DEPARTMENT OF THE NAVY
OFFICE OF COUNSEL
NAVAL UNDERSEA WARFARE CENTER DIVISION
1176 HOWELL STREET
NEWPORT RI 02841-1708

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PATENT COUNSEL
NAVAL UNDERSEA WARFARE CENTER
1176 HOWELL ST.
CODE 00OC, BLDG. 112T
NEWPORT, RI 02841

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Inventor Robert C. Higgins

If you have any questions please contact James M. Kasischke, Deputy Counsel, at 401-832-4736.

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ELECTRONIC STATUS MONITORING SYSTEM FOR SECURITY CONTAINERS

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT ROBERT C. HIGGINS, an employee of the United States Government, citizen of the United States of America and a resident of Tiverton, County of Newport and State of Rhode Island, has invented certain new and useful improvements entitled as set forth above of which the following is a specification:

MICHAEL F. OGLO, ESQ.
Reg. No. 20464
Naval Undersea Warfare Center
Division, Newport
Newport, Rhode Island 02841-1708
TEL: (401) 832-4736
FAX: (401) 832-1231
ELECTRONIC STATUS MONITORING SYSTEM FOR SECURITY CONTAINERS

STATEMENT OF GOVERNMENT INTEREST

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

BACKGROUND OF THE INVENTION

(1) Field of the Invention

The present invention relates to an electronic monitoring system, and more specifically, to a system for monitoring the removal and attachment of a fastener, such as a locking bar, associated with a security container or cabinet, wherein a signal which is unique for each particular cabinet is sent to a centralized monitoring station which keeps track of the fastener status of all cabinets that are being used no matter where they are located.

(2) Description of the Prior Art

Containers and cabinets housing confidential, classified or even highly classified material commonly employ safety mechanisms that guard against unwanted exposure of the material
being housed to adverse contingencies. A common safety
mechanism is a fastener, which may be a locking bar, that is
arranged with a locking device so that when the bar is attached
to the cabinet the drawers being lodged in the cabinets are
prevented from moving outward, thereby, making safe to unwanted
exposure of the materials therein.

The locking bars serve well their intended purpose, but the
actual use thereof suffers practical drawbacks. More
particularly, sometimes the locking bar is removed to allow the
drawers to be opened and the contents thereof revealed to an
authorized person, but sometimes the authorized persons forget
to reattach the locking bar to the cabinet, thereby exposing the
contents of the cabinet to adverse contingencies. Further, the
cabinets are sometimes placed at remote locations preventing
them from being viewed during conduct of normal activities,
thereby, leaving the contents of cabinets susceptible to
uncontrolled viewing. Normally, monitoring these remote
locations undesirably involves time-consuming tasks of
individuals that sometimes suffer from human error drawbacks.
It is desired that a monitoring system be provided to determine
whether the safety mechanism is in place so as to secure the
container or cabinet no matter where the container or cabinet is
located.
SUMMARY OF THE INVENTION

It is an object of the present invention to provide for a system for monitoring the status of containers or cabinets housing confidential, classified or highly classified materials.

It is a further object of the present invention to provide an electrical status monitoring system that determines the presence or absence of the security mechanism that ensures the security of a container or cabinet, even if the container or cabinet is located at a remote location.

It is a further object of the present invention to display the security status information of a secured container or cabinet at a central location.

It is a further object of the present invention to provide for an electronic system for monitoring a large number of containers or cabinets containing proprietary or classified documentation located at remote facilities utilized for military or commercial applications.

It is a further object of the present invention to provide for a system for monitoring the secured condition of containers or cabinets containing secured information and which does not suffer high labor intensity cost, and human error drawbacks of prior art systems.

In accordance with one aspect, an electronic monitor is provided for detecting the presence and absence of a fastener
that secures a cabinet with the presence thereof preventing the opening of one or more drawers being housed in the cabinet. The electronic monitor comprises; (a) a first electrode fixed at a predetermined location of the fastener; and (b) a current sensing network having second and third electrodes located in the cabinet in a predetermined manner so that the first electrode contacts both the second and third electrodes when the fastener secures the cabinet. The current sensing network generates current flow and an output signal when the first, second and third electrodes are in contact and which is representative that the fastener is secured. The electronic monitor further comprises a (c) transmitter connected to the output of the current sensing network and generates a predetermined signal of a selected communication system upon detection of a change in current flow.

In accordance with another aspect, an electronic monitoring system is provided for detecting and displaying at a central location the presence and absence of one or more fasteners that respectively secure one or more cabinets with the presence thereof preventing the opening of one or more drawers being housed in each of the one or more cabinets. The electronic monitoring system comprises; (a) a first electrode fixed at a predetermined location on each of the respective fasteners; and (b) a current sensing network for each of the one
or more cabinets and having second and third electrodes located 
on a respective cabinet in a predetermined manner so that the 
first electrode of a respective fastener contacts both the 
second and third electrodes of its respective cabinet when the 
respective fastener secures the respective cabinet. The current 
sensing network generates current flow and an output signal when 
the first, second and third electrodes are in contact and which 
is representative that the respective fastener is secured. The 
electronic monitoring system further comprises a (c) transmitter 
located on each of the cabinets and connected to the output of a 
respective current sensing network and generating predetermined 
signals of a communication link upon detection of a change in 
said current flow. Each of the transmitters generates 
predetermined signals which are different from each other. The 
electronic monitoring system further comprises a (d) receiver 
located at the central location and accepting and recognizing 
all of the different predetermined signals of all of the 
transmitters and generating respective output signals 
representative of the presence and absence of respective 
fasteners attached to respective cabinets.

BRIEF DESCRIPTION OF THE DRAWINGS

The appended claims particularly point out and distinctly 
claim the subject matter of this invention. The various
objects, advantages and novel features of this invention will be
more fully apparent from a reading of the following detailed
description in conjunction with the accompanying drawings in
which like reference numbers refer to like parts and in which:

FIG. 1 is a block diagram of the electronic status
monitoring system of the present invention;

FIG. 2 illustrates a cabinet having a locking bar attached
thereto;

FIG. 3 illustrates a schematic of the electronics housed
on a cabinet associated with the present invention; and

FIG. 4 is a block diagram of the receiver of the
electronic status monitoring system of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawings, FIG. 1 illustrates an
electronic monitoring system 10 for detecting and displaying at
a central location 12 the presence and absence of fastener
devices including bars, locks and clamps located at a remote
location 14 and respectively secured to one or more cabinets 16₁,
16₂ ... 16ₙ, with the presence thereof preventing the opening of
one or more drawers being housed in each of the one or more
cabinets 16₁, 16₂, 16ₙ.

More particularly, each of the cabinets 16₁, 16₂ ... 16ₙ has a
fastener 18, which in one form may be a locking bar, that
secures the contents of a respective cabinet 16 from adverse
contingencies and electronics 20 that respectively generate
output signals 22₁, 22₂ ... 22ₙ which represent the presence and
absence of a respective fastener 18 securing a respective
cabinet 16.

Each of the output signals 22₁, 22₂ ... 22ₙ is accepted and
recognized by a receiver 24 at the central location 12. The
receiver 24 generates respective output signals of the received
signals which are representative of the presence and absence of
the respective fastener 18 securing the respective cabinet 16
and which are displayed, via signal path 26 to respective
indicators 28₁, 28₂ ... 28ₙ to be further discussed hereinafter with
reference to FIG. 4.

The purpose of the electronic monitoring system 10 is to
determine whether the fastener, such as a vertical locking bar
18 for a security container or cabinet 16 is attached or
unattached with the attachment thereof preventing the contents
of cabinets 16 from being viewed. The status of the
attached/unattached locking bar 18 is sent back to a central
monitor, more particularly, to receiver 24, which displays the
status information. This configuration shown in FIG. 1 may be
used in a military or commercial building to monitor the status
of a large number of cabinets 16 containing proprietary or
classified documentation no matter where the cabinets 16 are
located. In the military where classified information is stored
in security containers, such as cabinets $16_1\ldots16_n$ or in the
commercial environment where proprietary information may be
guarded, as well as secured, there is a need for a centralized
monitoring system, such as the electronic monitoring system 10
of the present invention. Further details of the cabinets $16_1,$
$16_2\ldots16_n$ and fasteners $18_1,$ $18_2\ldots18_n$ may be further described
with reference to FIG. 2.

FIG. 2 shows one type of cabinet 16 often used for storing
classified material having a locking bar 18, which is secured by
passing the locking bar 18 through metal brackets 16A and 16B
with 16A being below each drawer 32, 34, and 36 and dimensioned
to accept and hold the lower portion of the locking bar 18. The
top of the bar 18 is inserted through bracket 16B that allows a
combination lock 30 to be used to capture and lock the locking
bar 18. The interaction of the locking bar 18 with the
electronics 20 may be further described with reference to FIG.
3, which illustrates the details of the electronics 20 contained
in cabinet 16, as well as one embodiment of a guidance assembly
assisting the mating of the locking bar 18 to the cabinet 16 and
comprising magnets 40A and 40B.

In general, the magnet 40A is placed on the cabinet 16 with
42 and 44 electrodes attached to the magnet 40A as shown in FIG.
3. The other magnet 40B preferably rests on the surface of the
locking bar 18 and has an embedded electrode 46 that makes
contact with the other 42 and 44 electrodes when the magnets 40A
and 40B meet. If desired, the magnet 40B may be embedded in the
locking bar 18. The magnet 40B is positioned adjacent and
preferably in contact with the electrode 46 and, similarly, the
magnet 40A is positioned adjacent and preferably in contact with
the electrodes 42 and 44. When the locking bar 18 is put in
place, an electrical connection is made between the 42 and 44
electrodes in the cabinet 16 and the electrode 46 in the locking
bar 18, and current flows through the circuit included in the
electronics 20, as shown by directional arrows 48 and 50. When
the locking bar 18 is removed, the electrical connection between
the first, second and third (46, 42 and 44) is broken and the
current becomes 0. The presence of current flow, and more
particularly the change in current flow, causes the electronics
20 to generate signal 22 and which is representative that the
locking bar 18 has either been attached (presence) or unattached
(absence) to the cabinet 16.

More particularly, with reference to FIG. 3, the first
electrode 46 is fixed at a predetermined location on the
fastener 18 and the second and third electrodes 42 and 44,
respectively are located on the cabinet 16 in a predetermined
manner, so that when the locking bar 18 is inserted into the
brackets 16A and 16B, the first electrode 46 contacts both the
second and third electrodes 42 and 44 providing electrical
connection therebetween. Conversely, when the locking bar 18 is
removed from the cabinet 16 the electrical connection is broken.

Although the magnet 40A, and the bar magnet 40B perform
well in assisting the electrical mating of the electrodes 42, 44
and 46, other devices may be used. For example, the desired
mating may be accomplished by mechanical means, such as
extensions from the locking bar 18 mating with cutouts in the
cabinet 16. The primary function is to ensure that the first
electrode 46 electrically mates with the electrodes 42 and 44 of
the current sensing network 52 shown in FIG. 3 when the locking
bar 18 is in place.

The current sensing network 52 comprises a source of
electrical energy that may be selected from the group consisting
of a DC battery 54 and AC excitation 56, each of which have
first and second ends 58 and 60 respectively. The current
sensing network 52 further comprises a current sensor 62, as
well as the second and third electrodes 42 and 44 that are
spaced apart from each other, with the second electrode 42
connected to the first end 58 of the source of electrical
excitation. The third electrode 44 is connected to a second end
64 of the current sensor 62, which has its first end 66
connected to second end 60 of the source of electrical energy.
The current sensor 62 has an output 68 connected to the input of a transmitter 70.

The current sensor 62 operates in a manner known in the art and upon detection of a change in current flow, generates output signal on signal path 68. The output signal on signal path 68 may also activate a status light 72. The electronics 20 may further comprise test 74, which is connected across the electrodes 42 and 44, as shown in FIG. 3. The test switch 74, when depressed, causes current flow which is sensed by current sensor 62 which, in turn, generates an output signal on signal path 68 which, in turn, causes the transmitter 70 to generate the output signal 22.

The transmitter 70 generates a predetermined signal of a selected communication link upon the detection of current flow. The predetermined signal is preferably a radio frequency (RF) signal and the communication link may be selected from the group consisting of a frequency shift key (FSK) technique and an amplitude shift key (ASK) technique.

In one embodiment, an FSK sequence of pulses is transmitted by transmitter 70 whenever the current sensor 62 senses a change in the magnitude of the current, such as DC current going from 0 to a positive (+) quantity, or conversely when the DC current goes from a positive (+) quantity to 0. When the current sensor 62 detects a change in the current’s magnitude, the RF
transmitter 70 is activated and the FSK pulse stream commences.

A short sequence of pulses (10 pulses per sequence), each having
a duration of 10 milliseconds in one embodiment, provides a high
degree of reliability in the receiver 24 detection capability,
to be further described hereinafter with reference to FIG. 4.

An alerting device 88 of FIG. 4 (also to be further described
with reference to FIG. 4) at the centralized status monitor
receiver 24 associated with each cabinet 16₁...₁₆ₙ is initialized
at installation to the OFF state when the locking bar 18 is put
in place for the first time at its respective cabinet 16. After
installation, the alerting device 88 will remain OFF until a
sequence of pulses is received, indicating that the cabinet
₁₆₁...₁₆ₙ has been opened; then, the alerting device 88 will be
activated to the ON state. Thereafter, the alerting device 88
state will change each time a pulse sequence, in the form of
signal 22, is transmitted by transmitter 70 and received by
receiver 24.

A FSK pulse sequence will be transmitted when the locking
bar 18 is either removed or put in place and the electrical
connection between electrodes 42, 44 and 46 is either broken or
established. A bit switch device, which may be part of each
transmitter 70, enables one to set the cabinet identification
number (e.g., 001). More particularly, the transmitter 70
installed in cabinet 16₁, may be enabled to transmit the binary
code 001, whereas the transmitter 70 installed in cabinet 16₈ may
be enabled to transmit the binary code 111. The receiver 24, as
well as the alerting device 88, may be further described with
reference to FIG. 4.

The receiver 24 is shown in FIG. 4, which illustrates an
arrangement for handling cabinets 16₁...16₈ where each respective
transmitter 70 transmits an output signal 22₁, 22₂, ... 22₈. The
receiver 24 comprises an antenna 80, which receives all the
different signals from all the transmitters and provides a
respective output thereof. The receiver 24 further comprises a
band pass filter 82 that is selected to receive and pass all of
the predetermined signals 22₁...22₈ that are within the selected
band of frequencies of interest. The band pass filter 82
provides a respective output for each of its received signals.

The receiver 24 further comprises matched filters 84₁, 84₂,
84₃, 84₄, 84₅, 84₆, 84₇, and 84₈. Each of the filters 84₁...84₈ is
connected to the output of the band pass filter 82 and each is
separately selected to receive and pass a particular wave form
comprising an output signal and corresponding to a respective
transmitter. For example, matched filter 84₁ is selected to pass
the waveform that is particular to the transmitter 70 contained
in the electronics 20 of cabinet 16₁. Each output of the match
filter 84₁...84₈ is routed to a signal processor 86, which provides
respective output signals representative of the presence and
absence of the fastener 18 being secured to its respective cabinet 16. More particularly, for example, if the signal processor 86 receives a signal from the matched filter 84₁ that received signal represents a current change has been sensed by the current sensor 62 in cabinet 16₁, which, in turn, represents that the locking bar 18₁, has either been removed (absence) from cabinet 16₁, or installed (presence) on cabinet 16₁. The receiver 24 further comprises the cabinet status devices 28₁...28₈, previously discussed with reference to FIG. 1 and each of which comprise an alerting device 88 and a cabinet identification (ID) 90, each having a switch 92 and wherein the cabinet ID 90 displays the associated binary code, e.g., 000 for cabinet 16₁. Each of the cabinets 16₁...16₈ further preferably are respectively provided with a storage device 94₁...94₈, which tracks the number of pulses received.

The arrangement shown in FIG. 4 is associated with a conventional matched filter detector 84₁...84₈ for eight (8) possible FSK signals (1 per cabinet), a storage device 94, which tracks and records the number of detection’s in response to the signal processor 86, and an alerting device 88 showing the status of each cabinet 16 locking bar 18.

In this embodiment, the storage device 94 changes state when 5 out of 10 pulses are detected. At installation, the unique container identifier and FSK frequency sequence is set by
using the digital bit set mechanism shown in FIG. 4, that is, if
the locking bar 18 is in place the associated switch 92 is
closed. More particularly, for example, if locking bar 18₁ is in
place, then switch 92₁ is closed and the cabinet ID 90₁ is
energized indicated by binary code (000). This mechanism sets
the specific FSK frequency sequence unique to that cabinet. In
one configuration, the code is as follows: f₁ represents 0 and
f₂ represents 1. Cabinet 16₁, more particularly its transmitter
70, identified as 000 would generate an FSK sequence f₁, f₁, f₁;
cabinet 16₂, more particularly its transmitter 70, identified as
001 would generate an FSK sequence f₁, f₁, f₂; and cabinet 16₃,
more particularly its transmitter 70, identified as 111 would
generate an FSK sequence f₂, f₂, f₂.

In another embodiment, the FSK RF signal is replaced by an
ASK (amplitude shift key) signal. The number of FSK pulses or
ASK pulse per sequence may vary. The detection scheme, which
was 5 out of 10 in our example, may be redefined all done in a
manner known in the art.

It should now be appreciated that the practice of the
present invention provides for an electronic monitoring system
that allows a fastener, such as a locking bar 18 to be used in
an arrangement comprising of a large number of cabinets. The
monitoring system 10 enables the security person to obtain
information about the status of each cabinet 16. The electronic
monitoring system 10 of the present invention can be implemented at one location using a computer to display the status of each container which, yields the benefits of saving time and effort commonly expended by security persons in a military or commercial complex.

It will be understood that various changes and details, steps and arrangement of parts and method steps, which have been described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.
ELECTRONIC STATUS MONITORING SYSTEM FOR SECURITY CONTAINERS

ABSTRACT OF THE DISCLOSURE

An electronic monitoring system is disclosed for detecting the open and closed conditions of containers or cabinets containing confidential or classified information. The electronic monitoring system includes a current sensor that detects the presence of a locking bar secured to the containers. A current sensor located on each cabinet operatively cooperates with the transmitter that transmits a signal to a central location, which provides an indicator of the secured or non-secured condition of the container.