United States Patent

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[54] **BILL TRAP**
6 Claims, 5 Drawing Figs.

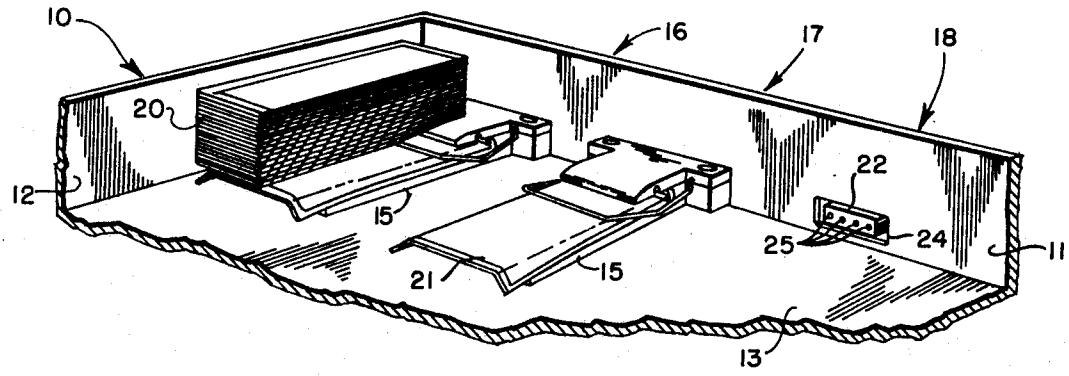
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[51] **Int. Cl.** **G08b 21/00,**
H01j 39/12
[50] **Field of Search** 109/38, 31,
2; 116/4, 75, 76; 200/61.59—62, 61.19, 52, 61.93,
52 (J); 340/280

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ABSTRACT: A device for detecting the removal of the last bill in a stack of paper currency for signalling or alarm purposes consisting of a magnet assembly supported in a "set" position by the last bill, which drops under the influence of gravity upon removal of the bill, to a position adjacent a pair of reed switches, causing their actuation and closure of electrical circuits. In one embodiment a double torsion spring is utilized to aid in "setting" the magnet assembly and to restrain the bill against accidental removal.



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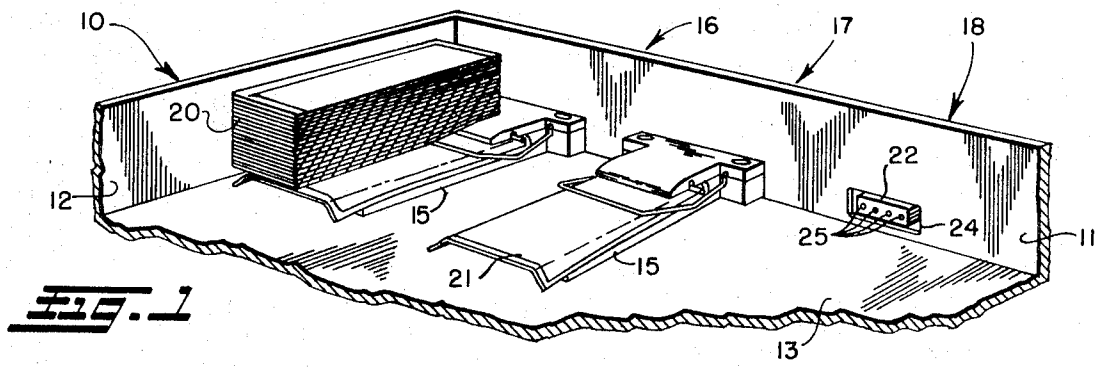


Fig. 1

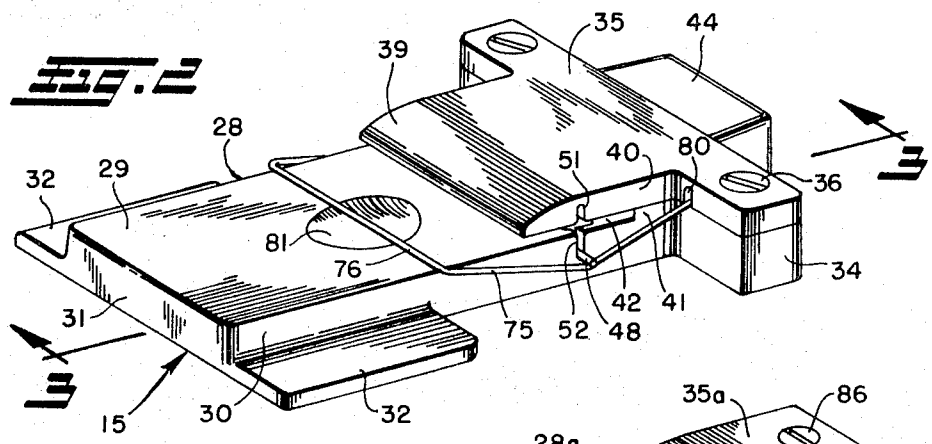


Fig. 2

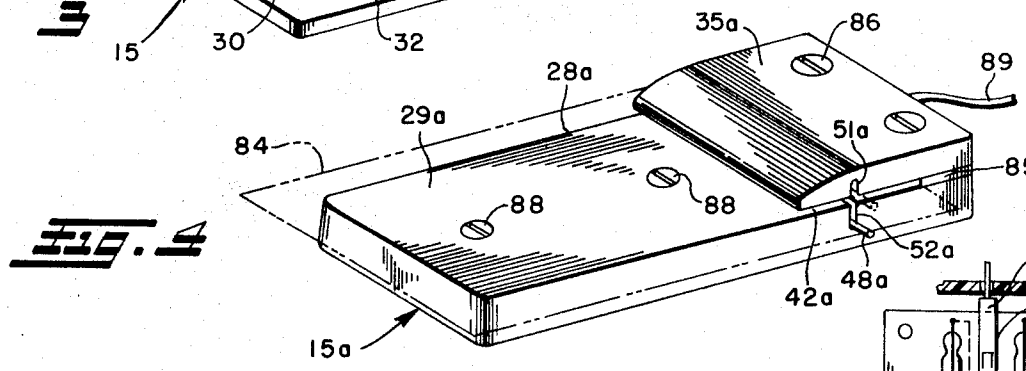


Fig. 4

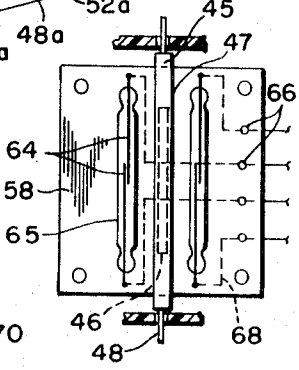


Fig. 5

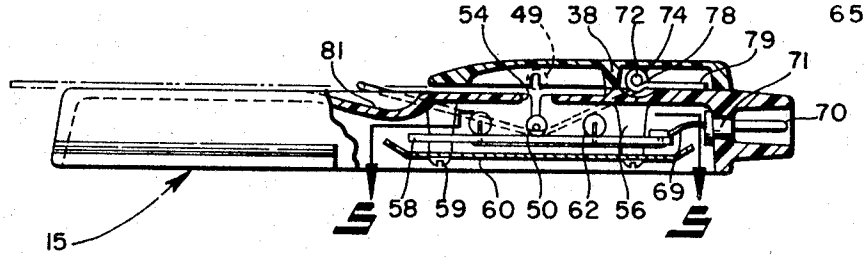


Fig. 3

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BILL TRAP

This invention relates to signalling devices and more particularly to a device which finds application in cash drawers of banks and the like wherein it is desired to obtain an automatic signal indicating the removal of the last bill in a stack of paper currency for replenishment purposes or for security reasons to provide an alarm of the removal of the currency.

It has become commonplace, especially in banks, savings and loan and similar institutions, to provide means of surveillance of the premises to deter appropriation of the property therein and to assist in the recovery of such appropriated property. Most commonly the signalling devices in use include remote alarms or remotely controlled cameras actuated by the depression of a switch which may be associated with each teller's window, for example, or under the control of the manager of the bank. While much consideration has been given to the location of the switching devices and the action required of the tellers for actuating such switches, it is apparent that any additional movement on the part of the teller could create an extremely dangerous situation and as such is to be avoided insofar as possible.

A convenient solution to the problem is to have the actuating mechanism in close association with the conventional paper-type currency which is most subject to being removed in the event of a breach of security of any institution. Even in such arrangements it is desirable to have the actuating mechanism in direct association with the currency so that not only is no additional movement of the teller required but also so that actuation can occur by action of any other individual upon removal of the currency.

Thus, various devices have been employed in the past to detect the removal of such currency on a direct contact basis wherein, for example, the electrical contacts of a switch are physically separated by the presence of a last bill in a stack of currency or the presence of such bill is detected by a sensitive microswitch arrangement. These devices have been somewhat deficient in requiring an accurate setting of the device and have been especially susceptible to fouling problems and the like, wherein for example, contacts become corroded or dirty and fail to operate reliably or the device is so sensitive as to require extreme care in its operation.

Therefore, it is one object of this invention to provide improved apparatus for the detection of the removal of the last item in a stack of currency or the like which apparatus is convenient to operate and readily adaptable to many existing environments.

It is another object of this invention to provide improved alarm and detection circuitry for paper currency which is more reliable than previous forms of apparatus and which includes features which aid in preventing the accidental removal of the alarmed bill.

It is another object of this invention to provide a bill trap device which employs a minimum of components and which is not susceptible of the fouling problems that exist in known forms of apparatus, wherein switching is effected by the magnetic operation of reed switch devices hermetically sealed against contamination.

In the drawings:

FIG. 1 is an environmental view of the preferred form of the apparatus situated in a conventional cash drawer of a banking institution;

FIG. 2 is an isometric view of the preferred form of the bill trap;

FIG. 3 is a partial cross-sectional view of the preferred form of the apparatus taken generally along the lines 3–3 of FIG. 2;

FIG. 4 is an isometric view of another embodiment of the invention; and

FIG. 5 is a partial cross-sectional view of FIG. 3 taken generally along the lines 5–5, showing the printed circuit board and magnet assembly in plan view.

Referring now to FIG. 1 and the environmental view of the invention, there is shown a partial view of a typical cash drawer 10 which might be employed in such banking institutions comprising back 11, side 12 and bottom 13 surfaces, which may be slidable as a conventional drawer into a suitable housing or may be adapted for portability within the institutions' premises, wherein the drawer 10 is filled with currency for the day's needs in a remote portion of the institution and placed within ready access of a teller for banking purposes. In either event the cash drawer 10 is adapted for receipt of stacks of currency in various denominations therein in a side-by-side manner as indicated in FIG. 1 for convenient access by the teller.

Several of the bill traps 15 of the invention are shown in place in the cash drawer 10 in side-by-side relation exemplifying a typical use for such bill traps. Three bill trap locations 16—18 are indicated in the cash drawer, the bill trap 15 in location 16 receiving a stack 20 of bills thereon which might comprise the standard United States currency of any denomination and comprising a stack of 100 or so items of such currency. Such stack 20 is partially cut away in FIG. 1 for a clearer view of the bill trap 15.

A second bill trap 15 is indicated in location 19 having only one item of currency 21 located therein, the bill trap 15 being depicted in a "set" condition by the single item of currency 21 and adapted for receipt of an additional stack of bills thereon. The third bill trap location 18 is indicated by an electrical receptacle 22 mounted in the backwall 11 of the cash drawer 10 in alignment with an aperture 24 therein, suited for insertion of a bill trap in place, electrical connection being made by conventional mating of prongs disposed on the bill trap with the connector devices 25 in the receptacle. It will be understood that such bill trap arrangement in the cash drawer 10 is merely exemplary and that connecting wires may lead from the receptacle 22 to suitable alarm or indication circuitry remote of the cash drawer 10 or that such interconnection can be made in a disconnectable manner, so that the cash drawer may be removed in its entirety for transportation to the vault. Preferably, however, the cash drawer 10 is permanently retained in location at the teller's cage for receipt of bill trap devices 15, when desired.

Referring now to FIGS. 2 and 3 showing respectively an isometric and partial cross-sectional view of the preferred form of the bill trap 15, such unit comprises a platform or base 28 formed conveniently of plastic or any other suitable material, of an inverted, generally rectangular box construction having a top surface 29 and sidewalls 30. The bill trap 15 may be scaled to any suitable dimension, but in most common use with standard United States currency, comprises a platform 28 having a top surface 29 of slightly smaller dimensions than that of the currency so that there is an overhang of the currency along both sides 30 of the platform 28 and along the forward wall 31 thereof. The platform 28 is formed with flanges 32 at the forward portion thereof and shoulders 34 at the rear, both extending in a lateral direction to assist in stabilizing the platform 28 when in position in a cash drawer and to provide additional mounting surfaces. The flanges 32 at the forward portion of the platform 28 are relatively thin webs located at the lower portion of the platform sides 30 while the shoulders 34 at the rear section are approximately the same thickness as the platform.

A support member 35, again most conveniently molded of plastic and conforming generally to the shape of the platform 28 and the rear shoulders 34 is mounted in fixed relation to the platform 28 in any conventional manner, most conveniently by screws 36 located in the shoulder portions and cooperating with bosses (not shown) in the shoulders 34 of the platform 28.

As indicated in FIG. 3, the support member 35 is also of boxlike construction having suitable webs 38 therein for support purposes and having a gently sloping forward edge 39 and enclosing sidewalls 40.

The support member 35 is of a length to extend over approximately one-third of the length of the top surface 29 of the platform 28 and is mounted a small distance above the platform by suitable spacers or by abutment with an elevated por-

tion 41 of the platform 28, to form a slot 42 between the support member 35 and the top surface 29 of the platform 28 for receipt of at least one item of the currency As indicated in FIG. 1, the support member 35 is of relatively low profile so as to support the rear portion of the stack of bills 20 thereon with relatively little distortion to the stack.

The rear section of the platform 28 culminates in a rearwardly extending rectangular housing 44 which forms a portion of the male part of an electrical connector, the housing 44 being adapted for receipt in the aperture 24 in the backwall 11 of the cash drawer 10. Alternatively, the housing 44 may be part of a commercially available electrical connector mounted at the rear of the platform 28. It will be apparent that, with a snug fit of the housing 44 in the aperture 24 and by means of the shoulder 34 and flange 32 construction of the platform of the bill trap, a fairly stable and sufficiently secured mounting arrangement will be established solely by frictional contact so that additional retaining means are not required, and so that the bill trap 15 can be readily removed or located in place at the convenience of the teller.

A magnet assembly 45 comprising a small magnet 46 inside a thin cylindrical nonmagnetic case 47 extending substantially the full interior width of the support member 35 and supporting a pair of axially extending protruding lugs 48 of somewhat smaller diameter is retained for movement between first 49 and second 50 positions located within the support member 35 and the platform 28 respectively, for detection of the presence or absence of an item of currency in the slot 42 of the bill trap 15. The support member 35 and the platform 28 have vertically oriented slots 51, 52 in their respective sidewalls 40, 30, the slots 51, 52 being located one above the other and adapted for receipt of the lugs 48 of the magnet assembly 45. The top surface 29 of the platform 28 includes an aperture 54 therein of slightly larger dimension than the profile of the cylindrical case 47 so as to allow free movement of the case 47 between the first and second positions 49, 50 but to serve as a partial guide for the magnet assembly 45 in the course of its movement.

Located within the platform 28 and supported on several bosses 56 therein is a printed circuit board 58 retained in place by screws 59 and shielded to some extent from the entrance of contaminants by a lower plate 60 mounted on the same bosses 56. A pair of reed switches 62 are mounted on the printed circuit board 58 in transverse orientation substantially parallel to the cylindrical case 47 and approximately in a common plane with the magnet assembly 45 when in its second position 50 within the platform 28. The reed switches 62 are mounted a short distance away from the magnet assembly 45 but are sufficiently close to be activated by the magnetic field of the magnet 46 when in the second position 50 and to be deactivated when the magnet assembly 45 is raised to the first position 49 within the support member 35.

The reed switches 62 are commercially available items and each comprises a pair of magnetically susceptible and electrically conductive leaves 64 mounted in cantilever fashion in the encapsulating closed end of a short section of glass tubing 65, the leaves 64 being adapted to partially overlie one another and to be attracted under the influence of a magnetic field to contact one another and complete an electrical circuit. Printed circuit techniques are employed to achieve an electrically conductive path between the leaves 64 of the reed switches 62 and connecting terminals 66 as indicated by the dashed lines 68 of FIG. 5. The connecting terminals 66 are in turn connected by lead wires 69 to prongs 70 forming the male portion of an electrical connector, the prongs 70 being supported in place in the housing 44 at the rear section of the platform 28 by suitable grommets 71. Electrical connection of the reed switches 62 with remote circuitry (not shown) is then made by insertion of the prongs 70 in the receptacle 22 mounted in the aperture 24 of the cash drawer 10.

Further located in the support member 35 on a transversely extending rod 72 secured in holes in suitable webs of the support member 35 is a torsion spring 74 having a double arm 75 and transverse connecting section 76. The torsion section 78 of the spring 74 circumscribes the rod 72 and is adapted, by means of the engagement of the rear legs 79 of the torsion section 78 with the top surface 29 of the platform 28, to urge the arms 75 downwardly and thus urge the connecting section against the top surface 29 of the platform 28. The connecting section 76 is of a length only slightly greater than the width of the platform 29 so that the arms 75 of the spring 74 lie closely adjacent the sides 30 of the platform 28. The arms 75 of the spring 74 are downwardly bent at a slight angle to lie below the protruding lugs 48 of the magnet assembly 45 when in the second position 50 and to be completely clear of the slot 42 to allow freedom of movement of the magnet assembly 45.

The arms 75 of the spring 74 are movable in a vertical direction, freedom being afforded by apertures 80 in the support member 35, and are adapted to be raised above the slot 42 when the connecting section 76 is manually elevated so that an item of currency may be freely inserted in the slot 42. Upon elevation of the connecting section 76 it will be seen that the spring arms 75 will contact the protruding lugs 48 and carry the magnet assembly 45 upwardly therewith into the support member 35, being guided by the slots 52, 51 in the platform 28 and support member 35 respectively. For ease in manually grasping the connecting section 76 of the spring 74 an indent 81 is provided in the top surface 29 of the platform 28.

Thus, it will be seen that once the bill trap 15 is in location in the cash drawer 10, it will be placed in a "set" condition by the elevation of the connecting section 76 of the spring 74, which carries the magnet assembly 45 into the support member 35, and by the insertion of an item of currency into the slot 42. When the spring 74 is released the connecting section 76 and double arms 75 will be urged to the position depicted in FIG. 2 thereby clamping the item in position, the double arm 75 arrangement imparting a fold to the item over the sides 30 of the platform 28 as indicated in FIG. 1, for additional securement purposes and to deter the accidental removal of the last item of currency. The magnet assembly 45 will be retained in the first or "set" position 49 in the support member 35 as the cylindrical case 47 will lie upon the top surface of the item of currency and be prevented from movement to the second 50 or "trip" position within the platform 28. When the last item is removed from the bill trap 15, being slid against the restriction of the spring 74 and out of the slot 42, the magnet assembly 45 will fall under the influence of gravity, being guided by the slots 51, 52 and the aperture 54 to the second position 50, thereby causing actuation of the reed switches 62, and completion of external electrical circuitry.

Another embodiment of the invention is shown in FIG. 4 wherein a simplified form of the bill trap 15*a* is depicted, an item of currency being indicated by the dashed lines 84. Numerals corresponding to the preferred embodiment of the invention are used in conjunction with the description of FIG. 4, with the subscript *a* appended, where corresponding parts are encountered. In this arrangement the bill trap 15*a* comprises a generally rectangular housing or platform 28*a* with a top surface 29*a* for support of a stack of currency. A similar support member 35*a* is mounted in overlying relation to the platform 28*a*, secured on a spacer piece 85 by a pair of mounting screws 86 to form a similar slot 42*a* for receipt of an item of currency.

Vertically aligned slots 52*a*, 51*a* are formed in the sidewalls of the platform 28*a* and support member 35*a* for receipt of and guidance of the protruding lugs 48*a* of a magnet assembly between "set" and "trip" positions.

In this embodiment of the invention the platform 28*a* is secured in position by screws 88 passing through bosses (not shown) in the interior of the platform for securement to a cash drawer or more likely for mounting on a suitable counter. The magnet assembly is elevated in a similar manner except that such action is accomplished by manually grasping the protruding lugs 48*a* of the magnet assembly and raising same to the "set" position. Placement of an item of currency 84 in the slot

42*a* then will retain the magnet assembly in the manner previously described. An array of reed switches is also employed adjacent the "trip" position of the magnet assembly, in this instance, however, connection to external circuitry is made by way of permanent connecting cable **89** rather than the separatable connector **25, 70** of the preferred embodiment.

It will be apparent that in the FIG. **4** embodiment of the invention the last item of currency **84** will conform more closely to the profile of the stack of currency supported thereabove to more completely disguise the presence of the bill trap **15***a* and to facilitate the removal of the last item **84** with the stack of currency.

We claim:

1. Apparatus for detecting the removal of the last item in a stack of paper currency and the like comprising a platform adapted for support of the stack of currency, means on said platform for supporting a portion of the currency, said means overlying a part of the platform for separation of at least one item of the currency and forming a slot with said platform for receipt of the forward edge of such item, a magnet assembly adapted for movement through said slot between first and second positions located within said support means and said platform, respectively, said magnet assembly being retained in the first position in said support means by the presence of the item of currency in said slot and movable to the second position within said platform under the influence of gravity when the item is removed, and a reed switch arrangement mounted in said platform adjacent the second position of said magnet assembly and adapted for actuation by the presence of the magnetic field of said magnet assembly for completion of an electrical circuit.

2. Apparatus as set forth in claim **1** further including guide means on said platform and said supporting means for restricting the movement of said magnet assembly to such first and second positions.

3. Apparatus as set forth in claim **2** wherein said guide means comprises first and second slots in said supporting means and said platform respectively, said first and second slots being vertically oriented, one above the other and adapted for receipt of a portion of said magnet assembly.

4. Apparatus as set forth in claim **1** further including means movably mounted on said platform for releasably clamping the item of currency in position on said platform and bias means operatively connected with said clamping means for urging same against said platform.

5. Apparatus as set forth in claim **4** further including means on said clamping means for engaging said magnet assembly, said engaging means being adapted to be moved with said clamping means to lift said magnet assembly from the second to the first position.

6. Apparatus as set forth in claim **5** wherein said clamping means, said engaging means and said bias means comprise a double torsion spring having a torsion section, a double arm and connecting section, said torsion section being fixed with respect to said platform, said connecting arm being adapted to transversely overlie said platform and said double arm being connected between said torsion section and said connecting section and extending beneath a portion of said magnet assembly, closely adjacent the sides of said platform, thereby to partially fold and secure the item of currency against said platform.