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[54] **ALARM CONDITION SENSOR**

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[51] **Int. Cl.** **E05g 3/00**

[58] **Field of Search** ..... 109/41, 42, 34, 31, 109/38, 24; 340/273, 256, 276; 200/DIG. 12; 161/196, 200, DIG. 7

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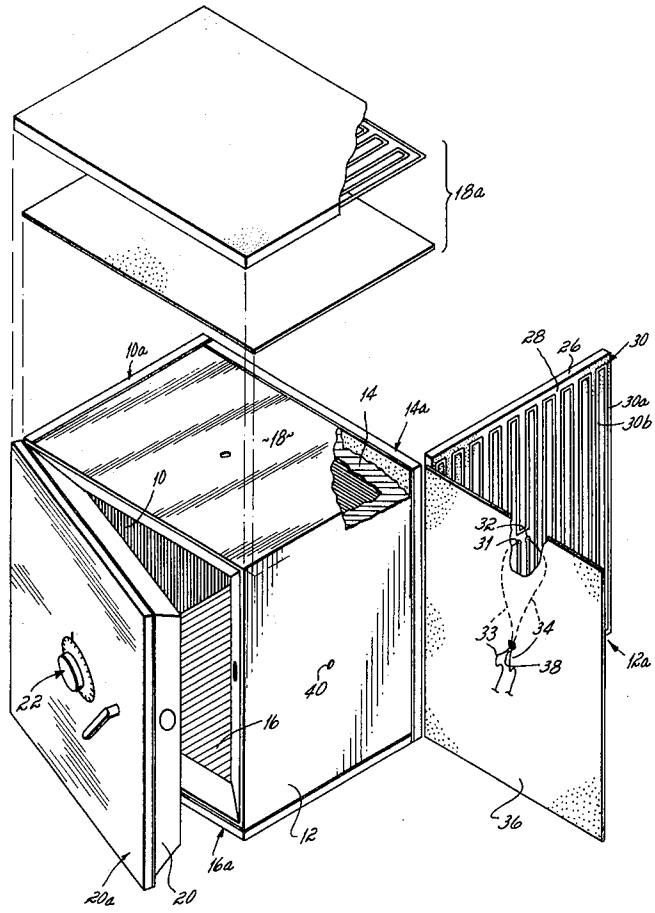
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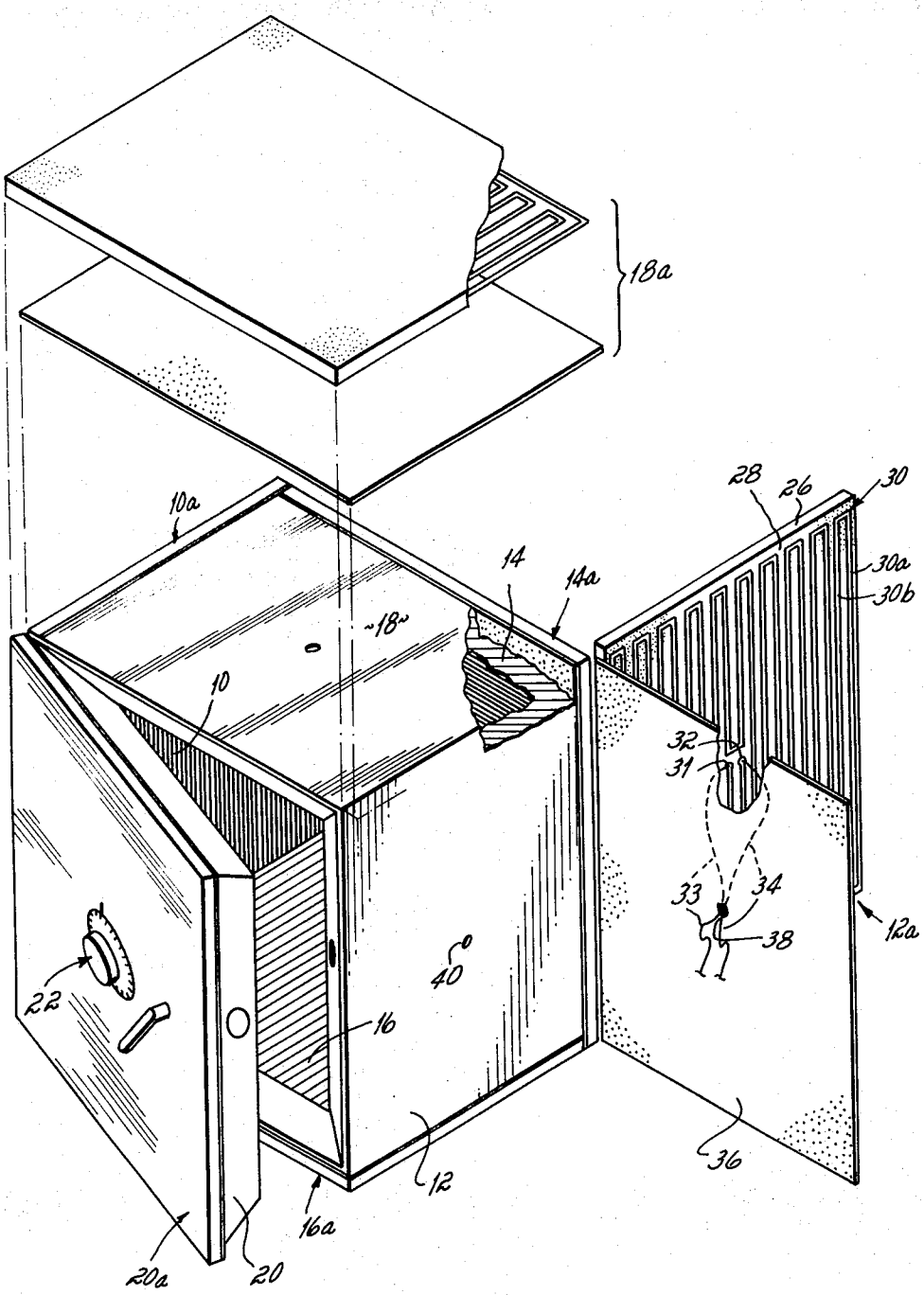
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[57] **ABSTRACT**

An alarm condition sensor for enclosing a device to be protected, such as a vault, which will change its electrical properties and thereby facilitate an alarm indication when a person tampers with the sensor and/or attempts to cut, burn or otherwise penetrate the protected device to gain access thereto. The alarm condition sensor includes frangible, opaque panels adhesively secured to the exterior surface of the protected device to completely enclose it. The panels have a printed circuit on the inside surface thereof which is electrically insulated from the exterior of the protected device, and due to the opaqueness of the panel is not visible from the outside. Attempts to pry, fold, bend, or otherwise remove the frangible panel prior to penetration of the protected unit itself will cause the panel, by virtue of its brittleness, to break, interrupting the electrical continuity of the printed circuit formed thereon. Similarly, attempts to drill, cut, or otherwise penetrate the protective panel, which necessarily occur prior to penetration of the protected unit, either interrupt the electrical continuity of the printed circuit or at least short-circuit it to ground via the vault which is typically of conductive material. In either case, a change in the electrical circuit occurs which can be sensed and an alarm indication provided prior to the point in time when the protective device is actually penetrated.

1 Claim, 1 Drawing Figure




18a
10a
28
26
30
30a
30b
14
14a
18
10
32
31
33
34
38
12a
40
22
16
12
36
16a
20a
20

ALARM CONDITION SENSOR

This invention relates to protection of devices against unauthorized access, and more particularly to the protection of vaults, safes and the like against access to the interior thereof by cutting, drilling, burning or otherwise penetrating the walls thereof.

A common method of gaining unauthorized access to the interior of a vault, safe or similar storage device is to make a hole in the wall of the device by drilling, cutting, burning or otherwise penetrating it. Different approaches to defeating unauthorized access of the type indicated are possible. In accordance with one approach, the material from which the vault or safe is fabricated is of a type which physically resists penetration to a degree sufficient to effectively prevent unauthorized access. In accordance with another approach, sensor means are provided on the vault or safe to detect when an effort is being made to penetrate it, whereupon an alarm indication, such as an audible signal, is activated, bringing the police to the scene, who are then in a position to halt the unauthorized activity.

It has been an objective of this invention to provide reliable, and yet economical, means for protecting a vault, safe or the like which will facilitate generating an alarm indication when penetration of the vault or safe to gain access thereto is attempted. In a preferred embodiment of this invention, this objective has been accomplished by completely enclosing the vault with opaque panels of frangible material each having a printed circuit on the inner surface thereof, the panels being secured to the exterior surface of the vault with adhesive which electrically insulates the printed circuit and vault. The brittle nature of the frangible panel results in its breaking, thereby interrupting the electrical continuity of the printed circuit, when an effort is made to pry, fold, bend, or otherwise remove the protected panel adhered to the vault exterior. Similarly, attempts to drill, cut or otherwise penetrate the vault results in interrupting the electrical continuity of the printed circuit, or at least short-circuiting it to ground via the vault which is typically conductive. In either case, the change in the electrical condition of the printed circuit occurs, is sensed, and an alarm provided, prior to actual penetration of the protected unit itself.

By virtue of the opaqueness of the protective, circuit-bearing frangible panels, the location of the printed circuit cannot be ascertained from the exterior thereof, and one attempting to penetrate the protected unit is unlikely to be successful without grounding or interrupting the electrical continuity of at least one portion of the printed circuit. Notwithstanding the brittle or frangible character of the protective panel which is located exteriorly of the printed circuit, the panel nevertheless has sufficient durability to withstand normal abuse without requiring additional protection. Finally, by reason of using an electrically insulative adhesive to mount the circuit-bearing surface of the frangible panel to the exterior surface of the vault, not only is the protective panel easily secured in place on the vault, but the circuit is maintained electrically insulated from the vault and hence will not, absent penetration, be short-circuited by contact with the vault wall which, as noted, is typically fabricated of electrically conductive material.

These and other advantages and features of the invention will become more readily apparent from a detailed description of the preferred embodiment thereof in which the figure is a perspective view, partially exploded, of a vault provided with the protective panel of this invention.

With reference to the figure, a conventional vault is shown of the type with which the protective panel of this invention is useful. The vault includes side walls **10** and **12**, rear wall **14**, bottom wall or floor **16** and top wall or ceiling **18**. A door **20** hinged along one vertical edge and provided with a suitable combination lock **22** selectively closes an access opening in the front of the vault. The walls and door of the vault are relatively thick, and preferably fabricated of hard, tough material such as steel, and accordingly inherently possess a high resistance to penetration by drilling, burning, cutting, or the like.

The alarm condition sensor of this invention is designed to facilitate provision of an alarm indication in the event that an attempt is made to gain unauthorized access to the interior of the vault, and includes a plurality of protective panels **10*a***, **12*a***, **14*a***, **16*a***, **18*a*** and **20*a*** secured to the exterior surfaces of side walls **10** and **12**, rear wall **14**, bottom and top walls **16** and **18**, and front door **20**, respectively. The protective panels **10*a***, **12*a***, **14*a***, **16*a***, **18*a*** and **20*a*** are identical in structure, although in certain cases differently sized to completely enclose their respectively differently sized associated vault wall surfaces. in view of such identity, only side wall protective panel **12*a*** is described.

Protective panel **12*a*** includes a relatively thin frangible, or brittle, substrate or layer **26**. The substrate **26** may be fabricated of a variety of materials, such as tempered hardboard marketed under the trademark MASONITE, laminated plastics marketed under the trademark FORMICA, etc. Alternatively, the substrate **26** may be constructed of glass or ceramic material. It is essential only that the substrate **26** be frangible, brittle, fracturable, or disintegratable such that any attempt to peel, pry or otherwise remove the substrate from the vault wall **12*a*** to which it is secured will result in the attacked portion of the substrate breaking away from the remaining portion of the substrate. For reasons to become apparent hereafter, the substrate **26** preferably is opaque.

Secured to the inner surface **28** of the frangible panel **26** and integral therewith is an electrically conductive element **30**, preferably of the printed type, in the form of an electrically conductive pattern of foil, conductive laminate, or other conductive material formed according to well known techniques utilizing photography, etching, plating, or the like. The printed circuit pattern, or conductive element, preferably is in the form of an elongated continuous conductor arranged in serpentine or zig-zag fashion with closely spaced adjacent sections **30*a***, **30*b***, ... and having opposite end terminals **31** and **32** to which flexible electrical leads **33** and **34** are secured.

The protective panel **26** is permanently secured in place on the vault, completely enclosing the exterior surface of side wall **12*a***, using an adhesive layer **36**. Adhesive layer **36** preferably is electrically insulative to prevent short-circuiting of adjacent sections **30*a***, **30*b***, . . . of the printed circuit **30** by the exterior wall of the vault **12*a*** which is usually fabricated of electrically conductive material such as steel or the like. The adhesive layer **36** may take the form of a double-sided plastic foam tape, the opposite surfaces of which have adhe-

sive qualities, and the body of which is electrically insulative. The electrical leads **33** and **34** connected to the ends **31** and **32** of the printed circuit **30** are preferably located remote from the peripheral edge of the panel **26** such as in the center of the panel as shown in the figure. When so located, the electrical leads **33** and **34** are not readily accessible for tampering. To facilitate connection of the electrical leads **33** and **34** of the printed circuit **30** to a suitable electrical sensing and alarm condition indicating circuit (not shown) located inside the vault, holes **38** and **40** are provided in the adhesive layer **36** and in the vault wall **12** through which the leads are inserted for connection to the sensing and indicating circuit (not shown) inside the vault.

A device to be protected, such as a vault, safe or the like, completely enclosed with the protective panels of this invention will provide an electrical condition change, which can be sensed and used to activate an alarm indicator, prior to actual penetration of the walls of the protected unit, such as side wall **12***a*. If an attempt is made to drill, burn, cut, or otherwise make a hole in the vault wall **12** to gain access to the interior of the vault, the cutting implement must necessarily pass through the protective panel **26** and in doing so passes through the printed circuit **30.** This either interrupts the electrical continuity of one or more of the conductive sections **30***a*, **30***b*, . . . thereof, or connects one or more of the sections to ground via the cutting implement and vault wall. Interruption of the electrical continuity or grounding of any single section **30***a*, **30***b* destroys the electrical continuity or alters the resistance between the terminals **31** and **32** thereof which, via leads **33** and **34,** can be sensed by conventional electrical continuity or resistance sensing circuits inside the vault to activate an alarm.

Alternatively, should an unauthorized attempt be made to remove the protective panel **12***a* prior to cutting a hole in the vault wall **12,** the electrical continuity of the printed circuit **30** will be interrupted and via leads **33** and **34** this condition sensed by a circuit (not shown) to provide an alarm. Specifically, any effort to peel, pry, chip, or otherwise remove the substrate **26** will, because of the frangible or brittle nature thereof, cause the attacked portion of the substrate to breakaway from the remaining portion which is not under attack. When the attacked portion of the substrate **26** breaks away, the printed circuit portion adhered thereto breaks away with it, destroying the electrical continuity of the printed circuit **30.**

The protective panel of this invention has a number of advantages. First, it represents an extremely inexpensive method of protecting a vault inasmuch as the cost of materials, namely, the frangible substrate **26,** printed circuit **30** and adhesive layer **36,** is quite modest. Also the cost of assembly, which involves little more than providing substrate **26** with a printed circuit **30** and adhering the interior surface **28** thereof to the vault wall via the double-sided adhesive **36,** can be quickly and easily accomplished without sophisticated tools or prior training. Additionally, by virtue of the opaqueness of the substrate **26,** the printed circuit pattern **30** is not visible from the outside, reducing the likelihood that it can be penetrated without either interrupting the continuity of the circuit or grounding it. Further, since the substrate **26** is itself fabricated of reasonably tough and rugged material, it is unnecessary to provide the protective panel **12***a* with an additional housing, skin, or the like to protect it against physical damage occasioned in the normal course of routine use. Finally, the protective panel of this invention provides a sensible change in its electrical characteristics when an attempt is made to penetrate the vault, prior to the point in time when the vault is actually penetrated. Thus, a warning alarm can be provided before the unauthorized party has actually had access to the contents of the vault.

Having described the invention, what is claimed is:

1. A penetration-responsive protected assembly comprising:

a vault having walls completely enclosing and thereby defining a protected interior, said walls having an exterior surface and being relatively thick to inherently inhibit access to said interior by making a hole therethrough, at least one of said walls being electrically conductive,

a protective panel located exterior of said one electrically conductive vault wall, said panel including

a. an opaque substrate of brittle electrically nonconductive material which is relatively thin and which inherently possesses low resistance to penetration, said substrate having an inner surface,

b. an electrically conductive circuit path secured to said inner surface of said substrate and having predetermined electrical characteristics,

c. an electrically insulative adhesive bonding said circuit-bearing inner surface of said substrate to said one exterior wall surface to preclude removal of said brittle substrate without altering the electrical characteristics of said printed circuit, and

d. an electrical sensing circuit electrically connected to said circuit path to detect interruption of said path and/or short -circuiting of said circuit path to said one electrically conductive vault wall.

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