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(54) CLOSING DEVICE FOR UNDERGROUND WASTE HOUSING

(57) It is provided a closing device (1) for underground waste housing comprising a frame (2) extending along a support plane (2a) and defining an opening (10) suitable for providing an access to an underground housing (11), at least one trapdoor (3) connected in a compliant way to the frame (2) at least by means of first constraint means (30) defining a first rotation axis (3a) around which the trapdoor (3) can rotate, in a configuration of use, with respect to the frame (2) in opposition to first opposition means (31) from a closed position in which the trapdoor (3) obstructs the opening (10) to an opening position in which the trapdoor (3) is rotated around said rotation axis (3a) towards the inside of the housing (11) freeing said opening (10), and at least one connector (5) extending along a main axis (5a) and constrained in a compliant way to the trapdoor (3) by means of first constraint means (30) and to the frame (2) by means of third constraint means (50) spaced from the first constraint means (30) along the main axis (5a) and defining a third rotation axis (5b) around which the connector (5) can rotate with respect to the frame (2) in such a way that the connector (5) can define at least the configuration of use in which the main axis (5a) is transverse to the support plane (2a) and the connector (5) protrudes within the housing (11), and a service configuration in which the main axis (5a) is transverse to the support plane (2a), the connector (5) protrudes outwards from the housing (11) and the trapdoor (3) is positioned outside the frame (2).

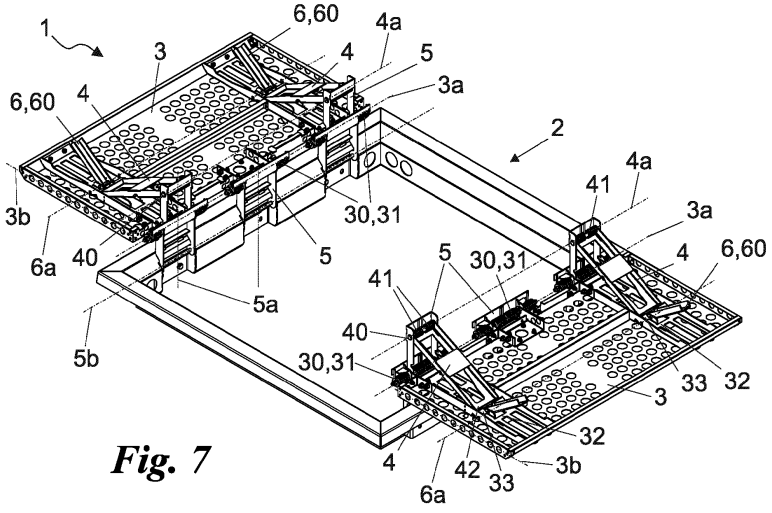


Fig. 7

EP 4 148 001 A1

Description

[0001] The present invention relates to a closing device for underground waste housing of the type specified in the preamble to the first claim.

[0002] More particularly, the present invention relates to a closing device for an underground housing accessible through an opening, cut in the surface of a soil or ground, and capable of allowing the insertion or extraction of an underground waste container.

[0003] A similar device is described in patent application CN-A-109760968.

[0004] As is well known, the waste disposal refers to the set of policies, procedures or methodologies aimed at managing the entire waste process, from its production to its final destination, thus involving various phases, including collection, transport, treatment, intended for example as disposal or recycling, up to the reuse of waste materials, usually produced by human activity, in an attempt to reduce their effects on human health and impact on the natural environment.

[0005] In particular, the collection of waste is carried out, depending on the regulations in force, with one or more waste collectors designed to contain the waste, typically already packed inside polymer bags, up to the transport stage.

[0006] For transport, motorised vehicles are normally used, commonly referred to as rubbish trucks, configured to collect and transport the bags to waste collection centres for treatm ent.

[0007] The known technique described includes some major drawbacks.

[0008] In particular, the collectors or bins for temporary waste collection are voluminous and numerous, e.g. inside waste collection islands, and can therefore disfigure the environment, as well as being a potential cause of disease and a receptacle for animals rummaging through the waste, e.g. rodents.

[0009] In order to remedy these drawbacks, underground collection systems have been adopted, especially in northern Europe, which make it possible to avoid the outdoor exposure of waste collectors or bins, thereby considerably reducing environmental pollution, as well as increasing the hygiene of the area in which these collectors are distributed.

[0010] An advanced system of this type is the pneumatic collection system, also known as the Automated Vacuum Waste Collection System or Sopsug; the latter is basically a system comprising drilled bins at the bottom connected to underground pipes linked to a specialised disposal centre.

[0011] The centre basically pneumatically sucks up the waste thrown into the bins and into the pipes, sorts and piles it into various waste groups which are then taken to a recycling centre.

[0012] Also known are underground systems comprising an underground housing accessible from the outside by means of an opening in the ground surface and configured to contain a removable container, essentially a cistern, e.g. accessible by means of a nozzle positioned on the side of the container configured to remain accessible even when the container is inserted in the housing.

[0013] The nozzle essentially comprises at least one hole through which waste can be thrown so that the waste reaches the bottom of the container by gravity.

[0014] The containers are removable and transportable to a recycling centre.

[0015] Since the openings of the housings are generally large, in order to ensure sufficient safety the collection systems are equipped with a locking device, generally consisting of two revolving doors configured to be opened in opposition means, typically one or more linear springs, and to be opened only when a bulky and heavy element, such as a waste container or tank, is supported, preventing a person passing through the doors from falling into the receptacle and injuring himself.

[0016] Examples of such types of systems are described, for example, in patent applications EP-B-2336053 and FR-B-3058133.

[0017] The patent EP-B-2336053, in particular, describes a system comprising opening flaps in opposition to linear springs positioned within a frame defining a triangular bracket in which the wall and flap transverse arm includes a movable end along the plane defined by the flap in opposition to the linear springs. In addition, the doors are removable in order to facilitate maintenance operations such as, for example, the removal of the waste container from the housing for transport.

[0018] The major drawbacks of the above-mentioned technique are that the springs must be very tenacious, considerably extendable and, therefore, expensive, and the fact that maintenance can only be carried out after the doors have been removed from the opening, which is time-consuming as well as labour-intensive since the doors are obviously not light. In many cases, it is in fact desirable to remove the doors with lifting machines or forklifts that are capable of lifting them.

[0019] The patent FR-B-3058133 describes a system comprising two doors constrained to a frame by hinges and including a release system responsive to contact with a removable waste container and counterweights, positioned beyond the constraining hinge outside the frame, configured to keep the doors pushed by gravity in the closed configuration. The major drawback of the above-mentioned patent is the fact that the release system involves hooks attached to bars that protrude inwards from the frame, thus creating encumbrances that may hinder the removal or insertion of the removable container into the housing.

[0020] In addition, the system can, in some cases, become blocked in opening with the counterweights locked in an unstable state of equilibrium, thus resulting in a high degree of inefficiency and danger to the system itself.

[0021] In conclusion, the flaps of the system described in FR-B-3058133 are not removable and, therefore, lead to significant internal encumbrances during maintenance

actions, e.g. in relation to internal cleaning of the housing, as well as offering very low operator safety during these phases.

[0022] In this situation, the technical task underlying the present invention is to devise a closing device for underground waste housing capable of substantially obviating at least part of the aforementioned drawbacks.

[0023] In the context of said technical task, it is an important scope of the invention to obtain a closing device for underground waste housing made from a simple structure, whose components are low-stress and which is, therefore, also economical.

[0024] Another important scope of the invention is to realise a closing device for underground waste housing that is extremely safe.

[0025] Furthermore, a further scope of the invention is to realise a closing device for underground waste housing which allows the total extension of the opening to be used without having unnecessary encumbrances given by the structure.

[0026] In conclusion, a further scope of the invention is to realise a closing device for underground waste housing having a high efficiency, reducing the steps and time required for carrying out maintenance, such as removal and insertion into the waste housing.

[0027] The specified technical task and purposes are achieved by underground waste housing closing device as claimed in the appended claim 1.

[0028] Preferred technical solutions are highlighted in the dependent claims.

[0029] The features and advantages of the invention are hereinafter clarified by the detailed description of preferred embodiments of the invention, with reference to the appended drawings, in which:

the **Fig. 1** illustrates a side view in detail of a closing device for underground waste housing according to the invention in configuration of use and in which the trap door is in the closed position;

the **Fig. 2** shows a side detail view of a locking device for underground waste housing according to the invention mounted on top of an underground housing in configuration of use and in which two trapdoors are in the closed position;

the **Fig. 3** is a perspective view of the underground waste enclosure of Fig. 2;

the **Fig. 4** is a perspective view of a closing device for underground waste housing according to the invention in configuration of use and in which two trapdoors are present in an opening position;

the **Fig. 5** illustrates a side view in detail of a locking device for underground waste housing according to the invention in configuration of use and in which the trapdoor is in an opening position;

the **Fig. 6** illustrates a side sectional view of the waste underground enclosing device of Fig. 4;

the **Fig. 7** is a perspective view of a closing device for underground waste housing according to the invention in a service configuration and in which there are two trapdoors positioned outside the frame;

the **Fig. 8** shows a side sectional view of the closing device for underground waste housing of Fig. 7 in which some trajectories performed by the trapdoors during rotation about the third rotation axis are visible;

the **Fig. 9** illustrates a perspective view of an example of an initial configuration of use of a closing device for underground waste housing according to the invention in which an object and, in particular, a waste container is about to be placed on the trapdoors;

the **Fig. 10** illustrates a perspective view of a second example of a configuration of use of a closing device for underground waste housing according to the invention in which the object is introduced through the device into the housing;

the **Fig. 11** is a perspective view of a third example of a maintenance, or non-use, configuration of a closing device for underground waste housing according to the invention in which the sides are rotated outside the frame;

the **Fig. 12a** depicts a simplified schematic diagram of a closing device for underground waste housing according to the invention in a configuration of use and in which the trapdoor is in the closed position and the drive means are in the rest position;

the **Fig. 12b** illustrates a simplified schematic diagram of the closing device for underground waste housing of Fig. 12a in which the actuating means are in the actuating position and the contact end of the post is pushed out of the seat of the locking means; and

the **Fig. 12c** illustrates a simplified schematic of the closing device for underground waste housing Figs. 12a-12b in which the trapdoor is pushed into the housing and the contact end of the post is pushed into the guide on the trapdoor by the second opposition means and translates, while the post rotates about the second rotation axis, along the axis of translation.

[0030] In the present document, the measurements, values, shapes and geometric references (such as perpendicularity and parallelism), when associated with words like "about" or other similar terms such as "approximately" or "substantially", are to be considered as except for measurement errors or inaccuracies due to production and/or manufacturing errors, and, above all, except for a slight divergence from the value, measurements, shape, or geometric reference with which it is associated. For instance, these terms, if associated with a value, preferably indicate a divergence of not more than 10% of the value.

[0031] Moreover, when used, terms such as "first", "second", "higher", "lower", "main" and "secondary" do not necessarily identify an order, a priority of relationship or a relative position, but can simply be used to clearly

distinguish between their different components.

[0032] Unless otherwise specified, as results in the following discussions, terms such as "treatment", "computing", "determination", "calculation", or similar, refer to the action and/or processes of a computer or similar electronic calculation device that manipulates and/or transforms data represented as physical, such as electronic quantities of registers of a computer system and/or memories in, other data similarly represented as physical quantities within computer systems, registers or other storage, transmission or information displaying devices.

[0033] The measurements and data reported in this text are to be considered, unless otherwise indicated, as performed in the International Standard Atmosphere ICAO (ISO 2533:1975).

[0034] With reference to the Figures, the closing device for underground waste housing to the invention is globally referred to as device **1.**

[0035] The device 1 is substantially a cover element for a housing **11.**

[0036] The housing 11 is preferably underground, or buried, and is thus formed within a soil and, more generally, extends mainly below the surface of a ground **12.**

[0037] Naturally, the housing 11 can be of any shape and size. Generally, the housing 11 has a rectangular parallelepiped shape, but it could also take different shapes.

[0038] In general, the housing 11 is delimited by one or more side walls **11a.**

[0039] The side walls 11a are walls extending from the access of the housing 11 to the bottom thereof. Thus, the side walls 11a are transverse to the ground 12 and define the shape of the housing 11.

[0040] The ground 12 can be made of any material and, in general, can be understood as the walkable ground surface.

[0041] Furthermore, preferably, the housing 11 is an underground compartment for waste collection. Therefore, it is suitable for accommodating at least one object **13.**

[0042] The object 13, as is known, generally includes a tank, substantially counter-shaped to the housing 11 or, in any case, having shapes and dimensions suitable to allow its insertion in the housing 11.

[0043] Even more in detail, the tank is generally provided on its top, i.e. on the part emerging from the housing 11 and the ground 12, with at least one vent communicating with the tank and suitable for allowing the introduction of waste of any kind inside the tank itself, i.e. inside the object 13.

[0044] Thus, the device 1 preferably comprises a frame **2.**

[0045] The frame 2 is substantially a preferably closed element, and particularly suitable for supporting the components of the device. Furthermore, the frame 2 defines an opening **10.**

[0046] The opening 10 is substantially the space enclosed or surrounded by the frame 2.

[0047] Thus, the opening 10 is capable of providing access to a housing 11.

[0048] The frame 2, in addition, extends predominantly along a support plane 2a. The support plane 2a is to be understood as a virtual plane, useful to define a reference system for describing the device 1 and not as a flat surface. The term predominantly also means that frame 2 may also include irregularities, but that it is generally simplified structurally as a closed element extending at least in a support plane 2a.

[0049] Naturally, the frame 2 may have a regular shape, e.g. square or rectangular, and the edges delimiting the frame 2 may all lie in the same support plane 2a.

[0050] The device 1 thus comprises at least one trapdoor **3.**

[0051] The trapdoor 3 is essentially a closing element, i.e. a cover, for example having the features of a door or a flap. The trapdoor 3 may therefore be distributed on a straight plane, or on a curved plane.

[0052] Furthermore, the trapdoor 3 may include at least one solid wall, or even a perforated wall, configured to allow the passage of air between the housing 11 and the external environment. In general, the trapdoor 3 is adapted, in at least one position, to be laid over the opening 10 to occupy the majority of it.

[0053] The trapdoor 3 is connected in a compliant way to the frame 2. In general, the trapdoor 3 is connected to the frame 2 in such a way that it can at least tilt with respect to the frame 2 to clear or obstruct the opening 10.

[0054] In detail, the trapdoor 3 may be connected in a compliant way directly or indirectly to the frame 2. The term directly means that the trapdoor 3 is directly connected to the frame 2. By the term indirectly it is meant that the trapdoor 3 may be bound to the frame 2 by means of other elements interposed between the frame 2 and the trapdoor 3, as further explained below.

[0055] In any case, preferably, the direct or indirect connection is preferably made by means of first constraint means 30.

[0056] Thus, the trapdoor 3 is directly or indirectly connected in a compliant way to the frame 2 at least via first constraint means **30.**

[0057] The latter preferably define a first rotation axis **3a.**

[0058] The rotation axis 3a is preferably parallel to the support plane 2a, but could also be transverse, preferably not perpendicular, to the support plane 2a.

[0059] The trapdoor 3 may therefore rotate about the first rotation axis 3a with respect to the frame 2.

[0060] In addition, the rotation of the trapdoor 3 with respect to the first rotation axis 3a occurs mainly when the device 1, or the trapdoor 3 itself, is in a configuration of use. In the configuration of use, the device 1 is adapted to allow the insertion and extraction of an object 13 from the housing 11 and to close, when the object 13 is extracted, the housing 11 itself.

[0061] Furthermore, the rotation of the trapdoor 3 occurs in opposition to first opposition means **31.**

[0062] The first opposition means 31 are substantially configured to oppose the rotation of the trapdoor 3 from a given position. Therefore, they are preferably elastic. Thus, they are also configured to return the trapdoor 3 to the given position. In detail, preferably, the first opposition means 31 oppose the rotation of the trapdoor 3 from the closed position to the opening position of the trapdoor 3.

[0063] In particular, in the closed position the trapdoor 3 obstructs the opening 10 making the housing 11 inaccessible. Thus, for example, the walls of the trapdoor 3 may, in that position, be arranged parallel to the support plane 2a.

[0064] In the opening position, the trapdoor 3 is, on the other hand, rotated around the rotation axis 3a towards the inside of the housing 11. In this way, the trapdoor 3 frees the opening 10, possibly but not necessarily leaning against a side wall 11a of the housing 11, and makes the housing 11 itself accessible from the outside.

[0065] The mechanism for moving the trapdoor 3 could comprise further components. For example, the device 1 could also comprise at least one post **4.**

[0066] If present, the post 4 is preferably connected to the frame 2.

[0067] As in the case of the trapdoor 3, the post 4 is also connected to the frame 2 in such a way that it can at least tilt with respect to the frame 2. Preferably, the post 4 is a component that accompanies the movement of the trapdoor 3 when the latter clears or obstructs the opening 10, i.e. it switches from the opening position to the closed position or vice versa.

[0068] In detail, the post 4 may be connected in a compliant way directly or indirectly to the frame 2. Again, the term directly means that the post 4 is directly bound to the frame 2. By the term indirectly, it is meant that the post 4 may be constrained to the frame 2 by means of other elements interposed between the frame 2 and the post 4, as further explained below.

[0069] In any case, the direct or indirect connection is preferably made by means of second constraint means **40.**

[0070] Thus, the post 4 is connected in a compliant way directly or indirectly to the frame 2 at least via second constraint means 40.

[0071] The latter may be similar to the first constraint means 30. Thus, they preferably define a second rotation axis **4a.**

[0072] The rotation axis 3a is preferably parallel to the first rotation axis 3a.

[0073] The post 4 may therefore also rotate about the second rotation axis 4a with respect to the frame 2.

[0074] In addition, the rotation of the post 4 with respect to the second rotation axis 4a also occurs mainly when the device 1, or the trapdoor 3 itself, is in a configuration of use.

[0075] Advantageously, in the configuration of use, the second constraint means 40 are spaced with respect to the first constraint means 30 transversely to the support plane 2a. This means that, when the device 1 is in use, the constraint means 30, 40 are positioned to be separated along a transverse direction, possibly perpendicular to the support plane 2a or parallel to a side wall 11a.

[0076] In other words, in the configuration of use, the second constraint means 40 may be above or below the first constraint means 30 with respect to the ground 12, i.e. considering the direction of gravitational acceleration.

[0077] Advantageously, the post 4 contacts the trapdoor 3. By contacting, it is meant that the post contacts the trapdoor 3, i.e. physically touches the trapdoor 3.

[0078] For example, the post 4 could be constrained in a compliant way to the trapdoor 3, similar to a brace, for example by means of a mechanical hinge or other equivalent elements. Alternatively, the post 4 could simply be supported, effectively creating a unilateral constraint, on the trapdoor 3.

[0079] In any case, the post 4 preferably contacts the trapdoor 3 by means of a contact end **42.**

[0080] The contact end 42 is essentially an extreme portion of the post 4. It may comprise a surface having sliding means or a low friction surface. Or, as mentioned above, the contact end 42 may be provided with a mechanical hinge suitable for enabling the constraint in a compliant way between the post 4 and the trapdoor 3.

[0081] In particular, it is preferable to equip the contact end 42 if, in the configuration in use, the second constraint means 40 are above the first constraint means 30, i.e. if the post 4 is above the trapdoor 3 with respect to the transverse direction to the ground 12. Conversely, it is absolutely not necessary to provide the contact end 42 with a hinge, especially if the post 4 is below the trapdoor 3 and, therefore, the first constraint means 30 are above the second constraint means 40 with respect to the transverse direction to the ground 12.

[0082] Advantageously, however, the contact end 42 is translatable on the trapdoor 3 along a translation axis 3b. The translation axis **3b** is preferably perpendicular to the first rotation axis 3a.

[0083] Thus, the fact that the contact end 42 can translate, for example by simple sliding or by means of a mechanical trolley or otherwise, with respect to the trapdoor 3 allows for an articulated triangular mechanism.

[0084] In this sense it should be noted that the post 4 and the trapdoor 3 define a triangular structure in which two sides and two vertices are fixed and given respectively by the length of the post 4, the distance between the constraint means 30, 40 and the constraint means 30, 40 themselves, and one vertex is mobile, i.e. the contact end 42, in such a way as to permit variation of both the dimensions of one side, given by the distance between the contact end 42 and the first constraint means 30, and the shape of the triangle which depends naturally on the relative position of the vertices and the length of the side.

[0085] Basically, when the trapdoor 3 and the post 4 are in the closed position, preferably, the mechanism defines a right-angled triangle, as clearly shown in Fig. 1.

When the trapdoor 3 and the post 4 are in the opening position, preferably, the mechanism defines at least an octusangular triangle or, even, a true straight line if contact ends 42, first constraint means 30 and second constraint means 40 are mutually aligned, as clearly shown in Fig. 5.

[0086] Advantageously, the post 4 may also rotate about the second rotation axis 4a with respect to the frame 2 from the closed position to the opening position in opposition to second means of opposition **41.**

[0087] The second means of opposition 41 may be similar to the first means of opposition 31. Thus, they may be elastic.

[0088] In detail, the second means of opposition 41 are particularly advantageous in the configuration in which the contact end 42 is unhinged.

[0089] Indeed, advantageously, the second means of opposition 41 are configured to push the post 4 into contact with the trapdoor 3.

[0090] This makes the constraint in a compliant way between post 4 and trapdoor 3 superfluous; however, this does not mean that the second constraint means 41 are not advantageously usable even when post 4 and trapdoor 3 are constrained in a compliant way at the contact end 42. In fact, if the second constraint means 41 are present in such a form of realisation, they make it possible to reduce the stresses to which the mechanical restraint is subjected.

[0091] In order to realise the sliding between the contact end 42 and the trapdoor 3, special arrangements may be provided.

[0092] For example, the trapdoor 3 may comprise a guide **32.**

[0093] The guide 32 preferably extends along the translation axis 3b. Furthermore, it is substantially configured to movably accommodate the contact end 42.

[0094] Thus, it may comprise a track bounded by side bulkheads within which the contact end 42 may slide by sliding or by means of rolling elements, within the guide 32. Naturally, the guide 32 is not an essential element of the invention since, particularly, but not only, if the device 1 is provided with second opposition means 41, the post 4 is pushed towards the trapdoor 3 and can move without it without the aid of a predetermined path defined by the guide 32.

[0095] The trapdoor 3 may also comprise locking means **33.**

[0096] If present, the locking means 33 are positioned along the translation axis 3b. In particular, they are positioned at a predetermined fixed point, for example in the middle of the length of the trapdoor 3 along the translation axis 3b.

[0097] Thus, the locking means 33 are configured to block in a resolvable way the contact end 42 in a closing configuration. Essentially, the locking means 33 block in a resolvable way the contact end 42 at the fixed positioning point along the translation axis 3b. In this way, the locking means 33 stabilise and ensure that the trapdoor 3 does not open uncontrollably.

[0098] In fact, the device 1 may also comprise actuating means **6.**

[0099] If present, the actuating means 6 are constrained in a compliant way to the trapdoor 3. Furthermore, they protrude at least partially from the trapdoor 3 outwards, i.e. from the side opposite the housing 11. Furthermore, the actuating means 6 are configured to release, at least when the trapdoor 3 is in the closed position, the contact end 42 from the constraint means 33.

[0100] Preferably, the actuating means 6 are configured to unlock the contact end 42 from the constraint means 33 whenever an object 13 is placed in support, by gravity, on the trapdoor 3. As the actuating means 6 protrude from the trapdoor 3, the object 13 interferes with the actuating means 6 causing it to move relative to the trapdoor 3.

[0101] More specifically still, the locking means 33 comprise a seat **33a.**

[0102] The seat 33a is preferably positioned at the fixed point. Furthermore, the seat 33a, which may also be a simple cavity, is adjacent to the guide 32.

[0103] Thus, the seat 33a is suitable for receiving the contact end 42. The actuating means 6 therefore preferably comprise at least one thrust element **60.**

[0104] The thrust element 60 is advantageously configured to push the contact end 42 out of the seat 33a when moved by the object 13. Thus, when the contact end 42 leaves the seat 33a, it may slide along the guide 32, if the latter is present, or generally slide along the axis of translation 3b relative to the trapdoor 3.

[0105] The thrust element 60 may be realised as a simple push button responsive, for example in opposition to elastic means, to the support of the object 13 and movable transversely to the axis of translation 3b.

[0106] Or, more preferably, the thrust element 60 may be a labile constrained to the trapdoor 3 by means of quarter constraint means **61.**

[0107] Similar to the first and second constraint means 30, 40, the quarter constraint means 61 define a fourth rotation axis **6a.**

[0108] The fourth rotation axis 6a is preferably parallel to the first rotation axis 3a. In detail, the thrust element 60 may preferably rotate about the fourth rotation axis 6a with respect to the trapdoor 3 in opposition to third opposition means **62.**

[0109] The third opposition means 62 are also preferably elastic. Furthermore, the third opposition means 62 oppose the rotation of the thrust element 60 from a rest position to a actuated position.

[0110] In the rest position, the thrust element 60 protrudes from the trapdoor 3 outwards. In the actuated position, the thrust element 60 occupies at least part of said seat 33a and, therefore, pushes the contact end 42 out of the seat 33a itself, thereby resolving the blockage.

[0111] Regardless of the presence, or absence, of the post 4 and the actuating means 6, the device 1 may advantageously also include a connector **5.**

[0112] As already mentioned, the trapdoor 3 can be indirectly connected to the frame 2. Indeed, if the connector 5 is present, the trapdoor 3 can be bound to the frame pr by means of the connector 5 itself.

[0113] The connector 5 preferably extends along a main axis **5a.**

[0114] The main axis 5a is preferably, but not necessarily, a straight axis. Thus, the connector 5 may be a beam element, for example a rod or bar, or a frame defined by several rods or bars.

[0115] In any case, the connector 5 is preferably constrained in a compliant way to the trapdoor 3 by the first constraint means 30. Furthermore, the connector 5 is advantageously constrained to the frame 2 via third constraint means **50.**

[0116] The third constraint means 50 are preferably spaced from the first hinge 30 along the main axis 5a.

[0117] Furthermore, the third constraint means 50 may be similar to the first constraint means 30 as well as the second constraint means 40 or even the fourth constraint means 61. Thus, they preferably define a third rotation axis **5b.**

[0118] The third rotation axis 5b is preferably parallel to the first rotation axis 3a.

[0119] The connector 5 may therefore also rotate about the third rotation axis 5b with respect to the frame 2. This means that, at the same time, the trapdoor 3 can also rotate with respect to the frame 2 around the third rotation axis 5b. Naturally, the trapdoor 3 can rotate about the first rotation axis 3a with respect to the connector 5 and, therefore, also with respect to the frame 2 to which the connector 5 is constrained in a compliant way. By rotating about the third rotation axis 5b, in any case, the connector 5 advantageously allows the definition of the configuration of use, as described above, and a maintenance configuration.

[0120] In the configuration of use, the main axis 5a is transverse to the support plane 2a and the connector 5 protrudes within the housing 11. In the maintenance configuration, the main axis 5a is preferably still transverse to the support plane 2a, but the connector 5 protrudes outwards from the housing 11, i.e. from the opposite side with respect to the configuration of use, and the trapdoor 3 is positioned outside the frame 2, as clearly shown in Figs. 7 and 11.

[0121] In the embodiment comprising the connector 5, the post 4, if present, is also constrained in a compliant way to the connector 5. In particular, the post 4 is constrained by the second constraint means 40.

[0122] The latter are, therefore, spaced with respect to the first constraint means 30 along the main axis 5a. Therefore, like the trapdoor 3, the post 4 can also rotate with respect to the connector 5 and, obviously, with respect to the frame 2. The post 4 can also rotate around the third rotation axis 5b, together with the trapdoor 3, with respect to the frame 2 by means of the connector 5 when the latter changes from the configuration of use to the maintenance configuration or vice versa.

[0123] Naturally, each of the opposition means 31, 41, 62 may comprise at least one torsion spring. Possibly each of the opposition means 31, 41, 62, or some of them, may comprise a plurality of torsional springs consecutively arranged along the rotation axes 3a, 4a, 6a respectively.

[0124] Furthermore, each of the constraint means 30, 40, 50, 61 may comprise at least one mechanical hinge or possibly also a plurality of hinges aligned along the rotation axes 3a, 4a, 5b, 6a, respectively.

[0125] Naturally, the device 1 may also comprise a plurality of trapdoors 3 connected, directly or indirectly, to the frame 2 in a mirror-like way.

[0126] In particular, the trapdoors 3 are connected to the frame in such a way that they occupy, in the closed position, the major part of the opening 10.

[0127] Furthermore, each of the trapdoors 3 may be constrained to a plurality of mutually distanced posts 4 along the second rotation axis 4a.

[0128] Additionally, if the trapdoors 3 are connected to the frame 2 via connectors 5, each of the trapdoors 3 may be constrained to a plurality of mutually spaced apart connectors (5) along the second rotation axis 4a.

[0129] The device 1 may allow a particular underground waste collection system to be realised in conjunction with the housing 11.

[0130] In the system, advantageously, the connector 5 of the device 1 is configured to rest on at least one of the side walls 11a when the connector is configured for use. In this way, the system is extremely stable when in use.

[0131] The operation of the underground waste enclosing device 1 described above in structural terms is as follows.

[0132] Essentially, the device 1 allows an object 13 to be introduced into or extracted from the housing 11 in such a way that the trapdoors 3 automatically open when the object 13 is placed against them and automatically close again when the object 13 is removed from the housing 11.

[0133] Furthermore, advantageously, the device 1 allows, if provided with one or more connectors 5, to realise, in addition to the configuration of use, a maintenance configuration in which the trapdoors 3 are folded out of the frame 2 and do not occupy any space in the housing 11 so as to allow free maintenance of the same.

[0134] The closing device 1 for underground waste housing according to the invention achieves important advantages.

[0135] In fact, the closing device 1 for underground waste housing is realised with a simple structure, whose components are lightly stressed and which, therefore, is also economical.

[0136] Furthermore, the underground waste enclosure 1 is extremely safe.

[0137] In addition, the closing device 1 for underground waste housing allows the total extension of the opening and the enclosure to be used without unnecessary en-

cumbrances, e.g. from the handling mechanism, since the latter can be completely folded out of the opening.

[0138] Thus, in conclusion, the closing device 1 for underground waste housing has a high efficiency, reducing the steps and time required for maintenance.

[0139] The invention is susceptible to variations within the scope of the inventive concept as defined by the claims.

[0140] Within this scope, all details are substitutable by equivalent elements and the materials, shapes and dimensions can be any.

Claims

1. Closing device (1) for underground waste housing comprising:

- a frame (2) extending mainly along a support plane (2a) and defining an opening (10) suitable for providing access to an underground housing (11) in such a way that said support plane (2a) is parallel to a ground (12) surrounding said opening (10),
- at least one trapdoor (3) constrained in a compliant way to said frame (2) at least through first constraint means (30) defining a first rotation axis (3a) around which said trapdoor (3) can rotate, in a configuration of use, with respect to said frame (2) in opposition to first opposition means (31) from a closed position in wherein said trapdoor (3) obstructs said opening (10) making said housing (11) inaccessible to an opening position in which said trapdoor (3) is rotated around said rotation axis (3a) towards the inside of said housing (11) by releasing said opening (10) and making it accessible from the outside of said housing (11),

and **characterized by** further comprising

- at least one connector (5) extending along a main axis (5a) and constrained in a compliant way to said trapdoor (3) through said first constraint means (30) and to said frame (2) by means of third constraint means (50) spaced from said first constraint means (30) along said main axis (5a) and defining a third rotation axis (5b) around which said connector (5) can rotate with respect to said frame (2) so that said connector (5) can define at least:
  - said configuration of use in which said main axis (5a) is transversal to said support plane (2a) and said connector (5) protrudes into said housing (11), and
  - a maintenance configuration in which said main axis (5a) is transverse to said support plane (2a), said connector (5) protrudes towards the outside of said housing (11) and said trapdoor (3) is positioned externally to said frame (2).

2. Device (1) according to claim 1, further comprising at least one post (4) contacting said trapdoor (3) through a contact end (42) movable on said trapdoor (3) along a translation axis (3b) perpendicular to said first rotation axis (3a) and constrained in a compliant way to said connector (5) by means of second constraint means (40) spaced with respect to said first constraint means (30) along said main axis (5a) and defining a second rotation axis (4a) parallel to said first rotation axis (3a) around which said post (4) can rotate with respect to said connector (5), said post (4) being able to rotate around said second rotation axis (4a) with respect to said frame (2) from said closed position to said opening position in opposition to second opposition means (41) configured to push said post (4) into contact with said trapdoor (3).

3. Device (1) according to any one of the preceding claims, in which said trapdoor (3) comprises a guide (32) extending along said translational axis (3b) and configured to movably accommodate said contact end (42), and locking means (33) positioned along said translation axis (3b) and configured for locking in a resolvable way said contact end (42) in said closing configuration.

4. Device (1) according to any preceding claim, comprising actuating means (6) constrained in a compliant way to said trapdoor (3), protruding from said trapdoor (3) and configured to unlock, at least in said closed position, said contact end (42) by said locking means (33) whenever an object (13) is placed in support by gravity on said trapdoor (3) interfering with said actuating means (6) and causing it to move with respect to said trapdoor (3).

5. Device (1) according to claim 5, wherein said locking means (33) comprise a seat (33a) adjacent to said guide (32) and capable of receiving said contact end (42) and said actuating means (6) comprise at least one thrust element (60) configured to push said contact end (42) out of said seat (33a) towards said guide (32) when moved by said object (13).

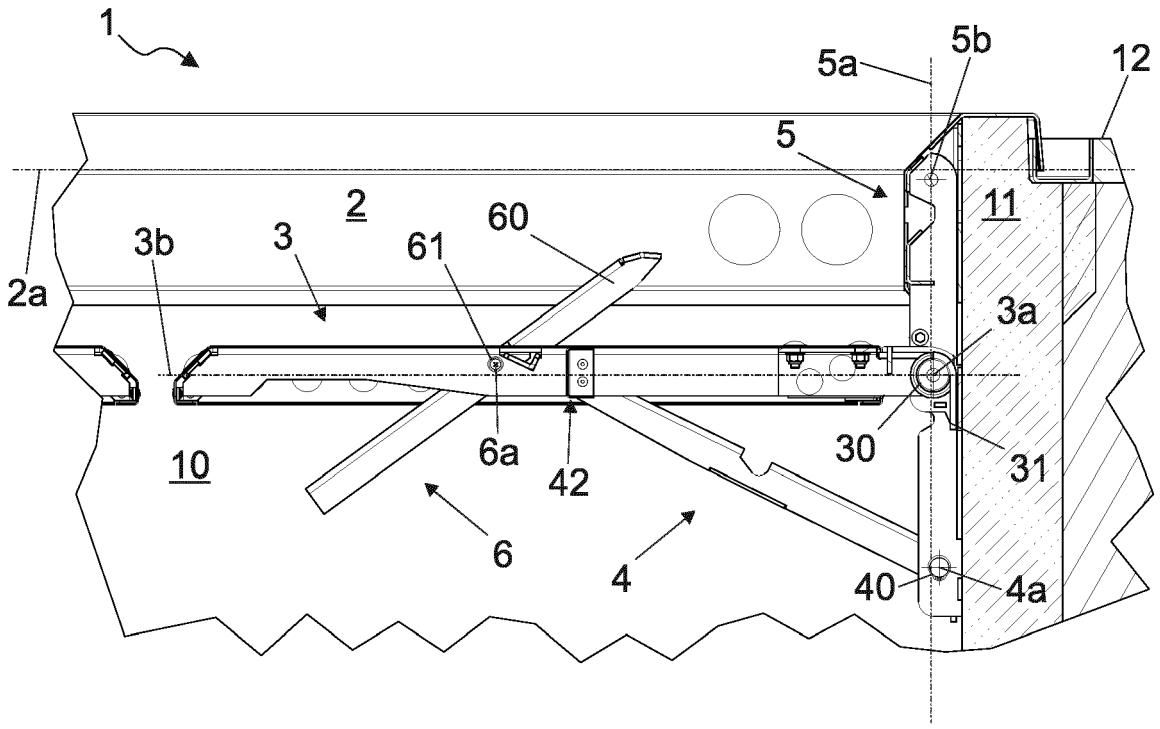
6. Device (1) according to claim 6, wherein said thrust element (60) is constrained in a compliant way to said trapdoor (3) by means of fourth constraint means (61) defining a fourth rotation axis (6a) parallel to said first rotation axis (3a) around which said thrust element (60) can rotate with respect to said trapdoor (3) in opposition to third opposition means (62) from a rest position in which at least part of said thrust element (60) protrudes from said trapdoor (3)

towards the outside and an actuation position in which said thrust element (60) occupies at least part of said seat (33a).

7. Device (1) according to any one of the preceding claims, wherein each of said opposition means (31, 41, 62) comprises at least one torsional spring and each of said constraint means (30, 40, 50, 61) comprises at least one mechanical hinge.

8. Device (1) according to any one of the preceding claims, comprises at least two said trapdoors (3) connected to said frame (2) mirror-like so as to occupy, in said closed position, most of said opening (10) and each connected to a plurality of said posts (4) and of said connectors (5) mutually spaced along said second rotation axis (4a).

9. Underground waste collection system including a device (1) according to any one of the preceding claims and said housing (11), wherein said housing (11) is delimited by one or more side walls (11a) transversal to said ground (12) and said connector (5) is configured to rest on at least one said side wall (11a) when it is in said configuration of use.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12
5
2
11
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3b
3
61
2a
3a
6a
42
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31
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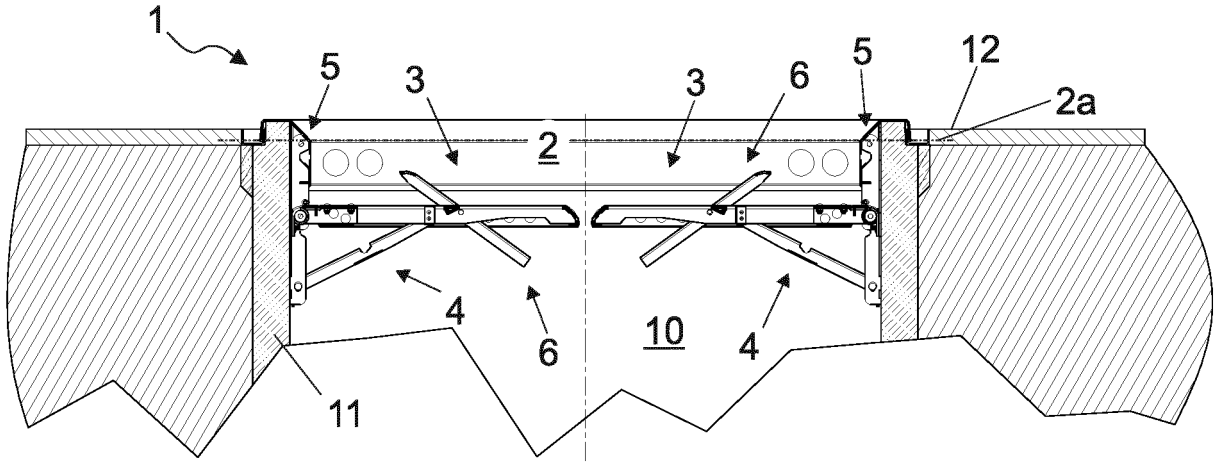
6
4
40
4a

Fig. 1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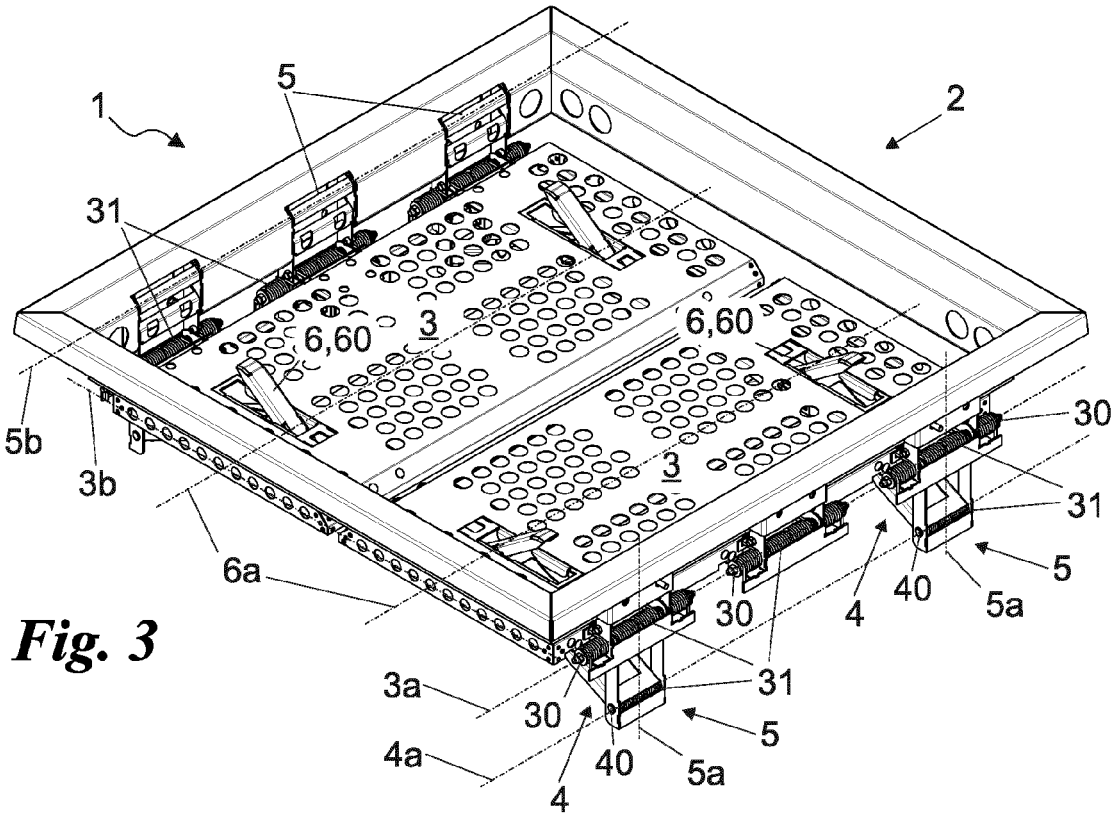
3
6
5
12
2a
2
4
6
10
4
11

Fig. 2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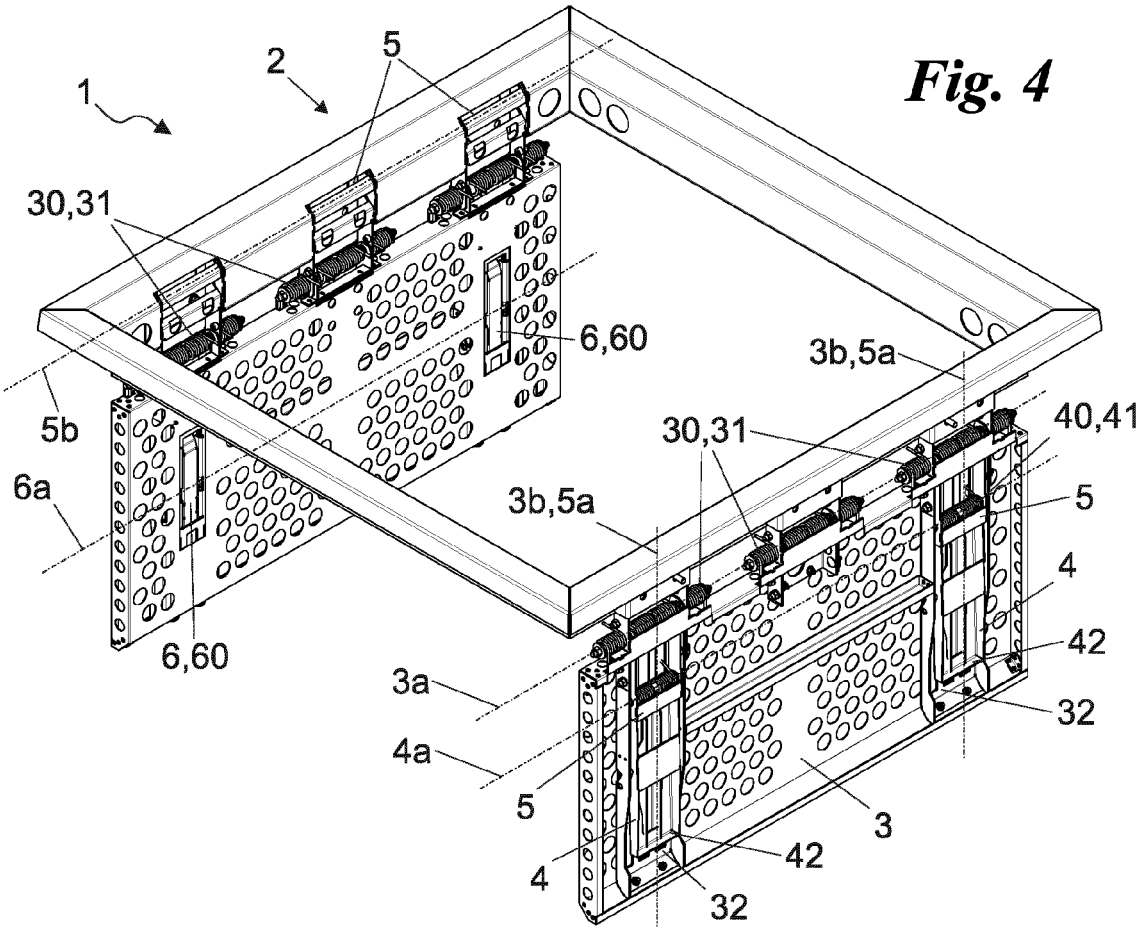
4a
40
5a
4

Fig. 3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3
42
4
32

Fig. 4

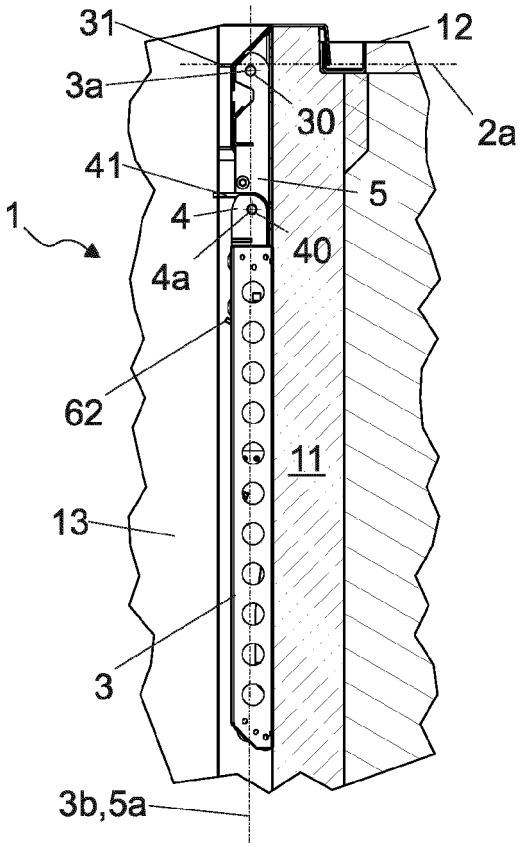
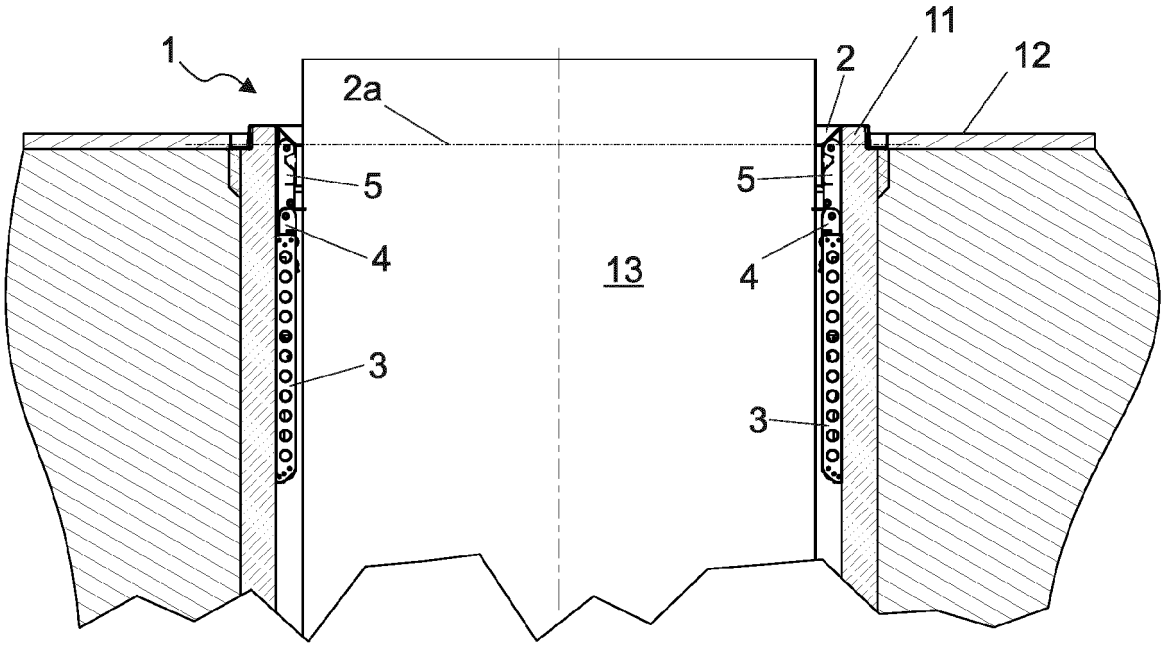


Fig. 5



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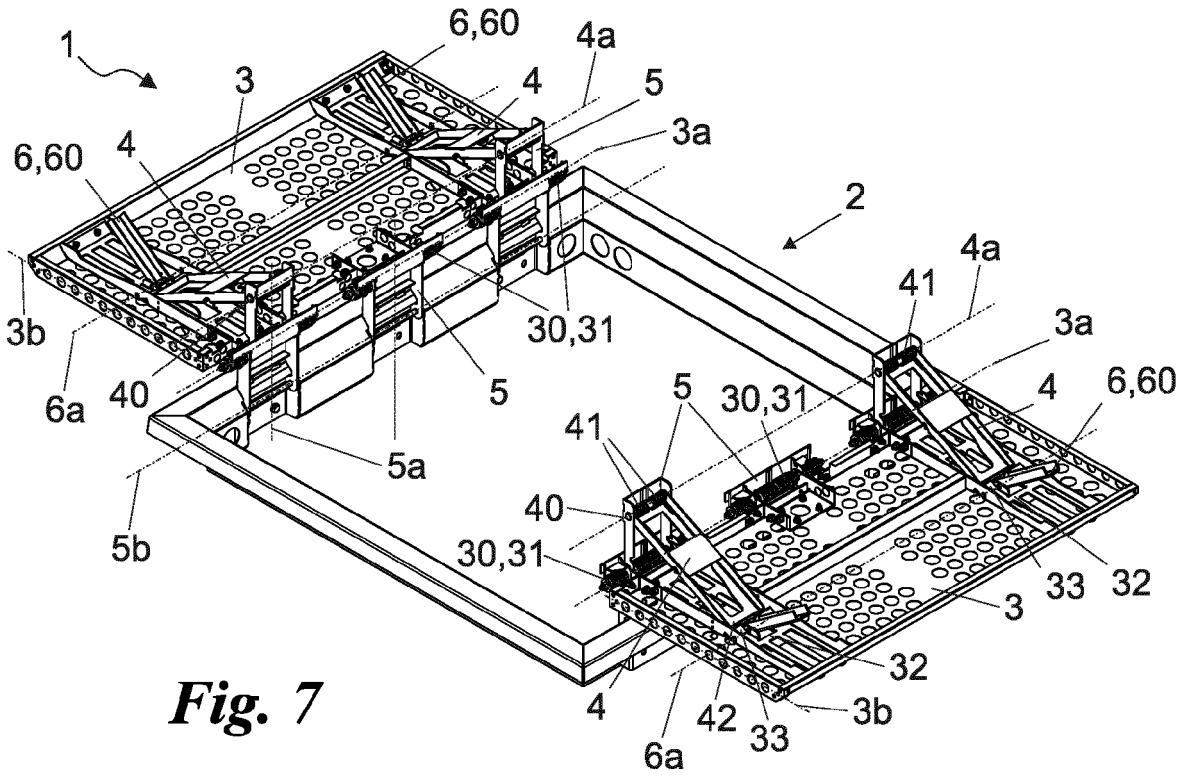
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5b
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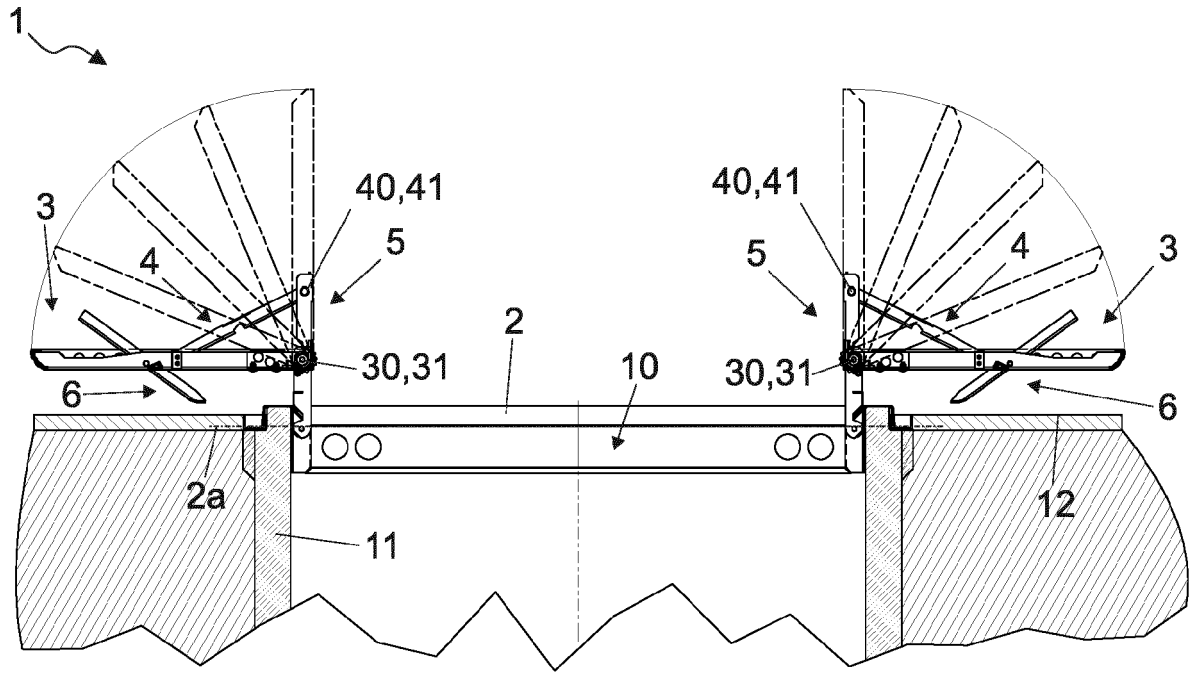
3
32
4
42
33
3b
6a

Fig. 7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2a
12
11

Fig. 8

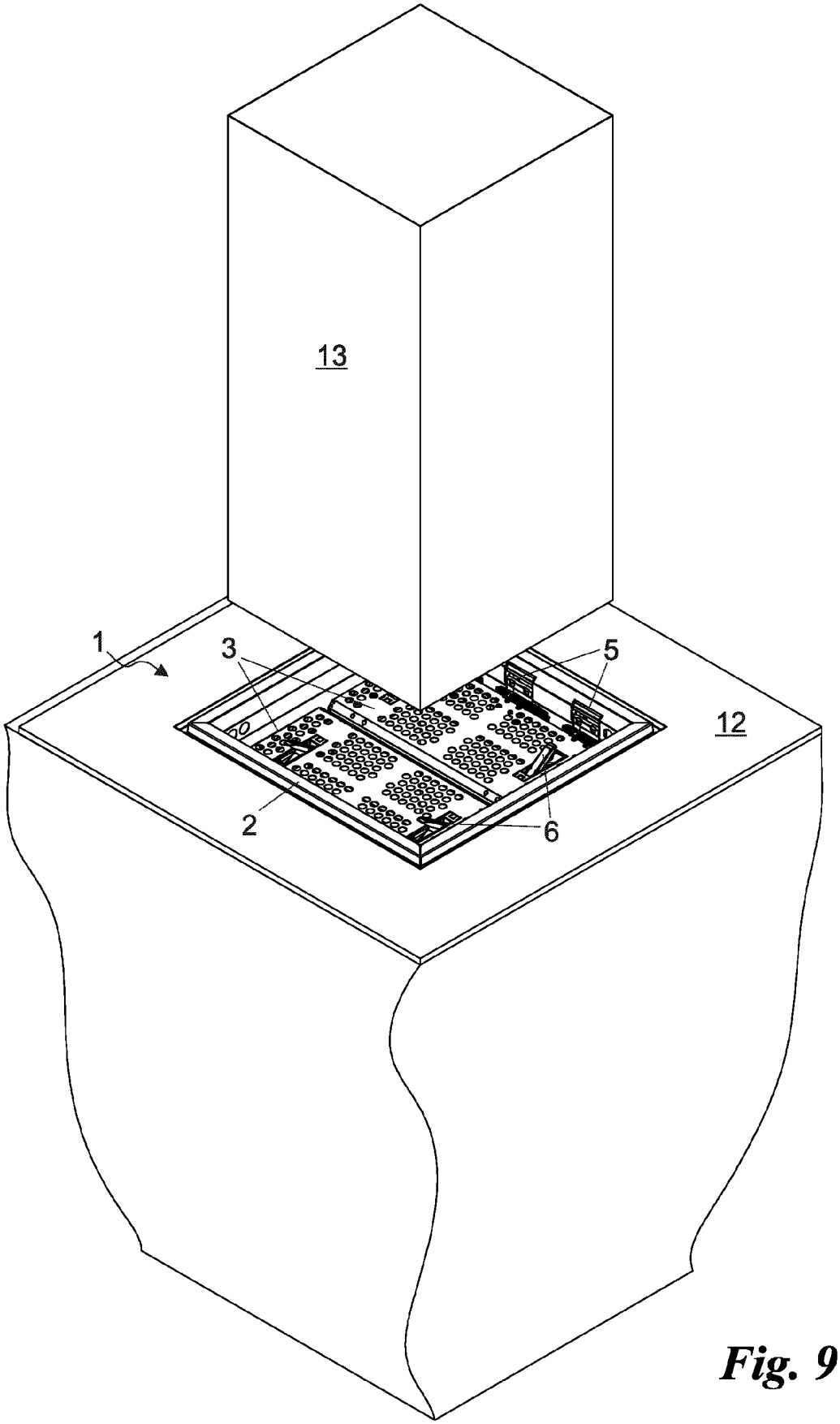

Fig. 9

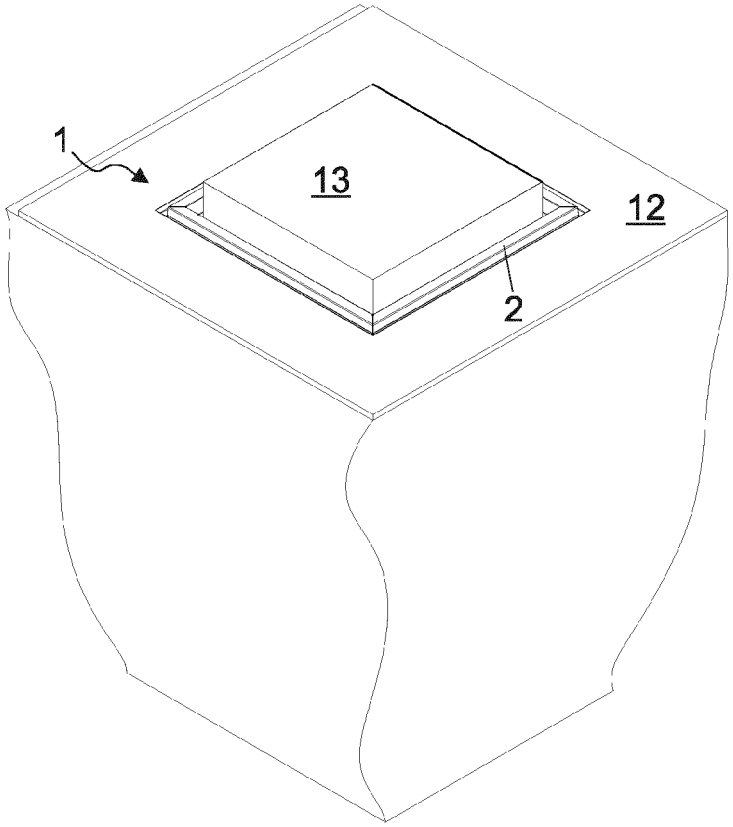

Fig. 10

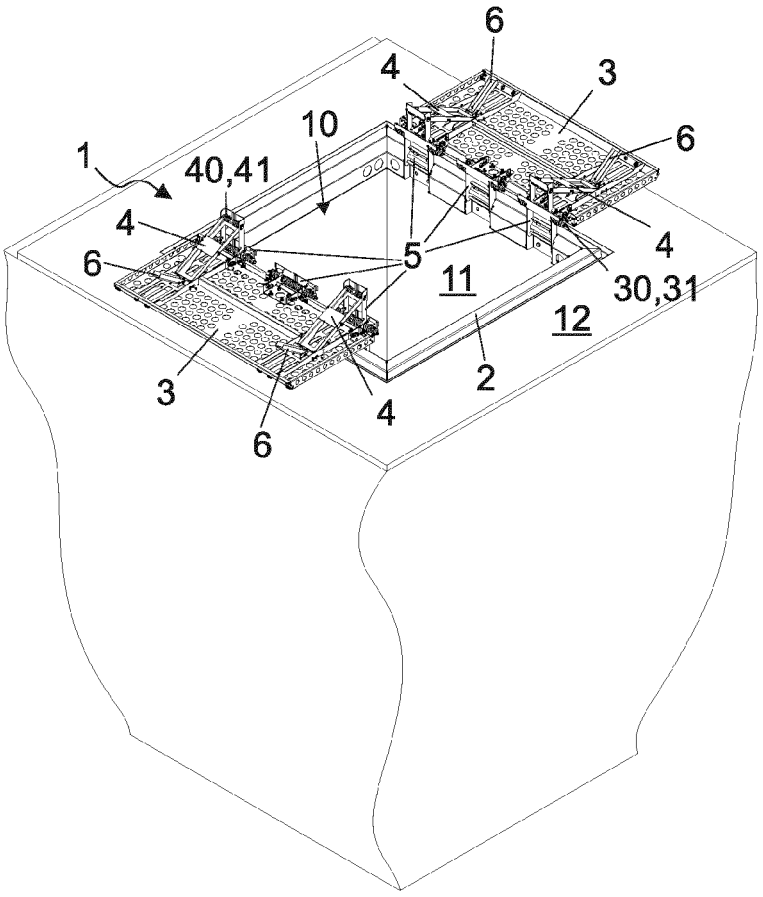

Fig. 11

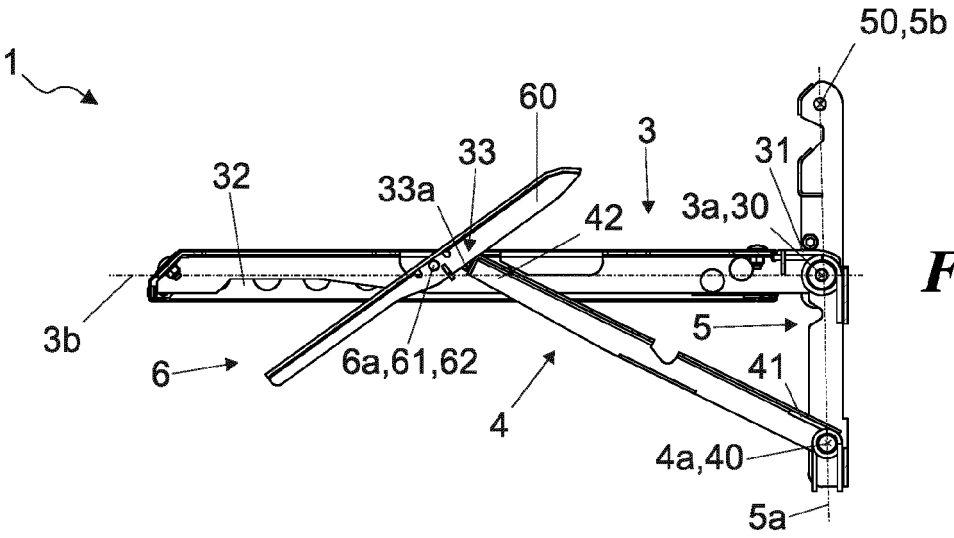

Fig. 12a

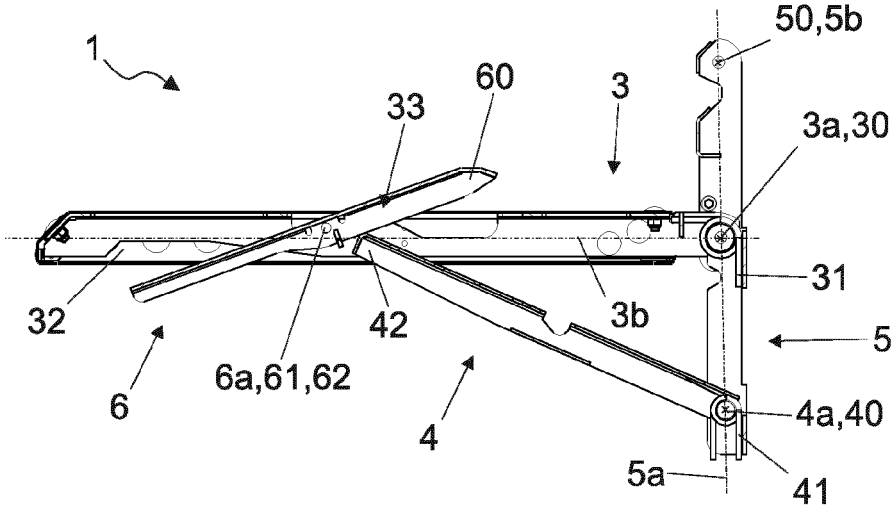

Fig. 12b

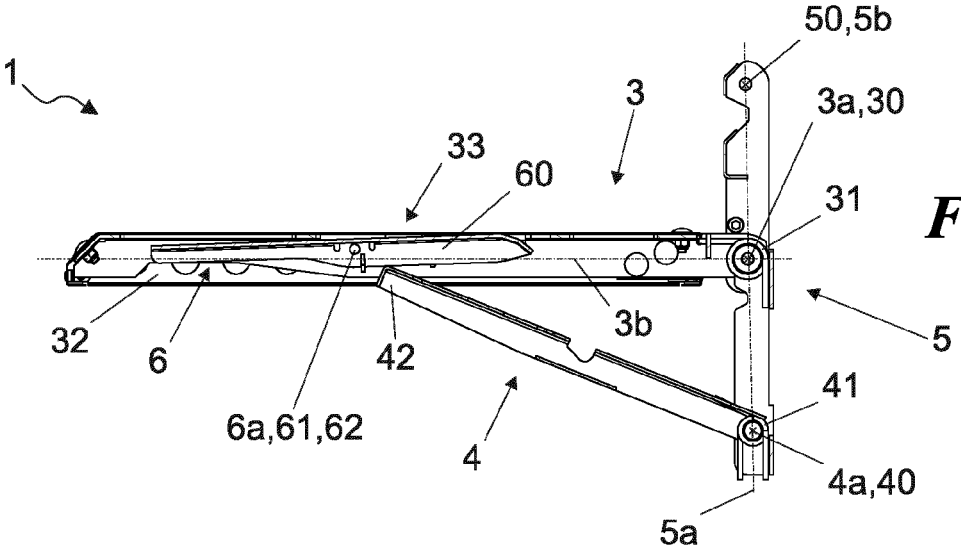

Fig. 12c

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EUROPEAN SEARCH REPORT

Application Number
EP 22 19 2670

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 109 760 968 A (ZOOMLION HEAVY IND SCI & TECH) 17 May 2019 (2019-05-17) * figures 1-5 * -----	1-9	INV. B65F1/14

TECHNICAL FIELDS SEARCHED (IPC)

B65F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	15 December 2022	de Miscault, Xavier

CATEGORY OF CITED DOCUMENTS

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15-12-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 109760968 A	17-05-2019	NONE	

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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- CN 109760968 A **[0003]**
- EP 2336053 B **[0016] [0017]**
- FR 3058133 B **[0016] [0019] [0021]**