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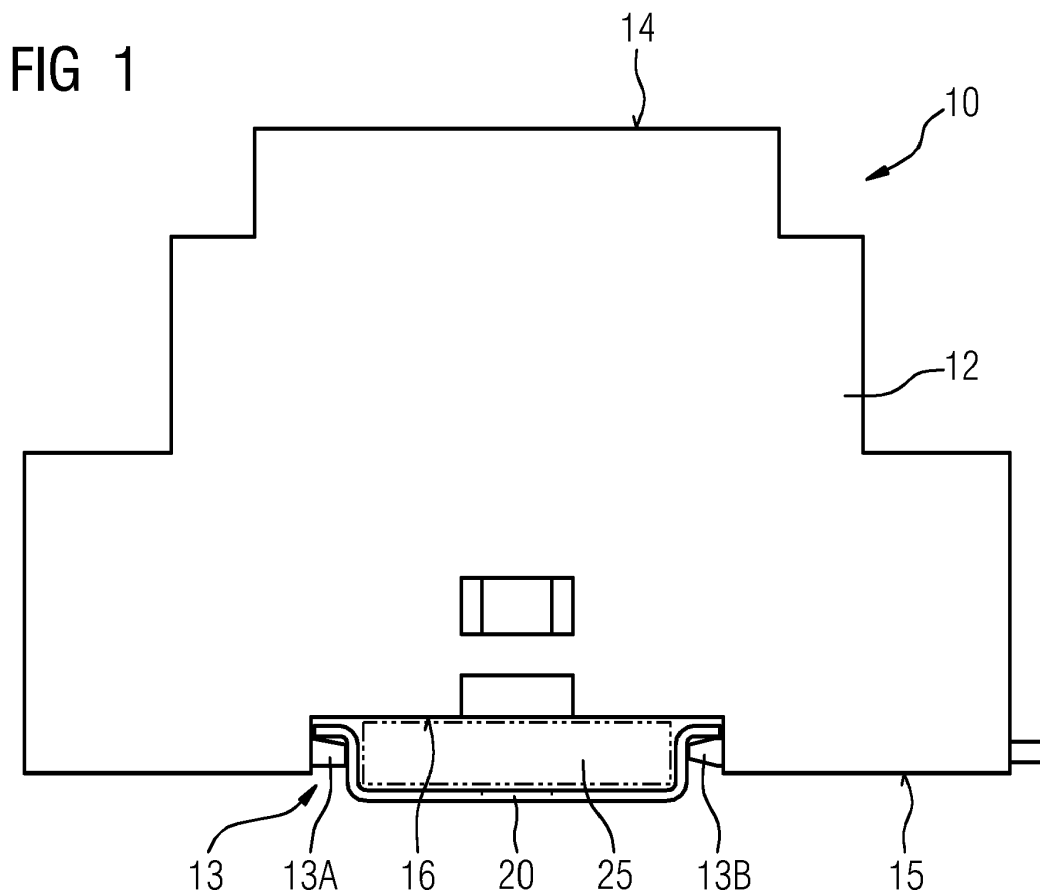
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(54) **ELECTRICAL DEVICE WITH A MOUNTING RAIL MOUNT**

(57) A rail-mountable device such as a top-hat rail-mountable circuit breaker carries one or more interface elements such as buttons or sockets on a device

surface facing into the enclosed space formed by the rail and the device when the device is mounted on the rail.



Description

[0001] The present invention relates to an electrical device with a mounting rail mount, particularly a DIN rail or top-hat rail mount.

[0002] A mounting rail, also known as a DIN rail, is a universal and standardized support usually made of a sheet metal profile. It is used in electrical engineering for fastening electrical equipment in, among others, distribution boxes, switch cabinets and junction boxes. The electrical equipment is, among others, circuit breakers, relays or controllers.

[0003] Electrical devices that are mounted to a DIN rail usually comprise some interface elements. Such interface elements include, among others, buttons, switches, LED indicators, electrical connectors and sockets. In addition, the electrical devices usually have markings such as brand and product information as well as mandatory technical information. Also the devices may have to reserve some surface space for ventilation needs. The surface area of the housing that is available for these interface elements and markings is limited, as the devices are mounted on the rail in a side-by-side manner which only leaves the comparatively small front surfaces of the device. In a typical one unit wide device that surface area has a width of only 17.5 mm and thus the total available surface area is of the order of 20 cm².

[0004] It is possible to increase the surface area by increasing the width of the device to for example a two unit width of 35 mm. That however is disadvantageous as it consumes space on the rail that could be used for another device instead and it requires an additional investment in material for the housing and for an additional circuit board (PCB).

[0005] The objective of the present invention is to provide an electrical device where the disadvantage mentioned above is reduced. This objective is achieved by an electrical device as claimed in claim 1.

[0006] An electrical device in accordance with the invention comprises a mounting rail mount such as a DIN rail mount as well as at least one interface element. It is characterized in that the interface element is arranged to face into the enclosed space formed by the device and the mounting rail when the device is mounted on the mounting rail.

[0007] In other words the interface element is arranged in a part of the particular surface area of the electrical device that faces towards the rail when it is mounted. This rear surface also bears the mount that is used to fasten the electrical device on the rail. Such electrical devices are typically constructed in such a way that the mount is essentially arranged in the center of the rear surface. Thus, the interface element is typically arranged in a central part of the rear surface.

[0008] Advantageously the electrical device of the invention comprises an interface element that does not occupy one of the front surfaces facing away from the rail. While the front surfaces are easily accessible even when

the electrical device is mounted on the rail, such easy access may not be necessary for every interface element. For example some interface element may only be used during maintenance or only in the case of a device fault. In this case the valuable front surface area can be used for such interface elements and markings that need to be more easily accessible or are mandatorily located on the front surfaces. In this way additional interface elements can be included with the electrical device without enlarging the surface area of the electrical device by extending its width.

[0009] Further features that may be added alone or together in exemplary embodiments of the invention include:

15 The mount, i.e. mechanical joint of the electrical device to the rail may be a releasable joint. Preferably, the device is latched onto the top-hat rail. The mount may for example comprise two clamps by which the electrical device is fastened to the rail. In this case the interface element is arranged between the clamps. In this way, whenever the electrical device is mounted on the rail, the interface element faces into said enclosed space.

[0010] The interface element may be a human-machine interface element, particularly a pressable button.

25 This button may have any effect on the electrical device, for example it may act as a mechanical release for another interface element or it may result in an electrical action or in a data transfer. In other alternatives the button may act as an override for another usually blocked function of the electrical device or it may effect the display of an internal state of the electrical device on an LED indicator.

[0011] As an additional advantage, this button is not practically accessible when the electrical device is mounted on the rail making pressing this button difficult to impossible unless the electrical device is taken from the rail first. Thus a button that should only be pressed under certain circumstances is placed in a way that makes accidental pressing of the button very unlikely.

40 **[0012]** The interface element may be a socket for a connector or device arranged on an electrical carrier board. In this case the socket is typically arranged on a side and on the border of the electrical carrier board facing said enclosed space. The socket may be a SIM-card socket, an SD-card socket or a Mini-SD card socket. Advantageously a memory card inserted into the socket cannot be removed while the electrical device is mounted on the rail. While unauthorized removal of such a memory card cannot be entirely prevented in this way the chance for accidental removal or accidental mechanical damage is minimized. Alternatively the socket can be arranged to only allow keeping a memory card inserted while the electrical device is not mounted. This may be done by placing the socket in such a way that the distance between it and the rail is insufficient for the length of a memory card. In this way a memory card can still be inserted as part of a maintenance procedure but cannot be kept in the socket accidentally or intentionally.

[0013] In other embodiments the socket may be an electrical connector socket for supplying the electrical device or a data transfer connection such as a USB socket. A socket for an electrical connector may be used to effect a power supply for the electrical device while it is dismantled and disconnected from for example a busbar that provides its regular power supply. A USB socket may be used to transfer data when for example a wireless data transfer is unavailable.

[0014] In further embodiments, the interface element may be an antenna plug or an LED indicator.

[0015] In a further advantageous embodiment the socket may be a socket for a bus-like data network such as CAN-Bus. Several electrical devices that are mounted on the rail may be connected to that data network using a single cable connection. The rail will act as an electrical conduit to that cable.

[0016] The device may comprise one or more second interface elements arranged to face into said enclosed space. In other words, there may be two or more interface elements facing into said enclosed space. These can be of the same type or of different types.

[0017] Preferably the housing of the device comprises an opening arranged to allow access to the interface element, particularly the socket, and arranged to open into said enclosed space. If the electrical device comprises more than one interface element facing into the enclosed space, the opening may encompass both elements or only a single one. Separate openings may be present for the interface elements.

[0018] The electrical device may be a switching device, particularly a circuit breaker, particularly a solid-state circuit breaker. It may also be a controller, such as a motor controller or a soft-start device. In another embodiment it may be a general-purpose device with at least two or at least three different data network sockets. In yet another embodiment it may be a contactor or relay.

[0019] The electrical device may have a width of one standard unit of 17.5 mm. Alternatively it may have a width of two or more standard units or an altogether different width.

[0020] An electrical system using the invention comprises a mounting rail, particularly a DIN rail, and one or more of the described electrical devices mounted on the rail. The electrical system may comprise devices different from the electrical devices described herein.

[0021] Embodiments of the present invention are now described with reference to the accompanying drawings to which the invention is not limited.

Fig. 1 depicts a side view of a circuit breaker device mounted on a DIN rail;

Fig. 2 depicts a perspective view of said circuit breaker device;

Fig. 3 depicts a rear surface of the circuit breaker device.

[0022] The illustrations of the drawings are in schematic form. It is noted that in different figures, similar or identical elements use the same reference signs. Fig. 1 and Fig. 2 show different views of an electrical device, in this case a circuit breaker 10. The circuit breaker 10 comprises a housing 12 of a type that is common in the art in its general form. Housing 12 comprises a mount 13 for mounting the device on a mounting rail in the form of DIN rail 20, a top-hat rail. DIN rails are known in the art as a standardized and universal support made of a sheet metal profile for fastening electrical equipment such as circuit breakers, relays or controllers in distribution boxes, switch cabinets or junction boxes or other enclosures. The 35 mm wide top hat rail (known as TH35 or TS35) is widely used, and many device housings are adapted for mounting on a top-hat rail.

[0023] Since the DIN rail 20 is typically mounted to an enclosure the available surfaces of the circuit breaker 10 are those facing upwards in fig. 1 or to the sides, hereinafter called front surfaces 14, while the downward-facing surface, hereinafter called rear surface 15, is unavailable as long as the circuit breaker 10 is mounted to the DIN rail 20. In both fig. 1 and fig. 2 the circuit breaker 10 is depicted as mounted on DIN rail 20.

[0024] In typical devices, the front surfaces are used for brand and other product information as well as for ventilation. In addition, the front surfaces hold any interface elements that are functionally necessary. Such interface elements include, but are not limited to, connectors, LEDs, buttons, card reader slots or antenna plugs.

[0025] While some of the interface elements must be easily accessible or visible, others may only be required rarely, for example for maintenance purposes or in the case of errors. Since only little of the surface area of the housing 12 is freely available adding an interface element for a valuable but rarely accessed functionality may require enlarging the device from, for example, a single unit width of 17.5 mm to a double unit width of 35 mm. This may be wasteful as it requires more material at least for the housing 12 and it also removes space for other devices on the DIN rail 20. The length and thus the available space for devices on DIN rail 20 is usually limited.

[0026] To improve the available surface area and provide additional space for interface elements the circuit breaker 10 makes use of the enclosed space 25 which is formed by DIN rail 20 and the rear surface of the circuit breaker 10. The enclosed space 25 is generally cuboid in shape and bordered on three sides by DIN rail 20 and on one side by the central part 16 of the rear surface of the circuit breaker 10. The central part 16 is itself bordered by the clamps 13A, 13B which together form the mount 13. Two narrow sides are open and somewhat accessible if the circuit breaker 10 is mounted on the DIN rail 20 alone but practically inaccessible if it is mounted side-by-side with other devices.

[0027] In the present embodiment of the invention the circuit breaker 10 uses the enclosed space 25 by comprising a button 17 and a micro-SD card slot 18 arranged

in the central part 16 of the rear surface of the circuit breaker 10. This arrangement is shown in fig. 3.

[0028] The button 17 is integrated in the housing 12 of the circuit breaker 10. As it is very flat, it is almost inaccessible when the circuit breaker 10 is mounted to DIN rail 20 even if no other devices are mounted beside it. If the circuit breaker 10 is removed from the DIN rail 20, the button 17 is easily accessible.

[0029] The micro-SD slot 18 comprises an opening in housing 12 that allows access to a micro-SD socket that is arranged on a PCB board that carries the electronics equipment of circuit breaker 10. When the circuit breaker 10 is mounted on DIN rail 20, the micro-SD slot 18 is not accessible at all in a way that allows insertion or removal of a micro-SD card. The socket is recessed sufficiently however that a micro-SD card can be inserted before mounting the circuit breaker 10 to DIN rail 20. Similar to the button 17, the micro-SD card is readily accessible when dismounting the circuit breaker 10. In an alternative embodiment the socket for the micro-SD card could also be arranged so that a micro-SD card could not be left in it when mounting the circuit breaker 10 on DIN rail 20 but could only be used when dismounted to avoid leaving an SD card inserted.

[0030] Thus, the circuit breaker 10 comprises two additional interface elements, in this case button 17 and micro-SD slot 18 in a way that does not interfere with its front surface. As a further advantage, the PCB space required for a socket is also located towards the rear of the circuit breaker 10 where other interface elements do not take up PCB space. In this way the interface elements are accessible when dismounting the circuit breaker 10, for example for maintenance purposes but do not otherwise occupy valuable device space. In this way alternative solutions, such as increasing the size of the device or making it necessary to open its housing 12 to gain access to button 17 or micro-SD slot 18 are avoided.

[0031] This is especially advantageous in a device where a low-constraint microcontroller device is equipped with a high number of different communication ports such as Ethernet or CAN bus but is supposed to remain a one unit width (17.5mm) device. As communication ports tend to be bulky on the scale of a one unit width DIN rail device and require a part of the housing surface as well as a nearby part of the PCB the invention allows fitting more communication ports in the device without making it larger than one unit.

[0032] In a second embodiment of the invention not shown in the figures the central part 16 of the rear surface of the circuit breaker 10 contains a socket for a cable connection, for example a Universal Serial Bus (USB) connection. With the limited height of the enclosed space 25, i.e. the limited length of a plug that is connected to the socket an angled socket will usually be required to be used for this socket. In this case the DIN rail 20 itself acts as an electrical conduit to the USB cable.

[0033] While USB allows connections between devices in a tiered star type formation another embodiment of

the invention may use a socket of a type that allows forming an actual bus, i.e. allowing multiple devices to share the same cable connection. This is the case for example for the Controller Area Network (CAN) bus. This protocol allows connecting several such devices with a single cable line that is carried by the DIN rail 20 as an electrical conduit.

List of reference numbers

[0034]

10	Circuit Breaker
12	Housing
13	Mount
13A, B	Clamps
14	Front surface
15	Rear surface
16	Central part of rear surface
17	Button
18	Micro-SD slot
20	DIN-rail
25	Enclosed space

Claims

1. An electrical device (10) with a mounting rail mount (13) comprising an interface element (17, 18), **characterized in that** the interface element (17, 18) is arranged to face into an enclosed space (25) formed by the electrical device (10) and a mounting rail (20) when the electrical device (10) is mounted on the mounting rail (20).
2. The electrical device (10) of claim 1 wherein the interface element (17, 18) is a human-machine interface element, particularly a pressable button (17).
3. The electrical device (10) of claim 1 wherein the interface element (17, 18) is a socket (18) for a connector or device arranged on an electrical carrier board.
4. The electrical device (10) of claim 3 wherein the socket (18) is arranged on a side of the electrical carrier board facing said enclosed space (25).
5. The electrical device (10) of one of the preceding claims wherein the housing (12) of the electrical device (10) comprises an opening arranged to allow access to the interface element (17, 18), particularly the socket (18), and arranged to open into said enclosed space (25).
6. The electrical device (10) of one of the preceding claims wherein the electrical device (10) comprises one or more second interface elements (17, 18) ar-

ranged to face into said enclosed space (25).

7. The electrical device (10) of claim 6 wherein the housing (12) of the electrical device (10) comprises an opening arranged to allow access to both interface elements (17, 18), the opening being arranged to face into said enclosed space (25) . 5
8. The electrical device (10) of one of the preceding claims wherein the mounting rail (20) is a DIN rail (20). 10
9. The electrical device (10) of one of the preceding claims wherein the socket (18) is a SIM-card socket, an SD-card socket or a Mini-SD card socket (18). 15
10. The electrical device (10) of one of the preceding claims wherein the electrical device (10) is a switching device, particularly a circuit breaker (10), particularly a solid-state circuit breaker. 20
11. The electrical device (10) of one of the preceding claims wherein the electrical device (10) has a width of one standard unit of 17.5 mm. 25
12. An electrical system comprising a mounting rail (20), particularly a DIN rail (20) and one or more electrical devices (10) of any of the preceding claims mounted on the mounting rail (20). 30

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FIG 1

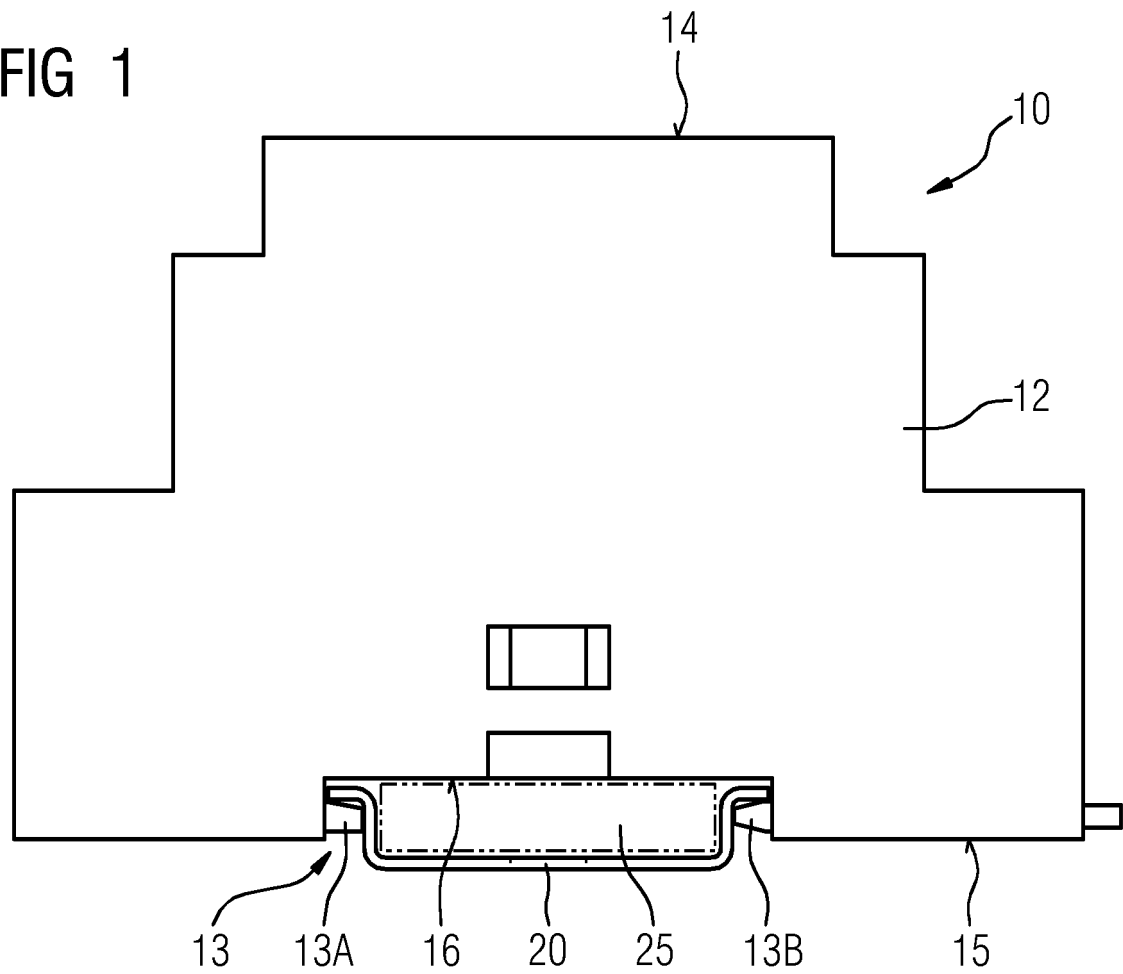


FIG 3

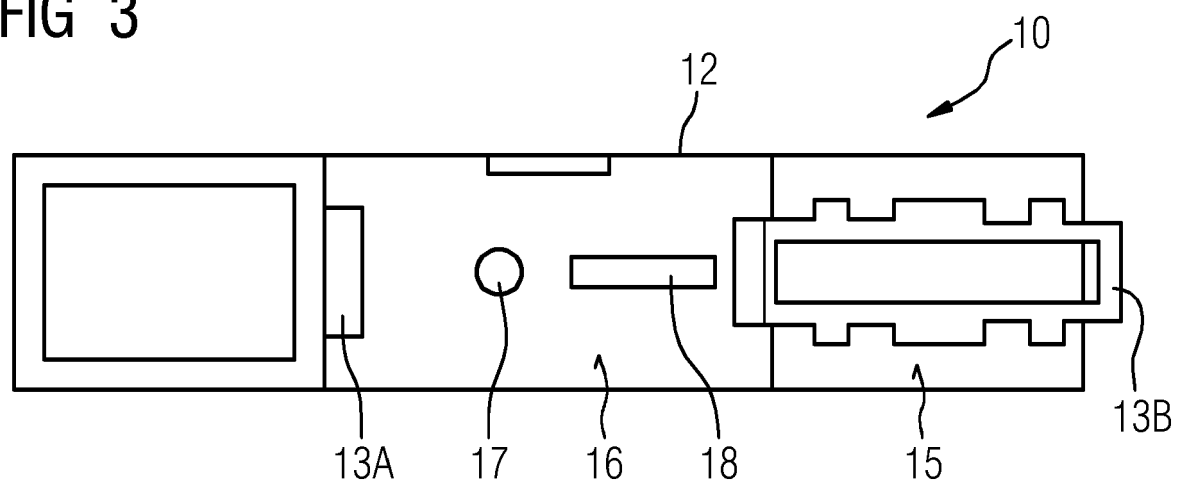
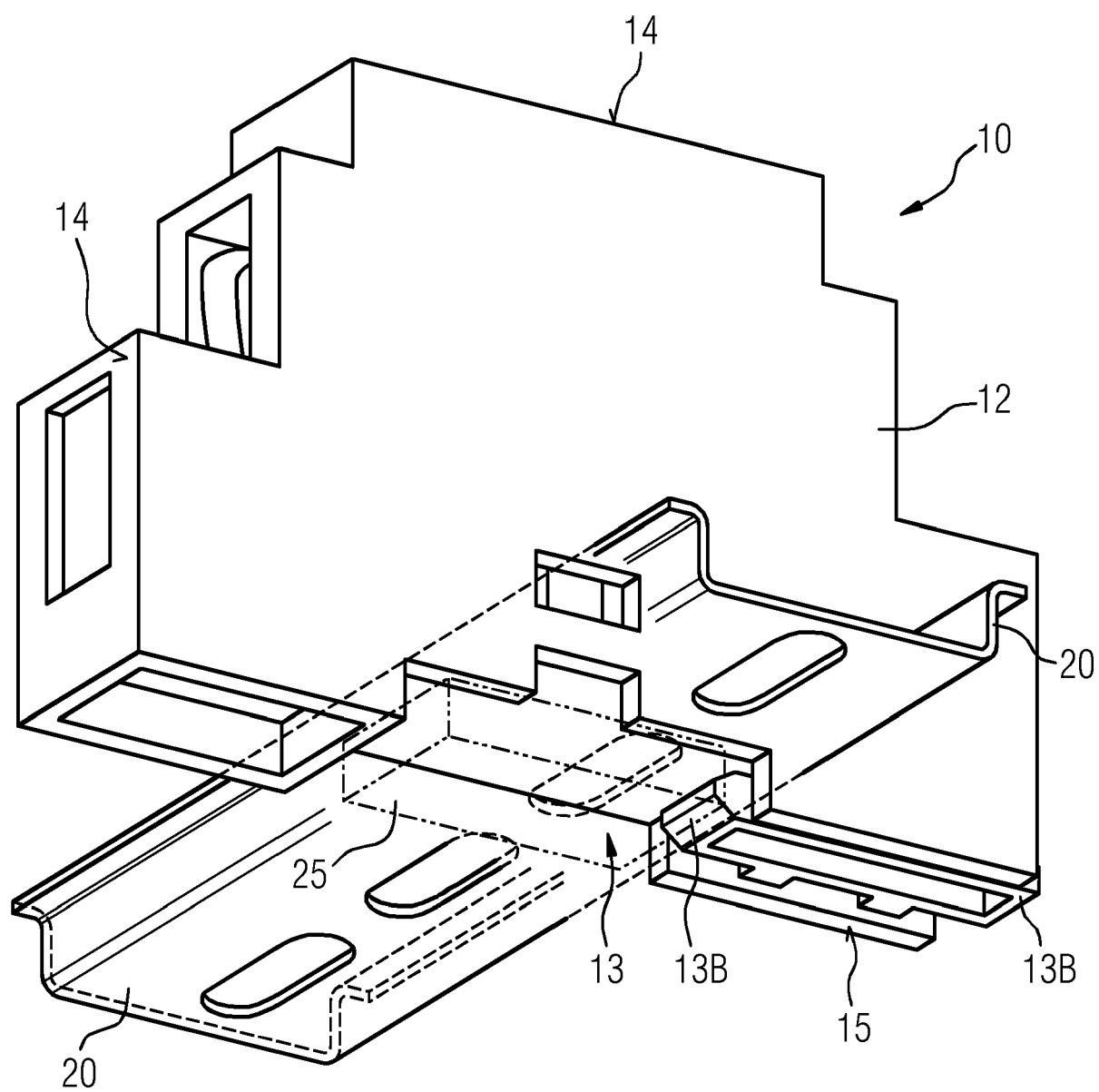


FIG 2





EUROPEAN SEARCH REPORT

Application Number
EP 21 15 7871

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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 21 July 2021	Examiner Arenz, Rainer
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			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 21 15 7871

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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