United States Patent [19]

Anastassakis

[11] **3,750,158**

[45] **July 31, 1973**

[54] **WEIGHT SENSITIVE SECURITY SYSTEM**

[76] Inventor: **Evangelos M. Anastassakis,** c/o Maxham & Schurgin, One Boston Place, Boston, Mass. 02108

[22] Filed: **June 2, 1972**

[21] Appl. No.: **259,010**

[52] U.S. Cl. **340/272,** 177/1, 177/50, 340/280

[51] **Int. Cl.. G08b 21/00,** G01g 19/00, G01g 23/18

[58] **Field of Search** ..... 340/272, 280; 200/85 R; 177/1, 245, 50; 235/91 L, 92 WT; 346/94

[56] **References Cited**

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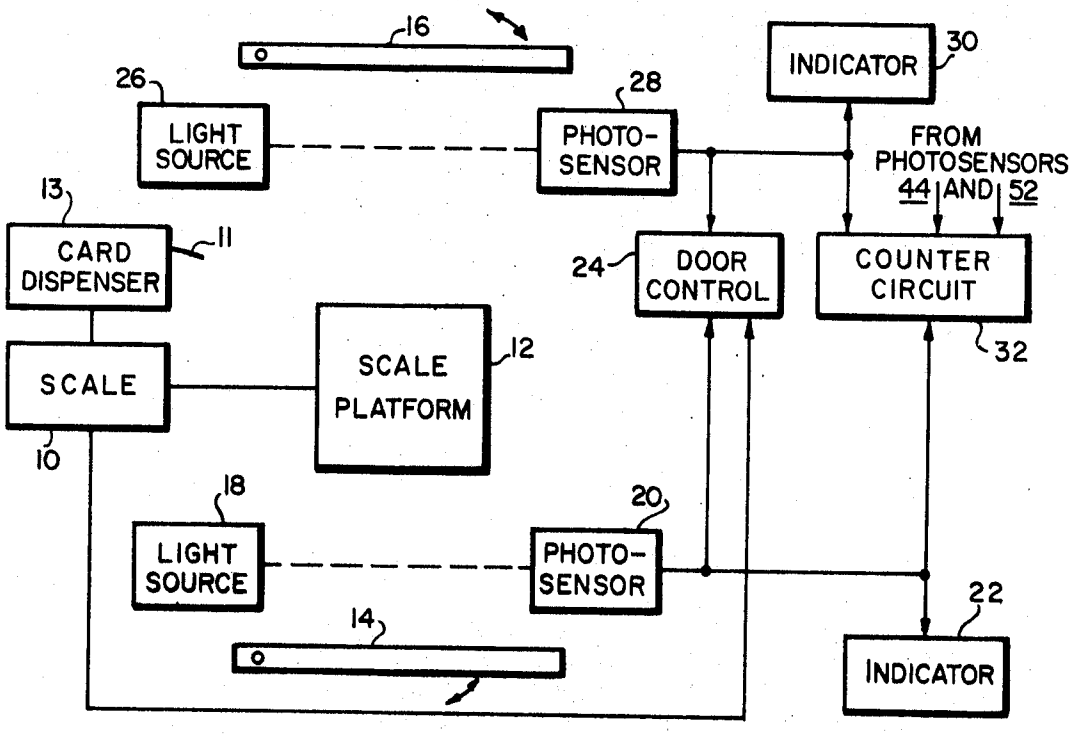
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Primary Examiner—John W. Caldwell
Assistant Examiner—Scott F. Partridge
Attorney—Joseph Weingarten, Stanley M. Schurgin et al.

[57] **ABSTRACT**

A security system for detection of the unauthorized removal of articles from a controlled area in which the weight of an individual is determined upon entrance into and exit from a controlled area, the difference between entrance and exit weights being employed to determine whether items are being removed. Upon entrance into a controlled area, an individual's weight is determined and a coded card provided indicating the entrance weight. Upon exit from the controlled area, the individual is again weighed and the exit weight compared with the entrance weight decoded from the card by card reading apparatus. The difference in entrance and exit weight is compared with a reference value and upon exceedance of the reference value causes an alarm indication.

9 Claims, 4 Drawing Figures



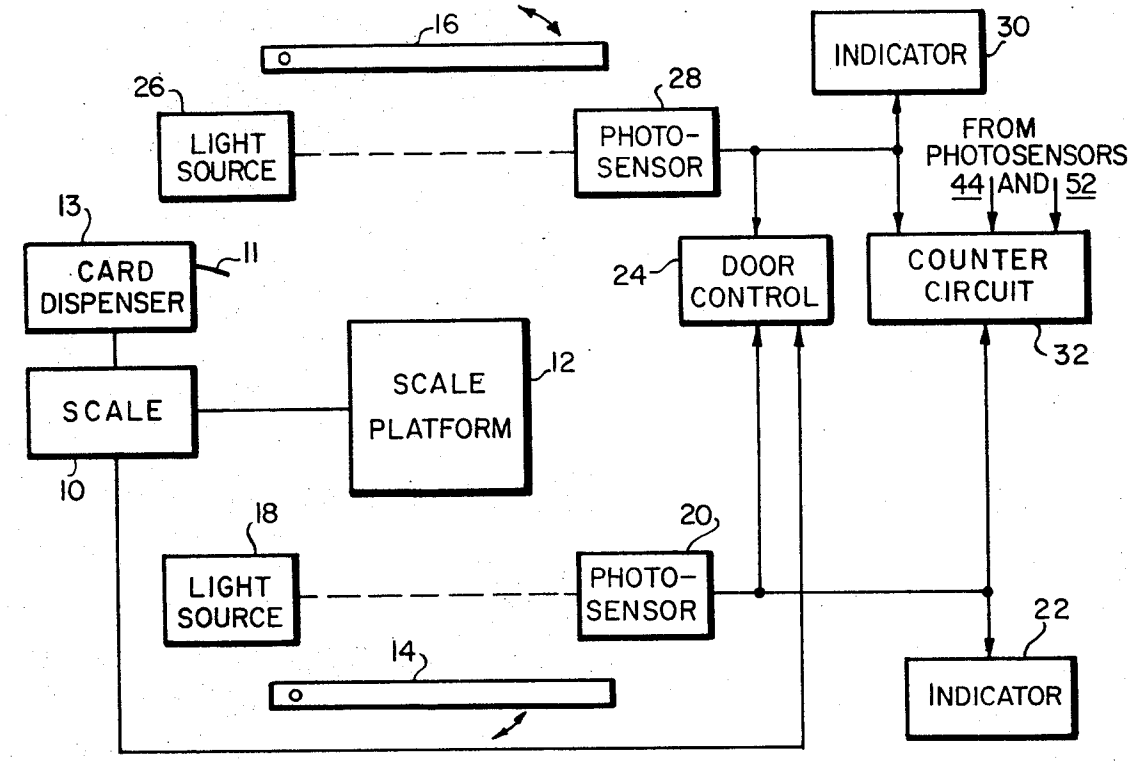

16
INDICATOR
30
26
28
LIGHT SOURCE
PHOTO-SENSOR
FROM PHOTOSENSORS 44 AND 52
13
CARD DISPENSER
11
24
DOOR CONTROL
COUNTER CIRCUIT
32
SCALE
SCALE PLATFORM
12
10
18
20
LIGHT SOURCE
PHOTO-SENSOR
22
14
INDICATOR

FIG. 1

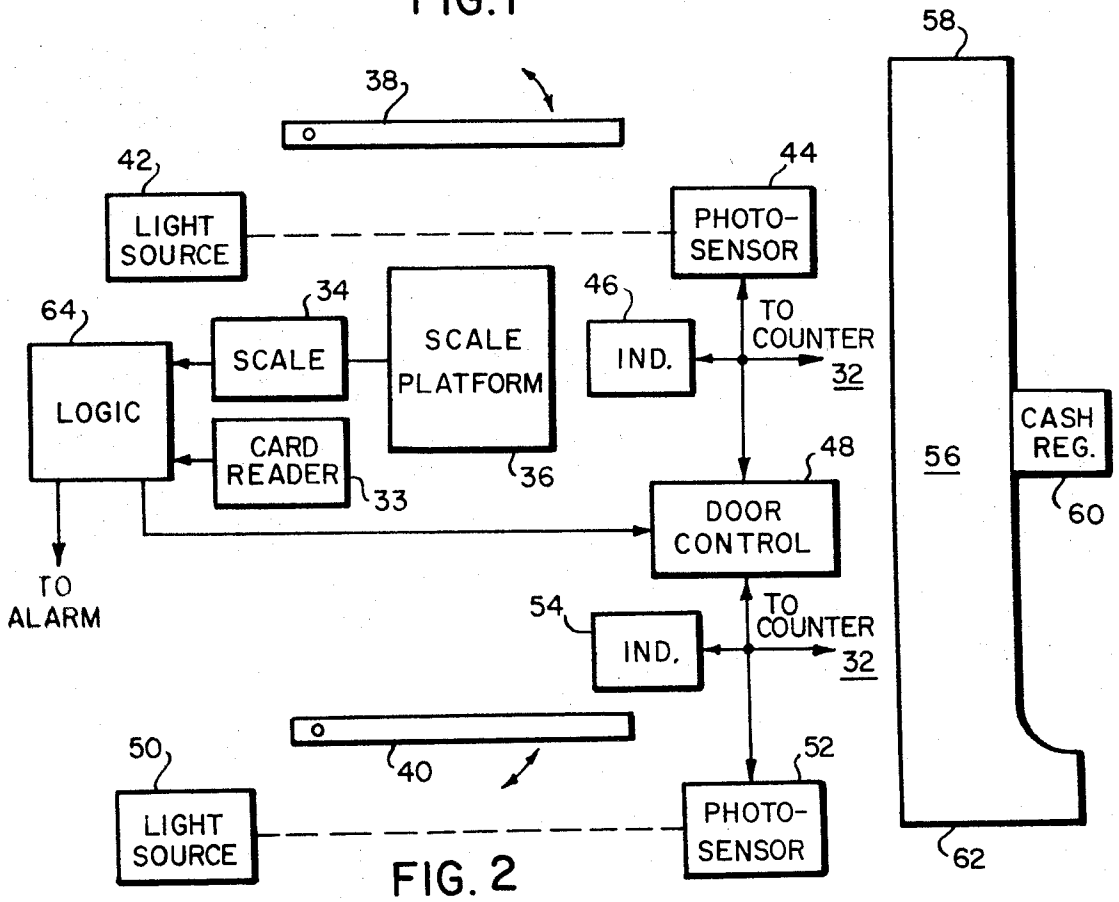

58
38
42
44
LIGHT SOURCE
PHOTO-SENSOR
64
34
46
SCALE
SCALE PLATFORM
IND.
TO COUNTER 32
LOGIC
CARD READER
33
36
48
56
CASH REG.
60
DOOR CONTROL
TO ALARM
54
IND.
TO COUNTER 32
40
50
52
LIGHT SOURCE
PHOTO-SENSOR
62

FIG. 2

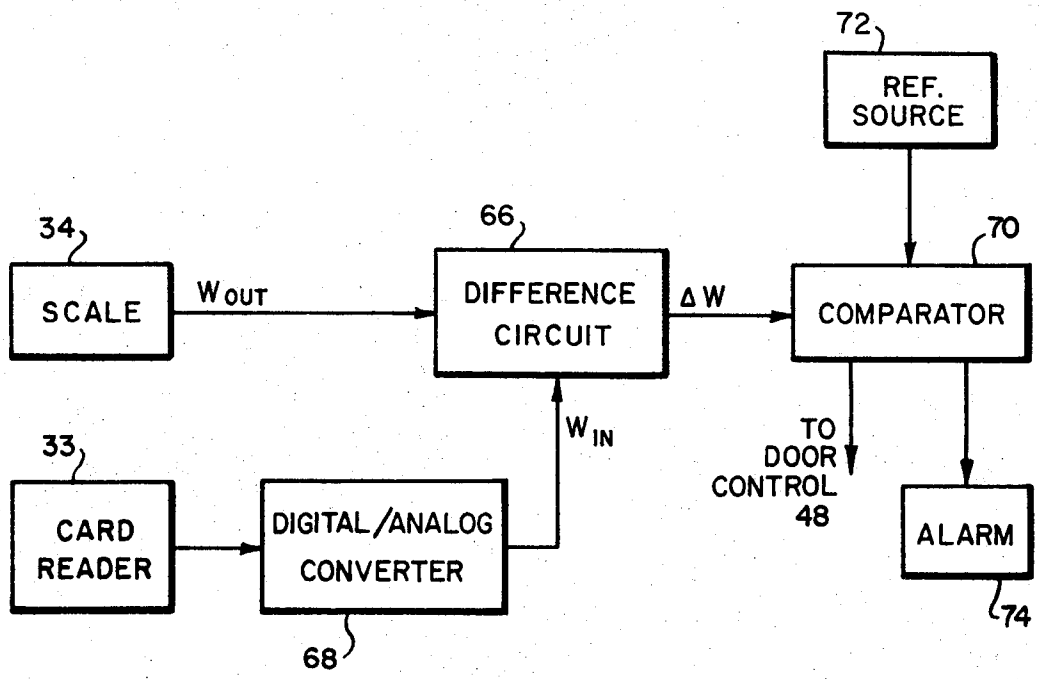

72
REF. SOURCE
34
SCALE
W OUT
66
DIFFERENCE CIRCUIT
Δ W
70
COMPARATOR
W IN
33
CARD READER
DIGITAL/ANALOG CONVERTER
68
TO DOOR CONTROL 48
ALARM
74

FIG. 3

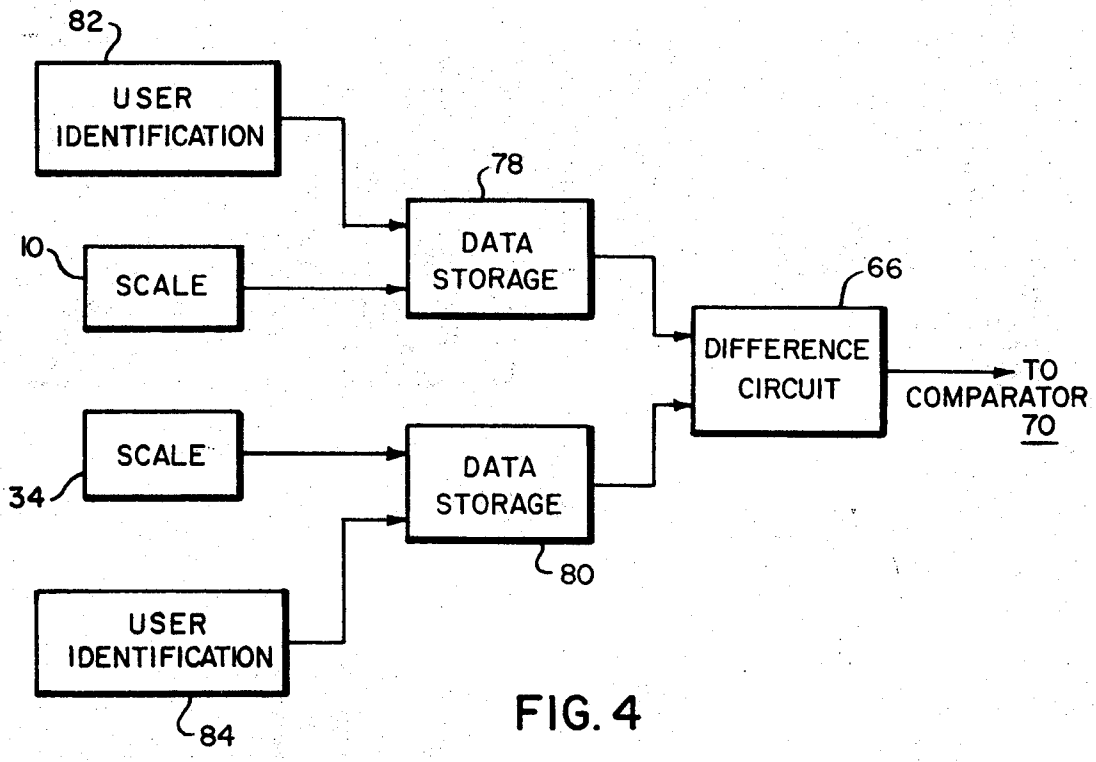

82
USER IDENTIFICATION
78
DATA STORAGE
10
SCALE
66
DIFFERENCE CIRCUIT
TO COMPARATOR 70
SCALE
34
DATA STORAGE
80
USER IDENTIFICATION
84

FIG. 4

WEIGHT SENSITIVE SECURITY SYSTEM

FIELD OF THE INVENTION

This invention relates to security systems and more particularly to a system for the detection of the unauthorized removal of articles from a controlled area by use of weight comparison techniques.

BACKGROUND OF THE INVENTION

Security systems are known for the prevention of theft or unauthorized removal of articles from stores, libraries and other areas to be controlled. In many such systems, sensible tags are placed upon items to be protected and the presence of such a tag at a sensing station at or near a store exit is employed to cause alarm actuation. It is an object of the present invention to provide a security system in which individual items within a store or other protected area need not be tagged or otherwise marked and in which the weight of an individual entering and leaving a protected area is employed to determine unauthorized article removal.

SUMMARY OF THE INVENTION

In accordance with the invention, the weight of an individual entering and leaving a protected or controlled area is determined and a difference between entrance and exit weights computed, this difference weight being compared with a reference value to provide a system output indication. The detection of a difference between entrance and exit weight which exceeds a predetermined reference value serves as an indication that an article is leaving the controlled area which was not with the individual upon his entrance into this area. Such detection causes the actuation of a suitable alarm indication and can also cause the locking of exit doors. If the difference between entrance and exit weights is within the tolerance provided by the system the person leaves the controlled area unimpeded.

Briefly, the invention comprises a controlled entrance to an area being protected, a platform scale or other suitable weighing means operative to determine the entrance weight of an individual and to issue a machine readable card bearing a representation of the measured entrance weight. At a controlled exit, the individual is again weighed such as by a platform scale and the entrance weight card inserted into a card reader operative to decode the weight recorded thereon and to cause comparison of this entrance weight with the exit weight determined at the exit station. The weight difference between entrance and exit weights is determined by associated logic circuitry and is compared in the logic with a reference value selected in accordance with predetermined system tolerance requirements. Upon exceedance of the reference value by the computed weight difference, an output indication is provided for the actuation of suitable alarms and if desired for the automatic locking of exit doors.

DESCRIPTION OF THE DRAWINGS

The invention will be more fully understood from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. 1 is a diagrammatic representation of entrance apparatus of a system embodying the invention;

FIG. 2 is a diagrammatic representation of exit apparatus of a system embodying the invention;

FIG. 3 is a block diagram representation of the signal processing circuitry of the embodiment of FIG. 2; and

FIG. 4 is a block diagram representation of an alternative embodiment of the signal processing circuitry of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The apparatus of the invention provided at an entrance to an area to be protected is depicted in FIG. 1 and includes a scale **10** having a scale platform **12** disposed at a controlled entrance through which individuals must pass to gain entrance into the controlled or protected area. A door or other suitable barrier **14** is provided at the entrance end of the scale platform **12**, while a second door or other barrier **16** is provided at the exit end of scale platform **12**. In typical embodiment, the entrance door **14** can be manually opened to enter the scale platform. A light source **18** is disposed in a position between door **14** and platform **12** and is operative to direct a light beam onto an associated photosensor **20** which is coupled to an indicator **22** and a door control **24**. Another light source **26** is disposed between the platform **12** and door **16** and is operative to direct a light beam onto an associated photosensor **28** which is also coupled to door control **24** and to an indicator **30**.

In operation, a person enters through door **14** onto the scale platform **12** and in so doing passes through the light beam from light source **18**, causing photosensor **20** to provide a signal to indicator **22**, the actuation of which indicates the presence of a person on platform **12**. The signal from photosensor **20** is also applied to door control **24** which can cause the latching of both doors **14** and **16**. Latching of door **14** prevents the exiting of a person from that door once he has entered the controlled area and also will prevent the entry of a second person onto the scale platform **12** while a person is being weighed. The latching of door **16** will cause the individual to remain on the scale platform for a time sufficient to obtain his weight. The weight determined by the scale **10** is imprinted or otherwise marked on a card or ticket **11** which is dispensed to the individual by card dispensing apparatus **13**. The card contains the weight in any suitable machine readable form, such as optically or magnetically sensible characters or in coded form such as punched holes or sensible marks.

Upon removal of the coded card from the dispenser **13** associated with scale **10**, an enabling signal is provided to door control **24**, and upon traversal by the individual of the light beam from light source **26**, causing photosensor **28** to provide a signal to door control **24**, the doors **14** and **16** are caused to be opened or unlocked to allow the egress of the person from the entrance area into the protected area and the entrance of another person onto the scale platform. The output signals from photosensors **20** and **28** can also be coupled to a counter circuit **32** which provides a talley of the number of individuals entering the protected area and a talley of the number of individuals leaving the protected area. An indicator **30** can also be energized by the photosensor **28** to provide an output indication that an individual has left the entrance zone into the protected area.

The portion of the system provided at the exit zone of a protected area is depicted in FIG. 2 in the context of a supermarket or other self-service store at which merchandise is placed upon a checkout counter for payment and subsequent packaging. At the exit zone as

shown in FIG. 2 a scale 34 and an associated scale platform 36 are provided with an entrance door 38 on one side of platform 36 and an exit door 40 on the opposite side thereof. A light source 42 is provided between door 38 and platform 36 for directing a light beam onto photosensor 44 and which, in turn, is operative to provide a signal to an associated indicator 46 and a door control 48. A light source 50 is disposed outside of door 40 and is arranged to direct a light beam onto photosensor 52 which is operative to provide an output signal to an indicator 54 and to door control 48. The photosensors 44 and 52 also apply an output signal to counter circuit 32. A merchandise counter 56 is disposed adjacent platform 36 and includes an area 58 in front of door 38 at which merchandise is deposited for checkout. A checkout attendant is stationed at a cash register 60 disposed centrally of counter 56 to check out items deposited thereon. An area 62 of counter 56 disposed outside of door 40 is provided for deposit of checked out merchandise which can then be removed by an individual leaving the protected area.

In passing through the exit zone, an individual enters via door 38 onto scale platform 36 and inserts the coded weight card into a card reader 33 which is associated with scale 34. Upon passage by the individual through the light beam from light source 42, the photosensor 44 provides a signal to door control 48 which locks doors 38 and 40 to prevent the entrance of more than one individual onto platform 36 and to prevent the exit by the individual present on the scale platform until after the weight comparison procedure is complete. Scale 34 is operative to determine the exit weight of the individual on platform 36 and to provide an output indication of this exit weight to logic 64 which also receives, from card reader 33, a representation of the entrance weight provided on the card dispensed to the individual at the entrance station.

The weight difference is employed to denote whether items are being removed from the controlled area. The added exit weight caused for example by the presence of a purloined article on an individual is detected at the exit zone and utilized by logic 64 to cause alarm actuation. The embodiment described does not provide an alarm condition if the exit weight is less than the entrance weight, such as could occur if an individual leaves a package in the controlled area; however, the system logic can be arranged to produce an output indication in this event to signal the possiblity that an item entering with a person into the area being protected has been left in this area.

The logic 64 is shown in FIG. 3 and includes a difference circuit 66 which receives as a first input the exit weight provided by scale 34 and as a second input the entrance weight decoded by the card reader 33 from the entrance weight card. The coded entrance weight is typically decoded in digital form and by means of a digital-to-analog converter 68, converted to analog form for application to the difference circuit. It will be appreciated that the weight determinations can be provided in either analog or digital form with the difference circuit operative accordingly. The output of difference circuit 66 is a signal representative of the algebraic difference between the entrance and exit weights, labeled ΔW and equal to $W_{out}-W_{in}$, and which is applied as one input to a comparator 70. The other input to the comparator is a reference signal provided by a reference source 72. This reference signal specifies the maximum weight difference tolerable in a particular system installation. Two output signals are provided by comparator 70 depending upon whether the measured weight difference between the exit and entrance weights is less than or greater than the reference value.

In the event that the weight difference is within the system tolerance range, that is, the weight difference is less than the reference level provided by reference source 72, comparator 70 is operative to provide an output signal to door control circuitry 48 to open or unlock door 40 and permit the exit of an individual from the controlled area. Door control circuitry 48 can also be operative to open or unlock door 38 to permit entry of another person onto platform 36. In the event that the weight difference is greater than the reference level, comparator 70 is operative to provide an outut signal to alarm circuitry 74 which can include a suitable alarm indicator. In this latter event, the exit door 40 normally will remain locked to prevent the egress of an individual until the cause of the excessive weight difference is ascertained.

In an alternative embodiment of the invention, the entrance and exit weight determinations can be provided by respective scales 10 and 34 to data storage registers or other suitable means for retaining a representation of the entrance and exit weights for difference computation without use of a coded weight card. Referring to FIG. 4, signals representative of the entrance and exit weights provided respectively by scales 10 and 34 are applied to respective data storage registers 78 and 80, the output of the respective registers being applied to difference circuit 66. User identification apparatus 82 and 84 is provided at respective entrance and exit zones to provide output indications of the identity of a person and which are employed to associate the entrance and exit weights of the identified individual for subsequent weight comparison. Such apparatus is per se well known and can be an identification card reader or a keyboard for manual entry of an identity code. The output signal from difference circuit 66 represents the weight difference which is then applied to comparator 70 for further processing as described above.

It will be appreciated that the invention can be implemented in different ways to suit specific operating requirements, and it is not intended to limit the invention by what has been particularly shown and described. It should be evident that the invention finds application in a variety of environments in which an area is to be protected from unauthorized article removal, for example in libraries, museums and stores.

What is claimed is:

1. A security system comprising:

means for determining the weight of an individual upon entry into a controlled area;

means for providing a first signal representative of said entrance weight;

means for determining the weight of said individual upon exit from said controlled area;

means for providing a second signal representative of said exit weight;

means operative in response to said first and second signals for providing an output signal representing the difference therebetween;

means for providing a reference signal representative of a maximum allowable weight difference between said entrance and exit weights; and

means operative in response to said reference signal and said output signal for providing an alarm indication in the event that said output signal represents a weight difference greater than that represented by said reference signal.

2. A security system according to claim 1 wherein:

said entrance weight determining means includes a scale having a platform on which an individual is disposed for weighing, and means for providing a coded card having a sensible representation of the entrance weight thereon;

said exit weight providing means includes a scale having a platform on which an individual is disposed for weighing; and

said first signal providing means includes means at the exit from said controlled area for reading said coded card and for providing said first signal representative of the entrance weight encoded thereon.

3. A security system according to claim 1 including:

an entrance zone at which said entrance weight is determined, an exit zone at which said exit weight is determined, and an entrance and exit barrier for each of said zones;

means at each of said zones for detecting the entry of an individual therein and the exit of an indivudal therefrom;

means operative upon detection of the presence of an individual in said entrance zone for locking said entrance barrier to prevent entry of another individual while one individual is already present, and for locking said exit barrier to prevent the egress of said individual into said entrance zone until his weight has been determined; and

means operative upon detection of the presence of an individual in said exit zone for locking the entrance barrier thereof to prevent entry of another individual until the individual in said exit zone has left said zone, and for locking the exit barrier of said exit zone to prevent egress of the individual in said exit zone in response to an output signal representing a weight difference greater than said maximum allowable difference.

4. A security system according to claim 1 including:

means for storing representations of the corresponding entrance and exit weights of an individual; and

means operative to provide said first and second signals in response to said stored representations.

5. A security system comprising:

an entrance zone through which individuals must pass for entry into a controlled area, said zone including:

means for determining the weight of an individual upon entry into said controlled area;

means for providing to said individual a coded card having a sensible representation of said entrance weight thereon;

an exit zone through which individuals in said controlled area must pass in leaving said controlled area, said exit zone including:

means for determining the weight of an individual upon exit from said controlled area;

means for providing a first signal representative of said exit weight;

means for sensing said coded card and for providing a second signal representative of the entrance weight decoded therefrom;

means operative in response to said first and second signals for providing an output signal representing the difference therebetween;

means for providing a reference signal representative of a maximum allowable weight difference between said entrance and exit weights; and

means operative in response to said reference signal and said output signal for providing an alarm indication in the event that said output signal represents a weight difference greater than that represented by said reference signal.

6. A security system according to claim 5 wherein said entrance and exit zones each include:

a selectively operable entrance and exit barrier disposed at respective entry and exit positions of said zone;

means for detecting the entry of an individual into said zone and for providing a detection signal in response thereto;

means for detecting the exit of an individual from said zone and for providing a detection signal in response thereto; and

control means operative in response to said detection signals for selectively locking and unlocking said entrance and exit barriers.

7. A security system according to claim 5 wherein said means operative in response to said first and second signals includes a difference circuit operative to provide an output signal having a magnitude representing the difference between the magnitudes of said first and second signals;

and wherein said reference signal responsive means includes a comparator circuit receiving said reference signal and said output signal and operative to provide an alarm signal in the event that said output signal is of a magnitude representing a weight difference greater than that represented by the magnitude of said reference signal.

8. A security system a,cording to claim 7 including counting means operative in response to the presence of each individual at said entrance and exit zones to provide an indication of the number of individuals entering and leaving said controlled area.

9. A security system according to claim 7 wherein said weight determining means each includes a scale having a platform on which an individual is disposed for weighing.

* * * * *