Title: REMOTE SMOKESTACK MONITOR SYSTEM BASED ON DIGITAL COMMUNICATION TYPE AUTOMATIC SMOKESTACK MEASURING DEVICE

Abstract: Disclosed is a remote smokestack monitor system using digital communication. The system includes at least one measuring device installed in a smokestack and including a first digital signal input/output terminal for measuring contaminants contained in exhaust gas of the smokestack to output a measured value signal and a status signal; and a data collector that receives, stores and outputs the measured value signal and the status signal in real time. Here, the data collector includes a second digital signal input/output terminal for transmitting and receiving a signal to and from the first digital signal input/output signal. The remote smokestack monitor system employs bidirectional communication between the measuring device in a smokestack and the data collector, so that set status and alarm information measured by the measuring device can be collected in real time, thereby making it possible to detect a changed set value as soon as the set value is changed.
Description

Title of Invention: REMOTE SMOKESTACK MONITOR SYSTEM BASED ON DIGITAL COMMUNICATION TYPE AUTOMATIC SMOKESTACK MEASURING DEVICE

Technical Field

[1] The present invention relates to a remote smokestack monitor system, and more particularly, to a system for monitoring exhaust gas of a smokestack, which employs digital communication.

Background Art

[2] A smokestack is a structure for exhausting gas generated through combustion of a fuel, and gas exhausted through the smokestack often contains various contaminants. Thus, the atmospheric environment preservation law designates a reference amount of gas allowed to be exhausted from a smokestack.

[3] Since it is dangerous for an operator to directly measure exhaust gas from a smokestack due to characteristics of the gas, a remote smokestack monitor system including a measuring device placed in the smokestack to obtain and transmit data to a control center is utilized. The remote smokestack monitor system measures concentrations of contaminants in exhaust gas from the smokestack at normal times and transmits data of the concentrations to the control center to monitor exhaustion of the contaminants at normal times.

[4] The measuring device used in such a remote smokestack monitor system employs an analog method or an analog-digital method. Here, communication between the measuring device and a data collector is realized according to an analog method, and communication between the data collector and a control center is realized according to a digital method. Thus, only unidirectional communication is allowed from a sensor to the data collector, and bidirectional communication is allowed from the data collector to the control center.

[5] Smokestacks are generally operated in various business sites and the control center regulates operation situations of the business sites. However, there is no choice but to directly visit and check the business site even if measurement values sent from the measuring device are abnormal or manipulated. This makes it difficult for the control center to secure reliability of the transmitted measured value since the measurement value sent from the sensor is transmitted to the control center through unidirectional communication.

Disclosure of Invention
Technical Problem

[6] The present invention has been conceived to solve such problems in the related art and an aspect of the present invention is to provide a remote smokestack monitor system for monitoring exhaust gas of a smokestack, which can secure reliability of a value measured by a measuring device and can confirm an operation status of the measuring device.

Solution to Problem

[7] In accordance with one aspect of the present invention, a remote smokestack monitor system using digital communication includes: at least one measuring device installed in a smokestack and including a first digital signal input/output terminal for measuring contaminants contained in exhaust gas of the smokestack to output a measured value signal and a status signal; and a data collector that receives, stores and outputs the measured value signal and the status signal in real time. Here, the data collector includes a second digital signal input/output terminal for transmitting and receiving a signal to and from the first digital signal input/output signal.

[8] The remote smokestack monitor system may further include a management server that receives data output from the data collector, controls the data collector, and transmits a signal for monitoring or controlling the at least one measuring device to the data collector.

[9] The signal for monitoring or controlling the at least one measuring device sent from the management server may include a signal for identifying at least one of a measurement range of the measuring device, a pressure of sample gas, a temperature of the sample gas, a flow rate of the sample gas, a set factor value, and a set factor.

[10] The status signal output from the at least one measuring device may include an alarm signal for informing the management server of abnormality if any one of intensity of light, lamp voltage, chamber temperature, and chamber pressure is abnormal.

[11] If the measured value received form the at least one measuring device is abnormal, the management server transmits a signal for identifying a status of the at least one measuring device to the data collector.

[12] Criteria by which the management server determines that average data are abnormal may include an instantaneous decrease in measured values, set measurement value exceeding, maintenance of a constant measurement value, a change in measurement range of the measuring device, a change in zero calibration gas value of the measuring device, a change in span calibration gas value of the measuring device, a change in correction factor of the measuring device, a change of offset, a change of standard deviation before and after a certain time point, generation of a sample gas pressure alarm, generation of a sample gas flow rate alarm, a case in which a measured value is
less than "0", generation of a set value exceeding alarm, shortage of effective data of
the measuring device, a change in password of the measuring device, generation of a
lamp voltage alarm, generation of a light intensity alarm, generation of a lamp tem-
perature alarm, generation of a lamp pressure alarm, generation of an alarm during
repair, and generation of a power outage alarm.

Communication between the at least one measuring device and the data collector
may include serial communication or LAN communication.

**Advantageous Effects of Invention**

According to the present invention, the remote smokestack monitor system employs
bidirectional communication between a measuring device in a smokestack and a data
collector, so that various status information can be collected from the measuring
device, thereby achieving more accurate management of the measuring device based
on the collected information.

In addition, since digital communication is not affected by a current signal, commu-
nication of the remote smokestack monitor system is prevented from being affected by
a current converter, thereby preventing measured values from being changed in a data
transmission process.

**Brief Description of Drawings**

Fig. 1 is a block diagram of a remote smokestack monitor system using digital com-
munication according to one embodiment of the present invention.

Fig. 2 is a table representing status information of a measuring device according to
the present invention.

[reference sign list]

100: remote smokestack monitor system
110: measuring device
120: data collector
130: management server

**Mode for the Invention**

Exemplary embodiment of the present invention will now be described in more detail
with reference to the accompanying drawings.

Referring to Fig. 1, a remote smokestack monitor system 100 using digital commun-
ication according to one embodiment of the invention includes a measuring device
110, a data collector 120, and a management server 130.

The measuring device 110 is installed in a smokestack to measure various con-
taminants exhausted from the smokestack and correction items such as oxygen, flow
rate, and temperature, and outputs a digital signal for indicating the measured value
through a first digital signal input/output terminal (not shown). The first digital signal
input/output terminal may be provided by mounting a digital communication card for input and output of a digital signal to and from the measuring device 110.

[26] Contaminants measured by the measuring device 110 include dust, sulfur oxide, nitrogen oxide, carbon monoxide, hydrogen chloride, ammonia, and hydrogen fluoride.

[27] Since a plurality of smokestacks is installed at a business site and the measuring device 110 is provided to each smokestack, a plurality of measuring devices 110 is used.

[28] The measuring device 110 outputs, as digital signals, status and alarm information of the measuring device 110 in addition to the measured values with respect to contaminants contained in exhaust gas and correction items. The status information of the measuring device 110 corresponds to factor values used to determine measurement values such as temperature, pressure, and measurement range of sample gas.

[29] As shown in Fig. 2, the factor values include a measurement range value (maximum and minimum) according to measurement methods, a set value excess alarm, calibration curve slope, a correction factor, a span calibration gas value, a zero calibration gas value, an offset, a lamp transmission percentage, a chamber temperature, a chamber temperature alarm, a chamber pressure, a chamber pressure alarm, light intensity, a light intensity alarm, a lamp voltage, a lamp voltage alarm, a sample gas flow rate, a sample gas flow rate alarm, a sample gas pressure, a sample gas pressure alarm, sample gas temperature, and a sample gas temperature alarm.

[30] The measurement range values (maximum and minimum) refer to a maximum value and a minimum value that can be measured by the measuring device 110, and the set value excess alarm corresponds to alarm information generated when a measured concentration of the measuring device 110 deviates from a measurement range. The calibration curve slope is a slope for converting a value indicated by an analyzer into a concentration on a diagram used in quantitative analysis, and the correction factor value corresponds to a factor value for compensating for an intervening element upon correction or management of the measuring device 110.

[31] The span calibration gas value corresponds to a value for measuring a maximum scale value of the analyzer, and the zero calibration gas value corresponds to a value for measuring a minimum scale value of the analyzer. The offset corresponds to an error or a transition value (difference from a reference value or a difference value), and the light transmission percentage corresponds to a light transmittance of sample gas.

[32] The chamber temperature corresponds to the temperature of a chamber in the measuring device 110, and the chamber temperature alarm corresponds to an alarm generated when the temperature of the chamber in the measuring device 110 is abnormal. The chamber pressure corresponds to the pressure of the chamber in the measuring device 110, and the chamber pressure alarm corresponds to an alarm
generated when the pressure of the chamber in the measuring device 110 is abnormal. The light intensity corresponds to an intensity value of light of a lamp installed in the measuring device 110, and the light intensity alarm corresponds to an alarm generated when the intensity of light emitted from the lamp in the measuring device 110 is abnormal. The lamp voltage corresponds to voltage of the lamp in the measuring device 110, and a lamp voltage alarm corresponds to an alarm generated when voltage of the lamp in the measuring device 110 is abnormal.

The sample gas flow rate corresponds to the flow rate of sample gas to be measured by the measuring device 110, and the sample gas flow rate alarm corresponds to an alarm generated when the flow rate of the sample gas to be measured is abnormal. The sample gas pressure corresponds to the pressure of the sample gas to be measured, and the sample gas pressure alarm corresponds to an alarm generated when the pressure of the sample gas to be measured is abnormal. The sample gas temperature corresponds to the temperature of the sample gas to be measured, and the sample gas temperature alarm corresponds to an alarm generated when the temperature of the sample gas to be measured is abnormal.

The measuring device 110 according to the present invention outputs an output value containing a factor value as a digital signal, and outputs signals regarding status and alarm information which cannot be output as an analog signal.

The data collector 120 receives, collects, and materializes digital signals measured and output by the measuring device 110 in real time. The data collector 120 stores the collected and materialized data as average data for 5 or 30 minutes, and transmits the stored average data to the management server. Here, the data collector 120 includes a second digital signal input/output terminal (not shown) for transmitting and receiving signals to and from the first digital signal input/output terminal of the measuring device 110.

The second digital signal input/output terminal may be provided by mounting a digital communication card on the data collector 120. Thus, when an existing data collector is configured to receive a digital communication card therein, the existing data collector may also be used without being changed.

The management server 130 transmits the transmitted signal to the measuring device to control the measuring device 110. The data collector 120 of the present invention may collect the measured value received from the measuring device 110 at least once every 5 seconds, and may have a function of storing or outputting a status of the measuring device 110 and its own status.

Since a plurality of measuring devices 110 may be provided, one data collector 120 receives signals from the plurality of measuring devices 110. If necessary, a plurality of data collectors 120 may also be provided.
The management server 130 receives average data from the data collector 120, and analyzes and stores the collected average data. Here, the average data correspond to data measured by the measuring devices 110, and the management server 130 analyzes and stores the average data. The management server 130 monitors whether the measuring devices 110 normally perform measuring operations based on the analyzed average data.

The management server 130 may control the measuring devices 110 through the data collector 120 as needed, and may transmit a control command for identifying abnormality of the average data to the measuring devices 110 through the data collector 120, if it is determined that the average data are abnormal.

Criteria by which the management server 130 determines that the average data are abnormal include an instantaneous decrease in measured values, set measurement value exceeding, maintenance of a constant measurement value, a change in measurement range of the measuring device 110, a change in zero calibration gas value of the measuring device 110, a change in span calibration gas value of the measuring device 110, a change in correction factor of the measuring device 110, a change of offset, a change of standard deviation before and after a certain time point, generation of a sample gas pressure alarm, generation of a sample gas flow rate alarm, a case in which a measured value is less than "0", generation of a set value exceeding alarm, shortage of effective data of the measuring device 110, a change in password of the measuring device 110, generation of a lamp voltage alarm, generation of a light intensity alarm, generation of a lamp temperature alarm, generation of a lamp pressure alarm, generation of an alarm during repair, and generation of a power outage alarm.

The management server 130 may determines whether the plurality of measuring devices 110 is normally operated or the data measured by the measured device 110 are accurate data according to the criteria. Further, control commands may be transferred to the measuring devices 110 through the data collector 120.

Although some embodiments have been provided to illustrate the present invention, it should be understood that these embodiments are given by way of illustration only, and that various modifications, variations, and alterations can be made without departing from the spirit and scope of the present invention. The scope of the present invention should be limited only by the accompanying claims and equivalents thereof.
Claims

[Claim 1] A remote smokestack monitor system using digital communication, comprising:

at least one measuring device installed in a smokestack and including a first digital signal input/output terminal for measuring contaminants contained in exhaust gas of the smokestack to output a measured value signal and a status signal; and

a data collector for receiving, storing, and outputting the measured value signal and the status signal in real time, the data collector including a second digital signal input/output terminal for transmitting and receiving a signal to and from the first digital signal input/output signal.

[Claim 2] The remote smokestack monitor system according to claim 1, further comprising: a management server that receives data output from the data collector, controls the data collector, and transmits a signal for monitoring or controlling the at least one measuring device to the data collector.

[Claim 3] The remote smokestack monitor system according to claim 2, wherein the signal for monitoring or controlling the at least one measuring device sent from the management server comprises a signal for identifying at least one of a measurement range of the measuring device, a pressure of sample gas, a temperature of the sample gas, a flow rate of the sample gas, a set factor value, and a set factor.

[Claim 4] The remote smokestack monitor system according to claim 2, wherein the status signal output from the at least one measuring device comprises an alarm signal for informing the management server of abnormality if any one of intensity of light, lamp voltage, chamber temperature, and chamber pressure is abnormal.

[Claim 5] The remote smokestack monitor system according to claim 2, wherein, if the measured value received from the at least one measuring device is abnormal, the management server transmits a signal for identifying a status of the at least one measuring device to the data collector.

[Claim 6] The remote smokestack monitor system according to claim 5, wherein criteria by which the management server determines that the average data are abnormal include an instantaneous decrease in measured values, set measurement value exceeding, maintenance of a constant measurement value, a change in measurement range of the measuring
device, a change in zero calibration gas value of the measuring device, a change in span calibration gas value of the measuring device, a change in correction factor of the measuring device, a change of offset, a change of standard deviation before and after a certain time point, generation of a sample gas pressure alarm, generation of a sample gas flow rate alarm, a case in which a measured value is less than "0", generation of a set value exceeding alarm, shortage of effective data of the measuring device, a change in password of the measuring device, generation of a lamp voltage alarm, generation of a light intensity alarm, generation of a lamp temperature alarm, generation of a lamp pressure alarm, generation of an alarm during repair, and generation of a power outage alarm.

[Claim 7] The remote smokestack monitor system according to claim 1, wherein communication between the at least one measuring device and the data collector is serial communication or LAN communication.
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<th>Measurement Method</th>
<th>State Information to be Transmitted</th>
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| U.V Photometric Method                   | Calibration curve slope  
Offset  
Span calibration gas value  
Zero calibration gas value  
Intensity of light  
Lamp voltage  
Chamber temperature  
sample gas flow rate |
| Infrared Absorption Method               | Calibration curve slope  
Correction factor  
Offset  
Span calibration gas value  
Zero calibration gas value  
Chamber temperature  
sample gas flow rate |
| Non-dispersive Infrared Absorption Method| Chamber temperature  
sample gas flow rate |
| Infrared Gas Analysis                    | Span calibration gas value  
Zero calibration gas value |
| Ion Electrode Method                     | Calibration curve slope  
Offset  
Span calibration gas value  
Zero calibration gas value  
Chamber temperature  
Chamber pressure  
sample gas flow rate  
sample gas pressure  
sample gas temperature |
| Light Scatter Integral Method            | Calibration curve slope  
Offset  
Span calibration gas value  
Zero calibration gas value  
Chamber temperature  
Chamber pressure  
sample gas flow rate  
sample gas pressure  
sample gas temperature |
| Chemiluminescent Method                  | Lamp transmission percentage  
Span calibration gas value  
Zero calibration gas value |
| Light Transmission Method                | Span calibration gas value  
Zero calibration gas value |
| Zirconia Analyzer                        | Span calibration gas value  
Zero calibration gas value |
INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2013/001363

A. CLASSIFICATION OF SUBJECT MATTER

G08C 19/00(2006.01)A, H04Q 9/00(2006.01)i, G05B 23/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G08C 19/00

Documentary searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS/KIPO internal

& Keywords: "remote, smokestack, monitor, control, device, system, measure, contaminant, exhaust, gas, management server, signal, control, current instantaneous value, collecting mode, input terminal, output terminal, transmitting signal"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>KR 10-0383046 BI (ENITECH CO. LTD.) 09 May 2003 See abstract , page 2-4 , c.laim 1 and f.igures 1-4.</td>
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Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

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