United States of America

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The Director

of the United States Patent and Trademark Office has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this United States

Patent

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John A. Squires

Director of the United States Patent and Trademark Office

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If the application for this patent was filed on or after June 8, 1995, the term of this patent begins on the date on which this patent issues and ends twenty years from the filing date of the application or, if the application contains a specific reference to an earlier filed application or applications under 35 U.S.C. 120, 121, 365(c), or 386(c), twenty years from the filing date of the earliest such application ("the twenty-year term"), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b), and any extension as provided by 35 U.S.C. 154(b) or 156 or any disclaimer under 35 U.S.C. 253.

If this application was filed prior to June 8, 1995, the term of this patent begins on the date on which this patent issues and ends on the later of seventeen years from the date of the grant of this patent or the twenty-year term set forth above for patents resulting from applications filed on or after June 8, 1995, subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b) and any extension as provided by 35 U.S.C. 156 or any disclaimer under 35 U.S.C. 253.

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Bernardini et al.

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(54) **COVER FOR A CAGE FOR LABORATORY ANIMALS, AND CAGE FOR LABORATORY ANIMALS INCLUDING SAID COVER**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 135 days.

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CPC ***A01K 1/031*** (2013.01); ***A01K 1/0058*** (2013.01); ***A01K 7/00*** (2013.01)

(58) **Field of Classification Search**
CPC A01K 1/031; A01K 1/0245; A01K 1/03; B65D 43/12
See application file for complete search history.

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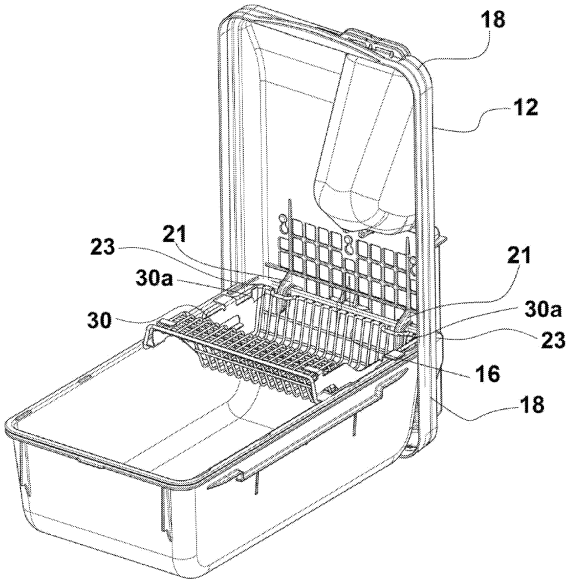
(57) **ABSTRACT**

A cage for housing laboratory animals, said cage comprising a tray and a cover which can be removed and switched between a first closing position, in which it is positioned on said tray thus stopping the access to the internal space delimited by said tray, and a second opening position, in which said internal space may be accessed.

11 Claims, 10 Drawing Sheets



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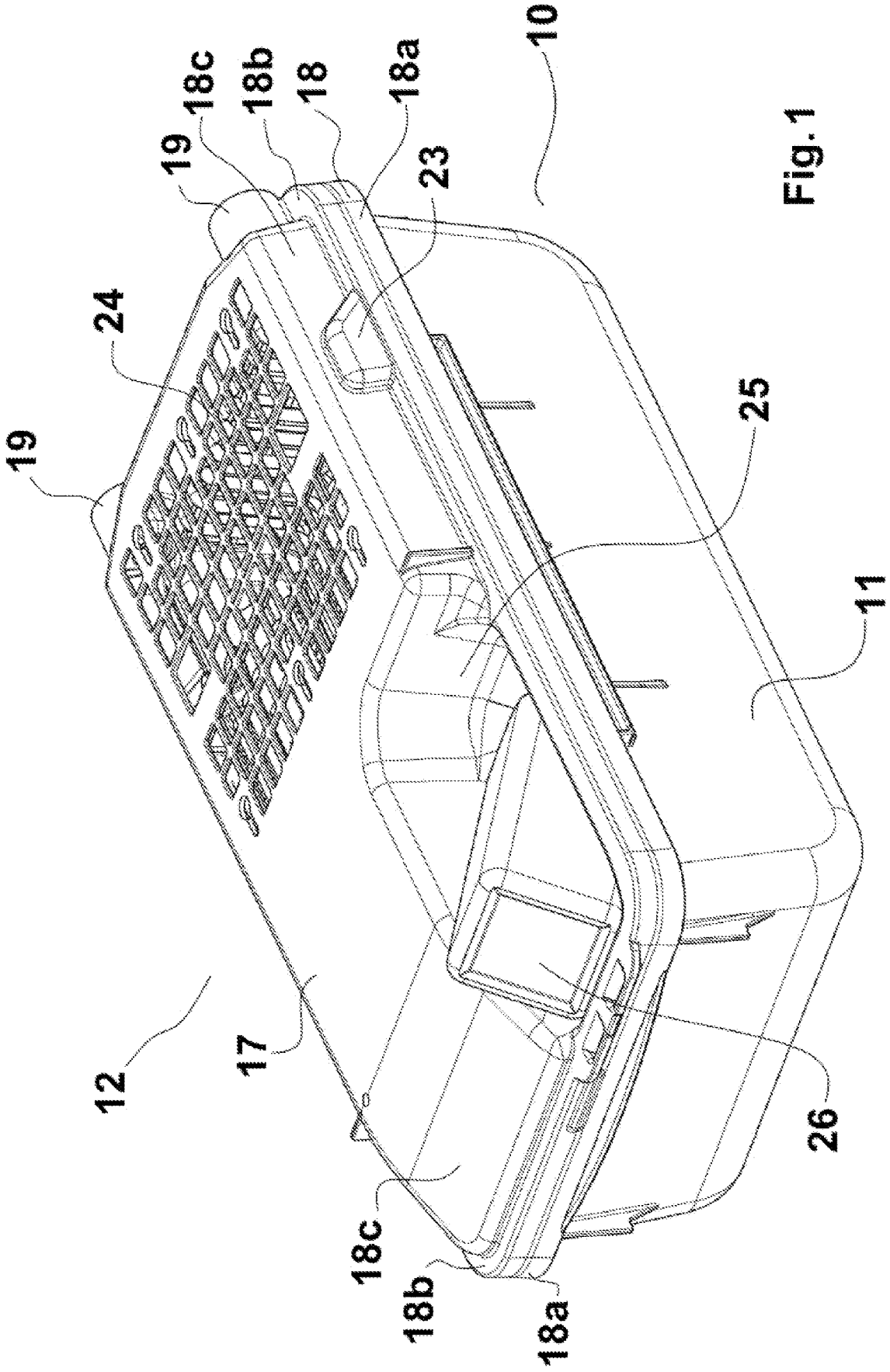


Fig. 1

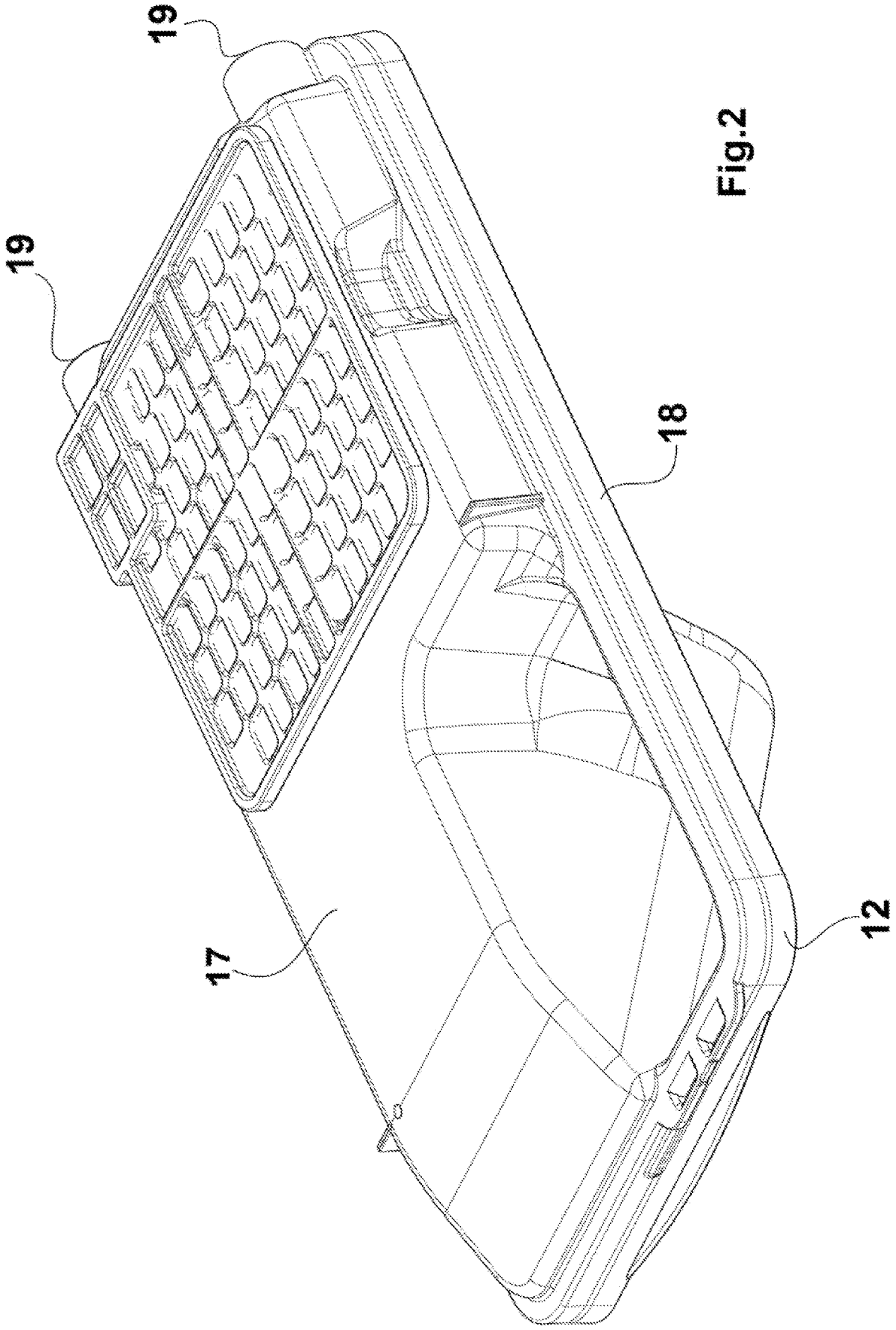


Fig.2

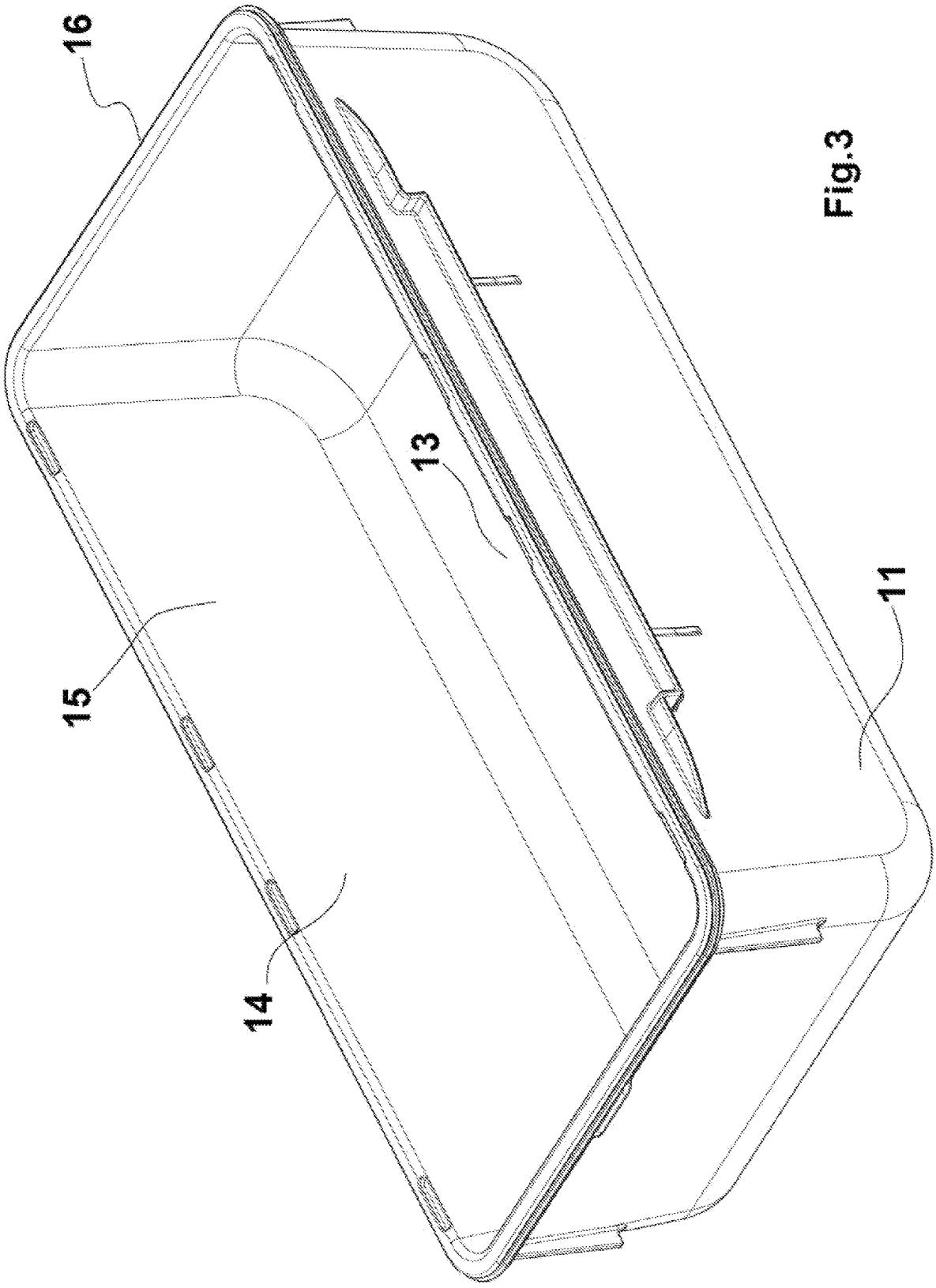


Fig.3

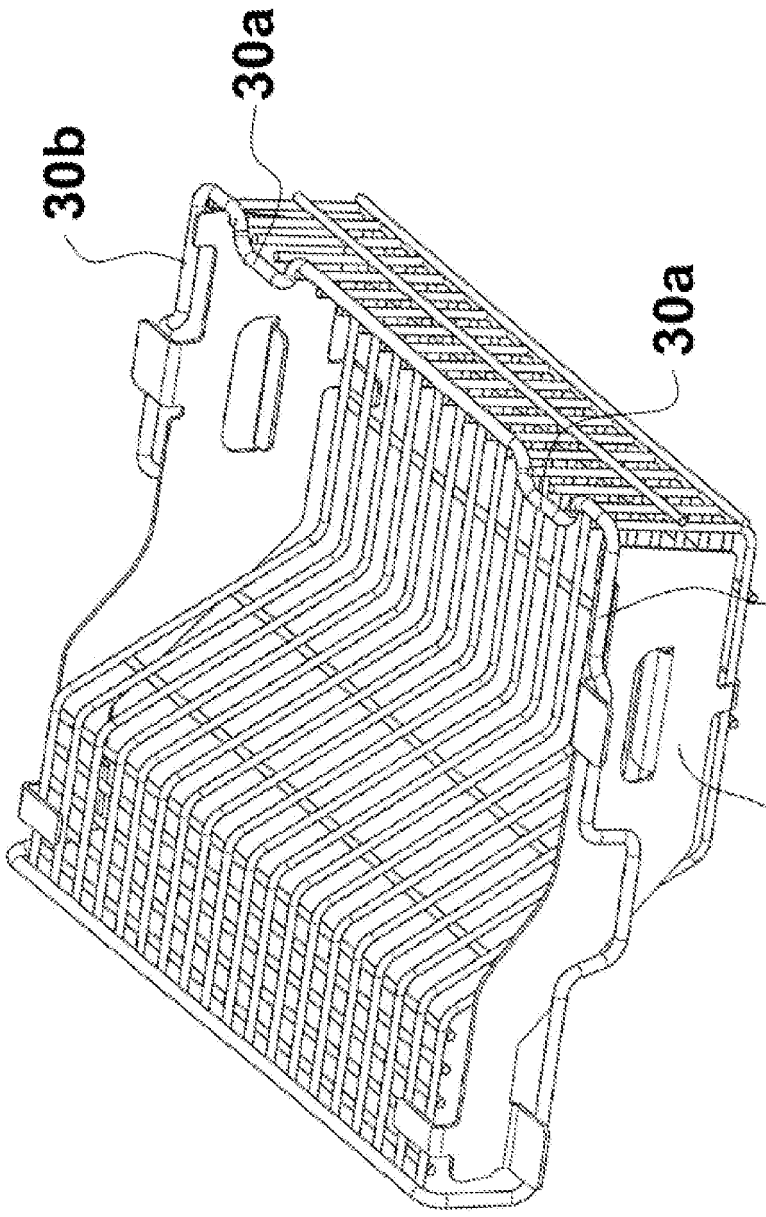


Fig. 4

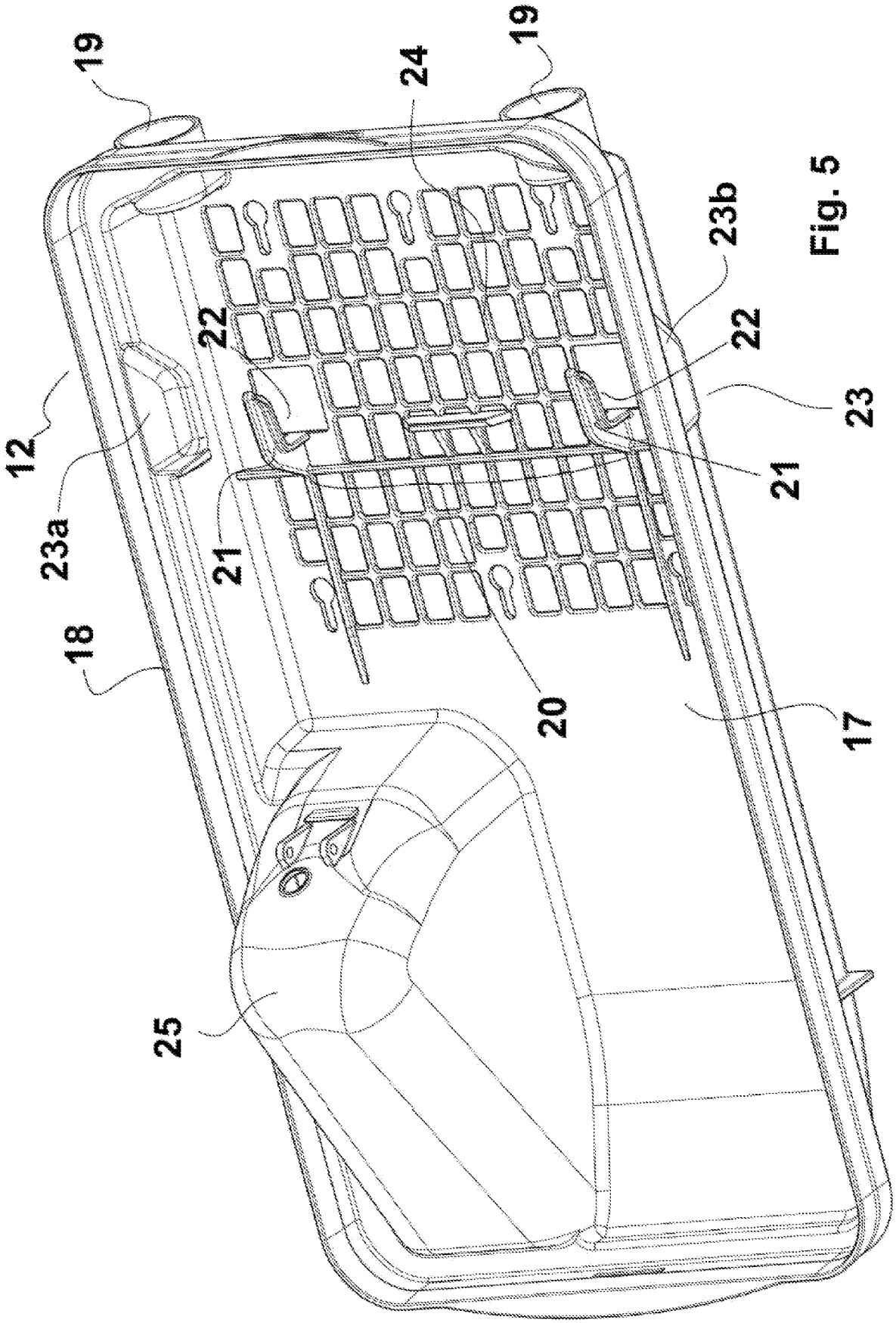


Fig. 5

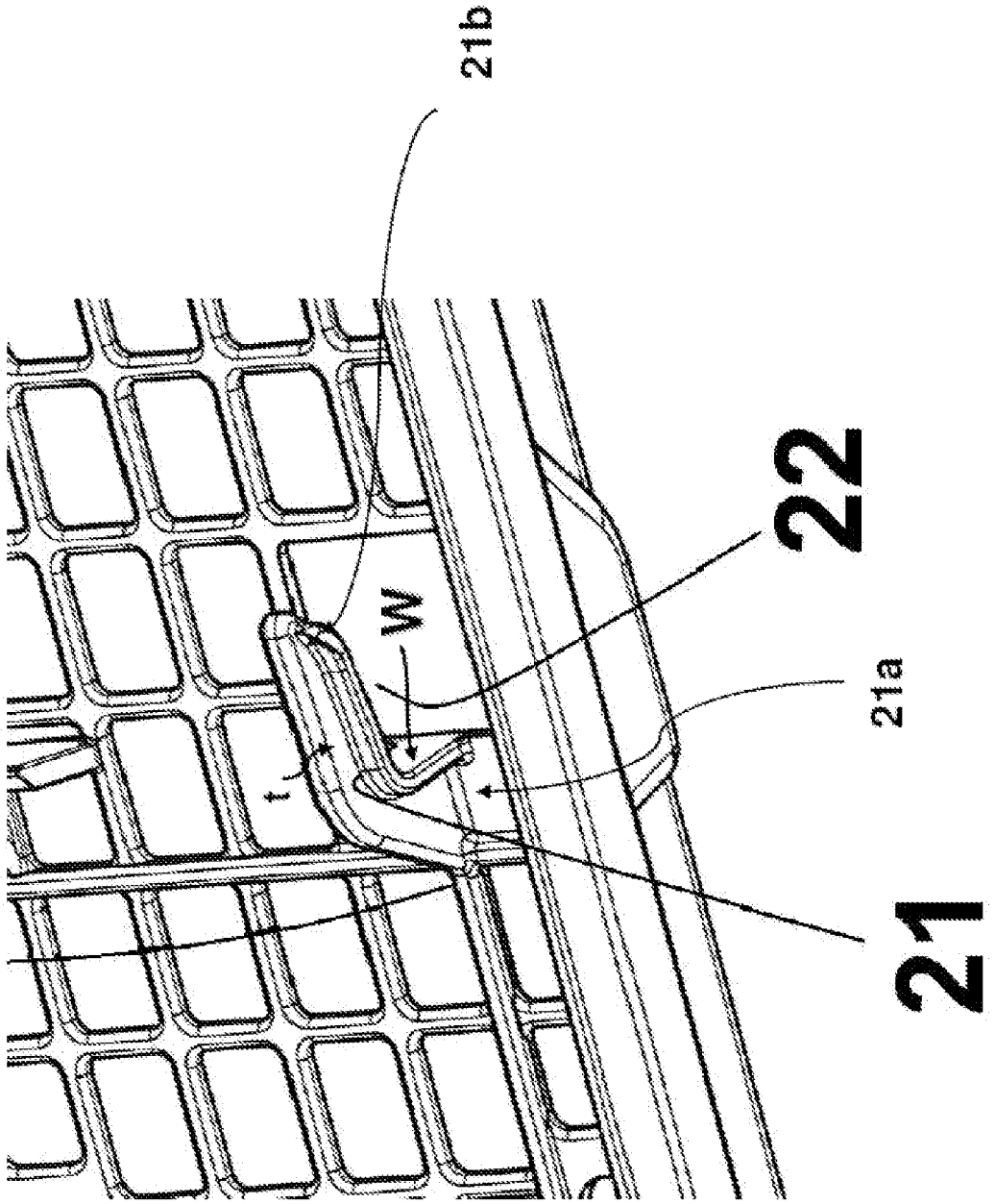


Fig. 5a

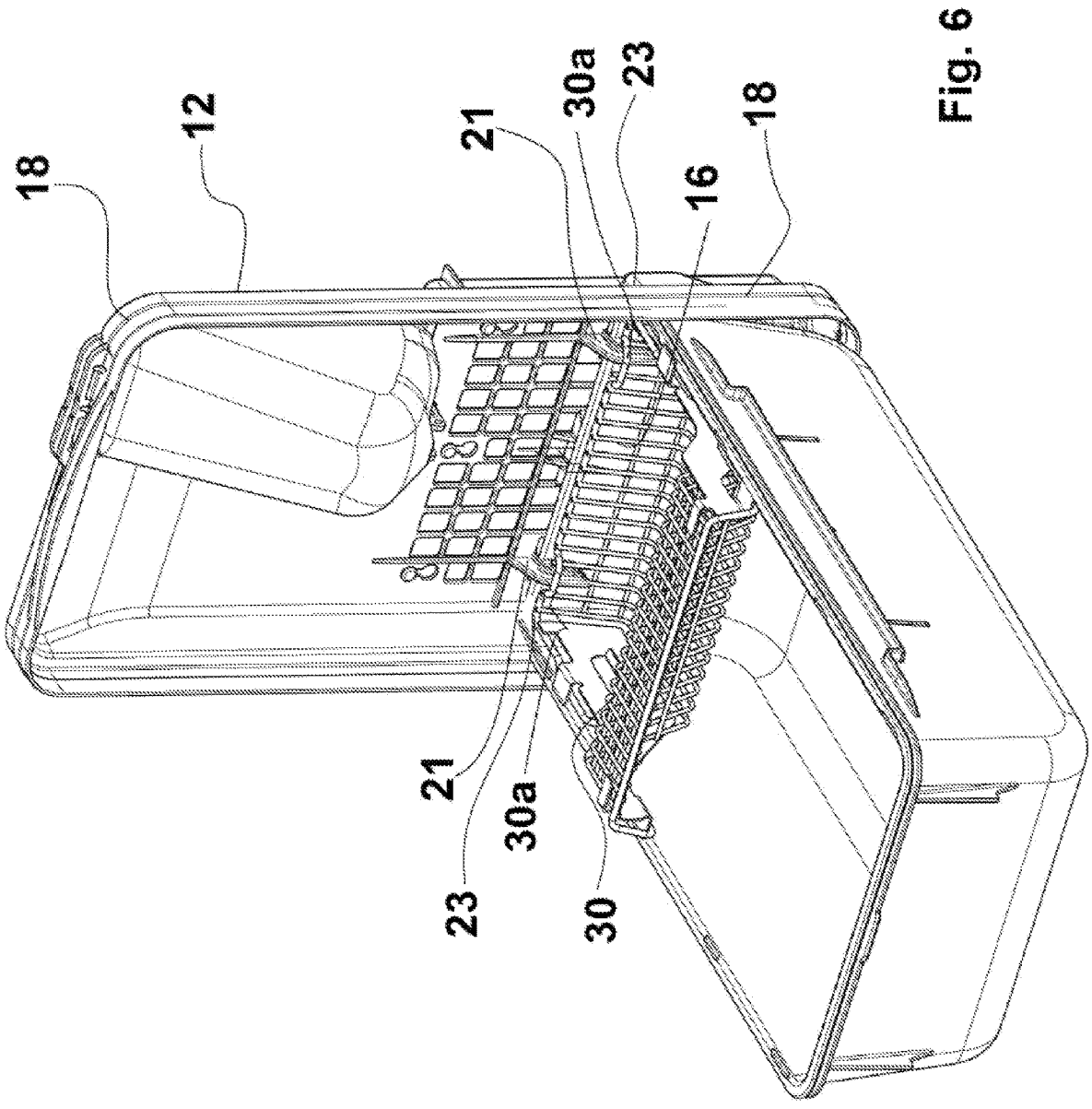


Fig. 6

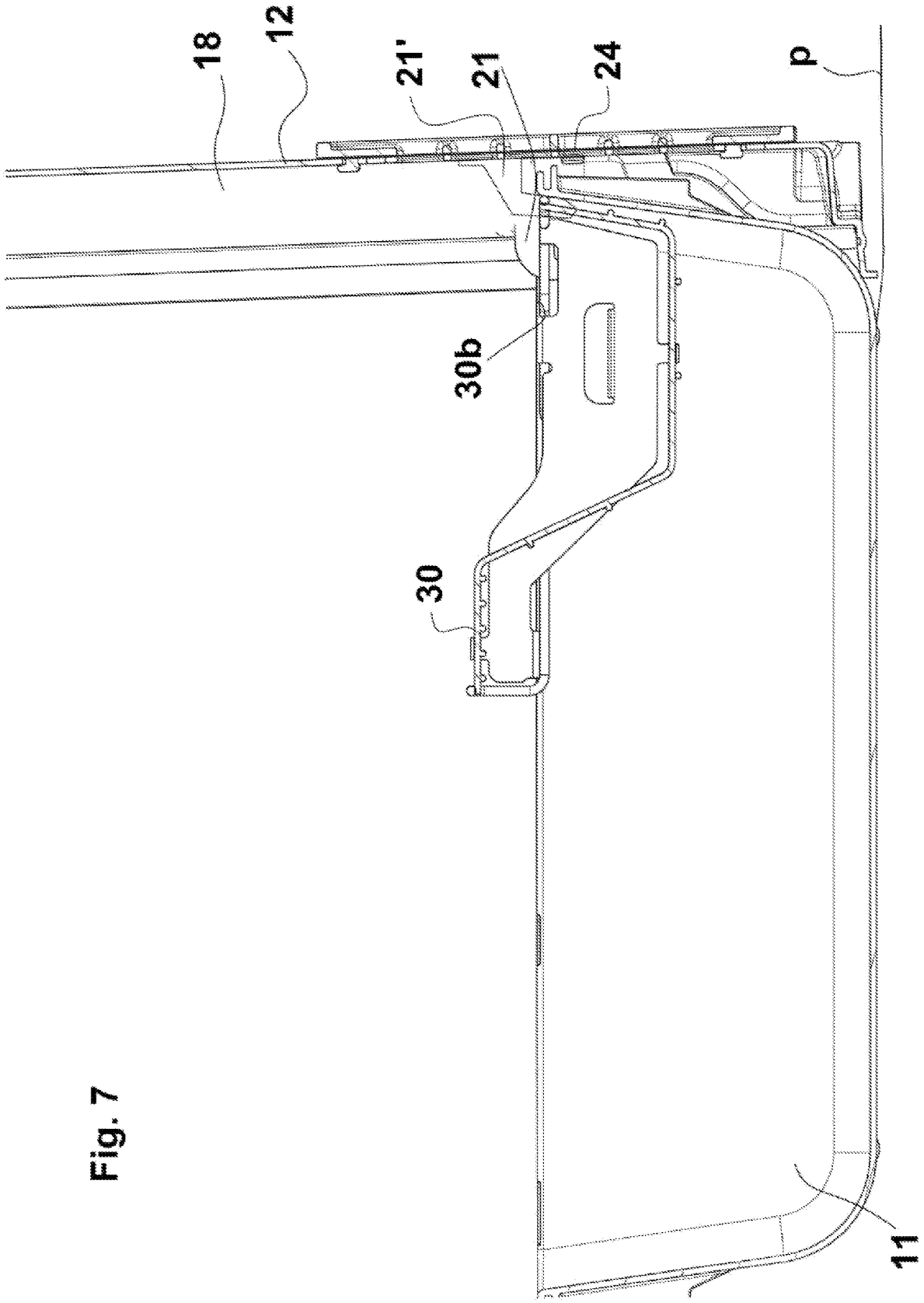


Fig. 7

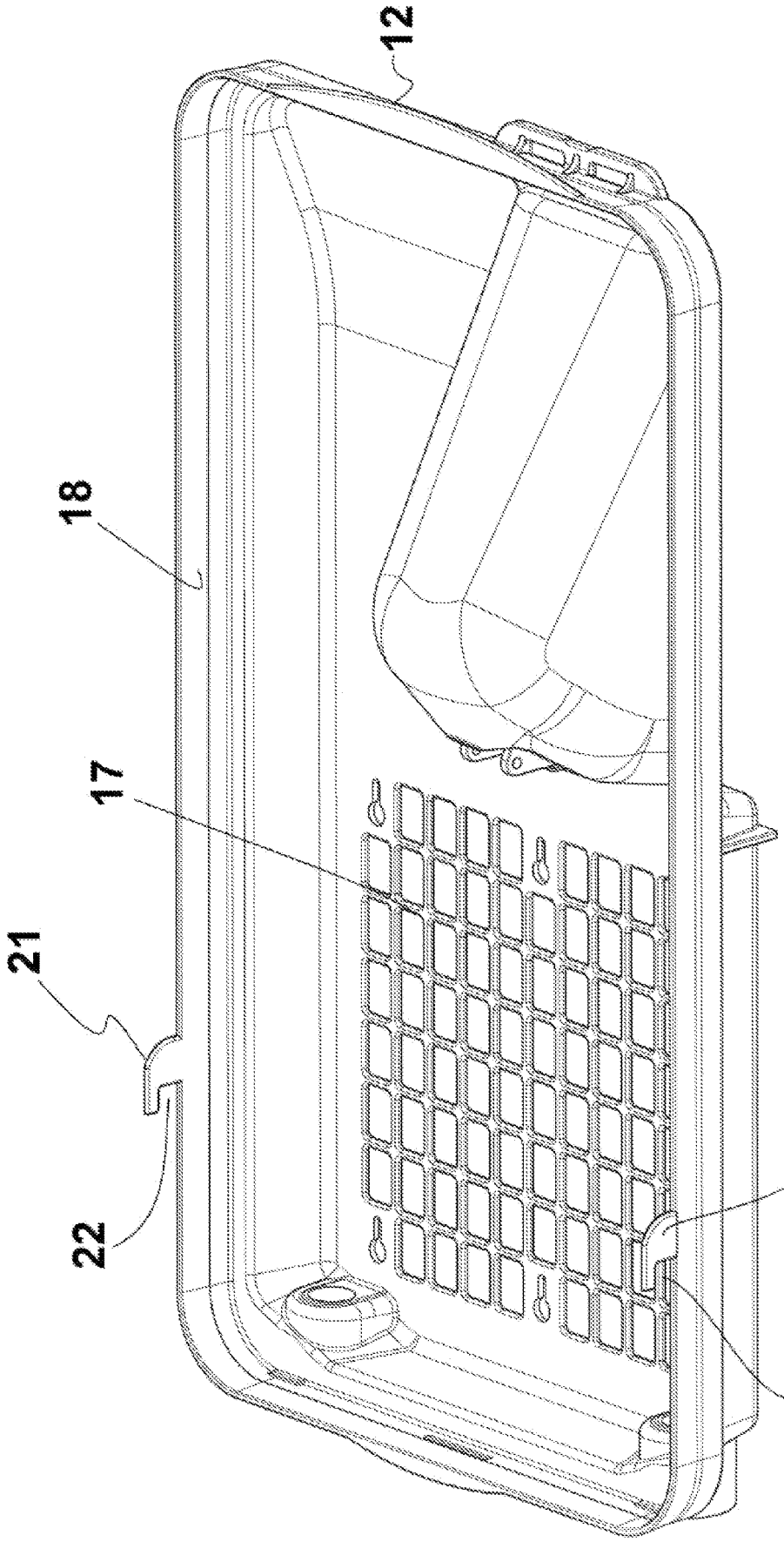
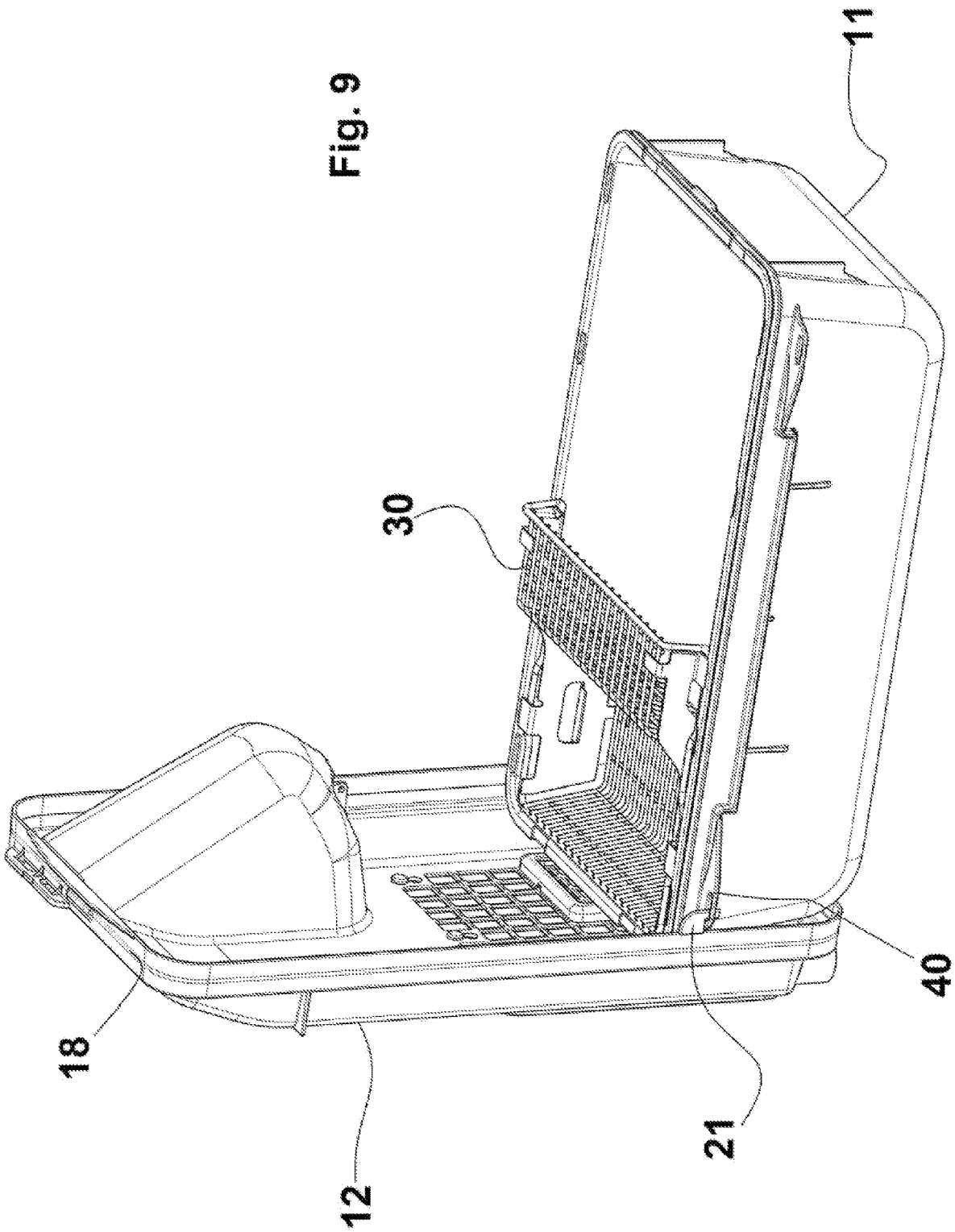


Fig. 8

Fig. 9



COVER FOR A CAGE FOR LABORATORY ANIMALS, AND CAGE FOR LABORATORY ANIMALS INCLUDING SAID COVER

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation of U.S. patent application Ser. No. 16/032,987, filed Jul. 11, 2018, which claims priority to Italian Patent Application No. 102017000078916 filed Jul. 13, 2017, the entirety of the disclosure of which is expressly incorporated herein by reference.

STATEMENT RE: FEDERALLY SPONSORED RESEARCH/DEVELOPMENT

Not Applicable

TECHNICAL FIELD OF THE INVENTION

The present invention belongs to the field of housing laboratory animals. In particular, the present invention relates to a cage for housing laboratory animals. In detail, the present solution relates to a cage of the kind identified above, provided with a novel opening and access system. In greater detail, the novel system according to the present invention relates to handling and positioning the cover of a cage of the aforesaid type.

BACKGROUND ART

To date, the use is widespread of cages for housing laboratory animals such as for example, small rodents or the like, the cages having variable sizes and shapes according to the number of animals to be housed and the conditions to be ensured to the animals themselves. For example, the use is widespread of "ventilated" cages, namely of cages in which a flow of forced air taken from a main circuit is caused to circulate.

However, in addition to specificities provided according to needs and/or circumstances, the cages of known type or at least those most commonly used essentially comprise a tray designed to contain the litter and a cover (also called top hereinafter); moreover, there is usually housed a third component in the tray, the trough, which is designed to contain the food in accessible position for the animals and so that the food does not come into contact with the litter. Finally, a bottle with the drinking water may be prepared inside the cage or also outside and resting on the cover.

The cover or top is positioned above the tray (and possibly fastened to the tray by means of suitable closing means such as clips or the like) and the desired seal is ensured due to a seal positioned between the two elements so that the tray-cover system is adequately isolated from the external environment, where the users of the housing operate, thereby avoiding contaminations both of the housing towards the inside of the cage, and from the inside of the cage towards the housing or external environment.

It indeed is to be considered that in most cases, the housing relates to "clean" animals, in particular called "SPF", specific pathogen free, wherein the volume and the inner surfaces of the cage in the case of "clean" animals are kept and are considered "clean", while everything outside the cage, including the external surface of the cage itself, is considered potentially "dirty" and contaminated.

To the contrary, the opposite concept applies in the case of potentially contaminated animals, in particular from a microbiological viewpoint, wherein t everything inside the cage is considered "dirty" and therefore potentially contaminating for the outside, including the operators.

In both cases, however, the primary need arises to avoid the exchanges and/or mixtures (in particular microbiological contaminations) of what is confined inside the cage and what is outside thereof, thereby maintaining the concept of aseptic conditions.

Therefore, it is apparent that all the operations requesting opening the cage, and in particular removing the cover, are to be carried out according to methods such as to avert the aforesaid mixtures and therefore any contamination of the cage and of the accessories therein and of the animals, but also of the external environment and in particular, of the operators. Such operations comprise for example, but not exclusively, changing the cage (in order to put the animal in a new tray with clean and dry litter, new food and sometimes fresh water), taking and relocating the animals according to the gender and before they reach reproduction maturity, wherein removing the cover is required also in the case of "procedures", such as for example, specific experiments, weighing the animals, injecting and/or taking samples of biological liquids, diagnostics, health check-ups, surgical interventions, etc., and wherein according to the most common methods implemented, the aforesaid operations are carried out in controlled atmosphere in change or microbiological safety cabinets.

Said microbiological safety cabinets, also more simply referred to as cage changes, essentially comprise a work surface struck by a flow of barrier gas, in particular of barrier air, which is perpendicular to the work surface, and possibly by a further flow substantially parallel to the work surface, said work surface being closed on two/three sides by means of fixed walls and accessible from one side at which there is prepared a vertical sliding window, wherein, due to the calibration of the one or more barrier flows taken from peripheral slits provided along the outer perimeter of the work surface, an attempt is made to obtain the desired protection and to avert the aforesaid contaminations of animals and/or cages and/or components and/or operator. In practice, the air walls prevent that which is outside the work surface from contaminating the material inside, and that which is inside and potentially contaminated from being outlet from the laminar flow system and reaching operators and environment.

However, the cages of known type complicate the operations summarized above, even compromising the effectiveness and/or reliability thereof.

Indeed, each of the operations summarized above necessarily requires handling the cover which is in particular to be first removed from the seat thereof on the tray, then positioned on the work surface (generally beside trays or in rear position, paying attention that the internal surfaces do not to come into contact with the work surface or other instruments resting thereon), and finally gripped (ensuring not to touch the inner surface thereof), removing it from the position thereof on the work surface and relocating it in the seat thereof above the tray, thereby reclosing the cage.

However, handling the cover results in a series of drawbacks, essentially due to the limited space on the work surface.

For example, when the cage is changed, both the "dirty" cage, with the animals and the used litter, and the new sterile "clean" cage are necessarily present on the work surface of the cabinet, with the apparent risk of accidental contact

between "dirty" components and "sterile" components and that the dirty cover comes into contact with clean components.

In the same way, on occasion of the separation of the genders, there are at least three cages present on the work surface of the cabinet: the original "dirty" one where there is contained the litter and at least two "clean" cages at the sides, each designed to receive the animals of one or the other gender; clearly the risk of contact between dirty components and clean components, in particular between the dirty cover and clean components, is increased here in consideration of the increased number of components to be arranged on the work surface.

In consideration of that disclosed above, the problems and/or drawbacks encountered in handling or managing the cages according to the prior art, in particular the covers of the cages according to the prior art, may be classified in the following groups.

1) Risk of contamination of the parts inside the cage and therefore of the animals, with external parts of the cage or with other objects
2) Risk of contamination of the operators
3) Risk of interrupting the integrity of the laminar flow and aseptic conditions inside the work cabinet
4) Ergonomic risk due to repetitive movements
5) Human risk due to the lack of a clear procedure guiding the operator

Concerning the risks under item 1), same are at least partly due to the fact that, for example, the hands of the operator may accidentally come into contact with the internal parts of the cover during each of the three handling steps described above. Moreover, when the cover is placed on the work surface, the internal parts thereof may touch potentially contaminated parts such as external parts of the cage itself, the work surface, containers, potentially contaminated test tubes or bottles present within the laminar flow. Finally, it is worth noting that such operations become difficult by the obligation—or at least the opportunity—for the operators to wear gloves, which decrease the friction and sensitivity of the operator's hands, by the minimal spaces inside of which the protection is ensured, and also by the front safety glass which certainly limits the freedom of movement of the arms.

Concerning the risks under item 2), it is worth noting that while the risk in housing generally is associated with the contamination of the animals by pathogens introduced by the operators or already present in the rooms of the housings, the same potential problems described above could result in the contamination of the operators and of the surrounding environment by animals that might host microbiological agents.

Concerning the risks under item 3), it is worth noting that as described above, the restricted area of the work surface often is crowded or occupied because, in addition to the trays being changed, there may be present a plurality of tools useful for the operations, such as containers for disinfectant and/or for the food, bottles for the water, test tubes, cups for microbiological screening, etc.

Such objects are to be carefully positioned inside the sterile area because if they are even briefly positioned outside during the handling and then used, they themselves could become contaminated or contaminate the environment; moreover, such objects may not be positioned along the perimeter of the laminar flow area because by obstructing the air intakes, they could nullify the protection normally ensured by the sterile flow curtain.

Therefore, the risk of human errors which may compromise the required sterility is high.

Concerning the risks under item 4, it is worth noting that even hundreds of cages are changed by a single operator every day in a housing facility: such a procedure results in the repetition of the same movements mainly by the wrist, fingers, elbow and shoulder of the animal care takers, such as opening the cover, positioning it on the work surface generally beside the tray and successively closing it, which result in a rotation of the wrist and of the hand by at least 180 degrees, first in one direction and then in the other. It is known that pathologies such as that of carpal tunnel may affect such operators, also due to these movements.

Finally, concerning the risks under item 5, it is to be noted that regardless of the system and the brand of cage used, no clear procedure for accessing the IVCs exists to date: each facility implements standard operations which tend to minimize the above-described risks, but there is no optimized process recommended by the suppliers because there is no system that simplifies, rationalizes and increases the safety and repeatability of such an operation.

In an attempt to overcome the drawbacks described above and therefore to reduce in particular the risks according to items 1) to 5), support devices have recently been proposed called "top holders", for supporting the cover (top) of the cage when the same is removed from the tray. In use, said supports are in particular positioned on the work surface of the change cabinet and when the cover is removed from the tray, same is positioned on one of them. Therefore, said supports at least partly facilitate the task of the operator, who knows where to position the cover; moreover, they limit the risk of the (dirty) inner surface of the cover coming into contact with clean components and/or being touched by the operator's hands.

However, although the top holders can be appreciated for the aforesaid reasons, they nevertheless have various drawbacks and do not provide a significant and complete solution to the problems disclosed above.

Indeed, also the top holder type systems present on the market are themselves to be positioned in fixed position on the already restricted work surface, thus occupying a portion thereof and restraining the handling of the cages.

Moreover, being placed externally to the cage on the sides or in rear position, they require an even larger handling space for the operator when they are opened and closed, with respect to that available in the absence thereof.

Therefore, it is the main object of the present invention to overcome or at least minimize the problems summarized above and encountered in the prior art.

In particular, it is a first object of the present invention to provide a solution which allows the facilitated handling of the cover of a cage for laboratory animals, thus limiting the risks of contamination. In detail, it is an object of the present invention to propose a solution which allows repositioning the cover by means of operations that are quick, safe and simple to be carried out. In greater detail, it is an object of the present invention to propose a solution which allows the aforesaid repositioning of the cover but at the same time does not complicate the operations of removing the cover, if desired and/or required.

DESCRIPTION OF THE PRESENT INVENTION

In consideration both of the drawbacks encountered in the prior art and of the pre-set objects or goals, the object of the present invention according to a first embodiment is a cage for housing laboratory animals, said cage comprising a tray

and a cover which can be removed and switched between a first closing position, in which it is positioned on said tray, thus stopping the access to the internal space delimited by said tray, and a second opening position in which said internal space may be accessed, when said cover comprises constraining means, when with the cover in said first closing position, said constraining means do not engage said tray, when contrarily, in said second opening position said constraining means engage a portion of said tray, and when said second position of said cover with respect to said tray is defined by the mutual engagement of said constraining means and said portion of said tray.

According to one embodiment, said constraining means are conformed in such a way that when said cover is in said second opening position, at least one portion of said cover is positioned adjacent to a side wall of the tray, and said cover is substantially parallel to said side wall of said tray.

According to one embodiment, said constraining means are conformed in such a way that when said cover is in said second opening position and said tray is resting on a plane, said cover is raised in respect to said plane.

According to one embodiment, said constraining means comprise at least one hook rigidly constrained to said cover and conformed so as to define a housing and engagement seat, when with said cover in said second opening position said at least one portion of said tray engaged by said constraining means is at least partially housed in said housing and engagement seat defined by said at least one hook.

According to one embodiment, said at least one portion of said tray at least partially housed in said housing and engagement seat defined by said at least one hook, is represented by a portion of a side wall of said tray.

According to one embodiment, said at least one portion of said tray at least partially housed in said housing and engagement seat defined by said at least one hook, is represented by an end portion of a side wall of said tray close to the upper edge of said side wall.

According to one embodiment, said at least one portion of said tray at least partially housed in said housing and engagement seat defined by said at least one hook, is represented by a portion of a side wall of said tray which extends from said side wall outwards from said tray.

According to one embodiment, said cover comprises a main, substantially flat portion, when said at least one hook extends from the inner surface of said main portion facing the inside of said tray with said cover in said first closing position.

According to one embodiment, said cover comprises a main, substantially flat portion and a side wall joined to said substantially flat portion, when said at least one hook extends from said side wall of said cover.

According to one embodiment, said constraining means comprise two of said hooks.

According to one embodiment, said cage comprises at least one trough designed in use to be placed inside said cage.

According to one embodiment, said cover defines a depression adapted to at least partially house a container for liquids, for example drinking water.

According to one embodiment, said cage is of the ventilated type, when said cover comprises means for inletting ventilated air into said cage.

Possible further embodiments of the present invention are defined in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be further clarified below by means of the following detailed description of the possible embodiments depicted in the drawings in which features and/or corresponding or equivalent component parts of the present invention are identified by the same reference numerals. It is to be noted that the present invention is not limited in any case to the embodiments described below and depicted in the drawings; contrarily, all those variants and/or modifications of the embodiments described below and depicted in the accompanying drawings, which are clear and apparent to those skilled in the art, fall within the scope of the present invention.

In the drawings:

FIG. **1** shows a perspective view of a cage according to one embodiment of the present invention;

FIG. **2** shows a perspective view of a cover of a cage according to one embodiment of the present invention;

FIG. **3** shows a perspective view of a tray of a cage according to one embodiment of the present invention;

FIG. **4** shows a perspective view of a trough for a cage according to one embodiment of the present invention;

FIG. **5** shows a perspective view of a cover of a cage according to one embodiment of the present invention;

FIG. **5***a* shows a perspective view of details of a cover of a cage according to one embodiment of the present invention;

FIG. **6** shows a perspective view of a cage according to one embodiment of the present invention, with the cover in opening position;

FIG. **7** shows a side view of a cage according to one embodiment of the present invention, with the cover in opening position;

FIGS. **8** and **9** show perspective views of a cover of a cage according to one embodiment of the present invention and of a cage according to one embodiment of the present invention with the cover in opening position, respectively.

DETAILED DESCRIPTION

The present invention is particularly applicable in the field of housing laboratory animals, this being the reason why the present invention is described below with particular reference to the applications thereof in the field of housing animals.

It is in any case worth noting that the possible applications of the present invention are not limited to those described below. Contrarily, the present invention is conveniently applied in all those cases in which there is a need to optimize the opening of a container including a main containment portion and a cover which can be switched between a first closing position, in which it stops the access to the inside of said main portion, and a second opening position, in which contrarily the inside of said main portion is allowed and/or possible.

The cage according to one embodiment of the present invention is identified as a whole in FIGS. **1** to **3** with numeral **10**; as depicted, the cage **10** comprises a tray **11** designed to contain the litter for animals to be housed (possibly together with other accessories such as for example, trough **30** in FIG. **4**), wherein the tray **11** substantially defines the space available to the animals. Again as depicted, the cage **10** comprises a closing cover **12** adapted to be positioned on tray **11** (and possibly fixed thereto by means of fastening means not shown) in the closing position in FIG. **1** (in which it stops the animals from leaving and also access to the inside of tray **11**) and to be removed from tray **11**, for example when there is a need for an operator to access the inside of tray **11** and/or when there is a need to carry out the operations summarized above, such as for

example, changing the litter or similar operations. In detail, as depicted, tray **11** has a box-like shape (rectangular in the non-limiting example depicted in the drawings) and comprises a substantially flat bottom **13** and four opposed two-by-two side walls **16** joined to one another and joined to bottom **13** (extending from bottom **13**) to define an internal space **14** of tray **11**. For the sake of conciseness, reference is indifferently made below to a single side wall **16** or also to the overall side wall **15**, as mentioned formed by the four opposed two-by-two side walls **16**. Cover **12** comprises an actual main cover portion **17** comprising at least a substantially flat portion, from which a wall or side edge or edgeguard **18** extends in substantially transverse direction (substantially perpendicularly to the flat portion of cover **12**). The side edge **18** comprises a first portion **18***a* which is arranged around the side walls **16** of tray **11** in the closing position and is joined to a second portion **18***b* which is arranged on the upper edge of the side walls **16** of tray **11** in the closing position. The second portion **18***b* is substantially parallel to the substantially flat portion of the main portion **17** of cover **12**. The side edge **18** also comprises a third portion **18***c* which is joined to the second portion **18***b* and to the main portion **17** of cover **12**. The third portion **18***c* of the side edge **18** is arranged above the internal space **14** of tray **11** in the closing position. Cover **12** also comprises one or more tray seats **23**, a grid **24**, a depression **25** for housing and positioning a container **26** for drinking beverages, and also air intakes **19** for introducing and discharging ventilated and/or forced air into and from cage **10**, respectively. In any case, the air intakes **19**, as well as the grid **24** and the aforesaid depression **25**, are not essential for the objects of the present invention and therefore a detailed description thereof is omitted for the sake of conciseness. The tray seats **23** of the cover **12** of FIG. **1** are formed in the side edge **18**, in particular in the second portion **18***b* and the third portion **18***c* of the side edge **18**. The cover **12** of FIG. **2** is similar to the cover of FIG. **1** but does not comprise tray seats **23**.

Concerning the trough **30** in FIG. **4**, according to methods which are essentially known and therefore are not described in detail, it is designed to be placed in cage **10**, for example as depicted in FIG. **6**, and is conformed so as to contain food and make it available to the animals, in particular so that the food does not come into contact with the litter. Trough **30** is not essential either for the objects of the present invention. Trough **30** comprises at least one trough seat **30***a*, **30***b*, in particular a recess formed on at least one edge of trough **30**, whose function will be described below.

Again as anticipated, the cage according to the present invention comprises peculiarities aiming to optimize the handling of cover **12**; said peculiarities are described below with reference to FIGS. **5** to **7**, in which component and/or characteristic parts of cage **10** according to the present invention described above with reference to other drawings, are identified by the same reference numerals.

Numeral **20** in FIG. **5** identifies constraining means as a whole, adapted to allow the facilitated positioning of cover **12** in an opening position different from the closing position in FIG. **1**, in which access to the internal space **14** of tray **11** may in particular be possible. Said constraining means **20** essentially comprise a pair of substantially identical hooks **21**, wherein again for conciseness reasons, a detailed description will be given below of one hook **21** alone.

As depicted, hook **21** extends from the inner surface of the main cover portion **17** (that is facing the internal space **14** of tray **11** with cover **12** in the closing position in FIG. **1**) and comprises a first extension portion substantially perpendicular to the main cover portion **17**, and an end extension portion which direction of extension lies on a plane which is substantially parallel to the main cover portion **17**. Therefore, hook **21** defines an engagement and housing seat **22** whose function is described in greater detail below with reference to the other drawings. Cover **12** of FIG. **5** comprises two tray seats **23**, each comprising an inner concave portion **23***a* which is open towards the space defined by the side edge **18** of the cover **12** and an outer convex portion **23***b* which projects outside the cover **12**.

As depicted, each hook **21** comprises a hook shaped support portion **21***a* with predefined substantially constant thickness t (in a direction perpendicular to the direction along which the extension portion extends or, in other words, in a direction parallel to the direction along which the two hooks **21** are opposite to each other).

Moreover, each hook **21** comprises an engagement portion **21***b* (provided to engage portions of the tray **11** as described in more detail below), said engagement portion **21***b* having a width w (in a direction perpendicular to the direction along which the extension portion extends or, in other words, in the direction of the thickness t of the support portion **21***a*) which is greater than the thickness t of said support portion). It is moreover worth noting how both hooks **21** are arranged inside the space defined by the side edge **18** of cover **12** at a predefined distance from the edge itself so that none of the hooks **21** engages or is in contact with any portion of tray **11** with cover **12** in the closing position in FIG. **1**. The hooks **21** therefore do not stop the removal and separation of cover **12** from the position in FIG. **1**, for example by raising, should there for example be a need to remove cover **12** and separate it from tray **11**, for example by positioning it on the work surface of a change cabinet. Thus, the hooks **21** allow repositioning cover **12** according to the following methods.

By raising the end of cover **12** opposite to the end including the air intakes **19** (the end opposite the seats **22**), and therefore to that towards which the hooks **21** are facing, and by translating it to rest on tray **11**, the hooks **21**, in particular the ends thereof, will engage (strike) the inner surface of the side wall **16** of tray **11**. At this point, with the ends of the hooks **21** in contact with the inner surface of the side wall **16**, the hooks **21** progressively engage respective end portions of the side wall **16** close to the upper edge of the side wall **16** by means of further rotation of cover **12** (clockwise with respect to FIG. **6**), wherein a respective end portion of the side wall **16** will be housed, in the end opening position in FIG. **6**, in the housing and engagement seat **22** of each of the hooks **21**, as mentioned close to the upper edge of the side wall **16**, and wherein a respective portion of the inner surface of the side wall **16** will be engaged (in contact with) the engagement portion **21***b* of each of the hooks **21**. The mutual engagement of the hooks **21** and of the side wall **16** gives stability to cover **12** in the opening position in FIG. **6**, wherein said stability is further improved by the engagement portions **21***b* (with width w greater than the thickness t of the respective support portion **21***a*), and wherein therefore there may be access and access is allowed to the inside of tray **11**, without any risk of cover **12** accidentally switching (returning) to the opening position in FIG. **1** or detaching from tray **11**, for example falling back onto the plane of a change cabinet. Obviously, the operations for repositioning cover **12** from the opening position in FIG. **6** to the closing one in FIG. **1** are opposite or inverted to those described above for switching from the closing position to the opening one, and therefore a detailed description thereof is omitted for conciseness reasons.

Moreover, in addition to the advantages related to the facilitated switching of the cover, it is worth noting how the system described ensures further advantages concerning the actual position of cover **12** in the opening position in FIG. **6**. Firstly, it is worth noting that one portion alone of the edge **18** of cover **12** is in contact with the outer surface of tray **11**. Moreover, cover **12** substantially is parallel to the side wall **16**, wherein therefore, also in the opening position in FIG. **6**, the mutual engagement of the hooks **21** and of the side wall **16** does not stop cover **12** from being separated from tray **11**, for example to be placed on the work surface of a change cabinet; contrarily, it will be required for this purpose to raise the cover, thereby releasing the hooks **21** from the side wall **16**. In the closing position, the tray seats **23** of cover **12** are arranged above the tray **11** and do not house any portion of the tray **11**, while in the opening position the tray seats **23** house at least one portion of a side wall **16** of tray **11**, in particular a portion of the intersection of two side walls **16**, namely a portion of a corner of tray **11**, as shown in FIG. **6**. In this position, a portion of a hook **21** is received in a trough seat **30***a* of the trough **30**. In particular, said portion of a hook **21** is arranged between the trough **30** and the side wall **16** engaged by this hook **21**. Moreover, as shown in FIG. **7**, with tray **11** resting on a work surface P, cover **12** is raised with respect to plane P, wherein no part or portion of cover **12** is in contact with said plane P.

With reference to FIGS. **8** and **9**, a description is given below of a further embodiment of cage **10** according to the present invention; component parts and/or features of same already described with reference to other drawings are also identified by the same numerals in FIGS. **8** and **9**.

As shown in FIGS. **8** and **9**, according to the embodiment depicted therein, the shape of the hooks **21** substantially corresponds to that of the support portions **21***a* of the hooks **21** according to the embodiment described above; indeed, the hooks **21** have substantially constant thickness t and each of them defines a housing and engagement seat **22** which is entirely similar to that defined by the hooks depicted for example, in FIG. **5**. Thus, in the case of this further embodiment, the placement of the hooks **21** differs from that of the hooks according to the preceding embodiment. Here indeed, the hooks **21** do not extend from the inner surface of the main cover portion **17** of cover **12**, rather from the side edge or edgeguard **18**, thus each defining an extension which substantially is parallel to the direction of extension of edgeguard **18**. Therefore, the hooks **21** are positioned more outwardly. Concerning tray **11**, each of the two opposed side walls **16** comprises a portion which extends from the wall itself outwards of the tray to define an engagement slot **40**. With cover **12** in the opening position in FIG. **9**, each of the hooks **21** engages a related slot **40**, wherein a portion of slot **40** is housed in the housing and engagement seat **22** of hook **21**.

The switching methods of cover **12** from the closing position to the opening one and vice versa, as well as the rest of the arrangement of cover **12** with respect to tray **11** in the opening position in FIG. **9**, substantially correspond to those described above, wherein a detailed description thereof is omitted for the sake of conciseness. The embodiment depicted in FIGS. **8** and **9** has the advantage that, during the switching of cover **12**, the risk of interference of the hooks **21** is avoided with components or accessories inside tray **11** due to the "external" position of the hooks **21**, wherein contrarily, the arrangement of the hooks **21** according to the embodiment of FIGS. **5** to **7** may result in the need to adapt the shape and/or the position of said accessories, for example of trough **30**. Moreover, also in the case of this embodiment, no part or portion of tray **11** is engaged or even only in contact with the hooks **21** with cover **12** in closing position.

Moreover, as apparent to those skilled in the art, each of the hooks **21** may be configured exactly as the hooks according to the previous embodiment, namely so as to comprise a support portion with a predefined thickness and an engagement portion with a predefined width greater than said thickness of said support portion, the slots **40** being in this case shaped and dimensioned so as to match with the respective hooks **21**.

Moreover, in both embodiments, the hooks and/or the respective slots can be configured so as to allow the cover **12**, in the closing position, to be removed from the tray **11**, for instance by raising or lifting said cover **12**.

It has therefore been demonstrated by the detailed description above of the embodiments of the present invention depicted in the drawings, that the present invention allows the desired results to be obtained and the drawbacks encountered in the prior art to be overcome or at least limited.

In particular, switching methods of cover **12** which are entirely impossible in the case of cages according to the prior art, are made possible by the present invention. In detail, such switching methods, which are entirely novel, allow opening the cage by means of switching cover **12** with no need to separate cover **12** from the tray **11**, wherein moreover, cover **12** may be separated from tray **11**, if required, according to methods substantially corresponding to those for separating the cover from the tray in the case of cages according to the prior art, in particular with cover **12** in both the opening and closing positions. In other words, there is absolutely no need to switch cover **12** beforehand into the opening position in order to separate cover **12** from tray **11** with the cover in closing position, wherein in the same way, there is no need to switch cover **12** beforehand from the opening position to the closing one to separate cover **12** from tray **11** with the cover in opening position.

Although the present invention was clarified above by means of a detailed description of the embodiments thereof depicted in the drawings, the present invention is not limited to the embodiments described and depicted in the drawings; contrarily, all those variants and/or modifications of the embodiments described and depicted in the accompanying drawings, which are clear and apparent to persons skilled in the art, fall within the scope of the present invention.

For example, the number of hooks **21** may vary and be selected according to the needs and/or circumstances. Likewise, the orientation of the hooks may be selected so that the hooks **21**, with the cover in the opening position, engage any one of the side walls **16** of tray **11**.

Moreover, constraining means **20** of magnetic type fall within the scope of the present invention, including for example magnets fastened to the cover and to the tray.

Finally, it is to be considered that the solution for repositioning the cover according to the present invention is applicable to covers of any type, in particular for non-ventilated cages as well.

In particular, although in the embodiments as depicted in the drawings and as disclosed above, the cover comprises a grid, covers without any grid fall as well within the scope of the present invention.

Moreover, although for those covers which comprise a grid, the hooks **21** are provided in correspondence of the grid **24** (extending down from the crossing elements of the grid), according to embodiments of the present invention the hooks can be provided outside the grid **24**, in particular

beside the grid **24** with reference to the longitudinal direction of extension of the cover **12** as shown in FIG. **7**, which shows an embodiment of cover **12** comprising a hook **21** which is arranged beside the grid **24** of the cover **12**, extends from the edge **18** of cover **12** and engages with a portion of the tray **11** close to an intersection of two side walls **16**. The end portion of hook **21** of the cover **12** of FIG. **7** is arranged in a trough seat **30***b* arranged close to an intersection of two edges of trough **30**. The cover **12** of FIG. **7** may also comprise a hook **21**' (shown with a transparent line) projecting from the grid **24**, like the hooks of the cover of FIG. **5**.

The scope of protection of the present invention is therefore defined by the claims.

What is claimed is:

1. A cage for housing laboratory animals, said cage comprising a tray and a cover, the cover being removable from the tray and switchable between a first closing position, in which the cover is positioned to prevent access to an internal space delimited by said tray, and a second opening position, in which the cover is positioned to allow access to said internal space,

wherein said tray comprises one or more side walls joined to a bottom to define said internal space,

wherein said cover comprises at least one hook, at least one tray seat, a main portion and a side edge extending in a substantially transverse direction from said main portion,

wherein said at least one tray seat comprises an inner concave portion which is open towards the space defined by the side edge of the cover and an outer convex portion which projects outside the cover,

wherein, in said first closing position, said at least one tray seat does not house any portion of said tray,

wherein, in said second opening position, said at least one hook engages at least one portion of said tray, said cover can be raised and removed from said tray and said inner concave portion and outer convex portion of said at least one tray seat house at least one portion of a side wall of the tray,

wherein said second position of said cover with respect to said tray is defined by the mutual engagement of said at least one hook and said at least one portion of said side wall of the tray,

wherein said at least one portion of said side wall of the tray engaged by said at least one hook in said second opening position is a portion close to an upper edge of said side wall, wherein, in said first closing position, the cover is in contact with the upper edge of this side wall;

wherein said at least one hook extends from the main portion of the cover and is spaced from the side edge of the cover,

wherein said at least one tray seat is formed in the side edge of the cover,

wherein the outer convex portion of said at least one tray seat comprises a convex surface which projects outside the side edge of the cover,

wherein the side edge of the cover comprises a first portion which is arranged around the side walls of the tray in the first closing position and is joined to a second portion which is arranged on the upper edge of the side walls of the tray in the first closing position,

wherein the side edge of the cover comprises a third portion which is joined to the second portion of the side edge and to the main portion of the cover,

wherein the third portion of the side edge is arranged above the internal space of the tray in the first closing position,

wherein said at least one tray seat of the cover is formed in the second and third portions of the side edge.

2. The cage according to claim **1**, wherein said at least one hook is configured such that when said cover is in said second opening position, the main portion of said cover is positioned adjacent to a side wall of the tray and is substantially parallel to that side wall of the tray, wherein, in said first closing position, the cover is in contact with an upper edge of this side wall.

3. The cage according to claim **1**, wherein said at least one hook is configured such that when said cover is in said second opening position and said tray is resting on a planar work surface, said cover is raised in respect to said planar work surface such that no portion of said cover is in contact with said planar work surface.

4. The cage according to claim **1**, wherein, in said first closing position, said at least one hook is arranged in the internal space of said tray and is not in contact with any portion of said tray.

5. The cage according to claim **1**, wherein said at least one portion of a side wall of the tray housed by said at least one tray seat in said second opening position is a portion of an intersection of two side walls of said tray, wherein, in said first closing position, the cover is in contact with an upper edge of these two side walls.

6. The cage according to claim **1**, wherein said at least one hook is arranged inside the space defined by the side edge of the cover and extends from the inner surface of said main portion of the cover facing the internal space of said tray with said cover in said first closing position.

7. The cage according to claim **1**, wherein said cage comprises at least one trough configured for placement inside said cage, wherein said at least one trough comprises at least one trough seat suitable to receive a portion of said at least one hook in said second opening position.

8. The cage according to claim **7**, wherein said at least one trough seat is a recess formed on at least one edge of the trough.

9. The cage according to claim **8**, wherein, in said second opening position, a portion of said at least one hook is received in said trough seat and is arranged between the trough and the side wall of the tray engaged by this hook.

10. The cage according to claim **1**, wherein the cover comprises a grid and the at least one hook is arranged beside said grid.

11. The cage according to claim **1**, wherein the outer convex portion of said at least one tray seat encloses the inner concave portion of said at least one tray seat.

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