

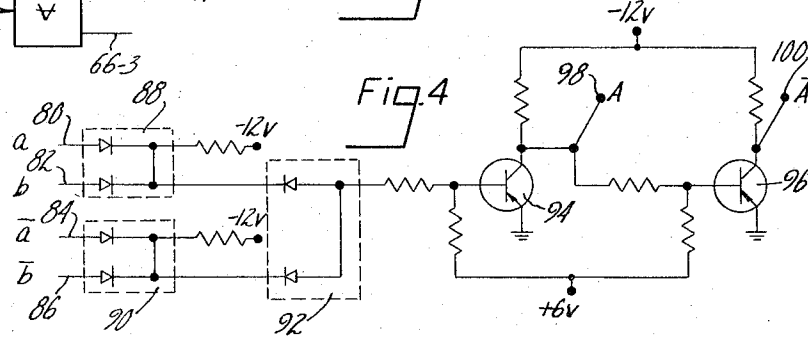
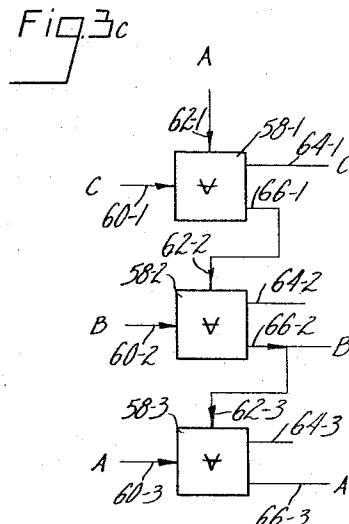
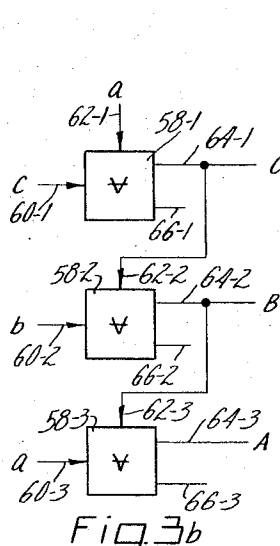
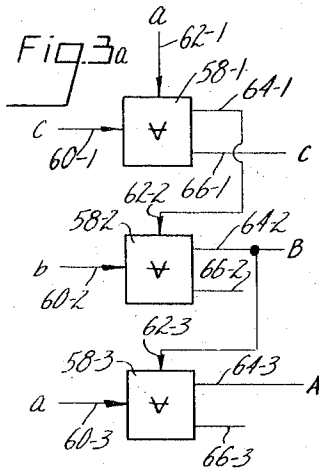
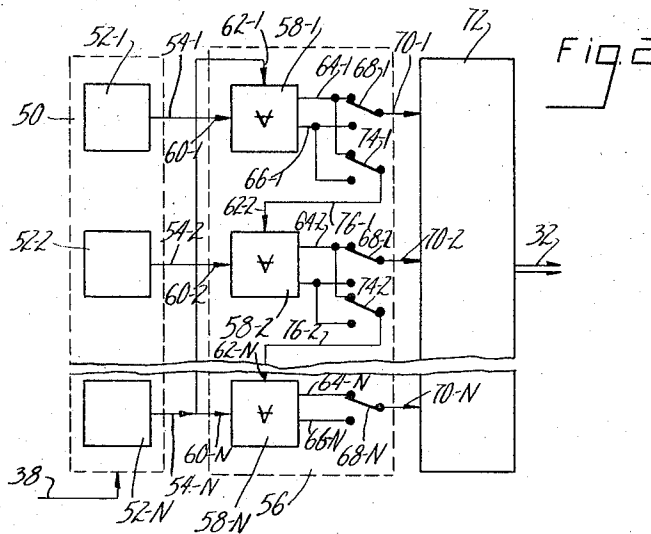
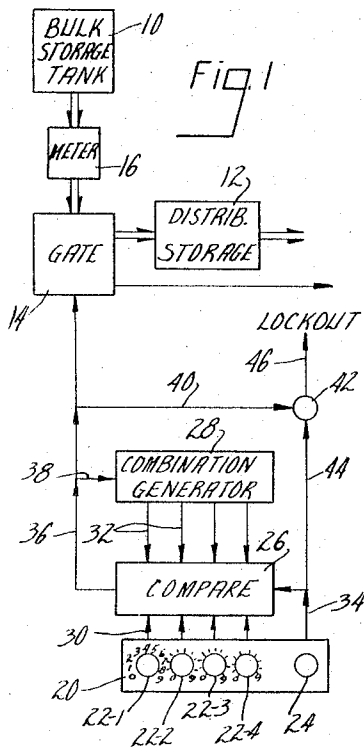
Feb. 28, 1967

AN WANG

3,306,318

SECURITY SYSTEM

Filed Feb. 26, 1965



1

3,306,318

SECURITY SYSTEM

An Wang, Lincoln, Mass., assignor to Wang Laboratories, Inc., Tewksbury, Mass., a corporation of Massachusetts
Filed Feb. 26, 1965, Ser. No. 435,480
12 Claims. (Cl. 137—552.5)

This invention relates to security systems and more particularly to coded combination generators for use with security systems.

The integrity of the security system is frequently a function of the ease or difficulty with which an unauthorized person may gain access to the material protected by the security system. Combination locks, of the type in which a number of digits must be arranged in a particular sequence to release the lock, are commonly used. The information about the digits and their sequence must be carefully guarded to protect the integrity of the system and the sequence of digits that will release the "lock" should be capable of change in case the digit sequence is lost or otherwise compromised. In certain systems it may be desired to change the digit sequence at frequent intervals. Such a system is useful in connection with the distribution of fungible commodities, such as electricity or fuel. For example, in the operation of retail gasoline stations, the wholesaler frequently wishes to control the amount of gasoline to which the retail station operator has access from a bulk storage tank. This control may be used for accounting purposes or for maintaining credit supervision on the retail station operator. The amount of gasoline that the wholesaler is willing to allow the station operator to withdraw from the bulk storage tank is a function of the credit position of that operator. Such control, however, is complex in that the retail station operator cannot have free access to the "key" that will release the "lock" on the bulk storage tank. A representative of the wholesaler could be sent out each time a retail station operator requested additional supplies of gasoline. However, such a system would substantially delay the availability of gasoline to the operator and entail substantially increased cost to the wholesaler. Alternatively, the retail station operator may merely call the wholesaler, and if his credit rating is satisfactory, the wholesaler will furnish him a "combination" or "key" for releasing a predetermined amount of gasoline. The retail station operator then utilizes that "combination" to obtain the additional quantity of gasoline. This "combination" should be capable of being revised automatically so that the operator must request a new combination to obtain an additional quantity of gasoline. The control apparatus for such a security system should be reliable, easy to operate, difficult to break (for example, the next combination should be difficult to predict), and not be subject to error, for example, due to temporary loss of control power.

Accordingly, it is an object of the invention to provide a novel and improved combination generator for a security system.

Another object of the invention is to provide a simple, reliable, and inexpensive apparatus capable of automatically changing a combination.

Another object of the invention is to provide a novel and improved system for control of fungible commodities.

In accordance with the invention there is provided in a security system a combination generator that includes a control register for storing signals representative of a number and a code generator. The control register has a plurality of outputs representative of the digits in that number, and the code generator includes a plurality of logic units corresponding in number to the outputs from the control register. Each logic unit has two inputs and

2

an output and the logic units are connected in cascade. One logic unit input is connected to receive a signal from the corresponding output of the control register, and each output is connected to the second input of the succeeding logic unit in the cascaded sequence (with the exception of the logic unit at the end of the cascaded sequence). A signal is applied to the second input of the logic unit at the beginning of the sequence from a suitable source such as the least significant stage of the control register. In response to each change in the setting of the control register, a different combination is generated from the outputs of the code generator. In the particular embodiment described hereinafter, the output of each logic unit is available in normal and complement form and switches are associated with each logic unit to individually select either the normal or complement output signal for application on the code generator output line and also for application to the subsequent logic unit in the cascaded sequence. By means of these switches, the number and variety of combinations that can be generated by this apparatus is significantly increased.

In this apparatus, it is preferable that the control register utilize mechanical register devices which remain in position when the combination generator is de-energized. The apparatus is packaged so that the setting of the control register and the switches cannot be determined externally of the package. An input register which has manually settable controls may be employed with the combination generator. The outputs of the input register are applied to a compare circuit, and the outputs of the code generator likewise are applied to the compare circuit. If the setting of the input register matches the output of the code generator, the compare circuit generates an output signal which releases the "lock" or takes other appropriate action. This generated output signal may be used to change the setting of the control register. The apparatus of the invention is simple and reliable and yet versatile in that a large number of different combinations may be generated, which combinations are difficult to predict. Thus, the apparatus provides a high degree of security for the system it supervises.

Other objects, features and advantages of the invention will be seen as the following description of a particular embodiment thereof progresses, in conjunction with the drawing, in which:

FIG. 1 is a block diagram of a security system, constructed in accordance with the invention, for control of the distribution of a fungible commodity;

FIG. 2 is a block diagram of the combination generator circuitry employed in the system shown in FIG. 1;

FIGS. 3a-c are a series of diagrams indicating different settings of the logic units of a combination generator of the type shown in FIG. 2, and

FIG. 4 is a schematic diagram of a logic unit component used in the combination generator shown in FIG. 2.

The system shown in FIG. 1 is a security system for control of distribution of gasoline from bulk storage tank 10 to a distribution storage tank 12. A gate or lock 14 is connected between the bulk tank 10 and the distribution tank 12 and an accumulator meter 16 may also be connected in the conduit between the two tanks. The gate 14 controls the transfer of a predetermined quantity of gasoline from tank 10 to tank 12, and the station operator may distribute the gasoline for sale from the distribution tank 12.

A security system in the form of a "combination lock" controls the operation of gate 14. This security system includes an input register 20 having four manually controllable settable knobs 22-1—22-4 and a release control 24. Coupled to this input register is compare circuitry 26 and combination generator circuitry 28. The input register applies signals over lines 30 to the compare cir-

circuitry 26 and the combination generator circuitry applies signals over corresponding lines 32 to that circuitry. In response to operation of control 24, a signal is generated on line 34 and applied to the compare circuitry. If the signals on lines 30 and 32 compare identically, the compare circuitry generates an output signal on line 36 which is applied to the gate 14 to release the lock and permit the transfer of a predetermined amount of gasoline (e.g. five hundred gallons) from bulk storage 10 to distribution storage 12.

The release signal on line 36 may also be applied over line 38 to the combination generator 28 to revise the combination. In addition, the release signal is also applied over line 40 to a security interlock 42 in the form of a stepping register to which an input signal is applied over line 44 each time release control 24 is operated. Interlock register 42 may be set to produce an output signal on line 46 after it has been stepped three times, for example, and the output on line 46 will prevent further transfer of gasoline from distribution storage 12 (lockout), for example, or provide a signal at a remote location that attempts are being made to release the "lock." Each signal on line 40 resets the interlock register 42. Thus, the interlock register provides a control on the number of times the input register controls 22 may be set and the release control 24 operated. This interlock permits the station operator, for example, to make one or two errors in setting the input register dials 22, but if repeated attempts to match the combination generated by the combination generator are unsuccessful, the system is automatically locked out. This interlock thus increases the security of the control system. It also may be used to detect endeavors to compromise the security system for obtaining unauthorized access to the supervised component.

A block diagram of the combination generator is shown in FIG. 2. This combination generator includes a control register 50 that has a plurality of stages 52-1-52-N. This combination generator in this embodiment is a stepping register which, in response to each signal applied on line 38, is advanced one count. In the particular embodiment, the stepping register includes mechanical devices which are stepped in response to the input signal and which remain in position when the control generator is de-energized.

The control register outputs on lines 54 are binary outputs and correspond to each order of a binary word representative of the number stored in the control register. The output on line 54-N is representative of the least significant order of the binary number and the output on line 54-1 is representative of the most significant order of that binary number.

These signals are applied to a code generator 56 which includes a plurality of exclusive OR circuits 58 that correspond in number to the orders of the binary word generated by the control register 50. Each exclusive OR circuit has inputs 60 and 62 and normal and complement outputs 64, 66, respectively. Two selection switches are associated with each logic unit (with the exception of the last logic unit 58-N which has only one selection switch associated with it). Selection switch 68 controls the application of a signal over output line 70 to a binary to digital converter 72 and selection switch 74 controls the application of the normal or complement output signal over line 76 to the second input of the next exclusive OR logic unit in sequence. Thus, the first inputs of the logic units are connected in parallel to the outputs of the control register 50, and they are connected in cascaded sequence and by means of their second inputs.

This combination generator provides a scrambled output on lines 32 as a function of the setting of the control register 50. In response to each different setting of the control register, a unique output of the command generator is produced with the connection shown in FIG. 2. Should other connections be utilized, as hereinafter de-

scribed, the number of different combinations available is modified. The combinations may be changed by virtue of changing the position of any one of the switches 68 or 74.

The operation of the command generator may be better understood with reference to FIGS. 3a-3c and the associated tables, which indicate the sequence of outputs for various switch settings. In FIGS. 3a and 3b the inputs to the three binary logic units are as indicated in FIG. 2, while in FIG. 3c the input to the logic unit is from the output signals applied on line 32. In other words, in the FIG. 3c arrangement, the control register is set to the setting of the scrambler output generated by the previous setting of the control register.

In the switch setting shown in FIG. 3a, switch 68-1 is set to connect line 70-1 to the complement output 66, while switch 74-1 is set to connect the sequence coupling line 76 to the normal output 64-1. Switch 68-2 is set to connect normal output 64-2 to output line 70 and switch 74-2 is set to connect normal output 64-2 to the third stage. Finally, the last stage, which is indicated as stage 58-3, has its normal output 64-3 connected to output line 70-3. This setting of the switches produces the following scrambled sequence combinations as indicated in the following table:

a b c	A B C
0 0 0	0 0 1
0 0 1	1 1 0
0 1 0	1 1 1
0 1 1	0 0 0
1 0 0	0 1 0
1 0 1	1 0 1
1 1 0	1 0 0
1 1 1	0 1 1

In FIG. 3b the switches are set so that each normal output (line 64) is connected both to output line 70 and to the sequence coupling line 76 for each logic unit. This switch setting produces the sequence combinations indicated in the following table:

a b c	A B C
0 0 0	0 0 0
0 0 1	1 1 1
0 1 0	1 1 0
0 1 1	0 0 1
1 0 0	0 1 1
1 0 1	1 0 0
1 1 0	1 0 1
1 1 1	0 1 0

In FIG. 3c the inputs as indicated above are revised and it is not a stepping register input but rather a feedback arrangement in which each input is revised as a function of preceding combination. In addition, the settings of switches 68 and 74 have been changed as indicated. This re-arrangement of the control register and the switch settings produces the following sequence indicated in the following table:

A B C	A' B' C'
0 0 0	1 0 0
1 0 0	1 1 1
1 1 1	1 1 0
1 1 0	0 0 1
0 0 1	0 1 1
0 1 1	1 0 1
1 0 1	0 0 0

(It will be noted that the sequence does not produce a sequence of eight different combination output numbers, but rather repeats after seven.)

A circuit diagram of a suitable logic unit 58 is shown in FIG. 4. That circuit has signals representative of the first and second inputs applied to inputs 80 and 82 and

5

complements of those signals applied to inputs 84 and 86. The normal inputs on lines 80 and 82 are connected through a first diode OR circuit 88 and the complement inputs on lines 84 and 86 are applied through a second diode OR circuit 90. The outputs of these two OR circuits are applied to a diode AND circuit 92 and the output of that AND circuit is applied to control the conduction of two transistors 94 and 96. When transistor 94 is conducting, the potential at terminal 98 is substantially ground (zero), and transistor 96 is not conducting, so that the potential at terminal 100 is substantially at -12 volts. Conversely, when transistor 94 is not conducting, the potential at terminal 98 is substantially at -12 volts and transistor 96 is then conducting so that the potential at terminal 100 is substantially at ground. The output signals at the terminals 98 and 100 correspond to the signals applied on lines 64 and 66 in the block diagram shown in FIG. 2.

While the security system of the invention has been disclosed as utilizing logic units of a particular form of binary exclusive OR circuits connected in a cascaded arrangement, which arrangement has distinct advantages from the standpoints of economy, reliability, and simplicity and the further advantage of facilitating the revision of the combination sequences, it will be understood that other logic arrangements may be utilized. Therefore, while a particular embodiment of the invention has been shown and described, it is recognized that further modifications thereof will be obvious to those of ordinary skill in the art, and therefore it is not intended that the invention be limited to the disclosed embodiment or to details thereof and departures may be made therefrom within the spirit and scope of the invention as defined in the claims.

What is claimed is:

1. A security system comprising an input register controllable by a subscriber to provide a first combination of digit signals,

a signal generator for generating a second combination of digit signals, said signal generator including a plurality of logic units connected in cascade, each said logic unit producing an output in response to an input signal and the output from the preceding logic unit in the cascaded series,

a comparator for providing an output signal upon actuation by the subscriber in response to a satisfactory comparison between said first and second combinations of digit signals groups to provide a lock release signal, and

means to apply said release signal to said signal generator to revise said second combination of digit signals.

2. The system as claimed in claim 1 further including means associated with each logic unit to optionally revise the value of the output from that unit.

3. The system as claimed in claim 1 wherein each logic unit includes an exclusive OR circuit.

4. The system as claimed in claim 1 wherein said combination generator includes a stepping register having a stage corresponding to each logic unit and wherein each said stage provides said input signal to its corresponding logic unit.

5. A security system comprising an input register controllable by a subscriber to provide a first combination of digit signals,

a signal generator for generating a second combination of digit signals, said signal generator including a shift register having a plurality of stages,

a plurality of exclusive OR logic units corresponding in number to the stages of said shift register, each said logic unit having two inputs and an output, said logic units being connected in cascade to apply the output from each logic unit to the input of the next logic unit in the cascaded series and the other

6

of said inputs being connected to the output of the corresponding stage of said shift register so that the outputs of said logic units provide said second combination of digit signals,

a comparator for providing an output signal upon actuation by the subscriber in response to a satisfactory comparison between said first and second combinations of digit signals groups to provide a lock release signal, and

means to apply said release signal to said signal generator to revise said second combination of digit signals.

6. The system as claimed in claim 5 further including means associated with each logic unit to optionally revise the value of the output from that unit.

7. The system as claimed in claim 5 wherein said logic units operate in the binary mode and each said logic unit provides a normal output signal and a complement output signal and further including a switch connected to said logic unit to select either said complement output signal or said normal output signal for application to the succeeding logic unit in the cascaded series.

8. The system as claimed in claim 7 wherein said signal generator further includes a binary to digital converter coupled to the outputs of said logic units and further including switch means connected between said logic units and said converter to select complement output signals or normal output signals of said logic units for application to said converter.

9. A security system for controlling the availability of a bulk fungible commodity to a subscriber comprising commodity storage means,

commodity distribution means, a conduit connecting said storage means and said distribution means for transferring said commodity from said storage means to said distribution means, a gate control in said conduit for preventing transfer of said commodity to said distribution means, an input register controllable by said subscriber to provide a first combination of digit signals,

a signal generator for generating a second combination of digit signals, said signal generator including a plurality of logic units connected in cascade, each said logic unit producing an output in response to an input signal and the output from the preceding logic unit in the cascaded series,

a comparator for providing an output signal upon actuation by the subscriber in response to a satisfactory comparison between said first and second combinations of digit signals groups to provide a gate release signal, and

means to apply said release signal to said signal generator to revise said second combination of digit signals, and to said gate control to allow transfer of said commodity from said storage means to said distribution means.

10. A security system for controlling the availability of a bulk fungible commodity to a subscriber comprising commodity storage means,

commodity distribution means, a conduit connecting said storage means and said distribution means for transferring said commodity from said storage means to said distribution means, a gate control in said conduit for preventing transfer of said commodity to said distribution means, an input register controllable by a subscriber to provide a first combination of digit signals,

a signal generator for generating a second combination of digit signals, said signal generator including a shift register having a plurality of stages,

a plurality of exclusive OR logic units corresponding in number to the stages of said shift register, each said logic unit having two inputs and an output, said logic units being connected in cascade to apply the output from each logic unit to the input of the next

7

logic unit in the cascaded series and the other of said inputs being connected to the output of the corresponding stage of said shift register so that the outputs of said logic units provide said second combination of digit signals,

a comparator for providing an output signal upon actuation by the subscriber in response to a satisfactory comparison between said first and second combinations of digit signals groups to provide a lock release signal, and

means to apply said release signal to said signal generator to revise said second combination of digit signals.

11. The system as claimed in claim 10 wherein said logic units operate in the binary mode and each said logic unit provides a normal output signal and a complement output signal and further including a switch connected to said logic unit to select either said complement output signal or said normal output signal for application to the succeeding logic unit in the cascaded series.

12. The system as claimed in claim 11 wherein said

8

signal generator further includes a binary to digital converter coupled to the outputs of said logic units and further including switch means connected between said logic units and said converter to select complement output signals or normal output signals of said logic units for application to said converter.

References Cited by the Examiner

UNITED STATES PATENTS

10	2,573,349	10/1951	Miller et al.	340—147
	2,602,116	7/1952	Skillman	340—147
	2,731,620	1/1956	Gottfried	340—147
	2,866,962	12/1958	Ellett	340—147
	2,905,926	9/1959	Aid	340—147
15	3,030,015	4/1962	Wieslander et al. ..	340—149 X
	3,063,468	11/1962	Dufour	137—552.5
	3,072,146	1/1963	Gizeski	137—552

20 M. CARY NELSON, *Primary Examiner*.

H. KLINKSIEK, *Examiner*.