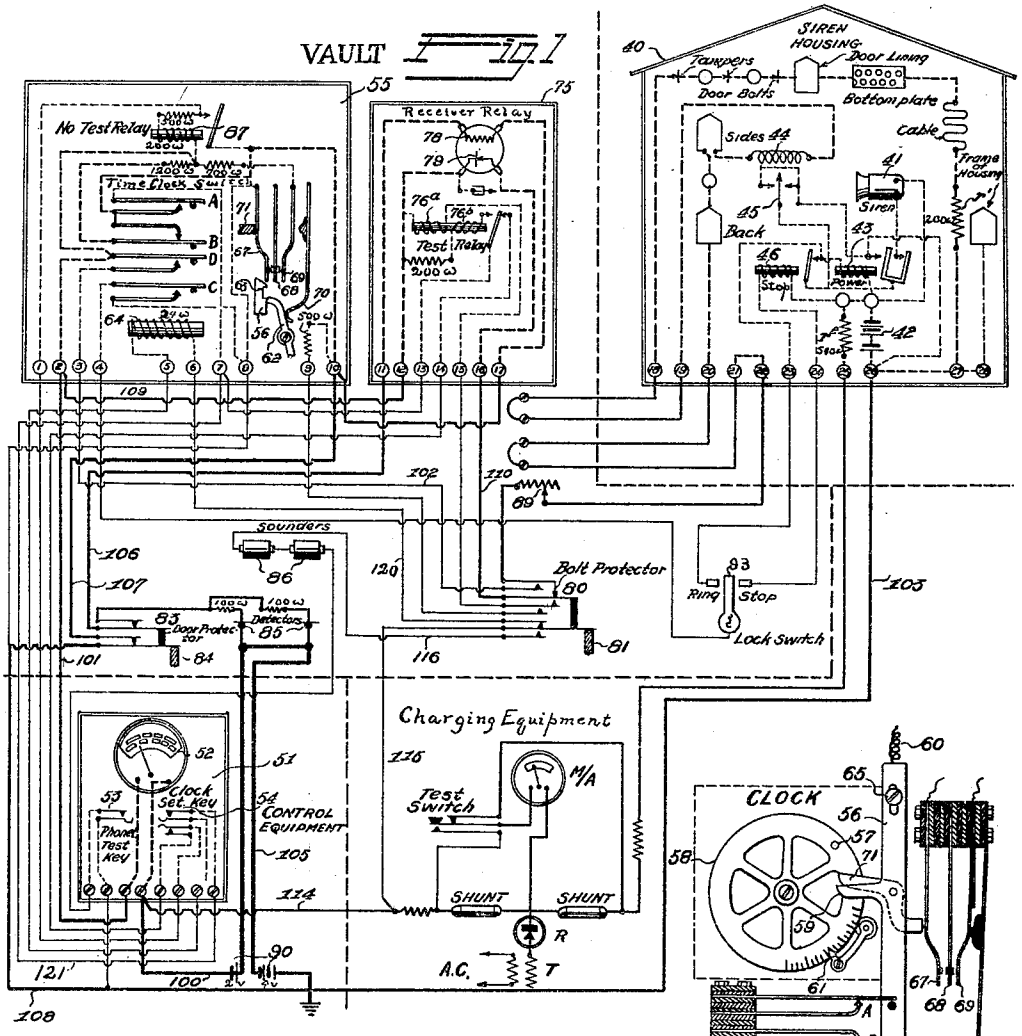
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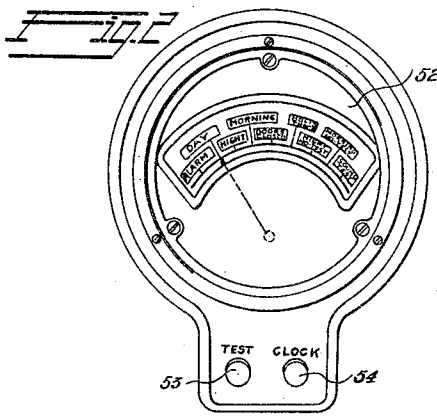
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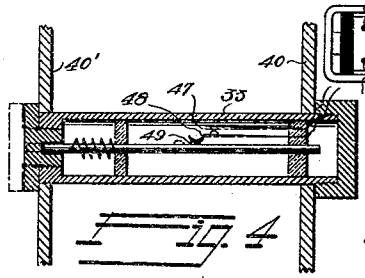
July 19, 1932. R. M. HOPKINS ET AL 1,867,834

ELECTRIC PROTECTION SYSTEM FOR BANK VAULTS, ETC

Filed Sept. 30, 1927







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Search Room

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UNITED STATES PATENT OFFICE

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ELECTRIC PROTECTION SYSTEM FOR BANK VAULTS, ETC.

Application filed September 30, 1927. Serial No. 223,183.

This invention relates to electric protection systems or detection systems for the protection of bank vaults or other guarded structures from burglary or unauthorized attempts to gain entrance thereto.

The purpose of the invention generally is to provide an equipment which is adapted to give an alarm upon the occurrence of feeble sounds or shocks applied to the guarded structure. More particularly it is the purpose of the present improvements to provide a system in which the sound detecting features are suspended during any desired period, as during the usual office hours, while maintaining the automatic electric alarm supervision of all protection circuits and a constant visual indication of the integrity of the circuits.

A further purpose of this invention is to provide means requiring certain operations both manual and automatic to be performed in sequence during the change from the completely protected night period to the partially suspended protected day period and vice versa.

In the following detailed description of the protection system constituting this invention reference will be made to the accompanying drawing in which—Figure 1 is a diagrammatic illustration of the system showing the various elements in their approximate relative positions, with the circuit connections and conditions as they exist during the closed protected position; Figure 2 is a front elevation of the milliammeter indicator calibrated to indicate the electrical condition of the circuits under different operative conditions; Figure 3 is an enlarged detail view of the contacts controlled by the supervisory clock mechanism; and Figure 4 is a longitudinal sectional view of one of the protector bolts.

The outside signaling device

The alarm mechanism is located in a housing 40, located at some difficultly accessible place on the outside of the building. Within the housing is located a motor-driven siren 41, with its operating battery, usually a sixteen-volt storage battery 42, together with a plurality of resistances r^1, r^2 and a set of control relays. These relays include one of heavy duty type 43 equipped with heavy contacts for closing the circuit between the battery and the siren motor; another of the galvanometer type 44, so arranged that its armature or pointer 45, will normally remain in an intermediate position between its contacts but will engage one contact when released or deenergized and the other contact when operated to its extreme position; and a third relay 46 of the well-known McCulloh type. Resistance r^1 is connected directly in the protection circuit extending between the signaling device and the protected premises and resistance r^2 is connected in the circuit used to control the charging of the storage battery 42.

The housing is constructed of heavy gauge sheet iron, having an open front which is closed by a downwardly swinging door 40^1, held closed by four heavy bolts of the type illustrated in Fig. 4. Each bolt 33 is associated with a set of contacts 47, 48 which are held closed by a plunger 49 when the bolts are set up tight, the contacts of all of the bolts being arranged serially in the protection circuit, which is broken when any of the bolts are loosened and backed out a few turns. Other tamper contacts are also connected to the door.

The inside of the housing and the door are protected by plates of bullet-proof steel and sheets of copper which are electrically insulated from the wall of the housing but are connected to the protection circuit so that a contact between them and the housing will upset the circuit and cause an alarm. The lower wall of the housing is perforated with small openings to permit the sound waves of the siren to escape.

The control panel

The control panel 51 which is located in the building but outside of the vault, comprises a small panel equipped with a milliammeter indicator 52 and two push button switches, one switch 53, for testing the circuit of the equipment and the other, 54, for tripping the time-controlled switch. These

switches are employed for controlling the operation of certain parts of the equipment during the closing period, while the milliammeter is used as a visual signaling device to indicate that such operations have been performed and also to show at all times the circuit conditions existing in the system.

The time controlled switch

The clock-controlled switch is enclosed in a separate housing 55, located within the vault or protected premises and includes four sets of contacts, A, B, C and D, controlled by a single operating bar 56 associated with an elapsed-time type clock movement, only the dial wheel 58, being shown in Fig. 3, which is adapted to be set to run for any period up to seventy-two hours. The relation between the clock and the contact-operating bar 56 is such that as the clock runs down, a pin 57 carried by the clock dial wheel 58, engages a lug or projection 59 on the bar, moving the bar longitudinally against a spring 60. When the clock has run down to zero, indicated by the pointer 61, the bar will have been moved far enough for a holding pawl 62 to drop into a notch 63 on the bar and thus will be held against a return movement when the clock is wound for another period. With the bar in this position, three of the sets of contacts, A, C, D, controlled by the bar are closed while the fourth set B, opens. The notch 63 is wider than the end of the pawl 62 to permit the clock to move the bar an appreciable distance after the pawl has dropped into the notch. This allows the clock to run a short time after the zero point on the dial has been reached and avoids the necessity of stopping the clock accurately at zero. The holding pawl is controlled by an electro-magnet 64, which when energized swings the pawl out of the notch and permits the spring 60 to pull the bar back to its released position. The extent of movement is governed by a pair of stop pins 65. In the released position of the bar the switch contacts A, D, C are opened and the switch contacts B are closed.

A fifth set of clock-controlled contacts consisting of three springs 67, 68, 69, is provided and arranged to be operated by the joint action of the pin 57 and a spring member 70 cooperating with the pawl 62. As the clock runs down, the pin 57 on the dial wheel engages a lever 71 pivoted on the bar 56, and causes it to move the spring 67 into engagement with the spring 68. The continued movement of the dial wheel causes the pin 57 to engage the projection 59 and move the bar downward until the pawl 62 swings into the notch. Thereupon the spring 70 engages the spring 69, moving it into engagement with the spring 68, the latter being already held in engagement with spring 67, by the lever 71, connection being thus established between the two outside springs.

If the clock is now wound for another run, the pawl 62 will hold the contact-operating bar 56 against movement, but the dial wheel pin 57 will move back away from the pivoted lever 71, thus permitting the spring 67 to break contact with the spring 68. When the pawl 62 is withdrawn from the notch by the energization of the magnet 64, the spring 70 moves away from spring 69, permitting the latter to separate from spring 68. The bar 56 also moves upwardly under the action of its spring 60, the unnotched portion of the bar sliding under the end of the pawl, thereby maintaining the springs 67, 68 and 69 separated.

Combination relay receiver phonetalarm unit

This unit is mounted in a separate housing 75, located within the vault, as indicated. It includes a testing relay of the McCulloh type having an armature with front and back contacts, and is provided with an energizing winding 76^a and a holding winding 76^b. Also a relay receiver, known as a "phonetalarm" which comprises a telephone type receiver 78 with the addition of a set of contacts 79 consisting of a diaphragm and an adjustable flexible member adapted to cooperate with it to control a local circuit.

The bolt protector

A switch 80 comprising a plurality of sets of contacts mounted on the inside of the vault door frame or architrave in such a position that when the door is closed and the bolts are thrown to locked position, one of the bolts will actuate a cam 81 to engage and operate the switch.

The door protector

A switch 83 located on the inside of the vault door frame or architrave and comprising two sets of contacts is placed in such relation to the door that when it is closed it engages a controlling lever 84 to close the contacts. When the door is open the contacts will be separated or open.

The sound detector sets

Each sound detector set comprises a sensitive microphone 85 and a sounding device 86 mounted on or adjacent to the ceiling inside the vault. The microphones are connected in a circuit which includes a battery and the relay receiver 78 previously described. The relations between the microphones and the relay receiver are such that any sounds produced inside the vault or any shocks applied to the vault or parts thereof from the outside, will be picked up or detected by the microphones and transmitted to the relay receiver, thereby producing an alarm condition in the system as will be described later.

Search Room

The sounding devices associated with the microphones are similar to single stroke buzzers and are used to set up sound disturbances in the microphones as a means of testing the condition of the equipment before applying the protection to the vault or protected premises.

The relays and miscellaneous resistances

There are two relays associated with the equipment located within the vault or protected premises; one, the "test relay" previously mentioned in connection with the relay receiver phonetalarm unit, mounted in housing 75, and the other, 87, of the same type mounted in housing 55, with the clock-controlled switch and which will be referred to as the "no-test relay". The latter is included in the system in such a manner that it will operate and cause certain indications to be made by the visual signal device if the protection is applied and the time switch is set in operation without first testing the equipment.

The miscellaneous resistances comprise five separate fixed units arranged to be introduced in various circuits at certain stages or intervals for the purpose of causing certain indications on the visual signal device as described later. Four of these units are indicated in the housing 55, the other being mounted in the housing 75. In addition to these, a variable resistance 89 is connected serially in the main protection circuit for the purpose of adjusting the total resistance of this circuit to compensate for a slight drop in the potential of the main battery supply.

The main battery

The main battery for the protection system, indicated at 90, located at any convenient point, is preferably a six volt storage battery with a four volt tap.

The manner in which the main battery 90 and siren battery 42 are charged from the A. C. mains through the transformer T and rectifier R will be evident to engineers and hence need not be described.

Operation of the system

(1) In order to apply the protection to the vault or protected premises the clock movement of the time-controlled switch is first wound for a run corresponding to the number of hours intervening before the next regular opening time. This interval may be any period up to seventy-two hours.

As previously described, this operation releases the pivoted lever 71 on the contact operating bar and permits the spring contact 67 to separate from spring 68. The equipment will now be in the "day position". Ten milliamperes will be flowing through the visual indicator 52 and its pointer will stand at designation "Day".

The "day circuit" may be traced as follows:—from grounded battery terminal through the six-volt battery, conductor 100, visual indicator 52, conductor 101, terminal 2, clock contacts D, terminal 3, conductor 102, upper pair of bolt contacts 80, variable resistance 89, terminals 22, 21, 20 inside the siren housing, and the back and side protecting linings, through the coil of galvanometer relay 44, terminals 19, 18, tampers, door bolts, door lining, inside bottom plate, cable, and resistance r^1, terminals 27, 26, and conductor 103 to ground. In this condition, the tongue 45 of the galvanometer relay will move to its central position, as shown.

(2) The vault doors are now closed causing the door to actuate the lever 84 of the door protector and close the contacts of switch 83, thereby closing two additional circuits.

One of these additional circuits leads through the detectors and the winding 78 of the relay receiver, making the phonetalarm active through the following circuits:—from grounded terminal through the four-volt battery, conductor 105, the two microphone detectors 85 in multiple, the door protector contacts 83, conductor 106, terminal 11, winding of relay receiver 78, terminals 17, 10, conductor 107, contacts of door protector 83, and conductor 108 to ground.

Another circuit is completed as follows:—from ground through the six-volt battery, conductor 100, visual signal 52, conductor 101, terminal 2, conductor 109, terminal 12, then through a divided circuit to the bolt protector contacts, one part through contacts 79 of the relay receiver, terminal 16, and conductor 110, the other part by way of winding 76^a of the test relay and terminal 15 to the bolt protector. The contacts 79 of the receiver relay constitute a short circuit around the test relay winding 76^a and therefore the latter is not energized. From the bolt protector the circuit continues through terminal 9, the 500 resistance, terminal 10, conductor 107, contacts of door protector 83, and conductor 108 to ground. The current in this circuit is 12 milliamperes and as it is carried through the visual signaling device 52, the indicator will stand at the designation "Doors closed".

Under the conditions just described the equipment is ready for a test of the phonetalarm feature.

(3) By operating the test button switch 53 on the control panel, the sounders or buzzers 86 are energized over a circuit from ground, through the six-volt battery, conductor 100, conductors 114, 115, contacts of bolt protector 80, conductor 116, sounders 86 and the contacts of test button switch 53 back to ground.

If the microphones 85 and relay receiver 78 are in proper operating condition, the

contacts 79 of the relay will momentarily separate thereby removing the short circuit around the winding 76[a] of the "test relay". This relay will then attract its armature which will be held against its front contact by a circuit through its locking winding 76[b] from the grounded six-volt battery through the visual indicator 52, conductor 101, terminal 2, conductor 109, through the resistance and locking winding 76[b], front contact and armature of the relay, terminal 13, terminal 7, clock contacts "A", terminal 10, conductor 112, contacts of door protector 83, and conductor 108 to ground.

The current in this circuit is 15 milliamperes and this added to the 22 milliamperes already flowing in the circuits previously traced through visual indicator 52 gives a total of 37 milliamperes, thus causing the indicator needle of the indicator 52 to swing over to the designation "Sound test". This proves that the microphones and circuits associated therewith are in proper condition.

(4) By next throwing the bolts to locked position the contacts of the bolt protector 80 are operated to change the circuits as follows:—

The lowest pair of springs which previously closed a circuit from the battery 90 through the buzzer sounders 86, now separate, thereby preventing any further operation of the sounders by the test key 53.

The intermediate set of contact springs which previously closed the divided circuit from terminal post 2 through the receiver relay contacts 79 in multiple with the winding 76[a] of the test relay, through the bolt contact and the 500-ohm resistance, door protector contacts 83 and back to grounded battery, are separated. The opening of this divided circuit reduces by 12 milliamperes the current flowing through the visual signaling device 52 so that 25 milliamperes now flows and the needle of the indicator therefore swings back to the designation "Bolts thrown".

A further movement causes the uppermost spring to engage the third spring contact and separate from the second contact. It will be seen that this operation results in substituting the receiver relay contacts 79 for the clock contacts "D" in the circuit extending between the vault and the circuits within the siren housing previously traced as the "Day circuit", thereby making the "phonetalarm" microphones effective in protecting the vault against attacks.

If for any reason the vault must be opened at this stage before the time set up on the clock of the time-controlled switch, the bolts may be thrown back to the unlocked position and the door opened without upsetting the system and causing an alarm. In this case the equipment would be restored to the "Day" conditions.

If, however, the closing is to proceed in the regular manner, the procedure will continue as follows:—

(5) By operating the clock setting key or button 54 on the control panel, a circuit is closed to energize the electro-magnet 64 associated with the time controlled switch, as follows:—from the grounded six-volt battery through conductor 100, conductor 114, conductor 115, bolt protector contacts, conductor 120, terminal 6, winding of magnet 64, terminal 5, contacts of clock key 54, conductor 121, terminal 7, clock contacts "A", terminal 10, conductor 107, contacts of door protector 83, and conductor 108 to ground.

The operation of magnet 64 withdraws the pawl 62 from the notch 63 and permits the contact operating bar 56 to be lifted by its retractile spring 60, thereby opening the clock contacts "A", "C" and "D" and closing contacts "B".

The separating of contacts "A" opens the holding circuit through the locking winding 76[b] of the test relay, releasing its armature and the circuit therethrough, thus reducing the current through the visual signaling device 52 by 15 milliamperes to 10 milliamperes.

The closing of contacts "B" establishes a circuit from terminal 2, through the 1200-ohm resistance, contacts "B", terminal 10, conductor 112, contacts of door protector 83, and conductor 108 to ground, with a current flow of 5 milliamperes which increases the current through the visual signaling device 52 to 15 milliamperes. The indicating needle therefore moves to the designation "Night".

The separation of contacts "D" opened the circuit between terminal 2 and the contacts of bolt protector 80, previously described as serving as an alternate circuit to the relay receiver contacts 79 in the circuit between the vault and the circuit through the outside signaling device in the siren housing when the bolts and associated contacts were in unlocked position.

The separation of contacts "C" opened the circuit from ground to the operating arm of the lock switch.

In the condition of the equipment just described, the vault is protected by the phonetalarm against attacks liable to produce sound vibrations inside of the vault or protected premises, as well as against attacks liable to produce shocks to the vault or parts thereof from the outside. This feature of the protection is operative in all phases of the system in which the doors are closed and the bolts are thrown to locked position.

In the condition just described, however, additional protection is provided by the opening of contacts "D" against attacks wherein attempts to open the door are made by throwing the bolts to the unlocked position. This

177 ELECTRICAL SIGNALING
Search Room

feature of the protection is now under the control of the time-controlled switch as will be further described below.

Alarm conditions

With the alarm set as just described, the circuit between the vault and the outside housing is completed and controlled through relay receiver contacts 79 and bolt protector contacts 80. The opening of either set of contacts, in the event of an attack will break the circuit. As a result of such a break the galvanometer relay 44 in the outside housing will be deenergized and the contact arm or needle 45 of this relay will release to the left engage the left-hand contact and close a circuit which will start the siren in operation. This circuit may be traced as follows:—

From the 16-volt battery 42 through the power relay winding 43, the armature and back contact of the stop relay 46 and the armature 45 and contact of the galvanometer relay 44 back to the other side of the battery at terminal 26.

As a result of the closing of this circuit the power relay 43 operates and closes a circuit for the siren as follows:—From the 16-volt battery 42 through the siren 41 and contacts of power relay 43 back to the battery. The power relay in addition to closing the siren circuit, closes a locking circuit for itself as follows:—

From the battery 42 through the relay winding 43, the contacts of the stop relay 46 to the armature of the power relay 43, and back to the other side of the battery through one of the power relay contacts. The siren immediately starts into operation and will continue to operate, due to the locked condition of the power relay circuit previously described, until the battery is exhausted or until the locking circuit is broken at the stop relay contacts.

If the alarm condition in the circuit is due to a break at the contacts 79 of the relay receiver, the bolt contacts or at any other part of the circuit and if the circuit immediately closes again, the locking condition of the power relay will continue with a corresponding continuing operation of the siren.

In case of an attack against the housing or any other part of the equipment resulting in a grounding of the circuit extending between the vault and the housing, the current in the circuit would be reduced and the contact arm 45 would fall back to the left and make contact in the same manner as in the case of a break and with the same results.

If, however, the attack should result in a reduction of resistance in the circuit, the current in the circuit would increase and due to such an increase the contact arm 45 of the galvanometer relay 44 would advance to the right and close the right-hand contact. The result of such operation of the galvanometer would be the same insofar as the siren is concerned.

In order to stop the operation of the siren and establish normal conditions, the locking circuit for the power relay 43 must be broken at the contacts of the stop relay 46. As this relay is enclosed in the housing with the siren, the winding is energized over a circuit from inside the protected premises by turning the contact arm 93 of the lock switch to the right against the "Stop" contact.

As a result of this operation the stop relay contacts open and break the operating and holding circuit for the power relay 43 which releases and stops the siren.

The lock switch is then returned to its normal position which breaks the circuit for the stop relay which in turn releases, closes its contacts and re-establishes the operating circuits for the power relay ready for another alarm. It should be noted here that in the case of an alarm after the clock has been set, the siren will continue in operation either until the batteries are exhausted or until the vault can be opened and the lock switch operated.

It should be further noted that the circuit leading to the contact arm of the switch is extended through contacts "C" of the time clock switch which are opened during the closed period. This feature is provided for the purpose of defeating any attempt to operate the stop relay during the open period and hold it in operation after the vault has been closed and the clock set.

Testing the outside signaling device

In order that the subscriber or attendant may be sure that the siren and its associated battery and power relay are in condition to function properly in case of an alarm, a switch is included as a part of the equipment for the purpose of making periodical tests. This switch is a part of the lock switch marked "Ring".

When the contact arm 93 of the lock switch is turned to the left against the "ring" contact a circuit is closed for the power relay 43 in the housing as follows:—From ground through conductor 108, terminal 8, contact "C" of the clock terminal 4, contact arm 93 and ring contact of the lock switch, terminal 24 of the siren housing, through the power relay winding 46, 16-volt battery 42, terminal 26, back to ground at terminal 26.

As a result of this operation the power relay 43 operates and closes the siren circuit from the battery 42 as previously described. The operation of the siren in response to the lock switch indicates that the stop relay 46 has released and that the contacts are closed and ready to function under alarm conditions.

At the point of digression in this description of the regular closing and opening oper-

ations, to describe the alarm and testing condition, the equipment and circuits had advanced to the point where the vault was closed, the alarm set for the night or closed period and the re-opening conditions were under the control of the clock controlled switch.

As the clock runs down and approaches the zero hour, the pin 57 on the dial wheel 58 (see Fig. 3) engages the pivoted lever 71 on the contact operating bar 56 and as the run down continues the lever 71 forces its associated contact 67 into engagement with the heavy central spring 68.

This spring has no connections leading to it and therefore no changes are made in any of the circuits by this action.

In the continued movement of the dial wheel 58 to zero, the pin 57 engages the projection 59 on the control operating bar and moves the bar endwise until just before the zero hour, the spring contacts "A", "B", "C" and "D" are operated.

Contacts "A" close. This action establishes the holding circuit 76^b of the test relay, but as the relay is deenergized no effect is produced in the equipment.

Contacts "B" open and break the circuit for the 1200-ohm resistance coil, reducing the current in the visual signaling device 52 to 10 milliamperes.

Contacts "D" close and establish the circuit from terminal 2 to the bolt contact 80 ready to function as the alternate in the circuit to the outside housing when the bolts are thrown to the unlocked position.

Contacts "C" close and establish the circuit from ground to the lock switch arm 93.

It should be noted here that contacts "D" are so adjusted that they will close a trifle earlier than contacts "B" open.

A short time before the dial wheel 58 has reached the zero hour, the four sets of contacts "A", "B", "C" and "D" will have functioned, and at the zero hour the holding pawl 62 for the contact operating bar will drop into the notch 63, its associated spring 69 will make contact and through the previous engagement of spring 67 with the central spring, will complete a circuit for the battery 90 through the 700-ohm resistance and the visual signaling device. The current in the signaling device 52 will increase to 18 milliamperes and the indicator pointer will advance to the designation "Morning".

Opening the vault

(6) Throw the bolts to the unlocked position and open the door. The action of throwing the bolts transfers the circuit to the outside housing from the relay receiver contacts 79 to the "D" spring contacts of the clock controlled switch.

The bolt contacts 80 also close the circuits for the test relay and as a result the visual signaling device 52 will show an increased current flow. This indication should be disregarded, however, as it is only a temporary condition and will correct itself as the doors open. As soon as the doors start to open, the door protector 83 releases, opens the energizing circuits for the microphones 85, the test relay and other associated circuits. The circuit through the 700-ohm coil will however remain closed and the visual signaling device 52 will stand at the previous designation for "Morning".

The clock should now be wound for a run corresponding to the elapsed time between the time of winding and the next opening time. This operation causes the dial wheel 58 to move away from the pivoted lever 71 whereupon its spring 67 moves away and breaks the circuit through the 700-ohm coil. The current through the visual signaling device 52 drops to 10 milliamperes and the indicator needle drops back to the designation "Day". The equipment and circuit conditions are now back to the condition where we started the operation.

In that part of the description just concluded and covering the various closing operations, we have considered the operations proceeding along the regular routine from the "day" condition back to the same condition of the equipment. We also considered the routine in the case where the vault was opened after the equipment had been advanced to the locked position in which the bolts had been thrown to locked position and the protective features of the phonetalarm equipment had been applied to the vault.

In order that the other possible closing conditions previously described may be clearly understood we will give some consideration to them.

Assuming that the vault is to be closed for a few hours only and that the sound test is to be eliminated the procedure would be as follows:—

Close the vault doors. This causes the door switch to operate and the equipment and circuit conditions are then as previously described when the visual signaling device indicates "Doors closed", and the equipment was ready for a test of the phonetalarm feature.

Next throw the bolts to the locked position. The bolt contacts operate and, in operating, the contacts make connections to include the relay receiver contacts 79 instead of the clock contacts "D" in the circuit leading to the siren housing. Also the circuit for the sounders and test key is broken at the bolt contacts. The current flowing through the visual signaling device during this phase is 10 milliamperes and the indicator stands at the designation "Day".

Assuming now that after the door has been closed and the bolts thrown, the subscriber

177 ELECTRICITY
-314

Search Room

finds that it will not be necessary to re-open until the regular opening time as set up on the time controlled switch, in which case he wants to have the re-opening controlled by the time controlled switch. This condition may also arise in the case of a regular closing where the door has been closed and the bolts thrown without a sound test having been made.

If the bolts could be thrown back to the unlocked position such a test could be made but we will assume that the time locks for the bolts prevent this so that the only thing to do is to set the time controlled switch in operation and eliminate the sound test feature.

In order to have a check on closings of this character the equipment and system are so arranged that such abortive closings will be indicated on the visual signaling devices, as will be further explained. The operation continues as follows:—

Operate the clock key 54 in the control cabinet. This key has two sets of contacts and when operated, one set of contacts makes connection before the others.

The one set completes a circuit for the "no test relay" 87, as follows:—From grounded battery terminal through the visual signal indicator 52, terminal 2, winding of the "no test relay" 87, through the 150-ohm resistance, terminal 1, clock key contacts 54, back contact and armature of the "test relay", terminal 13, clock contacts "A", terminal 10, door protector contacts 83, back to ground.

The "no test relay" 87 operates and closes a locking circuit from terminal 1, through its front contact and armature, terminal 10, and door protector contacts 83, back to ground. This locking circuit increases the current flow through the visual signaling indicator by 17 milliamperes

As the clock key 54 continues to advance, a circuit for the clock setting magnet 64 is closed at the other contact as follows:—

From grounded battery, through the clock magnet winding 64, clock setting key contacts 54, clock contacts "A", terminal 10, door protector contacts 83, back to ground

The clock magnet 64 disengages the pawl 62 from the notch 63, in the contact operating bar 56. The bar moves endwise upwardly and shifts the contacts of "A", "B", "C" and "D" as follows:—

Contacts "A" open and break the circuit leading back to the clock setting key 54.

Contacts "B" close and complete the battery circuit through the 1200-ohm resistance. This circuit increases the current flow by 5 milliamperes.

Contacts "C" open and break the connection to the "lock switch".

Contacts "D" open and break the alternate circuit between terminal 2 and the bolt contact.

The total current flowing through the visual signaling device is now 32 milliamperes and the indicator advances to a code designation for "Night no test".

The equipment and circuit conditions are now such that the re-opening is under the control of the time controlled switch. As the opening time approaches and the clock associated with the time control switch has almost reached the zero hour the pin 57 on the dial wheel 58 engages the pivoted lever 71 and causes the contacts to close as previously described. A short time before the zero hour, clock contacts "A", "B", "C" and "D" operate as follows:—

Contacts "A" close but there is no change in the equipment.

Contacts "D" close and establish the alternate circuit from bolt contact to terminal 2.

Contacts "B" open and the current flow is reduced to 27 milliamperes.

Contacts "C" close without causing any change in the equipment.

When the clock reaches the zero hour, clock contacts "E" operate and close a battery circuit through the 700-ohm resistance. The current through the visual signaling device increases to 35 milliamperes and the indicator advances to the designation "Morning no test".

Now throw the bolts back to the unlocked position and open the door.

The bolt contacts transfer the circuit between the vault and the housing from relay receiver contacts 79 to clock contacts "D".

The door contacts open and break down the holding circuit for the no test relay.

The current through the visual signaling device is reduced to 18 milliamperes and the indicator moves back to the designation "Morning".

Wind the clock associated with the time controlled switch for a run corresponding to the number of hours intervening between the time of winding and the next opening time.

This operation causes the pin 57 on the dial wheel 58 to release the pivoted lever 71. Contacts "E" open and the current flowing through the visual signaling device 52 is reduced to 10 milliamperes and the indicator moves back to the designation "Day".

Claims:—

1. In a burglar alarm system, a closed protecting circuit and an alarm, means operable upon the opening of said circuit or an abnormal change in the resistance thereof for actuating said alarm, current responsive indicating means in said circuit, a plurality of protective means at least one of which is operative at all times and another of which may be rendered inoperative for predetermined periods, said protective means including contacts in said closed circuit, clock operated means for shunting and rendering inoperative said second mentioned protective

means, said system including means cooperating with the protective means for changing the resistance of the circuit through said indicating means to indicate the proper or improper sequential operation of said protective means.

2. In a burglar alarm system, a closed protecting circuit and an alarm, means operable upon the opening or an abnormal change in the resistance of said circuit for actuating said alarm, current responsive indicating means in said circuit, a plurality of protective means at least one of which is operative at all times and others of which may be rendered non-operative for predetermined periods, said protective means including contacts in said closed circuit, clock operated means having switch contacts connected to said protective means and operating to control said non-operation thereof, said system including means cooperating with the protective means for changing the resistance of the circuit through said indicating means to indicate the proper or improper sequential operation of said protective means.

3. In a burglar alarm system as set forth in claim 2, one of said protective means having manually controlled contacts movable to different positions, in one position the contacts being in circuit with a plurality of said other protective means and in another position the contacts being disconnected therefrom.

In testimony whereof we affix our signatures.

RICHARD M. HOPKINS.
FREDERICK P. McINTOSH.