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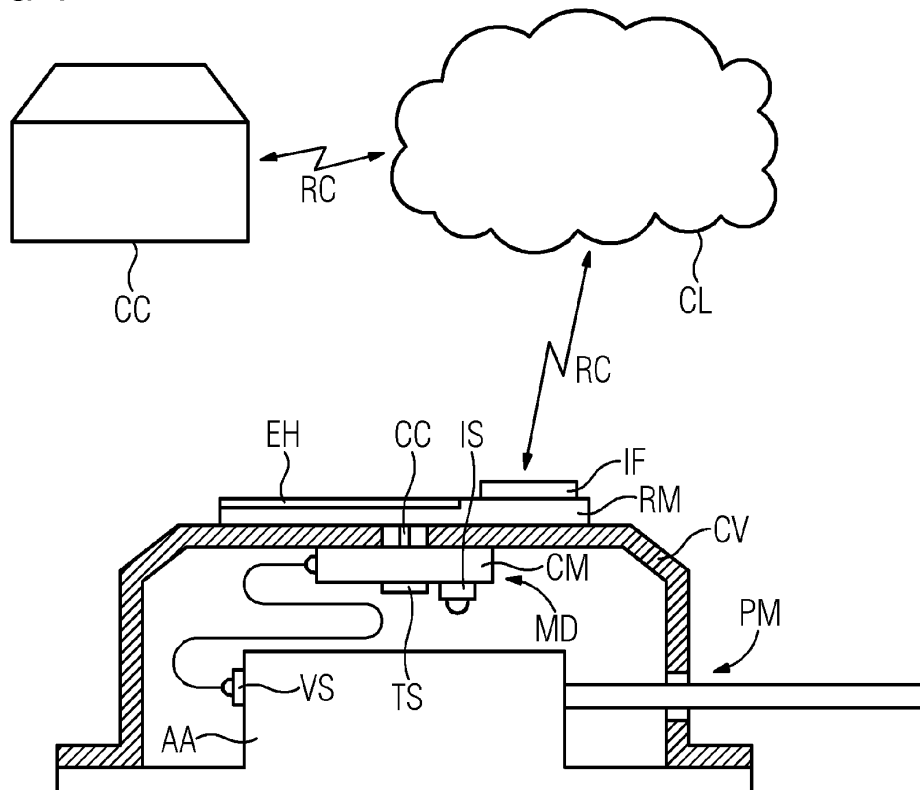
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(54) **COVER FOR MOUNTING ON A POINT MACHINE AND METHOD FOR PROVIDING A MONITORING OF A POINT MACHINE**

(57) The present disclosure refers to a cover (CV) for mounting on a point machine (PM) comprising an actuating assembly (AA). A monitoring device (MD) is arranged in or on the cover (CV) comprising at least one sensor (S) for acquiring data related to the operating sta-

tus of the point machine (PM), and an interface (IF) for outputting the data. Further, a point machine (PM) and a method for providing a monitoring of a point machine (PM) are provided.

FIG 1



Description

[0001] The present disclosure relates to a point machine comprising an actuating assembly. Further, the disclosure relates to a cover of that point machine. Particularly, the housing serves as a cover for a monitoring device providing data related to the operation status of the point machine. Further the disclosure relates to a method for providing a monitoring of a point machine. Finally, the disclosure relates to a computer program product as well as an apparatus for the computer program product, wherein the computer program product is equipped with instructions (program commands) for executing this method.

Background

[0002] A point machine is a type of equipment that is subject to major forces and serves as an important element of a safety critical process. Failure of the point machine has a direct and huge impact on the functioning of a rail infrastructure.

[0003] At present, the monitoring of the point machine is related to a fixed schedule of service intervals and rather time-consuming, i. e. authorized specialists must walk between the tracks to ensure the proper functioning of the point machine. In case of failure, a predetermined emergency process (corrective maintenance process) has to be effected to avoid any safety risks and/or irregularities regarding the rail traffic.

[0004] Various methods for monitoring and ensuring the proper functioning of a point machine are known. One of those methods is, for example, as outlined before, the manual monitoring of the point machine, i. e. authorized specialists must walk between the tracks to check several /critical parts of the point machine.

[0005] However, it is well known that the aforementioned monitoring process is rather time-consuming and cost-intensive.

[0006] Document EP 3 269 615 A1 describes a point machine comprising a housing and an actuating assembly arranged inside the housing, an actuating rod driven by the motor for moving at least one point blade of a point, and a fiber optic sensor which is directly attached to the point machine for detection of a parameter which indicates the condition of the point machine. However, it would involve a great deal of equipment and high costs if existing point machines had to be replaced for the purpose of better monitoring as outlined in the aforementioned document.

Summary

[0007] An object of the disclosure is to provide solutions for point machines which save costs and effort for maintenance and which also keep the costs and effort for installation of the solution to a minimum. In addition, it is an object of the disclosure to provide a method for

operating such point machines, the installation and operation of which should be as inexpensive as possible. Finally, another object of the disclosure is to provide a computer program product and an apparatus for providing the computer program product through which the above-mentioned method can be executed.

[0008] The object of the disclosure is solved by said cover whereby a monitoring device is arranged in or on the cover, comprising at least one sensor for acquiring data related to the operating status of the point machine, and an interface for outputting the data.

[0009] According to the present invention the existing cover of the point machine is replaced by a smart cover which is a device equipped with at least one sensor, preferably with multiple sensors providing monitoring data reflecting the operating status of the point machine. This replacing of the cover does not impact the safety critical mechanical parts (the actuating assembly) of the point machine but provides for more efficiently managed monitoring of the point machine which solves the problem mentioned above. Thus, the disclosure described hereby has no impact on the actuating assembly of the point machine and is designed to optimize its own asset management according to an automatic monitoring routine instead of manual maintenance actions. For this purpose, only the cover of the point machine must be changed which is advantageously connected to less investment effort. Subsequently, the disclosure leads to a reduction of monitoring costs as there is no manual surveillance.

[0010] The cover may be a kit for retrofitting. In addition, by way of retrofitting, the disclosed system can be conveniently installed and monitored in a simple technical process, at a low cost with high efficiency in less time. The kit of retrofitting can be produced in large numbers and therefore be offered at a lower price.

[0011] Unless otherwise stated in the following description, the terms "create", "calculate", "determine", "generate", "configure", "modify" and the like preferably refer to actions and/or processes and/or processing steps that change and/or generate data and/or transform the data into other data. The data is available as physical quantities, for example, as electrical impulses or measured values. The necessary instructions/program commands are combined in a computer program as software. Furthermore, the terms "receive", "transmit", "read in", "read out", "transfer" and the like refer to the interaction of individual hardware components and/or software components via interfaces. The interfaces can be implemented in terms of hardware, for example, wired or as radio connection, and/or in terms of software, for example, as interaction between individual program modules or program parts of one or more computer programs.

[0012] In the context of the disclosure, "computer-aided" or "computer-implemented" may, for example, be understood as an implementation of the process in which one or more computer/s execute/s or perform/s at least one procedural step of the process. The term "computer" should be interpreted broadly, covering all electronic de-

vices with data processing capabilities. Computers can thus be, for example, personal computers, servers, handheld computer systems, pocket PC devices, mobile radio devices and other communication devices that process data with the aid of computers, processors and other electronic devices for data processing, which can also be connected to a network. In the context of the disclosure, a "memory unit" can be understood to be, for example, a computer-readable memory in the form of a random-access memory (RAM) or data storage device (hard disk or data carrier).

[0013] "Program modules" are to be understood as individual functional units which enable the program sequence according to the disclosure. These functional units may be realized in a single computer program or in several computer programs communicating with each other. The interfaces realized in this way can be implemented within a single processor in terms of software or in terms of hardware if several processors are used.

[0014] In the context of the disclosure, a "processor" may be understood to be, for example, a machine, such as a sensor for generating measured values or an electronic circuit. A processor may be a central processing unit (CPU), a microprocessor or a microcontroller, for example, an application-specific integrated circuit or a digital signal processor, possibly in combination with a memory unit or memory module for storing program commands, etc. A processor may also be an integrated circuit (IC), in particular a field programmable gate array (FPGA) or an application-specific integrated circuit (ASIC), or a digital signal processor (DSP). A processor can also be understood as a virtualized processor or a soft CPU. For example, it may also be a programmable processor equipped with a configuration for executing a computer-based process.

[0015] An energy harvesting unit, especially a solar cell, may be mounted in or on the cover, and which may be configured to supply power to the monitoring device. If harvesting is used to generate energy, the advantage is that the replaced cover is independent of an energy supply. In particular, it can be easily retrofitted to existing point machines, because no external energy supply is required. This makes it easier to change the cover, and the associated costs can be further reduced.

[0016] The interface may be provided by a radio module configured to receive and transmit the data. The advantage of this embodiment is that the point machine can communicate via a wireless link with a control center, for example. In the control center, the data can be evaluated, so that necessary maintenance can be determined at low cost. Personnel on site is then only required for the necessary maintenance work and can be requested for this purpose.

[0017] The interface may be provided by a memory module which is configured to store the data. The advantage of this embodiment is that monitoring data acquired by the sensor can be stored. This makes it possible, for example, to read out the data at regular intervals. This

can be done, for example, via a wireless interface, via a wired connection or by means of a reader. The variant of a readout with a reader, in particular, is technically easy to implement.

[0018] The data may be modified by a calculation module which is configured to receive the data acquired by the sensor. The calculation module can be understood as a processor that allows the cover to run its own data processing. The calculation module can be used to control the processes in the cover or to process data measured by the sensor. This means that data can be read out in a pre-processed condition, for example to collect it in a control center. It is thus advantageous to implement a distributed intelligence of data processing.

[0019] The interface may be configured to be connected to a cloud. The acquired data for monitoring the operating status of the point machine is read in and can be accessed from a cloud. Cloud services can be provided for a huge number of functional components, e. g. a large number of point machines equipped with the cover. Components of the cloud infrastructure can be shared by all point machines which reduces the necessary investment.

[0020] The term "cloud" refers to an environment of cloud-computing which relates to an information technology infrastructure provided by a network or the internet. The cloud provides storage space, computing power or an application package as a service, all of which do not have to be installed on the local computer that is used by the cloud. The supply and use of the afore-mentioned services are provided exclusively by technical interfaces and protocols, e. g. by means of a web browser. The range of the services provided by cloud-computing comprise the information technology as a whole and consists, inter alia, of an infrastructure, platforms and software.

[0021] The at least one sensor or a plurality of sensors may be configured to detect at least one of the following conditions of the point machine: a temperature, the number of position changes of the point, vibrations caused by the actuating assembly, an image of the actuating assembly, the duration of position changes of the point.

[0022] An increased temperature can, for example, indicate an overload of the point machine. The increased temperature results from increased frictional losses, for example. Frictional losses can also indicate mechanical wear, i.e. if mechanical parts need to be replaced. Another possibility is to measure the environment temperature. Objective in this case is to verify whether certain patterns or anomalies of temperature progress can be correlated to other parameters for example ambient temperature. This is not the temperature of the motor.

[0023] The number of position changes can be counted to determine maintenance intervals. Maintenance may also be necessary as a precautionary measure if the switch has performed a certain number of position changes. Even if, for example, other sensors do not indicate any problems, it may be necessary to check that there

is enough lubrication.

[0024] The time required to shift the switch is directly proportional with the health state of the point machine.

[0025] The occurrence of increased vibrations can also be a sign of progressive wear. It is also possible that increased vibrations are triggered when mechanical parts are jammed. In any case, the increase in vibration indicates the need for maintenance.

[0026] A mathematical model can be based on the above-mentioned parameters to estimate the future values of the different parameters and gives an estimate of the future health state of the point machine.

[0027] Using an optical sensor, a movement of the actuating assembly can be detected. Based on the initiation of the movement one is able to capture the time the device operates. This can be compared with the vibration characteristics, especially the duration of the vibration causes by a position change.

[0028] With images (using a camera) of the actuator assembly an image processing can be performed. Image information can be evaluated to make assessments about the condition of the actuator assembly. This does not only concern the optical condition of the actuator assembly, but also the time consumed to perform a position change (this requires a sequence of images). However, the time for a position change can also be determined differently, for example by means of the vibration sensor as mentioned above.

[0029] A point machine, comprising an actuating assembly and a cover covering the actuating assembly, the cover including the features described above, also solves the mentioned problem and has the same advantages as mentioned above.

[0030] The problem is also solved by a method for providing a monitoring of a point machine, comprising the steps for:

- providing a cover to be mounted on the point machine, comprising an actuating assembly,
- arranging a monitoring device in or on the cover, comprising
 - at least one sensor for acquiring data related to the operating status of the point machine,
 - an interface for outputting the data,
- retrofitting the point machine by replacing the existing cover of the point machine by said cover equipped with the monitoring device.

[0031] This specifies a method by which existing point machines can be equipped for automatic monitoring. In particular, this can be effected by retrofitting a cover for the point machine. This solves the above-mentioned object, whereby the method forms said monitoring assembly. The advantages associated herewith have also been discussed above.

[0032] One of the advantages of the method is that it

reduces cost and time by connecting the cover to the existing point machine system without any modifications.

[0033] Additionally, it significantly reduces the cost incurred by employing authorized specialists and the use of maintenance equipment. In addition, the present disclosure creates an easy access to data related to the operating status of the point machine especially by using cloud services.

[0034] Furthermore, a computer program product with instructions for executing said method and/or its embodiments is claimed, wherein the method according to the disclosure and/or its embodiments can be executed by means of the computer program product.

[0035] In addition, an apparatus is claimed for storing and/or providing the computer program product. For example, the apparatus is a storage medium that stores and/or provides the computer program product. Alternatively and/or additionally, the apparatus is, for example, a network service, a computer system, a server system, in particular a distributed computer system, a cloud-based computer system and/or virtual computer system, which stores and/or provides the computer program product preferably in the form of a data stream.

Description of embodiments

[0036] The disclosure will now be described in detail in connection with preferred embodiments with reference to the accompanying drawings. They are by no means meant to be the exclusive description of the inventive concept hereby disclosed. Identical or similar drawing elements are marked with the same reference signs, respectively, and will only be discussed several times as there are differences between the drawings. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

[0037] The embodiments explained in the following are preferred embodiments of the disclosure. However, the embodiments each represent also individual features of the disclosure which are thus also to be regarded individually or in combinations other than the combination shown as part of the embodiments. Furthermore, the described embodiments can also be supplemented by further of the mentioned features of the disclosure.

[0038] It is noted that the disclosure may be described as a process which is depicted as a flowchart. Although a flowchart may describe the operations as a sequential process, many of the operations can be performed in parallel or concurrently.

FIG. 1 is an embodiment of a point machine according to the invention comprising a cover according to the invention shown as a sectional view,
 FIG. 2 is a block diagram showing function components of the monitoring device according to FIG. 1

FIG. 3 - FIG. 5 represent different steps of an embodiment of the method according to the invention.

[0039] A point machine PM is shown in Figure 1. An actuator assembly AA is illustrated which is covered by a cover CV. The cover CV is equipped with a monitoring device MD which allows for the monitoring of the action of the point machine PM.

[0040] The monitoring device MD comprises the following function elements:

- an energy harvesting unit EH to provide electrical energy to the monitoring device (this may be a solar cell),
- a radio module RM to provide an interface IF (e.g. an antenna) for building up a radio connection RC to other functional entities,
- a calculation module CM for triggering the processes to be performed by the monitoring device MD which is connected via a cable connection CC to the radio module RM,
- an optical sensor for capturing the duration of the point machine operation from the actuating assembly AA (single images or image sequences),
- a vibration sensor VS for recording the vibrations caused by the working cycles (e.g. position changes) of the actuating assembly,
- a temperature sensor TS, mounted on the surface of the actuating assembly AA and connected via a flexible cable CB to the calculation module CM.

[0041] Further, a Cloud CL is provided which realizes a cloud computing environment for providing a cloud service. The cloud changes data via radio connections RC with the calculating module CM and a control center CC. The Control Center CC performs a maintenance management for the point machine PM and further functional units, e.g. point machines, not shown in Figure 1.

[0042] In Figure 2 an architecture of the monitoring device MD is shown, which could be used in an arrangement of Figure 1. The central function element is the calculation module CM which contains a processor for modifying sensor data acquired by a sensor S (which represents one or a plurality of sensors, e. g. the optical sensor IS and/or the vibration sensor VS and/or the temperature sensor TS and/or other sensors not depicted in Figure 2) connected by means of an interface S1 to the calculating module CM. Moreover, the calculation module CM triggers and controls the processes to be performed by the monitoring device MD.

[0043] The acquired and calculated data can be stored in a memory module MM connected by means of an interface S2 to the calculating module CM. Alternatively or additionally, the data can be transmitted by the radio module RM connected by means of an interface S3 to the calculating module CM and then to an external entity like the cloud CL of Figure 1.

[0044] The radio module RM comprises a controller CR and an antenna AT which is driven by the controller CR using a transmission standard.

[0045] The energy harvesting module EH connected by means of an interface S4 to the calculating module CM provides electrical energy to the calculating module CM, which supplies the sensor S, the memory module MM and the radio module RM with this energy. The energy harvesting module EH comprises a solar cell SC and an energy storage unit ES for providing energy constantly (e.g. also in the night).

[0046] Figures 3 to 5 represent selected steps of the method of the disclosure. In Figure 3, the production of the cover CV to be retrofitted (kit for retrofitting KR) is depicted. This cover is equipped with the monitoring device MD in the inner side of the cover CV whereby the interface IF is located on the outer side of the cover CV. This kit for retrofitting may be used for the point machine PM of Figure 1 and may contain the functional elements of figure 2.

[0047] For retrofitting, an existing cover ECV covering the actuating assembly AA is removed from the point machine PM in a disassembly step DA, as depicted in Figure 3.

[0048] Turning to figure 3, in a retrofitting step RS the equipped cover CV is placed above the actuating assembly AA. Before fixing the cover CV, the temperature sensor TS is mounted on the actuating assembly AA. The length of the cable CB which is connecting the temperature sensor TS to the monitoring device MD is sufficient to provide freedom of movement to the cover to be placed above the actuating assembly AA.

Reference signs list

[0049]

CV	cover (equipped with monitoring device)
ECV	existing cover
PM	point machine
AA	actuating assembly
MD	monitoring device
S	sensor
TS	temperature sensor
IS	optical sensor
VS	vibrations sensor
IF	interface
CR	controller
AT	antenna
KR	kit for retrofitting
EH	energy harvesting unit
SC	solar cell
ES	energy storage unit
RM	radio module
MM	memory module
CM	calculation module
CL	cloud
CC	control center

RC radio connection
 DA disassembly step
 RF retrofitting step
 CC cable connection
 CB cable
 S1 ... interfaces

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- the number of position changes of the point,
- vibrations caused by the actuating assembly (AA),
- an image of the actuating assembly (AA),
- the duration of position changes of the point.

Claims

1. A cover (CV) for mounting on a point machine (PM) comprising an actuating assembly (AA),
characterized in that

a monitoring device (MD) is arranged in or on the cover (CV), comprising

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- at least one sensor (S) for acquiring data related to the operating status of the point machine (PM), and
- an interface (IF) for outputting the data.

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2. The cover (CV) according to claim 1, wherein the cover (CV) is a kit for retrofitting (KR).

3. The cover (CV) according to one of the preceding claims, wherein:

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- an energy harvesting unit (EH), especially a solar cell (SC), is mounted in or on the cover (CV), and
- which is configured to supply power to the monitoring device (MD).

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4. The cover (CV) according to one of the preceding claims, wherein the interface (IF) is provided by a radio module (RM) configured to receive and transmit the data.

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5. The cover (CV) according to one of claims 1 - 3, wherein the interface (IF) is provided by a memory module (MM) which is configured to store the data.

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6. The cover (CV) according to one of the preceding claims, wherein the data is modified by a calculation module (CM) which is configured to receive the data acquired by the sensor (S).

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7. The cover (CV) according to one of the preceding claims, wherein the interface (IF) is configured to be connected to a cloud (CL).

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8. The cover (CV) according to one of the preceding claims, wherein:
 the at least one sensor (S) or a plurality of sensors (S) is configured to detect at least one of the following conditions of the point machine (PM):

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- a temperature,

9. A point machine (PM), comprising:

- an actuating assembly (AA),
- a cover covering the actuating assembly (AA),
characterized in that
 a monitoring device (MD) is arranged in or on the cover (CV), comprising
- at least one sensor (S) for acquiring data related to the operating status of the point machine (PM), and
- an interface (IF) for outputting the data.

10. The point machine (PM) according to claim 8 comprising a cover (CV) according to one of claims 2 - 7.

11. Method for providing a monitoring of a point machine (PM), comprising the steps for:

- providing a cover (CV) to be mounted on the point machine (PM), comprising an actuating assembly (AA),
- arranging a monitoring device (MD) in or on the cover (CV), comprising
- at least one sensor (S) for acquiring data related to the operating status of the point machine (PM),
- an interface (IF) for outputting the data,
- retrofitting the point machine (PM) by replacing the existing cover (ECV) of the point machine (PM) by said cover (CV) equipped with the monitoring device (MD).

12. Computer program product with instructions for executing the method according to claim 11.

13. Apparatus for the computer program product according to claim 12, wherein the apparatus stores and/or provides the computer program product.

FIG 1

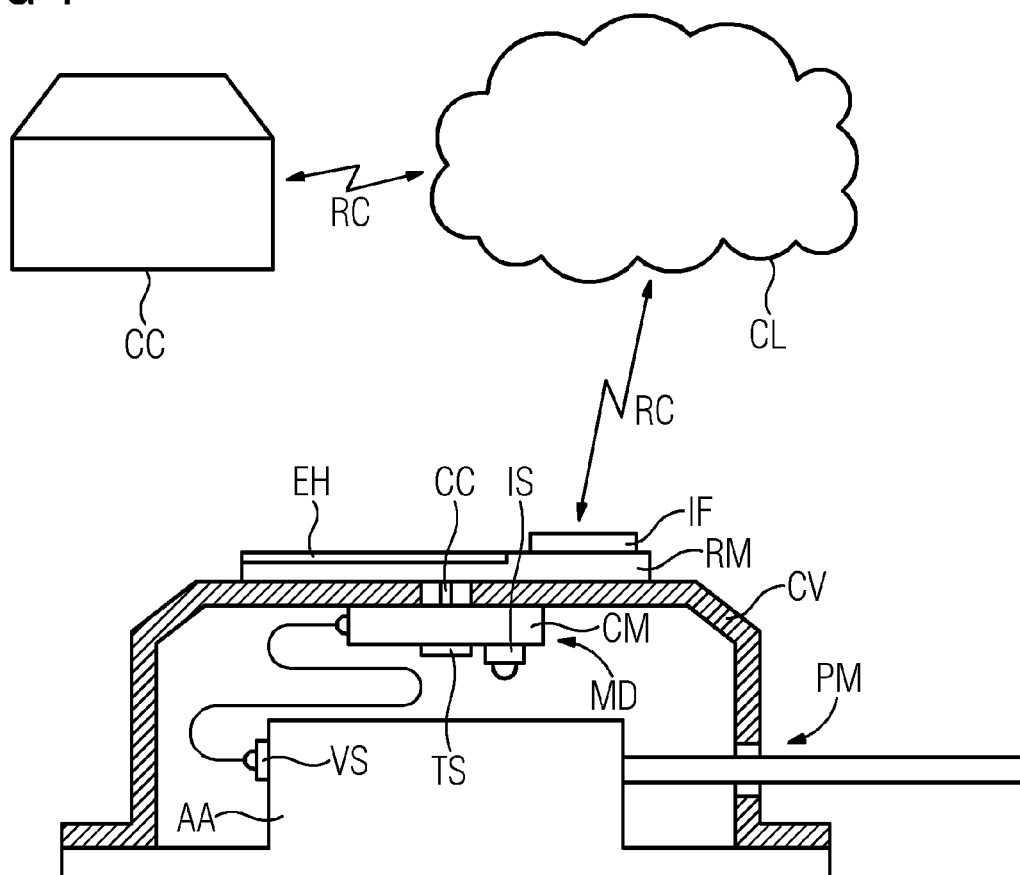


FIG 2

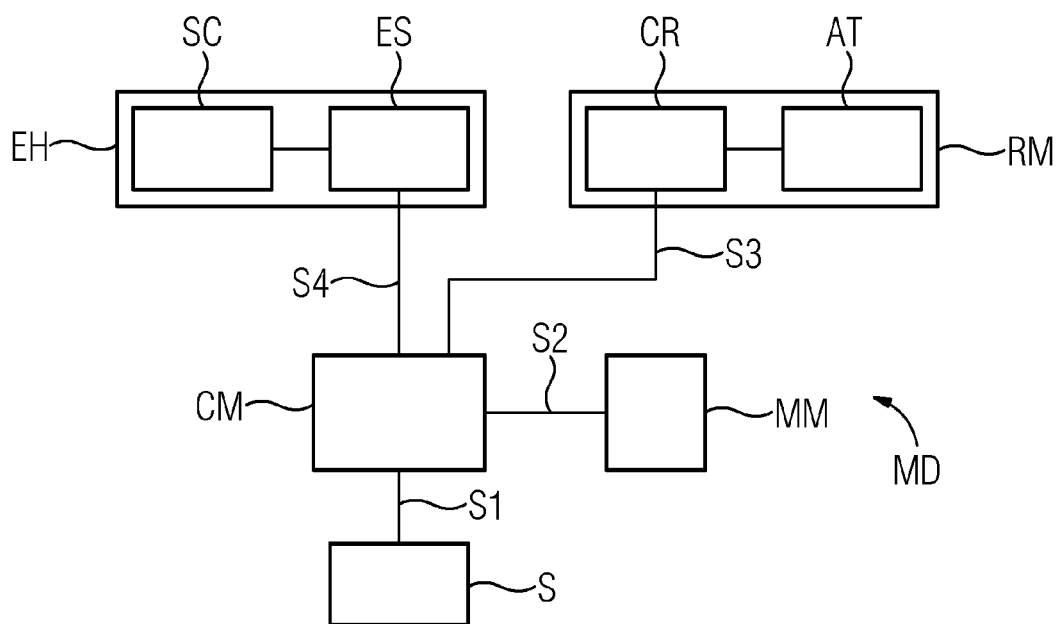


FIG 3

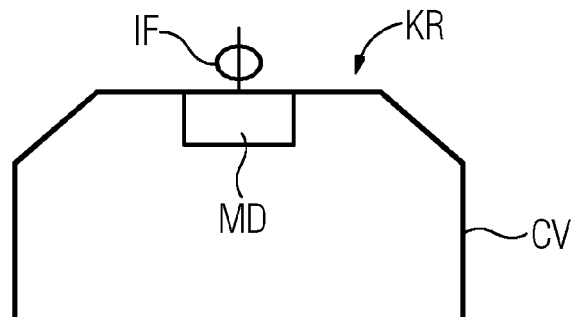


FIG 4

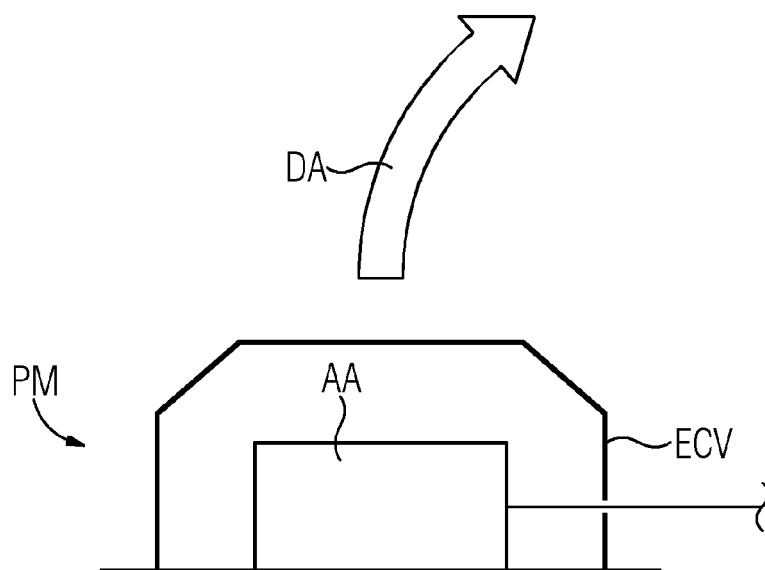
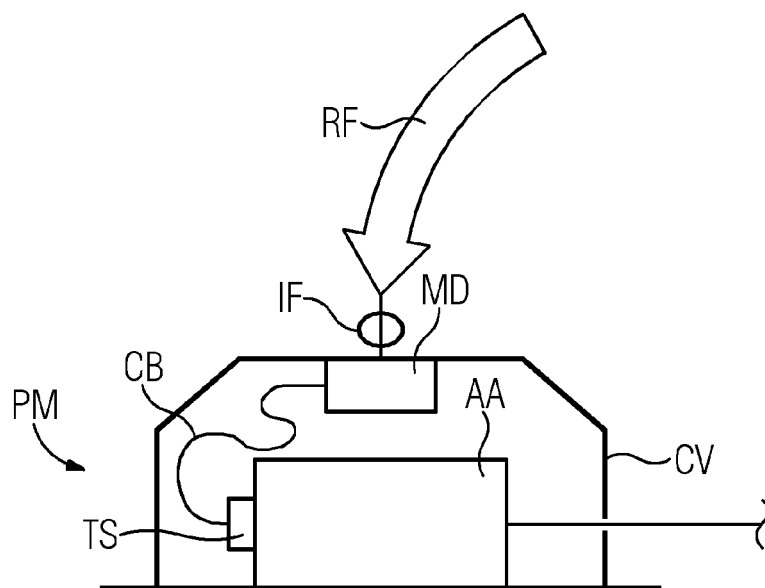


FIG 5





EUROPEAN SEARCH REPORT

Application Number
EP 20 16 6434

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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