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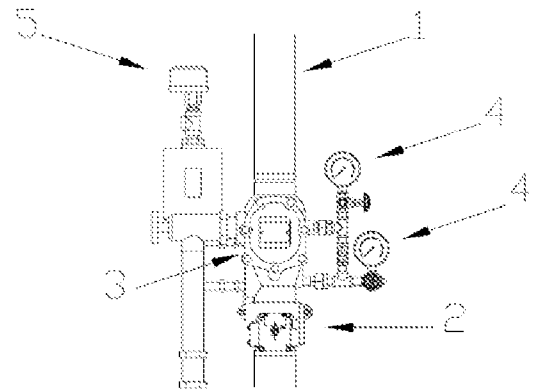
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(54)	Title	AUTOMATIC TESTING, INSPECTION, SURVEILLANCE, AND MAINTAINANCE SYSTEM OF WATER-BASED SYSTEMS
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(57)	Abstract	

An automatic testing, inspection, surveillance and maintenance system for water-based systems; the system comprising:
a local part and a remote part of the system, the local part of the system comprising:
- at least one valve for opening or closing a path for a fluid of the fire-protection system;
- a flow indicator for detecting a flow of a fluid through the path;
- a control unit for controlling the reliability-testing system;
- a local communications unit for sending signals and/or receiving signals; and
- at least one sensor for obtaining a parameter of a fluid of the fire-protection system,
the remote part of the system comprising:
- a remote communications unit for sending and/or receiving signals; and
- a user-interface unit for presenting information to a user of the system,
wherein the local communications unit is configured to obtain data from the sensor and the flow indicator and for communicating said information to the remote communications unit; the user-interface unit is configured to present information received by the remote communications to the user; and the remote and local parts collaborate to perform actions on given criteria controlled by AI or algorithms.



Description and claims

AUTOMATIC TESTING, INSPECTION, SURVEILLANCE, AND MAINTAINANCE SYSTEM OF WATER-BASED SYSTEMS

The present invention relates to a system for automatic testing, inspection, surveillance, and self-maintenance of water-based systems. Furthermore, the invention relates to a
5 method of automatic testing, inspection, surveillance, and self-maintenance of water-based systems.

Background

Water-based system, like automatic fire protection systems, are widely used for a number of applications. Automatic fire protection systems are used for fire safety in e.g. industrial
10 facilities, office buildings, apartment buildings and houses. Such system, like fire-protection systems, require testing and inspection on regular basis, to ensure that they are functioning as intended.

Manual inspection and testing of such systems may typically involve visual inspection of e.g. pipelines, detectors, and valves, and testing of e.g. valves and alarms. The inspection
15 and testing may be costly, time-consuming and at times disruptive. E.g. when testing a fire-protection system in a hazardous area, normal work and/or production involving said area may have to be interrupted.

Furthermore, work related to manual testing and inspection is often perceived as tedious, it can be challenging to properly document, and is prone to human errors.

20 The present invention provides a system that may eliminate or at least reduce the need for manual testing and inspection, and thereby cut costs and eliminate or reduce other drawbacks related to manual inspection. The present invention provides a way to improve the quality and ease of documenting testing and inspection of the fire-protection systems.

There exist known systems for partially automating testing and/or inspection of fire-

protection systems.

Bellcheck is one such system for testing a function of a firewater-delivery system, wherein an alarm of the system is tested for response to a given condition by use of a manually- or automatically operated valve. Bellcheck is a system for “fully automating weekly testing of alarm”, saving time, money and water, but is limited in its functionality compared to the inspections and testing that is required by standards for fire-protection systems. It automates the test locally and prints the results to paper for inspection. There is no recording of pressure, that can be used to detect leakage. Furthermore, it circulates the polluted water from the sprinkler side to the drinking water side of the system. This is not according to Europe standard (EN 1717). The test is not fully digitalised and up to date with IOT and requires that inspection must take place at a physical location.

DE 1020 1811 9776 A1 discloses a water extinguishing system (1), comprising: a fluid supply (20); a pump (30); and a testing line (40) having an opening element (2), which opening element is designed to open the testing line (40) in a test run of the pump (30). According to the invention, the testing line (40) also comprises a shut-off element (4), which is designed to close the testing line (40) when the water extinguishing system (1) is activated.

US 2020/226916 A1 discloses an Internet facilitated fire safety system and real time monitoring system comprising a plurality of smart fire safety devices and equipment, including fire extinguishers, hose reels, fire doors, exit lights, emergency lights, sprinkler tank and sprinkler system, system to monitor CO₂ and/or carbon monoxide level, and the likes. Each of these device and equipment is connected by an IOT interface device and a wireless gateway to computer servers an electronic communications network. The IOT interface devices have a plurality of sensors to detect the operational condition of that safety device and equipment data obtained from the sensors are analyzed and interpreted through software and algorithms by servers in the system. Since each fire safety device and equipment is electronically connected, it would be transmitting data and information on its operational status in real time and 24/7.

From WO 2015/015227 it is known a fire suppression system which includes: first and second fluid distribution devices; first and second fluid flow paths for connecting the respective first and second fluid distribution devices to a fluid source; first and second non-return valves positioned in the respective first and second fluid flow paths; first and second pressure sensing devices positioned in the respective first and second fluid flow

paths for sensing the pressure of fluid in the first and second fluid flow paths at respective first and second locations and for generating signals indicative of the sensed pressure at the first and second locations; and a controller for receiving the respective signals from the first and second pressure sensing devices and for providing an indication to a user as to the location or likely location of a potential fluid leak in the first or second fluid flow paths.

The invention

According to a first aspect, the invention relates to an automatic testing, inspection, surveillance, and maintenance system for a water-based system, such as fire-protection system, wherein the automatic testing, inspection, surveillance, and maintenance system comprises:

a local part and a remote part of the system, and

wherein the local part of the system comprises:

- a pipe system (1) having a back flow valve (3) dividing the pipe system (1) into an inlet side and an outlet side, and a main valve (2) on the inlet side,

- a pressure sensor (6) monitoring the pressure at the inlet side of the pipe system (1),

- a pressure sensor (6) monitoring the pressure at the outlet side of the pipe system (1),

- a flow path located at the outlet side of the pipe system (1) having a test valve (8) for opening and closing of the flow path;

- a flow indicator (5) at the outlet side of the pipe system (1) for detecting a flow of a fluid through the path;

- a control unit for controlling the testing, the surveillance, and;

the self-maintenance of the water-based system;

- a local communications unit for sending signals and/or receiving signals; and

- at least one sensor for obtaining parameters of a fluid of the water-based system, the remote part of the automatic testing, inspection, surveillance and maintenance system comprises:

- a remote communications unit for sending and/or receiving signals; and

- a server unit for storing data, analysis, AI surveillance, maintenance, and orchestrating testing; and

- a user-interface unit for presenting information to a user of the automatic testing, inspection, surveillance and maintenance system,

and wherein the local communications unit is;

- configured to obtain data from the sensor(s) and the flow indicator (5) and for

- communicating said information to the remote communications unit; and

- the user-interface unit is configured to present information received by the remote communications unit.

There are requirements stating that automatic fire-protection systems, such as fire extinguishing systems, such as sprinkler systems, shall be tested regularly, to ensure the sprinkler system functions as required. The system according to the first aspect of the invention is configured to automate the required testing. The interval of the testing varies between weekly, monthly, and other.

Note that “testing” may include both the testing of functions, obtaining data on one or more parameters of a fluid of the fire-protection system, and/or visual inspection of at least parts of the fire-protection system.

Note further that “local” refers to a position at, in and/or near the fire-protection system, whereas “remote” refers to a position remote from the fire-protection system.

Note further that when it is described that one part of the system is in connection with another part of the system, they may be directly connected to each other, e.g. via cable or wirelessly, or indirectly connected to each other, e.g. via other parts of the system, or via a server or other types of equipment that are not mentioned as being parts of the system in this document. The system can be said to comprise such non-mentioned parts.

The one or more parameters of the fluid may include e.g. temperature, pressure and/or pH of the fluid, and/or contents of the fluid such as certain chemicals in the fluid and/or bacteria in the fluid. Further that other parameters of the fluid that are not mentioned as being parts of the system in this document. The system can be said to comprise such non-mentioned parameters.

The flow indicator may be a flow detector or a pressure- or flow switch for indicating whether there is flow of fluid through a path of the fire-protection system and/or the system. The flow indicator may be configured to send an alarm signal in the event of a flow or in the event of a lack of flow. The system may be configured to register the alarm signal. In some embodiments of the system, it is configured to automatically document whether the alarm signal is registered or not. In some embodiments of the system, it is configured to automatically document data collected by the flow indicator.

A part of the system may also be part of the fire-protection system. E.g. the flow indicator may be a flow indicator of the fire-protection system.

The alarm signal may be an alarm signal that would in a non-test situation trigger a fire alarm of the fire-protection system. In some embodiments of the system, triggering the fire alarm is part of the testing procedure, and the alarm signal of the flow detector is configured to trigger the fire alarm, so as to test the fire alarm. The triggering of the fire alarm, and a result of the triggering of the fire alarm is registered by the system, and the result is automatically documented by the system.

The system allows for remote testing and inspection of a fire-protection system, which may lead to savings of e.g. time, money, and environmental impact. Furthermore, it may facilitate for more frequent testing, e.g. through substantially continuous testing of parameters of a fluid of the fire-protection system, and a better quality of testing and/or documentation of test results.

The system comprises a software for documenting data obtained from a test performed by the system. The software is designed for presenting said data. The system may comprise a device for presenting and/or storing data, such as a server, a computer, a tablet, a mobile phone, or a laptop.

The software improves the quality of documentation, and also lead to savings of time and expenses related to documentation.

The system may comprise a plurality of sensors for obtaining parameters of a fluid. It may comprise a plurality of different types of sensors for obtaining different parameters, such as a pressure sensor for obtaining a pressure of the fluid, a temperature sensor for obtaining a temperature of the fluid, a pH sensor for obtaining a pH of the fluid, a chemical sensor for obtaining data on a chemical component of the fluid, and/or a bacteria sensor for obtaining data on amount of bacteria in the fluid. The system may comprise a plurality of one or more of the different types of sensors.

The system may be configured for obtaining information about a fluid of the fire-protection system, such as a pressure of the fluid, a temperature of the fluid, a chemical component of the fluid, a pH of the fluid and/or a bacterial content of the fluid.

The fluid having the right pressure is important for the fire-protection system to be operable as intended, to be capable of discharging the fluid according to design to e.g. extinguish a fire. The temperature of the water is also of importance. If the fluid is too cold it may e.g. freeze, if it is too hot the pressure may damage the fire-protection system. Obtaining data on these parameters may therefore be greatly advantageous. Obtaining

information on the pH may also be important, as a fluid of incorrect pH may damage the fire-protection system and/or potentially cause harm to e.g. people and/or equipment upon discharge of the fluid. The level of bacteria in the fluid may also be important, particularly in a system where there may be a risk of the fluid leaking into a source of drinking water.

- 5 Knowing one or more of these parameters may be important for an operator of the fire-protection system to be able to efficiently keep the fire-protection system safe and reliable.

The system may be configured for obtaining data from the sensors substantially continuously or at certain intervals. The intervals may be short, and data may be obtained frequently, such as once every minute, once every thirty minutes or once every hour.

- 10 Furthermore, on suspected issues with the fire-protection system this interval can be automatically set to more frequent interval in order to further analyse the issue of concern.

The system may further be configured for testing an alarm of the fire-protection system at regular intervals, such as once per week, once per month or once every three months.

- 15 The alarm may be tested by opening a valve, detecting a flow by use of the flow indicator and by detecting if an alarm signal is sent e.g. if a flow of fluid is detected.

The system may comprise a sound-detecting device. The sound-detecting device may be used to detect a sound from an audible notification appliance of the fire-protection system. The system may be configured to test an audible notification appliance by use of the sound-detecting device, e.g. at regular intervals.

- 20 The system may further comprise an image- and/or video-capturing device. The image- and/or video-capturing device may be used to detect a visual signal from a visible notification appliance of the fire-protection system. The system may be configured to test a visible notification appliance by use of the image- and/or video-capturing device, e.g. at regular intervals.

- 25 The image- and/or video-capturing device, or a plurality of such devices, may be set up such as to a portion of the fire-protection system, all of the fire-protection system, or an all parts of the fire-protection system that requires visual inspection. The system may be arranged such that all necessary visual inspection of the fire-protection system can be performed remotely.

- 30 The audible notification appliance may e.g. be an appliance emitting a loud audible signal to indicate that a fire has been detected. The visible notification appliance may e.g. be an appliance emitting a blinking and/or moving light to indicate that a fire has been detected,

an appliance that displays a text to indicate that a fire has been detected. The notification appliances may e.g. be appliances for indicating that a condition increasing the risk of a fire has been detected.

5 Testing of the fire-protection system by use of the system according to the invention may be performed on regular intervals but may additionally or alternatively be performed at any time. An operator may e.g. send a signal to initiate a test and/or to document a result of the test. The signal may be sent from a remote location.

10 The system may further comprise one or more sensors for detecting e.g. pressure of a fluid in a cooling system for a pump for the fire-protection system, one or more level-indicators for monitoring the level of a fluid in a reservoir of the fire-protection system, and/or one or more other pieces of equipment monitoring a feature of the fire-protection system and/or a backup or support system for the fire-protection system, such as a secondary power supply, a power supply, a fluid-delivery system, etc.

15 One, some or all parts, including e.g. sensors, flow-indicators, valves, level-indicators, image-capturing devices, etc., of the system may be connected to the Internet of Things. The part or parts connected to the Internet of Things may be accessed by use of a computer device from any location wherein said computer device has access to the internet. The access to the part or parts may be protected by use of software that enables such protection. An operator of the system may operate the system via the internet
20 connection and by use of the Internet of Things.

The system being connected to the internet of things may advantageously improve the accessibility to the system and thereby improve the control of the status/reliability of the fire-protection system.

25 The software may comprise a software that through a computer device notifies an operator of the system that a test of a fire-protection system should be performed. The software may be configured to provide a plurality of different notifications. The notification or notifications may be communicated at regular intervals. The intervals may vary for different notifications, and may be given e.g. once per week, once per month, once per third month, once per half a year, once per year, once per three years, once per five
30 years, once per ten years, etc. If the operator does not respond and/or does not respond properly, e.g. by not signing off for carrying out or controlling or documenting the result of a test, the notification system may give further notifications, e.g. by sending reminders. One or more alarms may be features of the delivery of notification. The software may be

set up to report to authorities and/or an owner of a fire-protection system and/or a third party if a test is not documented in the software within a relevant deadline for the test.

Notification by the software may increase quality of testing and/or documentation and increase the reliability of a testing scheme.

- 5 The system may be connected to one or more parts of the fire-protection system to make readings of the status of the parts. E.g. one or more valves of the fire-protection system may be connected to the system, so that the system can register whether the one or more valves are open or closed. Furthermore, one or more parts of the fire-protection system may be connected to the system such that the parts may be manipulated by use of the
- 10 system. That way, the system may be used to correct errors in the fire-protection system, such as e.g. opening a valve, adjusting a pressure of the fluid of the fire-protection system, adjusting a temperature of the fluid of the fire-protection system, and more.

A skilled person will understand that electrical equipment that may be used for testing purposes for testing a fire-protection system, that have not been mentioned so far or at all

15 in this document, may fall under the scope of the invention according to the first aspect and form part of the system.

According to a second aspect, the invention relates to a method for remote testing a water-based system by use of the automatic testing, inspection, surveillance and maintenance system according to the first aspect of the invention, wherein the method

20 comprises the following steps:

- obtaining data on a parameter of a fluid by use of a sensor of the automatic testing, inspection, surveillance and maintenance system;
- opening a valve to open a flow path for a fluid of the automatic testing, inspection, surveillance and maintenance system;
- 25 - obtaining data from a flow indicator on whether a fluid of the water base system flows through the flow path;
- obtaining data on whether or not an alarm signal is released as a result of the indication from the flow indicator;
- transferring the obtained data to the computer device by use of the local communications
- 30 unit and the remote communications unit;
- documenting the obtained data by use of the software in the computer device.

The method may further comprise any one or more of the following steps:

- notifying an operator that a test has to be performed;

- obtaining data, by use of a sensor, on a temperature, a pressure, a pH, a chemical content and/or a bacterial content of the fluid of the fire-protection system;
- documenting data automatically in the software;
- obtaining data in the form of an image, such as a still photography or a movie, of the fire-protection system as part of a visual inspection of the fire-protection system;
- obtaining an audio recording of a sound emitted by the fire-protection system as part of a test of an audible alarm of the fire-protection system;
- obtaining data on a state of a support system for the fire-protection system, such as e.g. a secondary energy supply system, a fluid-delivery system;
- manually and/or automatically controlling a result of a test registered in the software; and
- checking off on having performed a control of a test and/or a test by use of the software; and
- a method for detecting if a pipe system, non-return or a backflow-valve is leaking comprising: computing, based on a plurality of time series of measurements of properties of the fluid such as but not limited to pressure, wherein the time series measurements are taken from different locations in the fluid system, determining the function of the non-return or backflow-valve using machine learning processing, wherein the time series of measurements of properties of the fluid are inputs to the machine learning processing; and
- a method for predicting if a pipe system, non-return or a backflow-valve is due for service and or replacement of parts comprising: computing, based on a plurality of time series of measurements of properties of the fluid such as but not limited to pressure, wherein the time series measurements are taken from different locations in the fluid system, determining the function of the non-return or backflow-valve using machine learning processing, wherein the time series of measurements of properties of the fluid are inputs to the machine learning processing.

The steps may all be advantageous for allowing automatic and remote testing of a fire-protection system, thus potentially improving e.g. availability, quality and frequency of the testing and/or reducing the cost and time-consumption related to testing. One or more of the steps may also improve the quality and reliability of documentation of results from tests and of performance of tests.

Description of embodiments

In the following is described examples of preferred embodiments, some of which are illustrated in the accompanying drawings, wherein:

Fig. 1 shows a simple schematic representation of a section of a standard fire-protection system, typically found on fire sprinkler system;

Fig. 2 shows a simple schematic representation of a section of a standard fire-protection system, typically found on fire sprinkler system, including a portion of an embodiment of the system;

Fig. 3 shows a schematic representation of an embodiment of a fire-protection system, with a portion of an embodiment of the system.

The drawings are simple schematic representations of possible embodiments or parts of embodiments of the system. Hereunder are first described some possible embodiments that are not shown in figures, then follows description of the drawings mentioned above.

In a first embodiment of the invention according to the first aspect, a typical fire protection system like fire sprinkler, the fire protection system comprises of a pipe system 1, with a main valve 2, and a back flow/alarm valve 3. This also include manometers for reading of pressure on inlet side and at the actual fire system side 4, and either a manual alarm bell or an electrical alarm transmitter 5.

In a second embodiment of the invention according to the first aspect, the fire protection system is set up for automatic testing of a fire-protection system for a building. The system comprises pressure transmitters substantially continuously monitoring the pressure of the fluid of the fire-protection system to test for irregularities.

The automatic testing, inspection, surveillance, and maintenance system further comprises a control unit, a local communications unit, and a remote communications unit, the local communications unit being connected to the remote communications unit. In some embodiments, the control unit may comprise the local communications unit 7. In some embodiments, a plurality of parts of the testing system may comprise a local communications unit, parts such as one or more pressure transmitters, one or more flow indicators, one or more pressure switch, and/or one or more other sensors.

The control unit of the second embodiment of the invention according to the first aspect is connected to the pressure transmitters to control the pressure transmitters and to receive results from the monitoring performed by the pressure transmitters. Furthermore, the control unit is connected to the local communications unit to communicate results to the remote communications unit.

A test valve is included in the second embodiment. The test valve is connected to the control unit. Regularly, the test valve is opened, to open a flow path, on signal from the control unit, to test that fluid will flow through the flow path and to test that a flow indicator in the form of a pressure or flow switch will register the flow and send an alarm signal. The control unit is connected to the pressure or flow switch and configured to register whether or not flow is detected by the pressure or flow switch and whether or not an alarm signal is sent from the pressure or flow switch. The control unit will communicate results from the test by use of the local communications unit to the remote communications unit.

The second embodiment further comprises a documentation system, comprising a software and a computer device comprising the software, placed remotely from the fire-protection system. The computer further comprises the remote communications unit, and the results from tests communicated from the tests performed by use of the test valve, the pressure or flow switch and the pressure transmitters communicated to the remote communications unit from the local communications unit are registered and thus documented in the software of the computer device.

The computer device further comprises a user-interface unit for an operator of the reliability-testing system to interact with the software and read and react to the results from the tests. The software is further configured for the operator to interact with the reliability-testing system, such as to initiate a certain test or manipulate a setting of an interval of an automatic testing schedule. In another embodiment, the software may be configured for the operator to be able to manipulate a setting related to the fire-protection system, such as altering the fluid pressure of the fire-protection system, the fluid temperature of the fire-protection system, an alarm signal of the fire-protection system, and more. The local communication unit may in such an embodiment be connected to a control unit of the fire-protection system, and/or the control unit of the reliability-testing system may be configured to and connected to the fire-protection system in a way that allows such manipulation of the fire-protection system.

The software is further configured to communicate with the operator and to remind the operator of tests that have to be performed and under some circumstances and for some tests of deadlines for performing said tests. Furthermore, the software is configured to require the operator to sign off for certain tests and maintenance activities at certain intervals, such as that:

- sprinklers, nozzles, monitors of the fire-protection system have been controlled for obstructions and damages;

- all valves of the fire-protection system that shall be open are open;
- the pressure of the fluid of the fire-protection is within an acceptable interval and changes correctly when valves are opened; and
- a sufficient amount of fluid is available to the fire-protection system.

5 The software is further configured to monitor through mentioned sensors the condition of the system. Given certain criteria it will perform actions controlled by AI or algorithms. Actions such as: Notifying, perform maintenance tasks through installed devices, send extra data.

10 In a third embodiment of the first aspect of the invention, the testing system, in addition to the parts of the testing system according to the second embodiment, further comprises sensors for obtaining data on bacterial and chemical content of the fluid of the fire-protection system and temperature of the fluid. These sensors are substantially continuously testing the fluid by monitoring it for contents and temperature. The sensors are connected to the local communications unit, so that results from the tests can be
15 transferred to the remote communications unit, documented in the software and presented to an operator through the user-interface unit.

The third embodiment comprises a sensor for detecting if a pump is started when an alarm test is run. The sensor will send a signal to the remote communications unit by use of the local communications unit to indicate whether the pump is started or not.

20 Furthermore, a pressure sensor 6 of the second embodiment is configured to register a change of pressure of the fluid of the fire-protection system during the alarm test.

The third embodiment further comprises a fluid-level indicator placed inside a fluid reservoir of the fire-protection system, to monitor the level of fluid in the reservoir.

25 Furthermore, the third embodiment is configured to register and document if a signal is sent to a fire-alarm central when a fire-alarm test is performed.

In a third embodiment, the reliability-testing system comprises fluid-level indicators arranged and configured to monitor a level of fuel and a level of lubricating oil for a diesel pump of the fire-protection system, and sensors for monitoring oil pressure and water flow through a cooling water circuit for the diesel pump. The third embodiment is further
30 configured to detect that the diesel pump runs and restarts correctly under given circumstances. The sensors and indicators mentioned are connected to a local communications unit of the reliability-testing system to transfer results of tests via a

remote communications unit of the reliability-testing system to a computer device of the reliability-testing system to be documented in a software of the computer device.

A fourth embodiment, in addition to having all the parts of the above-mentioned three embodiments, includes a sound-registering device for detecting sound released by an audible notification appliance of the fire-protection system. The fourth embodiment further includes several image-capturing devices for providing pictures and film for remote visual inspection of the fire-protection system. The image-capturing devices and the sound-registering device are connected to the computer device via the communication units, so that the data provided by the image-capturing and sound-registering devices can be documented in the software of the computer device.

Figure 1 illustrates a portion of a typically fire-protection system, like a fire sprinkler system.

Figure 2 shows a portion of an embodiment of the testing system arranged in connection with a fire-protection system 1. The portion of the testing system comprises two pressure sensors 6 for monitoring a pressure in a fluid of the fire-protection system 1, a valve 8 for opening a path for the fluid and a pressure or flow switch 5 for providing an indication of whether or not there is a flow of fluid in the flow path. Although not shown, the pressure sensors 6, the valves 2, 8 and the pressure or flow switch 5 are connected to a control unit which in turn is connected to a local communications unit which in turn is connected to a remote communications unit which in turn is connected to a computer device comprising a software. Results from automatic tests and substantially continuous monitoring performed by use the manometers 4, the valve 2, 8 and the pressure or flow switch 6 are automatically transferred to the computer device and documented in the software.

Figure 3 shows a schematic representation of an embodiment of a testing system Figure 2. The embodiment shown in the embodiment in Figure 3 comprises two pressure transmitters 4, two temperature sensors located at one or more places in the fire system 9, two valves 2, 8, two pressure or flow switches 10, located at one or more places in the fire system, all being connected to a control unit 7. The control unit in turn is connected to a local communications unit 7, which in turn is connected either with wire or wirelessly to a remote communications unit 11, which in turn is connected to a server solution or computer device 12. The server solution or computer device 12 comprises a not shown user-interface unit and a software. The control unit 7 can be used to control and collect

readings from the valves 2, 8, the pressure or flow switches 10, the pressure transmitters 4 and the temperature sensors 9, and communicates readings via the communications units and the computer device to the software. By use of the software and the user-interface unit, an operator can check the readings.

- 5 It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. This also include described parts as part or fully of incorporated fire system valves, skids, control panels, central, or equivalent. In the claims, any reference signs placed between parentheses
- 10 shall not be construed as limiting the claim. Use of the verb "comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements.

- The mere fact that certain measures are recited in mutually different dependent claims
- 15 does not indicate that a combination of these measures cannot be used to advantage.

Claims

1. An automatic testing, inspection, surveillance and maintenance system for a water-based system, such as a fire-protection system; wherein the automatic testing, inspection, surveillance and maintenance system comprises a local part and a remote part, and
- 5 wherein the local part of the automatic testing, inspection, surveillance and maintenance system comprises:
- a pipe system (1) having a back flow valve (3) dividing the pipe system (1) into an inlet side and an outlet side, and a main valve (2) on the inlet side,
 - 10 - a pressure sensor (6) monitoring the pressure at the inlet side of the pipe system (1),
 - a pressure sensor (6) monitoring the pressure at the outlet side of the pipe system (1),
 - a flow path located at the outlet side of the pipe system (1) having a test valve (8)
 - 15 for opening or closing of the flow path,
 - a flow or pressure indicator (5) at the outlet side of the pipe system (1) for detecting a flow of a fluid through the path;
 - a control unit for controlling the testing, the surveillance, and the self-maintenance of the water-based system,
 - 20 - a local communications unit for sending signals and/or receiving signals; and
 - at least one sensor for obtaining a parameter of a fluid of the fire-protection system,
- wherein the remote part of the automatic testing, inspection, surveillance and maintenance system comprises:
- 25 - a remote communications unit for sending and/or receiving signals; and
 - a server unit for storing data, analysis, AI surveillance, maintenance, and orchestrating testing; and
 - a user-interface unit for presenting information to a user of the automatic testing, inspection, surveillance and maintenance system,
 - 30 and wherein the local communications unit is:
 - configured to obtain data from the sensor(s) and the flow indicator (5) and for communicating said information to the remote communications unit; and
 - the user-interface unit is configured to present information received by the remote communications unit.

2. The system according to claim 1, wherein the flow indicator is a pressure or flow switch.
3. The system according to claim 1 or 2, wherein the testing system comprises a plurality of valves, a plurality of flow indicators and/or a plurality of sensors.
- 5 4. The system according to any one of the preceding claims, wherein the parameter of the fluid is the pressure of the fluid.
5. The system according to any one of the preceding claims, wherein the system comprises at least one sensor for obtaining a pressure of the fluid of the water-based system and other optional sensors for obtaining properties of the fluid of the
10 water-based system.
6. The system according to any one of the preceding claims, wherein the system is connected to the internet of things.
7. The system according to any one of the preceding claims, wherein the system comprises a documentation unit for documenting information from the system,
15 wherein the documentation unit is configured for at least partially automatic documentation of the information.
8. A method for remote testing a water-based system by use of the automatic testing, inspection, surveillance and maintenance system according to any one of the preceding claims, the method comprising the following steps:
20
 - obtaining data on a parameter of a fluid by use of a sensor of the system;
 - opening a valve to open a flow path for a fluid of the water-based system;
 - obtaining data from a flow indicator on whether a fluid of the water-based system flows through the flow path;
 - obtaining data on whether or not an alarm signal is released as a result of the
25 indication from the flow indicator;
 - transferring the obtained data to the computer device by use of the local communications unit and the remote communications unit;
 - documenting the obtained data by use of the software in the computer device;
 - performing actions on given criteria controlled by AI or algorithms.
- 30 9. A method for detecting if a non-return or a backflow-valve is leaking according to claim 8, the method comprising: computing, based on a plurality of time series of measurements of properties of the fluid such as but not limited to pressure, wherein

the time series measurements are taken from different locations in the fluid system, determining the function of the non-return or backflow-valve using machine learning processing, wherein the time series of measurements of properties of the fluid are inputs to the machine learning processing.

- 5 10. A method for predicting if a non-return or a backflow-valve is due for service and or replacement of parts according to claim 8, the method comprising: computing, based on a plurality of time series of measurements of properties of the fluid such as but not limited to pressure, wherein the time series measurements are taken from different locations in the fluid system, determining the function of the non-
10 return or backflow-valve using machine learning processing, wherein the time series of measurements of properties of the fluid are inputs to the machine learning processing.

Krav

1. Et automatisk test-, inspeksjons (i form av ettersyn/kontroll)-, overvåkings- og vedlikeholdssystem for et vannbasert system, for eksempel et brannsikringssystem; hvor det automatiske test-, inspeksjons-, overvåkings- og vedlikeholdssystemet
5 omfatter en lokal del og en ekstern del, og hvor den lokale delen av det automatiske test-, inspeksjons-, overvåkings- og vedlikeholdssystemet består av:
 - et rørsystem (1) som har en tilbakestrømningsventil (3) som deler rørsystemet (1) i en innløpsside og et uttaksside, og en hovedventil (2) på innløpssiden,
 - en trykksensor (6) som overvåker trykket på innløpssiden av rørsystemet (1),
 - 10 - en trykksensor (6n) som overvåker trykket på utløpssiden av rørsystemet (1),
 - en strømningsbane plassert på utløpssiden av rørsystemet (1) som har en testventil (8) for åpning eller lukking av strømningsbanen,
 - en strømnings- eller trykkindikator (5) på utløpssiden av rørsystemet (1) for å oppdage en strøm av en væske gjennom banen;
 - 15 - en kontrollenhet for styring av testing, overvåking og selvvedlikehold av det vannbaserte systemet,
 - en lokal kommunikasjonsenhet for sending av signaler og / eller mottak av signaler; og
 - minst én sensor for å oppnå en parameter for en væske i det automatiske test-, inspeksjons-, overvåkings- og vedlikeholdssystemet, hvor den eksterne delen av
20 det automatiske test-, inspeksjons-, overvåkings- og vedlikeholdssystemet består av:
 - en ekstern kommunikasjonsenhet for sending og/eller mottak av signaler; og
 - en serverenhet for lagring av data, analyse, AI-overvåking, vedlikehold, og
25 dirigering av testing; og
 - en brukergrensesnittenhetsenhet for å presentere informasjon til en bruker av det automatiske test-, inspeksjons-, overvåkings- og vedlikeholdssystemet, og hvor den lokale kommunikasjonsenhetsen er:
 - konfigurert til å hente data fra sensoren (e) og strømningsindikatoren (5) og for å
30 kommunisere nevnte informasjon til fjernkommunikasjonsenhetsen; og
 - brukergrensesnittenhetsen er konfigurert til å presentere informasjon mottatt av den eksterne kommunikasjonsenhetsen.
2. Systemet i henhold til krav 1, hvor strømningsindikatoren er en trykk- eller strømningsbryter.

3. Systemet i henhold til krav 1 eller 2, hvor testsystemet består av et flertall av ventiler, et flertall av strømningsindikatorer og/eller et flertall av sensorer.
4. Systemet i henhold til en av de foregående kravene, hvor parameteren til væsken er væskens trykk.
- 5 5. Systemet i henhold til en av de foregående kravene, hvor systemet består av minst en sensor for å avlese et trykk på væsken i det vannbaserte systemet og andre valgfrie sensorer for å avlese egenskaper av væsken i det vannbaserte systemet.
6. Systemet i henhold til en av de foregående kravene, hvor systemet er koblet til tingenes internett (Internet of Things/IoT).
- 10 7. Systemet i henhold til en av de foregående kravene, hvor systemet består av en dokumentasjonsenhet for å dokumentere informasjon fra systemet, hvor dokumentasjonsenheten er konfigurert for minst delvis automatisk dokumentasjon av informasjonen.
- 15 8. En metode for fjerntesting av et vannbasert system ved bruk av det automatiske test-, inspeksjons-, overvåkings- og vedlikeholdssystemet i henhold til et av de foregående kravene, metoden som omfatter følgende trinn:
 - innhenting av data om en parameter for en væske ved bruk av en sensor i systemet;
 - åpne en ventil for å åpne en strømningsbane for en væske av den automatiske testingen, inspeksjon, overvåking og vedlikeholdssystem;
 - 20 - innhenting av data fra en strømningsindikator om hvorvidt en væske fra det automatiske test-, inspeksjons-, overvåkings- og vedlikeholdssystemet strømmer gjennom strømningsbanen;
 - innhenting av data om hvorvidt et alarmsignal frigjøres som følge av indikasjonen fra strømningsindikatoren;
 - 25 - overføre de innhentede dataene til datamaskinen ved bruk av den lokale kommunikasjonsenheten og den eksterne kommunikasjonsenheten;
 - dokumentere de innhentede dataene ved bruk av programvaren i dataenheten;
 - utføre handlinger på gitte kriterier kontrollert av AI eller algoritmer.
- 30 9. En metode for å oppdage om en tilbakeslags- eller tilbakestrømningsventil lekker i henhold til krav 8, metoden som omfatter: databehandling, basert på flere tidsserier

av målinger av væskens egenskaper som, men ikke begrenset til trykk, hvor tidsseriemålingene tas fra forskjellige steder i væskesystemet, bestemmer funksjonen til ikke-retur- eller tilbakestrømningsventilen ved hjelp av maskinlæringsbehandling, hvor tidsserien for målinger av fluidets egenskaper legges inn i maskinlæringsbehandlingen.

5

10. En metode for å forutsi om en tilbakeslags- eller tilbakestrømningsventil må ha vedlikehold/service og/eller utskifting av deler i henhold til krav 8, metoden som omfatter: databehandling, basert på flere tidsserier av målinger av fluidets egenskaper, for eksempel, men ikke begrenset til trykk, hvor tidsseriemålingene er hentet fra forskjellige steder i væskesystemet, bestemme funksjonen til ikke-retur- eller tilbakestrømningsventilen ved hjelp av maskinlæringsbehandling, hvor tidsserien for målinger av væskens egenskaper er innganger til maskinlæringsbehandlingen.

10

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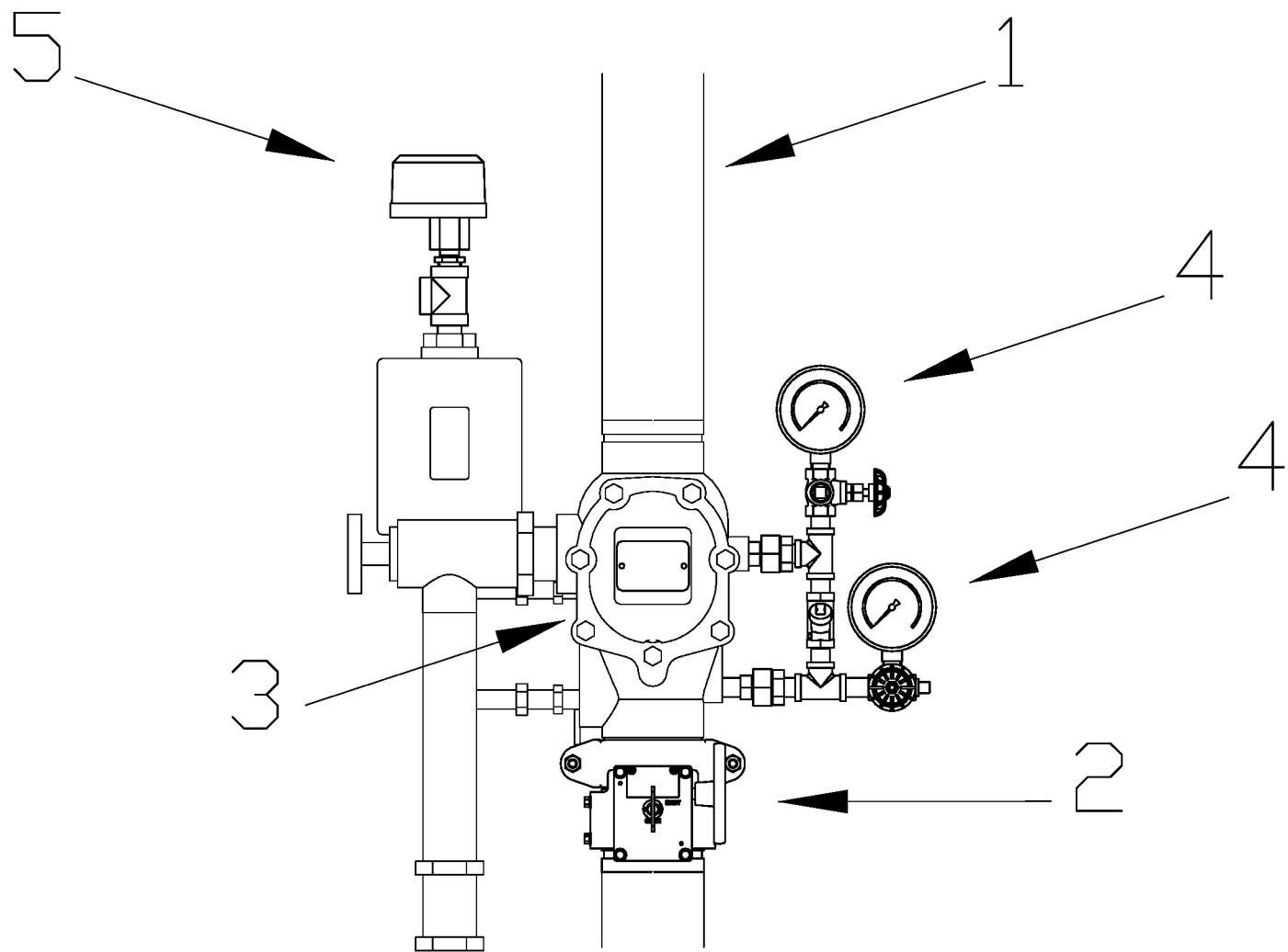


Fig. 1

2 / 3

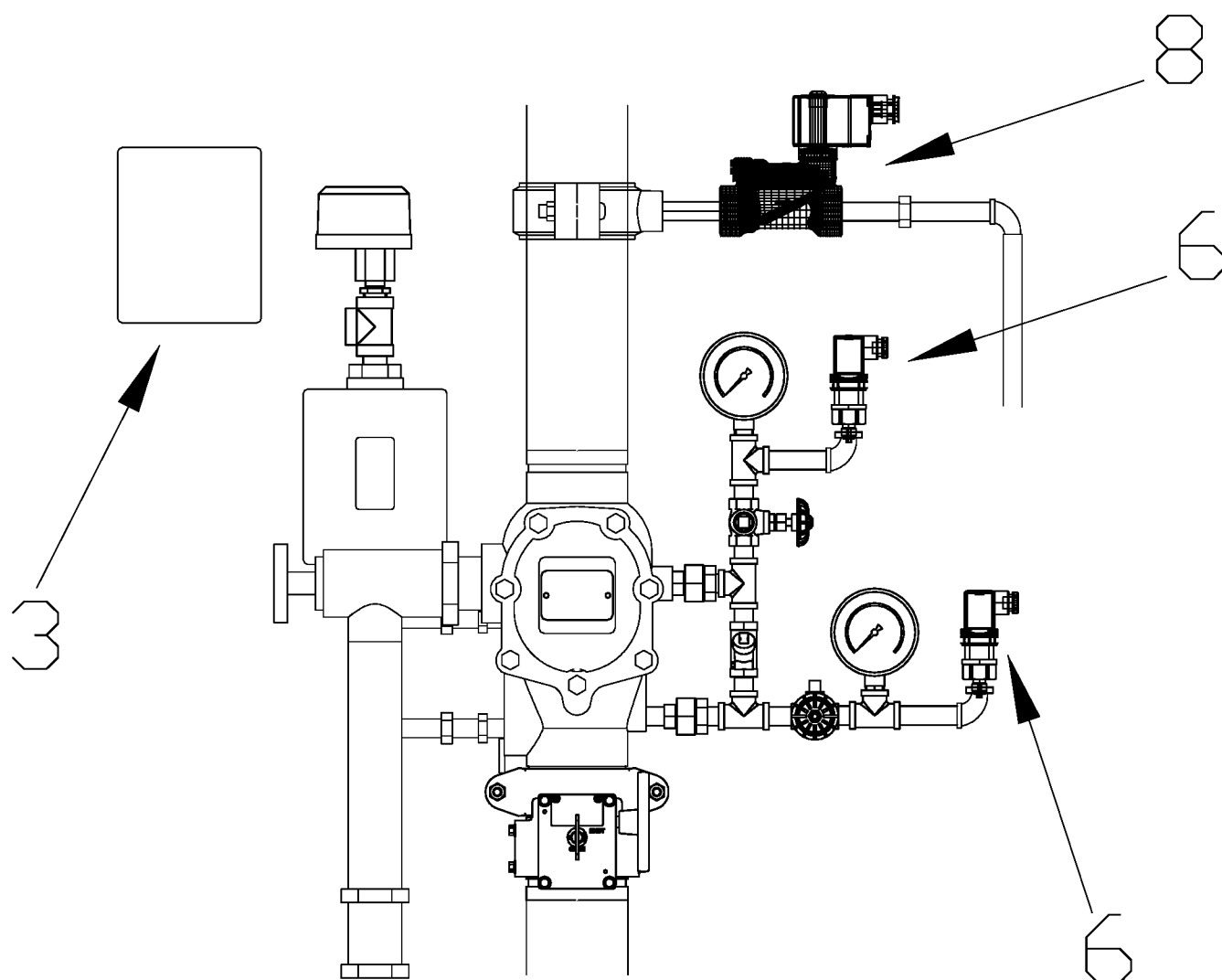


Fig. 2

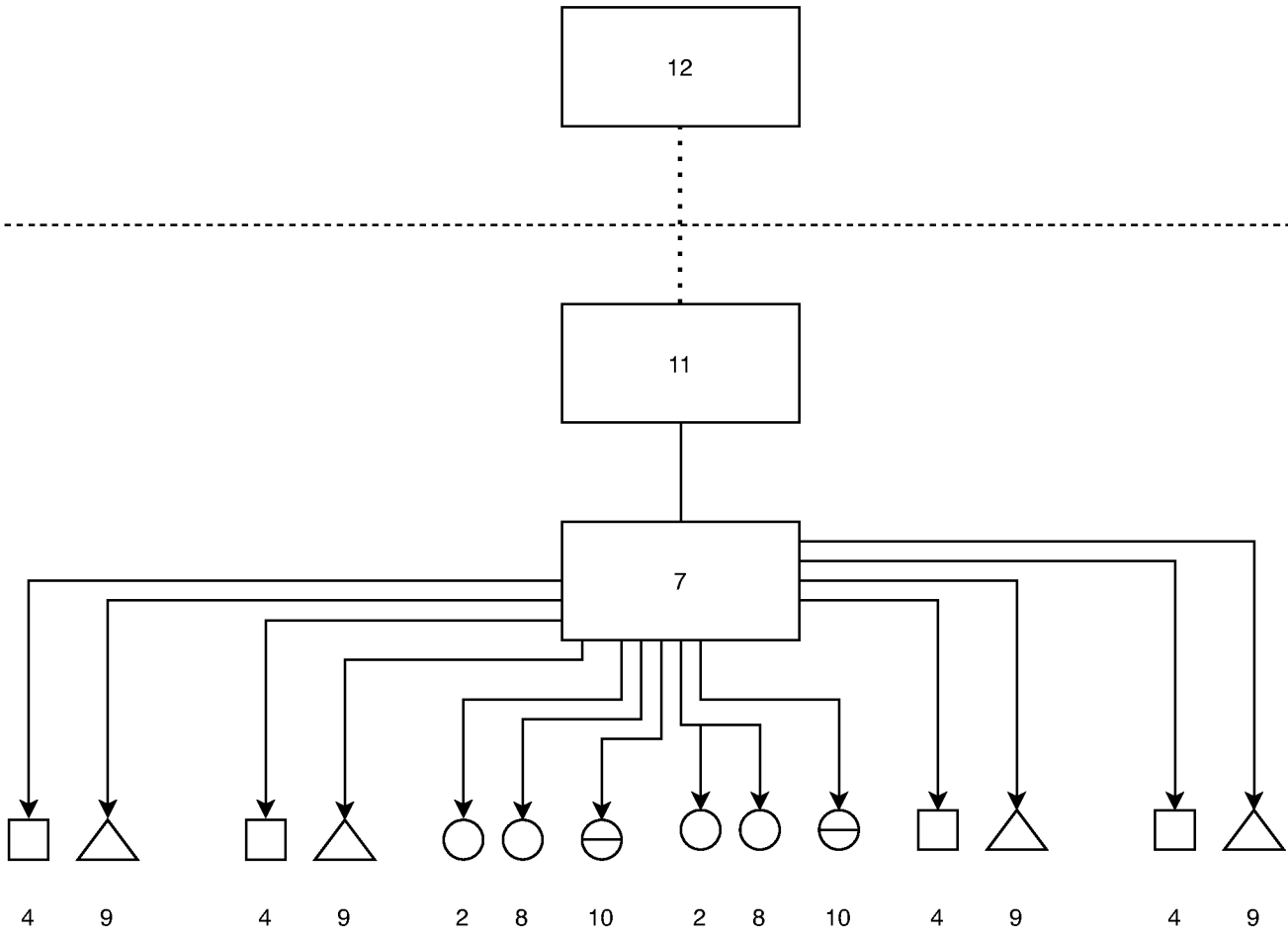


Fig. 3