Nov. 17, 1942. P. N. SMITH 2,302,271

ALARM SYSTEM

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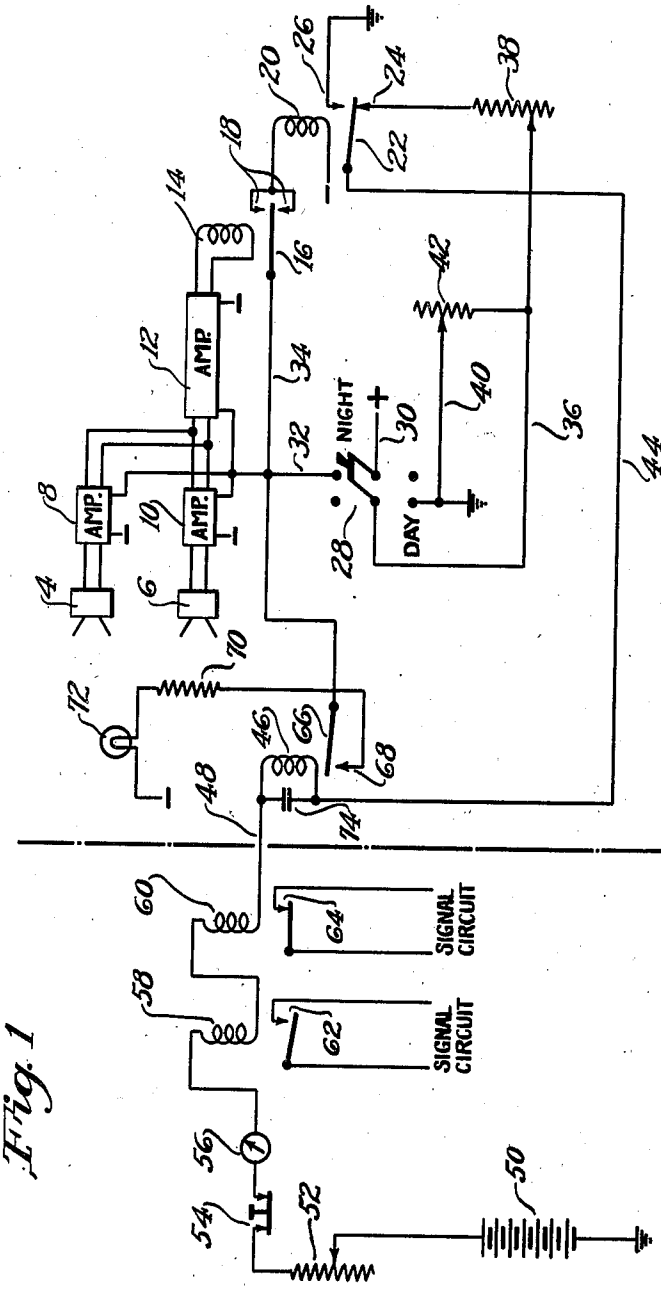

Fig. 1

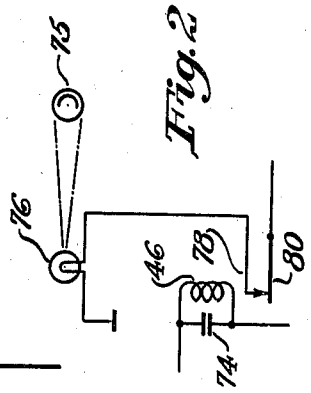

Fig. 2

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ALARM SYSTEM

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7 Claims. (Cl. 177—314)

The present invention relates to alarm systems and more particularly to burglar alarm systems in which responsive devices located at one or more local stations are arranged to transmit signals to a central office.

Such systems involve responsive devices of a variety of types, one of the common types being the photoelectric cell which is continuously energized by a beam of light directed thereon so that the presence of an intruder is indicated by interruption of the beam. Another type of responsive device is the radiometer described in the patent to Hayes No. 1,954,204 and the patent to Hall No. 2,115,578, which operates by the radiant energy emitted from the intruder himself, and is therefore particularly useful for this service because of its ability to pick up radiation from any point within its field of vision.

Burglar alarm systems involving responsive devices of any type may be made self-supervising to the extent of indicating failure of electrical connections to the central office and other faults of similar nature, but are frequently defective in failing to guard against other inoperative conditions, such as diminishing sensitivity of the responsive devices themselves, malicious disablement thereof by persons who have gained legitimate access to the premises in order to prepare for a subsequent illegal entry, etc.

The principal object of the present invention is to provide means for routine supervision of the equipment whereby the effect of an intruder may be completely simulated so that the equipment cannot be left in inoperative condition for any extended period.

Since the local station or stations may be separated from the central office by considerable distances, it is desirable that the wiring connections be kept to a minimum, and another object of my invention is to provide means whereby the above-mentioned test may be effected without the necessity of connections in addition to the actual signal transmitting circuits.

With these objects in view, the present invention comprises the system hereinafter described and particularly defined in the claims.

In the accompanying drawing Fig. 1 is a diagram of the preferred form of the system involving radiometers of the type disclosed in the Hayes and Hall patents, and Fig. 2 is a diagram of a modification of the system to employ photoelectric cells.

As shown in Fig. 1, the apparatus at the central station is indicated to the left of the dot-and-dash line, and that at the premises to be protected is shown at the right thereof. A single wire connects the central station equipment with the equipment at the premises.

The space to be protected is provided with one or more radiant energy sensitive devices indicated at 4 and 6 herein, such devices being preferably of the type described in the Hayes and Hall patents above referred to. Such devices are operated by the radiant energy emitted by the intruder himself. Preferably, each device is provided with a grating or screen of the type described in the Smith Patent No. 2,198,725, to insure that the radiant energy impinging on the receivers will be varied or modulated during movements of the intruder about the space to be protected. The receivers are sensitive to changes in radiant energy no matter how generated, and are therefore useful to detect an incipient fire in the protected space.

Each receiver is provided with a local amplifier designated at 8 and 10, and the outputs of these amplifiers are connected to the input of a main amplifier 12, the output of which is connected to the coil 14 of a balanced relay. The relay has a movable contact 16, which under normal conditions is held midway between two fixed contacts 18. Upon de-energization or increased energization of the coil 14, the movable contact engages one or the other of the fixed contacts 18. Connected with the contacts 18 is a relay 20 having a movable contact 22 normally engaging a fixed contact 24, and adapted to close on another fixed contact 26 when the relay is energized.

The foregoing circuits are under the control of a double-throw switch 28 adapted to be thrown into either the "night" or "day" position. One of the blades of the switch is connected by a wire 30 with the positive terminal of a local battery, as indicated by a plus sign. The contact with which this blade engages in the night position is connected by wiring 32 to the circuits for energizing the amplifiers. A wire 34 connects the wire 32 with the movable contact 16 of the relay 14. One side of the relay 20 is connected to the negative terminal of the local battery as are also the appropriate energizing circuits of the several amplifiers. The other movable blade of the switch 28 is connected by a wire 36 through a variable resistor 38 with the contact 24 of the relay 20. The contact with which this blade of the switch connects in the day position is connected directly to ground and

also through a wire 40 and variable resistor 42 with the connection 36.

The movable contact 22 of the relay 20 is connected by a wire 44 with a relay coil 46 to be presently described. From the relay 46 a line 48 runs to the central station.

The central station includes a battery 50 connected at one side to ground and at the other side to the line 48 through a current-adjusting resistor 52, a manual switch 54 to permit opening of the line, a current meter 56, and two signal relays 58 and 60, all in series. The relay 58 has contacts 62 which are normally open, but are adapted to close upon an increase in line current to operate a suitable signal, and the relay 60 has normally closed contacts 64 which are adapted to open upon a decrease in line current to operate another signal. The signals may be any suitable type and are not shown in the drawings.

Considering the parts thus far described and assuming the switch 28 to be thrown to night position, it will be seen that the amplifiers are energized and that the relay 14 is sufficiently energized to hold the movable contact 16 in its mid-position, the relay 20 being then de-energized. A continuous circuit may be traced from ground through the battery 50, the central station equipment, the line 48, the relay 46, wire 44, contacts 22, 24, resistor 38, resistor 42, and wire 40 to ground. The resistors 38 and 42 as well as the resistor 52, are adjusted to maintain a standard line current which is indicated by the meter 56, this current being just sufficient to maintain the relay 60 energized, and insufficient to pick up the contacts of the relay 58. Under such conditions a change of radiant energy falling on either or both of the receivers will result in a change in energization of the relay 14, thus either attracting or releasing the movable contact 16 to close on one of the fixed contacts 18 and establish an energizing circuit for the relay 20. Contact 22 then closes on 26 so that resistors 38 and 42 are shunted, thereby increasing the line current and giving an indication on the meter 56, as well as on the signal controlled by the relay 58.

When the premises are to be opened for business, the switch is thrown to day position, thereby disconnecting the local battery. Also, the resistor 42 is shunted, thereby increasing the line current. The increase of current to the standard day value is indicated on the meter 56 and may also, if desired, be indicated by the signal controlled through the relay 58. The central station operator is thus advised that the premises are occupied and he need pay no further attention to the equipment until he receives an indication of establishment of standard night current when the switch 28 is thrown to night position.

The apparatus as thus far described is self-supervising to the extent of automatically indicating any failure in the line or in the power and output circuits of the amplifiers. Thus a break in the line is indicated by operation of the underload relay 60, and a ground fault by operation of the overload relay 58. Failure of the amplifiers to maintain the relay 14 continuously energized causes closure of the contacts 16, 18 with consequent operation of the central station signal equipment.

The invention also provides for supervision of the receivers 4 and 6, as well as the input circuits of the amplifiers 8 and 10, and in fact, any other equipment not subject to the automatic supervision above noted. This is accomplished by a routine test which may be carried out on regular schedule at the central office. For this purpose the relay 46 which is continuously energized under normal conditions is provided with a movable contact 66 adapted to close on a fixed contact 68 when the relay is de-energized. The contact 66 is connected to the wire 32 which as previously described is connected to the positive terminal of the local battery through the switch 28 when the latter is set to night position. The contact 68 is connected through a resistor 70 and a lamp 72 with the negative terminal of the local battery. The lamp 72 is arranged in the protected space so that radiant energy emitted therefrom is picked up by both of the receivers 4 and 6. The relay 46 is shunted by a large condenser 74, preferably not less than 40 microfarads in capacitance.

For the routine test the central station operator simply opens the switch 54 momentarily. The switch 54 is held open long enough to insure de-energization of the relay 46, usually two or three seconds. The switch 54 is then closed. The relay 46 does not re-energize immediately because of the time constant afforded by the condenser 74. Consequently, the lamp 72 remains energized for a short period after the line is again closed. If all parts are in working order, the relay 14 will usually operate to transmit a signal to the central office when the switch 54 is closed. It is to be noted that, as stated in the Hall patent, the receivers operate on changes of radiant energy rather than on actual quantities of radiant energy impinging thereon, and consequently a signal may not be transmitted at this time if the switch 54 has been held open so long that the lamp 72 has come up to full brilliance before the switch 54 is closed. It has geen found, however, that due either to mechanical oscillation of the receiver diaphragms or to electrical oscillations in the amplifiers, a number of swings usually occur and one or more signals will ordinarily be given unless the switch 54 has been held open for too extended a period. But whether or not a signal is given at the time of closure of the switch 54, a signal will certainly be given shortly thereafter when the magnetic field of the coil 46 builds up sufficiently to attract its contact 66 and open the lamp circuit. The extinction of the lamp results in a change of radiant energy which is effective to give the desired signal if the parts are in working order; in fact, several signals may be given due to the oscillating effect above mentioned. In any event, the central office will receive a definitive signal that all parts of the equipment are in proper condition. Immediately thereafter equilibrium conditions are established and the system is in normal condition for fire and burglar detection.

If for any reason the equipment is not in proper working order, no signals will be given at the central office after the closure of the switch 54. This is an indication that attention is required at the premises.

If only a single detector is used for the protected space the resistor 70 may be omitted. When two detectors are used the purpose of the resistor is to adjust the lamp current to such a value that the radiant energy emitted from the lamp will be just sufficient to operate the equipment if both receivers are in working order, but will be insufficient to give a signal if only one of the receivers is in working order.

It will be noted that this method of routine supervision is accomplished without the necessity

of any additional wiring between the central office and the premises. In practice the central office will have equipment for a number of establishments, in which case a line 48 will run from the central office to each of the premises to be protected. Since the central office may be located at a distance from some of the detected premises, the invention offers important advantages in installation costs. According to the preferred system, a routine check test is made once each hour through the night for each installation.

The routine check test system is equally applicable to other forms of radiant-energy detectors. For example, in the use of the photoelectric cell a similar arrangement is used except that the relay connections are reversed. As shown in Fig. 2, a photoelectric cell 75 is continuously energized by a beam of light from a lamp 76. The beam is directed past a door or window and the detection of an intruder depends upon the interruption of the beam. The energizing circuit for the lamp 76 includes contacts 78 and 80, similar to the contacts 66 and 68 of Fig. 1, except that they are maintained normally closed by the relay winding 46. The remainder of the connections are similar to those of Fig. 1.

The photoelectric system is self-supervising in most respects, but would not automatically indicate some conditions of intentional tampering. For example, a person who had gained access to the premises during the day might introduce an extra source of illumination which would keep the cell 75 energized notwithstanding interruption of the beam from the lamp 76; or he might disable the relay 20 so that the system would not respond to a subsequent intrusion. Such conditions are guarded against by routine tests, carried out by opening of the central office switch 54. The switch 54 is opened long enough to drop the contact 80, thus extinguishing the light 76. Upon closure of the switch 54 the relay is not immediately energized so that the lamp 76 remains dark for a short period. If the equipment is in working order, the central office equipment indicates this short dark period, followed by the normal current flow. On the other hand, an immediate indication of normal current after closure of the switch 54 is a warning of trouble, requiring immediate attention at the premises.

It will be observed that the manual supervising devices, in either form of the invention, simulate an actual intruder and therefore render it impossible for the system to be inoperative for a period greater than the time between routine tests. Not only is the system protected against loss of sensitivity in the equipment, but also against intentional disablement by persons who have gained access to the local equipment under "day" conditions. In the preferred operation of the system a manual test is made within a few minutes after the system has been converted for "night" operation, whereby any such disablement may be immediately detected, and other tests are made at regular intervals during the night. It will be understood that the "night" setting is used for Sunday and holiday conditions, or to any other conditions under which the premises are unoccupied.

Having thus described the invention, I claim:

1. An alarm system comprising a local station having a radiant-energy-sensitive device responsive to radiant energy emitted from any source within the space to be protected, a central office having a signal device, a single normally closed signaling circuit between the local station and the central office, test means at the local station including a normally extinguished source of radiant energy and a relay in said signaling circuit having a large time constant and energized while the circuit remains closed, said relay having contacts to energize said source when the relay is de-energized, and control switch at the central office for opening and closing the signaling circuit to de-energize and slowly re-energize the relay and thereby briefly to energize the source of radiant energy in time-lagging relation to the opening and closing of the circuit.

2. An alarm system comprising a local station having a radiant-energy-sensitive device responsive to radiant energy emitted from any source within the space to be protected, a central office having a signal device, a single normally closed signaling circuit between the local station and the central office, test means at the local station including a normally extinguished source of radiant energy and a relay in said signaling circuit energized while said circuit remains closed, a condenser shunting the relay to delay energization and de-energization thereof, relay contacts to energize said test source when the relay is de-energized, and control switch at the central office for opening and closing the signaling circuit to cause the source of radiant energy to be energized briefly following an opening and re-closing of the circuit.

3. An alarm system comprising a local station having a photoelectric cell and a source of light directed thereon, a central office having a signal device, a single normally closed signaling circuit between the local station and the central office, a relay in said circuit at the local station and energized while the signaling circuit remains closed, the relay having a large time constant to delay energization and de-energization thereof, relay contacts operative when the relay is de-energized to cut off the illumination from the cell, and means at the central office operative to control the relay by opening and thereafter closing the signaling circuit to cause the relay to be de-energized and re-energized in time delayed relation to the circuit opening and closing.

4. An alarm system comprising a local station having a photoelectric cell and a source of light directed thereon, a central office having a signal device, a single normally closed signaling circuit between the local station and the central office, a relay in said circuit at the local station and energized while the circuit remains closed, the relay having a large time constant to delay energization and de-energization thereof, relay contacts operative when the relay is de-energized to cut off the illumination from the cell, and a switch in said circuit at the central office operative upon a single opening and closing to control the relay to cause the same to cut off the illumination from the cell for a brief period after the circuit is re-closed.

5. An alarm system comprising a local station having a responsive device operable upon the presence of an intruder, a central station having a signal device, a normally closed signaling circuit connecting the local station and the central station, test means at the local station operable to simulate the presence of an intruder, a normally energized relay in the circuit and having a movable contact to operate the test means when the relay is de-energized, a switch at the central station to open and close said circuit, and means for delaying attraction of the

relay contact after opening and closing of the circuit to hold the test means operative for a short time after switch closure.

6. An alarm system comprising a local station having a responsive device operable upon the presence of an intruder, a central station having a signal device, a normally closed signaling circuit connecting the local station and the central station, test means at the local station operable to simulate the presence of an intruder, a normally energized relay in the circuit and having a movable contact to operate the test means when the relay is de-energized, a switch at the central station to open and close said circuit, and means shunting the relay to delay re-energization of the relay following an opening and closing operation of the switch to hold the test means operative for a short time after switch closure.

7. An alarm system comprising a local station having a responsive device operable upon the presence of an intruder, a central station having a signal device, a normally closed signaling circuit connecting the local station and the central station, test means at the local station operable to simulate the presence of an intruder, a normally energized relay in the circuit and having a movable contact to operate the test means when the relay is de-energized, a switch at the central station to open and close said circuit, and a condenser shunting the relay to delay re-energization of the relay following an opening and closing operation of the switch to hold the test means operative for a short time after switch closure.

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