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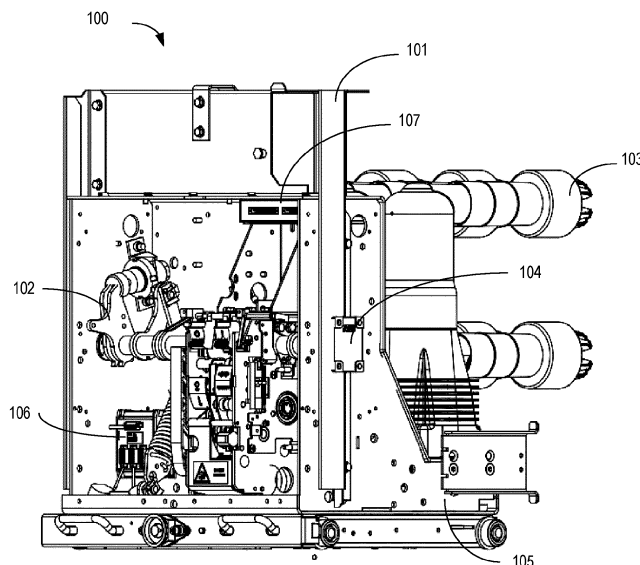
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(54) **CIRCUIT BREAKER**

(57) A circuit breaker is disclosed that comprises: a frame; a breaker main body configured to connect and disconnect the circuit; a sensor connected to the breaker main body and configured to collect state parameters of the breaker main body; and a data processing module detachably mounted on the frame and electrically connected to the sensor, wherein the data processing module is configured to process state parameters collected by the sensor and output processed state parameters to

a device outside the circuit breaker. The circuit breaker described here implements the full digital function and outputs state parameters of the circuit breaker in real time for use by the users. By a multi-dimensional operation monitoring, the management of the health condition of the circuit breaker is implemented, continuity and reliability of the operations are promoted, the maintenance cycle is extended, and the maintenance cost is reduced.



Description

FIELD

[0001] Embodiments of the present disclosure relate to the field of electrical equipment in general, and more specifically, to a circuit breaker.

BACKGROUND

[0002] The working condition of a circuit breaker is critical to its control. Usually, working condition of the circuit breaker is collected by sensors and then processed by the data processing module (e.g., concentrator) for subsequent use by users. The existing circuit breakers are free of the data processing module. In such case, after purchasing a circuit breaker, the users need to separately configure the data processing module according to the usage of the sensor in the circuit breaker and select a corresponding output device based on the data processing module to cooperate therewith, which increases the selection cost.

SUMMARY

[0003] The purpose of the present disclosure is to provide a circuit breaker that addresses at least partially the above and other potential issues.

[0004] According to a first aspect of the embodiments of the present disclosure, there is provided a circuit breaker. The circuit breaker comprises: a frame; a breaker main body configured to connect and disconnect a circuit; a sensor, connected to the breaker main body and configured to collect state parameters of the breaker main body; and a data processing module detachably mounted on the frame and electrically connected to the sensor, wherein the data processing module is configured to process state parameters collected by the sensor and output processed state parameters to a device outside the circuit breaker.

[0005] In the embodiments according to the present disclosure, the data processing module is arranged inside the circuit breaker, such that the circuit breaker can process the data collected by the sensor and then directly output the data for use by the users. Accordingly, the full digital function of the circuit breaker is realized, and the state parameters of the circuit breaker can be output in real time for users to use. By a multi-dimensional monitoring, the management of the health condition of the circuit breaker is implemented, continuity and reliability of the operations are promoted, the maintenance cycle is extended, and the maintenance costs can be reduced.

[0006] In one embodiment, the data processing module and the frame are connected by fasteners. Through the above embodiment, the data processing module can be disposed inside the circuit breaker in the simplest way, which reduces the installation complexity.

[0007] In one embodiment, the data processing mod-

ule includes a concentrator. Through the above embodiments, multiple sensor signals can be processed at the same time and the efficiency of data processing is improved.

[0008] In one embodiment, the data processing module includes a plug adapted to connect the data processing module to the device external to the circuit breaker. Through the above embodiment, the data of the data processing module can be output more easily.

[0009] In one embodiment, the plug includes a serial interface. Through the above embodiment, the output data of the data processing module can be received by most of the existing display apparatuses and the suitability of the data output is improved.

[0010] In one embodiment, the data processing module is connected to the sensor in a wired manner. Therefore, a reliable connection of the circuit is ensured.

[0011] In one embodiment, the data processing module is connected to the sensor in a wireless manner. The above embodiment can enrich the connection modes of the circuit, reduce the wiring inside the circuit breaker and decrease the electromagnetic interference (EMI) in the circuit breaker.

[0012] In one embodiment, the sensor includes a current sensor configured to detect currents passing through the breaker main body, and the data processing module is configured to generate indication information in response that the currents exceed a current threshold. Accordingly, potential risks of the circuit breaker can be determined in advance in combination with dynamics of the running currents.

[0013] In one embodiment, the sensor includes a temperature sensor configured to detect the temperature of the breaker main body, and the data processing module is configured to generate indication information in response that the temperature exceeds a temperature threshold. The above embodiment can ensure that the circuit breaker works in a normal temperature range and improve the reliability of the circuit breaks.

[0014] In one embodiment, the sensor includes a state sensor configured to monitor a mechanical state of the breaker main body, and the data processing module is configured to generate indication information in response to a change of the mechanical state. In the above embodiment, the mechanical motion state of the circuit breaker is monitored to further quantize the health condition of the circuit breaker, effectively identify the early failure of the mechanical component and ensure normal operations of the circuit breaker.

[0015] In one embodiment, the sensor includes a secondary device state sensor configured to monitor a state of a secondary device of the breaker main body, and the data processing module is configured to generate indication information based on the state of the secondary device. Through the above embodiment, the early failure of the control circuit components can be identified to ensure safe operation.

[0016] In one embodiment, the sensor includes a force

sensor (e.g. a pressure sensor) configured to monitor a contact force (e.g. a contact pressure) of the breaker main body, and the data processing module is configured to generate indication information in response to a change of the contact force. The above embodiment can intuitively quantize the health condition of the breaker mechanism, effectively identify the early failure of the mechanical component and normal operation of the circuit breaker can be guaranteed.

[0017] In one embodiment, the data processing module analyzes a health condition of the circuit breaker according to the state parameters and displays a residual electrical endurance of the circuit breaker. The above embodiment can promote continuity and reliability of the operations, extend the maintenance periods and reduce the maintenance costs.

[0018] It is to be understood from the following description that the proposed circuit breaker implements the full digital function, such that the monitoring data of the sensor can be directly output for use by the users without configurations.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Through the following detailed description with reference to the accompanying drawings, the above and other objectives, features, and advantages of the embodiments of the present disclosure will become more apparent, wherein a plurality of embodiments of the present application is illustrated in an exemplary and non-restrictive manner, wherein:

Fig. 1 illustrates a structural diagram of a circuit breaker in accordance with embodiments of the present disclosure;

Fig. 2 illustrates a schematic diagram related to the mounting of the data processing module inside the circuit breaker in accordance with embodiments of the present disclosure.

DETAILED DESCRIPTION OF EMBODIMENTS

[0020] Principles of the embodiments of the present disclosure are now explained with reference to various exemplary embodiments shown in the attached drawings. It should be understood that those embodiments are described solely to enable those skilled in the art to better understand and further implement the present disclosure and is not intended for limiting the scope of the disclosed embodiments. It should be noted that similar or same reference signs can be used in the drawings where feasible, and similar or same reference signs can represent similar or same functions. Those skilled in the art will readily understand from the following description that alternative embodiments of the structure and/or method described in the text can be adopted without deviating from the principles of the embodiments of the present disclosure described herein.

[0021] The structure of the circuit breaker in accordance with example embodiments of the present disclosure is explained in detail below with reference to Figs. 1 and 2. Referring to Fig. 1, a structural diagram of the circuit breaker in accordance with embodiments of the present disclosure is demonstrated.

[0022] As shown in Fig. 1, the circuit breaker 100 described here includes a frame 101, a breaker main body 102, sensors 103, 104, 105, 106 and a data processing module 107. The frame 101 is used for mounting the sensors 103, 104, 105, 106 and the data processing module 107. The breaker main body 102 is provided for connecting and disconnecting the circuit. The sensors 103, 104, 105, 106 collect state parameters of the breaker main body, while the data processing module 107 processes the state parameters collected by the sensors 103, 104, 105, 106 and outputs the processed state parameters to a device outside the circuit breaker 100 for user to use.

[0023] In some embodiments, the data processing module 107, for example, may be a concentrator for acquiring data of the sensors (such as sensors 103, 104, 105, 106) mounted on the breaker main body 102, for data processing, storage and uploading. The concentrator converts sensor data collected through the protocol into user-identifiable signal forms and outputs the converted signals. Besides, when the data satisfy a given condition, the concentrator outputs an indication signal. For example, when the data values collected by the temperature sensor are higher than a predetermined threshold, the concentrator may output an alarm signal. The data processing module 107 analyzes a health condition of the circuit breaker 100 based on the state parameters output by the sensors and displays a residual electrical lifetime of the circuit breaker 100. In other embodiments, the data processing module 107 may be other data processing elements. This may be determined based on the specific design requirements and costs.

[0024] In some embodiments, the data processing module 107, for example, may be connected to the sensors in a wired manner, e.g., by cables. In other embodiments, to meet the special needs for connection, e.g., isolation is required between the sensors and the data processing module 107, the data processing module 107 may, for example, be connected to the sensors in a wireless manner, e.g., by WiFi. This may be determined according to the specific design requirements and costs.

[0025] In some embodiments, the data processing module 107 may include a plug adapted to connect the data processing module 107 to the device outside the circuit breaker 100 (e.g., display), to upload the processed data to the external device for use by the user. For example, the plug includes a serial interface, such as RS-232, RS-485 etc., to fit common devices. In other embodiments, the data processing module 107 can include other types of connectors, to connect with the external device of the circuit breaker 100, e.g., connecting to a mobile phone outside the circuit breaker 100 via WiFi.

As such, the data of the respective sensors may be observed via pages on the mobile phone. This may be determined according to the specific design requirements and costs.

[0026] The sensors 103, 104, 105, 106 are provided for monitoring a variety of state parameters of the breaker main body 102 for use by the user. For example, the health condition of the circuit breaker is managed by a multi-dimensional operation monitoring; health score and operation and maintenance advice and plan of the circuit breaker are provided to promote continuity and reliability of the operations, extend the maintenance period and reduce the maintenance costs.

[0027] In some embodiments, the sensors include a temperature sensor 103 for detecting at least one of a temperature of the breaker main body 102, a temperature at a bus of a switch gear where the circuit breaker 100 is located and a temperature at a cable of the switch gear. When the temperature value collected by the temperature sensor 103 is higher than a predetermined threshold, the data processing module 107 may output the alarm signal.

[0028] In some embodiments, the temperature sensor 103, for example, may be self-powered without additional wirings and maintenance. In addition, the long-term stable operation of the temperature sensor is secured by using magnetic saturation techniques. In some embodiments, the temperature sensor 103 may adopt the radio frequency technique, to electrically isolate temperature-measuring units at high voltage side inside the sensor 103 from receiving units at low voltage side, thereby ensuring safety. In other embodiments, the temperature sensor 103 may be of other types, which may be determined according to the specific design requirements and costs.

[0029] In some embodiments, the sensors also include a current sensor 106 for detecting working currents of the breaker main body 102. When the currents exceed a current threshold, the data processing module 107 generates indication information.

[0030] In some embodiments, the sensors also include a secondary device state sensor which is configured to monitor the state of the secondary device of the breaker main body, such as currents and operation time of closing coils, opening coils and energy storage motors, so as to extract signature waveforms from current curves, identify incipient failure in the circuit breaker 100 and ensure safe operations. When an incipient failure is identified, the data processing module 107 generates the indication information.

[0031] In some embodiments, the current sensor 106 is a Hall sensor independent of the original control system and protection system of the circuit breaker 100. Such sensor will not affect the inherent reliability of the circuit breaker 100. In other embodiments, the current sensor 106 also may be of other types, which may be determined according to the specific design requirements and costs.

[0032] In some embodiments, the sensors may include

states sensors, e.g., attitude sensor 104 and transient sensor 105, which monitor the mechanical conditions of the breaker main body 102 to directly quantify the health condition of the circuit breaker 100, effectively identify the early failures of the mechanical component inside the circuit breaker 100 and ensure normal operations of the circuit breaker 100. When the data detected by the attitude sensor indicate a change of the mechanical condition or an early failure of the mechanical component is identified, the data processing module 107 may output the alarm signals.

[0033] For example, motion curves of the mechanical mechanism within the circuit breaker 100 extracted via the attitude sensor are used to monitor the motion state of the mechanical mechanism in real time and calculate single or multiple mechanical characteristic parameters of the circuit breaker 100, e.g., stroke, closing time, opening time, average closing speed, average opening speed, closing overstroke and opening rebound etc. In conjunction with the transient sensor, more parameters may be obtained, e.g., spring stroke, clearance of vacuum interrupter and contact force of vacuum interrupter etc.

[0034] In some embodiments, the attitude sensor 104, for example, may be angular sensor which detects the motion angle of the mechanical mechanism's motion within the circuit breaker 100. In other embodiments, the posture sensor 104 may be of other types, which may be determined according to the specific design requirements and costs.

[0035] In some embodiments, the transient sensor 105, for example, may be the force sensor that detects changes of the force of the mechanical mechanism within the circuit breaker 100. In other embodiments, the transient sensor 105 may be of other types, e.g., pressure sensor, configured to monitor contact pressure of the breaker main body 102, and the data processing module 107 is configured to generate indicated information in response to the change of the contact pressure. This may be determined according to the specific design requirements and costs.

[0036] Next, Fig. 2 is referred to explain how the data processing module 107 is mounted. Fig. 2 illustrates a schematic diagram related to the mounting of the data processing module within the circuit breaker in accordance with embodiments of the present disclosure. In the examples shown in Fig. 2, the data processing module 107 and the frame 101 are connected via fasteners.

[0037] To be specific, a threaded hole 109 is provided on a housing of the data processing module 107. Meanwhile, a through-hole 110 is also arranged at a corresponding position of the frame 101 where the data processing module 107 is mounted. On a side of the frame 101 opposite to the side where the data processing module 107 is mounted, a screw 108 is mounted into the threaded hole 109 of the data processing module 107 via the through-hole 110 of the frame 101, such that the data processing module 107 is mounted on the frame 101. At the meantime, the position of the frame 101 at

which the data processing module 107 is mounted may be determined as per the specific design.

[0038] In other embodiments, the data processing module 107 may be mounted in other ways. For example, a guide rail (not shown) is arranged on a sidewall inside the frame 101, and a mounting part is disposed on the guide rail and may slide on the guide rail. The data processing module 107 may be mounted on and detached from the mounting part. In such way, the position of the data processing module 107 may be adjusted as required. This may be determined according to the specific design requirements and costs.

[0039] According to the embodiments of the present disclosure, the data processing module is integrated inside the circuit breaker, such that various kinds of state parameters of the circuit breaker can be directly output to the external device for the convenience of users.

[0040] Although the claims of the present application are formulated against specific feature combinations, it should be understood that the scope of the present disclosure also includes any novel features explicitly or implicitly disclosed or summarized by the present disclosure, or any novel combinations regardless of whether they relate to the same solutions in any of the current claims. Applicant hereby declares that new claims may be formulated to include these features and/or combinations thereof during the examination procedure of the present application or the application further derived from the present application.

Claims

1. A circuit breaker (100), comprising:

a frame (101);
a breaker main body (102) configured to connect and disconnect a circuit;
a sensor connected to the breaker main body (102) and configured to collect state parameters of the breaker main body (102); and
a data processing module (107) detachably mounted on the frame (101) and electrically connected to the sensor, wherein the data processing module (107) is configured to process state parameters collected by the sensor and output processed state parameters to a device outside the circuit breaker (100).

2. The circuit breaker (100) of claim 1, wherein the data processing module (107) and the frame (101) are connected by fasteners.

3. The circuit breaker (100) of claim 1 or 2, wherein the data processing module (107) has data processing, storage and upload functions.

4. The circuit breaker (100) of any of claims 1 to 3,

wherein the data processing module (107) includes a plug adapted to connect the data processing module (107) to a device outside the circuit breaker (100).

5. The circuit breaker (100) of claim 4, wherein the plug includes a serial interface.

6. The circuit breaker (100) of any of claims 1 to 5, wherein the data processing module (107) is connected to the sensor in a wired manner.

7. The circuit breaker (100) of any of claims 1 to 5, wherein the data processing module (107) is connected to the sensor in a wireless manner.

8. The circuit breaker (100) of any of claims 1 to 7, wherein the sensor includes a current sensor configured to detect currents passing through the breaker main body (102), and the data processing module (107) is configured to generate indication information in response that the currents exceed a current threshold.

9. The circuit breaker (100) of any of claims 1 to 8, wherein the sensor includes a temperature sensor configured to detect a temperature of the breaker main body (102), and the data processing module (107) is configured to generate indication information in response that the temperature exceeds a temperature threshold.

10. The circuit breaker (100) of any of claims 1 to 9, wherein the sensor includes a state sensor configured to monitor a mechanical state of the breaker main body (102), and the data processing module (107) is configured to generate indication information in response to a change of the mechanical state.

11. The circuit breaker (100) of any of claims 1 to 10, wherein the sensor includes a secondary device state sensor configured to monitor a state of a secondary device of the breaker main body (102), and the data processing module (107) is configured to generate indication information based on the state of the secondary device.

12. The circuit breaker (100) of any of claims 1 to 11, wherein the sensor includes a pressure sensor configured to monitor a contact pressure of the breaker main body (102), and the data processing module (107) is configured to generate indication information in response to a change of the contact pressure.

13. The circuit breaker (100) of any of claim 1 to 12, wherein the data processing module (107) analyzes a health condition of the circuit breaker (100) accord-

ing to the state parameters and displays a residual electrical lifetime of the circuit breaker (100).

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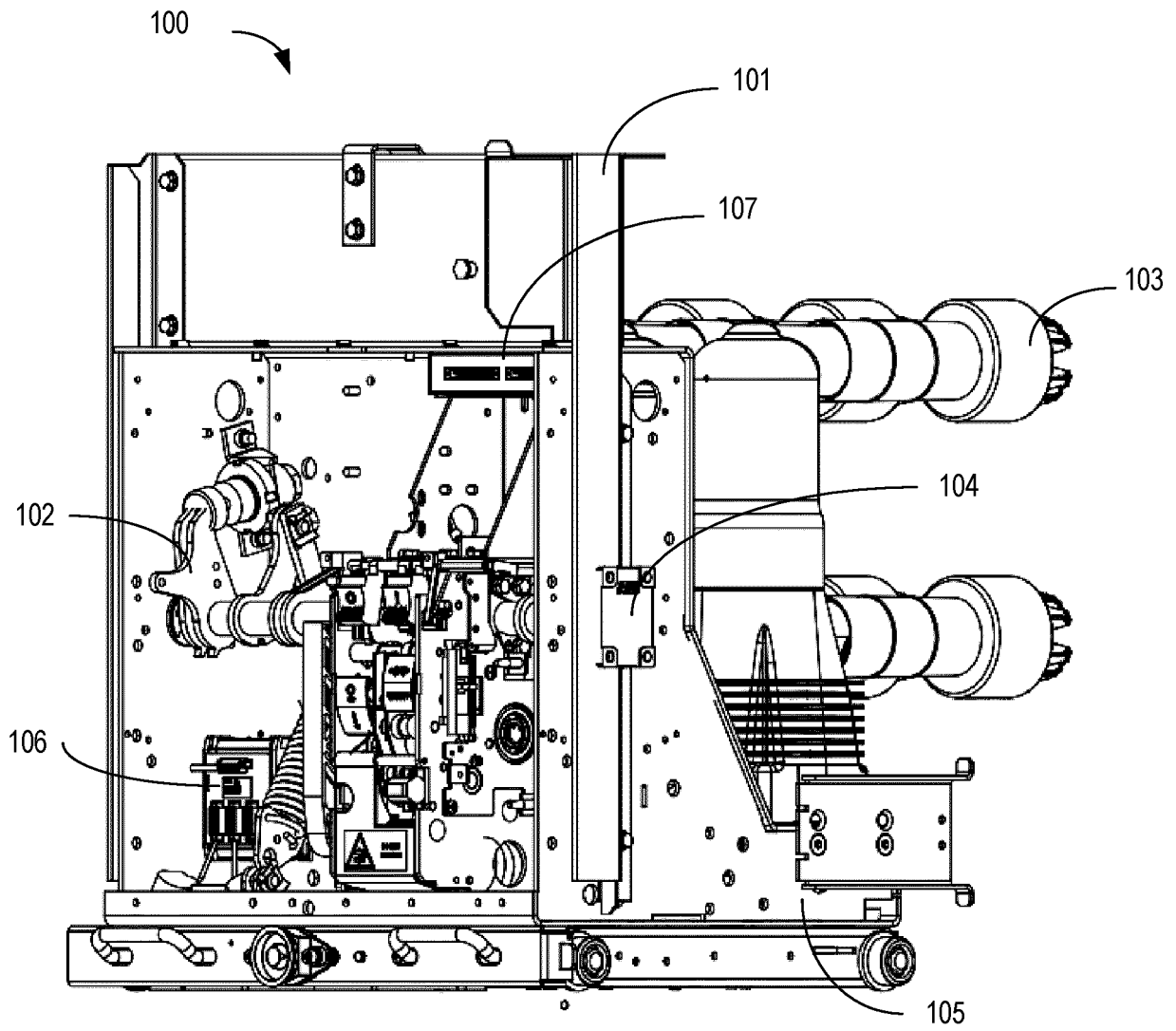


FIG. 1

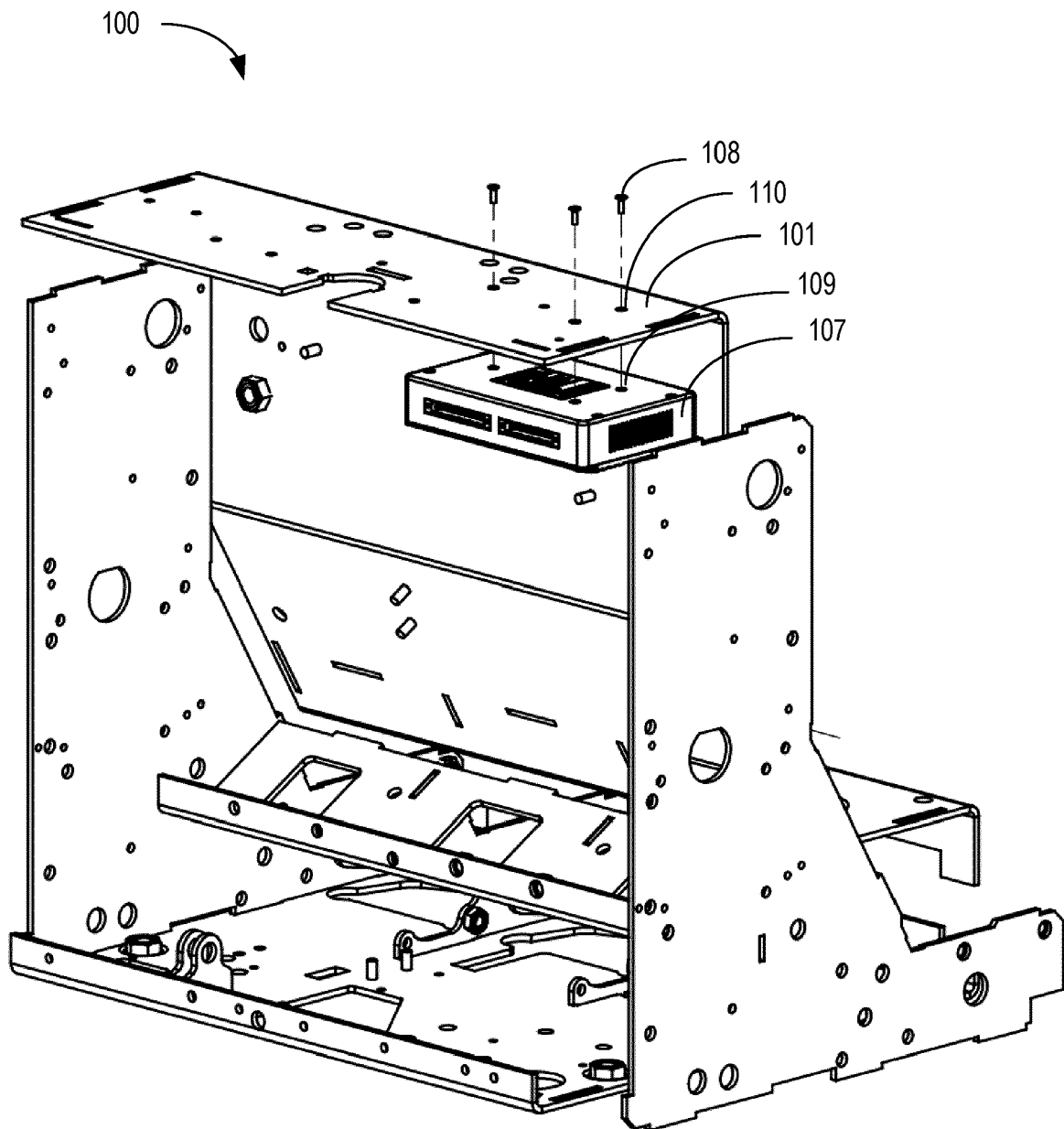


FIG. 2



EUROPEAN SEARCH REPORT

Application Number

EP 22 19 8429

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EPO FORM 1503 03.82 (P04C01)

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			TECHNICAL FIELDS SEARCHED (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 3 February 2023	Examiner Pavlov, Valeri
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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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.
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