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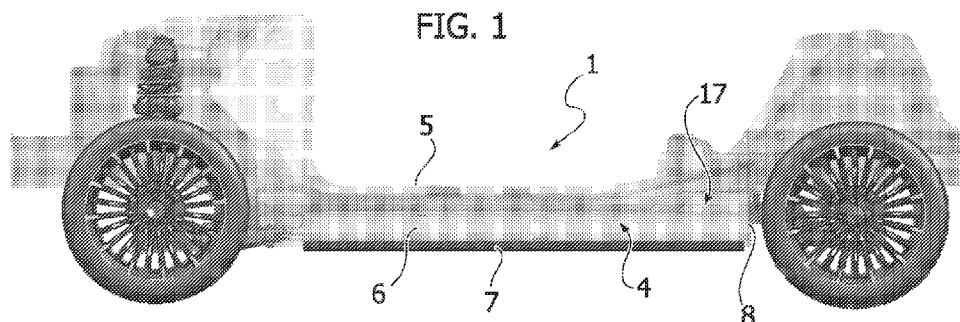
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(54) Title: AN ELECTRIC MOTOR-VEHICLE FRAME EQUIPPED WITH A SYSTEM FOR ACTIVATING THE ELECTRICAL CONNECTION OF THE BATTERY ASSEMBLY



(57) Abstract: A motor-vehicle frame (1) is described comprising: - a battery assembly including a plurality of battery modules (3) each having a plurality of battery cell clusters (3'), - a vehicle platform (5) and a pair of side members (6) longitudinally extending at the sides of the platform (5), - a containment pocket (4) for the battery modules (3), - an activation system (19) of the electrical connection of the battery assembly, arranged to activate the electrical connection after positioning the battery modules (3) within the containment pocket (4).



“An electric motor-vehicle frame equipped with a system for activating the electrical connection of the battery assembly”

TEXT OF THE DESCRIPTION

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Field of the invention

The present invention relates to an electric motor-vehicle frame comprising a platform, a pair of side members extending longitudinally at the sides of the platform, and a power unit for propulsion of the vehicle comprising a battery assembly including a plurality of battery modules each having a plurality of battery cell clusters.

Prior art

The design of the battery assembly and the mounting on the vehicle are fundamental factors for the success of an electric motor-vehicle, such as an electric city car. It is, in fact, necessary to house a sufficient number of battery cells to ensure relatively high voltage and power supply, while identifying at the same time an arrangement of the battery cells that constitutes the most rational solution possible in terms of space occupied in the vehicle.

According to a now consolidated technique, the battery cells are rigidly connected to the platform of the vehicle, at specific reinforcement areas of the platform. One of the problems encountered in this solution is that, when the battery assembly is at this point obsolete, it is difficult to carry out maintenance and/or replacement of the battery assembly, therefore in some cases having to scrap the entire vehicle even though it is generally still performing well.

The Italian patent **N° 10 2019 000003015** in the name of the same Applicant illustrates a new configuration of an electric vehicle comprising a battery assembly slidably mounted, in a transverse direction with respect to the longitudinal direction of the vehicle, above the platform and within a cavity defined between the platform and a raised structure to support a vehicle seat.

However, this solution is not without some drawbacks, including having to specifically design the cavity for each different vehicle model,

depending on the vehicle seat support structure arranged above the platform.

There is, therefore, a need to develop a modular and standardized solution, with reduced costs and a simple and intuitive assembly method,
5 which makes the maintenance operations and replacement of the battery assembly extremely easy, as well as the electrical connection operations of the battery modules.

Object of the invention

10 The object of the present invention is to overcome the drawbacks of the prior art.

More specifically, one object of the present invention is to produce a vehicle with an integrated power supply unit and relative extremely easy and intuitive assembly, maintenance and replacement operations.

15 An additional object of the invention is to propose a standardized vehicle architecture that allows a modular approach in the assembly of the power supply unit, without requiring major structural complications and significant cost increases.

20 An additional object of the invention is to propose a solution that allows the battery assembly to be connected and disconnected quickly and intuitively, without affecting the safety for operators.

Summary of the invention

25 In order to achieve one or more of the aforesaid objects, the invention relates to a motor-vehicle frame having the characteristics that are indicated in the attached claim 1.

Further preferred characteristics and advantages are indicated in the dependent claims.

30 The invention is also directed at an assembly and maintenance method as indicated in the attached claims 11, 12.

Brief description of the figures

35 Further characteristics and advantages of the invention will become apparent from the description that follows with reference to the attached drawings, provided purely by way of non-limiting example, wherein:

- Figure 1 is a schematic side view of a motor-vehicle frame according to a preferred embodiment, incorporating a containment pocket for a battery assembly,

5 - Figure 2 is a perspective view of the containment pocket illustrated in the previous figure,

- Figure 3 is an additional perspective view of the motor-vehicle frame including a guide structure for mounting the battery assembly,

- Figure 4 is a partially exploded perspective view illustrating a step of the battery assembly mounting method,

10 - Figures 5A-5C illustrate a preferred embodiment of a battery module,

- Figure 6 is a partially exploded perspective view illustrating an additional step of the battery assembly mounting method,

15 - Figure 7A is an elevation view of the battery assembly mounted inside the containment pocket,

- Figure 7B is an enlarged scale view of one of the battery modules installed on board the vehicle,

- Figure 8 is a partially exploded perspective view illustrating an additional step of the motor-vehicle frame mounting method,

20 - Figure 9 is a perspective view illustrating the battery modules installed inside the pocket, and a related system for activating the electrical connection of the batteries,

- Figures 10A–11C are enlarged scale schematic views of some characteristics of the activation system of Figure 9,

25 - Figures 12A, 12B are, respectively, a front view and a side view of the electrical connection activation system, in a disconnected position, and

- Figures 12C, 12D are, respectively, a front view and a side view of the electrical connection activation system, in a connected position.

30 Detailed description of more embodiments

In the following description various specific details are illustrated aimed at a thorough understanding of examples of one or more embodiments. The embodiments may be implemented without one or more of the specific details, or with other methods, components, materials, etc. In
35 other cases, known structures, materials or operations are not shown or

described in detail to avoid obscuring various aspects of the embodiments. The reference to “an embodiment” in the context of this description indicates that a particular configuration, structure or characteristic described in relation to the embodiment is included in at least one embodiment.

5 Therefore, phrases such as “in an embodiment”, possibly present in different places of this description do not necessarily refer to the same embodiment. Moreover, particular conformations, structures or characteristics can be combined in a suitable manner in one or more embodiments and/or associated with the embodiments in a different way
10 from that illustrated here, for example, a characteristic here exemplified in relation to a figure may be applied to one or more embodiments exemplified in a different figure.

The references illustrated here are only for convenience and do not therefore delimit the field of protection or the scope of the embodiments.

15 In the attached drawings, numeral 1 indicates - in its entirety - a motor-vehicle frame designed for housing a power supply unit 2 for the propulsion of the vehicle. In the following description and in the attached drawings, the power supply unit 2 is a battery assembly comprising a plurality of battery modules 3 each having a plurality of clusters of battery
20 cells 3' which are arranged side by side, in a given direction, within a containment space.

In a per se conventional manner, the motor-vehicle frame 1 comprises a platform 5 and a pair of side members 6 which extend longitudinally at the sides of the platform 5.

25 According to the present invention, the battery modules 3 are installed within a containment space of the motor-vehicle formed by a containment pocket 4 extended beneath the platform 5 of the motor-vehicle. More specifically, observing Figure 2 in particular, it can be noted that the containment pocket 4 is delimited by an upper wall defined by the platform
30 5 of the motor-vehicle, two opposite side walls formed by the side members 6 of the motor-vehicle, and a lower wall formed by an additional sheet metal element 7 spaced apart from the platform 5 and defining a general plane substantially parallel to the platform 5. It should, therefore, be noted that, compared to a conventional vehicle frame, to create the containment pocket
35 4 it is sufficient to prepare the additional sheet metal element 7 that defines

the lower wall of the pocket 4.

According to an additional characteristic, the containment pocket 4 has a rear access opening 8 to allow the insertion of the battery modules 3 within the pocket 4. In one or more embodiments, the containment pocket 4 is completely open at the rear to allow the insertion of the battery modules 3 within the pocket 4, along the longitudinal direction of the vehicle frame 1. It will, therefore, be appreciated that the containment pocket 4 is a frontally and laterally closed space (with reference to the vehicle frame), extended below the platform 5, and configured to house the battery assembly 2, which is inserted into the pocket 4 through the access opening 8.

According to an additional characteristic of the invention, as illustrated for example in Figures 3, 4, inside the containment pocket 4 there is a guide structure 9 configured to facilitate the mounting of the battery assembly 2 within the pocket 4. In fact, as described in detail below, the battery modules 3 comprise sliding means 10 suitable for cooperating with a respective longitudinal element of the guide structure 9, so that the modules 3 are slidably mounted along the longitudinal direction of the vehicle, through the aforesaid access opening 8.

The guide structure 9 comprises two side guides 9' extended along the opposite sides of the containment pocket 4 parallel to a respective side member 6. Each side guide 9' has an inner side surface configured to accommodate the sliding means 10 of the module 3 and allow the sliding of the module 3 inside the pocket 4. The guide structure 9 also comprises a front cross-member 9'' extended along the closed front surface of the containment pocket 4, and connected at its opposite ends to a respective side guide 9'. When the containment pocket 4 is completely empty, the first battery module 3 inserted in the pocket 4 will be able to slide along the side guides 9', up to a final position abutting against the front cross-member 9''.

In one or more embodiments, the guide structure 9 also comprises a central guide 9''' extended parallel to the side guides 9' in a substantially equally spaced position between them. The central guide 9''' comprises two opposite side surfaces respectively facing towards a respective side guide 9', configured to accommodate respective sliding means 10 of the battery module 3. The sliding means 10 of the battery modules 3 may, therefore, comprise sliding elements provided on opposite sides of the outer surface

of the battery module 3, configured to cooperate respectively with a side guide 9' and with the central guide 9". Thanks to the provision of the central guide 9", two side-by-side sliding passages are therefore created inside the pocket 4, for the assembly, along the respective sliding passage, of a sequence of battery modules placed side-by-side, until the pocket is filled 4. These modules will, therefore, have a width substantially corresponding to the distance (along the transversal direction of the frame 1) between a side guide 9' and the central guide 9".

Preferably, the guide structure 9 is made using extruded aluminum components fixed inside the containment pocket 4 by means of fixing means (for example rivets), which connect respective portions of the guide structure 9 to the structural elements forming the pocket 4. Alternatively, the side guides 9' may be made in one piece with the side members 6 of the vehicle.

In one or more embodiments, the guide structure 9, in addition to allowing the modules 3 to slide along the longitudinal direction of the vehicle frame 1, ensuring alignment between the modules, also allows the battery modules 3 to be protected in the case of impact of the vehicle, thus increasing safety for passengers.

Figure 4 is a partially exploded perspective view wherein a step of the assembly process of the modules 3 within the pocket 4 is illustrated. Note that two adjacent pairs of battery modules 3 are already slidably engaged within the containment pocket 4, wherein each pair is axially inserted within a respective sliding passage; additional modules 3 must be assembled in the rear part of the containment pocket 4. Once all the battery modules 3 have been inserted, these are attached to the guide structure 9 with additional fixing means, so as to form a battery assembly 2 integrated with the guide structure 9 rigidly connected to the containment pocket 4. In the final installed configuration, the modules 3 are in contact with each other along the longitudinal direction of the vehicle. With the central guide 9", in the transversal direction the modules 3 are adjacent to each other, but not in mutual contact, as they are arranged along the opposite sides of the central guide 9".

The number of battery modules 3 is defined for each new vehicle designed, depending on the available cell technology and the performance

requirements of the vehicle itself.

As indicated previously, the battery modules 3 comprise sliding means 10 arranged to cooperate with a respective longitudinal element of the guide structure 9.

5 Figures 5A-5C illustrate a preferred embodiment of the battery modules 3. According to a first characteristic, the battery cells 3' are arranged within a tray of cells 11 (Figure 6A) having a containment drawer structure defining a space for positioning the battery cells 3'. The tray 11 comprises a main support wall 11' for positioning the cells 3' (illustrated in
10 Figure 6B), a front wall, a rear wall opposite the front wall and two opposite side walls carrying the aforesaid sliding means 10 along their outer surface, designed to cooperate with the guiding structure 9. Preferably, the sliding means 10 comprise one or more freely rotatable wheels arranged along opposed surfaces of the module 3, to cooperate with a respective element
15 of the guide structure 9 (for example, a side guide 9' and the central guide 9''). Figure 6C illustrates the final configuration of the battery module 3, wherein an upper cover 12 is arranged above the cells 3', thus defining a closing surface parallel to the main support wall 11', and interfaced perimetrically with the side walls, front and back of the tray 11. The battery
20 cells 3' of each module 3 are therefore arranged inside a tray 11 equipped with a sliding mechanism capable of sliding along the longitudinal elements of the guide structure 9. Of course, the sliding means 10 may vary with respect to what is described above and illustrated in the drawings, creating other types of sliding elements well known to those skilled in the art (for
25 example low-friction pads).

Further characteristics of the battery modules 3 are indicated below: Figure 7A is an elevation view of the battery assembly 2 mounted within the containment pocket 4 of the electric vehicle; Figure 7B is an enlarged scale view of one of the battery modules 3 installed on board the vehicle. To
30 appreciate some details of the modules 3, in Figures 7A, 7B the modules 3 are illustrated without the closing covers 12. According to an additional illustrated characteristic, each tray 11 comprises centering elements 13 designed to guarantee the correct alignment and attachment of the modules 3 inside the containment pocket 4. For example, the centering elements 13
35 may be arranged along the front wall of the tray 11, to cooperate with

respective elements on the rear wall of another module already inserted in the pocket 4. Reference 14 also indicates one or more attachment brackets configured for receiving connection elements to stably fix the modules 3 to the guide structure 9 once positioned inside the pocket 4. In the illustrated
5 example, the attachment brackets 14 protrude from the opposite side walls of the tray 11 to create a connection with respective portions of the side guides 9' and the central guide 9".

According to an additional characteristic of the invention, the frame 1 comprises an integrated thermal management system to manage the
10 temperature of the battery assembly. The system is configured to manage the temperature of the batteries and keep it as constant as possible during operation, in order to optimize performance, heating or cooling the batteries depending on the operating conditions. The integrated system is designed to dissipate the heat generated or to heat as needed, by circulating coolant
15 or heating fluid through the battery modules 3.

Observing Figures 7A, 7B, note that each tray 11 comprises connection sockets 15 of the thermal management system to be connected to each other, to circulate the coolant along the battery assembly. Each tray 11 comprises a front connection socket and a rear connection socket
20 protruding, respectively, from the front wall and the rear wall of the tray 11, so that the front socket of a tray inserted into the pocket 4 may be connected to the rear socket of another tray already in place inside the pocket 4.

With reference to Figure 7A, the trays 11 that are inserted inside the pocket 4 when still empty, and arranged against the front cross-member 9",
25 include at least one front socket connectable to a coolant circulation duct (not shown). Reference 32 indicates an exchanger operationally connected to a heating system mounted on board the vehicle, so as to allow the continuous circulation of coolant along the battery modules 3.

Observing Figure 7A it will therefore be appreciated that the
30 integrated cooling system allows the circulation of coolant, along the battery modules 3, through the connection sockets 15 of the modules. Each module 3 comprises within it an integrated duct element placed in communication with the front and rear connection socket. Therefore, the battery modules 3 are already set up for the circulation of fluid, so as not to require the
35 mounting of a specific circuit in addition to the size of the battery assembly.

The circuit is closed with a duct arranged in front of the modules 3 inside the pocket 4 which connects the inner circuit of the battery assembly, via said exchanger 32, with the thermal circuit of the vehicle. The rear connection sockets of the modules 3 that face the rear access opening 8, may be connected with additional tubes or other hydraulic elements carried by the closing cover of the pocket 4, so as to close the circuit for circulating the coolant. In accordance with the embodiment illustrated in Figure 7A, in this rear part of the circuit there is a pump 34 for circulating the fluid and an expansion tank 33. The pump 34 and the tank 33 are in fluid communication with the rear sockets of the modules 3 which face the rear opening 8, via a further duct 35 equipped with at least one coupling 36 for filling/emptying the system. The circulation of fluid along the ducts is indicated with the illustrated arrows.

According to an additional characteristic illustrated in particular in Figure 6, the guide structure 9 also comprises an assembly of auxiliary guides 20 spaced above the guide structure 9, inside a rear area 17 of the containment pocket 4. In fact, as illustrated in Figures 1, 2, at this rear area 17, the platform 5 has a slightly curved upwards conformation. It will therefore be appreciated that the containment pocket 4 generally has a constant height determined by the spacing of the platform 5 and the further sheet metal element 7, and a rear area 17 with a greater height determined by the curvature of the platform 5.

The assembly of auxiliary guides 20 facing the rear access opening 8 comprises two opposite auxiliary side guides 20' joined by an auxiliary front cross-member 20".

In one or more embodiments, the guide structure 9 comprises two side support arms 31 configured to laterally support the auxiliary guide structure 20 at a higher height than the side guides 9'. For each auxiliary side guide 20', a side support arm 31 is connected at its opposite ends to a respective side guide 9' and to the side guide 20'. Preferably, the side arm 31 extends substantially in an oblique direction, as the distance between the two auxiliary side guides 20' is smaller than the distance between the two side guides 20. In other words, the width of the containment space between the side guides 9' is greater than that between the auxiliary side guides 20'. It will therefore be appreciated that the side support arms 31 are

configured to support the assembly of auxiliary guides 20 in a raised position with respect to the side guides 9'.

According to a preferred embodiment, the assembly of auxiliary guides 20 is configured only for mounting a service battery module 3" including a plurality of electronic components for the operation of the battery assembly 2, including one or more control units of the batteries, and a pump to control the circulation of coolant. Also for this module, there is a tray carrying the battery cells and including sliding means to slide the module along the auxiliary side guides 20', up to a position abutting against the auxiliary front cross-member 20".

In the final assembled configuration, the support surface of the service module tray 3" is not in contact with the upper surface of the modules 3 slidably mounted along the side guides 9'.

In the final assembled configuration, once the insertion of the battery modules 3 within the containment pocket 4 has been completed, the containment pocket 4 is closed along the access opening 8 by positioning a closing cover 18 (Figure 8). Preferably, the closing cover 18 is an equipped cover equipped with components interfaced with the service module 3". As indicated previously, the containment pocket 4 is a frontally and laterally closed space which has a single rear access opening 8. Advantageously, to seal the battery assembly 2 inside the containment space it is therefore sufficient to carry out a seal limited to the perimeter of the closing cover 18.

In light of the characteristics described above, it will therefore be appreciated that the electric vehicle frame 1 comprises a platform 5 with an integrated guide structure 9 to receive a plurality of sliding trays 11 each forming a battery module 3. The guide structure 9 is arranged inside a closed containment space, which is an integral and structural part of the platform 5. The insertion of the battery modules 3 into the containment space occurs through an access opening 8, along the longitudinal direction of the vehicle.

Thanks to the set of characteristics described, the general configurations of the sliding trays 11 and the containment space allow standardizing and facilitating the assembly, maintenance, and replacement of the battery modules 3. The containment pocket 4 is configured to facilitate the rapid installation of the battery modules, with a portion of open surface

limited precisely to allow the insertion of the battery modules 3 within the pocket 4.

According to an additional characteristic of the invention, the frame 1 comprises an activation system 19 of the electrical connection of the batteries, arranged to activate the electrical connection after positioning of the battery modules 3 within the containment pocket 4. In this regard, Figure 9 is a perspective view illustrating an embodiment of the activation system 19 applied to the battery modules installed within the containment pocket, and Figure 10 is an enlarged scale schematic view of the activation system 19.

The system 19 is configured both to activate the electrical connection of the batteries during production of the vehicle, and to deactivate the electrical connection in order to proceed with maintenance or replacement of the battery assembly.

The system 19 comprises a screw-nut mechanism 19' configured for moving one or more electrical contact devices 21 to be connected to respective electrical contact portions 22 of the battery modules 3. As will be evident from the following description, the screw-nut mechanism 19' is configured to control a vertical translation movement of the electrical contact devices 21 to connect the electrical contact devices 21 with the electrical contact portions 22 of the batteries, or to disconnect them, depending on the actuation direction controlled on the mechanism 19'.

The mechanism 19' carrying the electrical contact devices 21 is positioned inside the pocket 4, above the battery modules 3, and is arranged to be operated after the positioning of the battery modules 3 inside the pocket, to activate the electrical connection of the battery assembly 2.

In one or more embodiments, the screw-nut mechanism 19' comprises an endless screw 23 extended inside the pocket 4 above the battery modules 3.

In one or more embodiments, the electrical contact devices 21 so-called bus bars comprise at least one conductive plane 21' having conductive tracks 24 to be connected to the electrical contact portions 22 of the battery modules 3.

In one or more embodiments, the screw-nut mechanism 19' comprises a transmission unit 25 operatively connected to the screw 23 and

interfaced with the contact devices 21, to control an approaching movement of the contact devices 21 following the rotation of the screw 23, until the connection is made between the conductive tracks 24 and the electrical contact portions 22 of the battery modules 3.

5 In accordance with what is illustrated in Figure 9, the screw 23 extends longitudinally along the containment pocket 4 above the modules 3 and supports a plurality of electrical contact devices 21 spaced along the screw 23, with related transmission units 25, depending on the number and arrangement of the modules 3 within the pocket 4.

10 Considering the arrangement of the modules 3 in Figure 9, note that the mechanism 19' is positioned above the central guide 9" forming two side-by-side sliding passages, for mounting along the respective sliding passage of a row of battery modules.

As illustrated in Figure 10A, each transmission unit 25 may support
15 a single electrical contact device 21 or two side-by-side and spaced apart electrical contact devices 21, each of which carries a pair of conductive tracks 24 to be connected to respective contact portions 22 of the modules 3. The transmission units 25 carrying two devices 21 may be moved to connect four different modules with the respective conductive tracks 24. The
20 transmission units 25 carrying a single device 21 may be moved to connect two different modules with the respective conductive tracks 24.

Observing the enlarged scale view of Figure 10B, note that each conductive plane 21' is extended parallelly above the modules 3, at the opposite ends of which there are the conductive tracks 24 vertically
25 extended in the direction of the upper face of a respective module 3. In the deactivated position, the terminal ends of the conductive tracks 24 are spaced apart from the respective electrical contact portions 22 of the modules 3. In this regard, note that the upper covers 12 of each module 3 are equipped with special openings at the electrical contact portions 22, to
30 enable contact with the respective conductive track 24.

In one or more embodiments, each conductive plane 21' defines an electrically conductive portion with conductive tracks 24 arranged for quick male-female connection with a respective electrical contact portion 22.

With reference to the illustrated example, wherein the central sliding
35 guide 9" is present, the screw 23 is mounted above the central guide 9",

with the conductive tracks 24 extending vertically at the sides of the central guide 9", above respective electrical contact portions 22 of the modules 3.

In the final assembled configuration, illustrated in Figure 9, the rear end of the screw 23 is positioned near the rear access opening 8, so that it
5 can be easily rotated to activate the electrical connection, before closing the pocket 4 with the cover 18. In the illustrated embodiment, wherein the upper auxiliary guide structure 20' is present, the screw 23 remains accessible to the operator, despite all the battery modules being already installed, given that the support surface of the tray of the upper module is not in contact with
10 the upper surface of the modules 3 slidably mounted along the side guides 9', thus defining a space within which the screw 23 extends.

With particular reference to Figure 10B, in one or more embodiments, the transmission unit 25 comprises:

- a first transmission element 26 axially engaged with the endless
15 screw 23, configured to translate along the longitudinal direction, integral with the rotation of the screw 23, wherein the first transmission element 26 is provided with at least one laterally protruding cam element 27,
- a second transmission element 29 that supports the conductive connection plane 21' and interfaced with the first transmission element 26,
20 wherein the second transmission element 29 is equipped with a cam guide 30 wherein the cam element 27 can slide. The cam guide 30 is shaped to guide, through interaction with the cam element 27, a vertical lowering movement of the second transmission element 29 and therefore of the contact device 21 to connect the conductive tracks 24 to the electrical
25 contact portions 22 of the modules 3.

Observing Figure 10C, note that the second transmission element 29 comprises one or more connection portions 29' in mutual engagement with one or more respective engagement portions (for example, shaped like a slot) obtained on a respective contact device 21. This configuration allows
30 controlled "clearance" to be obtained between the conductive plane 21' and the second transmission element 29, allowing recovery of any geometric tolerances due to an imperfect alignment between the trays carrying the battery cells.

Figures 12A, 12B are, respectively, a front view and a side view of
35 the electrical connection activation system 19, in a disconnected position;

Figures 12C, 12D are, respectively, a front view and a side view of the electrical connection activation system 19, in a connected position.

Before activating the rotation of the screw 23, the cam element 27 of the first transmission element 26 is inserted into an inlet portion of the cam guide 30 (Figure 11A).

During operation, following the rotation of the screw 23, the first transmission element 26 translates along the screw 11 and the second transmission element 30 carrying the contact device 21 is forced to lower towards the battery modules 3, due to the interaction between the cam element 27 and the cam guide 30 shaped with an oblique straight pattern (Figure 11B). When the cam element 27 reaches the stroke-end position, the electrical contact devices 21 are in the lowered position (Figure 11C). The lower contact surface of the conductive tracks 24 is therefore electrically connected to the contact portions 22 of the battery modules (Figures 12C, 12D).

Naturally, by rotating the screw 23 in the opposite direction, compared to that indicated above, the devices 21 lift, disconnecting the conductive tracks 24 from the respective modules 3.

In light of the characteristics described, the electric vehicle frame 1 according to the invention provides an integrated battery assembly 2 and relative extremely easy and intuitive assembly, maintenance and replacement operations. The system 19 allows connection and disconnection of the battery assembly quickly and intuitively, without affecting the safety of operators who could otherwise come into contact with high voltage components.

According to an aspect of the invention, the assembly method of the electric vehicle frame 1 includes the following steps:

- creating a vehicle platform 5 with integrated containment pocket 4;
- preparing a guide structure 9 inside the containment pocket 4;
- arranging an activation system 19 for the electrical connection of the batteries inside the pocket 4;
- sliding the battery modules 3 inside the containment pocket 4, along the guide structure 9;
- installing a service battery module 3";
- activating the electrical connection system 19;

- mounting a closing cover 18 configured to close the access opening 8 of the containment pocket 4;

- mounting the rear suspension of the vehicle.

Of course, to make the battery assembly 2 operational, it is
5 necessary to carry out further battery assembly activation steps well known to those skilled in the art, such as for example the mounting of the "charge port" and the arrangement of the specific wiring for high voltage (HV).

Advantageously, the rear suspension of the vehicle may comprise a
10 single suspension module comprising a cross-member at the ends of which the wheel assemblies extend. The cross-member is connected to the platform at one of its end areas, behind the containment pocket 4.

In one or more embodiments, the maintenance process determined
by the previously described structure comprises: removing the rear
suspension module, opening the rear cover 18, rotating the screw 23 to lift
15 the contact devices 21, removing the obsolete modules 3.

Of course, without prejudice to the principle of the invention, the
details of construction and the embodiments may vary widely with respect
to those described and illustrated purely by way of example, without
departing from the scope of the present invention, as defined by the
20 attached claims.

CLAIMS

1. A motor-vehicle frame (1) comprising:

- a battery assembly including a plurality of battery modules (3) each
5 having a plurality of battery cell clusters (3'),
- a vehicle platform (5) and a pair of side members (6) longitudinally
extending at the sides of the platform (5),
- a containment pocket (4) for containing the battery modules (3),
extended under the platform (5) and having an access opening (8) to enable
10 assembling of the battery assembly inside the containment pocket (4),
wherein said containment pocket (4) defines a containment space delimited
above by the platform (5), laterally by the side members (6) and below by
an additional sheet element (7) spaced apart from the platform (5) and
defining a general plane substantially parallel to the platform (5),
- 15 - an activation system (19) of the electrical connection of the battery
assembly, arranged to activate the electrical connection after positioning the
battery modules (3) within the containment pocket (4), wherein the
activation system (19) is positioned within the pocket (4) above the battery
modules (3),
- 20 - wherein said activation system (19) comprises a screw-nut
mechanism (19') and at least one electrical contact device (21) to be
connected to respective electrical contact portions (22) of the battery
modules (3), wherein the screw-nut mechanism (19') is configured for
driving a vertical translation movement of said at least one electrical contact
25 device (21) for electrically connecting or disconnecting the battery modules
(3) according to an actuation direction of the screw-nut mechanism (19').

2. A motor-vehicle frame (1) according to claim 1, wherein the screw-
nut mechanism (19') comprises an endless screw (23) extending along the
longitudinal direction of the frame (1) above the battery modules (3), and at
30 least one transmission unit (25) operatively connected to the screw (23) and
interfaced to at least one electric contact device (21), configured for driving
a vertical translation movement of the electric contact device (21) following
the rotation of the screw (23), the electrical contact device (21) comprising
at least one conductive plane (21') to be connected to the electrical contact
35 portions (22) of the battery modules (3).

3. A motor-vehicle frame (1) according to claim 2, wherein the transmission unit (25) comprises:

- a first transmission element (26) axially engaged with the endless screw (23), configured to translate along the longitudinal direction of the frame (1), integrally with the rotation of the screw (23), wherein the first transmission element (26) is provided with at least one cam element (27),

- a second transmission element (29) supporting the electric contact device (21) and interfacing with the first transmission element (26), wherein the second transmission element (29) is provided with a cam guide (30) wherein the cam element (27) is slidably mounted, the cam guide (30) being shaped to guide, by interaction with the cam element (27), a vertical lowering movement of the second transmission element (29) and the electric contact device (21).

4. A motor-vehicle frame (1) according to claims 2 or 3, wherein the conductive plane (21') extends parallel above the modules (3) and comprises at its ends respective conductive tracks (24) extended along a vertical direction perpendicular to the upper face of the modules (3) assembled within the containment pocket (4).

5. A motor-vehicle frame (1) according to claim 4, wherein said battery modules (3) comprise sliding means (10) configured to cooperate with a respective guide structure (9) arranged inside the containment pocket (4), in such a way that the battery modules (3) are slidably mounted along a longitudinal direction of the vehicle within said containment pocket (4), through said access opening (8).

6. A motor-vehicle frame (1) according to claim 5, wherein the guide structure (9) comprises two side guides (9') extending along opposite sides of the containment pocket (4), parallel to a respective side member (6), wherein each side guide (9') has an inner side surface configured to receive the sliding means (10).

7. A motor-vehicle frame (1) according to claim 6, wherein the guide structure (9) comprises a central guide (9'') extended parallel to the side guides (9') and placed substantially at equal distance between them, said central guide (9'') comprising two opposite side surfaces configured to receive respective sliding means (10) of two adjacent battery modules (3).

8. A motor-vehicle frame (1) according to claim 7, wherein the screw-

nut mechanism (19') comprises an endless screw (23) extending along the longitudinal direction of the frame (1) above the central guide (9'') of the guide structure (9), with the conductive tracks (24) extending vertically to the sides of the central guide (9''), above respective electrical contact portions (22) of the modules (3).

5 **9.** A motor-vehicle frame (1) according to claim 5, wherein each battery module (3) comprises a cell tray (11) for placing the battery cells (3'), having a main support wall (11') for positioning the cells (3'), a front wall, a rear wall opposite to the front wall and two opposite side walls carrying the
10 sliding means (10).

10. A motor-vehicle frame (1) according to claim 6, wherein the guide structure (9) comprises an auxiliary guide assembly (20) spaced above the side guides (9'), within a rear area (17) of the containment pocket (4), wherein, at the rear area (17), the platform (5) has an upwardly curved
15 shape.

11. A method for assembling a motor-vehicle frame (1) according to any of the preceding claims, comprising actuating the screw-nut mechanism (19') along a first direction, in order to drive a vertical translational movement of at least one electrical contact device (21) for connection with the electrical
20 contact portions (22) of the battery modules (3).

12. A method for repairing a motor-vehicle frame (1) according to any one of claims 1-10, comprising driving the screw-nut mechanism (19') along a second direction, in order to drive a vertical translational movement of the at least one electrical contact device (21) for disconnecting the electrical
25 contact portions (22) of the battery modules (3).

FIG. 1

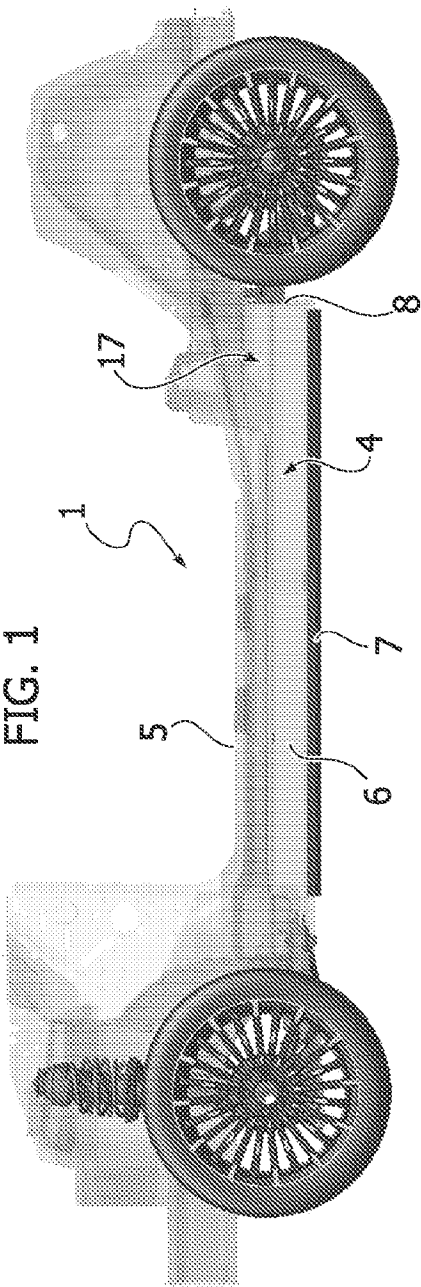


FIG. 2

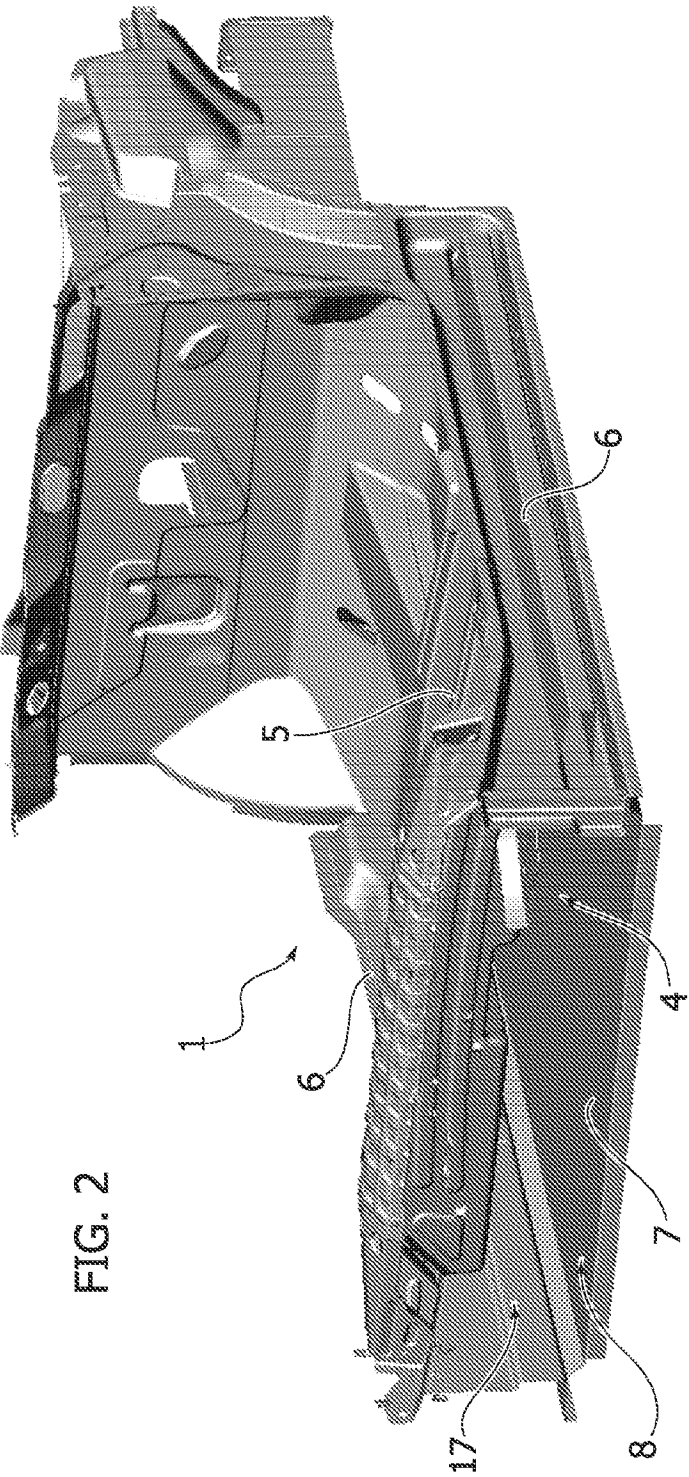
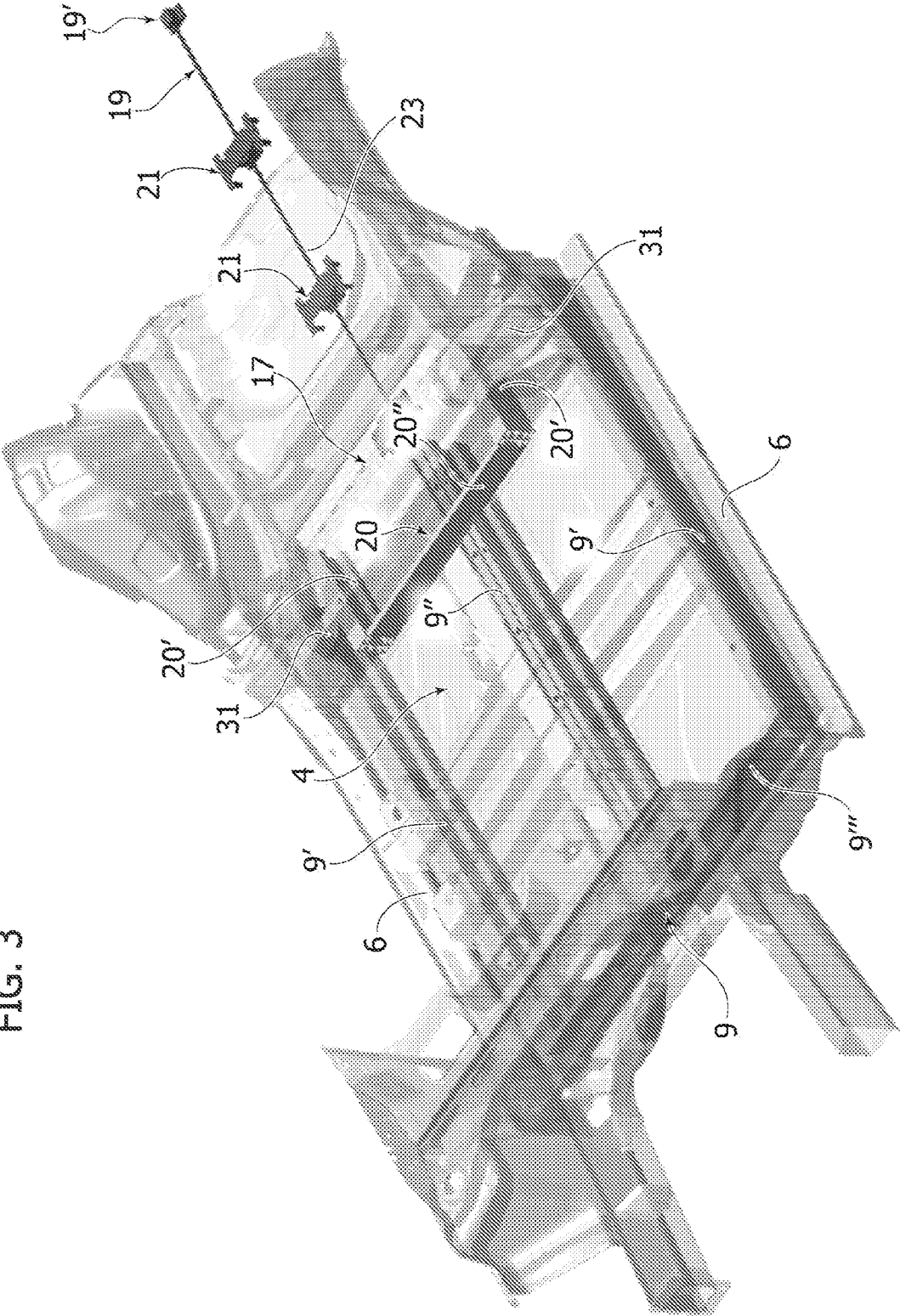


FIG. 3



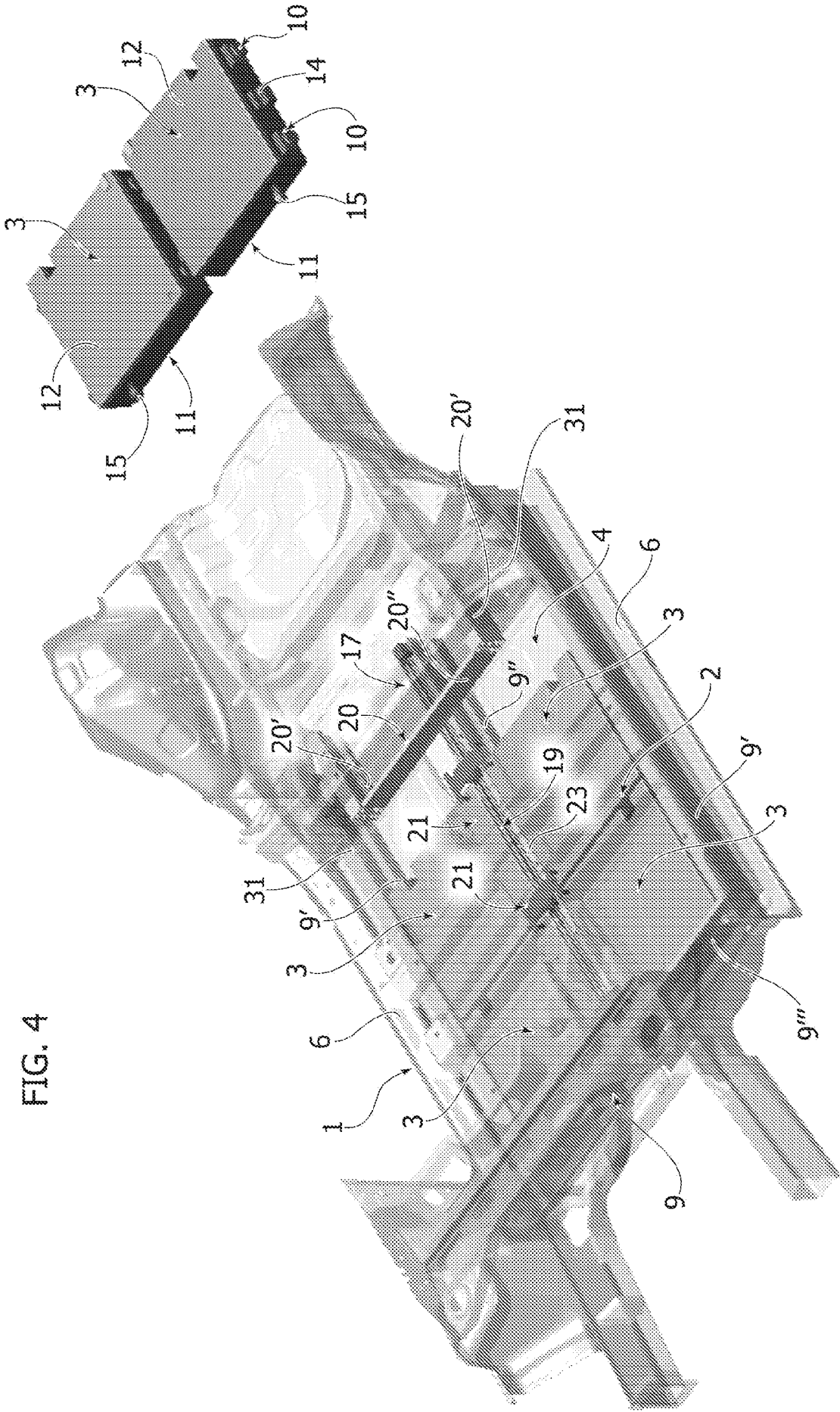


FIG. 5A

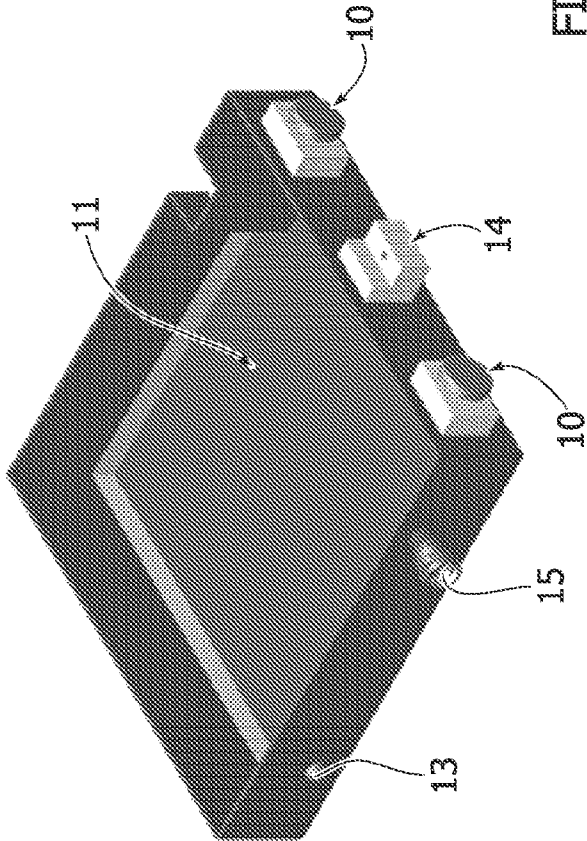


FIG. 5B

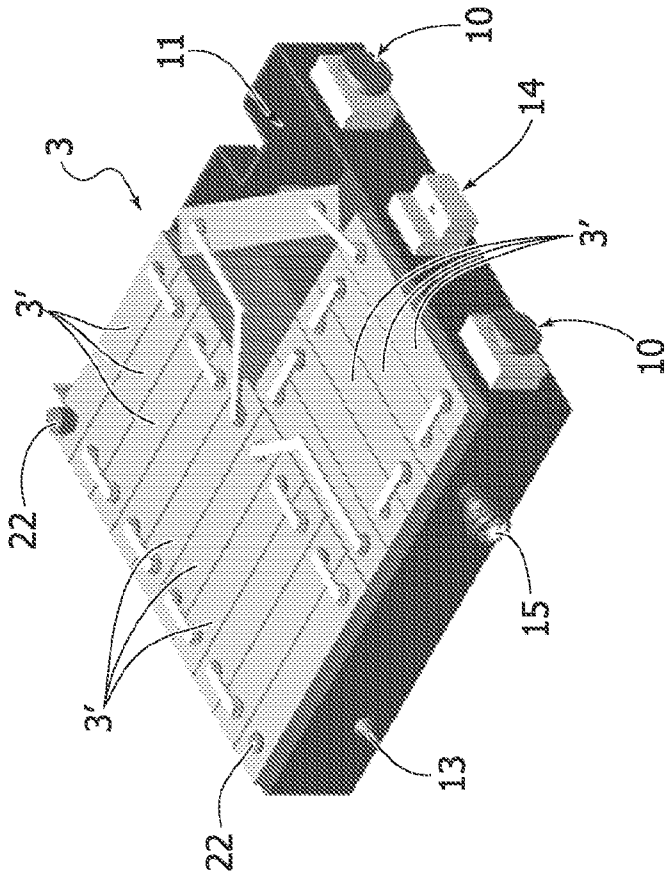
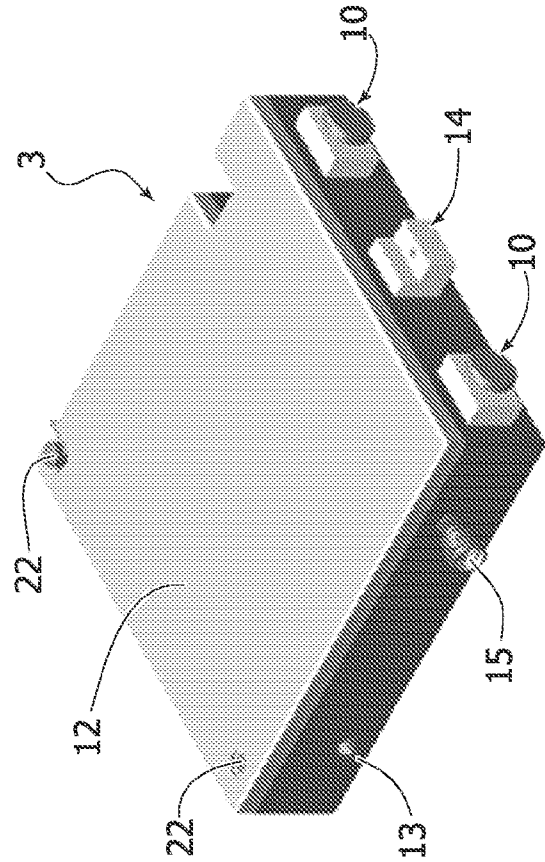
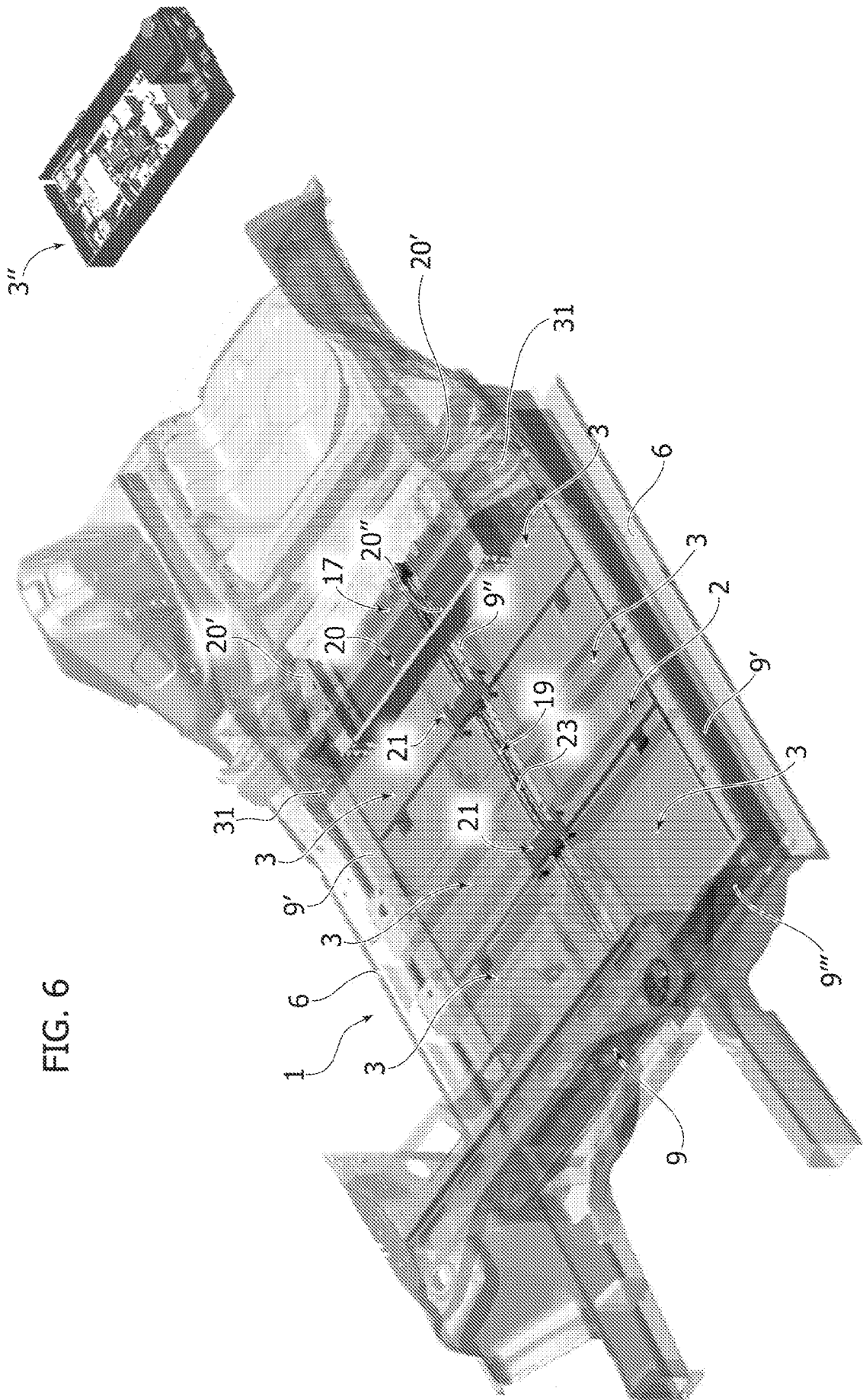


FIG. 5C





6
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L

FIG. 7A

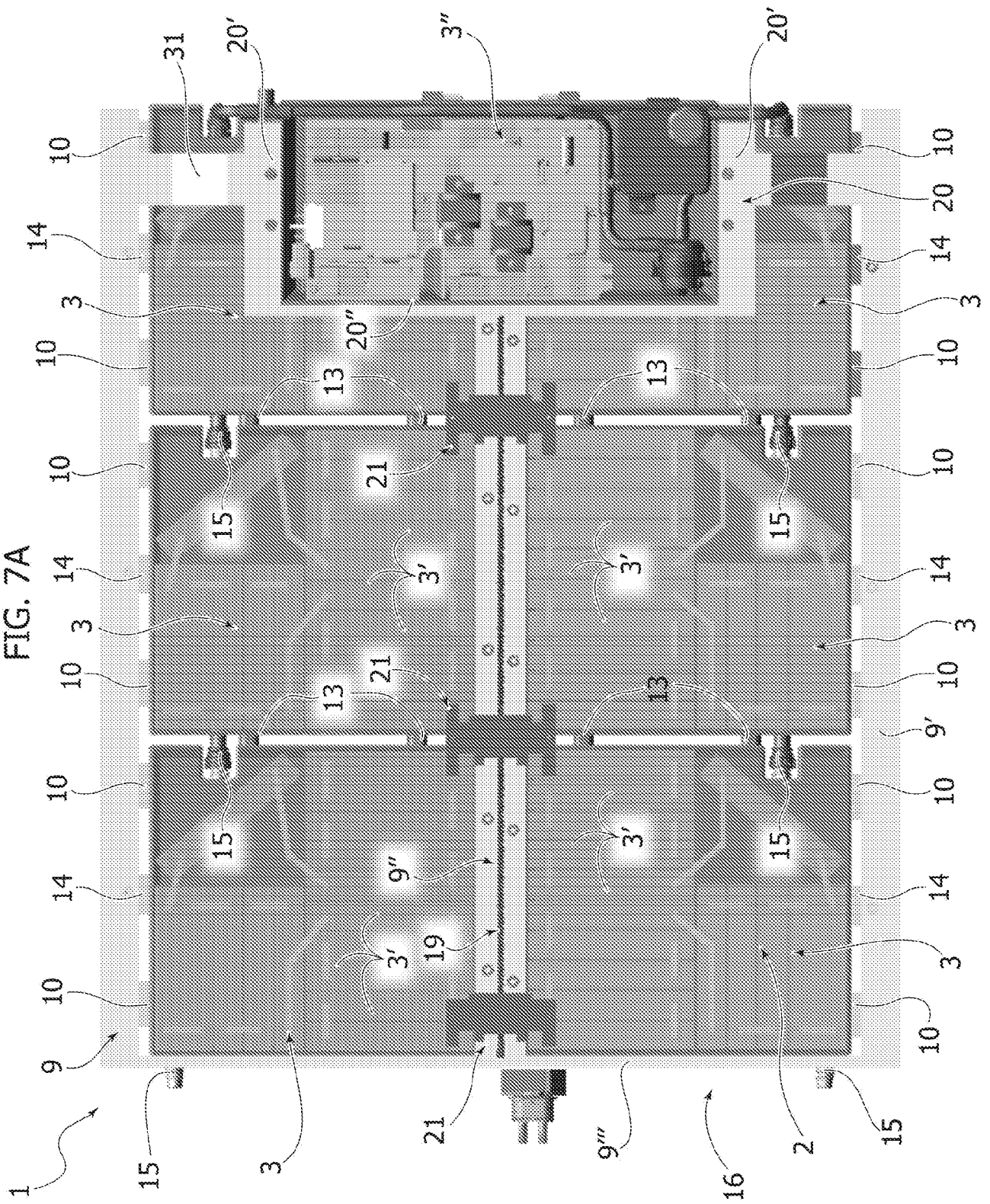


FIG. 7B

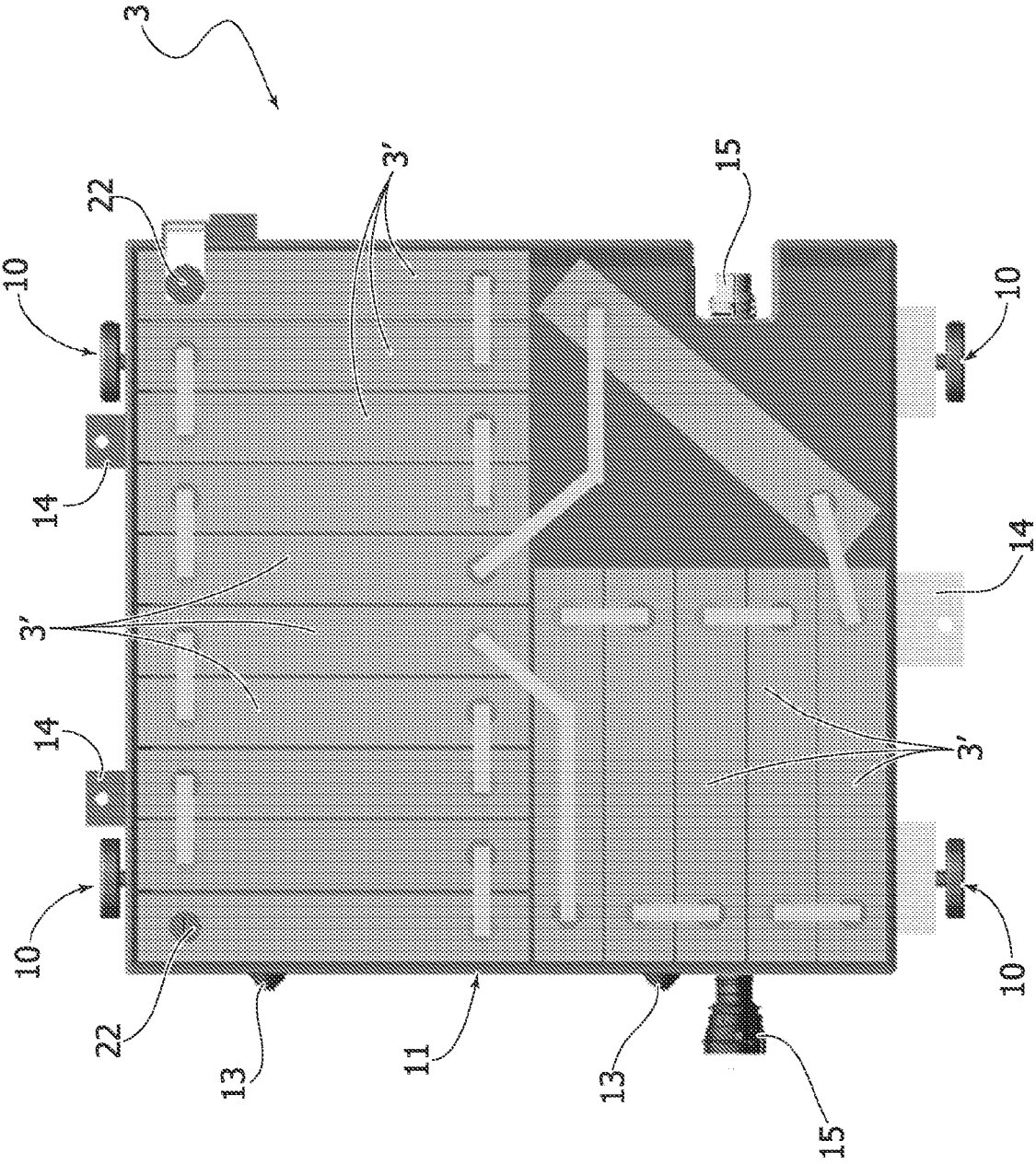


FIG. 9

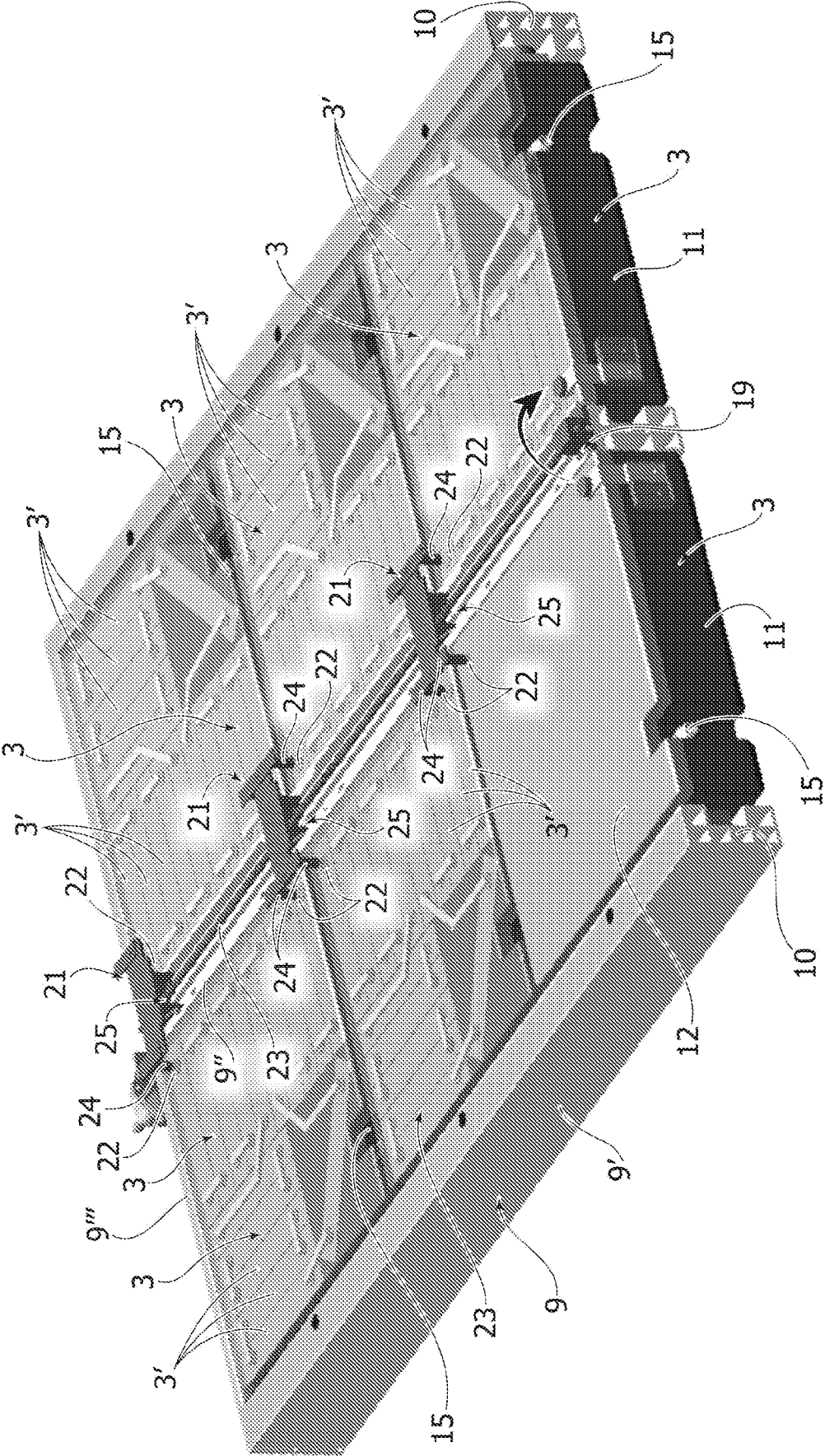


FIG. 10A

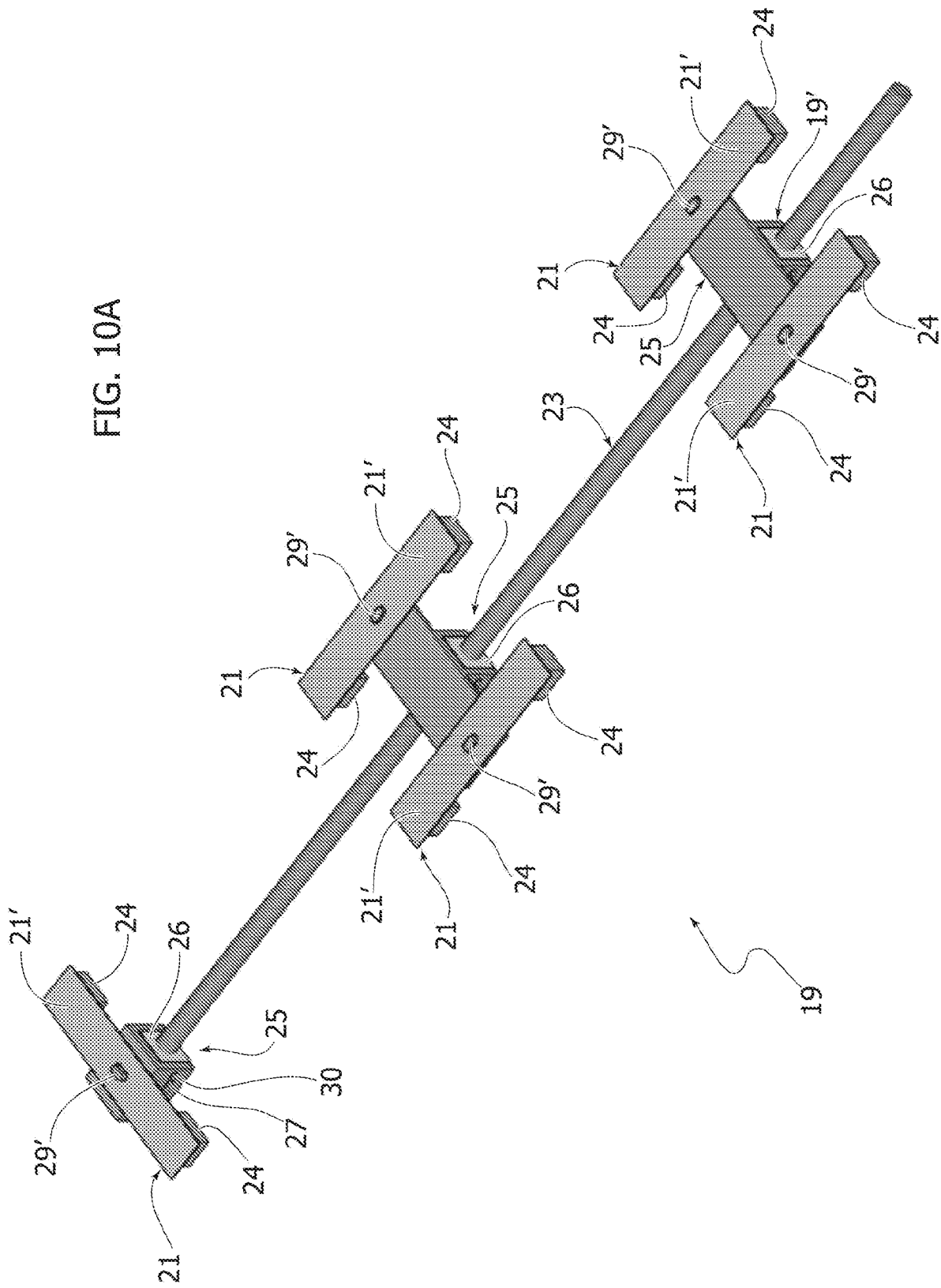


FIG. 10B

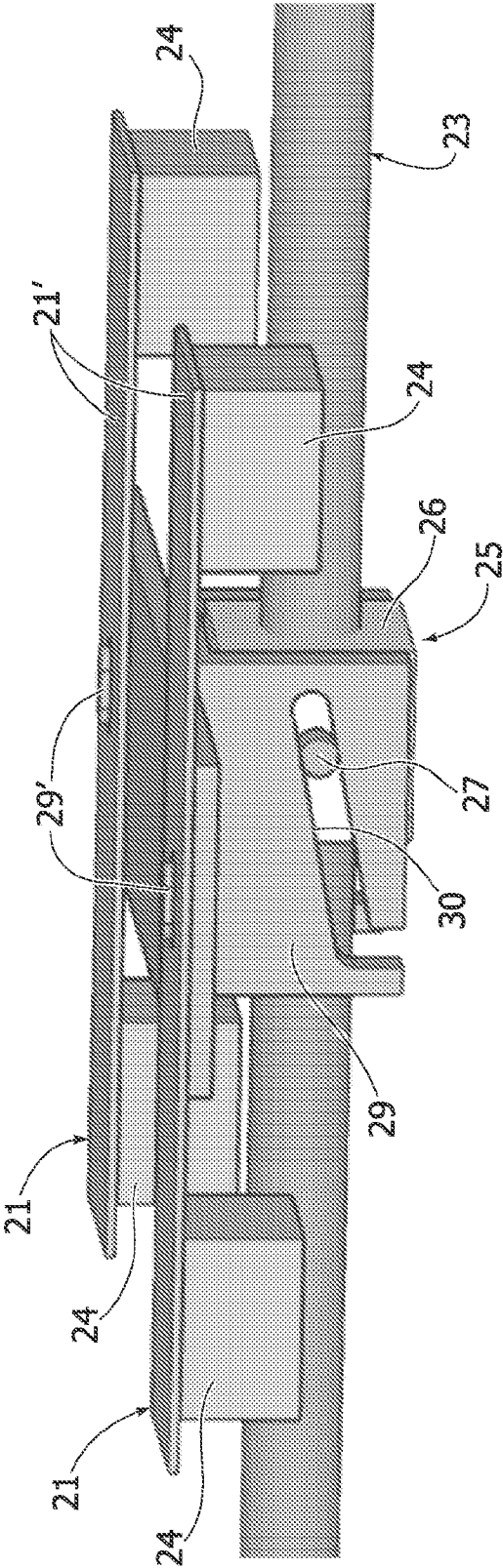


FIG. 10C

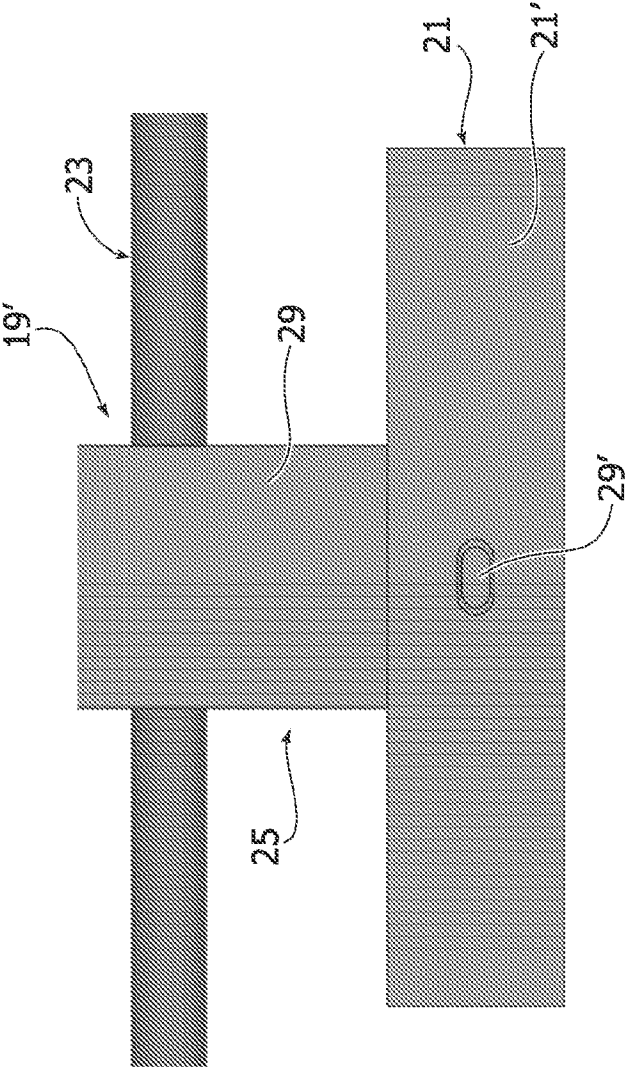


FIG. 11A

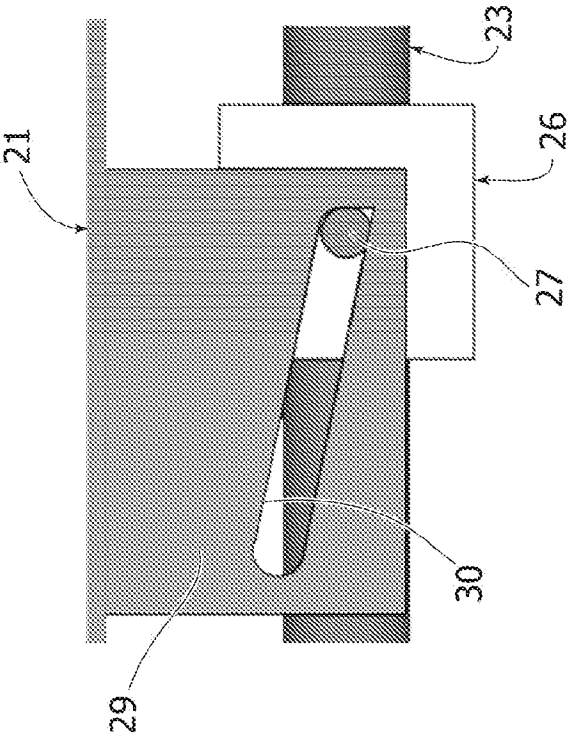


FIG. 11B

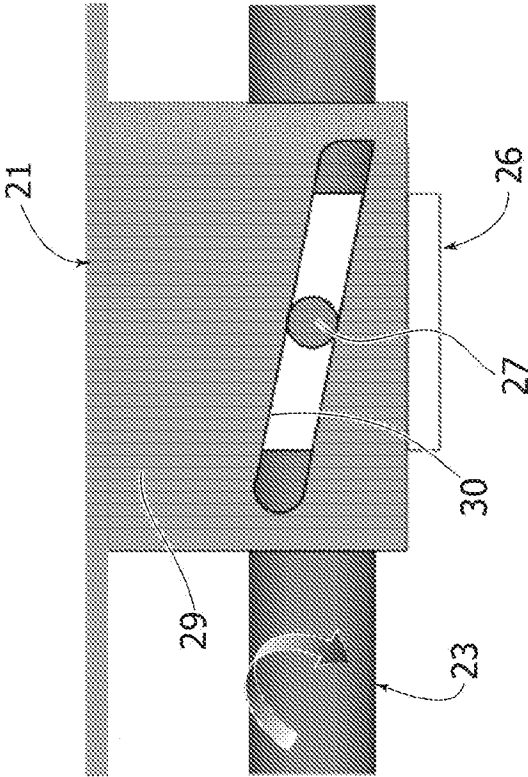


FIG. 11C

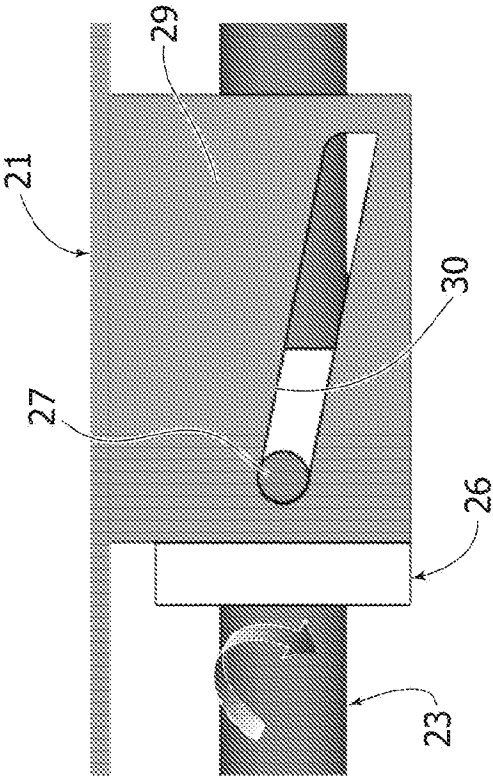


FIG. 12A

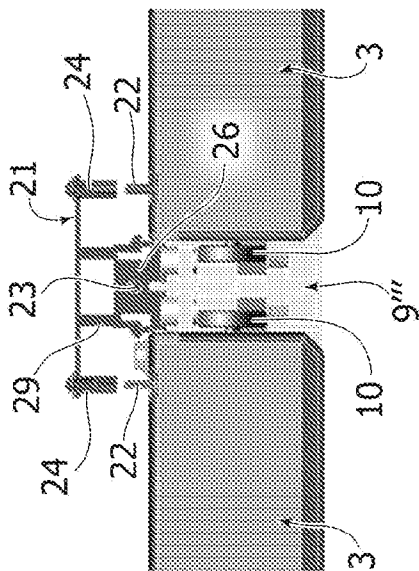


Fig. 12C

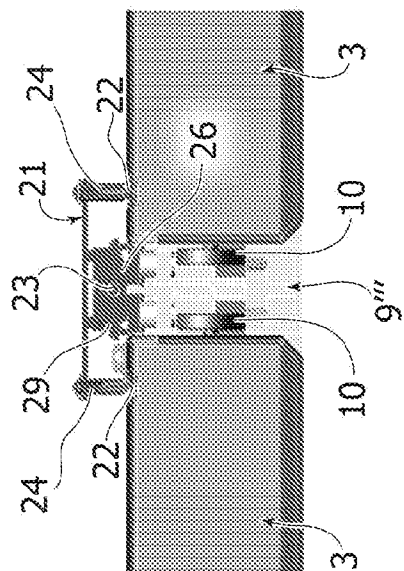


FIG. 12B

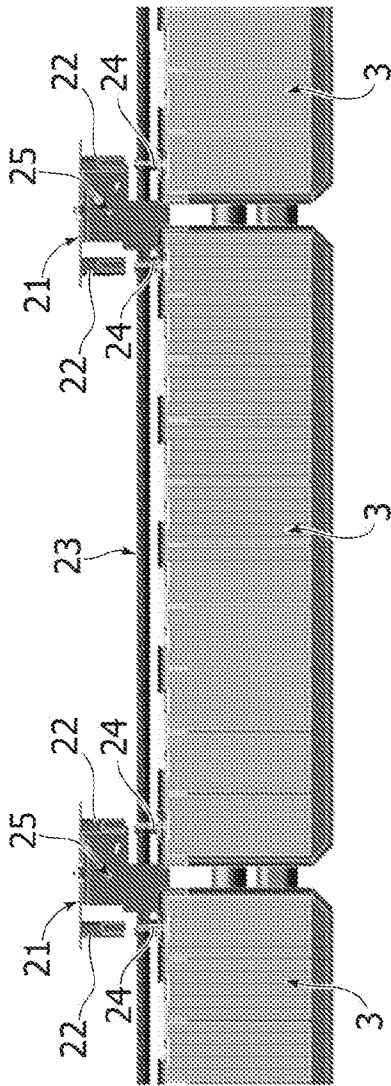
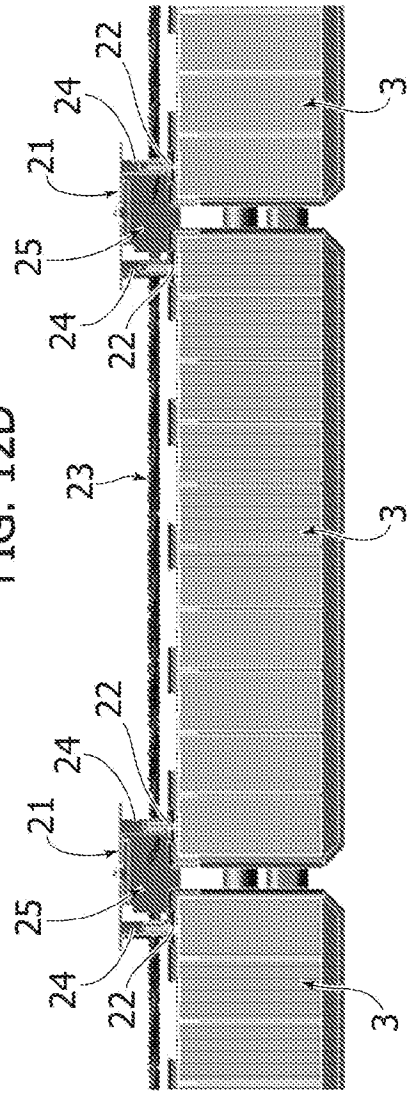


FIG. 12D



INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/052150

A. CLASSIFICATION OF SUBJECT MATTER					
INV.	H01M50/202	H01M50/204	H01M50/249	H01M50/258	H01M50/269
	H01M50/296	B60L50/64	B60L50/60	H01M50/574	
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)					
H01M B60L					
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					
C. DOCUMENTS CONSIDERED TO BE RELEVANT					
Category*	Citation of document, with indication, where appropriate, of the relevant passages				Relevant to claim No.
A	US 2018/109016 A1 (FEES HEINER [DE] ET AL) 19 April 2018 (2018-04-19) figures 1-7				1-12

A	CN 212 323 159 U (RICARDO TECH CONSULTING SHANGHAI CO LTD) 8 January 2021 (2021-01-08) figures 1-3				1-12

A	US 2020/067042 A1 (BAUMGARDT ANDREAS [DE] ET AL) 27 February 2020 (2020-02-27) paragraphs [0079] - [0083]; figures 1-6				1-12

A	US 2015/207130 A1 (MAGUIRE PATRICK DANIEL [US] ET AL) 23 July 2015 (2015-07-23) figures 1-7 paragraphs [0018] - [0032]				1-12

	-/-				
☒ Further documents are listed in the continuation of Box C.					
☒ See patent family annex.					
* Special categories of cited documents :					
"A" document defining the general state of the art which is not considered to be of particular relevance			"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention		
"E" earlier application or patent but published on or after the international filing date			"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone		
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)			"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art		
"O" document referring to an oral disclosure, use, exhibition or other means			"&" document member of the same patent family		
"P" document published prior to the international filing date but later than the priority date claimed					
Date of the actual completion of the international search			Date of mailing of the international search report		
30 April 2024			21/05/2024		
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016			Authorized officer Gücin, Taha		

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2024/052150

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 534 364 A (WATANABE SATOSHI [JP] ET AL) 9 July 1996 (1996-07-09) figures 1-5 columns 1-9 -----	1-12

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Information on patent family members

International application No

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