it is necessary that the watchman operate the boxes in succession to avoid a delinquency signal. This system further includes a means for non-interfering and successive recording of the watchman's signals. The system further includes a combination of means for transmitting and recording emergency alarm signals or armed guard signals with a means for distinguishing between said signals, thereby affording the watchman the opportunity of summoning special aid in certain cases or unusual emergencies. The system also includes switching means for controlling the time and sequence of operation of the watchman's boxes and for disconnecting the delinquency indicator so that the boxes may be operated in any order and within any time interval without causing a delinquency alarm.

The principal object of the invention is to provide a new and improved apparatus for use as a watchman's supervisory and signaling system.

A further object is to provide a watchman's tour system wherein the supervising officer is enabled to supervise a large number of box tours with a minimum amount of effort.

Another object of this invention is to provide a watchman's tour system wherein the number of the last operated box is indicated by a station indicator.

A further object of this invention is to provide a watchman's tour system wherein report signals and emergency call signals may be transmitted from the regular report boxes.

A still further object of this invention is to provide additional signal boxes in each tour circuit for the purpose of transmitting armed guard signals which may summon aid of any desired kind.

Another object of this invention is to provide a watchman's tour circuit capable of transmitting a plurality of types of signals, a means for distinguishing said types of signals and a single recording means for making a record of each individual signal.

Still another object of this invention is to provide a watchman's tour system comprising a plurality of watchman's loops with a recording means for distinctively recording a plurality of different types of identification signals and the loop identification.

A further object of this invention is to provide switching means for permitting the watchman to operate the tour boxes in random order and within any time interval.

Another object of this invention is to provide recording means for recording certain or all of the watch report signals.

A still further object of this invention is to provide a watchman's tour system wherein the emergency call signals and the armed guard signals may be recorded in preference to the regular watch report signals.

Another object of this invention is to provide a watchman's tour supervisory system wherein actuation of the delinquency cut-off means, the sequence switching means or the emergency or armed guard alarm will cause the printing of a record of the particular element which has been operated.

Other objects and features of this invention will be apparent from consideration of the following detailed description taken in connection with the drawings wherein:

Fig. 1 shows the relation between the circuits illustrated in Figs. 2 to 5.

Fig. 2 shows a circuit diagram of a watchman's loop circuit and apparatus for controlling the station indicator.

Fig. 3 shows a circuit diagram of another portion of the control apparatus associated with the loop circuit.

Fig. 4 shows a part of the recording control circuit and the loop selector.

Fig. 5 shows a circuit diagram of the recording apparatus common to all loops.

Fig. 6 shows an example of the recorder sheet used in the recorder shown in Fig. 5.

A brief general description of the operation of the system and apparatus used in connection therewith will now be given, reference being had to Fig. 1 of the drawings. The watchman's tour system is divided into a plurality of zones, each zone including a watchman's loop together with repeater, station indicator, delinquency and printer control apparatus individual thereto. The system may include a number of loops in a single building or a number of loops in separate buildings whereby a plurality of watchmen may be supervised from a single central office. The zones are connected through separate lines to the central office which comprises a loop selector for connecting each individual loop to the

transmitting apparatus as that loop becomes active for reporting a watch report signal. The transmitter is in turn connected to a printer which records all signals received from each of the zones in non-interfering and successive fashion. The apparatus local to each zone is shown in Figs. 2 and 3 while the central office equipment, including the loop selector, transmitter and printer, is shown in Figs. 4 and 5.

When the watchman transmits his report signal, it is repeated and indicated on the station indicator which serves to designate the last station operated on the route. The signals to be recorded are transmitted from the station indicator through the printer control apparatus to the loop selector at the central office. The loop selector in turn causes the transmitting apparatus to control the printer for recording the signals from each of the zones in the system.

The station indicator for one loop circuit and the printing apparatus for all of the loop circuits wil be briefly described. The watchman's watch report transmitting stations, only three of which are shown, are connected to the relay K shown in Fig. 2 and when the watchman operates a transmitter to report to the central station, the repeating relay K is energized. The transmitter has a number of teeth thereon corresponding to the number of the station plus two, the contact spring resting between the first two teeth. The first tooth is active only on a second round of the signal and designates an emergency signal while the second tooth sends a prefix signal on the first round of signals to indicate a watch report signal. The third tooth starts the station number. A more detailed description of the signals will be given later. The prefix space timing relay Q is subsequently energized, acting on the first impulse. During the subsequent space between impulses relay K releases energizing relay V while Q holds up since it is a slow-release relay. On the second impulse, relays K and W are energized, also the selector switch S, which will be called the station selector. After the second impulse, K releases and the selector switch rotates one step but the other relays mentioned above stay energized. During the following impulses K controls the selector to step the switches to temporarily register the box code. After the last impulse of the signal train, the second auxiliary counting relay W releases to in turn step the station indicator selector switch ST. The station indicator operates an indicating device to show the last watchman's station which has been operated. When relay W released, the reset magnet D—RS of the delinquency indicator shown in Fig. 3 was also operated to reset the delinquency indicator and prevent a delinquency alarm. After the release of relay W, relays V and Q also release and the selector S is stepped back to its normal position while the station indicator remains in its last position.

If the watchman has not followed the proper sequence in operating his tour of stations, or has failed to operate a box within a given time interval, the relay W is released so that the selector steps back to the normal position without having energized the station indicator ST or the delinquency indicator shown in Fig. 2. As a result a delinquency alarm is actuated to warn the station operator that the watchman is failing to operate his stations properly.

Figs. 4 and 5 show the printing apparatus which records the signals from the stations at the beginning and the end of the watchman's tour. The printing operation is controlled by the recording relay Z shown in Fig. 3, which is energized from the station indicator ST.

The system also provides a means for enabling the watchman to transmit an emergency signal which may be so designated on the recording tape. Ordinarily the watchman's station is operated by rotation of a key, but he may transmit an emergency signal by opening the box and pulling it for several rounds so that a prefix signal takes effect. The first round of signals would operate the system in the normal manner described above, and the second round of signals will operate relays K, Q and V as before, but between the first and second pulse, the relay Q will be released to prepare a circuit for emergency relay E. On the second signal impulse relay W is energized and relay V is deenergized during the following space. On the next pulse the station selector S is energized and steps during the following space. At the end of the round, relay W releases to step the station indicator ST and energizes the relay E shown in Fig. 3 which in turn controls the recording of the emergency signal.

It is sometimes desirable to arrange the system so that the watchman will not be compelled to operate his stations in sequence or within a given time interval, and therefore the sequence switch SQ is provided for allowing the station indicator ST to operate and relay Z to be energized so that a signal is always recorded regardless of the sequence of operation of the watchman's stations.

The operation of the printing apparatus will now be briefly described. As mentioned above transmission of the ordinary report signal energizes relay Z while transmission of an emergency signal energizes relays Z and E. Assuming that the ordinary watch report signal is received by the station indicator apparatus, relays Z, R and A are operated, relay A shunting the relay R by the condenser F so that the relay R is deenergized by A except for the charge on condenser F. Relay A operates the loop selector LS and also another selector SS. The loop selector selects the particular station indicator which has stored the watch report signal and then the connection is extended through the relay C which stops the loop selector. C locks and energizes relay U which also locks itself and the relay A. Relay U controls the transmitting selector, T, relay P sending stepping impulses to the magnets ST1, ST2, ST3 and ST4. Every time relay P picks up, it releases selector T which in turn makes one step to thereby shunt relay P and deenergize it. On the next impulse P again energizes and steps the selector T. This continues for the duration of the printer stepping impulses. The number of impulses transmitted to the magnets ST1—4 is controlled by relays J1—4 which are energized to cut off the respective stepping circuits in accordance with the signal to be recorded. The stepping magnets are to position the proper type characters so that a recording may be made of the transmitted code and the nature of the report and after the tenth step of the transmitter T the printing magnet PR is energized to print a record of the transmitted signal. After the tenth step of the transmitter, a circuit is completed for shunting the relay Z and the transmitter steps one more step to cause stepping of the printer paper and releasing of the magnet RL

energized by the transmitter T. The printer wheels are reset to the common position and relays A, U, C, R and J1—4 are deenergized. The transmitter T is stepped back to normal and is ready for any other signal which may be stored in another station indicator.

If an emergency signal is transmitted from a watchman's station, relays Z and E are energized to in turn energize the relays AP and AL. The relay AP interrupts the starting circuit for all signals except emergency and armed guard signals so that there can be no delayed printing of emergency or armed guard signals. As before, the relay R starts the transmitting equipment, controlling the printer wheels to record the words "emergency call." The remainder of the signal is recorded in the usual manner.

When the armed guard signal is received, relays E and Z are energized as before, the station indicator is stepped to a position causing the printer wheels to record the words "armed guard call." If two or more calls are stored in the station indicators simultaneously the loop selector acts to select each call separately and in the proper sequence.

If a watchman fails to operate his transmitter in the proper sequence, the apparatus at the central station is operated to cause a delinquency alarm. In Fig. 3 a minute impulse contact energizes the delinquency indicator D—AD once every minute and if the watchman fails to operate the boxes in the required manner, the reset magnet of the delinquency indicator will not be energized, the delinquency indicator being stepped until its alarm contacts are closed. Closing of the alarm contacts energizes bus bar B—2 to start up the transmitter T as before to record a signal on the printer. When the watchman operates the box which he failed to operate in the normal manner the alarm relays are deenergized. The delinquency switch DS is provided for disabling the delinquency alarm and when it is operated relays R and A are energized to start the selectors LS and SS. The transmitter T is started and relays J2 and J3 position the printing wheels to cause recording of the words "delinquency indicator off."

Similarly when the sequence switch SQ is operated the words "sequence control" are brought into position on the printer wheels.

In case of an emergency or armed guard signal the relay AL is energized and locks in thereby giving a continuous audible and visible alarm which can only be silenced by the operator operating his acknowledgement key ACK. This energizes relay O to cause release of relay AL thereby silencing the alarm. At the same time relays R, A, C and U are energized to in turn properly control the relays J1, J2 and J4 for printing the words "supervisor's acknowledgment."

The system having been described in general, a detailed description thereof will now be given. The watchman's tour system comprises a number of loop circuits disposed within a single building or within a number of different buildings, each loop including a number of tour boxes for the purpose of supervising the watchman's route. In this manner a number of watchmen may be supervised from a central station and each watchman may be compelled to cover a prescribed tour. Each tour box comprises a transmitting wheel such as that shown in station I at the top of Fig. 2 of the drawings. It is to be noted that the transmitter wheel has a plurality of teeth thereon corresponding to the number of the station plus 2 and it should be further noted that the pen spring normally rests between the first two teeth, the purpose of which will now be described. When the wheel 3 is rotated in the direction of the arrow the pen spring is lifted away from the code wheel by the teeth thereof to transmit two impulses by grounding the loop circuit. The first impulse is a normal prefix which designates that the signal transmitted is the normal watch report signal, while the second impulse designates the number of the station which has been operated. The operation described above occurs on the first round of the transmitter wheel, but if an emergency occurs the watchman may operate the transmitter wheel for a number of rounds in which case during subsequent rounds the first tooth on the wheel 3 causes a marking impulse followed by an abnormally long space to be transmitted for the purpose of controlling the recording equipment to record an emergency signal.

When a watch report signal is transmitted, the first tooth on the code wheel of station III, for instance, grounds the circuit for box relay K from battery through the coil of relay K through the pen spring at box III to ground thereby transmitting the normal prefix signal. Relay K is energized and closes a circuit for space-timing relay Q from battery, through the 25th or normal bank contact of the second bank of selector S through an obvious circuit to the coil of relay Q through contact 3 of auxiliary counting relay W, make contact 3 of relay K which was closed when relay K was energized, contact 2 of auxiliary counting relay V and through the resistor 10 to ground. Relay Q pulls up and closes a holding circuit from its lower coil terminal to resistor 10 through its own contact 2 thereby locking itself when the make contact 3 of relay K opens. This last mentioned contact opens when relay K releases during the space following the first signal impulse. At the same time back contact 3 of K closes and applies a shunt to relay Q which can be traced from battery through the left hand normally closed contact of switch 15, back contact 3 of K and contact 3 of W to the lower terminal of coil Q, the upper terminal of which is also connected to battery through the 25th contact of the second bank of selector S. The space between impulses is not of sufficient duration to cause relay Q to release due to the inductive effect of its coil.

At the same time, a circuit is closed for relay V from battery through make contact 1 of relay Q, back contact 1 of relay K, lower winding of relay V and resistor 11 to ground. Relay V pulls up and locks in through its make contact 1 and back contact 1 of relay W to battery. Thus the normal prefix signal is deleted. The second impulse received from the box again operates relay K and closes a circuit for relay W which may be traced from battery through the left hand contact 5 of relay V, right hand contact of switch 15, make contact 2 of relay K, the coil of relay W and resistor 12 to ground. Relay W pulls up and locks in through its make contact 1 to battery. Thus the first two impulses from the watchman's box III have energized relays Q, V and W.

The locking circuit of relay V is changed at this time since the break contact 1 of relay W is now open, but this is ineffective since this contact is now bridged by the make contact 1 of relay K which is now closed. When relay W is operated, selector magnet S is energized through a circuit which can be traced from battery through contact 3 of relay Q, make contact 4 of

V, contact 4 of K, and through the coil S to ground. When relay K releases during the following impulse, the selector magnet S is deenergized at contact 4 of relay K and its armature moves the associated wipers of the selector one step forward to position 1.

At the same time the coil of relay W is short-circuited by back contact 2 of relay K. The duration of the space between impulses, however, is not sufficient to cause relay W to drop. It will be noticed that the previous locking circuit of the lower winding of relay V is now open at contact 1 of relay K but the relay stays operated since its original operating circuit is closed when back contact 1 of relay K closes. The relay V is maintained energized by the make-before-break contacts 1 of relay K which are so arranged that one makes before the other breaks in order never to interrupt the continuity of the circuit through the lower winding of relay V. When the selector S was stepped forward to position 1 the selector operated the cam 16 to in turn operate the switch 15 so that the make contacts of switch 15 are no longer closed and the shunt circuit of relay Q is therefore opened. The operating circuit of relay Q is likewise opened since the second wiper of selector S is not making contact with its 25th bank contact. However, this contact is bridged by the right hand contact 5 of relay V so that relay Q remains energized.

The remaining impulses of the watch report signal from station number III will have no effect on relays Q, V and W since they all stay operated between impulses and the selector S is stepped one step whenever relay K releases. It will thus be seen that the first impulse of the coded signal is deleted as far as the selector S is concerned for a reason which will become apparent later. The selector S is therefore moved one step less than the number of impulses received from the box whereby if the number of impulses received from the box is 4, the selector S will be in position 3 at the end of the signal impulses from the watchman's box thereby temporarily registering the box number. After a short time interval, the shunt across relay W through back contact 2 of relay K will become effective and cause relay W to release its armature. If the box has been operated according to schedule, the station indicator ST will at this time be in position number 2, which means that the box operated before was box number 2.

When relay W releases, a circuit is closed from battery through contact 3 of the second wiper and bank of selector S, back contact 4 of relay W, make contact 3 of relay V, the third contact and wiper of the first bank of selector S, the second contact and wiper of the first bank of station indicator selector ST, conductor 100 to contact 2 of relay Z shown in Fig. 3, conductor 101, interrupter contact of the station indicator ST, and the coil of ST to ground. The station indicator ST will operate through this circuit in self-interrupting fashion. In other words relay W identifies the termination of the code and controls the start of subsequent operations.

At the time of release of relay W, the reset magnet D—RS of the delinquency indicator D, shown in Fig. 3, is energized through a parallel circuit which branches off from conductor 100 through the normally closed contact 1 of switch DS and winding D—RS to ground. These circuits are obviously interrupted as soon as the wipers of ST leave position 2, thereby causing the indicator ST to stop in position 3 to permanently register the box number and indicate that station number III is the last station which has been operated.

When relay W releases, a shunt is applied to the lower winding of relay V which can be traced from battery through the normally open contact of switch 15 which is now closed, contact 2 of W to the upper terminal of the winding of relay V, the lower terminal of which is also connected to battery. Consequently this relay will be slowly de-energized and release its armature. It will be noted that the upper winding of relay V, which is connected in multiple with the coil of interrupter contact of station indicator ST, is also deprived of current when the operating circuit of magnet ST is opened.

Relay V having released, relay Q is also de-energized by the opening of right hand contact 5 of V and at the same time a circuit is closed for selector S from battery through the second bank and wiper of S, back contact 4 of W, back contact of 3 of V, interrupter contact of S of the coil S to ground. Therefore selector S will operate through the above circuit breaking its own current until it reaches the normal position 25 at which time the wiper of the second bank opens the circuit permanently and S is again in its home position. In other words, relay V determines the instant at which selector S returns to its home position.

In case the watchman should not operate the boxes successively and within the allowed time period and should pull box number 5 when he was supposed to pull box number 4, the station indicator being in position 3, there will be no circuit closed for either the station indicator or the reset magnet of the delinquency indicator when relay W is released at the end of the report signal. When relay W releases, relay V will drop out after a short delay due to the shunt across its lower winding and selector S will be reset to the home position as explained above. The box signal will therefore fail to step the station indicator and the delinquency indicator thereby causing a delinquency alarm. The delinquency indicators may be of the types shown in the patents to R. M. Hopkins, Nos. 1,942,814 and 1,942,815 of January 9, 1934.

If the box happens to be the first or last on the route and is operated according to schedule, its signal will not only cause resetting of the delinquency indicator and operation of the station indicator but will also cause recording of the signal on the printing recorder. Assuming the last box number on the route to be 17, the selector S will be stepped up to position 17 in the manner explained above and, when relay W releases at the end of the report signal, a circuit is closed for magnet ST from battery through the second wiper and bank of selector S, back contact 4 of W, make contact 3 of V, the 17th bank contact and wiper of the first bank of selector S, the 16th bank contact and wiper of the first bank of station indicator ST, conductor 100, the second contact of relay Z, conductor 101, interrupter contact and coil of ST to ground. ST will again operate, breaking its own circuit for several steps since bank contacts 16 to 24 of bank 1 of ST are strapped together and will come to a stop in position 25. The reset magnet D—RS will be energized at the same time as described above. The upper winding of relay V is simultaneously held energized through a parallel circuit branching off wire 101 to prevent this relay from releasing prematurely. When the wipers of ST reach position

25, a circuit is closed from the 17th bank contact of bank 1 of selector S through the 25th bank contact of bank 2 of station indicator ST, the 17th contact of the third bank and wiper of selector S, conductor 102, through back contact 1 of relay Z, the series resistance 20 and relay Z to ground. Relay Z operates and locks in through its make contact 1 thereby causing the signal to be recorded on the printing recorder, as will be explained in detail later.

Box signal recording.—Relay Z is also operated uopn reception of a report signal from box I as its circuit is closed in position 1 of selector S through a circuit which may be traced from battery through the first contact and wiper of the second bank of selector S, back contact 4 of relay W, make contact 3 of relay V, the first contact and wiper of the first bank of selector S through the wiper of the second bank of station indicator ST, in position 1, the first contact and wiper of bank 3 of selector S, conductor 102, the first back contact of relay Z, resistor 20 and the coil of relay Z to ground. Again the signal is recorded on the printing recorder as in the case of the last box on the route. If the number of boxes on a circuit exceeds 10, one or more intermediate boxes are also arranged to record their signals on the printer, corresponding bank contacts of bank 3 of selector S being multipled.

Ordinarily the watchman may transmit his usual watch report signal by the insertion of his key in the watch report box but under certain circumstances he may desire to transmit an emergency call signal whereupon by opening the box and pulling it for several rounds he may transmit an emergency call signal which is recorded as such. When the watch box is operated by pulling the lever for several rounds, a prefix 1 is brought into play for rounds following the first so that the single group of impulses ordinarily transmitted by the watch station will be preceded by a single impulse followed by an abnormally long space. The impulse wheel is cut in such a manner that a space approximately three times the length of the space between the regular teeth occurs between the prefix tooth and the first tooth of the regular transmitting teeth. Therefore there will be a longer space between the first impulse which is the prefix impulse and the following signal transmitting teeth. Assuming the box number to be III, the first round of signals will consist of four impulses and will operate the apparatus exactly as explained above.

If the watchman is not scheduled to pull the particular box, it will have no permanent effect upon the apparatus at the control center but when the first impulse of the following round is received the operation will be quite different. Prefix space timing relay Q is energized as described above when K is first energized and during the following space, K releases and energizes V likewise as before. However, since this space is of longer duration due to the spacing of the teeth on the transmitter wheel, the shunt across relay Q from plus through the left hand normally closed contact of switch 15, back contact 3 of relay K, and contact 3 of relay W to the lower side of relay Q, becomes effective and relay Q releases after a certain delay. Back contact 1 of Q closing shunts the lower winding of relay V through back contact 1 of K, back contact 1 of Q, contact 2 of W to the upper terminal of the lower winding of relay V, but the space between the prefix and the box code is not of sufficient duration to cause relay V to release.

When the next impulse is received, which is the first impulse of the box code, relay W is energized in the same manner as before, from battery through the left hand contact 5 of V, right hand contact of switch 15, make contact 2 of K, the coil of relay W and the resistor 12 to ground. During the following space, relay V is deenergized because the former operating circuit through make contact 1 of relay Q is no longer closed and make contact 1 of K and back contact 1 of W are both open. When the next impulse is received, a circuit is closed for selector S from battery through contact 5 of relay W, back contact 4 of relay V, contact 4 of relay K of the stepping coil of selector S to ground. During the following space between signal impulses, selector S is stepped forward one step to position 1 and at this time relay V is reenergized from battery through the normally open contact of switch 15 which closed when the selector S was stepped forward, back contact 1 of relay Q, the lower winding of relay V and resistor 11 to ground. Relay V closes a locking circuit for itself through its contact 1 and make contact 1 of K, which is effective during impulses. The following impulses again operate selector S through a different circuit which can be traced from battery through the second bank and wiper of selector S, make contact 4 of relay W and make contact 4 of relay K. Selector S is thus moved three steps since four impulses are transmitted by the box in addition to the prefix impulse and selector S temporarily registers the box code as in the case of a watch report signal.

The emergency prefix impulse and the normal prefix impulse of the following four are deleted as far as selector S is concerned, the reason being that the first impulse received may be the emergency prefix impulse and in that case is additional to the impulses representing the station number and it is therefore deleted in all cases. This means that the normal station signal which is transmitted by the box must consist of one impulse more than is necessary to indicate the number of the box. If the first impulse received is actually the emergency prefix impulse, it is followed by a longer space as described above and in that case the first impulse of the following normal station signal is also deleted, as will be evident from the above description and therefore the selector S is always moved the same number of steps whether the emergency prefix impulse is received or not.

As explained above in connection with reception of the ordinary night watch report signals, relays V and W stay energized as long as the impulses are coming in, the only difference for emergency signals being that the circuit for the lower winding of relay V is closed during space intervals from battery through the make contact of switch 15, back contact 1 of relay Q and back contact 1 of relay K instead of from battery through make contact 1 of Q and break contact 1 of K as previously. At the end of the emergency call signal, relay W releases due to the shunt through back contact 2 of relay K and a circuit is now closed from battery through the second bank and wiper of selector S, back contact 4 of relay W, make contact 3 of relay V, back contact 4 of relay Q which is open for ordinary night watch signals, conductor 103 to the lower winding of emergency relay E and ground thereby energizing relay E. Energization of emergency relay E closes a circuit from battery through bank 2 of selector S, back contact 4 of relay W, make contact 3 of relay V, conductor 104, make contact

4 of relay E, contact 2 of relay Z, conductor 101, the interrupter contact and the coil of station indicator ST to ground so that ST will operate even though it has not been in the proper position with respect to the box signal received. Assuming the box number to be III station indicator ST will operate in self-interrupted drive until it reaches position 3. At the same time the reset magnet of the delinquency indicator is energized as explained before and likewise the upper winding of relay V in order to prevent this relay from releasing prematurely. When station indicator ST reaches position 3 a circuit is closed from battery at the wiper associated with bank 2 of the switch S through the third bank contact of bank 1 of selector S, the third bank contact of bank 2 of station indicator ST, conductor 105, contact 1 of emergency recording relay E, resistor 20 and the coil of recording relay Z to ground, thereby operating relay Z and stopping station indicator ST by breaking contact 2. Relay Z locks in through make contact 1 which also locks in relay E through contact 2 of relay E and the upper winding thereof, thus causing an emergency signal to be recorded on the printing recorder, as will be described later. A short time after operation of relay Z, relay V releases and resets selector S to the home position to be ready for the next round, as explained above.

The system also includes armed guard boxes which are connected in each of the loop circuits for the purpose of summoning assistance, the distinction being that in this box the pen spring is so arranged in relation to the code wheel that the prefix 1 is transmitted even when a single round is transmitted and, in addition to the distinctive number assigned to the box, which is larger than any number assigned to a regular box the recording on the printer is also distinctive due to the designation "armed guard call" on the tape. The distinctive characteristics of the printing operation will be explained in detail later on.

Another feature of this invention is the provision of a sequence control switch SQ, Fig. 3, which is provided for each of the station indicator units for the purpose of arranging the system so that night watch boxes on a particular route can be pulled in any sequence and every incoming report signal will reset the delinquency indicator to prevent a delinquency alarm. When the switch SQ is thrown, it will permit the operation of the station indicator for all signals regardless of sequence, since contact 1 of the sequence switch SQ is connected in multiple with contact 4 of relay E so that the operation of the station indicator will be similar to emergency signals with the exception of relay E. However, relay Z is energized since contact 2 of switch SQ is in multiple with bank 3 of selector S through wires 102 and 105, thereby causing the watch report signal to be recorded on the printing recorder.

Another switch DS, shown in Fig. 3, of the drawings, serves to disconnect the delinquency indicator, as will be described later. A recording is made when the position of either switch DS or SQ is changed as will also be explained below.

All phases of operation of the system have been described up to and including the operation of recording relay Z which controls the printer, shown in Figs. 4 and 5, for printing the watchman's tour signals of various characteristics. As described above, the signals from the watchman's loop control selector S and station indicator ST to thereby control the delinquency indicator and relay Z and, in emergencies, relay E. In a case where a station signal is to be recorded on the printing recorder, recording relay Z is operated and if the signal happens to be an emergency signal, emergency recording relay E is also operated.

Assuming the signal to be the usual watchman's report signal, the operation of relay Z closes a circuit shown in Figs. 3 and 4 which can be traced from battery through contact 5 of relay C shown in Fig. 4, contact 1 of relay AP in the transmitter unit, busbar B5, through back contact 6 of relay E of the particular station indicator unit which has been operated by the watchman's loop connected therewith, contact 3 of relay Z, resistor 24, busbar B2, back contact 5 of auxiliary starting relay A, contact 4 of relay C and the coil of main starting relay R to ground. Relay R operates, closing the circuit for relay A from ground through contact 1 of relay P shown in Fig. 5, conductor 401, make contact of relay R, resistor 26 and the coil of relay A, through resistor 28 to plus. Relay A energizes and operates to close make contact 4 thereby connecting the coil of relay R in multiple with a condenser F which previously had been charged through a circuit extending from battery through back contact 4 of relay A, resistor 50, condenser F and ground. Shortly after closing of front contact 4 of relay A, the former operating circuit of relay R is opened at back contact 5 of relay A. Relay R is now dependent on the charge of condenser F for holding up its armature, the purpose of this circuit being to cause release of relay R after a short time in case the starting circuit should be opened again before selecting operations have been completed.

When relay A closes its contact 3, a circuit is completed for the loop selector LS from battery through contact 3 of relay A, back contact 2 of relay C, and the interrupter contact and coil of loop selector LS to ground, selector LS operating through this circuit in self-interrupted drive. Another selector SS operates in a multiple circuit which can be traced from back contact 2 of C through the break contact of stop relay B, interrupter contact and coil of selector SS to ground. The operation of this second selector has no part in the operation of the circuit at this time and will be described later on. Selector LS moves its wipers step by step until its first wiper reaches a point where a circuit is closed from battery through contact 5 of relay C, contact 1 of relay AP, over busbar B5, back contact 6 of relay E, contact 3 of relay Z, to conductor 201 of the particular station indicator unit. Conductor 201 is connected to contact 2 of bank 1 of selector LS. From this point the circuit is completed through the wiper of bank 1 of selector LS through the left hand winding of stop relay C, contact 1 of relay A to back contact 2 of relay U to ground. Therefore relay C operates and breaks the operating circuit of loop selector LS and selector SS by opening the back contact 2 when the proper station indicator is found.

Energization of relay C closes a holding circuit which may be traced from battery through contact 3 of relay A, make contact 2 of relay C, through the right hand winding of relay C to ground. Contact 5 of relay C opens and substitutes right hand winding of start relay U for contact 5 in the former operating circuit of the left hand winding of relay C, while this winding is short-circuited by contact 1 of relay C. Relay U

energizes and locks in from ground through its make contact 2, the left hand winding of relay U, through contact 3 of relay A to battery. Make contact 1 of relay U closes and locks in relay A so as to make it independent of relay R and its condenser F for holding the armature energized during the remainder of the operation.

Energization of relay U starts the operation of transmitting selector T shown in Fig. 5. Selector T in conjunction with relay P sends impulses to the four stepping magnets ST1 to ST4 of the printer to set up the typewheels in the proper position for printing the transmitted signal. The printer may be of the type shown and described in applicant's prior Patent No. 2,126,025 issued August 9, 1938. When the upper make contact 4 of relay U closes, the transmitting selector T is energized from battery through upper make contact 4, conductor 301, bank contact 25 or bank contact 12 of bank 2, either of which is used as the normal rest position of selector T, wiper of bank 2 of selector T, contact 3 of relay P and the coil of selector T to ground. The stepping magnet of selector T is thereby energized and closes its auxiliary make contact to energize relay P through the coil of relay P, conductor 402 and make contact 3 of relay U to battery. Make contact 2 of P closes and applies ground to all four of the stepping magnets St1 to St4 of the printer through the back contacts of the associated J relays, through busbar BL and the lower contact 4 of relay U to battery, thereby causing the ST relays to move their ratchet wheels one step. When relay P operates, contact 3 of relay P opens and selector T releases but relay P does not drop out when the make contact of T breaks since it stays energized through the resistor 32 and the coil of transmitter selector T in series. This holding current is too low to affect the magnet of selector T and when the armature of selector magnet T has completed its back stroke, moving the wipers forward one step, the back contact of selector T closes thereby shunting out the coil of relay P which causes the armature to drop out with a slight delay. This assures positive operation of the transmitting selector T as well as sufficient duration of the impulse for the printer stepping magnets. When contact 3 of relay P closes again, the magnet T is reenergized for a new cycle. For this step and those following the circuit may be traced from battery through the second bank and wiper of selector T in series with contact 3 of relay P.

Let it be assumed that watch box 14 of the first watch route has been operated for a watch report signal and that relay Z in the corresponding station indicating unit has been energized in accordance with the above description. As also explained above the relay Z controls the relay P and transmitting selector T of Fig. 5. When relay P releases after the transmitter T has moved its wipers for the first step, a circuit is closed for relay J1 which can be traced from ground through back contact 2 of relay P, the left hand winding of relay J1, conductor 404, through the wiper and bank contact 2 of bank 3 of loop selector LS to code bus bar 1 which is connected in Fig. 4 through the first and thirteenth bank contact of bank 1 of selector T. As the wipers of selector T are now resting on the first or thirteenth bank contact, depending on whether they started from the twenty-fifth or twelfth position, the circuit is completed to battery. Relay J1 is therefore energized and in opening its back contact prevents further impulses from reaching the stepping magnet ST1 of the printer. Relay J1 is locked in through its make contact and right hand winding to battery on bus bar BL which is connected through the lower contact 4 of relay U.

Another circuit is simultaneously closed from ground through back contact 2 of P, the left hand winding of J3, conductor 403, wiper and contact 2 of bank 5 of selector LS, conductor 302 to bank 4 of the station indicator selector ST which is connected to the first watch route. Since this wiper is now in position 14 the circuit is completed through bank contact 14 of bank 4 to bus bar 1 where battery is now available from bank 2 of selector T. Relay J3 is therefore operated and by opening its back contact prevents further impulses from going to the third printer stepping magnet ST3. At the same time it closes a holding circuit through its make contact and its right hand winding through the same circuit mentioned above in connection with relay J1. After the second step of selector T, another circuit is closed for relay J2 when relay P releases, the circuit extending from ground through back contact 2 of relay P, through the left hand winding of J2, conductor 405, through the wiper of bank 4 of loop selector LS, bank contact 2 of bank 4, conductor 303 to bank 3 of the station indicator ST, contact 14 of station indicator ST, conductor 106, back contact 5 of relay E to the code bus bar 2. From this bus bar a connection is made to the second and fourteenth bank contact of bank 1 of selector T on one of which contacts the wipers of this selector are now resting, the circuit thereby being completed to battery. Relay J2 operates and opens its back contact thereby breaking the circuit of the second printer stepping magnet ST2 and locking in through its right hand winding and its make contact through the same circuit as traced above for releasing J1 and J3. The following impulses will now operate only the fourth stepping magnet of the printer and when relay P releases after the fourth impulse a circuit is closed for relay J4 from ground through back contact 2 of relay P through the left hand winding of relay J4 over conductor 406, through bank 6 of loop selector LS. This wiper is now resting on bank contact 2 which is connected through conductor 304 to the wiper of bank 5 of station indicator ST. This wiper is resting on its fourteenth bank contact from which a connection is made to code bus bar 4 which is in turn connected to bank contacts 4 and 16 of bank 1 of transmitter T on one of which contacts the wiper is resting at this time thereby completing the circuit to battery. Relay J4 operates, breaks the circuit of the fourth stepping magnet ST4 of the printer and locks in through its right hand winding and its make contact as in the case of the other J relays. The following impulses can have no effect on the printer since the circuits have all been broken to the ST magnets and when relay P releases after the tenth step of transmitter T, a circuit is closed from ground through back contact 2 of relay P, printer magnet PR, the tenth or twenty-second contact of bank 1 of transmitter T to battery. The printer magnet attracts its armature and records the signals set up by the stepping magnets ST1 to ST4 on the tape which will be "zone 1, watch station 14." The date and time is also printed alongside of the signal recorded by the printer. Selector T stops at this time since its former operating circuit through its bank 2 directly to battery is no

longer closed because the tenth or twenty-second contacts are connected through the make contact of printer magnet PR to battery through an obvious circuit. As soon as the printer magnet completes its stroke the operating circuit for transmitter T will be completed through the wiper of bank 2 and make contact 2 of relay PR to battery, thus assuring positive operation of the printer magnet.

The following table illustrates by way of example the subject matter to be recorded by each printer wheel, the first wheel indicating the zone, the second wheel the nature of the call, and the third and fourth wheels indicating the number of the station. The table further indicates the exact information printed on any particular step of each printer wheel.

	1st wheel	2nd wheel	3rd wheel	4th wheel
Step 1	Zone 1	Armd. guard call	1	1
Step 2	Zone 2	Watch station	2	2
Step 3	Zone 3	Emergency call	3	3
Step 4	Zone 4	Sequence control	Off	4
Step 5	Zone 5	Watch del. after	On	5
Step 6	Zone 6	Supvr's delinq.		6
Step 7	Zone 7	Delinq. indicator		7
Step 8	Zone 8	Supvr's. ack.		8
Step 9	Zone 9	Tamper signal		9
Step 10	Zone 10			0

When the wipers of transmitter T are in position 10 or 22 respectively, another circuit is closed which can be traced from ground through back contact 3 of relay X shown in Fig. 3, conductor 305, through the tenth or twenty-second bank contact and wiper 4 of transmitter T, wiper of bank 3 of transmitter T which is also on its tenth or twenty-second bank contact, conductor 407 to the wiper of bank 2 of loop selector LS, this wiper being on bank contact 2, conductor 306 and the right hand coil terminal of the relay Z of the station indicator connected to the first watchman's route. Since the other side of the coil of relay Z is also connected to ground, the above traced circuit applies a shunt to relay Z causing it to release its armature.

The transmitter T advances to position 11 or 23 respectively and in case of position 23 will step forward to position 24 since coil T is energized through bank 2 by an obvious circuit. The printing magnet PR is released when back contact 2 of relay P breaks prior to the moving of the wiper arms and the paper is moved forward one step at this time as explained in the patent to M. W. Muehter No. 2,126,025, isued August 9, 1938. When the wipers of transmitter T have stepped to the 11th or 24th contacts a circuit is closed from battery through the wiper of bank 1 and its 11th or 24th contact through the break contact of printer magnet PR, the coil of release magnet RL and back contact 2 of relay P to ground. The release magnet resets all type-wheels to their normal position and closes the back contact of a latch switch L which was opened on the first step of the stepping magnets ST1—4 as shown in the above identified Muehter patent.

At the same time relay A of Fig. 4 is shunted through a circuit which can be traced from the left hand coil terminal of relay A, conductor 408, the 11th or 24th bank contacts of the fourth and third banks of selector T in series, conductor 409 and the right hand terminal of coil A. Relay A releases, thereby causing C and U to release when contact 3 of relay A opens their locking circuits. It should be noted that the former operating circuit of the left hand winding of relay C has already been opened when relay Z deenergized and opened its contact 3. The winding of relay R is restored to its normal operating circuit which is also opened at contact 3 of relay Z. Lower contact 4 of relay U deenergizes relays J1 to 4 when relay U is deenergized.

In view of the above circuit changes a circuit is now closed from the battery through the back contact L of the printer, conductor 410, contact 5 of U which closed when relay U was deenergized, conductor 411, the eleventh or twenty-fourth contact of bank 2 of transmitter T, the wiper of bank 2, contact 3 of relay P and the coil of selector T to ground, causing the selector T to move its wipers to positions 12 or 25 respectively, which positions are the normal ones.

If another watch report signal from a different zone or watch route has been stored on the respective station indicators and is waiting to be recorded, the loop selector LS under the control of relay Z in the proper zone equipment will now connect the transmitting equipment of Figs. 4 and 5 to that particular station indicating unit through the cable and wires extending upwardly in the upper left hand corner of Fig. 4 and the transmitter will operate the recorder in a similar manner to that described above. It will be noted that in the case of a different zone, the bank contact of bank 3 of selector LS which is assigned to that zone, is connected to the corresponding code bus bar so that the second contact of selector LS is connected to bus bar 1 whereby the station indicator in the first zone would cause "zone 1" to be recorded. In the case of zone 2, the fourth contact of bank 3 of selector LS is connected to bus bar 2 so that the station indicator of zone 2 will cause the printing of "zone 2." Thus the particular bus bar determines the number of impulses which the first stepping magnet ST1 is to receive which in turn determines the zone number to be recorded on the tape. The number of the box which is printed on the tape is determined by the position of the corresponding station indicator ST and the interconnection between the bank contacts of the fourth and fifth banks of the station indicator ST to the code bus bars. As the loop selector LS can only connect to one station indicator unit at one time, the signals will be recorded without interference and successively from each zone.

In the case where an emergency signal is to be recorded, relay Z is operated in the usual fashion and relay E is also energized in the particular station indicator unit. Relay E, by closing its contact 3, completes a circuit from battery through bus bar B18, the coil of relay AP to ground and also the lower winding of relay AL to ground thereby energizing both relay AL and AP. When relay AL energizes a locking circuit is closed from battery through back contact 1 of relay O, contact 1 of relay AL, its upper winding and ground. An obvious circuit is also closed for the special attention light 49 and bell 50. With relay AP energized its back contacts open to interrupt the starting circuit for the recording of any but emergency and armed guard call signals, in order to give preference to these and allow them to be recorded first. The back contact of relay AP removes battery from bus bars B5 and B6, thereby interrupting the starting circuit for recording the other signals. The

starting circuit for the recording of the emergency signal under consideration is completed from battery through contact 5 of relay C in Fig. 4, bus bar B4, make contact 6 of relay E of the particular indicator unit, through contact 3 of relay Z in the same unit, resistor 24, bus bar B2, back contact 5 of relay A in Fig. 4, back contact 4 of relay C and the coil of relay R to ground. Relay R starts the transmitting equipment in Fig. 5 and operates the recorder in exactly the same manner as previously explained in connection with the usual watch report signals except that relay J2 is operated at a different time as will be explained below. The circuit for relay J2 at this time is closed when relay P releases after the third impulse to the printer stepping magnets through a circuit which can be traced from ground through back contact 2 of relay P, left hand winding of relay J2, conductor 405 to the wiper 4 in bank 4 of selector LS, bank contact 2 which is connected through conductor 303 to bank 3 of station indicator ST. From there the circuit extends over bank contact 14, assuming that box 14 has been operated, conductor 106, make contact 5 of relay E to code bus bar 3 which is connected to bank contacts 3 and 15 of the first bank of printer T on one of which the wiper is resting at this time. This causes the line of type "emergency call" to be brought into printing position instead of "watch station" as in the previous case. When relay Z releases, relay E also releases since make contact 1 of Z opens the locking circuit of the upper winding of relay E. The remainder of the restoration of the apparatus to normal is the same as described previously in connection with recording of regular watch report signals.

In the case of armed guard signals, relay E is again energized and the operation will be the same as explained above for emergency call signals except that relay J2 will be operated after the first impulse to the stepping magnets of the printer. This circuit can be traced through the same relays and conductors as just described in connection with emergency signals except that from conductor 303 the circuit extends through the third wiper and bank of station indicator ST directly to code bus bar 1 since the bank contacts of the third bank of selector ST which are assigned to armed guard stations are connected directly to that bus bar, namely contacts 18 to 21. All armed guard stations have special numbers assigned to them so that their operation steps the station indicator to these contacts. Bus bar 1 is connected to bank contacts 1 and 13 of bank 1 of selector T, one of which contacts is closed after the first step to complete the circuit to battery. As mentioned above, relay J2 will be operated after the first impulse to the stepping magnets of the printer and the line of type "armed guard call" will be stepped up into printing position and record accordingly on the tape.

If emergency or armed guard signals are coming in on different loops at the same time, selector LS will connect with the next indicator unit after recording the first round of the first signal and go on taking signals from each indicating unit in succession. As the emergency call signals are multi-round signals, the same signal will be recorded several times on the tape. In case of emergency and armed guard signals coming in on several loops simultaneously, it might happen that selector LS would not return to the first indicator unit in time for recording the second round before the third signal round on that circuit has come in. However, this has no harmful effect except that one round of the box will be lost. Under these circumstances when relay W releases after the reception of a box signal, relays Z and E are still energized, since the previous round has not yet been recorded. Contact 2 of Z being open, the circuit for station indicator ST and the upper winding of relay V is obviously open and relay V releases after a short interval due to the shunt applied to its lower winding through break contact 1 of K, back contact 1 of Q and contact 2 of relay W. When relay V releases, the circuit is closed for selector S as described above through which it operates in self-interrupted drive, thereby bringing its wipers back to the home position, so that the indicator equipment will be ready for reception of the following round.

As described before in the general description of this invention, a delinquency indicator is provided in each station indicator unit for sounding a delinquency alarm in the event that the watchman fails to operate the boxes in the proper sequence within the given time period. The delinquency indicator shown in Fig. 3 receives ground impulses every minute through the minute impulse contact, which is controlled by a clock circuit, through the coil of the delinquency indicator advance magnet D—AD, through contact 2 of switch DS and back contact 2 of relay DA to battery. Thus the delinquency indicator is periodically stepped through a series of steps to time the period between watch box operations. If the watchman fails to operate his boxes accordong to schedule, the reset magnet of the delinquency indicator will not be energized and the delinquency indicator will continue to be stepped forward until its alarm contacts operated by a cam on the stepping mechanism close. This completes a circuit which can be traced from battery through contact 6 of relay C, contact 2 of relay AP, bus bar B6, left hand contact 1 of the delinquency indicator, contact 1 of relay D—A through the resistor 25 to bus bar B2, thereby starting the transmitter T by operating relay R as explained above in connection with the recording operation. The signal will now be recorded on the printer and the operation is the same as explained above for night watch signals, except that selector LS comes to a stop in position 3 because of connection to contact 1 of D—A. When relay C operates, the right hand winding of relay X is inserted in the operating circuit of the left hand winding of relay C. Relay X operates and locks in from ground through its lower contact 2, its left hand coil and through contact 3 of relay A to battery. The upper contact 2 of relay X energizes relay U through an obvious circuit and the operation of the printer is similar to that explained above, except that the relay J2 operates after five impulses as wiper 4 of LS is resting on bank contact 3 making connection to bus bar 5, bringing the line of type "delinquency after" into printing position. The complete recording would be for instance "zone 1," "deliinquency after," and the number of the last-operated box. When transmitter T reaches its position 10 or 22 respectively, a circuit is closed from battery through make contact 3 of relay X, conductor 305, the tenth or twenty-second bank contact of the fourth and third bank of selector T and the associated wipers in series, conductor

407, through the second wiper and bank of loop selector LS in position 3, conductor 307 to the proper station indicator unit, the coil of relay D*A, bus bar B20 and coil of relay D—AL shown in Fig. 5 to ground. Relays D—A and D—AL operate in series, relay D—A closing a locking circuit through the right hand alarm contact of the delinquency indicator and through its lower make contact 2 to battery, this circuit also locking in relay D—AL. Relay D—AL, in closing its contact, energizes an audible alarm 60 connected thereto. When break contact 1 of relay DA opens, it interrupts the former starting circuit for relay R and prevents repetition of the recording and since back contact 2 of relay D—A is now open, further impulses are prevented from energizing the particular delinquency indicator advance magnet D—AD. In the meantime, the printing operation is completed in the same manner as described above.

When the watchman pulls the box that he neglected to pull at the proper time, the delinquency indicator resets and its alarm contacts open, relays DA and D—AL become deenergized as described above in connection with reception of night watch signals. It is also possible to silence the audible delinquency alarm by turning the corresponding delinquency indicator off by means of the switch DS shown in Fig. 3. When this switch is operated, a circuit is closed for the reset magnet of the delinquency indicator which can be traced from ground through the coil of the reset magnet D—RS, the make contact 1 of switch DS to contact 3 of relay DS—A and make contact 2 of relay D—A to battery. The delinquency indicator is thereby reset and D—A and D—AL are deenergized as mentioned above. When contact 2 of switch DS opens, further minute impulses are prevented from energizing the particular delinquency indicator magnet D—AD.

When the delinquency switch DS is thrown, the operation is recorded on the recorder through operation of the circuit which will be described below. At the same time the switch DS is thrown, a circuit is closed from battery through contact 6 of relay C, contact 2 of relay AP, bus bar B6, contact 3 of switch DS, back contact 1 of relay DS—A, resistor 25, bus bar B2, contact 5 of relay A, contact 4 of relay C and the coil of relay R to ground, thereby causing relay R to operate. Relay A operates as described and selectors SS and GS start to run. When the first wiper of selector SS reaches the point which is connected to the particular station indicator unit of zone 1, for example, a circuit is closed from battery through the start circuit just mentioned above, back contact 1 of relay DS—A, conductor 308, bank contact 2 of the first bank of selector SS, the wiper of this bank, contact 2 of relay A, the coil of relay B and back contact 3 of relay C to ground. Relay B operates and by opening its contacts interrupts the operating circuit of selector SS but selector LS continues to operate. When the wiper of bank 1 of selector LS reaches its first contact, a branch circuit is closed from the first wiper of selector SS to the first bank contact in bank 1 of selector LS, through its wiper and the left hand winding of relay C, contact 1 of relay A and back contact 2 of relay U to ground. Relay C operates and stops the selector LS locking itself as described above and also inserting the right hand winding of relay X into the former operating circuit of the left hand winding of relay C as described previously. Relay X operates to energize relay U through an obvious circuit and start the transmitter T. The number of impulses transmitted to the first printer wheel is again controlled through the third bank of loop selector LS but a connection is made from bank contact 1 where the wipers of selector LS are now resting to the wiper 3 of selector SS. Connections are made to the contacts of the third bank of selector SS in a similar manner to that explained above for loop selector LS in order to set up the proper zone number on the first typewheel of the printer. Relay J2 which controls the indication recorded by the second typewheel is energized after the seventh impulse because of the fact that connections are made between the contacts of the fourth bank of selector SS to the code bus bars which extend the circuit from code bus bar 7 through bank 4 of selector SS, bank contact 1 and the fourth wiper of loop selector LS, conductor 405 to the left hand winding of relay J2, thereby bringing the line of type "delinquency indicator" into the printing position. Relay J3 is energized after the fourth step of transmitter T through a circuit which can be traced from ground, through back contact 2 of relay P, left hand winding of relay J3, conductor 403, contact 1 of relay X, conductor 413, bank contacts 4 or 16 of the third and fourth banks and associated wipers of selector T in series to battery. The third typewheel is therefore positioned to print "off". Relay J4 will energize through conductor 406 when relay U pulls up since bank contact 1 of bank 6 of loop selector LS is connected through the blank bus BL and the lower contact 4 of relay U to battery. Therefore, no indication will be printed in the fourth column. When selector T reaches position 10 or 22 respectively, a circuit is closed from battery through make contact 3 of relay X over conductor 305, through the tenth or twenty-second bank contact of the fourth bank of transmitter T, conductor 407, through the second wiper and bank contact 1 of selector LS, the second wiper of switch SS and its second bank contact, conductor 309 and the coil of relay DS—A to ground. Relay DS—A then energizes and locks in through the upper half of its winding in series with its own contact 2 to battery. Back contact 1 of relay DS—A opens and interrupts the former starting circuit for relay R, preventing repetition of the recording operation.

A similar recording operation takes place when the sequence control switch SQ is operated. The printing wheels will be positioned to print the words "sequence control off." When either of the control switches is returned to their normal position for instance, DS, a circuit can be traced from battery through contact 5 of relay C, contact 1 of relay AP, bus bar B5, contact 4 of switch DS, make contact 1 of relay DS—A, resistor 26 to bus bar B2 through the coil of relay R to ground. Relay R being the starting relay for transmitter T, the same recording operation takes place as described above. However, relay U is operated directly instead of by relay X and relay J3 is not energized after the fourth step of transmitter T because contact 1 of relay X is open. Relay J3 will be energized after the fifth step of transmitter T when direct connection is made for the left hand winding of J3 through the fifth or seventeenth contacts of the third and fourth banks and the associated wipers of transmitter T in series to battery. The result is that the indication "on" will be brought in printing position on the third typewheel instead of "off." When selector T reaches position 10 or 22 re-

spectively, a circuit is closed from ground, through back contact 3 of relay X conductor 305, bank contacts 10 or 22 of the fourth and third bank of transmitter T in series over conductor 407, wiper and contact 1 of the second bank of loop selector LS, wiper and second contact of the second bank of selector SS, conductor 309 to the lower terminal of the coil of relay DS—A. Two halves of this coil are now connected in multiple in such a way that the two fields set up by them oppose one another causing the relay to release its armature and interrupting the starting circuit for relay R for opening make contact 1 of relay DS—A. The remainder of the restoring operation is the same as described above.

In case of an emergency or armed guard signal, relay AL is energized and locks in giving a continuous audible and visible alarm which can only be silenced by the operator by his acknowledgment key ACK shown in Fig. 5. A circuit is closed from battery through key ACK, resistor 40 and the coil of relay 0 to ground thereby energizing this relay and locking it in through its make contact 1 which bridges the key ACK. Back contact 1 of relay 0 breaks and causes relay AL to release silencing the alarm bell 50 and extinguishing the special signal lamp 40. At the same time, a starting circuit for relay R is closed from battery through contact 5 of relay C, contact 1 of relay AP, bus bar B5, contact 2 of relay 0, conductor 412, resistor 42, back contact 5 of A, back contact 4 of relay C and the coil of relay R to ground. Selector SS has no part in the recording of this signal but conductor 412 is also connected to the 25th bank contact of the first bank of loop selector LS and relays R, A, C and U operate in sequence as explained above for station signals. As soon as relay U energizes, relays J1, 3 and 5 pull up as the corresponding bank contacts of the third, fifth and sixth bank of loop selector LS are connected to bus BL. Relay J2 is energized after the eighth step of selector T, determined by the connection to the corresponding bank contact of bank 4 of selector LS. This brings the line of type "supervisor's acknowledgment" into printing position, nothing being printed in the other columns. In the tenth or twenty-second position of selector T, a shunt is applied to the coil of relay 0 through a circuit extending from ground through back contact 3 of relay X, conductor 305, the tenth or twenty-second bank contacts and wipers of the fourth and third banks of selector T, conductor 407, the second wiper and bank of loop selector LS in position 25, conductor 310, the lower terminal of the coil of relay 0 and ground. Relay 0 is thereby caused to be energized thereby restoring it to normal condition.

From the above description of the complete watchmen's report system it is evident that this invention provides a complete circuit and recording means for supervising a plurality of watchmen's tour loops. In addition to the usual report boxes, there is provided special signal boxes such as arm guard call boxes for the purpose of summoning help in case of holdups or the like. The system further provides a means whereby the watchman may send an emergency signal for the purpose of indicating an emergency condition on his tour. The system is also provided with delinquency and sequence control switches whereby the system may be operated in such a manner that the watchman must operate his boxes in a given sequence or the sequence switch may be thrown to allow the watchman to operate the boxes in any order which he desires.

It is also evident from the above description that a recording circuit is provided which is common to a plurality of watchmen's tour circuits or loops and which records ordinary report signals in non-interfering and successive fashion, emergency and arm guard calls signals, operation of the delinquency indicator alarm and operation of the sequence switches or acknowledgment keys. The recording means also records the transmitted signals or reports successively in the order in which they are received and without interference between signals.

Further modifications of this invention within the scope of the appended claims will be apparent to those skilled in the art.

What is claimed is:

1. In a signaling system, at least two loop circuits, each loop including a plurality of coded impulse transmitters each arranged to send both normal and emergency signal code groups, the normal codes of the transmitters on the same loop circuit being different from each other, station indicators individual to each loop circuit for storing transmitted signals, means for operating said station indicators only when the associated impulse transmitters are operated to transmit normal signal codes in the proper sequence, a common recorder for all of said loop circuits and means for operating said recorder to record signals stored in said station indicators and to record emergency signals sent at any time from any of said impulse transmitters.

2. In a signaling system, at least two loop circuits, each including a plurality of coded impulse transmitters arranged in a predetermined order, said transmitters being arranged to transmit predetermined signal code groups when operated, station indicators individual to each loop circuit for storing transmitted signals from said transmitters, means for operating said station indicators only when the associated impulse transmitters are operated in the proper sequence, a recorder, means for operating said recorder to record signals stored in all of said station indicators, an alarm and means to operate said alarm when transmitters are not operated in the proper sequence.

3. In combination, a signal transmitting station for transmitting a code and an emergency signal, a station selector responsive to said signal transmitter for temporarily storing said signals, a normal relay responsive to said station selector, an emergency relay, a station indicator responsive to said station selector for permanently registering said code, a timing relay responsive to said emergency signal for controlling said emergency relay, an impulse counting relay responsive to the timing relay for counting the emergency signal and the first impulse of the code and an auxiliary timing relay for timing the operation of the station selector.

4. In combination, a loop circuit including a plurality of watchmen's tour transmitting stations, a coded impulse transmitter at each station for transmitting at least two distinctive types of signals having different time characteristics, timing means for distinguishing between said distinctive types of signals, means for registering signals from said transmitting station, recording means for recording said distinctive types of signals and means for establishing a connection from the registering means to control the

operation of said recording means in accordance with the number of the transmitting station and the type of signal.

5. A signaling system comprising a coded impulse transmitter for transmitting a single digit box code and an emergency signal and a repeater connected to said transmitter for repeating said signals comprising an input, a normal output circuit and an emergency output circuit, a relay connected to said input for distinguishing between said box code and said emergency code and for partially completing said emergency output circuit upon the occurrence of said emergency signal, and means responsive to said box code signal for completing the circuit to both outputs whereby all box code signals are repeated to the normal output.

6. In a signaling system, a loop circuit including a plurality of transmitting stations, some of said stations having means thereat for transmitting a single digit box code plus identification impulses having a time characteristic for signifying one type of signal and other stations having means thereat for transmitting a single digit box code plus identification impulses having a different time characteristic for signifying another type of signal, timing means responsive to the transmitted signals for repeating the box code and distinguishing between the identification impulses and recording means for making a permanent record of the box numbers as they are transmitted and the identifying description of the type of signal transmitted.

7. In a signaling system, a plurality of loop circuits, each loop including a plurality of transmitting stations, each station comprising a coded impulse transmitter for transmitting a box code plus identification impulses, means associated with each loop circuit and responsive to transmitted signals for repeating the code and distinguishing between different types of signals in accordance with said identification impulses, storage means individual to each loop for storing said repeated code, a recording means for recording the box code and indicating the type of signal and means for selecting the storage means when it is actuated and connecting the recorder thereto.

8. In a signaling system, a transmitting station for transmitting a single digit watch report code signal or an emergency code signal, a repeater connected thereto, a printer for recording signals transmitted from said transmitting station, a printing relay responsive to the code repeated by said repeater for controlling said printer, an emergency printing relay responsive to emergency signals for setting up a control circuit for controlling the printer to print an emergency call signal and a cut off relay responsive to said emergency signal for disabling the control circuit set up by said printing relay whereby normal watch report signals are prevented from interfering with the recording of emergency signals.

9. In a signaling system, a plurality of loop circuits, each loop including a plurality of transmitting stations, each station comprising a coded impulse transmitter for transmitting a supervisory code signal, a printer common to said loop circuits for recording code signals in response to operation of said transmitters, a loop selector common to said loops for connecting said printer to the various loops, a printing relay individual to each loop and responsive to the code for controlling the printer and means responsive to said printing relay for starting and stopping said loop selector at the beginning and end of each code whereby signals from individual loops are recorded in non-interfering and successive order.

10. In a watchman's tour system, a watchman's loop circuit including a plurality of coded impulse transmitters, each transmitter having a number of teeth corresponding to the number of the station plus two prefix transmitting teeth for normally transmitting a watch report signal or an emergency signal when a prefix impulse is transmitted, means comprising a repeating relay responsive to all signal impulses from said transmitters, means comprising a station selector switch responsive to said relay for temporarily registering the number of the reporting transmitter as repeated by said relay, means comprising a station indicator responsive to said station selector for permanently registering predetermined number of the reporting stations and checking the sequence of transmitter operation, means comprising a recording relay responsive to operation of a transmitter which has been operated in its proper sequence, an emergency recording relay, means for identifying the prefix character to be printed which signifies the type of signal received and controlling said emergency recording relay if an emergency signal is received comprising a timing relay for timing the interval between the first and second impulses, means comprising a printing recorder for printing watch report signals and emergency call signals in response to operation of said recording relay or said emergency recording relay and means responsive to said recording relay for establishing a connection from said station indicator to said printing recorder whereby the type of signal and the station number are recorded.

11. In a watchman's tour system, a plurality of watchmen's loop circuits, each loop circuit including a plurality of coded impulse transmitters, each transmitter having a number of teeth corresponding to the number of the station plus two prefix transmitting teeth, means for repeating all signal impulses from said transmitters, means responsive to said repeating means for temporarily registering the number of the reporting transmitter, means responsive to said registering means for permanently registering the number of the reporting station and checking the sequence of transmitter operation, a printing means for printing all types of signals, a printer control means responsive to operation of a transmitter which has been operated in its proper sequence for controlling said printing means, an emergency printer control means, means for selecting the prefix character to be printed which signifies the type of signal received and controlling the printing and emergency printing control means and a loop selecting means responsive to said printing control means for establishing a connection from said permanent registering means to said printing means whereby the printing means can record the designation of the type of signal and the station number.

12. In a watchman's tour system, a watchman's loop circuit including a plurality of coded impulse transmitters therein, a repeating relay responsive to all signal impulses from said transmitters, a station selector responsive to said relay for registering the number of the reporting transmitter, a plurality of code bus bars, means for energizing certain bus bars in accordance with the number of the signaling station, a printing

recorder for printing the number of the signaling station, a recording relay responsive to the repeating relay for controlling said printing recorder and a station indicator responsive to said station selector for connecting selected code bus bars to said recording relay whereby said printing recorder is energized to print the designation of the type of signal and the number of the signaling transmitter.

13. In a watchman's tour system, a watchman's loop circuit including a plurality of transmitting stations, each station being adapted to transmit a box code and an emergency prefix signal, a repeating relay connected to said loop for repeating all signals, a station selecter responsive to said repeating relay for temporarily storing said signals, a watch report relay responsive to said station selector, an emergency relay, a station indicator responsive to said station selector for permanently registering said box code, a prefix timing relay responsive to the space after the emergency prefix for controlling the emergency relay, an impulse counting relay responsive to the prefix timing relay for counting the emergency prefix and the first impulse of the box code and an auxiliary timing relay for timing the box code and the operation of the station selector.

14. In a watchman's tour system, a watchman's transmitting station adapted to transmit a box code and an emergency prefix signal, a repeating relay for repeating all signals from said transmitting station, a station selector for storing signals repeated by said repeating relay, a watch report relay controlled by said station selector, an emergency relay, a station indicator for registering said box code, a timing relay for controlling said emergency relay, an impulse counting relay responsive to said timing relay for counting the emergency prefix and the first impulse of the box code and an auxiliary timing relay for timing the box code and terminating the operation of the station selector.

15. In a watchman's tour system, a watchman's loop circuit including a transmitting station adapted to transmit a box code and an emergency prefix signal, a station selector for temporarily storing all signals, a normal relay controlled by said station selector, an emergency relay, a station indicator responsive to said station selector for permanently registering said box code, means for timing all signals from said transmitting stations to distinguish normal code signals from emergency signals and to control said normal relay or said emergency relay in accordance with the received signal and means for timing the box code and terminating the operation of said station selector.

16. In a watchman's tour system, a plurality of loop circuits each including a plurality of wathmen's tour transmitting stations, a coded impulse transmitter at each station for transmitting at least two distinctive types of signals, means individual to each of said loop circuits for distinguishing between said distinctive types of signals, station indicators individual to said loop circuits for registering signals from said transmitting stations, delinquency indicators responsive to said station indicators, a recorder controlled by said distinguishing means and common to said loop circuits for recording said distinctive types of signals or a delinquency signal and a selector common to said loop circuits for establishing a connection from the station indicators to control the operation of said recorder in accordance with the number of the transmitting station.

17. In a watchman's tour system, a loop circuit including a watchman's tour transmitting station, a coded impulse transmitter for transmitting at least two distinctive types of signals, means individual to said loop circuit for distinguishing between said distinctive types of signals, a station indicator individual to said loop circuit for registering signals from said transmitting station, a recorder responsive to said distinguishing means and connected to said loop circuit for recording said distinctive types of signals and a selector connected to said loop circuit for establishing a connection from the active station indicator to control the operation of said recorder in accordance with the number of the transmitting station.

18. A signaling system comprising a coded impulse transmitter for transmitting a single digit box code consisting of marking and spacing signals and a second signal consisting of the same single digit box code and a prefix signal comprising a marking impulse of normal length followed by a spacing signal of greater than normal length and a repeater connected to said transmitter for repeating said signals comprising an input, a normal output circuit and an emergency output, a relay connected to said input for repeating all signals, a prefix space timing relay responsive to the repeating relay for registering the first marking impulse and timing the space signal thereafter to partially prepare a circuit to the emergency output upon the occurrence of a spacing impulse of greater than normal length, a first auxiliary counting relay for registering the first spacing signal and preparing a circuit to both outputs, and a second auxiliary relay for registering the second marking impulse and completing the circuit to the outputs whereby all subsequent box code signals are repeated to the normal output.

19. In a watchman's tour system, a watchman's loop circuit including a watch report station therein comprising a coded impulse transmitter for transmitting a single digit box code, the first round consisting of marking signals equal to the number of the box plus a normal prefix and the second round consisting of the same single digit box code plus an additionad prefix separated from the normal prefix by an abnormally long space, a repeater connected to said loop comprising timing and impulse counting relays for deleting said prefixes and repeating the box numbers, a station selector energized through circuits established by said relays for temporarily registering the box numbers, a station indicator energized by said relays and said station selector for permanently registering said box numbers, an armed guard transmitter in said loop circuit having the same type of code as said other station and adapted to transmit both prefix signals on the first round plus sufficient code impulses to step said station indicator to a special position, a recording relay energized through a circuit established by said auxiliary relays, said station selector and said station indicator, an emergency relay energized by said prefix space timing relay, and said auxiliary relays and a recorder responsive to said recording or emergency relays and said station indicator for recording either a watch report, an emergency or an armed guard signal and the box number.

20. In a watchman's tour system, a watchman's loop circuit including a plurality of watch report

stations therein each of said stations comprising a coded impulse transmitter for transmitting a single digit box code, the first round consisting of marking signals equal to the number of the box plus a normal prefix and the second round consisting of the same single digit box code plus an additional prefix separated from the normal prefix by an abnormally long space, means connected to said loop circuit for deleting the prefix signals, distinguishing the type of signal transmitted and repeating the box number, means for recording the station numbers in accordance with the numbers transmitted from said loop circuit and means for recording the type of signal in accordance with the time relation existing between the prefix impulses and the box number impulses.

21. In a watchman's tour system, a watchman's loop circuit including a plurality of coded impulse transmitting tour boxes therein and at least one coded impulse transmitting armed guard box, a repeating relay responsive to all signal impulses from said boxes, a selector responsive to said relay for registering the number of the reporting boxes, a plurality of code bus bars, a printing recorder for printing the number of the signaling box, a recording relay for controlling the said printing recorder and a station indicator responsive to said selector for connecting certain code bus bars to said recorder and for energizing said recording relay whereby said printing recorder is energized to print the designation of the type of signal and the number of the signaling box.

MANFRED W. MUEHTER.