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(54) **METHOD AND APPARATUS FOR CONSTRUCTING A DISASTER RELIEF SHELTER**

(57) After events such as natural disasters, such as floods or earthquakes, it is essential for relief organisations and/or groups to be able to establish buildings from which they can operate effectively and quickly. The present invention comprises two panels 1, 2 couplable together via cooperating male 21 and female 22 connec-

tors, and a cable passing axially through them, the cable tensionable to generate a compressive load that urges the panels 1, 2 together. In this way, a strong and secure connection may be made between panels 1, 2 in order to construct a robust disaster relief shelter quickly and easily.

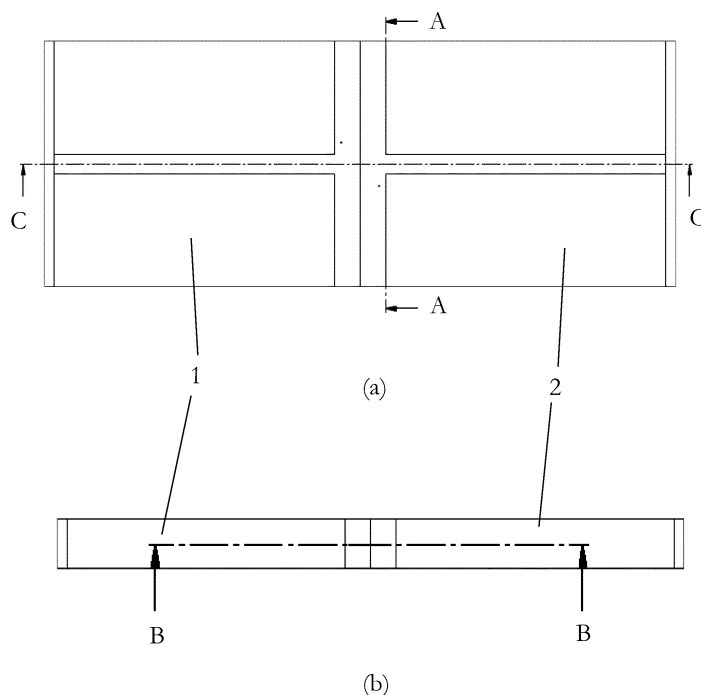


Figure 1

Description

[0001] The present invention relates generally to a pre-fabricated construction material and a method of method of assembling a building and finds particular, although not exclusive, utility in constructing disaster relief shelters.

[0002] After events such as natural disasters, such as floods or earthquakes, it is essential for relief organisations and/or groups to be able to establish buildings from which they can operate effectively and quickly. Various such buildings are known to be used; however, each suffers from some form of disadvantage.

[0003] For example, it has been known to use standard ISO shipping containers as a make-shift building; however, as can be appreciated, such shipping containers are large and bulky to transport, and it is preferable to have some form of building that can be collapsed and/or disassembled.

[0004] Another solution is to use tents, in particular inflatable emergency shelters; however, these are often less robust than is preferred. Other 'flat-pack' type buildings take a great deal of time to construct and make sufficiently robust to cope with the demanding environment in which they are to be used.

[0005] According to a first aspect of the present invention, there is provided a prefabricated construction material for use in assembly of a disaster relief shelter, the prefabricated construction material comprising: a first panel for use as a first section of wall of the disaster relief shelter, the first panel comprising: two opposing first panel faces arranged parallel to the plane of the first panel; at least one first panel perimeter face extending between respective perimeters of the two opposing first panel faces; and a first panel through hole extending through the first panel substantially parallel to the plane of the panel; a male connector attached to the first panel, the male connector comprising an elongate projection having a longitudinal bore therethrough, the longitudinal bore in communication with the first panel through hole; a second panel for use as a second section of wall of the disaster relief shelter, the second panel comprising: two opposing second panel faces arranged parallel to the plane of the second panel; at least one second panel perimeter face extending between respective perimeters of the two opposing second panel faces; and a second panel through hole extending through the second panel substantially parallel to the plane of the second panel; a female connector attached to the second panel, wherein the female connector is configured to be operatively engageable with the male connector, the female connector comprising an axial bore configured to receive the male connector therein, the axial bore in communication with the second panel through hole; a cable arrangeable to extend through the first panel through hole, the longitudinal bore, the axial bore and the second panel through hole; and a loading device configured to tension the cable such that, when the male connector is operatively engaged with the

female connector, a compressive load urges the first panel and the second panel together.

[0006] The present invention therefore comprises two panels couplable together via cooperating male and female connectors, and a cable passing axially through them, the cable tensionable to generate a compressive load that urges the panels together. In this way, a strong and secure connection may be made between panels in order to construct a robust disaster relief shelter quickly and easily.

[0007] The first panel may be a wall component, for instance, the opposing first panel faces may comprise an interior wall surface opposing an exterior wall surface, and may have a wall cavity therebetween, which may be empty, or may be filled with sound/thermal insulation or some other filler material. The above and following optional features of the first panel may be applied mutatis mutandis to the second panel.

[0008] The first panel may be substantially planar/flat and/or curved (e.g. partially curved and partially flat); in particular, the two opposing first panel faces may be substantially planar/flat and/or curved (e.g. partially curved and partially flat).

[0009] The at least one first panel perimeter face may, with the two opposing first panel faces, bound a volume of the first panel. The at least one first panel perimeter face may be a single first panel perimeter face, which may for instance form a panel having a substantially circular / cylindrical shape. The at least one first panel perimeter face may comprise two, three or four (or more) first panel perimeter faces, which may for instance form a panel having a shape substantially that of a semi-circle, triangle / triangular prism, square / rectangle / cuboid.

[0010] The plane of the panel may be parallel to a surface having the largest surface area of the surfaces forming the panel; that is, one or both of the two opposing first panel faces may have a surface area greater than the or each of the first panel perimeter face(s).

[0011] The first panel through hole may extend through the first panel from on or the first panel perimeter faces to an opposing first panel perimeter face. The first panel through hole may extend through the first panel from the single first panel perimeter face (where there is only one) to an opposing portion of the single first panel perimeter face. The first panel through hole may extend through the first panel so as to avoid one or both of the two opposing first panel faces.

[0012] Where we refer to a bore or hole being in 'communication' with another bore or hole, this is to be understood as meaning that there is a path between the interior of one hole or bore to the other hole or bore. In particular, 'communication' may be 'fluid communication'.

[0013] The first panel through hole, the longitudinal bore and the second panel through hole may have substantially the same diameter and/or lateral dimensions. Alternatively, the first panel through hole and the second panel through hole may comprise a substantially hollow

interior of the first panel.

[0014] The external profile of the male connector may be substantially the same as the internal profile of the female connector, for close fit.

[0015] The first panel may comprise a further male connector, and the second panel may comprise a further female connector, each arranged such that the both the first pair of connectors referred to above, and the further pair of connectors, are operatively couplable together at the same time. In this way, twisting or the first and second panels relative to one another is substantially prevented.

[0016] Similarly, the first panel may comprise a female connector, and the second panel may comprise a male connector, each arranged such that the both the first pair of connectors referred to above, and the current specified pair of connectors, are operatively couplable together at the same time. In this way, again, twisting or the first and second panels relative to one another is substantially prevented.

[0017] Alternatively or additionally, the first panel may comprise a further male connector or a female connector arranged to be connectable to a corresponding female or male connector on a third panel. In this way, a structure may be formed by coupling a series of panels together. In some embodiments, the cable may be arrangeable to extend through a third panel through hole, a longitudinal bore of a male connector on the third panel, an axial bore of a female connector on the first panel, the first panel through hole, the longitudinal bore, the axial bore and the second panel through hole, such that when the cable is tensioned, a compressive load urges the third panel and the first panel together.

[0018] The prefabricated construction material may comprise a series of panels arrangeable in a closed loop to form a perimeter wall of a building.

[0019] The prefabricated construction material may further comprise a connector lock configured to substantially inhibit axial movement of the male connector relative to the female connector.

[0020] The prefabricated construction material may further comprise a hinge connected between the first panel and the second panel such that the first panel and the second panel are pivotally connected to one another along respective perimeters.

[0021] The male connector may be movable between a projecting position, in which the male connector protrudes from a surface of the first panel to which it is attached, and a retracted position in which the male connector is at least partially withdrawn into the surface of the first panel to which it is attached.

[0022] In this way, the male connector may be protected from damage when not in use.

[0023] The female connector is movable between a projecting position, in which the female connector protrudes from a surface of the second panel to which it is attached, and a retracted position in which the female connector is at least partially withdrawn into the surface of the second panel to which it is attached.

[0024] In this way, the connection between the first and second panels may be strengthened due to the female connector extending across the boundary between the first and second panels.

[0025] The prefabricated construction material is configured to move the connector between the projecting position and the retracted position in response to pivotal movement of the first panel with respect to the second panel about the hinge.

[0026] In this way, retraction of the male and female connectors may be automatic.

[0027] According to a second aspect of the present invention, there is provided a method of assembling a disaster relief shelter, the method comprising the steps of: providing the prefabricated construction material according to any preceding claim; inserting the male connector into the axial bore of the female connector; passing the cable through the first panel through hole, the longitudinal bore, the axial bore and the second panel through hole; and tensioning the cable such that a compressive load urges the first panel and the second panel together.

[0028] The above and other characteristics, features and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention. This description is given for the sake of example only, without limiting the scope of the invention. The reference figures quoted below refer to the attached drawings.

Figure 1 shows a section of a wall constructed from two panels.

Figure 2 is vertical cross-section of the panel of Figure 1 along the line A-A.

Figure 3 is a vertical cross-section of the panel of Figure 1 along the line B-B.

Figure 4 is a perspective view of the hinge unit of the panel of Figure 1, shown in an open position.

Figure 5 is an oblique cross-sectional view of the panel of Figure 1 along the line D-D of Figure 2.

Figure 6 is a perspective view of the hinge unit of Figure 4, shown in a closed position.

Figure 7 is a cross-sectional view of the panel of Figure 1 along the line C-C.

[0029] The present invention will be described with respect to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting. Each drawing may not include all of the features of the invention and therefore should not necessarily be considered to be an embodiment of the invention. In the drawings, the size of some of the elements may be exaggerated and not drawn to scale for illustrative purposes. The dimensions and the relative dimensions do not correspond to actual reductions to practice of the invention.

[0030] Furthermore, the terms first, second, third and

the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequence, either temporally, spatially, in ranking or in any other manner. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that operation is capable in other sequences than described or illustrated herein.

[0031] Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes and not necessarily for describing relative positions. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that operation is capable in other orientations than described or illustrated herein.

[0032] It is to be noticed that the term "comprising", used in the claims, should not be interpreted as being restricted to the means listed thereafter; it does not exclude other elements or steps. It is thus to be interpreted as specifying the presence of the stated features, integers, steps or components as referred to, but does not preclude the presence or addition of one or more other features, integers, steps or components, or groups thereof. Thus, the scope of the expression "a device comprising means A and B" should not be limited to devices consisting only of components A and B. It means that with respect to the present invention, the only relevant components of the device are A and B.

[0033] Similarly, it is to be noticed that the term "connected", used in the description, should not be interpreted as being restricted to direct connections only. Thus, the scope of the expression "a device A connected to a device B" should not be limited to devices or systems wherein an output of device A is directly connected to an input of device B. It means that there exists a path between an output of A and an input of B which may be a path including other devices or means. "Connected" may mean that two or more elements are either in direct physical or electrical contact, or that two or more elements are not in direct contact with each other but yet still cooperate or interact with each other. For instance, wireless connectivity is contemplated.

[0034] Reference throughout this specification to "an embodiment" or "an aspect" means that a particular feature, structure or characteristic described in connection with the embodiment or aspect is included in at least one embodiment or aspect of the present invention. Thus, appearances of the phrases "in one embodiment", "in an embodiment", or "in an aspect" in various places throughout this specification are not necessarily all referring to the same embodiment or aspect, but may refer to different embodiments or aspects. Furthermore, the particular features, structures or characteristics of any embodiment or aspect of the invention may be combined in any suitable manner, as would be apparent to one of ordinary skill in the art from this disclosure, in one or more embodiments or aspects.

[0035] Similarly, it should be appreciated that in the description various features of the invention are some-

times grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure and aiding in the understanding of one or more of the various inventive aspects. This method of disclosure, however, is not to be interpreted as reflecting an intention that the claimed invention requires more features than are expressly recited in each claim. Moreover, the description of any individual drawing or aspect should not necessarily be considered to be an embodiment of the invention. Rather, as the following claims reflect, inventive aspects lie in fewer than all features of a single foregoing disclosed embodiment. Thus, the claims following the detailed description are hereby expressly incorporated into this detailed description, with each claim standing on its own as a separate embodiment of this invention.

[0036] Furthermore, while some embodiments described herein include some features included in other embodiments, combinations of features of different embodiments are meant to be within the scope of the invention, and form yet further embodiments, as will be understood by those skilled in the art. For example, in the following claims, any of the claimed embodiments can be used in any combination.

[0037] In the description provided herein, numerous specific details are set forth. However, it is understood that embodiments of the invention may be practised without these specific details. In other instances, well-known methods, structures and techniques have not been shown in detail in order not to obscure an understanding of this description.

[0038] In the discussion of the invention, unless stated to the contrary, the disclosure of alternative values for the upper or lower limit of the permitted range of a parameter, coupled with an indication that one of said values is more highly preferred than the other, is to be construed as an implied statement that each intermediate value of said parameter, lying between the more preferred and the less preferred of said alternatives, is itself preferred to said less preferred value and also to each value lying between said less preferred value and said intermediate value.

[0039] The use of the term "at least one" may mean only one in certain circumstances.

[0040] The principles of the invention will now be described by a detailed description of at least one drawing relating to exemplary features of the invention. It is clear that other arrangements can be configured according to the knowledge of persons skilled in the art without departing from the underlying concept or technical teaching of the invention, the invention being limited only by the terms of the appended claims.

[0041] Figure 1a shows a side view of section of a wall constructed from a first panel 1 and a second panel 2.

[0042] Figure 1b shows a top view of the section of a wall in Figure 1a.

[0043] Figure 2 is partial vertical cross-section of the second panel 2 of Figure 1 along the line A-A, showing

a hinge unit 5, which will be described in more detail with reference to the following figures, embedded in the second panel 2.

[0044] Figure 3 is a partial vertical cross-section of the wall of Figure 1 along the line B-B. The hinge unit 5 is shown in cross-section extending between the first panel 1 and the second panel 2. The hinge unit 5 comprises a first housing 11 embedded in the first panel 1 and a second housing 12 embedded in the second panel 2. The first and second housings 11, 12 are substantially identical, with each housing 11, 12 located in their respective panels 1, 2 rotationally offset by 180 degrees from the other housing 12, 11. That is, as shown in figure 3, the first housing 11 has a first end that is adjacent to a first end of the second housing 12, the first end of the first housing 11 being substantially identical to the first end of the second housing 12.

[0045] Disposed within the first housing 11 is a male connector 21 and disposed within the second housing is a female connector 22, the male connector 21 being inserted into the female connector 22, with each connector 21, 22 extending across the boundary between the first panel 1 and the second panel 2, and across the boundary between the first housing 11 and the second housing 12.

[0046] Each connector 21, 22, is disposed on a front face of a respective backing plate 31, which is movable within the housing in a longitudinal direction, such that the connectors 21, 22 are movable across the boundary between the first panel 1 and the second panel 2, and across the boundary between the first housing 11 and the second housing 12, and are retractable into their respective housings 11, 12.

[0047] On the rear face of each backing plate is provided a coupling rod 33 pivotally coupled thereto at a first end. The following description describes only one side of the hinge unit 5, but can be applied to both sides. At an opposing end of the pivot rod 33, a pin 35 (not shown in figure 3) extends through a first slot 37 (not shown in figure 3) to connect to a first transmission wheel 41 (e.g. a cog or gear, which may or may not have teeth) pivotally mounted on the housing 11, 12 about a first pivot axis 39. The first transmission wheel 41 may be circular, or preferably may not be circular, but may have (for instance) a perimeter having two circular arcs of different circumference but cantered on the first pivot axis 39. For clarity, in the example shown, the first transmission wheel 41 is shown in two parts mounted on the first pivot axis 39, both parts of which configured to rotate together on the first pivot axis 39. In particular, an exterior perimeter of the first transmission wheel 41 is configured to engage with second transmission wheel 42 mounted on an axle 51 that extends through the respective housing 11, 12 to an opposite side thereof, where a third transmission wheel 43 is disposed on the axle 51. The third transmission wheel 43 is arranged to engage with a fourth transmission wheel 44 pivotally mounted on the respective housing 11, 12 about a second pivot axis 53. A peg 55 (not shown in figure 3) extends through a slot 57 and is

pivotally connected to a first end of an armature 59. The armature 59 is rotatably coupled at its opposing end to a first end of a coupler 61. The coupler 61 is pivotally and rotatably connected at its first end in a channel 63 of one of the housings 11, 12, and is pivotally connected at a second end to a pivot point 65 on the other of the housings 12, 11.

[0048] In this way, as the first panel 1 and second panel 2 are moved apart from the connected position shown in figure 3, the first end of the coupler 61 slides in channel 63 toward the open face of its respective housing 11, 12. This pulls the armature 59 such that the peg 55 moves along slot 57, thereby rotating the fourth transmission wheel 44 about the second pivot axis 53. Due to the interaction of the fourth transmission wheel 44 with the third transmission wheel 43, the axle 51 is rotated, thereby rotating the second transmission wheel 42. Again, rotation of the second transmission wheel rotates the first transmission wheel 41 about the first pivot axis 39, pulling the pin 39 along first slot 37, drawing pivot rod 33 with it. This retracts the respective backing plate 31 and thereby withdraws the male and/or female connector 21, 22 into the respective housing 11, 12, thereby preventing damage occurring to either the male and/or female connector during storage of the panels 1, 2.

[0049] An optional lock is shown in figure 3, whereby a cam 71 may move a locking pin 73 to inhibit movement of the first transmission wheel 41, thereby preventing disconnection of the first panel 1 from the second panel 2. The cam 71 may be operated by any conventional means, such as by key, handle or similar.

[0050] The male 21 and female 22 connectors include a common internal bore 81 through which a cable may be passed. The cable is not shown for the purpose of clarity; however, tensioning the cable may enable a clamping force to be applied to hold the male connector 21 under compressive load inside the female connector 22, such that the first panel 1 and the second panel 2 may be held securely together. For instance, the cable may be connected at either end to a side of each panel 1, 2 opposite the respective housing 11, 12 embedded therein, for instance by an eye bolt. A ratchet tensioner may be provided along the length of the cable, to apply tension thereon, and to draw the two opposing sides of the panels 1, 2 together.

[0051] Further detail of the configuration of the male and female connectors 21, 22 are provided below with reference to figure 5.

[0052] Figure 4 is a perspective view of the hinge unit 5 of the wall of Figure 1, shown in an open position.

[0053] Figure 5 is an oblique cross-sectional view of the panel of Figure 1 along the line D-D of Figure 2. A spring 83 is located within the interior female connector 22 to provide an abutment surface against which the male connector 21 is arranged to push. Pushing the abutment surface (and thereby compressing the spring 83) releases an annular arrangement of locking arms 85 (disposed around the interior of the female connector 22) that are

configured to engage into an annular recess in an exterior of the male connector 21. In this way, the connectors may be held together by the compressive force of the male connector 21 inside the female connector 22.

[0054] Figure 6 is a perspective view of the hinge unit 5 of Figure 4, shown in a closed position.

[0055] Figure 7 is a cross-sectional view of the hinge unit 5 of Figure 1 along the line C-C.

Claims

1. A prefabricated construction material for use in assembly of a disaster relief shelter, the prefabricated construction material comprising:

a first panel for use as a first section of wall of the disaster relief shelter, the first panel comprising:

two opposing first panel faces arranged parallel to the plane of the first panel;
at least one first panel perimeter face extending between respective perimeters of the two opposing first panel faces; and
a first panel through hole extending through the first panel substantially parallel to the plane of the panel;

a male connector attached to the first panel, the male connector comprising a elongate projection having a longitudinal bore therethrough, the longitudinal bore in communication with the first panel through hole;

a second panel for use as a second section of wall of the disaster relief shelter, the second panel comprising:

two opposing second panel faces arranged parallel to the plane of the second panel;
at least one second panel perimeter face extending between respective perimeters of the two opposing second panel faces; and
a second panel through hole extending through the second panel substantially parallel to the plane of the second panel;

a female connector attached to the second panel, wherein the female connector is configured to be operatively engageable with the male connector, the female connector comprising an axial bore configured to receive the male connector therein, the axial bore in communication with the second panel through hole;

a cable arrangeable to extend through the first panel through hole, the longitudinal bore, the axial bore and the second panel through hole; and

a loading device configured to tension the cable such that, when the male connector is operatively engaged with the female connector, a compressive load urges the first panel and the second panel together.

2. The prefabricated construction material of claim 1, further comprising a connector lock configured to substantially inhibit axial movement of the male connector relative to the female connector.

3. The prefabricated construction material of claim 1 or claim 2, further comprising a hinge connected between the first panel and the second panel such that the first panel and the second panel are pivotally connected to one another along respective perimeters.

4. The prefabricated construction material of any preceding claim, wherein the male connector is movable between a projecting position, in which the male connector protrudes from a surface of the first panel to which it is attached, and a retracted position in which the male connector is at least partially withdrawn into the surface of the first panel to which it is attached.

5. The prefabricated construction material of any preceding claim, wherein the female connector is movable between a projecting position, in which the female connector protrudes from a surface of the second panel to which it is attached, and a retracted position in which the female connector is at least partially withdrawn into the surface of the second panel to which it is attached.

6. The prefabricated construction material of claim 4 or claim 5, when dependent directly or indirectly on claim 3, wherein the prefabricated construction material is configured to move the connector between the projecting position and the retracted position in response to pivotal movement of the first panel with respect to the second panel about the hinge.

7. A method of assembling a disaster relief shelter, the method comprising the steps of:

providing the prefabricated construction material according to any preceding claim;
inserting the male connector into the axial bore of the female connector;
passing the cable through the first panel through hole, the longitudinal bore, the axial bore and the second panel through hole; and
tensioning the cable such that a compressive load urges the first panel and the second panel together.

8. A prefabricated construction material substantially

as hereinbefore described with reference to the accompanying drawings.

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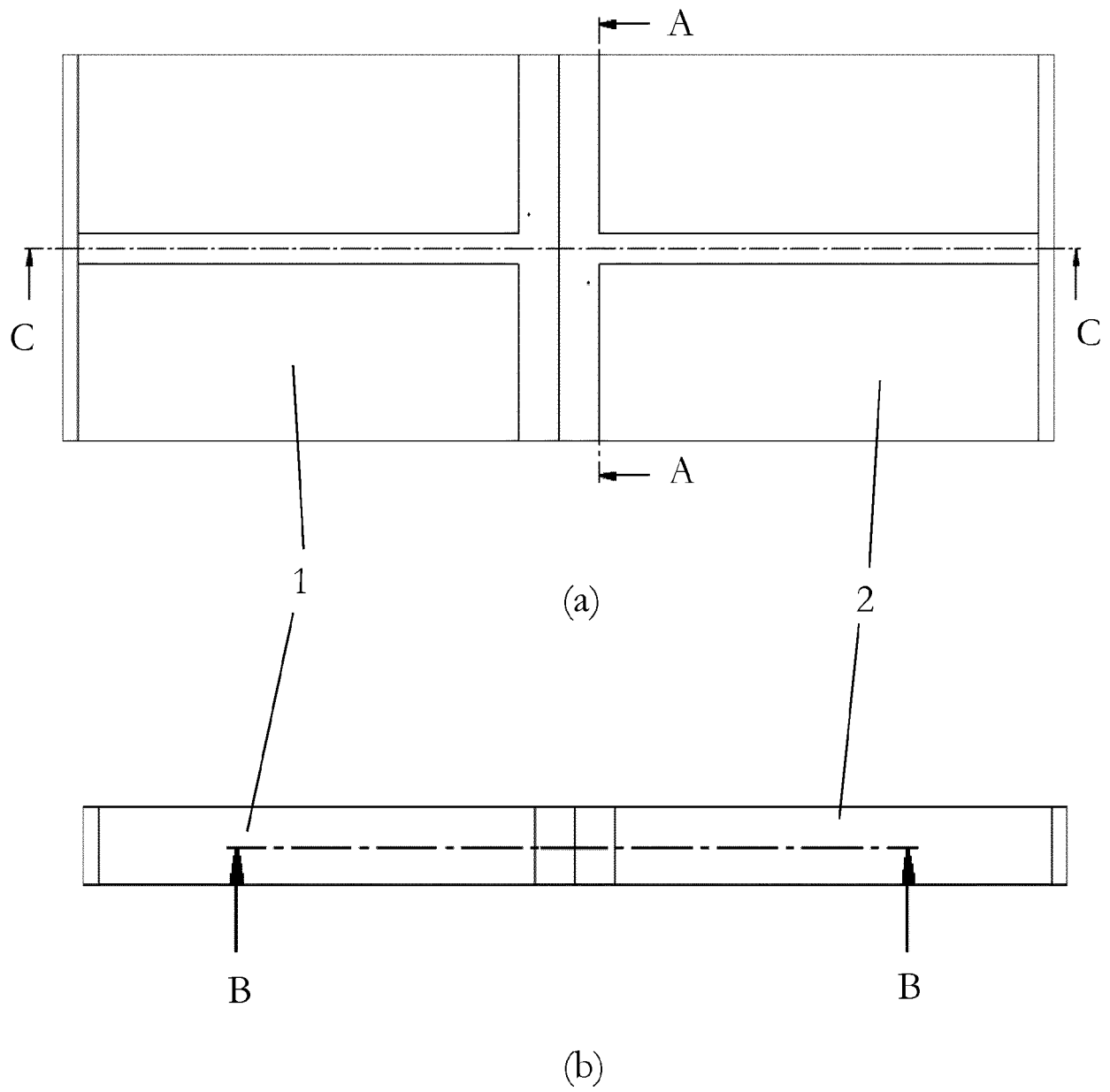


Figure 1

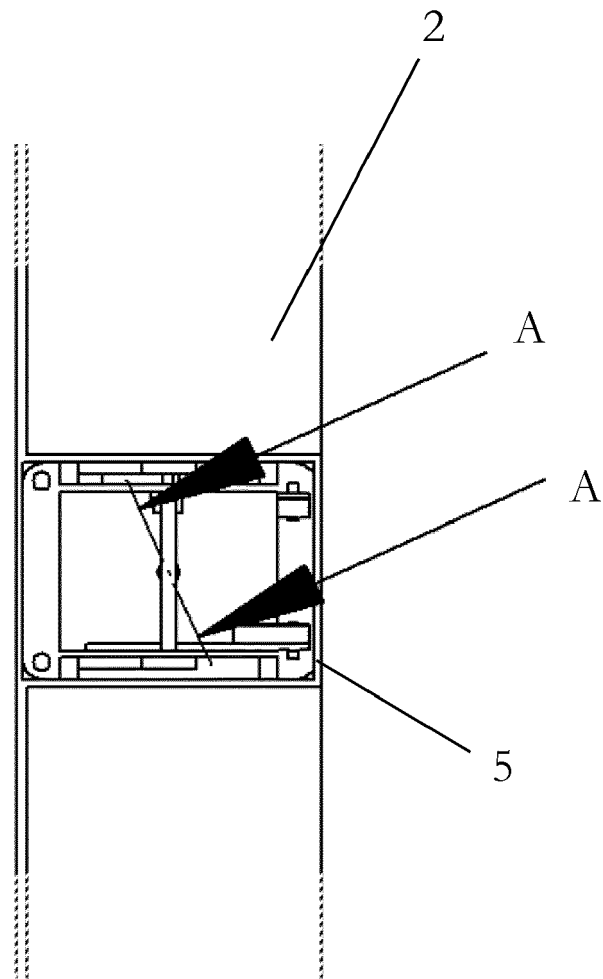


Figure 2

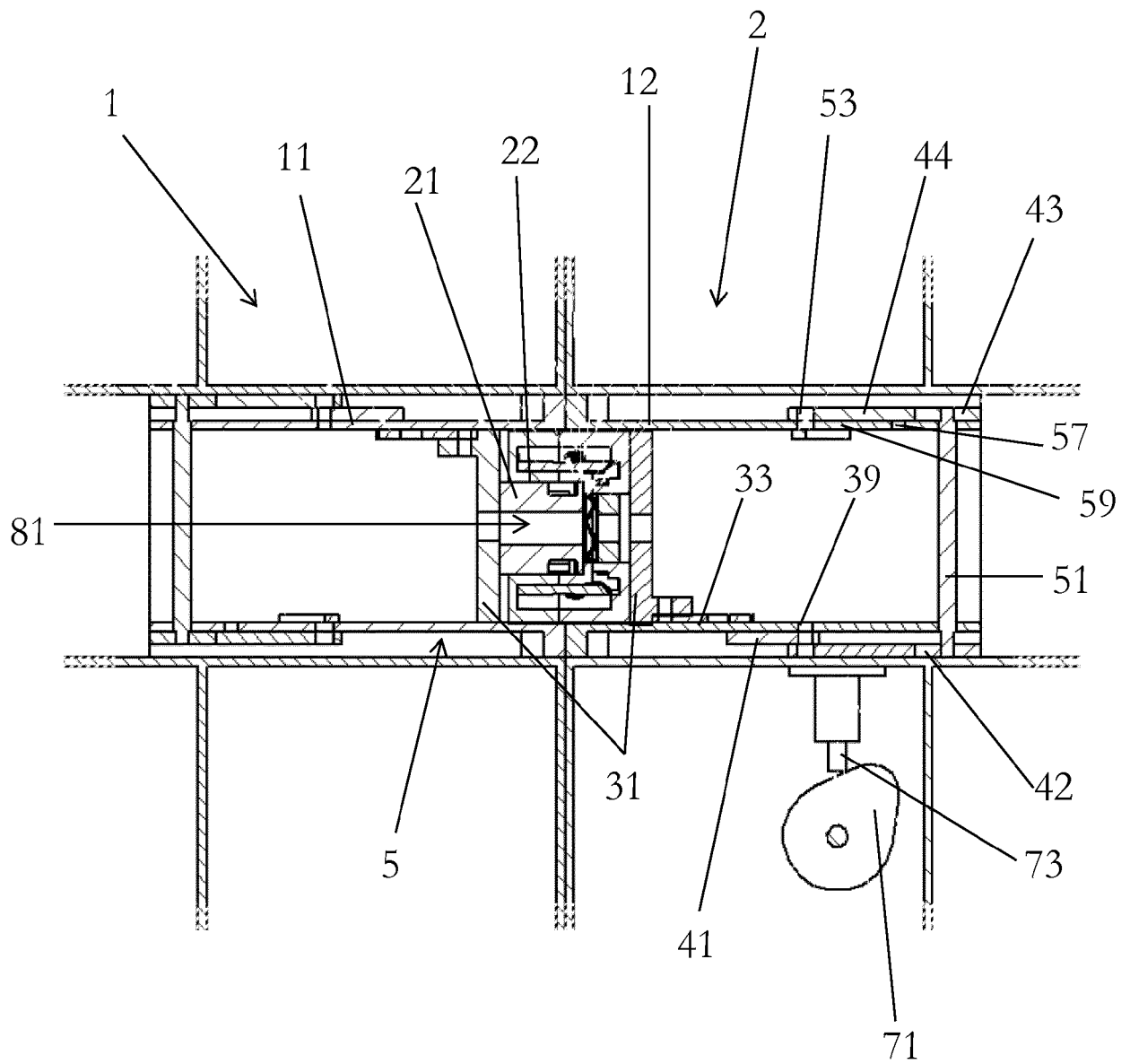


Figure 3

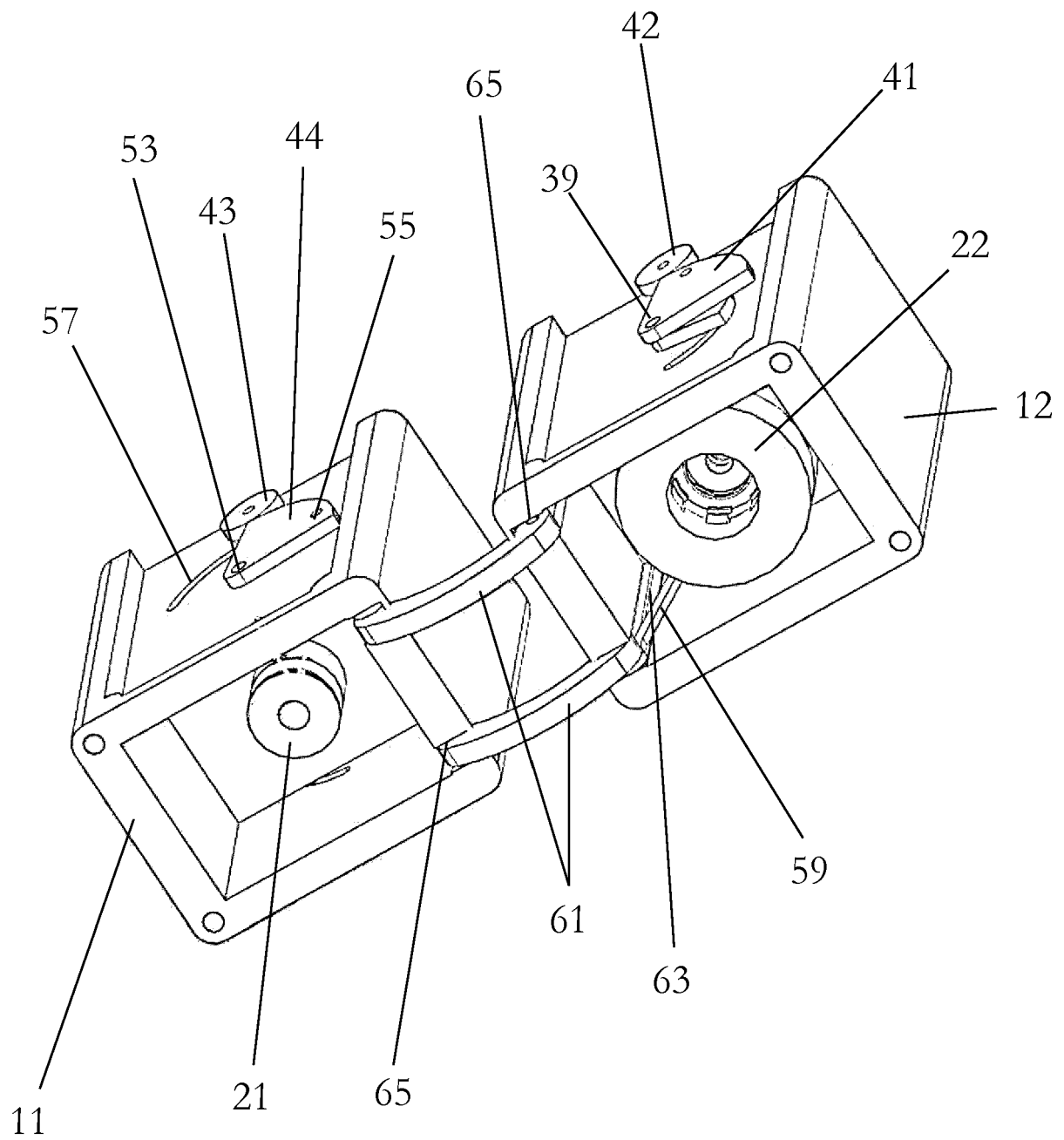


Figure 4

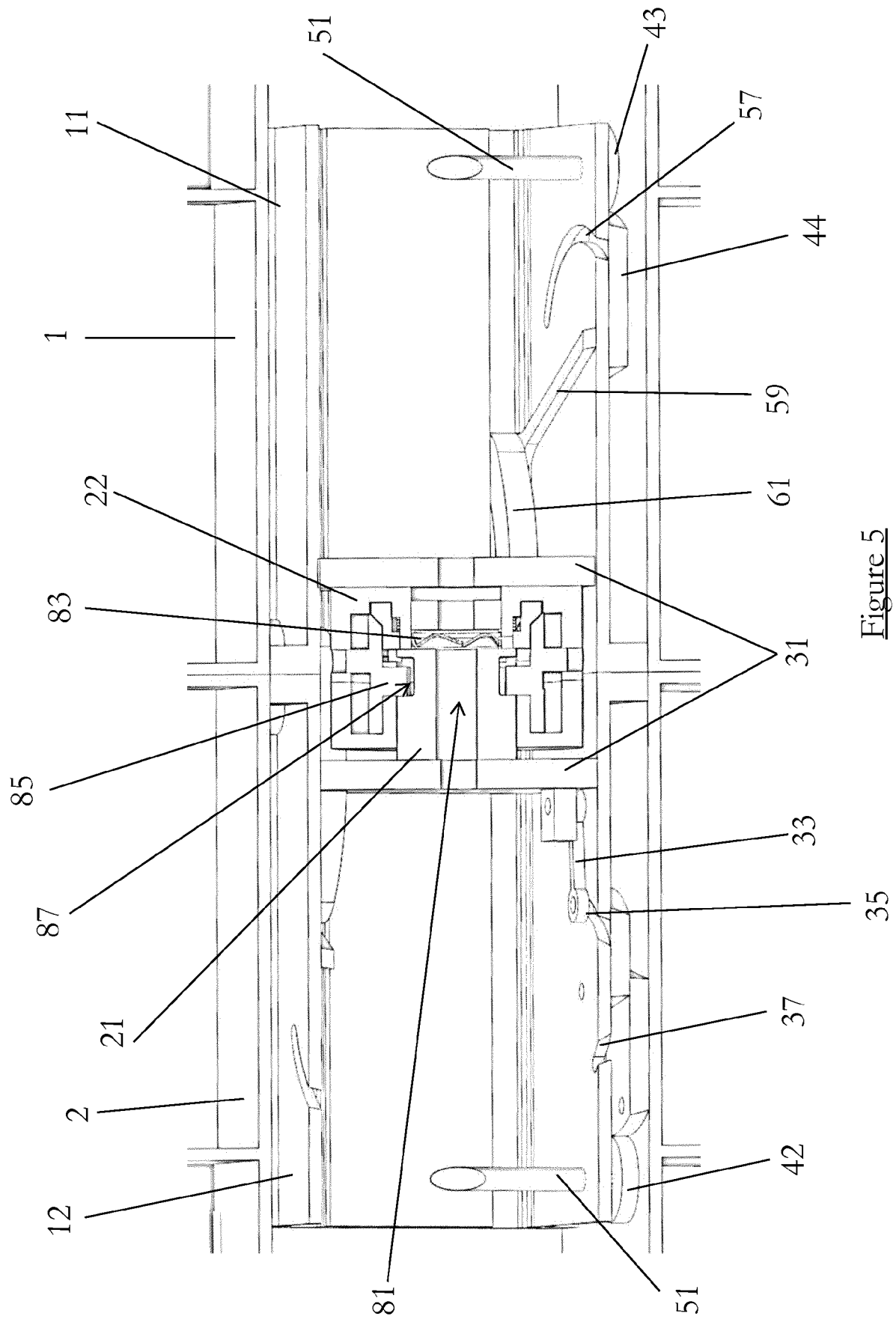


Figure 5

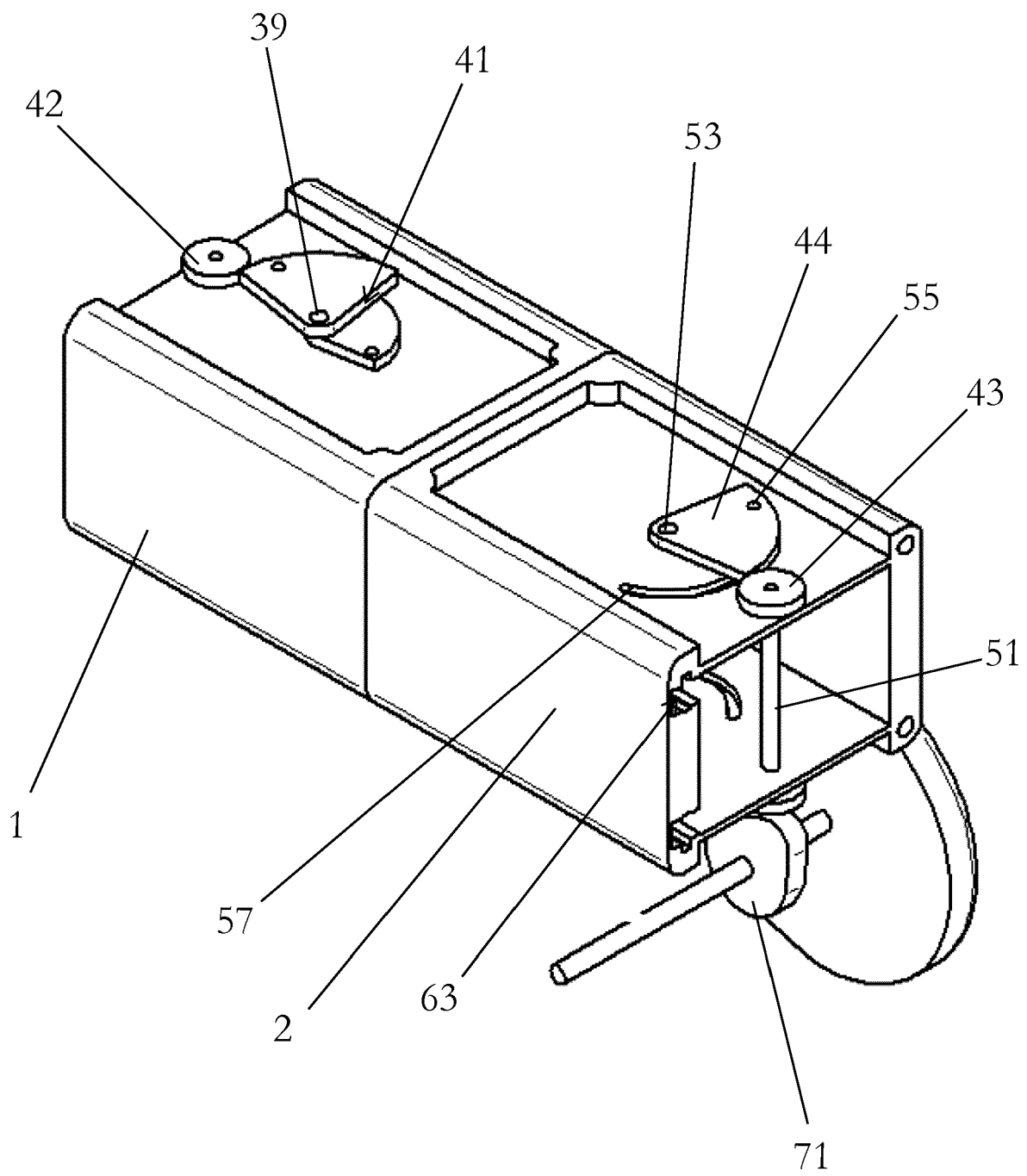


Figure 6

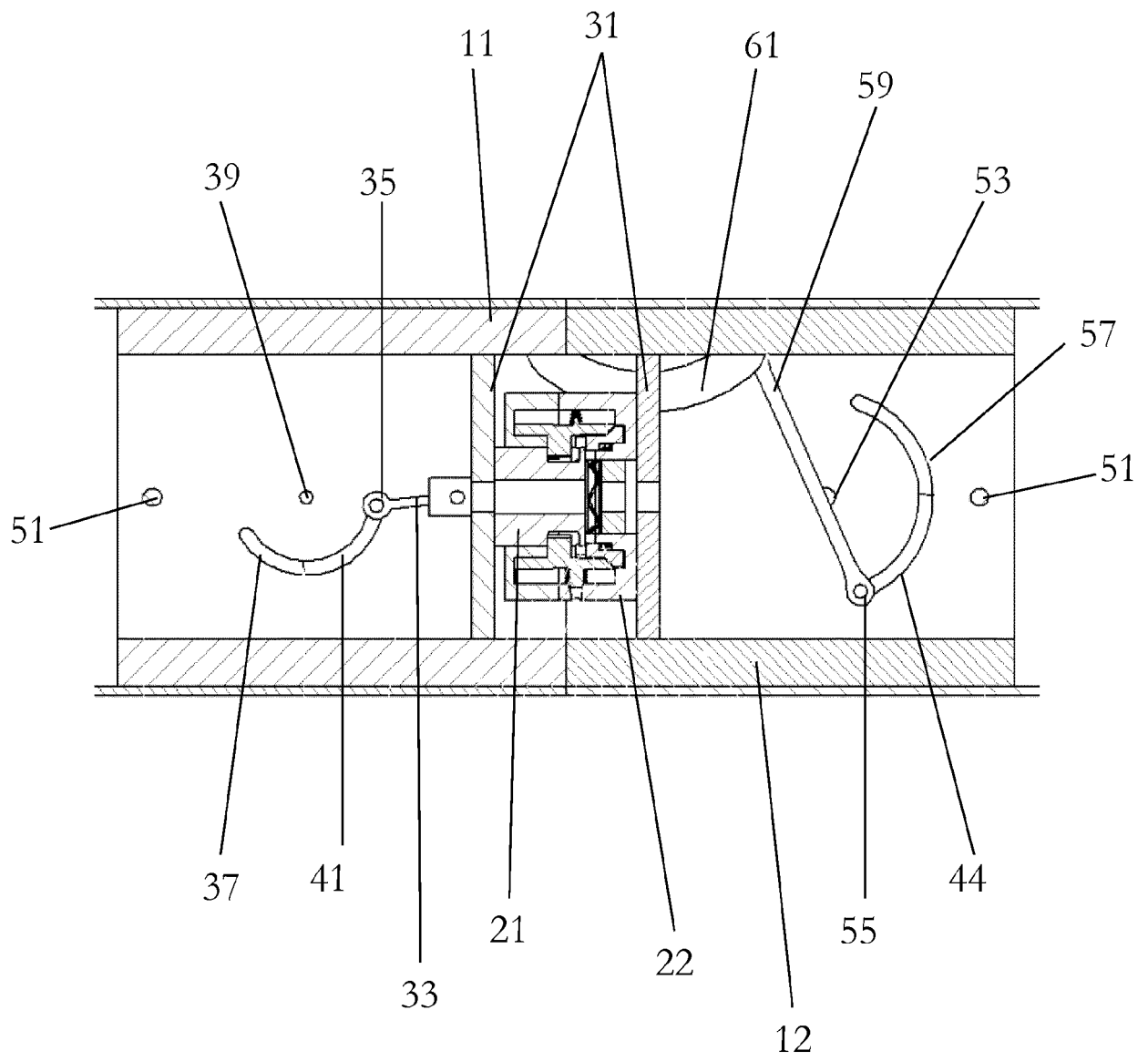


Figure 7



EUROPEAN SEARCH REPORT

Application Number
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Place of search Munich		Date of completion of the search 12 January 2018	Examiner Valenta, Ivar
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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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