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REMOTE MONITORING UNIT1 BACKGROUND OF THE INVENTION

(1) Field of the Invention

The present invention generally relates to a remote monitoring unit, and more particularly to a remote monitoring unit for monitoring the security of a remote site building from a central control equipment via radio transmission.

(2) Description of the Prior Art

Conventionally, a security control system has been utilized as a countermeasure, for preventing crimes and disasters in a building (or an office) whose security is to be monitored. The security control system generally includes a camera, a fire detecting sensor and other sensors installed at a remote site location to be monitored, and a central control equipment installed in a security corporation. A video signal output by the camera and detection signals output by the sensors are transmitted from the building to the central control equipment via a transmission cable linking the monitored building to the central control equipment.

In a case of the security control system of the type described above, a security personnel at a location of the central control equipment always monitors the security of a plurality of buildings by means of video signals and detection signals received from the remote site, and controls operations of cameras and sensors installed in the monitored buildings in a concentrated manner. It is known that a camera, a temperature sensor, a gas sensor and other sensors are used as surveillance sensors installed in the monitored buildings. The temperature sensor senses the occurrence of a fire at a monitored location by detecting a



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1 temperature change there higher than a prescribed
level. The gas sensor senses the presence of smoke at
the monitored location by detecting a concentration of a
specific gas there greater than a prescribed level.

5 When the above described monitoring system is
used for security purposes, it is necessary to
separately install several surveillance sensors such as
a camera and a temperature sensor at different locations
of a remote site to be monitored. Also, it is necessary
10 to separately install several telephone lines or cables
for transmitting output signals of the respective
surveillance sensors from the remote site building to
the central control location. Separately made
installations of the sensors and the transmission lines
15 have been very troublesome. Thus, the installation of
the security control system becomes expensive, as the
system requires several surveillance sensors to be
placed in the remote site building.

 When a showroom of the building is monitored,
20 several surveillance sensors of the above described
security control system must be placed at locations of
the showroom; this is detrimental to the appearance of
objects being displayed in the showroom. It is thus
desirable that the surveillance sensors of the security
25 control system are built so as to be compact and not
detrimental to the appearance of the objects at the
monitored locations.

SUMMARY OF THE INVENTION

30 Accordingly, it is a general object of the
present invention to provide an improved remote
monitoring apparatus in which the above described
problems are eliminated.

1 Another and more specific object of the
present invention is to provide a remote monitoring
apparatus for use in a security control system, which
apparatus includes a plurality of different surveillance
5 sensors accommodated in an enclosure case and can be
easily and inexpensively installed at a location of a
monitored site with no undesired effects on the
appearance of the monitored object. The above mentioned
object of the present invention is achieved by a remote
10 monitoring apparatus which includes a camera for
producing a video signal from a picture of a remote site
location being monitored, an image processor for
outputting an image signal through an image processing
process from the video signal produced by the camera, a
15 microphone for producing a sound signal from a sound at
the remote site location, a temperature sensor for
outputting a detection signal when a temperature change
higher than a predetermined level is detected at the
remote site location, a gas sensor for outputting a
20 detection signal when a concentration of oxygen gas
smaller than a predetermined first level or a
concentration of hydrogen gas greater than a
predetermined second level is detected in the remote
site location, a converter for outputting digital
25 signals by converting the image signal of the image
processor, the sound signal of the microphone, the
detection signal of the temperature sensor, and the
detection signal of the gas sensor, and a radio
transmitter for transmitting the output digital signals
30 of the converter to a radio receiver of a control
equipment via radio transmission, the control equipment
being capable of telecommunications of the output
digital signals with a central control equipment via a

1 public line. In this remote monitoring apparatus, the
camera, the image processor, the microphone, the
temperature sensor, the gas sensor, the converter, and
the radio transmitter are built together in an enclosure
5 case to form the remote monitoring apparatus, and the
security of the remote site location is monitored from
the central control equipment by placing the remote
monitoring apparatus at the remote site location.

According to the remote monitoring unit of the
10 present invention, several surveillance sensors are
accommodated in the enclosure case, and it is not
necessary to separately place the surveillance sensors
and the transmission lines therefor at locations of a
remote site building to be monitored. Thus, the
15 installation of the remote monitoring unit can be easily
made at a low cost. The remote monitoring unit of the
present invention is constructed as a one-piece unit,
and no undesired effects result on the appearance of the
monitored object when the unit is installed. In
20 addition, the output signals of the surveillance sensors
3 through 6 are transmitted to the control center 7 via
radio transmission, thus preventing the transmission of
the signals from being inoperative when a fire occurs at
the monitored location as in the conventional monitoring
25 system which requires the installation of the
transmission lines for transmitting the signals.

Other objects and further features of the
present invention will become apparent from the
following detailed description when read in conjunction
30 with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG.1 is a plan view showing a preferred

1 embodiment of a remote monitoring unit according to the present invention;

FIG.2 is a sectional view showing the remote monitoring unit shown in FIG.1;

5 FIG.3 is a perspective view showing the remote monitoring unit accommodated in a domed case; and

FIG.4 is a block diagram showing a security control system which utilizes the remote monitoring unit according to the present invention.

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DESCRIPTION OF THE PREFERRED EMBODIMENT

A description will now be given, with reference to FIGS.1 through 3, of a preferred embodiment of a remote monitoring unit according to the present invention. FIGS.1 and 2 show a remote monitoring unit according to the present invention which is used in a security control system. As shown in FIGS.1 and 2, this remote monitoring unit 1 includes a case 2 for enclosing a black-and-white camera 3, a temperature sensor 4, a microphone 5, a gas sensor 6, an infrared lamp 28, a radio transmitter 12, and other component parts therein. The case 2 has an upper domed cover 2a and a lower base 2b, as shown in FIG.3. FIGS.1 and 2 show a condition of the remote monitoring unit when the upper domed cover 2a is removed from the lower base 2b.

The camera 3 of the remote monitoring unit 1 is a black-and-white, charged-coupled device (CCD) camera which utilizes solid-state image sensors to produce approximately 250 thousand picture elements. The picture receiving angle of the camera 3 is set to an angle of 120 degrees relative to a center line of the monitoring unit 1. The camera 3 having a relatively large height is arranged at an upper central portion of

1 the remote monitoring unit 1 corresponding to the top
center of the upper domed cover 2a. In the remote
monitoring unit 1 shown in FIG.3, only a top portion of
the camera 3 is exposed to the exterior, at the top of
5 the upper domed cover 2a. The temperature sensor 4, the
microphone 5, and the gas sensor 6, which are relatively
small in height, are arranged at lower peripheral
portions of the remote monitoring unit 1 corresponding
to outer peripheral portions of the lower base 2b. The
10 arrangement mentioned above allows the construction of a
remote monitoring unit having a smaller height than in
the prior art technology. The camera 3 generates a
video signal providing a motion picture of a monitored
location (e.g., an office or a showroom), and this
15 signal is output to the radio transmitter 12 via an
image processor 13 (shown in FIG.4).

The infrared lamp 28 is provided in the
vicinity of the camera 3 in order to project infrared
light to the monitored location so that a clear picture
20 of the monitored location can be taken by means of the
black-and-white camera 3. The infrared light emitted by
the infrared lamp 28 is invisible to the human eye. By
means of the camera 3 and the infrared lamp 28, it is
possible to pick up a picture of a very dark location so
25 that the conditions of such a location may be monitored
without bringing the remote monitoring unit to the
attention of a person illegally entering the location.
If a color camera is provided in the remote monitoring
unit, it is necessary to illuminate the monitored
30 location using a lamp which emits a visible light.
However, if the color camera is used, together with such
a lamp, a burglar entering the location would
immediately notice the presence of the camera and the

1 lamp. According to the monitoring unit of the present
invention, the black-and-white camera 3 and the infrared
lamp 28 are used together, and it is thus possible to
pick up a picture of a monitored location without
5 bringing the remote monitoring unit to the attention of
a person entering the location. Thus, the security of
the location can be effectively monitored.

The temperature sensor 4 of the remote
monitoring unit 1 is a thermoelectric sensor which
10 utilizes a platinum thermocouple for sensing a
temperature change due to the heat of a person entering
the monitored location. The temperature sensor 4 of
this embodiment uses a plurality of heat wires (e.g.
sixteen heat wires) to increase the accuracy of the
15 temperature measurement. By means of this temperature
sensor, it is possible to detect a temperature change
(due to the heat of a person entering the monitored
location) in the monitored location greater than a
predetermined normal temperature level. Thus, when a
20 burglar enters the monitored location wherein the
temperature sensor 3 is in operation, the temperature
sensor 3 outputs a detection signal to the radio
transmitter 12 via an A/D converter 15 (shown in FIG.4)
of the remote monitoring unit 1.

25 Instead of the temperature sensor of the type
mentioned above, an infrared sensor may also be used in
the remote monitoring unit 1. The infrared sensor
senses a change of infrared light effected when a heat
source moves in a measurement area. Thus, by means of
30 the infrared sensor, a temperature change greater than a
predetermined normal temperature level at the monitored
location can also be sensed. Hence, it is possible to
detect whether or not a person enters the monitored

1 location by means of the infrared sensor as in the case
of the above mentioned temperature sensor 4.

The microphone 5 of the remote monitoring unit
1 is a flat, non-directional microphone which can
5 collect a sound in various areas of the monitored
location. The microphone 5, during operation, generates
a signal from a sound in the monitored location, and
this signal is output to the radio transmitter 12 via
the A/D converter 15 immediately when a sound is
10 produced at the monitored location. The use of the flat
microphone allows the construction of a compact, thin
remote monitoring unit.

The gas sensor 6 is built in a one-piece form
as shown in FIGS.1 and 2. The gas sensor 6 is made from
15 a combination of a limited current type oxygen sensor
and a thin-film type hydrogen sensor, so that it can
detect whether or not a concentration of oxygen gas at
the monitored location is smaller than a predetermined
level, and detect whether or not a concentration of
20 hydrogen gas at the monitored location is greater than a
predetermined level. In this respect, it is known that
if a fire occurs in a closed place, a concentration of
hydrogen gas is increased and a concentration of oxygen
gas is decreased even before carbon dioxide is
25 increasingly produced due to the combustion reaction.
Thus, by means of the gas sensor 6, early detection of a
fire occurring at the monitored location can be
achieved. When the gas sensor 6 detects occurrence of a
fire at the monitored location, the gas sensor 6 outputs
30 a detection signal to the radio transmitter 12 via the
A/D converter 15.

In the remote monitoring unit 1 according to
the present invention, the camera 3, the microphone 5,

1 and the infrared lamp 28 are normally switched off and
not in operation. When any abnormal condition (gas or
heat) of the monitored location is detected by either
the gas sensor 6 or the temperature sensor 4, the
5 operations of the camera 3, the microphone 5, and the
infrared lamp 28 are immediately commenced in response
to the detection signal output by either the gas sensor
6 or the temperature sensor 4. Therefore, when the
occurrence of a fire at the monitored location is
10 detected by the gas sensor 6, the detection signal and
the picture of the monitored location are transmitted by
the radio transmitter 12 from the remote monitoring unit
to a radio receiver of a control center via radio
transmission. The above mentioned information is
15 further transmitted from the control center to a central
control equipment via a public line. The occurrence of
a fire is then notified to an operator at the central
control equipment by utilizing the picture signal and
the detection signal, and he can view the picture of the
20 monitored location displayed on a monitor of the central
control equipment so as to check whether or not a fire
has actually occurred at the monitored location.
Accordingly, a countermeasure can be quickly taken in
accordance with the causes and conditions of the fire
25 occurring therein or any person entering the monitored
location. Also, erroneous detection of a fire or
intruder due to a malfunction of the security control
system can be discovered in advance.

The remote monitoring unit 1 includes the
30 image processor 13 (shown in FIG.4), for receiving an
image signal from the camera 3 and performing the image
processing for the received image signal. It also
includes the A/D converter 15 for receiving the signals

1 from the sensors 4 through 6 and the image processor 13,
to produce digital signals therefrom, and it includes a
control part 30 (shown in FIG.4) for receiving the
detection signals of the sensors 4 and 6 so as to
5 control operations of the camera 3, the microphone 5 and
the infrared lamp 28 in response to the detection
signals being received. These circuits of the remote
monitoring unit 1 are mounted on three printed circuit
boards 8 through 10. The remote monitoring unit 1 of
10 this embodiment having four surveillance sensors
accommodated in the enclosure case 2 requires several
electronic parts 11 for processing the output signals of
these surveillance sensors. The electronic parts 11 are
divided into three groups, and they are respectively
15 arranged on the printed circuit boards 8 through 10.

As shown in FIG.2, the first printed circuit
board 8 with the largest surface area is raised from the
lower case 2b of the case 2, the second printed circuit
board 9 with an intermediate surface area is raised from
20 the first board 8, and the third printed circuit board
10 with a smallest surface area is raised from the
second board 9. The printed circuit boards 8 through 10
on which the electronic parts 11 are mounted are thus
arranged, and they are built on the case 2 such that
25 peripheral portions of each of the boards 8 though 10
are in accordance with the configuration of the upper
domed cover 2a. This arrangement also allows the
construction of a compact, thin remote monitoring unit.

The radio transmitter 12 of the remote
30 monitoring unit 1 transmits the output signals of the
surveillance sensors 3 through 6 from the remote
monitoring unit 1 to a control center 7 (shown in FIG.4)
via radio transmission. The radio transmitter 12 has a

1 built-in antenna 17 and is formed in a small-sized
transmitter. As described above, the radio transmitter
12 is provided in the remote monitoring unit 1 at a
peripheral portion of the lower base 2b which is located
5 outside the printed circuit boards 8 through 10. This
arrangement allows the construction of a compact, thin
remote monitoring unit.

As described above, the remote monitoring unit
1 includes several surveillance sensors 3 through 6
10 accommodated in the case 1, and it is not necessary to
separately install the sensors and the corresponding
transmission lines at various locations of a remote site
building to be monitored. Thus, the installation of the
remote monitoring unit can be easily made at a low
15 cost. The remote monitoring unit is constructed as a
one-piece unit, and the unit installed at the remote
site location is not detrimental to the appearance of a
monitored object. Also, the remote monitoring unit can
be easily assembled and the manufacture can be made at a
20 low cost.

It should be noted that the black-and-white
camera 3, the microphone 5, and the infrared lamp 28 are
not always in operation in the remote monitoring unit
1. The operations of the camera 3, the microphone 5,
25 and the lamp 28 are commenced immediately when any
person entering the monitored location is detected by
the temperature sensor 4 or when a predetermined level
of the concentration of hydrogen gas or oxygen gas is
detected by the gas sensor 6. Thus, an increased life
30 of each of these parts can be achieved, and the power
required for the operations of the remote monitoring
unit can be reduced because the camera 3, the infrared
lamp 28, and the microphone 5, requiring a relatively

1 large consumption of power, are less frequently driven.

Next, a more detailed description will be given of operations performed by the remote monitoring unit according to the present invention. FIG.4 shows
5 the arrangement of a security control system which utilizes the remote monitoring unit according to the present invention. In FIG.4, those parts which are the same as corresponding parts shown in FIGS.1 and 2 are designated by the same reference numerals, as in the
10 previous figures. As shown in FIG.4, the security control system includes at least a remote monitoring unit 1 as described above, a remote site control center 7 for receiving information from the monitoring unit 1 and transmitting the information, and a central control
15 equipment 14 for receiving the information from the control center 7.

In general, the security control system to which the present invention is applied has a hierarchical structure including the central control
20 equipment 14, a plurality of control centers 7, and a plurality of remote monitoring units 1. The central control equipment 14 is installed in, for example, a security corporation, and receives monitoring information from each of the control centers 7 and
25 controls operations of the control centers 7. Each control center 7 is installed in, for example, a guard operation room of a remote site building to be monitored. The remote monitoring units 1 are respectively installed in compartment rooms of the
30 remote site building. Each control center 7 in the guard operation room of the building receives monitoring information from each of the remote monitoring units 1 in the building, and transmits the received information

1 from the remote site building to the central control
equipment 14 of the guard corporation via a public line.

As shown in FIG.4, the remote monitoring unit
also includes a control part 30 for controlling
5 operations of the above described parts including the
camera 3, the temperature sensor 4, the microphone 5,
the gas sensor 6, the infrared lamp 28, the image
processor 13, the A/D converter 15, and the radio
transmitter 12. In the remote monitoring unit described
10 above, only the temperature sensor 4 and the gas sensor
6 are normally in operation; the camera 3, the
microphone 5 and the infrared lamp 28 are normally
switched off and not in operation. When a temperature
change greater than a predetermined level due to the
15 heat of a person entering the monitored location or a
fire occurring therein is detected by the temperature
sensor 4, or when a concentration of oxygen gas smaller
than a predetermined level, or a concentration of
hydrogen gas greater than a predetermined level due to a
20 fire occurring therein is detected by the gas sensor 6,
the output signal of the temperature sensor 4 and/or the
output signal of the gas sensor 6 are sent to the
control part 30. Then, the control part 30 respectively
switches on the camera 3, the microphone 5 and the
25 infrared lamp 28 by sending a control signal to these
parts 3, 5 and 28 in response to the output signal of
the temperature sensor 4 or the output signal of the gas
sensor 6. Thus, the operations of the camera 3, the
infrared lamp 28, and the microphone 5 are commenced by
30 the control part 30, so that the camera 3 takes a
picture of the monitored location, the microphone 5
collects sound therein, and the infrared lamp 28
projects infrared light to the monitored location.

1 The image processor 13 of the remote
monitoring unit 1 receives a picture of a monitored
object picked up by the camera 3, performs an image
processing for the received picture, and outputs a
5 signal, indicating the picture of the monitored object,
to the A/D converter 15. The output signal of each of
the temperature sensor 4, the microphone 5 and the gas
sensor 6 are also output to the A/D converter 15. The
A/D converter 15 converts the output signals of the
10 surveillance sensors to digital signals. The radio
transmitter 12 transmits the digital image signal and
the digital detection signals (which are received from
the A/D converter 15) to the radio receiver 16 of the
control center 7 via radio transmission. The radio
15 transmitter 12 of the remote monitoring unit 1 includes
a built-in antenna 17, and the radio receiver 16 of the
control center 7 includes an antenna 18.

When digital signals from the remote
monitoring unit 1 are received by the radio receiver 16
20 of the control center 7, the received digital signals
are converted by a modem 19 into a signal form suitable
for long-distance transmission. The modulated signals
are transmitted from the control center 7 to the central
control equipment 14 via a public line 23 (such as a
25 telephone line). In the meantime, the digital signals
received at the modem 19 are also sent to a D/A
converter 20 of the control center 7, and the D/A
converter 20 converts the received digital signals into
analog signals. These analog signals are supplied from
30 the converter 20 to a monitor 21 and an alarm unit 22.
At the monitor 21, the picture of the monitored location
taken by the camera 3 is displayed. The alarm unit 22
produces a suitable acoustic or visible alarm

1 information in accordance with the received analog
signal when the signal received from the remote
monitoring unit 1 indicates the detection of any
disaster or intruder at the monitored location.

5 When the signals from the remote monitoring
unit 1 are received by the central control equipment 14
via the public line 23, a modem 24 of the central
control equipment 14 reconverts the received signals,
and a converter 25 converts the signals into a suitable
10 form. The converted signals from the converter 25 are
then input to a host computer 26, and the corresponding
monitoring information indicated by the received signals
is stored in a storage medium of the host computer 26.

 In the above described embodiment, the
15 black-and-white camera 3, the temperature sensor 4, the
microphone 5, the gas sensor 6, the image processor 13,
and the infrared lamp 28 are all accommodated in the
case 2. However, a remote monitoring unit including all
these parts in the case 2 is not always necessary. For
20 example, when an unmanned room into which no person will
enter is to be monitored, it is not necessary to provide
the microphone 5 in the remote monitoring unit 1. When
the monitored location is not a dark place, it is not
necessary to provide the black-and-white camera 3 and
25 the infrared lamp 28 in the remote monitoring unit, or a
color camera can be used instead.

 Further, the present invention is not limited
to the above described embodiment, and variations and
modifications may be made without departing from the
30 scope of the present invention.

1 PATENT CLAIMS

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1. A remote monitoring apparatus for monitoring security of a remote site location from a central control equipment via radio transmission, said remote monitoring apparatus comprising:

10 camera means (3) for producing a video signal from a picture of a remote site location being monitored;

an image processor (13) for outputting an image signal through an image processing process for said video signal produced by said camera means;

15 a microphone (5) for producing a sound signal from a sound at said location;

a temperature sensor (4) for outputting a detection signal when a temperature change higher than a predetermined level is detected at said location;

20 a gas sensor (6) for outputting a detection signal when a concentration of oxygen gas smaller than a predetermined first level or a concentration of hydrogen gas greater than a predetermined second level is detected in said location;

25 a converter (15) for outputting digital signals by converting said image signal of said image processor, said sound signal of said microphone, said detection signal of said temperature sensor, and said detection signal of said gas sensor; and

30 a radio transmitter (12) for transmitting said output digital signals of said converter to a radio receiver of a control equipment via radio transmission, said control equipment being capable of

1 telecommunications of said output digital signals with a
central control equipment via a public line,
characterized in that said camera means (3),
said image processor (13), said microphone (5), said
5 temperature sensor (4), said gas sensor (6), said
converter (15), and said radio transmitter (12) are
built in an enclosure case (2) to form said remote
monitoring apparatus (1), and the security of said
remote site location is monitored from said central
10 control equipment by placing said remote monitoring
apparatus (1) at said remote site location.

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2. A remote monitoring unit according to
claim 1, characterized in that said camera means (3) and
said microphone (5) are normally not in operation, and
start operating when said detection signal is output by
20 said temperature sensor (4) due to said temperature
change.

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3. A remote monitoring unit according to
claim 1, characterized in that said camera means (3) and
said microphone (5) are normally not in operation, and
start operating when said detection signal is output by
30 said gas sensor (6) due to either said concentration of
said oxygen gas lower than the predetermined first level
or said concentration of said hydrogen gas higher than
the predetermined second level.

1 4. A remote monitoring unit according to
claim 1, characterized in that said camera means (3)
comprises a black-and-white camera, and an infrared lamp
(28) provided in the vicinity of said black-and-white
5 camera for projecting infrared light to said remote site
location.

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 5. A remote monitoring unit according to
claim 1, characterized in that said enclosure case (2)
includes an upper domed cover (2a) and a lower base
(2b), and said camera means (3) includes a
15 black-and-white camera utilizing a number of solid-state
image sensors, said camera being arranged at an upper
central portion of said case whose location corresponds
to a top central portion of said upper domed cover (2a),
said temperature sensor (4), said microphone (5) and
20 said gas sensor (6) being arranged at lower peripheral
portions of said case, said lower peripheral portions
having locations corresponding to outer peripheral
portions of said lower base (2b).

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 6. A remote monitoring unit according to
claim 1, characterized in that said gas sensor (6) is
30 formed with an oxygen sensor and a hydrogen sensor, said
oxygen sensor detecting whether or not a concentration
of oxygen gas in said remote site location is smaller
than said predetermined first level due to a fire

1 occurring therein, and said hydrogen sensor detecting
whether or not a concentration of hydrogen gas in said
remote site location is greater than said predetermined
second level due to a fire occurring therein, a
5 detection signal thus being output to said converter
(15) when said concentration of said oxygen gas is
smaller than said predetermined first level, or when
said concentration of said hydrogen gas is greater than
said predetermined second level.

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