

ALARM REPORTING APPARATUS

BACKGROUND OF THE INVENTION

5 1. Field of the Invention

 This invention relates to an alarm reporting apparatus used for an alarm system utilizing a telephone line and, more particularly, to an alarm reporting apparatus capable of monitoring disconnection of a
10 telephone line.

2. Description of the Related Art

 Various alarm systems for centrally monitoring buildings, condominiums, etc., by installing an alarm reporting apparatus in each building, connecting this
15 alarm reporting apparatus to a monitoring center at a remote place and monitoring the buildings at a monitoring center have been put into practical application. Various sensors such as burglar sensors, disaster sensors, etc., are connected to the alarm reporting apparatus in such an
20 alarm system, and when any of these sensors detects abnormality, an alarm report is made to the monitoring center through the telephone line. When the telephone line is disconnected for some reason or other in this alarm system, the alarm report does not reach the
25 monitoring center even the sensor detects abnormality, and the alarm system does not function.

 Therefore, a signal is periodically transmitted from the alarm reporting apparatus to the monitoring center, at a time interval of one to two hours, for
30 example, and the monitoring center monitors the periodical transmission of this signal. If this signal is not periodically received, the monitoring center judges that the telephone line is disconnected, and guards are sent to the corresponding building to confirm
35 safety and to take necessary measures in accordance with the situation.

 At the alarm reporting apparatus end, on the

other hand, a current flowing through the telephone line is monitored at the time of transmission of the periodical signal described above. If the current is not detected at this time, the alarm reporting apparatus
5 judges that disconnection exists in the telephone line, and alerts stand-by personnel, by sounding a buzzer, that the telephone line is disconnected. Between the transmissions of the periodical signal, the telephone line is open and the detection of disconnection by the
10 line current cannot be made. Therefore, a voltage between the lines is monitored while the line is open, and the telephone line is judged as being disconnected if the voltage is not detected.

However, detection of the line voltage is
15 conducted by connecting a high resistance between the telephone lines to cause a very small current to flow and detecting this very small current. In other words, since the detection of disconnection by monitoring the line voltage is effected by detecting a smaller current in
20 comparison with the monitor for the line current, it is easily susceptible to the influence of noise and is likely to invite an erroneous judgement. In contrast, since the monitor for disconnection using the line current uses a greater current value and is less affected
25 by noise, disconnection can be detected more reliably. It may be therefore conceivable to shorten the transmission interval of the periodical signal and to increase the number of times of monitoring by the line current. In this case, however, another problem develops
30 in that the operating cost of the system increases because the number of times of transmission increases.

SUMMARY OF THE INVENTION

In an alarm reporting apparatus for reporting the occurrence of an abnormality to a destination through a
35 telephone line, the present invention is directed to detecting disconnection of a telephone line at low cost without inviting an erroneous judgement.

The present invention was completed in order to accomplish the object described above. In an alarm reporting apparatus for reporting the occurrence of an abnormality to a predetermined destination upon detecting
5 such abnormality, the apparatus monitors a voltage applied between the telephone lines when the telephone lines are open. When any abnormality is detected by the monitor using the line voltage, the telephone line is closed and a line current is monitored. When any
10 abnormality is detected during the monitoring of this line circuit, the apparatus judges that the telephone line is disconnected, and outputs a disconnection signal.

To accomplish such an object, the alarm reporting apparatus comprises line voltage monitor means for
15 monitoring a line voltage when a telephone line is open, and detecting an abnormality of the line voltage; line current monitor means for monitoring a line current when the telephone line is closed, and detecting an
20 abnormality of the line current; line closing means for effecting the closing operation of a D.C. circuit of the telephone line; and disconnection judgement means connected to the line voltage monitor means, the line current monitor means and the line closing means.

When the line voltage monitor means detects an
25 abnormality, the disconnection judgement means causes the line closing means to close the D.C. circuit of the telephone line, and when the line current monitor means subsequently detects an abnormality when the line is closed, the judgement means judges that a disconnection
30 has occurred in the telephone line, and outputs a disconnection signal. When no abnormal input is given by the line current monitor means while the line is closed, the judgement means judges that no disconnection exists in the telephone line.

35 According to this construction, when a disconnection occurs while the telephone line is open, the line voltage drops and the line voltage monitor means detects an

abnormality. Next, when the line current does not flow although the telephone line is closed, the line current monitor means detects an abnormality. In consequence, the disconnection judgement means outputs the
5 disconnection signal. On the other hand, when the line voltage monitor means detects an abnormal voltage due to the noise although disconnection does not occur, the line current flows when the telephone line is subsequently closed, and the line current monitor means detects this
10 line current. When this line current is detected, the disconnection judgement means judges that no disconnection has occurred. Therefore, the disconnection signal is not outputted, and an erroneous operation due to the noise can be prevented.

15 Monitoring by the line current is effected only when disconnection is judged as occurring by the monitor of the line voltage. Therefore, the number of times of closing of the line can be reduced, and an increase in the operation cost of the alarm system can be prevented.

20 In the present invention, it is also possible to accumulate the very small current in a capacitor and to monitor the discharge current of the capacitor instead of detecting the very small current due to the line voltage so as to monitor the line voltage. In this case, the
25 influences of the noise on the discharge current become smaller, so that the line voltage can be monitored under the state where the influences of the noise are small. Therefore, the occurrence of the erroneous operation due to the noise can be reduced, and the number of times of
30 closing the line for monitoring the line current can be further reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

The above object and features of the present invention will be more apparent from the following
35 description of the preferred embodiments with reference to the accompanying drawings, wherein:

Fig. 1 shows a structural example of an alarm system

to which an alarm reporting apparatus of the present invention is applied;

Fig. 2 is a circuit diagram showing an example of the alarm reporting apparatus of the present invention;

5 Fig. 3 is a circuit diagram showing a line voltage monitor circuit used for the alarm, reporting apparatus shown in Fig. 2;

10 Fig. 4 is a circuit diagram showing a line current monitor circuit used for the alarm reporting apparatus shown in Fig. 2;

Fig. 5 is a flowchart showing a processing operation of a CPU shown in Fig. 2; and

15 Fig. 6 is a circuit diagram showing a modified example of the line voltage monitor circuit shown in Fig. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the present invention will be explained with reference to the accompanying drawings.

20 Fig. 1 is a block diagram showing the construction of an alarm system to which an alarm reporting apparatus is applied.

In Fig. 1, reference numerals 3, 3 ... denote buildings in which the alarm reporting apparatus 4 is installed and which is the object of monitoring. The
25 alarm reporting apparatus 4 installed in each building 3 is connected to a central monitor 2 of a monitoring center 3 at a remote place through a telephone line 5 and a switchboard 8. Reference numeral 10 denotes a stand-by station in which guards stand by. The stand-by
30 station 10 is connected to the central monitor 2 of the central monitor center 1 through the telephone line 5 and the exchange 8.

Various sensors 6, 6, ... such as burglar alarms, disaster alarms, etc., disposed at predetermined
35 positions of the building under supervision are connected to the alarm reporting apparatus 4. Further, telephones 7 and facsimiles 9 are connected to the

telephone line 5 through the alarm reporting apparatus 4.

When any sensor 6 outputs an alarm signal in the alarm system shown in Fig. 1, the alarm reporting apparatus 4 reports an alarm to the central monitor 2.

5 Upon receiving this alarm report, the central monitor 2 displays the occurrence of the alarm to the personnel inside the monitoring center 1. The monitoring center 1 reports the alarm to the stand-by station 10 in accordance with its kind and sends the guards to the
10 building in which the alarm is detected.

The alarm reporting apparatus 4 transmits a predetermined signal to the central monitor 2 periodically (every hour, for example). The central monitor 2 monitors reception of this signal and when the
15 periodical transmission is interrupted, it judges that disconnection occurs in the telephone line 5 and sends the guards to the building.

The guards sent to the monitor building confirm safety and take necessary measures in accordance with the
20 given situation.

Fig. 2 shows the construction of the alarm reporting apparatus 4.

In the alarm reporting apparatus 4 of this embodiment, a disconnection judgement circuit 21 is
25 inserted between the alarm monitor circuit 12 and the telephone line 5 so as to detect disconnection of the telephone line on the side of the alarm reporting apparatus 4. Various sensors 6, 6, ... and facsimiles 9 are connected to the alarm monitor circuit 12.

30 The alarm monitor circuit 12 normally connects the telephone line 5 to the telephones 7 and to the facsimiles 9. When any of the sensors 6, 6 detects abnormality and outputs the signal, the telephone line is closed by circuit closing means 13 and the alarm signal
35 is sent to the central monitor 2. To detect the disconnection of the telephone line 5, the alarm monitor circuit 12 periodically closes the telephone line and

transmits a predetermined signal to the central monitor 2. Since the construction and the operation of this alarm monitor circuit 12 are well known in the art, its detailed explanation will be omitted.

5 The disconnection judgement circuit 21 is disposed so as to detect the disconnection of the telephone line 5 on the side of the alarm reporting apparatus. Input terminals L1 and L2 of the disconnection judgement circuit 21 are connected to the telephone line 5 and its
10 output terminals L1' and L2' are connected to the alarm monitor circuit 12. One of the input terminals L1 is connected to one of the output terminals L1' by the line current monitor circuit 24, and the other input
15 terminal L2 is directly connected to the other output terminal L2'. A line voltage monitor circuit 23 is inserted between the input terminals L1 and L2. The output signal of the line current monitor circuit 24 and that of the line voltage monitor circuit 23 are inputted to a CPU (Central Processing Unit) 22.

20 An alarm circuit 25, comprised a buzzer or a flashing lamp, is connected to the CPU 22. The CPU 22 is connected to the line closing circuit 13 inside the alarm monitor circuit 12, outputs a command signal for closing the line, and detects the line closing state.

25 Fig. 3 shows the construction of the line voltage monitor circuit 23.

 The voltage between the input terminals L1 and L2 is rectified by a full wave rectifier D1 and is divided by resistors R1 and R2. The voltage of the power source V1
30 is divided by resistors R3 and R4. Both of these divided voltages are inputted to a comparator CP1, and a transistor Tr is ON/OFF controlled by the output of the comparator CP1. A photo-diode PD1 of a photo-coupler PC1 is connected between the transistor Tr and the power
35 source V1. A photo-transistor PT1 of the photo-coupler PC1 is connected to the CPU 22.

 Here, when the line voltage is a steady value, the

output of the comparator CP1 becomes L (low) and the transistor Tr is turned OFF. Therefore, no current flows through the photo-diode PD1 and the photo-transistor PT1 is turned OFF. In contrast, when the line voltage drops,
5 the output of the comparator CP1 becomes H (high) and the transistor Tr is turned ON, so that the current flows through the photo-diode PD1 and the photo-transistor PT1 is turned ON.

10 Fig. 4 shows the construction of the line current monitor circuit 24.

A photo-diode PD2 of a photo-coupler PC2 is connected between the input terminal L1 and the output terminal L1'. The output of a photo-transistor PT2 is connected to the CPU 22. Here, when the current flows
15 through the telephone line 5, the photo-transistor PT2 is turned ON, and when the current does not flow, the photo-transistor PT2 is turned OFF.

The operation of the CPU 22 of the disconnection judgement circuit 21 will be explained with reference to the flowchart of Fig. 5. By the way, this disconnection
20 judgement circuit 21 is disposed for detecting the disconnection of the telephone line 5 on the side of the alarm reporting apparatus 3, as already described. The processing for detecting the disconnection of the
25 telephone line 5 on the central monitor sensor (1) side is executed by the alarm monitor circuit 12 in the same way as in the prior art systems.

First, whether or not the telephone line 5 is open is judged at the step S1 in Fig. 5. This judgement
30 checks the state of the line closing circuit 13 inside the alarm monitor circuit 12. When the result proves NO (closed), the flow proceeds to the step S4 and when it is YES (open), the flow proceeds to the step S2.

The line voltage is monitored at the step S2. Here,
35 the state of the photo-transistor PT1 of the line voltage monitor circuit 23 is checked. Since the telephone line 5 is open under the state of the step S2, the state

can be judged as normal if the circuit voltage exceeds a predetermined value, and as abnormal if it is lower than the predetermined value. In other words, the state is judged as normal if the photo-transistor PT1 is turned
5 OFF, and the flow returns to the step S1. If this transistor is turned ON, the state is judged as abnormal and the flow proceeds to the step S3.

There is the case where the state is judged as abnormal due to the influences of noise, although no
10 disconnection exists in practice. Therefore, the flow proceeds to the operation for confirming the disconnection of the step S3. et seq.

At the step S3, the CPU 22 outputs the signal to the line closing circuit 13 of the alarm monitor
15 circuit 12 and the telephone line is closed inside the alarm monitor circuit 12. Incidentally, when the line is closed, a predetermined signal is transmitted from the alarm reporting apparatus 3 to the monitoring center 1, whenever necessary.

20 At the step S4, the line current is monitored. Here, the state of the photo-transistor PT2 of the line current monitor circuit 24 is checked. Since the telephone line 5 is closed under the state of the step S4, the state can be judged as normal if the line
25 current exceeds a predetermined value and as abnormal if it is lower than the predetermined value. In other words, the state is judged as normal when the photo-transistor PT2 is turned ON, and the flow returns to the step S1. If this transistor PT2 is turned OFF, the state
30 is judged as abnormal and the flow proceeds to the step S5. Since monitoring of this line current is effected by using a greater current than the monitor of the line voltage, erroneous judgement caused by noise does not occur.

35 At the step S5, the reporting circuit 25 outputs the alarm, and the disconnection judgement operation is completed. As the alarm output, sounding the buzzer or

flashing the lamp is effected, and the alarm reporting apparatus (3) side can determine the disconnection of the telephone line 5.

As explained above, when the possibility of the
5 disconnection is judged as existing by monitoring the
line voltage, the existence of the disconnection is
subsequently judged by monitoring the line current.
Therefore, even when any erroneous judgement occurs
during the monitor of the line voltage due to the noise,
10 the disconnection of the telephone line can be always
judged correctly. Since the monitoring of the line
current is carried out only when the line is open and
when an abnormality of the line voltage is detected, the
number of times of closing the telephone line can be
15 reduced, and an increase in the cost of the system
operation can be prevented.

In the embodiment described above, the disconnection
judgement circuit 21 is constituted separately from the
alarm monitor circuit 12, but the disconnection judgement
20 circuit 21 can be assembled into the alarm monitor
circuit 12.

Next, a modified example of the line voltage monitor
circuit 24 will be explained with reference to Fig. 6.

In Fig. 6, symbol C1 represents a capacitor for
25 building up a very small current flowing due to the line
voltage. A full wave rectifier D3 for rectifying the
line voltage D3, a constant voltage circuit CC1, a photo-
transistor PT3 of a photo-coupler PC3 and a diode D4 are
connected, as a charging circuit, to this capacitor C1.
30 By the way, the constant voltage circuit CC1 comprises a
transistor TR1, a zener diode ZD1 and resistors R5, R6
and R7. Further, a discharge resistor R8, a photo-
transistor PT4 of a photo-coupler PC4 and a photo-
diode PD5 of a photo-coupler PC5 are connected, as a
35 discharging circuit, to the capacitor C1. The photo-
diode PD3 of the photo-coupler PC3 in the charging
circuit and the photo-diode PD4 of the photo-coupler PC4

in the discharging circuit are alternately turned ON and OFF in a predetermined interval by a control signal from the CPU 22.

5 When the telephone line 5 is not disconnected and
the line voltage is normal, the photo-diode PD3 in the
charging circuit is turned ON and then the photo-
transistor PT3 is turned ON. During this ON period, the
capacitor C1 is charged by the very small current due to
10 the line voltage through the resistor R7. Next, when the
photo-diode PD4 in the discharging circuit is turned ON,
the photo-transistor PT4 is then turned ON, and the
capacitor C1 is discharged through the discharge
resistor R8. This discharge current turns ON the photo-
15 diode PD5 of the output photo-coupler PC5 and turns ON
the photo-transistor PT5.

 The CPU 22 judges that no disconnection exists in
the telephone line 5 when a turn-ON of the photo-
transistor PT5 is detected at the time of discharging
(when the photo-transistor PT4 is turned ON). When the
20 telephone line 5 is disconnected, on the other hand, the
line voltage does not exist any more. Therefore, even
when the photo-diode PD3 in the charging circuit is
turned ON, the capacitor C1 is not charged, so that the
output photo-transistor PT5 is turned OFF during
25 discharge. The CPU 22 judges that the possibility of the
occurrence of disconnection exists in the telephone
line 5 when it detects turn-OFF of the output photo-
transistor PT5 at the time of discharge. The flow
proceeds to the processing of the step S3 et seq. in
30 Fig. 5, and confirmation by the line current is made.

 Even when the noise occurs, the influences of noise
is smaller than that of the discharge current of the
capacitor C1 building up the very small current.
Therefore, the possibility of the erroneous judgement of
35 the line voltage due to the noise becomes smaller, and
the number of times of closing the line for monitoring
the line current can be further reduced.

When the condition of the telephone line becomes worse and noise frequently appears on the telephone line, the line closing operation might be conducted frequently. In such a case, the frequency of the occurrence of the judgement of abnormality by the line voltage monitor circuit 26 and the subsequent judgement of normality by the line current monitor circuit 24 is monitored, and when the CPU 22 judges that the occurrence frequency is high, the CPU 22 executes the control so that the charging/discharging interval of the capacitor C1 of the line voltage monitor circuit 26 becomes longer. The occurrence frequency in this case is calculated by, for example, counting the number of times of the occurrence of such phenomena and when the counts exceeds five times within one hour, for example, the charging/discharging interval of the capacitor C1 is again set from 30 ms to 1 second.

According to the present invention, the disconnection of the telephone line can be always monitored in the alarm reporting apparatus for reporting the occurrence of the alarm to the destination, and the operation can be carried out at a low cost without inviting the erroneous judgement.



THIS SHEET HAS BEEN
REPLACED

CLAIMS

1. An alarm reporting apparatus for reporting the occurrence of an abnormality to a predetermined destination through a telephone line upon detecting an abnormality, comprising:

line voltage monitor means for monitoring a line voltage when said telephone line is open, and detecting an abnormality of the line voltage;

line current monitor means for monitoring a line current when said telephone line is closed, and detecting an abnormality of the line current;

line closing means for closing a D.C. current of said telephone line; and

disconnection judgement means, operatively connected to said line voltage monitor means, said line current monitor means and said line closing means, for causing said line closing means to close said D.C. circuit of said telephone line when said line voltage monitor means detects an abnormality, judging that a disconnection exists in said telephone line when said line current monitor means subsequently detects abnormality under the line closure state, and outputting a disconnection signal.

2. An alarm reporting apparatus according to claim 1, wherein said line voltage monitor means includes:

a capacitor charged by a line current when said telephone line is open;

means for repeatedly charging and discharging said capacitor in a predetermined cycle; and

means for outputting an alarm signal when a discharge current is not detected at the time of discharge.

