March 10, 1959 L. H. CHASE 2,877,361

BURGLAR ALARM SYSTEM

Filed April 12, 1957

2 Sheets-Sheet 1

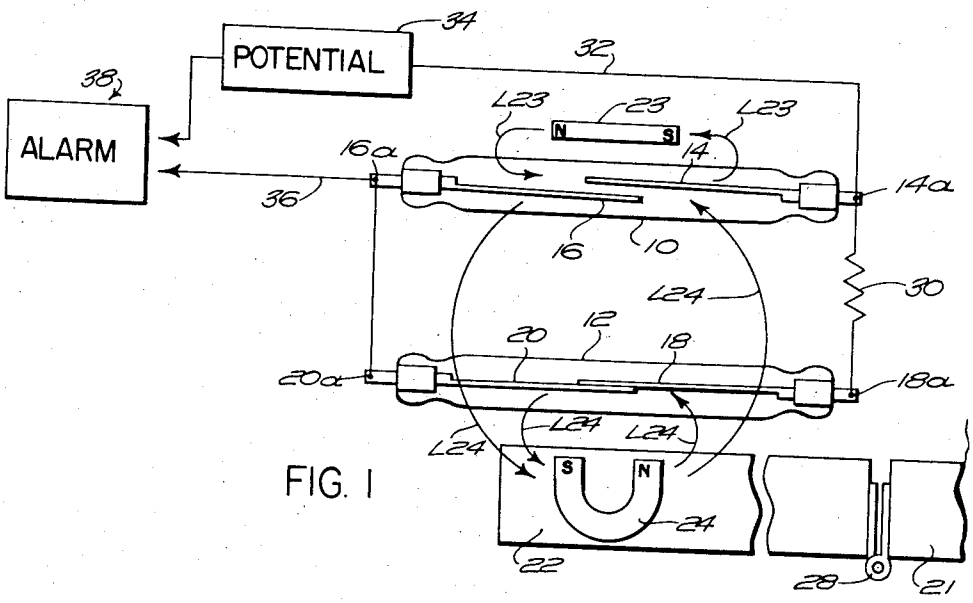


FIG. 1

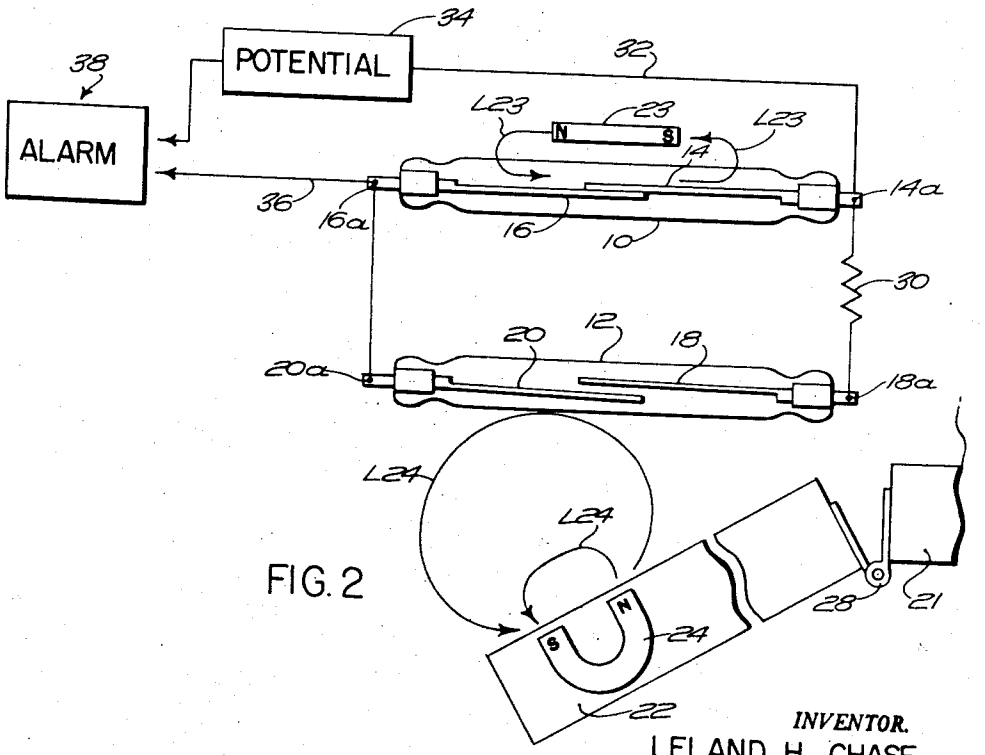


FIG. 2

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2 Sheets-Sheet 2

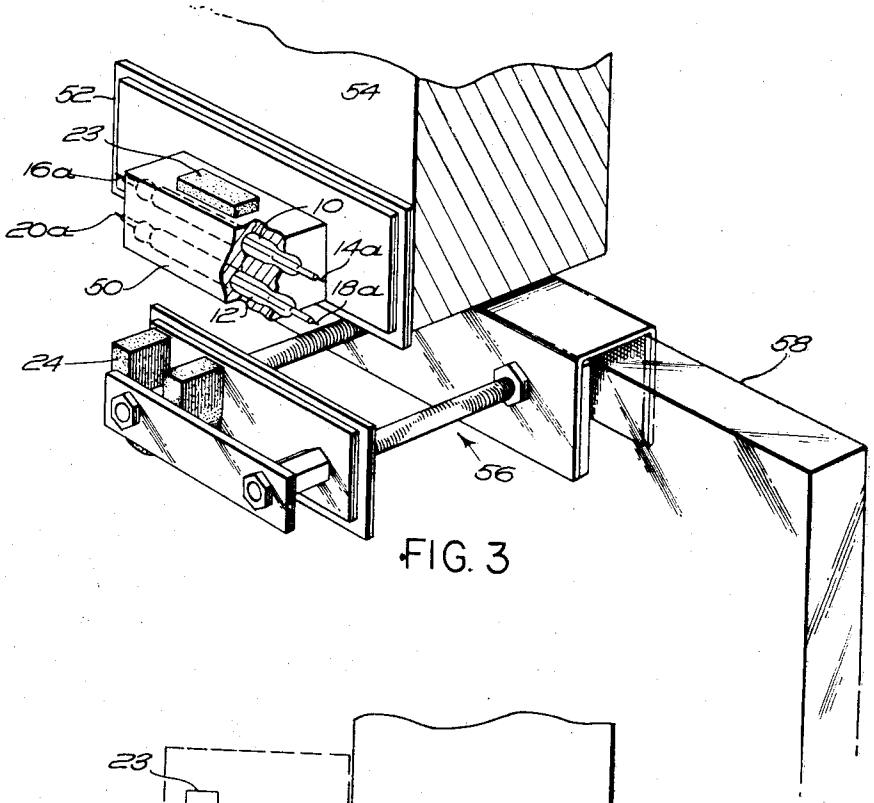


FIG. 3

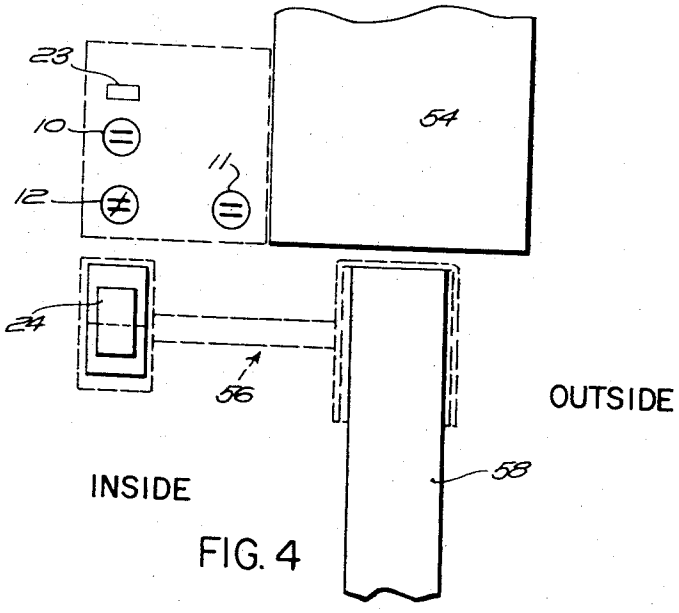


FIG. 4

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BURGLAR ALARM SYSTEM

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7 Claims. (Cl. 307—112)

This invention relates to electrical burglar alarm systems and especially to a system which detects motion between relatively movable elements, for example, the opening of a closure member by a burglar or other unauthorized individual. It more particularly relates to a pair of switches arranged to have their positions changed in response to a movement of a door or the like in a protected area, the change causing a suitable alarm to be given.

It is one object of this invention to provide a novel system of the kind described which is simple in construction, inexpensive to manufacture, easy to install and manipulate and durable in use.

One embodiment of the invention has a pair of switches whose contacts are movable between open and closed positions under the influence of a magnetic field and a biasing force. The switch contacts assume predetermined positions due to the biasing force when the closure member is open and assume positions opposite to those predetermined positions due to the force from a magnet when the closure member is closed. This switching arrangement is combined with a conventional alarm circuit which is adapted to respond to changes in current therein so that the above changes in the switch positions due to movement of the door result in an alarm.

In an embodiment of the kind described the apparatus may be arranged so that a signal will be given in the event of an open contact in any part of the circuit or in the event of a failure of one of the switches to function properly.

In the drawings:

Fig. 1 is a partly schematic diagram of the burglar alarm system of this invention associated with a closure member which is shown in the closed position;

Fig. 2 is a view like Fig. 1 but howing the effect of opening of the closure member;

Fig. 3 is a perspective view from the inside of an area to be protected showing the location of the switches and magnets relative to a closed closure member; and

Fig. 4 is a partly schematic showing of another embodiment of the invention showing the closure member in closed position.

Referring now to Figs. 1 and 2 of the drawings, the numerals **10** and **12** denote a pair of normally open switches each comprising flexible reed contacts **14** and **16** and **18** and **20**, respectively. The reed contacts in each switch are formed preferably of ferromagnetic material and, to combat environmental conditions such as dirt and moisture, are encased within a glass bulb which may be filled with an inert gas. These switches have the property that their normally open contacts close when they are in a magnetic field of a certain strength. A switch of this type is described in U. S. Patent 2,289,830 to Ellwood.

The switch elements **10** and **12** are mounted on a stationary part of a building structure adjacent a closure member for an opening in an enclosure, for example, on

the frame **21** of a door **22** to a room to be protected from unauthorized entry. A biasing magnet **23** is mounted above the upper switch **10** in fixed position relative to the switches. The magnetic field for the magnet **23** is represented by the lines of force emanating from and returning to magnet **23** as indicated by the lines L_{23}. The numeral **24** denotes an actuator magnet which is of greater strength than magnet **23** and is mounted on the door which is attached to the frame by means of a hinge **28**. The magnetic lines of force emanating from and returning to magnet **24** are indicated by the lines L_{24}.

Terminal **16***a* of switch **10** is connected to terminal **20***a* of switch **12**, and a resistance **30** is connected in series with terminals **14***a* and **18***a* of switches **10** and **12**, respectively. A line **32** having a source of potential **34** therein is connected to terminal **14***a*, while a line **36** is connected to the other terminal **16***a*. Lines **32** and **36** lead into an alarm circuit denoted generally by the numeral **38**. The alarm circuit **38** is sensitive to either a predetermined increase or a predetermined decrease in current through it to give an alarm. Any of a number of known alarm circuits **38** may be employed, one example being that shown in U. S. Patent 2,747,177 to Keller which exhibits the property that once there is a change in the steady state current through it, the alarm will continue regardless of any subsequent change.

With the position of the door **22** and the polarity of the magnets as shown in Fig. 1, the reed contacts **14** and **16** of switch **10** remain in their normally open positions. It is believed that the flux lines from actuator magnet **24** (L_{24}) oppose the flux lines from bias magnet **23** (L_{23}) in the reed contacts **14** and **16** with the result that they cancel or annul one another. However, the magnet **24** is so close to the lower switch element **12** that its flux lines L_{24} acting on reed contacts **18** and **20** are not annulled by flux lines from bias magnet **23** and they cause the contacts to close. Thus in the closed position of the door the opposed fields of magnets **23** and **24** acting upon the switch **10** annul one another while the field of magnet **24** at switch **12** is strong enough to close this switch despite magnet **23**.

The path taken by the current with the door in the closed position, as shown in Fig. 1, is as follows: source of potential **34**, lead **32**, resistance **30**, reed contacts **18** and **20**, terminal **20***a*, terminal **16***a*, lead **36**, alarm circuit **38** and back to the other side of the source of potential. In practice the alarm circuit **38** is adjusted so that in the position of the switches shown in Fig. 1 no alarm will be given. For a given alarm circuit this adjustment will depend upon the value of the resistance **30**, the resistances of the various leads and the value of the potential **34**.

Fig. 2 of the drawings shows the effect upon the switches of movement of door **22** to the open position. Such movement carries the actuator magnet **24** away from the switches **10** and **12** and thereby weakens the influence of the field of this magnet on these switches. Accordingly, the reed contacts **18** and **20** of the switch **12** assume their normally open position because magnet **23** is too far away from switch **12** to close these contacts. However, the magnet **23** is close enough to switch **10** to close its contacts **14** and **16** when actuator magnet **24** is removed by opening the door. A new path now taken by the current is through lead **32**, terminal **14***a*, reed contacts **14** and **16**, terminal **16***a* and lead **36**. The total current is greater than before because the resistance **30** has been by-passed. This increased current causes the alarm circuit **38** to respond.

Because there is a critical balance between the fields of magnets **23** and **24** when the door is closed, a relatively slight change in the magnetic forces acting upon the

switches will disturb the balance with a consequent alarm. As a result of the criticality, any successful attempt to prevent the normal operation of the switches **10** and **12** by introducing an external magnetic field would be extremely difficult. If such an external field were of one polarity and of too great a strength, it would aid the influence of bias magnet **23** on switch **10** enough to result in its closure. This would cause the resistance **30** to be by-passed and increase the total current thereby giving an alarm. The introduction of such a magnet would also annul the influence of magnet **24** on switch **12**, causing it to open.

If the external magnetic field so introduced were of the opposite polarity and also of too great a strength, it would aid the influence of magnet **24** on switch **10**, again causing this switch to close and give an alarm. If the external magnet were too weak regardless of its polarity, its field would have no effect upon the switches **10** and **12**. Thus an external magnet would have to be of both the proper polarity and strength in order to circumvent the initiation of an alarm.

In practice, the alarm circuit **38** as well as the source of potential **34** may be located at a point remote from the premises in which the protected area is located. For example this circuit and potential source may be at the "central station" of a burglar protection company.

It is a feature of this invention that complete supervision of the system is realized. Thus, in the door closed position, if any of the leads which join the switches, resistor and alarm circuit become open, the current in the alarm circuit will fall to zero and an alarm will result.

If the door is opened and the switch **10** fails to close, an open circuit will again result because both switches will then be open. If the switch **12** should fail to open when the door is opened, an alarm condition will still result since the switch **10** will close and the current through alarm circuit **38** will increase even though switch **12** is also closed.

In Fig. 3 an actual installation of the invention is shown in perspective with all housing covers removed. The switches **10** and **12** and the biasing magnet **23** are mounted in a casing **50**. This casing is in turn mounted on a plate **52**, and the latter is secured above the inside of the frame **54** of a door **58** adapted to swing in both directions to open. The actuator magnet **24** is mounted on a bracket **56** which clips over the top of the door **58**.

The possibility of defeat of the system by the introduction of a third magnetic source is extremely small as previously mentioned, but it is theoretically possible if such a third magnetic source of proper strength is oriented with respect to the switches so that the polarity of its field corresponds to the polarity of the actuator magnet on the door. In practice such a manipulation would be very nearly impossible, but nevertheless Fig. 4 of the drawings discloses an embodiment which makes even such an unlikely defeat of the system virtually impossible. Fig. 4 shows schematically a second embodiment of the invention which utilizes a third magnetically-responsive switching element. The circuit of this embodiment is the same as previously described except that a third switch element **11**, identical with switching elements **10** and **12**, is connected directly across leads **32** and **36** (see Figs. 1 and 2). As shown in Fig. 4, switch **11** is located nearer the door frame **54** than switches **10** and **12**. In the closed position of the door the switch **10** is open and the switch **12** is closed (as in the embodiment of Figs. 1 and 2) under the influence of magnets **23** and **24**. The third switch **11** is also open since, due to its location relative to magnets **23** and **24**, neither magnetic field is strong enough to cause its reed contacts to close.

The operation of this embodiment is the same as that of the first embodiment and possesses all of the latter's advantages. It additionally provides even greater protection against defeat of the system by the attempted introduction of a third magnetic field. If such a field were introduced from the outside of the door the reed contacts of switch **11** would close, the current in alarm circuit **38** would again be increased, and an alarm would be given.

I claim:

1. In a burglar alarm system: first and second switches each having an arm which is movable between open and closed positions, which is normally in open position and which is responsive to the force of a magnetic field to move in one direction to closed position; means normally exerting a biasing force on the arm of one switch to move said arm in the opposite direction to closed position; a source of magnetic field located adjacent the switches, the force from said source balancing the effect of the biasing force on the said one switch arm to allow said arm to move to its normally open position, and said source acting upon said normally open second switch arm to move it to closed position.

2. In a burglar alarm system: first and second switches each having at least one arm movable between open and closed positions under the influence of a magnetic field; a first source of magnetic field adjacent the first switch and normally holding the arm of the first switch in closed position, said first switch arm moving to open position when the effect of the magnetic field from said first source is removed, said first source being sufficiently remote from said second switch so that the arm of said second switch is unaffected by the field of said first source; a second source of a magnetic field adjacent the switches and normally holding the arm of the second switch in closed position, said second source being oriented so that its polarity is opposite to the polarity of said first source and being sufficiently close to said first switch so that the effects of said two magnetic fields on said first switch arm substantially annul each other and said first switch remains open.

3. The structure of claim 2 wherein a resistance is in series with the second switch and the first switch when closed bypasses said resistance and second switch.

4. The structure of claim 3 wherein an alarm circuit responsive to a change of current through it is in series with both the first and second switches.

5. The structure of claim 4 including a third normally open switch having at least one arm movable between open and closed positions under the influence of a magnetic field, said third switch being connected across said first switch and being adjacent the said first and second switches.

6. In a burglar alarm system: a normally open switch having contacts of magnetic material at least one of which is movable between open and closed positions under the influence of a magnetic field; a first magnetic source adjacent the switch, magnetic lines of force from said source passing between the contacts in one direction, the number of said lines being sufficient to normally move said movable contact to closed position, a second magnetic source also adjacent the switch, magnetic lines of force from said second source passing between said contacts in a direction opposite to said one direction and being sufficient in number to annul the effect on the movable switch contact of the lines of force from the first magnetic source.

7. The structure of claim 6 including a second switch having at least one contact movable between open and closed positions under the influence of a magnetic field, said second magnetic source being adapted to be mounted on a movable closure member movable from a first closed position in which the said second magnetic source is adjacent the switches to a second open position in which the second source is remote from the switches, the second switch having its movable contact moved into closed position by the magnetic lines of force from

the second magnetic source when said second magnetic source is adjacent said switches and having its movable contact moved into open position when said second source is remote from said switches, whereby both switch contacts change position upon movement of the closure member from closed position to open position.

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