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(71) Applicant: **PFEIFFER VACUUM** [FR/FR]; 98 Avenue de Brogny, 74000 ANNECY (FR).

(72) Inventor: **CUMONT, Sylvain**; C/O PFEIFFER VACUUM, 98 Avenue de Brogny, 74000 ANNECY (FR).

(74) Agent: **CROONENBROEK, Thomas** et al.; 11 Avenue des Tilleuls, 74200 THONON LES BAINS (FR).

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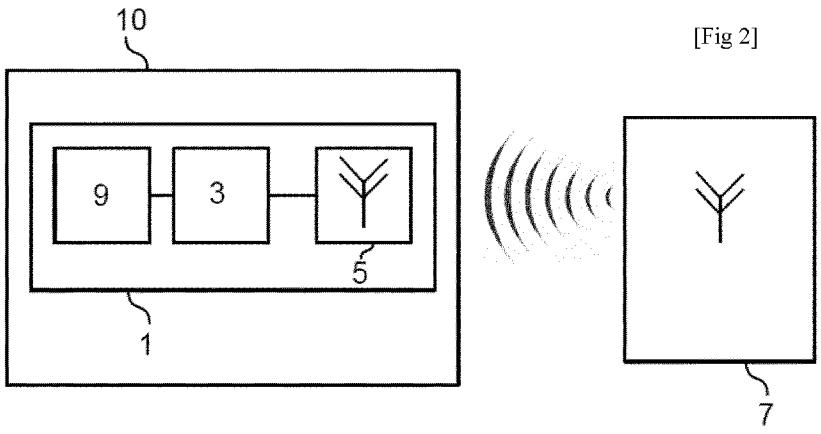
(54) **Title:** VACUUM INSTALLATION EQUIPMENT

[Fig 2]



(57) **Abstract:** Equipment (10) of a vacuum installation, characterized in that it comprises an electronic communication module (1), said electronic module (1) comprising: - a non-volatile memory (3), - a processing unit (9) associated with the non-volatile memory (3) and configured to allow values of parameters associated with the equipment (10) in the non-volatile memory (3) to be read and backed up when the equipment (10) is powered by a general power supply of the equipment (10), - a passive wireless communication module (5) associated with the non-volatile memory (3) and configured to receive a power supply signal from a reader (7) external to the equipment (10) and to return to said reader (7) an information signal comprising the values of the parameters backed up in the non-volatile memory (3), the passive wireless communication module (5) being powered by the power supply signal from the external reader (7).

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Description

Title of the invention: Vacuum installation equipment

Vacuum installations comprise multiple items of mechanical and electrical equipment which require tracking and regular maintenance in order to prevent any failure. It is therefore suitable, when a failure occurs, to be able to rapidly identify the origin of the failure and allow a rapid repair of the equipment by having access to information associated with this equipment such as a reference number to be able to order a defective part.

However, such tracking can be complex and require considerable time to retrieve certain information such as the latest errors encountered by the equipment. In case of failure of the equipment, such information may not be accessible. Furthermore, it is necessary to be able to recover these data without powering up the equipment again.

It is therefore suitable to provide a solution that makes it possible to simplify the tracking and maintenance of equipment of a vacuum installation and to limit the time required for this tracking in order to limit the number of failures and allow a rapid response in the event of failure. The documents WO2014197779 and EP3451547 describe wireless communication equipment allowing a transfer of data between a non-volatile memory of a passive device and an external reader.

To this end, the subject of the present invention is equipment of a vacuum installation comprising an electronic communication module, said electronic module comprising:

- a non-volatile memory,
- a processing unit associated with the non-volatile memory and configured to allow values of parameters associated with the equipment to be read and backed up in the non-volatile memory when the equipment is powered by a general power supply of the equipment,
- a passive wireless communication module associated with the non-volatile memory and configured to receive a power supply signal from a reader external to the equipment and to return to said reader an information signal comprising

the values of the parameters backed up in the non-volatile memory, the passive wireless communication module being powered by the power supply signal from the external reader.

The use of such an electronic module in equipment of a vacuum installation makes it possible to have rapid access to multiple items of information associated with the equipment even when the equipment is not powered. In fact, for the purposes of services, of stock management, of flows in service centres or on site, it may be useful to have access to the configuration, identification and operating parameters of equipment of a vacuum installation such as a vacuum pump or a leak detector or a solenoid valve without needing to power up the equipment, notably to have tracking or control of the operation of the equipment. Such access to the parameters of the equipment notably makes it possible to anticipate certain failures or facilitate the repair of the equipment when a failure occurs. Simple and rapid access to certain information such as the serial number of equipment but also operating parameters such as its duration of use or the various errors that have occurred on the equipment or even the value of certain operating parameters makes it possible to improve and facilitate the tracking and maintenance. Furthermore, powering up the equipment may take considerable time or may not be possible in the event of failure of the equipment without the use of such a module. Furthermore, with the power supply of the electronic module being provided by the signals transmitted by an external reader, there is no need to use a battery or cell which require periodic charging and/or changes.

According to another aspect of the present invention, the passive wireless communication module is configured to receive a power supply signal comprising values of parameters associated with the equipment and to back up these parameter values in the non-volatile memory.

Such a feature makes it possible to back up or modify certain parameters associated with the equipment even when the latter is not powered which may make it possible to rapidly make updates, avoid the occurrence of failures when restarting or configuring the equipment without electrical power supply.

According to a supplementary aspect of the present invention, the non-volatile memory comprises at least one secure part in which the reading and/or the backing up of the parameter values associated with the equipment by an external

reader is authorized only for identified external readers and/or requires a password.

According to an additional aspect of the present invention, the passive wireless communication module uses a communication protocol from among the following protocols:

- a near-field communication protocol, also called NFC,
- a radiofrequency identification protocol, also called RFID.

According to another aspect of the present invention, at least some of the parameters whose values are backed up in the non-volatile memory are dynamic parameters whose value can vary over time, notably when the equipment is operating.

According to a supplementary aspect of the present invention, the parameters comprise operating parameters of the equipment, notably at least one of the following parameters:

- a duration of operation of the equipment or of an element of the equipment,
- a number of cycles of the equipment,
- a power or a power integral of the equipment,
- faults encountered by the equipment,
- a temperature of an element of the equipment,
- vibratory levels measured on an element of the equipment,
- a current threshold of the equipment,
- dates of maintenance of the equipment or of an intervention of a technician on the equipment,
- a servocontrol parameter of the equipment,
- a bias current of the equipment,
- operating values, notably the latest operating values, of the equipment before the triggering of a fault or a powering down of a general power supply of the equipment.

According to a supplementary aspect of the present invention, the processing unit of the electronic module is connected to a general processing unit of the equipment via a communication bus.

According to an additional aspect of the present invention, the equipment is a vacuum pump or a leak detector or a solenoid valve.

Other features and advantages of the invention will become more apparent on reading the following description, given as an illustrative and nonlimiting example, and the attached drawings in which:

[Fig 1] represents a simplified diagram of equipment of a vacuum installation according to an embodiment of the present invention;

[Fig.2] represents a simplified diagram of the equipment of Figure 1 and of an external reader.

In these figures, the elements that are identical bear the same references.

The following embodiments are examples. Although the description refers to one or more embodiments, that does not necessarily mean that each reference relates to the same embodiment, or that the features apply only to a single embodiment. Simple features of different embodiments can also be combined or swapped to provide other embodiments.

The present invention relates to equipment of a vacuum installation. A vacuum installation is understood to mean any installation comprising pumping devices that make it possible to obtain a pressure lower than atmospheric pressure in a part of the installation.

The equipment of the vacuum installation is, for example, a vacuum pump, a leak detector or a solenoid valve and comprises an electronic communication module configured notably to allow data associated with the equipment to be recovered by a remote reader without requiring the equipment to be powered up.

Figure 1 represents a diagram of an exemplary embodiment of equipment 10 of a vacuum installation comprising an electronic communication module 1. The electronic communication module 1 comprises a non-volatile memory 3 configured to back up values of parameters associated with the equipment 10, notably when the latter is operating, for example when the equipment 10 is powered up.

Different types of parameters can be backed up in the non-volatile memory 3 such as, for example, a reference number of the equipment 10 or reference numbers of the various parts of the equipment 10, the dates of intervention of a maintenance service on the equipment, but also configuration or operating parameters of the equipment 10. These parameters can be dynamic parameters which can change over time when the equipment 10 is operating. These dynamic parameters correspond, for example, to a duration of operation of the

equipment 10 or of an element of the equipment 10, an operating power or a power integral of the equipment 10 or of an element of the equipment 10, faults encountered by the equipment 10 or by an element of the equipment 10, a temperature or a temperature variation of an element of the equipment 10, vibrations or vibratory levels measured on an element of the equipment or a number of operating cycles of the equipment 10.

The parameters stored in the non-volatile memory can thus depend on the equipment of the vacuum installation. Thus, in the case of a vacuum pump, the stored parameters will be able to be a current threshold in the pump or the temperature of the bearings supporting the rotors of the vacuum pump or an operating power of the pump. In the case of a solenoid valve, the parameters will be able to be a number of openings and/or closures in the case of an on/off solenoid valve used to isolate a chamber for example or a servocontrol coefficient in the case of a solenoid valve used to regulate a flow rate, notably a gas flow rate or to regulate a pressure of a gas. In the case of a leak detector, for example a sniffer mode leak detector for which the element to be tested is pressurized with a tracer gas and a sniffer probe linked to a gas analyser is positioned in proximity to the element to be tested to detect the presence of tracer gas or a sprinkler mode leak detector for which the element to be tested is sprinkled with tracer gas with a sprinkler gun, the volume inside the element to be tested being linked to a gas analyser, the parameters can also comprise a bias current of the gas analyser.

The electronic communication module 1 also comprises a processing unit 9 associated with the non-volatile memory 3 and configured to allow values of parameters associated with the equipment 10 to be read and backed up in the non-volatile memory 3. The processing unit 9 is, for example, implemented by a microcontroller or a microprocessor.

The processing unit 9 is, for example, connected to a general processing unit 11 of the equipment 10 via a communication bus 13 such as a databus of CAN (Controller Area Network) type. Alternatively, the processing unit 9 and the general processing unit can be combined in a single general processing unit of the equipment 10.

Thus, when it is operating, the equipment 10 can write or read values of parameters such as the parameters presented above in the non-volatile memory 3 via the communication bus 13 and the processing unit 9.

The electronic communication module 1 also comprises a passive wireless communication module 5 associated with the non-volatile memory 3. The passive wireless communication module 5 and the non-volatile memory are, for example, arranged on a common printed circuit or are linked by wire.

The passive wireless communication module 5 is configured to receive a power supply signal from a reader 7 (visible in Figure 2) external to the equipment 10 and to return to said reader 7 an information signal comprising at least some of the parameters stored in the non-volatile memory 3 in response to the power supply signal. The passive wireless communication module 5 comprises, for example, an antenna configured to receive electromagnetic waves emitted by the reader 7.

The communication protocol used to establish the communication between the passive wireless communication module 5 and the reader 7 is, for example, one of the following protocols:

- a near-field communication protocol, also called NFC,
- a radiofrequency identification protocol, also called RFID.

The sending of the parameters stored in the non-volatile memory 3 by the passive wireless communication module 5 to the reader 7 is for example done by modulating the power supply signal received from the reader 7, the modulated signal being then returned as information signal to the reader 7.

The passive wireless communication module 5 can also be configured to receive a power supply signal from the reader 7 and comprising values of parameters associated with the equipment 10 and to back up these values in the non-volatile memory 3. That for example relates to the values of configuration parameters of the equipment 10 which will, for example, be used by the equipment 10 when it is subsequently operated. These parameters can correspond to at least some of the parameters described previously.

The electronic communication module 1 is thus powered by a general power supply of the equipment 10 when the equipment 10 is operating and is powered by the power supply signals emitted by the reader 7 when the equipment 10 is not operating and is powered down by switching off of the general power

supply. It is also possible to read and/or write values of parameters associated with the equipment 10 with the reader 7 while the equipment 10 is powered by its general power supply.

The non-volatile memory 3 can be secured, partially (only for certain stored parameters) or totally (for all the stored parameters) in read or write mode. This securing relates, for example, to access to the non-volatile memory 3 requiring a password or access authorised only to one or more predefined identified readers or a combination of these methods. Other methods for securing the non-volatile memory 3 known to the person skilled in the art can also be used. Certain parameter values in the non-volatile memory 3 can also be accessible only in read mode without being able to be modified. That can, for example, relate to values of static parameters such as a reference number of the equipment 10. A reader 7 can be configured to be authorised to read and/or write data associated with a plurality of electronic devices 1 incorporated in different equipment 10, for example all of the equipment of a vacuum installation or of a production site comprising such installations.

In the case of dynamic parameters such as a duration of operation of the equipment or of an element of the equipment such as a motor, the value of the parameter can be updated at regular time intervals or only at predetermined instants, for example when the equipment 10 is switched off.

In operation, when the equipment 10, for example a vacuum pump 10, is powered, for example via a powering up of the equipment, the values of various operating parameters can be backed up regularly in the non-volatile memory 3. These backups are, for example, performed by the sending of a signal comprising the updated values of these parameters by the general processing unit 11 of the vacuum pump 10 to the electronic communication module 1 via the databus 13. These parameters relate, for example to an operating time of the vacuum pump 10 and to faults encountered by the vacuum pump 10. These backups are, for example, performed cyclically every second, every minute or upon a change of state of the vacuum pump such as the powering down thereof. The non-volatile memory 3 also comprises static parameters such as a reference number of the vacuum pump 10 and configuration parameters of the vacuum pump 10 such as a maximum operating power.

When the vacuum pump is switched off and powered down, for example following a failure of the vacuum pump, the values of all or some parameters stored in the non-volatile memory 3 are recovered by an external reader 7. A dialogue can be established between the external reader 7 and the electronic communication module 1 so that the user of the external reader 7 can select the parameters which have to be returned to the external reader 7.

To allow these parameters backed up in the non-volatile memory 3 to be read, the external reader 7 is placed in proximity to the vacuum pump 10, for example within a radius of between a few centimetres and 10 m depending on the range of the communication protocol used and the communication protocol of the reader 7 is activated so that power supply signals are transmitted to the electronic device 1. In response to the power supply signals from the reader 7, the electronic device 1 returns an information signal comprising the values of the selected parameters stored in the non-volatile memory 3.

The values of the parameters recovered by the reader 7 make it possible to see the latest faults encountered by the vacuum pump 10, for example an overheating or an overspeed of the motor of the vacuum pump 10 which can make it possible to rapidly detect the origin of the failure of the vacuum pump 10 and thus reduce the time required to repair the vacuum pump 10.

Thus, if the failure is due to an overheating caused by the fact that the maximum operating power of the vacuum pump 10 was too high, it is also possible to modify the value of the parameter corresponding to the maximum operating power of the vacuum pump in the non-volatile memory 3, for example by sending a new value of the parameter corresponding to the maximum operating power in a power supply signal transmitted by the external reader 7 to the electronic communication module 1.

Thus, when the vacuum pump 10 is restored to operation, the general processing unit 11 reads, via the processing unit 9, in the non-volatile memory 3 of the electronic communication module 1, the value of the maximum operating power and thus adjusts the power setpoint of the vacuum pump 10 when it is restarted which makes it possible to prevent a new overheating due to an excessively high maximum operating power (adaptation of parameters).

The use of an electronic communication module 1 comprising, on the one hand, a non-volatile memory 3 associated with a processing unit 9 to read and/or back

up parameters associated with the equipment 10 of a vacuum installation and, on the other hand, a passive wireless communication module 5 configured to communicate with an external reader 7, thus makes it possible to be able to read the value of the parameters stored in the non-volatile memory 3 even when the equipment 10 is not operating or powered up. Such an electronic communication module 1 can also allow values of parameters associated with the equipment to be backed up in the non-volatile memory 3 when the equipment 10 is not operating or powered up. Such an electronic communication module 1 therefore makes it possible to simply and rapidly access data associated with the equipment 10 without requiring the equipment 10 to be powered up.

Claims

[Claim 1] Equipment (10) of a vacuum installation, characterized in that it comprises an electronic communication module (1), said electronic module (1) comprising:
- a non-volatile memory (3),
- a processing unit (9) associated with the non-volatile memory (3) and configured to allow values of parameters associated with the equipment (10) in the non-volatile memory (3) to be read and backed up when the equipment (10) is powered by a general power supply of the equipment (10),
- a passive wireless communication module (5) associated with the non-volatile memory (3) and configured to receive a power supply signal from a reader (7) external to the equipment (10) and to return to said reader (7) an information signal comprising the values of the parameters backed up in the non-volatile memory (3), the passive wireless communication module (5) being powered by the power supply signal of the external reader (7),
characterized in that the non-volatile memory (3) comprises at least one secure part in which the reading and/or the backing up of the parameter values associated with the equipment (10) by an external reader (7) is authorized only for identified external readers (7) and/or requires a password.

[Claim 2] Equipment (10) of a vacuum installation according to the preceding claim, wherein the passive wireless communication module (5) is configured to receive a power supply signal comprising values of parameters associated with the equipment (10) and to back up these parameter values in the non-volatile memory (3).

[Claim 3] Equipment (10) of a vacuum installation according to one of the preceding claims, wherein the passive wireless communication module (5) uses a communication protocol from among the

following protocols:
- a near-field communication protocol, also called NFC,
- a radiofrequency identification protocol, also called RFID.

[Claim 4] Equipment (10) of a vacuum installation according to one of the preceding claims, wherein at least some of the parameters whose values are backed up in the non-volatile memory (3) are dynamic parameters whose value can vary over time, notably when the equipment (10) is operating.

[Claim 5] Equipment (10) of a vacuum installation according to Claim 4, wherein the parameters comprise operating parameters of the equipment (10), notably at least one of the following parameters:
- a duration of operation of the equipment (10) or of an element of the equipment (10),
- a number of cycles of the equipment,
- a power or a power integral of the equipment (10),
- faults encountered by the equipment (10),
- a temperature of an element of the equipment (10),
- vibratory levels measured on an element of the equipment (10),
- a current threshold of the equipment (10),
- dates of maintenance of the equipment (10) or of an intervention of a technician on the equipment (10),
- a servocontrol parameter of the equipment (10),
- a bias current of the equipment (10),
- operating values of the equipment (10) before the triggering of a fault or a powering down of the general power supply of the equipment (10).

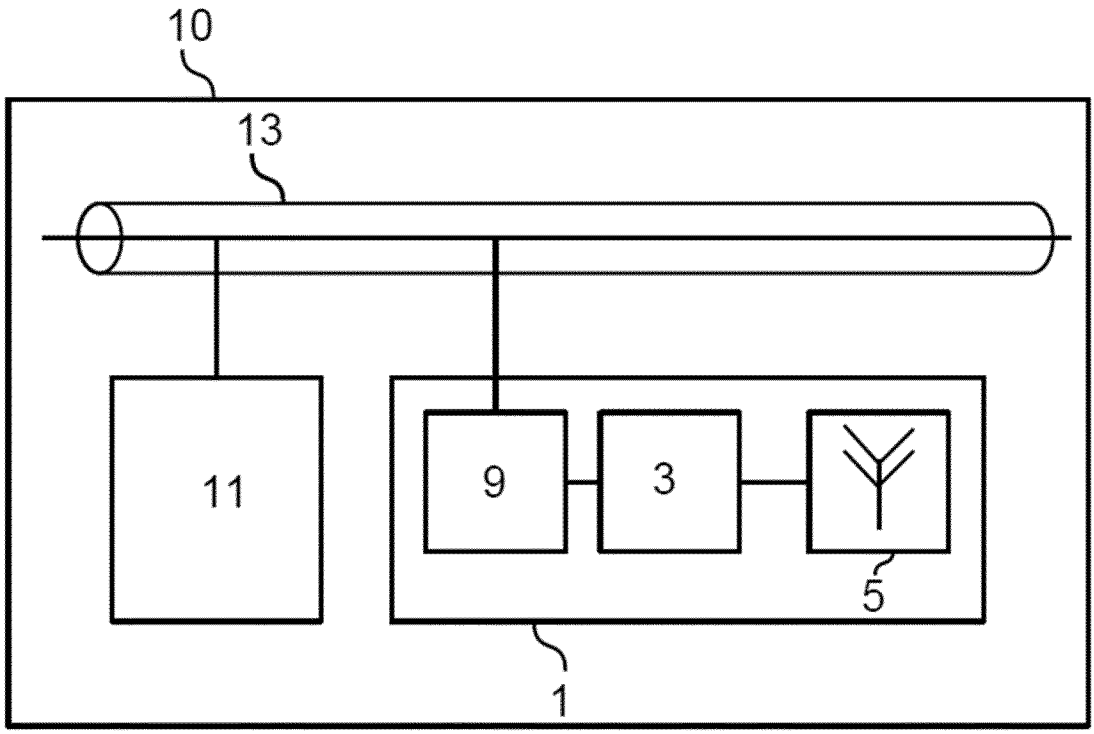
[Claim 6] Equipment (10) of a vacuum installation according to one of the preceding claims, wherein the processing unit (9) of the electronic module (1) is connected to a general processing unit (11) of the equipment (10) via a communication bus (13).

[Claim 7] Equipment (10) of a vacuum installation according to one of the preceding claims, characterized in that the equipment (10) is a vacuum pump.

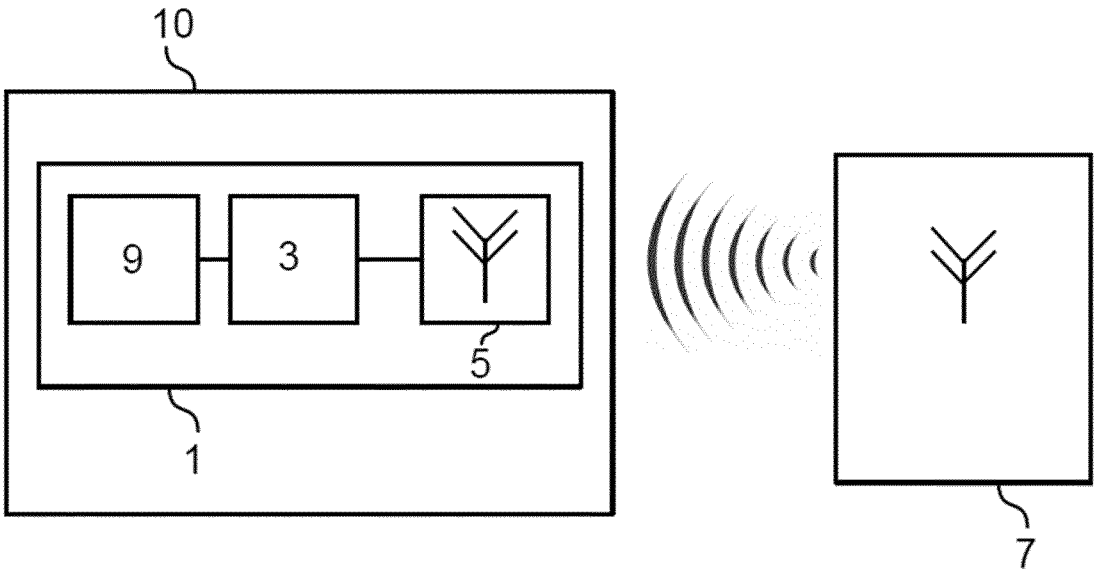
[Claim 8] Equipment (10) of a vacuum installation according to one of Claims 1 to 6, characterized in that the equipment (10) is a leak detector.

[Claim 9] Equipment (10) of a vacuum installation according to one of Claims 1 to 6, characterized in that the equipment (10) is a solenoid valve.

[Fig 1]



[Fig 2]



INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. G06K19/07 G06K19/073
ADD.

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)
G06K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2014/197779 A1 (FISHER CONTROLS INT [US]) 11 December 2014 (2014-12-11)	1-9
Y	figures 1,2,4,5,7,8 paragraphs [0023] - [0045] paragraphs [0054] - [0062] paragraphs [0064] - [0066]	1-9
Y	EP 3 451 547 A1 (YOKOGAWA ELECTRIC CORP [JP]) 6 March 2019 (2019-03-06) figure 1 paragraphs [0027] - [0038] paragraphs [0056] - [0064]	1-9

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Grob, Mark

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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