United States Patent [19]

Laman

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[45] **July 31, 1973**

[54] **SECURITY SYSTEM FOR ARTICLE HANDLING APPARATUS**

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[52] **U.S. Cl.** **318/563,** 209/111.8, 242/181, 318/574

[51] **Int. Cl.** **G05b 9/02**

[58] **Field of Search** ..... 340/213 R, 421; 179/100.2 B; 242/181, 198; 274/4 F; 318/563, 565, 574; 109/38; 335/17; 209/80.5, 111.8

[56] **References Cited**

UNITED STATES PATENTS

2,941,738	6/1960	Burke	242/181
3,588,658	6/1971	Van Der Slyus	318/565 X
3,604,373	9/1971	Crowley et al.	109/38
3,629,822	12/1971	Johnson	179/100.2 B X
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Primary Examiner—Richard A. Schacher
Attorney—Herbert F. Somermeyer et al.

[57] **ABSTRACT**

In an automatic article handling system, the article carrying conveyor or carriage includes sensing means for sensing characteristics of an article to be conveyed. If a given characteristic exceeds a predetermined threshold, the conveyor is automatically disabled requiring manual intervention to restart it which protects stored articles from said given characteristic. In a magnetic record document system, the given characteristic may be a magnetic field exceeding a predetermined threshold external to the article to be conveyed. Such external magnetic field could be capable of altering magnetic documents stored in the article handling system. In another version, the given characteristic could be weight or other undesired phenomena exceeding a given threshold.

10 Claims, 6 Drawing Figures

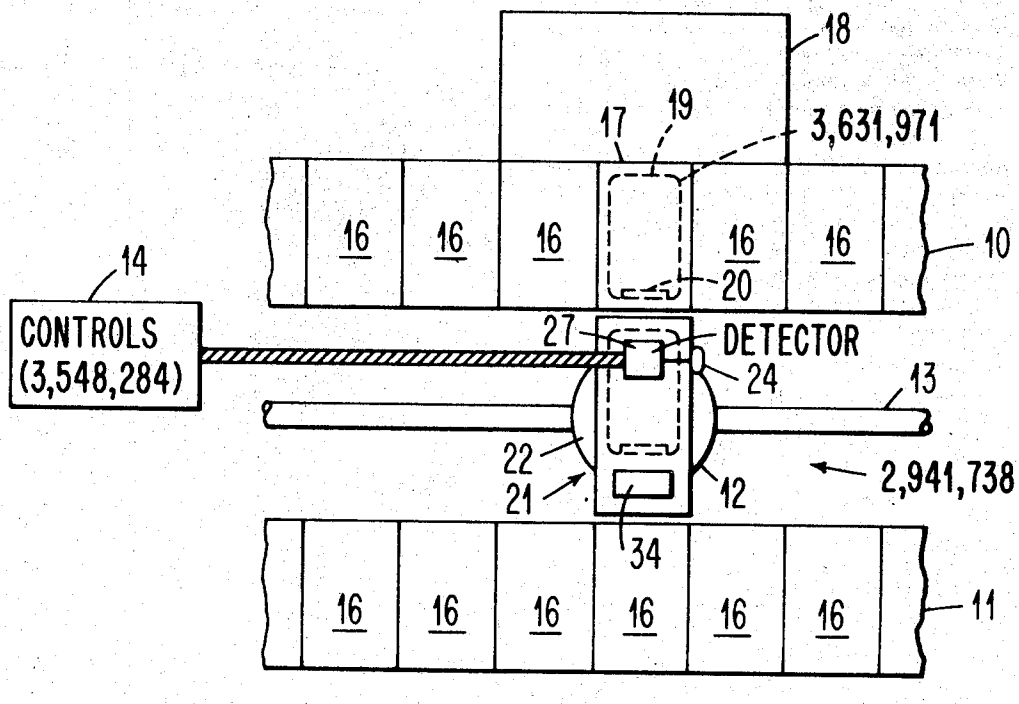


FIG. 1

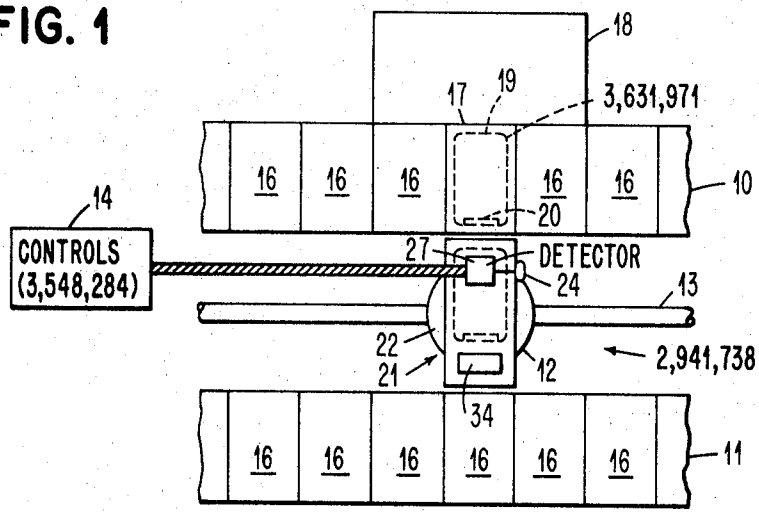


FIG. 2

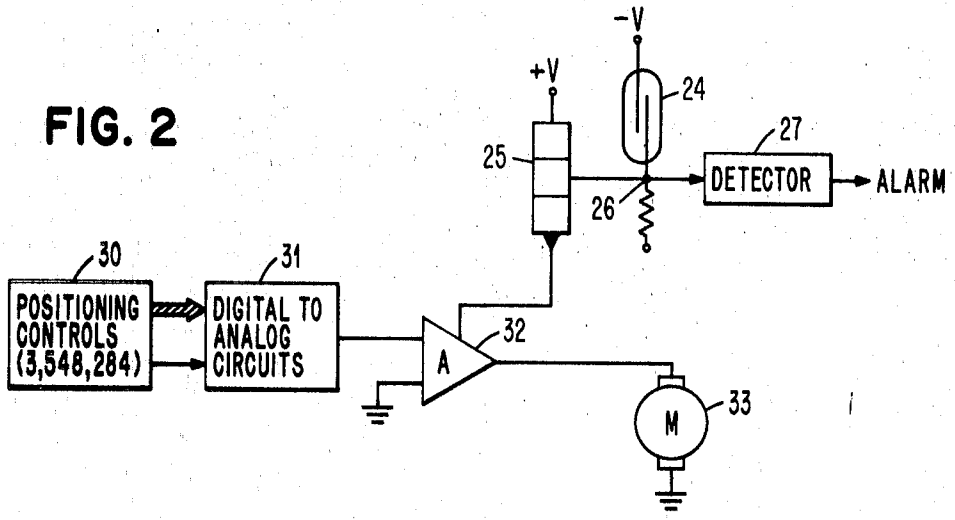


FIG. 3

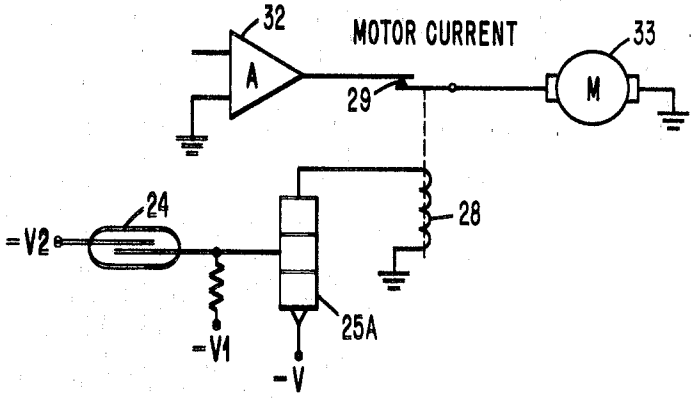


FIG. 4

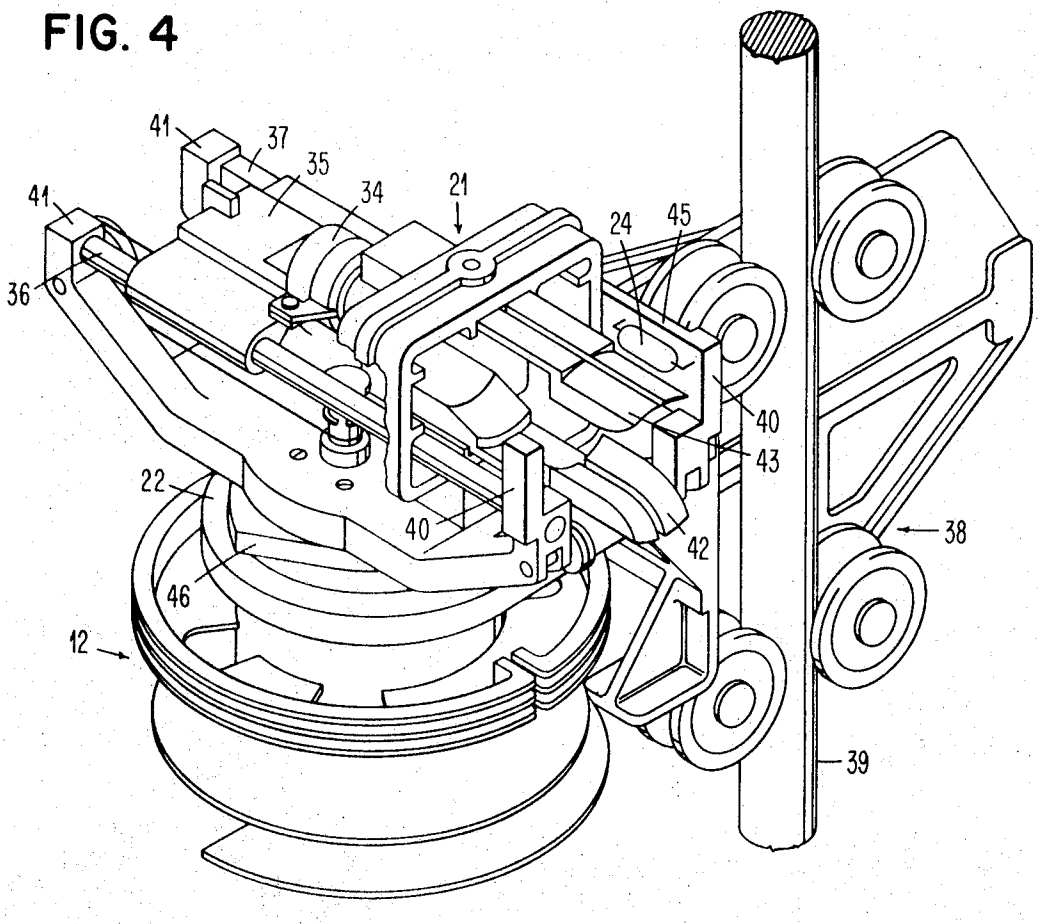


FIG. 6

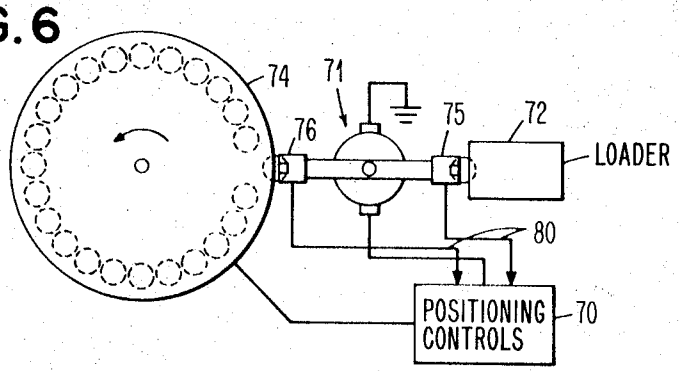
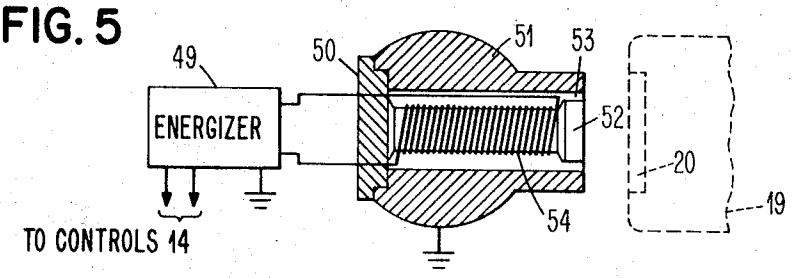


FIG. 5



SECURITY SYSTEM FOR ARTICLE HANDLING APPARATUS

BACKGROUND OF THE INVENTION

The present invention relates to secure article storage and retrieval systems of the automatic type, and particularly to those article handling systems adapted to handle erasable records.

Automatic article handling apparatus is susceptible to damage or alteration by intentionally inserted articles capable of being handled by the system which exhibits characteristics detrimental to stored articles or the article handling system itself. While such an intentional intrusion is to be avoided, sabotage operations, particularly by those individuals somewhat familiar with the article handling system, could avoid most security procedures and introduce articles exhibiting detrimental characteristics into the system.

Of particular interest is the data processing industry which relies heavily on magnetic records for storage of data bases, programs, and as an input media. Such records are magnetically alterable either intentionally or unintentionally by external magnetic fields either from a magnetic transducer, a permanent magnet held in the proximity of the media, or an electromagnet. Because of the values ascribed to the records recorded on such media, it is of utmost importance that the integrity of the recorded information be maintained at an exceptionally high value. Undesired magnetic radiation can alter the record such that the data is no longer retrievable. The susceptibility of such records when recorded using nonsaturating recording techniques may be higher than those utilizing saturable recording. Nonsaturating recording techniques are usually found in the higher density recording systems, i.e., those systems usually associated with high-performance data processing systems. This means the data contained in such records may have a higher value than those using saturating magnetic recording and, hence, should be more closely protected.

Many present-day data processing systems rely on manual transportation of the tape volumes, disk packs, or other magnetic media from a set of storage compartments to a read/write station. Facilities have been provided for preventing access to storage compartments through the use of Hall Effect detectors; that is, a safe containing a plurality of magnetic records would not be openable in the presence of a magnetic field which would tend to erase or destroy the magnetic records contained within the safe. Even at this, upon removal of the record media from the safe, there is an exposure that subsequently generated stray fields could inadvertently or intentionally erase the records before data processing operations could retrieve the information.

In automatic magnetic media libraries, such as that shown in Burke et al., U.S. Pat. No. 2,941,738, in addition to erasing or altering a single record volume such as a reel of tape, a magnet could be disposed in the XY carriage of the Burke et al tape library and, under programmed control, alter each and every tape volume contained in the tape compartments of the library; that is, a permanent magnet disposed in a tape container could be loaded onto the XY carriage with the carriage programmed to access or pass by every storage compartment thereby exposing every tape reel to the effects of the permanent magnet fields.

In other article handling systems, similar problems can be encountered.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved article handling system which automatically detects intrusion of an article exhibiting undesired characteristics and prevents handling of such article within a system.

According to the present invention, an article storage and retrieval apparatus has a plurality of article storage compartments with article accessing means relatively movable with respect thereto. Article transfer ports are provided for exchanging articles outside of the apparatus. On the accessing means capable of containing at least one of the articles, there is provided sensing means for sensing a given characteristic of an article when carried and, upon detecting the given characteristics exceeding a given threshold, the accessing means is deactivated. Such detection may occur when the accessing means receives the article or while transporting the article.

In a document processing apparatus constructed as set forth above, the given characteristic may be an external magnetic field; and the sensing means may be a so-called magnetic reed switch which is responsive to the external magnetic field to open or close an electric circuit which controls the accessing means. In other article handling systems, other characteristics can be sensed for controlling the operation of the storage and retrieval apparatus in accordance with the invention.

The foregoing and other objects, features, and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawing.

THE DRAWING

FIG. 1 is a greatly simplified diagrammatic illustration of the present invention when used to detect a magnetic field emanating from an article which exceeds a given threshold.

FIG. 2 is a simplified block signal flow diagram of a control circuit usable with the FIG. 1 illustrated apparatus.

FIG. 3 is a second simplified circuit diagram illustrating control for an accessing means in accordance with the present invention.

FIG. 4 is a simplified perspective view of an article carrying mechanism with which the present invention may be practiced.

FIG. 5 is a simplified and diagrammatic showing of an electromagnetic picker assembly usable with the FIG. 4 illustrated apparatus.

FIG. 6 is a simplified diagrammatic showing of a second embodiment of the present invention.

DETAILED DESCRIPTION

FIG. 1 is a simplified plan view of a dual wall tape storage article and retrieval system constructed in accordance with Burke et al., U.S. Pat. No. 2,941,738. A pair of facing open-sided storage walls **10** and **11** have an XY carriage **12** movable therebetween along track **13**. A set of controls **14**, which may include the apparatus shown in U. S. Pat. (Beach et al.) No. 3,584,284, controls XY carriage **12**. Each storage wall **10** and **11** has a plurality of storage compartments **16** arranged in

a rectangular array such as shown in the Burke et al. patent supra. Additionally, one or more input/output ports **17** extend through the array between storage compartment **16** from an article processing station **18**, which may be a tape drive as shown in Burke et al. supra, and the open side of storage wall **10**. Port **17** may be replaced by other cartridge transfer devices, such as an array of compartments pluggable into one of the storage walls **10** or **11**. The tape volumes or tape cartridges usable with the present invention are preferably of the type shown in U. S. Pat. (Rinkleib) No. 3,631,971, or suitable modifications thereof. That is, it is preferred that the media cartridge be relatively small, for example, roughly two inches square and three inches long. Such media, when recorded, exhibits a small or limited external magnetic field enabling sensing of recorded signals, as is well known.

In one system incorporating the invention, electromagnetic selection of a cartridge **19** from the I/O port **17** or any of the compartments **16** uses a magnetizable or magnetic disk **20** disposed at one end of the cartridge and an electromagnet as shown in FIGS. **4** and **5**. The detector as described herein will also detect objectional stray magnetic fields from such electromagnet.

All of cartridges **19** in storage compartments **16** have magnetic disk **20** facing toward track **13**. Accordingly, XY carriage **12** has a mechanism to access or store cartridges **19** with magnetic disk **20** facing toward track **13**. This means the orientation of the cartridge in wall **10** is opposite to the orientation of the cartridge in wall **11**. Accordingly, XY carriage **12** swivels with the cartridge accessing mechanism generally denoted by numeral **21** being pivotably secured on rotatable platform **22**, as best seen in FIG. **4**.

In accordance with the present invention, a sensing element such as magnetic reed switch **24**, is suitably mounted upon accessing mechanism **21**. Mechanism **21** fetches cartridge **19** from I/O port **17** or equivalents or any of the storage compartments **16** and places it on carriage **12** for transport to another location such as described in Beach et al. U.S. Pat. No. 3,584,284. Upon the cartridge being completely inserted in accessing mechanism **21**, magnetic reed switch **24** senses the external magnetic field of the cartridge **19** to be transported. If the magnetic field exceeds the threshold determined by the characteristics of magnetic reed switch **24**, the switch opens an electrical circuit under influence of the external magnetic field. Such open circuit is detected by detector **27** with an alarm signal being sent to controls **14**. Such an alarm signal and control of XY carriage **12** is best understood by next referring to FIGS. **2** and **3**.

When arrays **10** or **11** have a plurality of input ports **17**, placing sensing means or reed switch **24** on the carriage simplifies circuit design. It also enables the sensing means to detect generation of a magnetic field after an article is being transported. For example, an inertial switch could connect a battery to an electromagnet or a radio signal could be used to actuate an electromagnet after intrusion into the system.

In FIG. **2**, positioning controls **30** constructed in accordance with the Beach et al patent, supra, drive digital analog circuit or converter **31** which may favorably correspond to the D-to-A converter **160** of the Beach et al. patent. The analog output of converter **31** is supplied through power amplifier **32** (compare with the Beach et al. amplifier **165**) to drive XY carriage motor **33**. In the FIG. **2** illustration, the +V voltage supply for power amplifier **32** is supplied through power-switch transistor **25**, thence to amplifier **32**. Reed switch **24**, when open (not under the influence of an external magnetic field above the selected threshold), permits +V supply to actuate transistor **25** to current conduction for operating motor **33**. Accordingly, XY carriage **12** can be operated under controls **14**. As soon as the magnetic field is encountered by reed switch **24**, such as would be provided by a powerful permanent magnet inserted into a cartridge **19**, reed switch **24** closes supplying −V for making transistor **25** nonconductive, thereby removing power from amplifier **32**. This disables motor **33** preventing any movement of XY carriage. An elevator motor (not shown) effecting vertical motion to picker mechanism **21** can be similarly controlled. Dynamic braking of motor **33** for preventing any motion whatsoever of carriage **12** can be provided in accordance with the teaching of H. E. Van Winkle in the IBM TECHNICAL DISCLOSURE BULLETIN, Volume 14, No. 2, July 1971, on Page 384.

An alarm may be sounded by adding detector **27** to sense the voltage at **26**. If there is positive voltage, detector **27** supplies a "normal" signal. However, if point **26** is negative, detector **27** supplies an alarm signal to sound an alarm. Appropriate manual intervention or CPU control of the article handling system can then be provided. The alarm, for example, could trigger an interruption signal to the controlling data processing for enabling the data processor to automatically exercise control over the article handling system for preventing any operation whatsoever until appropriate manual intervention has been completed.

In the event transistor **25** does not have the current conducting capabilities required by amplifier **32**, a relay may be interposed. For example, in FIG. **3**, amplifier **32** supplies its motor-driving current through the normally open relay contacts **29** to motor **33**. Relay coil **28** closes contacts **29** as long as reed switch **24** has its contacts open, i.e., outside the effect of a strong external magnetic field. Upon power off, or upon the detection of an external magnetic field, contacts **29** open causing motor **33** to become inactive. Transistor **25A** actuates relay coil **28** in the same manner that transistor **25** conveyed power to amplifier **32**.

Referring next to FIG. **4**, a simplified perspective view illustrates a pivotal accessing mechanism having sensing element **24** mounted thereon. Platform **22** is mounted on vertically movable carriage **38** which, in turn, is mounted on a horizontally movable carriage (not shown). Vertical guide rod **39** guides accessing mechanism **21** along a desired vertical path. Each cartridge being transferred is received between a pair of outwardly extending bifurcated resilient cartridge-receiving fingers **42** and **43**. Reciprocating electromagnet **34**, shown in FIG. **5**, is on reciprocating carriage **35** movable along guideways **36** and **37**. To fetch a cartridge or store same, carriage **35** is moved against stops **40**, the electromagnet energized by energizer **49** (FIG. **5**), and the electromagnet assembly moved to abut stops **41**, the cartridge traveling position. Actuation of carriage **35** is not further described, because any suitable means can be used therefor.

Once the cartridge (not shown) is secured between retaining fingers **42** and **43**, photoelectric sensing means (not shown) may indicate to the control circuit

that a cartridge is within the mechanism **21**. At this time, reed switch **24** is continuously sensing for external magnetic fields for controlling the electrical power to the carriage motors as shown in FIGS. **2** and **3**. An electronic detector-amplifier (not shown) may be mounted on the back side of mounting circuit board **45**. Suitable cabling extends between the carriage and the control circuits, details of which are not pertinent to the practice of the present invention.

Accessing mechanism **21** being pivotally secured on platform **22** has detent **46** engagable with a detent receiving means (not shown) on the opposite side for aligning electromagnet **34** with a storage compartment for accessing or storing a cartridge. Suitable motors are mounted on the carriage for rotating the accessing mechanism, actuating electromagnet carriage **35**, and moving platform **22** vertically.

The electromagnet is diagrammatically shown in FIG. **5**. It includes magnetic back plate **50** with an annular outer pole **51** extending around the entire assembly. A rod-shaped inner pole **52** extends coaxially of outer pole **51**, forming annular gap **53** between the two pole pieces. The annular gap with the pole configurations limits the external magnetic field under normal operation to that being immediately proximate to the magnetic disk **20** shown in dotted line form. Winding **54** extends around inner pole **52** for supplying selective magnetic energy for securing the cartridge disk **20** to the electromagnet pole faces. Energizer or amplifier **49** selectively supplies current to coil **54** in response to suitable control signals from controls **14** (FIG. **1**). The generation of such control signals is not further described.

Referring next to FIG. **6**, a second embodiment of the present invention is illustrated. Positioning controls **70** control pivotal accessing mechanism **71** to exchange cartridges with loader **72**. When a cartridge is received in accessing mechanism **71** from loader **72**, mechanism **71** rotates clockwise toward continuously rotating storage carousel **74**. The timing is such, as controlled by control **70**, that as the cartridge holder **75** reaches a position adjacent carousel **74**, the cartridge can be ejected on the fly to the carousel. In a similar manner, cartridge holder **76** can receive a cartridge from carousel **74** for depositing in loader **72**. Both cartridge holders **75** and **76** have a sensing element such as reed switch **24** supplying alarm signals over lines **80** to control **70**. Control **70**, upon detecting an excessive external magnetic field in either holder **75** or **76**, de-energizes accessing mechanism **71** protecting the records contained in carousel **74**. The details of on-the-fly exchange of cartridges with loader **72** and carousel **74** are not pertinent to the practice of this invention and are not further described for that reason.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. An article storage and retrieval apparatus having a plurality of article storage compartments, article accessing means, an article I/O means, means effecting relative movement of said accessing means and said compartments and I/O means for automatically exchanging articles therebetween,

the improvement including in combination:

means on said accessing means for receiving a cartridge capable of containing one of said articles;

sensing means in said apparatus sensing for a given characteristic of an article inside said cartridge; and

control means responsive to said sensing means indicating said given characteristic to inhibit operation of said accessing means.

2. The apparatus set forth in claim **1** wherein said sensing means is on said accessing means.

3. The apparatus set forth in claim **2** wherein said articles being transported successfully by said accessing means exhibit said given characteristic always below a given threshold, and said control means being responsive to said sensing means indicating said given characteristic above said given threshold to inhibit operation, and detecting said given characteristic below said given threshold to permit operation of said accessing means.

4. The apparatus set forth in claim **3** wherein said given characteristic is an external magnetic field.

5. The subject matter set forth in claim **4** wherein said article constitutes a recorded magnetic record member erasable by an external magnetic field.

6. The subject matter of claim **5** wherein said sensing means includes a magnetic reed switch disposed on said accessing means; and

means establishing an article carrying position on said accessing means immediately proximate to said sensing means.

7. The subject matter of claim **6** further including motor control means and power supply means and electrical means including said reed switch electrically interposed between said power supply means and said motor control means for turning off the motor control means whenever said reed switch is actuated.

8. The subject matter of claim **7** further including electromagnet means on said accessing means and a magnetic disk on each of said articles adapted to be engaged with said electromagnetic means, and means actuating said electromagnetic means for picking said cartridge by electromagnetic attraction to said disk, and said electromagnetic means having an external field less than said given threshold.

9. A control for an article handling mechanism having a movable XY carriage with an article carrying portion,

the improved control including in combination:

motive control means for controlling said XY carriage;

power supply means;

electrical connecting means including sensing means on the carriage disposed in juxtaposition to said article carrying portion and electrically interposed between said power supply means and said motive control means; and

said sensing means having threshold means responsive to a given phenomenon which is a product of said article and being in proximate relation to said article carrying portion to effectively connect or disconnect said motive control means whenever said phenomenon is below or above a given threshold, respectively.

10. The control set forth in claim **9** wherein said phenomenon is a magnetic field and said threshold element is a magnetic reed switch actuable by a given strength magnetic field.

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