

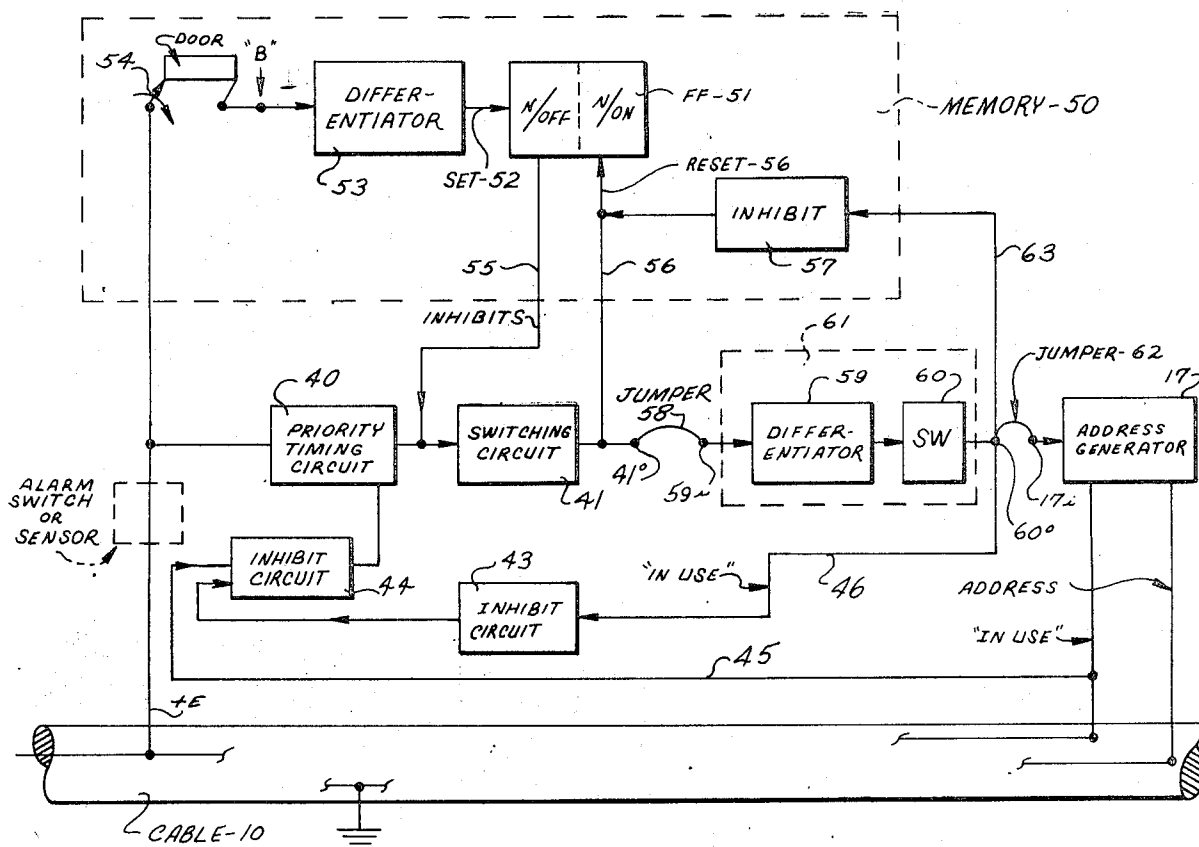


FIG. 1

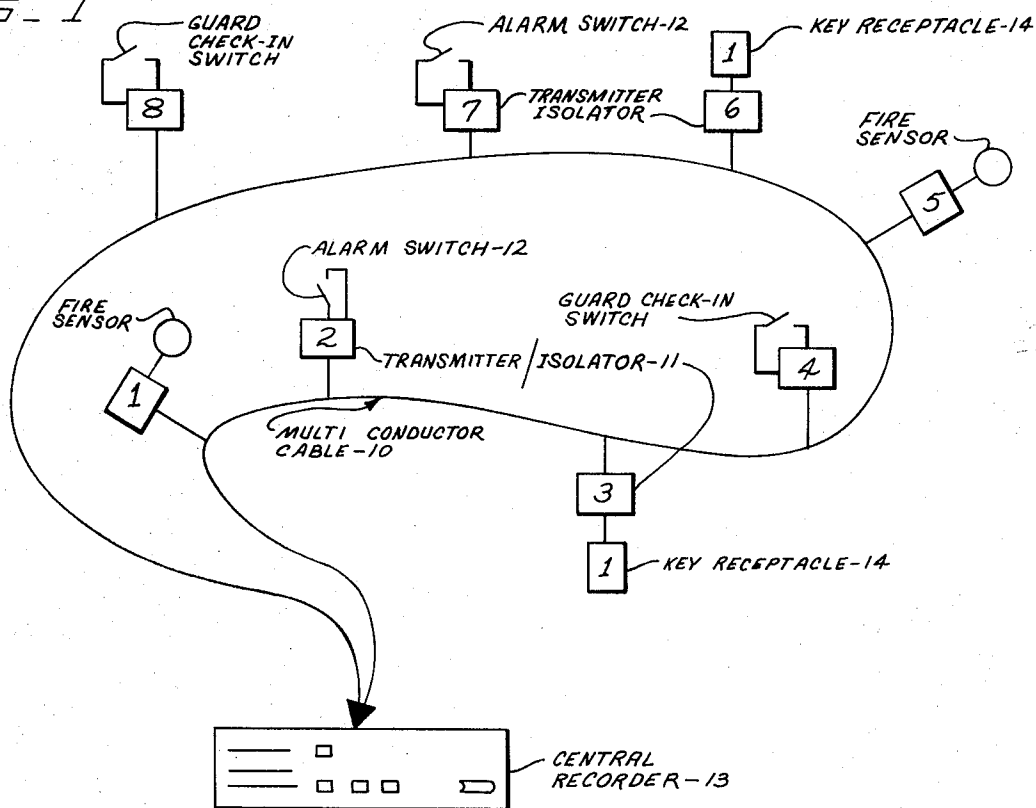
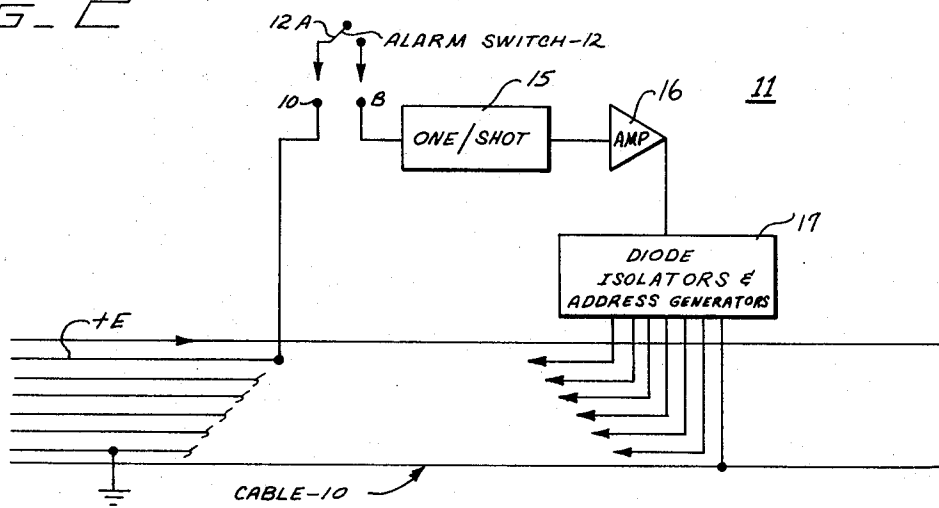


FIG. 2



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FIG. 3

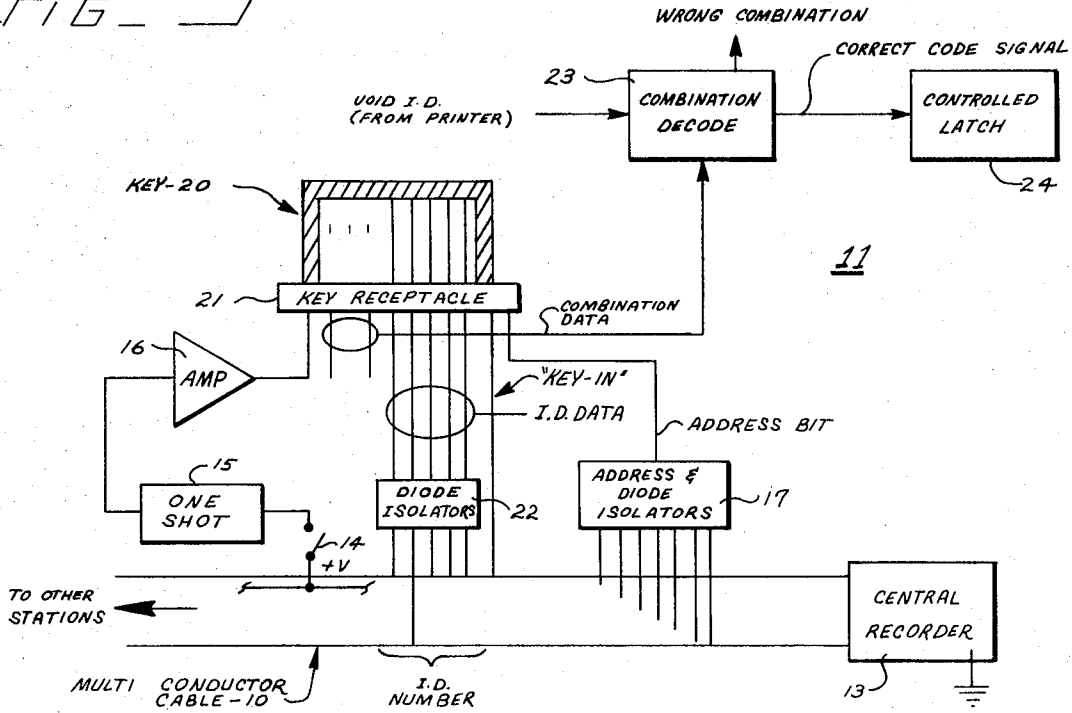


FIG. 4

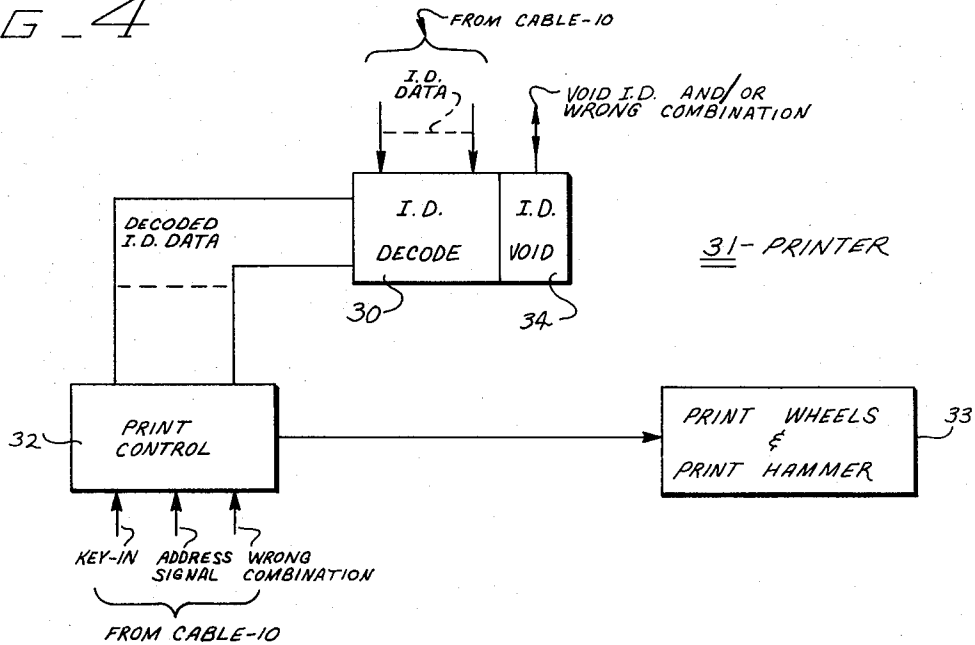


FIG. 5

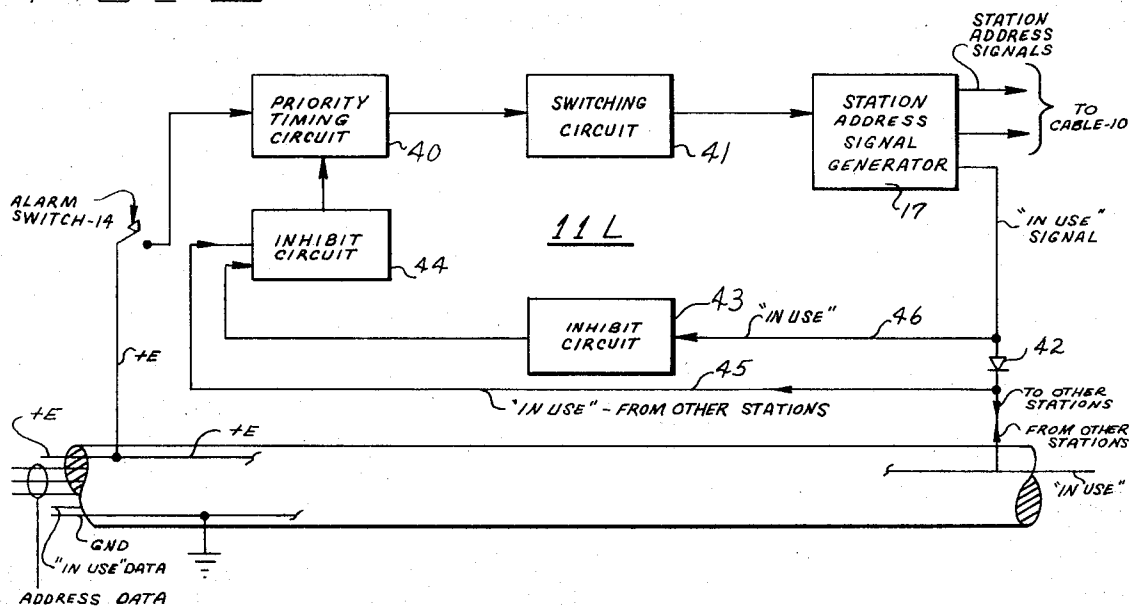


FIG. 6

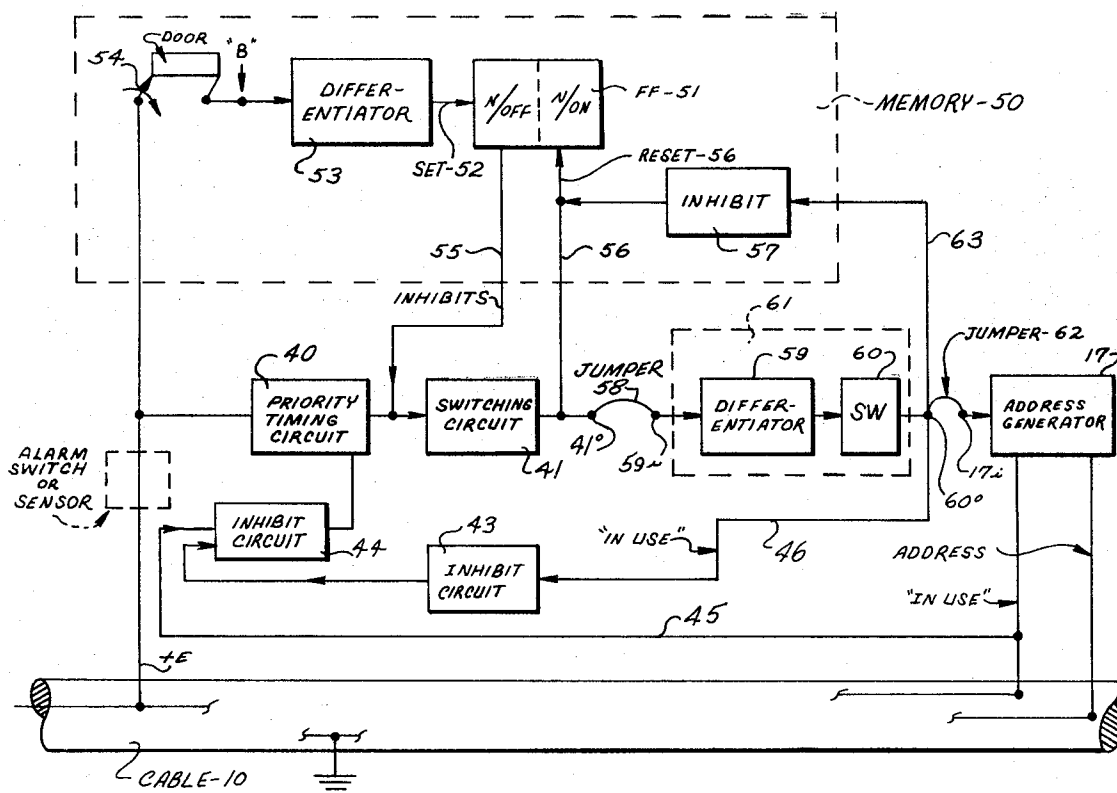


FIG. 7

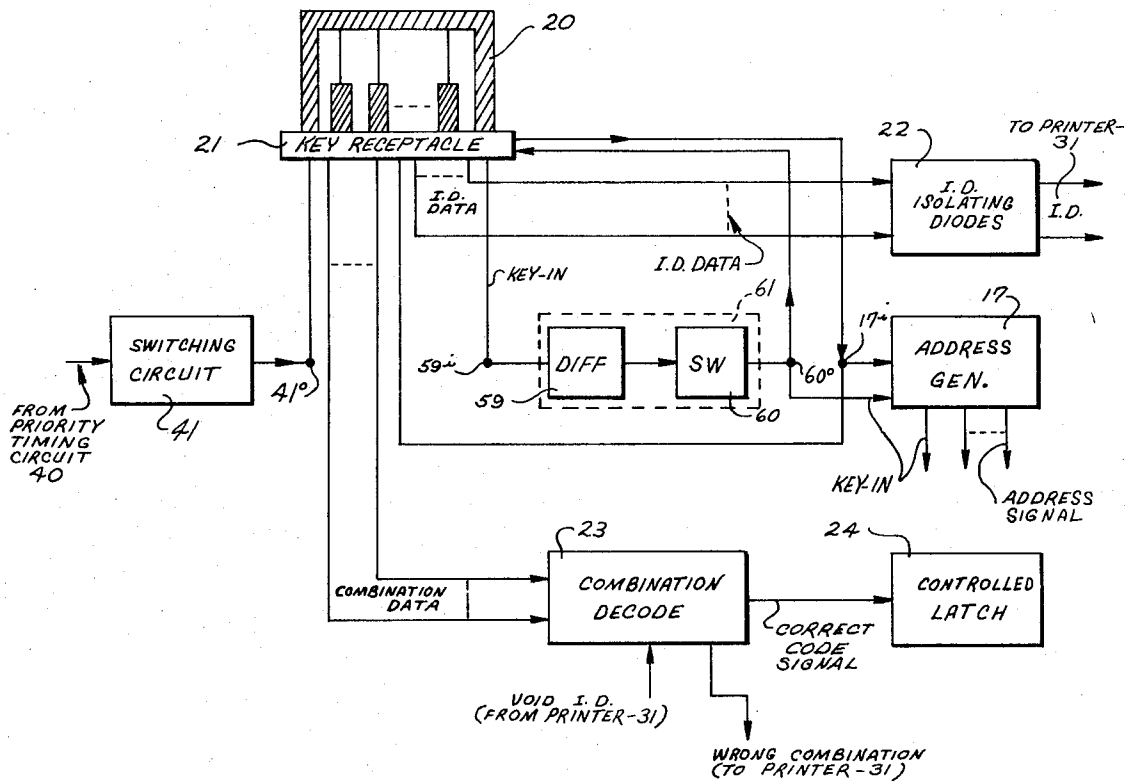


FIG. 7A

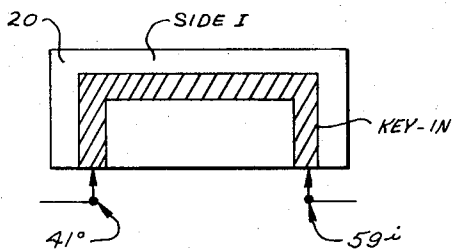
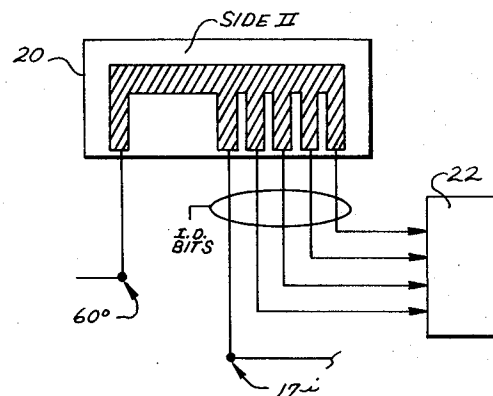
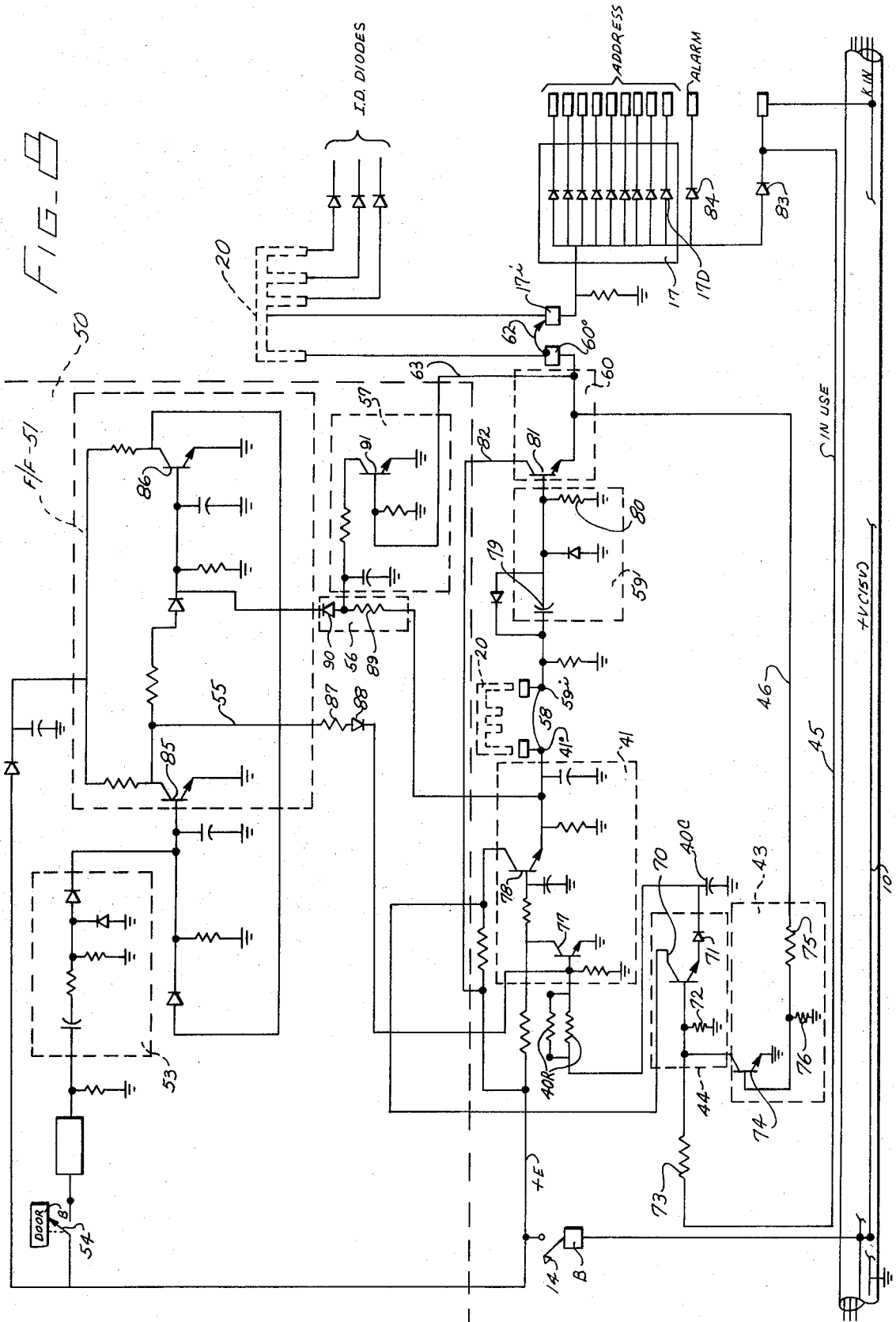


FIG. 7B





SINGLE CABLE SIGNALING SYSTEM

DESCRIPTION OF THE PRIOR ART AND THE PRESENT INVENTION

This invention relates to a single cable signaling system and more particularly to a single cable system adaptable for use as a guard check-in system or an alarm type system. In the alarm type system the alarm may be automatically operated in response to the sensing of some preselected condition.

At the present time there are systems in use in which a plurality of stations are coupled to a central control point for monitoring a multiplicity of stations. These stations may be coupled to a single cable for convenience. In general, these prior art systems are synchronously controlled from a central station to continuously monitor or scan the stations coupled thereto. In these prior art types of systems the condition of the stations are continuously interrogated to determine whether or not there has been a change in condition at the remote station and if so, a signal is transmitted back to the central station or recorder for signaling and/or for recording the particular sensed event. The present invention provides a single cable signaling system that allows a plurality of stations coupled to a single cable to be monitored in an asynchronous fashion completely independent of any control device or timing circuit at a central control station. The single cable signaling system of the present invention will be coupled with a central recorder, display unit or computer for recording and/or displaying the change of condition that is sensed at any station coupled to the single cable. The system may be defined so as to automatically sense a particular condition at any one station, such as a fire sensor, for example, which would activate an alarm and transmit an alarm signal to the central recorder. In addition, the station may be arranged to be manually actuated by a guard as he inspects the stations on the cable during his rounds so that by manually operating a switch he transmits signals along the cable for recording the fact that he appeared at the station at a certain time to assure that the guard is attending to his duties. To this same end, the guard may be provided with a key for use at the individual stations to transmit the fact that he has appeared at a certain station.

The advantage of employing a key for recording the appearance of a guard at a station is that the key may include user identification information which may also be transmitted to the central recorder to record the identification of the guard as well as the station at which he appeared. In all of these embodiments, in the actuation of a station, either manually or automatically or by means of a coded key each station is constructed and defined to generate an address or station location signal unique to the particular station and which signals are transmitted along the single cable for recording along with any other desired information.

Another important aspect of the present invention is that when a plurality of stations generate signals simultaneously the transmitting elements for each station are defined with priority signal generating means for determining from a time standpoint the priority of each station in which the stations may "seize" the cable. This allows the signals to be transmitted sequentially along the cable in accordance with the priorities without conflict between the signals and without any loss of information. Along with the address information signaling

the change of condition at a station or the key information, the station transmitters are defined for providing a cable "in use" inhibit signal that is transmitted to each of the other stations on the cable to prevent the other stations from seizing the cable. This "in use" signal is also coupled to a switching circuit for the individual station at which it is generated to prevent the "in use" inhibit signal from turning off the transmitter until after it has transmitted the desired data to the central recorder. The system may also be adapted to employ electrical keys that are presently extensively used for electrically controlling a door latch or similar apparatus wherein the electrical key is operative for locking and unlocking the latch. One such electrical key that has been extensively used is the subject of U. S. Pat. Re. 27,013 granted on Dec. 22, 1970. In this type of electrical key, the key carries, in addition to the unlocking information, key user identification information which may be unique to a particular user and which may also be derived from the key and transmitted along the single cable. This type of key is disclosed in the copending application bearing Ser. No. 35,061 and entitled ELECTRONIC IDENTIFICATION KEY ACTUATED CONTROL SYSTEM. The present invention in some of its aspects is related to this copending patent application. In this respect the central control unit that is employed for the present invention may be a printer of the type disclosed in said copending application bearing Ser. No. 35,061. When this type of printing apparatus is employed the printer may include means for voiding out certain key identification numbers and rendering them invalid and inoperative for operating the electrically controlled latch.

From a method standpoint, the present invention is directed to a method of monitoring a plurality of independent stations through a common recording station through the steps of coupling a single cable to a plurality of signal generating stations and transmitting the signals generated at each station to a common point along a cable. Each of the signals transmitted along the cable are recorded at the common point. Any station signals that are generated substantially simultaneously are controlled in a preselected priority to allow the signals to transmit sequentially and thereby allow all of the signals to be recorded at the common recording point. The method may also include the transmission of a signal from an activated station to each of the other stations coupled to a cable to prevent the transmission of signals along the cable to the other stations until the first transmitting station coupled to the cable has terminated its transmission and allows the other stations to transmit in accordance with the preselected priorities. The method may also comprise the step of storing a station actuation signal for a preselected time interval to allow other signals to be transmitted along the cable to be recorded and then releasing the stored signal at a time when the cable is free to allow the stored signal to be transmitted and recorded.

From a structural standpoint, the present invention includes a single cable signaling system comprising a plurality of signaling stations each including individual means for generating address signals to a central station. A single cable is coupled to each of the signaling stations for transmitting any signals generated at a station to a central station and includes priority means at each station for controlling the signal generating means in a preselected time relationship with respect to the

other stations so that when a plurality of stations are actuated at substantially the same time, all of the signals may be sequentially transmitted along the cable to the central station. The individual signal generating means at each of the stations may include signals for identifying the individual stations or address signals. The system is defined wherein the stations include means for manually operating the signal generating means or means for automatically operating the signal generating means for generating preselected station identification signals to be transmitted along the cable. In this respect the manually operated signal generating means may be an electrical key for transmitting key information including key user identification to a central station or recorder. The system may also be advantageously constructed and defined wherein the individual signaling means for each station includes means for transmitting a cable "in use" signal to each of the other stations to maintain them in a de-energized condition when one of the other stations seizes a cable to prevent the loss of information due to the simultaneous transmission of signals along the cable and allows the signals to be transmitted under the control of the priority circuit means. For this purpose, when the means for activating the signal means is of a relatively short duration the station may include memory means for storing the signal indicative of the actuation of the station to allow it to be utilized and transmitted along the cable at a time when the cable is free thereby allowing the station to transmit without loss of such information. From a practical standpoint the priority means for controlling the transmission of the signals along the single cable may be a timing circuit means arranged at each station wherein each timing circuit has a different time interval defined to allow the signals to be asynchronously transmitted in accordance with the preselected priority or timing.

These and other features of the present invention may be more fully appreciated when considered in the light of the following specification and drawings, in which:

FIG. 1 is a schematic illustration of the single cable signaling system embodying the present invention;

FIG. 2 is a schematic-block diagram of the coupling of a single transmitting station in accordance with the system of FIG. 1;

FIG. 3 is a schematic-block diagram of a single station as illustrated in FIG. 2 where an electrical key may be utilized for operating the station and transmitting signals along the single cable in accordance with the system of FIG. 1;

FIG. 4 is a block diagram of a central printing station that may be employed including for the stations activated by the electrical key system illustrated in FIG. 3;

FIG. 5 is a block diagram of a system employing a key for actuating a station and illustrating an arrangement for transmitting a cable "in use" signal to its own station as well as the other stations coupled to the cable;

FIG. 6 is a block diagram of the system similar to FIG. 5 in which memory means is incorporated for storing the change of condition at a station;

FIG. 7 is a block diagram of the system of FIG. 6 illustrating a modification of the system of FIG. 6 for the purposes of utilizing an electrical key for actuating a station rather than the switch illustrated in FIG. 6;

FIG. 7A is a schematic illustration of the connection of certain key segments of an electrical key into the system of FIG. 7;

FIG. 7B is a schematic illustration of the connection of a different set of key segments of an electrical key for use in the system of FIG. 7; and

FIG. 8 is a schematic-circuit diagram of a station coupled to a single cable in accordance with the systems illustrated in FIGS. 5 and 6.

Now referring to the drawings a single cable signaling system in accordance with the present invention will be described in detail. The general organization of the single cable signaling system is illustrated in FIG. 1. The function of the signaling system is to recognize an activated remote station that is coupled to a multi-conductor cable and to send certain information or data resulting from the activation of the station along with the identification of the station location or address to a central recorder or printer. As is evident from examining FIG. 1, a multiplicity of stations may be coupled to a single conductor 10 and each station may be constructed and defined for activating a transmitter/isolator 11 in a particular fashion depending upon the desired results. For example eight stations are illustrated coupled to the multi-conductor cable 10 in FIG. 1. Some of the stations include a fire sensor for sensing preselected temperatures and activating a switch which in turn activates the transmitter 11 for transmitting signals along the cable 10 while the other stations are illustrated as having manually operated alarm switches 12 coupled for activating a transmitter/isolator 11. Other stations are illustrated as being activated by means of a key receptacle 14 adapted for receiving an electrical key which initiates the generation of the signals from the transmitter/isolator 11. Stations 4 and 8 are provided with a manually operated switch which is identified as a guard check-in switch. These latter types of stations are employed to monitor a guard's activities to be sure that he makes his rounds and records the times that he stops at the various stations. Many other variations are possible with such a system. In each case, a transmitter/isolator 11 when activated, either manually or automatically, transmits a signal indicative of the activation of a station and the address of the station to a central recorder 13 which may be a printer. The address of the station may be coded in terms of binary coded characters or bits to represent the station numbers as identified in FIG. 1, namely stations 1 through 8. For the purpose of activating a station by means of the key receptacle 14, an electrical key that is satisfactory for this purpose is disclosed in U.S. Pat. Re. 27,013. In addition to the elementary type of key and control circuit disclosed in U.S. Pat. Re 27,013 an electrical key having the usual unlocking information may also have key user identification information recorded thereon whereby the key identification information is also transmitted along the cable 10 to a recorder 13 along with the address information for the particular station. Such an electrical key and the control circuits therefor are described in the copending patent application bearing Ser. No. 35,061.

It should also be recognized that the central recorder 13 in a practical embodiment may be embodied as a printer for printing out the information transmitted along the cable 10. The recorder 13, however, need not be restricted to a printer but may be a visual display device, a computer or any other type of recording appara-

tus desired in accordance with the particular application for the single cable signaling system.

Now referring to FIG. 2, the logic diagram for one of the transmitter/isolators 11 adapted to be responsive to the manual operation of the alarm switch 12 will be examined. In this embodiment the alarm switch 12 is coupled to the power lines of the multi-conductor cable 10. These power lines are identified as the line +E and the ground potential line. The +E conductor is coupled to one terminal of the alarm switch 12 connected to the operating arm for the switch 12A. The normal open circuit condition of the arm 12A maintains the transmitter de-energized. The other terminal of the alarm switch 12 is coupled to provide an input signal to the one-shot multivibrator 15 which, in turn, has its output coupled to an amplifier 16. The amplified output of the one-shot multivibrator 15 is coupled to a network 17 identified as a diode isolator and address generator. This network 17 may comprise a network of diodes coupled to be responsive in a parallel circuit relationship to the output signals from the amplifier 16 for generating a signal identifying the particular transmitter/isolator 11 or an address signal. For this purpose the diodes may be arranged in terms of the 8-4-2-1 binary code for identifying the particular station. For example, if the transmitter 11 as represented in FIG. 2 is station No. 7, then the network 17 will have three diodes arranged therein to provide output signals in accordance with the 4-2 and 1 bits (0111) for representing the decimal digit 7. The signals generated in response to the activation of the one-shot multivibrator 15 are coupled to individual conductors on the cable 10 through the addressing diodes and are transmitted along the cable to the central recorder 13. It will also be recognized that with a multiplicity of stations coupled to the cable 10 that the diodes within the network 17 also prevent the coupling of signals from the other stations into the transmitter 11 as desired.

Now referring to FIG. 3 a transmitter/isolator 11 similar to stations 1 and 6 wherein an electrical key is employed for activating the transmitter 11 is illustrated. The particular electrical key that may be employed is the basic key disclosed in U.S. Pat. Re. 27,013. As illustrated in FIG. 3 the particular key 20 is constructed and defined so that it not only has unlocking or combination data recorded thereon but also I.D. or key user identification information recorded thereon. This type of key is disclosed in the copending patent application bearing Ser. No. 35,061.

It will be recognized that the aforementioned copending patent application includes the basic features of the particular electronic lock and key that is the subject of U.S. Pat. Re. 27,013. This patent discloses an electrical key wherein the key is basically defined on an insulative substrate carrying a plurality of conductive and non-conductive segments recorded thereon and arranged in a preselected pattern or combination for unlocking a particular latch. The key is insertable into an energizable receptacle for providing a plurality of output signals from the receptacle for providing a plurality of output signals from the receptacle in accordance with the pattern of segments recorded thereon. The signals derived from the receptacle are representative of the pattern of conductive segments on the key and are coupled to a sensing circuit which may be a "logical" circuit for determining the validity of the combination on the key for operating the latch. This

type of key and control apparatus is employed in the present invention. If a more detailed disclosure of this type of key and control apparatus is required, reference may be had to U.S. Pat. Re. 27,013 which is incorporated herein by reference. The type of electrical key employed for the purposes of the present invention also incorporates the teachings of the copending application bearing Ser. No. 35,061 in that the key is also constructed as including user identification information or I.D. information. The key, then, is operable only for unlatching a door or controlled access when the key includes not only the correct unlocking information but also a valid identification number. The determination of the validity of the identification number may also be effected by means of sensing circuits employing logical networks as more specifically described in the aforementioned copending U.S. Pat. application Ser. No. 35,061. It will be recognized that the keys per se disclosed in the latter mentioned copending application are not the subject of the present application.

To further facilitate the understanding of the present invention the recording apparatus employed for the purposes of the present invention may be the type of printing apparatus described in said copending application bearing Ser. No. 35,061. In particular, the printing unit is a commercially available printer which is described in the copending application as being available from the Datatotal Company (now known as the Hecon Corporation) 31 Park Road, New Shrewsbury, N. J. The particular feature of this printer is that it can be advantageously employed to not only record the information as to usage of the key but also may be readily adapted for rendering certain identification numbers valid or invalid. The present invention will be described on the basis of the structure for recording and voiding out identification numbers as specifically disclosed in the copending application and more specifically FIG. 5 thereof. For the purposes of the present invention the information derived from the printing unit includes the electrical signal indicative that a key inserted has a void identification number and also the print command that is applied to the print hammer (identified as the hammer 71 in the copending patent application) for printing out all of the information once the printing wheels have been rotated to the correct character for printing out the sensed information. This print command signal and the signal indicative of a void identification number is utilized in the control apparatus for the present invention and the detailed disclosure with respect to the printer and its associated operations are incorporated herein by reference from the copending patent application bearing Ser. No. 35,061.

In this particular embodiment, then, the key 20 is employed with a key receptacle 21 for electrically powering the key to allow the information recorded thereon to be derived therefrom as corresponding voltage signals. As is evident from referring to the aforementioned U.S. Pat. Re. 27,013 and the copending application bearing Ser. No. 35,061 the information derived from the key receptacle 21 is the combination data and the I.D. data. In addition, a key-in signal is derived therefrom which signals the placement of a key 20 in the receptacle 21 for activating the transmitter 11 in the embodiment illustrated in FIG. 3. The receptacle 21 is powered through the manual operation of a switch 14 coupled to the power lines of the multiconductor cable 10. Alternatively, the switch 14 may be omitted and the

key 20 may be employed as a switch through the insertion and withdrawal of the key into and from the receptacle 21. The normally open contact for the switch 14 is coupled to the input circuit of the one-shot multivibrator 15 which in turn is coupled to the amplifier 16. The output of the amplifier 16 is coupled to power the key receptacle 21. An address and diode isolator network 17 is illustrated in FIG. 3 coupled to an output line from the key receptacle 21 that is identified as the address bit. This signal is derived from the key 20 in response to the signal from the amplifier 16 and is applied to the network 17 as disclosed in conjunction with FIG. 2. This address bit line will be activated when the switch 14 is closed to thereby activate the one-shot multivibrator 15. This will transmit the address signal along the cable 10 to the central recorder 13. In addition, since the key 20 has identification information recorded thereon, the I.D. data bits are coupled to a diode isolator network 22. The diode isolator network 22 receives the I.D. data bits from the key receptacle 21 and couples them to individual conductors in the cable 10 for transmission to the recorder 13 along with the address information. In this instance it should be noted that the diode network 22 merely provides electrical isolation and the diodes are not arranged in a coded relationship for the generation of binary coded signals. It will be recalled that this is true since the I.D. information is recorded on the key 20. The combination data normally derived from the key receptacle 20 is applied to a combination decode network 23 of the type described in the aforementioned patent and copending patent application. This combination data is operated on by the combination decode network to determine the validity or invalidity of the combination data for operating a controlled latch 24. In addition the signal indicative of a valid or invalid identification number is derived from an auxiliary circuit which may be the printer for signaling the validity of the key identification number. This signal indication of the identification number is also applied to the combination decode network 23. The output of the network 23 may be indicative of a wrong combination for unlocking or operating the latch 24 or a correct code signal for operating the latch 24. The correct code signal results only when the combination data is correct and the I.D. data signals are not signaled as being invalid or void. The correct code signals and the wrong combination signals may also be coupled to the central recorder 13 along with the remaining station signals.

The central recorder 13 for the purposes of FIG. 3 may be the printer described hereinabove which allows the control of the validity of the I.D. numbers to be effected. Specifically, the printer described in the copending application from the Hecon Corporation may be employed. The printer disclosed in the copending application includes a patchboard for controlling the validity of the I.D. numbers of the keys employed with the system. The detailed description of such a printer may be found in the aforementioned copending patent application and which disclosure is incorporated herein by reference. For the purposes of the present invention, the block diagram of the essential elements of such a printer is illustrated in FIG. 4. The I.D. data derived from the key receptacle 20 and transmitted along the cable 10 may be applied to the I.D. decode network 30 associated with a printer 31. The I.D. decode network

and applies it to a print control network 32. These I.D. data bits are received by the print control network 32 in combination with a key-in signal, an address signal and the wrong combination signal transmitted along the cable 10. This information then is applied to the print wheels and print hammer illustrated as the block 33 for printing out the desired information as described in said co-pending patent application. The I.D. decode network 30 is arranged with an I.D. void element 34 for sensing the key identification numbers that are invalid or void or to be rendered invalid for operating the controlled latch 24. This structure and operation is also discussed in the aforementioned copending patent application in detail.

Now referring to FIG. 5, a transmitter 11-L incorporating a "line-in use" inhibit signal will be described. It will be recognized that with a multiplicity of stations coupled to the cable 10 and the use of a central recorder 10 for recording the signals transmitted along the cable that a number of stations may seize the cable 10 at the same time. For this purpose a transmitter 11-L is provided in accordance with the present invention for generating an "in use" signal that is coupled to all of the other transmitters 11-L coupled to the cable 10 to prevent the transmission of information from the other stations until after the station that has first seized the cable 10 has terminated its transmission. For this purpose each of the transmitters 11-L are provided with a priority timing circuit for providing a time controlled sequence in which the multiplicity of stations that have seized the cables will transmit the information to the recorder 13. In accordance with this modification, the station which has the highest priority will seize the line first and when its signals are terminated or fade away the station having the next highest priority will be activated to allow its locally generated signals to be transmitted along the cable and in seizing the cable transmits an "in use" signal to inhibit the other stations that may have been activated but have a lower priority. Assuming, then, that a station is provided with an alarm switch 14 for manually actuating the transmitter 11-L, the signal generated by the operation of the switch 14 is coupled to a priority timing circuit 40. The priority timing circuit controls the conduction of a switching circuit 41 for transmitting signals. The switching circuit 41 is coupled to the station address signal generator 17 for generating and transmitting the desired signals to the cable 10. In this instance, an additional line is provided from the generator 17 for generating the "in-use" output signal. This "in-use" signal is coupled by means of the isolating diode 42 to the "in-use" line of the cable 10 which transmits the "in use" signal to all of the other transmitters 11-L coupled to the cable. The "in-use" signal is also coupled to a local inhibit circuit 43 which coacts with a remote inhibit circuit 44, which is responsive to the "in-use" signals received from the cable. The remote inhibit circuit 44 is provided for controlling the activation of the priority timing circuit 40. When the inhibit circuit 44 is activated, the priority circuit 40 is de-energized or non-conductive and therefore the switching circuit 41 is maintained in its normal non-conductive condition. The inhibit circuit 43 is coupled to be responsive to the "in use" output signal from the local address signal generator 17 and is derived directly therefrom. Specifically, it is coupled to the line 46 on the opposite side of the diode 42 from the "in-use" lead wire 45 for the remaining stations on the

cable 10. The purpose of the local inhibit circuit 43 is to prevent the "in-use" signal from turning off its own transmitter 11-L in response to the local generation of an in-use signal as would normally occur but for the provision of such circuitry.

The priority timing circuit 40 controls the operation or the conductive condition of the switching circuit 41 and thereby controls the generation of the address signals to be transmitted along the cable 10. The priority circuit 40 is a timing circuit which may be an R-C timing circuit that is arranged to have a preselected time constant relative to the time constants for the priority circuits provided at the other stations coupled to the cable 10. When no external or remote inhibit signals are applied to the inhibit circuit 44, the timing circuit 40 will be activated and after the preselected time interval it will be timed out to allow the switching circuit 41 to conductively respond to the signal provided from the priority circuit 40. The time constants for the priority circuits 40 of each of the transmitters 11-L, then, automatically control, when activated, the priority or sequence in which the signals are transmitted along the cable 10 in the event that a plurality of signals seize the cable simultaneously or in a time overlapping relationship. The control of the transmission of the signals when stations do seize the cable 10 in a time overlapped relationship is afforded by the "in-use" signal coupled to all of the stations on the cable 10 to prevent the energization of timing circuit 40 until after the cable 10 is free.

From the above-described structure, the operation of the transmitter 11-L should be evident. In summary, however, it will be noted that the transmitter 11-L will be actuated through the operation of the alarm switch 14 for coupling a signal to the priority timing circuit 40. If no other station has seized the cable 10, then, no signal will appear on the "in-use" signal line 45 to activate the inhibit circuit 44. Accordingly, after the circuit 44 is activated, the timing circuit is rendered operative so that with the elapse of time interval selected for the circuit 40, the switching circuit 41 will switch to its conductive state and provide an output signal to the address signal generator 17. The signal received from the circuit 41 will cause the address signals to be generated and transmitted from the network 17 along a cable 10 to the recorder 13. At this time, the "in-use" signal is generated and transmitted to the other stations coupled to the cable 10 through the diode 42. At this same time, the "in-use" signal will appear on the local "in-use" lead wire 46 for activating the inhibit circuit 43. This circuit will prevent the operation of the inhibit circuit 44 and allow the transmitter 11-L to continue to transmit its signals until it completes its transmission. It will also be recognized that in the event that none of the other stations on the cable 10 is transmitting at a time when the alarm switch 14 is activated that no "in-use" signal will appear on the lead wire 45 to activate the inhibit circuit 44. If there is an "in use" signal on line 45, it will prevent the signal generated through the operation of the alarm 14 from activating the priority timing circuit 40 and thereby prevent the generation of the signals from the other stations at this same time. The priority circuit 40 will be activated when the "in-use" signal appearing on line 45 terminates to allow the transmission in the usual fashion. It should also be recognized that if during the time interval that the priority timing circuit 40 is being inhibited and another station

attempts to seize the cable 10 that the transmission from the plurality of activated stations will be controlled or governed by the time constants of the circuits 40 for the individual stations or transmitters 11-L. Stated differently, the sequence of transmissions is solely and automatically under the control of the timing circuits for each of the stations to allow the stations to transmit sequentially without overlapping in time and thereby not lose any information.

It will be recognized that under certain conditions, a signal at a particular station that is utilized to activate the transmitter will be generated so quickly that the information will be lost if it cannot immediately seize cable 10. For example, if a door is being monitored at one of the remote stations, the door may open and close so fast that the operation of the door may never be recorded or a signal transmitted along the cable 10. To this end, the embodiment of FIG. 6 incorporates a memory feature for storing the fact that there has been a change of condition at a particular station such as the opening and closing of a door. The memory element is identified in FIG. 6 in dotted outline as the element 50. The memory element 50 comprises a bistable switching circuit or flip-flop 51 having its "set" input lead 52 coupled to the output of a differentiator circuit 53. The input circuit to the differentiator circuit 53 may be coupled to a switch 54 for sensing the opening and closing of a door as illustrated in FIG. 6. For this purpose such a switch is powered from the power leads of the cable 10 as in the other embodiments. The operation of the door, then, is effective for operating the switch 54 for providing a signal to the differentiator circuit 53 for triggering the "set" input 52 of the flip-flop 51 and switching the state thereof. The flip-flop element 51 is normally in its "reset" state. Accordingly, as illustrated in FIG. 6, the "set" section of the element 51 is normally non-conductive and the "reset" normally conductive. The output signal from the "set" element of the flip-flop 51 is coupled as an input to the switching circuit 41 and normally functions to inhibit the operation of the circuit 41 when the latter is in the "reset" condition. A "reset" input 56 is coupled to allow the flip-flop element 51 to be reset to its normal state from the "set" state. The "reset" input 56 is pulsed through an inhibit circuit 57 coupled to be responsive to the output signal from the switching circuit 61. The flip-flop 51 will be reset after the signal from the switching circuit 61 has terminated to prepare the station for the next operation. It will be noted that the transmitter 11-L is structurally organized as in the embodiment illustrated in FIG. 5 to include the inhibit circuits 43 and 44 for controlling the timing circuit 40. The output of the timing circuit 40 is coupled in combination with the signal from the flip-flop element 51 appearing on the lead wire 55 therefor. The arrangement illustrated in FIG. 6 is adapted to allow an electrical key to be employed in the system including keys of the type described hereinabove. As illustrated, however, the contacts provided for implementing the use of an electrical key are connected together by means of jumpers 58 and 62. The jumper 58 connects the output of the switching circuit 41 as an input signal to a differentiator 59 coupled to the switch 60. The differentiator 59 and switch 60 comprise the output switching circuit from the transmitter 11-L and are enclosed in the block illustrated in dotted outline and identified as the block 61. The output of the switching circuit 61 or, specifically,

the output from the switch 60 is coupled to the further jumper 62 for coupling to the address generator 17 for activating same. The jumper 62, as in the case of the jumper 58 is provided for shorting the contacts that may be employed for the use of an electrical key. The output of the circuit 61 is also coupled by means of the lead wire 63 as an input to the inhibit circuit 57 for resetting the flip-flop 51. A local "in-use" signal is also derived from the circuit 61 and coupled by means of lead wire 46 to the local inhibit circuit 43.

The operation of the circuit of FIG. 6 including the memory element 50 is merely modified relative to the operation of the embodiment of FIG. 5 for the purpose of monitoring and signaling the operation of a door and to store the information representative of the door operation and to provide the stored information to the transmitting circuit at a time when the cable 10 is not seized by any other stations and allow it to be transmitted in the usual fashion. For this purpose, when a door is quickly opened and closed, the switch 54 is operated and the signal provided thereby is differentiated by the circuit 53. The output of the differentiator 53 switches the flip-flop 51 to the "set" state and provides a signal on the lead wire 55 for removing the inhibiting signal from the switching circuit 41. The flip-flop 51 is maintained in its "set" state until it is reset by the signal appearing on the lead wire 56. It will be recognized that if an "in-use" signal appears on the lead wire 45 that the priority timing circuit will be inhibited and no signals will be generated from the station 11-L. If it is assumed that the "in" use signal on lead wire 45 has been terminated, the priority timing circuit 40 will then be activated. At this time, with the flip-flop 51 in the "set" state, the signal on the lead wire 55 is not inhibiting the operation of the switching circuit 41. Therefore, with all external inhibits turned off the circuit 44 will not prevent the operation of the timing circuit 40 nor will the storage state of the flip-flop 51 prevent the switching circuit 41 from being activated. Accordingly, with the timing out of the circuit 40, the state of the circuit 41 will be switched to trigger the system and generate the necessary signals from the transmitter 11-L. Specifically, the output signal coupled to the differentiator 59 will provide output signals on the lead wire 63, the "in use" lead wire 46 and by means of the jumper 62 to the address generator 17. The address signals then will be transmitted along the cable indicative of the fact that the door had been operated. The output signal from the switch 60 appearing on the lead wire 63 is coupled to the inhibit circuit 57 for switching the flip-flop 51 to its reset state. The inhibit circuit 57 is provided to prevent the resetting of the flip flop 51 until after the pulse appearing at the output of the switching circuit 60 has terminated. After this time interval, the inhibit circuit 57 will allow the reset pulse on lead wire 56 to be coupled to the flip-flop 51 and it will be reset. With the resetting of the flip-flop 51 the inhibit signal will again appear on its output lead wire 55 to prevent the operation of the circuit 41.

It should also be recognized that in the embodiment of FIG. 6 the arrangement is illustrated for detecting the quick opening and closing of the door by means of a switch 54. As illustrated in FIG. 1, a sensor such as a fire sensor may be employed for detecting an overheated condition in lieu of the switch 54. In this instance, the power lead identified as the +E lead may include an alarm switch or a sensor in series with the lead

+E for activating the differentiator 53 and recording the fact that the alarm or sensor has sensed a preselected condition. The alarm or sensor will be coupled to point B and the switch 54 will be omitted. The operation of the system will then be the same as the operation described hereinabove.

Now referring to FIG. 7, the arrangement for controlling a latch by means of an electrical key will be described. It should be understood that if a latch or a door is being controlled by means of an electrical key 20 that the memory element 50 described in combination with FIG. 6 will not be employed. For this purpose, the key 20 will have two sides having conductive segments recorded thereon. One side of the key identified in FIG. 7A as side I will be used as a switch, while the other side will be used to derive the I.D. information therefrom. This latter disc is illustrated in FIG. 7B and is identified as side II. For the purpose of utilizing an electrical key 20 the jumpers 58 and 62 described in combination with the embodiment of FIG. 6 are omitted as well as the memory element 50. The contacts 41' and 59' which were connected together by means of the jumper 58 are electrically connected by means of side I of the key 20. The jumper 62 normally connects 60' with contacts 17' and this connection is made by means of side II of the key as illustrated. The arrangement is such, then, that the output of the switching circuit 41 is connected to contact 41' which will be connected to the key receptacle 21 for powering the key 20 so that the key-in segment recorded on the key 20 will be coupled to the terminal 59' and thereby effectively operate in the same fashion as the jumper 58. Accordingly, the signal appearing at the output of the switching circuit 41 will appear at the input of the differentiator circuit 59 and consequently at the switching circuit 60. The output terminal 60' for the circuit 60 will now be coupled back to the key receptacle 21 to power the I.D. segments on the key 20 so that the I.D. bits may be coupled to the I.D. isolating diode network 22. The output of the network 22 will be coupled to the printer as previously described.

A conductive segment is also provided on the key 20 for jumping to the contact 17' which is coupled to the input of the address generator 17 upon receiving a key-in signal for providing a corresponding key-in or "in use" output signal from the address generator 17. The combination data is derived from the key receptacle and applied to the combination decode element 23 for controlling the controlled latch 24 as previously described. It should be evident, then, that the employment of a key 20 in the network will function essentially as discussed in conjunction with the embodiments of FIGS. 5 and 6 with the exception that a key I.D. signal will also be transmitted along the cable 10.

The detailed circuit diagram of the transmitter having the "in use" signal capabilities and the memory capabilities are illustrated in FIG. 8. The circuits of FIG. 8 will first be described in its structural organization and operation without reference to the memory element 50. FIG. 8 illustrates the typical circuit configuration for a transmitter 11-L. In this arrangement, the priority timing circuit 40 comprises the capacitor 40C connected in series with parallel combination of the resistive elements 40R. The capacitor 40C is connected to the output electrode of the transistor switching circuit 70 for the inhibit circuit 44. The inhibit circuit 44 is illustrated as a transistor switch 70 having its emitter

electrode connected with a diode 71 coupled to one terminal of the capacitor 40C in common with the terminals of resistors 40R. The remaining terminal of the capacitor 40C is connected to ground potential. The base electrode for the transistor 70 is connected by means of a resistor 72 to ground and has an input signal resistor 73 also coupled to the base in common with the output electrode for the transistor switch 74. The input resistor 73 is coupled to a line "in use" inhibit line 45 to receive the "in use" signals from the remaining stations. The inhibit circuit 43 comprising the transistor switch 74 is coupled to the output of the switch 60 by means of the lead wire 46. The lead wire 46 is coupled to the base electrode of the transistor 74 by means of a series resistor 75 and a parallel dropping resistor 76 coupled between the base side of the lead wire 46 and ground potential. The transistor 74 for the "local" inhibit circuit 43 is normally in a non-conductive condition and is rendered conductive when the in-use signal is coupled from the switch 60 onto the lead wire 46. This signal inhibits all of the other "in-use" signals that may be coupled to the transistor 70 and protects turning off the transmitter 11-L once it is activated for transmitting signals. This inhibiting action results from the application of the output signal from the transistor switch 74 to inhibit the switching action of the transistor 70.

The inhibit circuit 44 includes the transistor switch 70 and is coupled to be responsive to an "in-use" signal appearing on lead wire 45 from the other stations for preventing the generation of a signal from the transmitter 11-L. The transistor switch 70 is coupled to the transistor switch 77 by means of the R-C timing circuit, 40C and 40R. Once the transmitter is activated for generating station signals by a switch or otherwise, the transistor 77 will be in a conductive condition. This will inhibit the switching of the transistor 78 coupled thereto and thereby prevent the coupling of a signal from the transmitter. When the transistor 70 is rendered non-conductive as a result of the fading of the "in-use" signals, the priority timing circuit will be activated. This will result in the capacitor 40C discharging through the resistor 40R and eventually will reach a voltage level to render the transistor 77 non-conductive. When this occurs the transistor 78 will be rendered conductive. When the transistor switch 78 is rendered conductive for a predetermined interval it will cause the capacitor 79 coupled to the contact 59' to charge up. The capacitor 79 in combination with a resistor 80 comprises a differentiating network 59. The differentiated pulse from the differentiating network 59 is coupled to the switching element 60 illustrated as the transistor switch 81. The transistor switch 81 has its emitter electrode connected to the contact 60' and also to the local "in-use" lead wire 46. The other contact connected by the jumper 62 is the contact 17' and functions as the input terminal for the address generator 17. The address generator 17 includes a plurality of diodes 17D arranged in the 8-4-2-1 binary format for generating address signals to be coupled to the individual conductors of the multi-conductor cable 10 as previously described. The collector electrode for the transistor 81 is coupled by means of the lead wire 82 to the positive source of potential derived from cable 10. The signal applied to an "in-use" diode 83 is coupled to the other stations coupled to the cable 10 as well as being

coupled onto the lead wire 45 for coupling to its own remote inhibit circuit 44.

The operation of the above described circuit is as previously described. It will be assumed that the alarm switch 14 is coupled to the terminal B for applying the voltage source from the cable 10 to the lead wire identified as +E when operated. The operation of the switch 14 will power the circuits for signaling the necessary data to be transmitted along the cable 10. In this embodiment the jumpers 58 and 62 are utilized to complete the circuits through the transmitter 11-L. If none of the other stations has seized the cable 10, there will be no "in-use" signal appearing on line 45 and therefore the inhibit circuit 44 will be maintained in a non-conductive condition. It will be recognized that if one of the other stations has seized the cable 10 that the transistor 70 for the inhibit circuit 44 will be rendered conductive until the other station has terminated its transmission thereby preventing transmission until the "in-use" signal has faded. When this occurs the transistor 70 will be rendered non-conductive. With the transistor 70 switching off the capacitor 40C will be discharged through the resistors 40R and switch the transistor 77 to a non-conductive condition at the end of the R-C time interval selected. With the switching of the transistors 77 to the non-conductive condition the transistor 78 will be rendered conductive and a pulse will be applied to charge up capacitor 79. The capacitor 79 will discharge through the resistor 80 for triggering the transistor switch 81. The pulse from the transistor 81 will be sent by means of the jumper 62 to the address generator 17, as previously discussed. It will also be noted that a further signal identified as the alarm signal may be coupled to the cable 10 by means of an alarm diode 84 and is coupled to be responsive to a signal appearing at terminal 17'.

When the memory element 50 is employed the circuit will be modified so that there is a direct circuit connection from the point B in the memory circuit 51 to the switch 54 for triggering the flip-flop 51. (Switch 14 is omitted). This signal will be differentiated by the R_c differentiator network 53 for rendering the transistor 85 of the flip-flop element 51 conductive from its normal non-conductive state. The transistor 85 is arranged in a flip-flop configuration with a transistor 86. The transistor 86 is normally arranged in a conductive condition and has a feedback circuit from its collector electrode coupled to the base electrode for the transistor 85. When the transistor 85 is rendered conductive, then, the transistor 86 is rendered non-conductive or in a high voltage state. In the same fashion, a feedback circuit from the transistor 86 will maintain the transistor 85 in its conductive condition. The lead wire 55 from the flip-flop element 51 is normally employed to supply current to the base of the transistor switch 77 to maintain it in a conductive condition and thereby inhibit the operation of the transistor 78 and thereby the generation of signals from the station. This condition prevails until the flip-flop is switched to its "set" condition. When the transistor 85 is rendered conductive this circuit no longer supplies current through the resistor 87 and the diode 88 to keep the transistor 77 in a conductive condition and will therefore remove the inhibit signal at the transistor 78. The transistor 85 is in a conductive condition when the switch 54 is operated to place the flip-flop 51 in the "set" state. When all of the other stations have terminated their transmission, then,

the transistor 70 for the inhibit circuit 44 will be rendered non-conductive and the timing capacitor 40C will discharge through the resistor 40R and in accordance with the time constant for the circuit, it will now render the transistor 77 non-conductive. This will cause a signal to be coupled through the transistor 78 to the switching circuit 81 as previously described. At this time also a signal from the transistor switch 81 is fed back by means of the lead wire 63 to the flip-flop 51 for resetting it to its normal condition. For this purpose the lead wire 63 is coupled to a transistor inhibit circuit 57 which is coupled to a series reset circuit 56 connected to the reset input for the flip-flop 51. The reset circuit 56 comprises a series combination of the resistor 89 and the diode 90. One terminal of the diode 90 is coupled into the input circuit for the transistor 86 for resetting the latter while the free end of the resistor 89 is coupled to the emitter electrode for the transistor 78. With the rendering of the transistor 78 conductive and the triggering of the switch 81, the current would be supplied to the transistor 86 for switching the flip-flop to its normal reset state but for the provision of the inhibit circuit 57. The inhibit circuit 57 includes a transistor switching circuit 91 coupled intermediate the resistor 89 and the diode 90 for controlling the conduction of the reset circuit 56. This circuit is defined so that the inhibit circuit 57 prevents the reset circuit 56 from being operative until a pulse from the switch 81 is terminated. At this time the flip-flop 51 will be reset and the memory will be in the correct state for accepting and storing the next signal to be generated.

As described hereinabove, the station 11-L may be employed with an electrical key rather than the switches 14 or memory 50. For this purpose, FIG. 8 illustrates the relative locations (in dotted outline) of the two sides of a key 20 as it would be employed in the detailed circuit. The terminal B would be connected directly to the power lines of the cable 10 with the power application to the circuits being controlled through the insertion of a key 20 into its receptacle 21. The aforementioned side I of the key 20 would jumper the contacts 41' and 59' (the jumper 58 having been previously removed). When the "in use" signals faded, transistor 77 would be rendered non-conductive and transistor 78 conductive and the operation of the remaining circuits would be as described hereinabove with particular reference to the modifications of the circuit illustrated and described in conjunction with FIGS. 7.

What is claimed is:

1. A single cable signaling system comprising a plurality of signaling stations each including individual means for generating a control signal for transmission to a central station, a single cable coupled to each of the signaling stations for transmitting the generated control signal from each of the signaling stations to a central station, and priority timing means for controlling the priority of transmission of control signals from said plurality of signaling stations when said plurality of signaling stations are simultaneously actuated, said priority timing means producing a different time delay at each of said plurality of stations with the length of said time delay at each of said plurality of stations establishing a time controlled sequence in which said control signals from said plurality of signaling stations are transmitted to said central station.

2. A single cable signaling system as defined in claim 1 wherein said control signal generated at each of said signaling stations is a signal for identifying the signaling stations.

3. A single cable signaling system comprising a plurality of signaling stations each including individual means for generating signals for transmission to a central station,

a single cable coupled to each of the signaling stations for transmitting the generated signals to a central station,

priority timing means producing a time delay at each station for establishing a time controlled sequence in which a plurality of signal generating means actuated at substantially the same time transmit their respective generated signals in an order determined by the length of the time delay produced at each station,

said individual signal generating means generating signals for identifying the signaling stations, and at least one of the stations including key means for manually actuating the signal generating means and for generating unique key means user identification information for coupling to the cable for transmission thereby.

4. A single cable signaling system as defined in claim 3 wherein the central station includes means for printing out the signals transmitted along the cable.

5. A single cable signaling system as defined in claim 3 wherein each of the individual signal generating means includes means for transmitting a cable "in use" signal to each of the other stations during transmission to said central station to maintain the other stations in a non-transmitting condition to prevent the simultaneous transmission of signals along the cable and allow the signals of the other stations to be transmitted under the control of the priority timing means when the "in use" signal is terminated.

6. A single cable signaling system as defined in claim 5 wherein the individual signal generating means includes means coupled to be responsive to its own individual "in use" signal to prevent the termination of its own signal generating means.

7. A single cable signaling system as defined in claim 5 including means for operating the signal generating means and wherein at least one of the signaling stations include memory means connected to be responsive to means for actuating the signal generating means and recording the actuation of same to allow the signal generating means to be operative in response to the stored information in the memory means after the cable is free for transmission.

8. A single cable signaling system as defined in claim 7 including means for automatically resetting the memory means upon termination of the signal generating means.

9. A single cable signaling system as defined in claim 3 wherein the priority means comprises timing circuit means.

10. A single cable signaling system as defined in claim 9 wherein the timing circuit means comprises R-C timing circuit means.

11. A single cable signaling system comprising a plurality of signaling stations each including individual means for generating station identification signaling information and means for actuating the generating means,

a single cable coupled to each of said signaling stations for transmitting the signaling information, recording means coupled to the cable for receiving and recording the signaling information transmitted thereto,

said actuating means of at least one of the stations including key means for manually actuating the signal generating means upon activation of said one station by said key means, and wherein the key means of at least one station comprises a coded key having preselected control actuation recorded thereon for actuating the signal generating means and having unique key identification information recorded thereon, the unique key identification information being coupled to the cable for transmission to the recorder only when the station identification information is generated.

12. A method of monitoring a plurality of independent stations with a common recording station comprising

coupling a single cable to a plurality of signal generating stations,

transmitting the signals generated at each station to a common point along the cable,

recording at the common point each of the signals transmitted along the cable,

providing a different transmission time delay to each of the independent stations according to a predetermined priority established at each of said sta-

tions, controlling the transmission of the signals to be recorded in a preselected timing priority to allow a station that is transmitting to prevent transmission from the remaining stations and once the transmitting station has finished transmitting to allow the remaining stations that are actuated substantially simultaneously to transmit, and

sequentially transmitting said signals from said remaining stations in accordance with the duration of the different transmission time delays provided at each station to allow the remaining signal generating stations each to transmit their respective signals at different times as determined by said different time delays to provide a predetermined sequence of transmission determined by the length of said time delays associated with said remaining stations.

13. A method of monitoring a plurality of independent stations as defined in claim 12 including storing a station actuating signal occurring while signals are transmitted along the cable for a time interval to allow any signals transmitted along the cable to be recorded and then releasing the stored signal at a time when the cable is free to transmit if for recording.

14. A method of monitoring a plurality of independent stations as defined in claim 12 including transmitting a signal by a station to itself to prevent the termination of its own signal along the cable.

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