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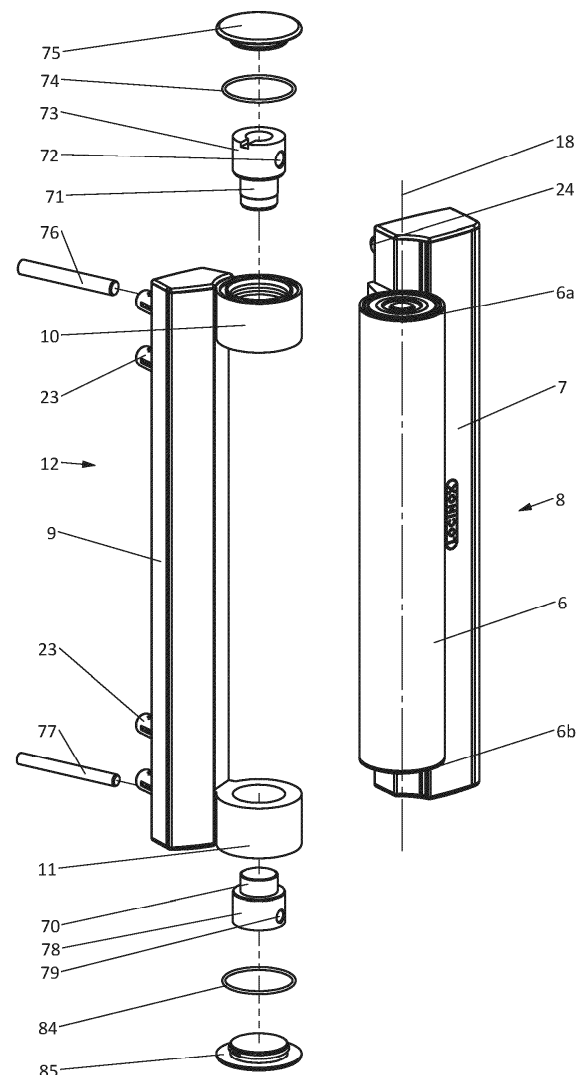
(71) Applicant: **Locinox**
8790 Waregem (BE)

(72) Inventor: **SIX, Ivo**
8790 Waregem (BE)

(74) Representative: **Gevers Patents**
De Kleetlaan 7A
1831 Diegem (BE)

(54) AN ELECTRICALLY OPERATED HINGE

(57) An electrically operated hinge (5) comprising: a support hinge member (8); a gate hinge member (12) pivotably mounted thereon; and an electrically operated actuator. The support hinge member comprises: a central knuckle (6) which extends in a longitudinal direction between a first end (6a) and a second end (6b). The gate hinge member comprises: a first knuckle (10) adjacent the first end; and a second knuckle (11) adjacent the second end. The actuator is situated substantially entirely within the central knuckle. Each end of the central knuckle is provided with an internal support, the actuator being located between the internal supports in the longitudinal direction. Each end of the central knuckle is provided with a roller bearing adjacent the internal support on an opposite side than the actuator. The central knuckle engages an outer side of the roller bearings and the first and second knuckle each have a cylindrical protrusion engaging an inner side of the roller bearing.

**Fig. 2****EP 4 818 443 A1**

Description

Technical field

[0001] The present invention relates to an electrically operated hinge for hinging a closure member to a support. The present invention further relates to a closure system comprising the hinge.

Background art

[0002] Electrically operated hinges are known for indoor applications. Examples are disclosed in US 11,072,964 B2 and US 11,639,625 B2 which both disclose an electrically operated hinge for hinging a closure member to a support. The hinge comprises: a support hinge member and a gate hinge member pivotably mounted on the support hinge member. The support hinge member includes: a support leaf configured to be fixed to the support and a cylinder barrel which extends between a first end and a second end in a longitudinal direction and which forms a knuckle of the hinge. The gate hinge member includes: a gate leaf configured to be fixed to the closure member; and at least one further knuckle of the hinge situated adjacent the cylinder barrel. The hinge further comprises an electrically operated actuator integrated within the knuckles of the hinge and configured to actuate the hinge.

[0003] The hinges disclosed in US 11,072,964 B2 and US 11,639,625 B2 are a butterfly type hinge with three knuckles, namely a central knuckle formed on one support hinge member and two adjacent knuckles formed on the gate hinge member. As disclosed in US 11,639,625 B2, an electronic control module is provided externally to the hinge.

[0004] The hinges disclosed in US 11,072,964 B2 and US 11,639,625 B2 are specifically intended for indoor use and are unsuited for outdoor gate applications for various reasons.

[0005] Firstly, the forces required with outdoor gates are typically much larger than indoor doors. This is especially applicable for heavy duty hinge applications with gates having a weight up to 150 kg or even up to 200 kg. There are naturally also external factors in play for outdoor applications, e.g. wind loads that may be exerted on the gate. The known hinges thus cannot be readily used on outdoor gates due to an insufficiently strong electric drive.

[0006] Secondly, the outdoor environment (e.g. humidity, temperature variations, precipitation conditions, etc.) is detrimental to the electronics.

[0007] Thirdly, placement of hinges on wooden structures allows for more leeway than on metal profiles which are common in outdoor applications. For example, an additional fixation opening may be easily provided in a wooden structure to correct an erroneous one, which cannot be readily done in metal profiles.

[0008] Electrically operated hinges are also known for

outdoor applications. For example, CN 107 816 285 A discloses an electrically operated hinge for hinging a gate to a support. The hinge comprises a support member fixed to the support and a gate member fixed to the gate.

The electric motor is integrated in the gate member and its output axis engages the support member.

[0009] The hinge disclosed in CN 107 816 285 A is executed as a nose hinge positioned between the gate and support. A downside of such a design is the support-gate separation is quite large which may be undesirable.

[0010] Another downside of the hinge disclosed in CN 107 816 285 A is the assembly involved. More specifically, the support member is placed on the support and the gate member is positioned on the gate in separate stages. The hinge is then finally assembled on site together with the necessary bearings. This leads to a high risk of dirt and contamination, not to mention the numerous mistakes that may be made during assembly.

[0011] There are also no (or limited) options available to adjust the hinge placement in order to address alignment issues between the gate and the support. Furthermore, it seems that the gate member and actuator can be simply lifted from the support member which is undesirable from a safety point of view.

[0012] Furthermore, when using electrically operated hinges, it is common that the rotation direction of the actuator is changed depending on the handedness of the closure system. This involves programming of the actuator, which may be cumbersome or require the use of a professional.

[0013] A general problem with electrically operated hinges for outside use is water infiltration in the housing. This infiltration may result from unsealed openings in the hinge and lead to soiling, e.g., accumulation of dirt due to water flowing within the hinge. This is of course undesirable and can lead to malfunctions. Another form of water infiltration is condensation forming on the inside of the housing, which condensation can also interfere with the electric and/or electronic components of the hinge.

Disclosure of the invention

[0014] An object of the present invention is to provide an electrically operated hinge which at least partially alleviates one or more of the above-mentioned disadvantages.

[0015] According to an aspect, the present invention relates to an electrically operated hinge for hinging a closure member, such as a gate, to a support, the hinge comprising: a support hinge member comprising: a support leaf configured to be fixed to the support; and a central knuckle which extends between a first end and a second end in a longitudinal direction, a gate hinge member pivotably mounted on the support hinge member and comprising: a gate leaf configured to be fixed to the gate; a first knuckle of the hinge situated adjacent the first end of the central knuckle; and a second knuckle of the hinge situated adjacent the second end of the central

knuckle, an electrically operated actuator integrated within the knuckles of the hinge, wherein: the actuator is situated substantially entirely within the central knuckle; the first end of the central knuckle is provided with a first internal support and the second end of the central knuckle is provided with a second internal support, the actuator being located between the internal supports in the longitudinal direction; the first end of the central knuckle is provided with a first roller bearing adjacent the first internal support on an opposite side than the actuator and the second end of the central knuckle is provided with a second roller bearing adjacent the second internal support on an opposite side than the actuator, the central knuckle engaging, either directly or indirectly, an outer side of the roller bearings; and the first knuckle has a first cylindrical protrusion engaging, either directly or indirectly, an inner side of the first roller bearing and the second knuckle has a second cylindrical protrusion engaging, either directly or indirectly, an inner side of the second roller bearing.

[0016] Providing the electrically operated actuator within the central knuckle results in an easier assembly method for the hinge. More specifically, contrary to the known actuators disclosed in US 11,072,964 B2 and US 11,639,625 B2 which require a placement from either end of the hinge, the hinge according to the present invention allows sliding the gate hinge member directly onto the support hinge member with only minimal components to be inserted afterwards.

[0017] Furthermore, the weight of the closure member needs to be borne by the support. The specific construction of the hinge according to the present invention optimizes the required force transfer over the hinge. More specifically, the roller bearings are placed near the ends of the central knuckles allowing engagement with the cylindrical protrusions in the first/second knuckles. There is thus a force transfer from the closure member to the gate leaf connected with the first/second knuckle. The respective cylindrical protrusion of the first/second knuckle then engages the roller bearing which in turn engages the central knuckle that is part of the support hinge member.

[0018] According to the present invention, the hinge is formed as a butterfly hinge. This provides a strong, secure and reliable hinge which is more suited as a heavy duty hinge than compared to a barrel hinge with only two hinge knuckles.

[0019] An embodiment of the present invention is characterized in that the actuator is provided with an output member, such as an output shaft, and the first cylindrical protrusion engages the output member.

[0020] Any rotation of the electrically operated actuator is in this embodiment directly transferred to the first cylindrical protrusion which is part of the gate hinge member. There is thus no need for intermediary elements that increase design complexity and increase the malfunction risk.

[0021] An embodiment of the present invention is char-

acterized in that the first internal support is substantially annular with the output member and/or the first cylindrical protrusion extending therein.

[0022] This annular internal support enables the desired direct coupling of the actuator with the gate hinge member without relying on externally visible connection elements.

[0023] An embodiment of the present invention is characterized in that a sealing ring is provided between the first internal support and the first cylindrical protrusion.

[0024] This sealing ring aids in avoiding water infiltration that could occur via the end of the central knuckle. This end is typically open to, as described above, provide the coupling between the actuator and the gate hinge member. The sealing ring in this opening surrounding the cylindrical protrusion provides a water barrier to reduce or eliminate water ingress via this way into the central knuckle which houses the electrically operated actuator.

[0025] An embodiment of the present invention is characterized in that the second internal support is substantially disc-shaped thereby substantially closing the second end of the central knuckle.

[0026] Such a disc-shaped support acts as an end cap for the second end of the central knuckle. Water ingress is in this manner severely reduced or even eliminated.

[0027] An embodiment of the present invention is characterized in that the first knuckle and the second knuckle both have a proximal end adjacent the central knuckle and a distal end facing away from the central knuckle, the first cylindrical protrusion extending beyond the proximal end of the first knuckle into the central knuckle and the second cylindrical protrusion extending beyond the proximal end of the second knuckle into the central knuckle.

[0028] Each cylindrical protrusion in this embodiment has a section located within a respective one of the first/second knuckle and a section located within the central knuckle to allow engagement with the roller bearings therein.

[0029] An embodiment of the present invention is characterized in that the distal end of the first knuckle and the second knuckle are provided with a cover, a seal preferably being located between the cover and its respective knuckle.

[0030] The cover is not only aesthetically pleasing, it further reduces the number of open areas of the hinge to reduce or eliminate water infiltration. The presence of a seal further enhances the water infiltration reduction properties.

[0031] An embodiment of the present invention is characterized in that each cylindrical protrusion is fixed to its respective knuckle, in particular by means of a transversely extending pin.

[0032] The use of transversely extending pins is a well-known and reliable way to couple mechanical elements in a non-rotatable manner in the field of outdoor hinges.

[0033] An embodiment of the present invention is characterized in that the support hinge member is configured to be irrotatably fixed to the support with its longitudinal

axis in a first orientation for a right-handed closure member and in a second orientation, opposite to the first orientation, for a left-handed closure member.

[0034] This provides a hinge for both left-handed and right-handed closure members. Specifically, for a right-handed closure member, the support hinge member is mounted to the support with its longitudinal axis in a first orientation (e.g. upright or upside down) and the gate hinge member is connected to the closure member. For a left-handed closure member, the support hinge member is mounted to the support with its longitudinal axis in a second orientation that is opposite to the first orientation (e.g. upside down or upright) and the gate hinge member is connected to the closure member.

[0035] This upside down positioning allows always placing the same hinge member to the support and the other one to the closure member. This is particularly advantageous when the shape of the hinge members is chosen to correspond in part to the shape of the support or the closure member

[0036] Furthermore, irrespective of the orientation, the rotational motion of the actuator for closing or opening the closure member stays the same (e.g. clockwise or counter-clockwise depending on how the hinge is configured). There is thus no need to reconfigure the hinge control depending on the handedness of the closure member.

[0037] An embodiment of the present invention is characterized in that the first knuckle and the second knuckle both have a proximal end adjacent the central knuckle and a distal end facing away from the central knuckle, the first cylindrical protrusion extending beyond the proximal end of the first knuckle into the central knuckle and the second cylindrical protrusion extending beyond the proximal end of the second knuckle into the central knuckle, and in that the first cylindrical protrusion is supported by the first roller bearing in the first orientation and the second cylindrical protrusion is supported by the second roller bearing in the second orientation.

[0038] Due to gravity acting on the gate, the gate hinge member is subject to a vertically downwards force. The upper one of the first/second knuckle is supported by the central knuckle which is part of the support hinge member. The vertical force is in this manner transferred directly, i.e. via the cylindrical protrusions, from the upper one of the first/second knuckle to the support hinge member fixed to the support irrespective of the orientation of the hinge. There is thus no need to involve more complex mechanisms (e.g. where parts are hanging from one another) to bear the gate.

[0039] An embodiment of the present invention is characterized in that each roller bearing is a ball bearing, in particular a steel ball bearing. Such bearings are more suited to transmit forces in the longitudinal direction.

[0040] An embodiment of the present invention is characterized in that the hinge further comprises an electronic control module configured for controlling the actuator, and in that the support hinge member comprises a hollow free space which forms an electrical enclosure in which

said electronic control module is housed.

[0041] This provides good protection for electronic equipment in the outdoor application area. By providing the needed space in the support hinge member, the electronic control components inside the electrical enclosure are shielded from most atmospheric conditions, esp. humidity and precipitation.

[0042] Furthermore, providing the electronic control module in the support hinge member allows conveniently providing the needed electrical supply. More specifically, the electric supply can be routed via the support directly to the support hinge member so that no cables are exposed to the outside environment. There is thus also no need to rely on flexible wiring, cable bridges and the like that would be needed in case the electronic control module is provided on the closure member or the gate hinge member.

[0043] An embodiment of the present invention is characterized in that the hollow free space is formed within the support leaf.

[0044] This placement has several benefits compared to placing the hollow free space in line with the hinge knuckles. Firstly, the support leaf has fewer dimensional restrictions thus allowing to more easily adapt this for housing the electronics rather than having to adapt the electronics to fit within the hinge knuckle dimensions. Secondly, the support leaf is directly fixed to the support, thus readily allowing the electrical connection.

[0045] An embodiment of the present invention is characterized in that a connection extends between the hollow free space and an interior of the central knuckle along which one or more cables may extend.

[0046] In order to provide power to the actuator, the most reliable way is through a direct cable connection. Especially in outdoor applications, other indirect ways (e.g. induction) are less reliable. The provision of a connection from the hollow free space in the support hinge member to the central knuckle allows to provide such a power cable via an enclosed, invisible space. This not only protects the cable from atmospheric conditions, it also hides this from view resulting a desired aesthetics.

[0047] An embodiment of the present invention is characterized in that said connection is mainly U-shaped and/or is sealed by a curable sealant.

[0048] The use of a U-shaped connection acts as a siphon application so that any moisture is collected at the lowest point and it thus drained from both the central knuckle interior and the hollow free space where the electronics reside.

[0049] The use of a curable sealant ensures that no moisture can transfer between the central knuckle interior and the hollow free space.

[0050] An embodiment of the present invention is characterized in that the electronic control module comprises one or more printed circuit boards (PCBs) which are disposed substantially along the length of the support leaf in the longitudinal direction, wherein, preferably, the electronic control module comprises at least two printed

circuit boards with each being located in a different electrical enclosure placed inside said hollow free space.

[0051] Disposing the PCBs along the length of the support leaf maximises the available space for the electronics without having to increase the thickness of the leaf. Furthermore, placing each PCB in their own electrical enclosure reduces the water infiltration risk and optimizes the weather resistance of the electronic components.

[0052] An embodiment of the present invention is characterized in that the hollow free space comprises an access opening allowing to position the electrical enclosure therein, the access opening particularly being provided in a wall section of the support leaf which extends in the longitudinal direction. Preferably, the access opening is sealed by means of at least one cover profile.

[0053] An access opening is a convenient way to position the electronic components in the support leaf as compared to other method, e.g. by having a multi-part support leaf. It further allows readily replacing these parts if needed. Placing the access opening in the longitudinal wall section allows to provide a larger opening as compared to having this opening in a top or bottom face of the support leaf. The use of a cover profile allows to obscure the access opening from view.

[0054] An embodiment of the present invention is characterized in that the electrical enclosure comprises a beam-shaped two-part housing having a base part and a cover part.

[0055] A two-part housing allows for easy assembly and/or replacement of a malfunctioning component, whilst providing the desired ingress protection rating (e.g. IP 55 or IP 56).

[0056] An embodiment of the present invention is characterized in that the support leaf comprises a cable receiving member configured for allowing a power cable and/or a communication cable to pass therethrough, wherein, preferably, at least one cable extends from the electrical enclosure into and through the cable receiving member.

[0057] Providing a dedicated cable receiving member reduces the risk of wrongly assembling the hinge to the support. Having the cable already running from the electrical enclosure through the cable receiving member means that this cable exits the hinge which ensures that it may be conveniently coupled to the corresponding cable (e.g. power or communication) in the support.

[0058] An embodiment of the present invention is characterized in that the cable receiving member is adjustable with respect to the support leaf in said one of: the longitudinal direction and the transverse direction.

[0059] This ensures that, within the adjustment margins for the support hinge member with respect to the support, the cable receiving member is adjustable in the same way. In other words, the adjustment of the hinge is reflected also in the cable receiving member so that the cable can always enter the support in a same position.

[0060] An embodiment of the present invention is char-

acterized in that the support leaf comprises fastening members configured to fix the support leaf to the support and the gate leaf comprises fastening members configured to fix the support leaf to the gate.

[0061] Preferably, these fastening members are formed as fixture sets disclosed in EP 1907712 or EP 3575617 or WO2024156376, the contents of which are incorporated herein by reference. The Applicant commercializes such fixture sets which come with the following advantages. Firstly, they are pre-mounted on the hinge and thus cannot be wrongly placed with respect to the hinge. Secondly, they are known to handle large forces and each fixture set can withstand up to 10kN of pulling force. Thirdly, they are well suited for mounting components on hollow metal profiles without requiring welding, cutting, drilling, milling, etc. operations which could damage the finish coating.

[0062] An embodiment of the present invention is characterized in that the fastening members of the support leaf are adjustable with respect to the support leaf in one of: the longitudinal direction and a transverse direction which is perpendicular to the longitudinal direction, and in that the fastening members of the gate leaf are adjustable with respect to the gate leaf in the other one of: the longitudinal direction and the transverse direction.

[0063] These adjustment options allow to vary the position of the gate with respect to the support and thus allow better aligning the closure system as a whole.

[0064] Advantageously, the adjustment in the transverse direction is provided on the support. Typically, the support is wider in this transverse direction than the gate thus allowing a larger adjustment.

[0065] An embodiment of the present invention is characterized in that the support leaf and the gate leaf each comprise ribbed areas which cooperate with the fastening members to adjust the position thereof. The ribs preferably extend perpendicular to the adjustment direction.

[0066] These ribbed areas are a known way in which two elements may be differently positioned with respect to one another in an adjustable manner, while also providing a strong connection (once fastened) with a minimal risk of relative movement.

[0067] An embodiment of the present invention is characterized in that the fastening members of the support leaf and the fastening members of the gate leaf are symmetric with one another upon a 180° rotation of the hinge.

[0068] In this embodiment, the placement of the fastening members is identical irrespective of the first/second orientation. The pattern of fixation openings in the support/closure member is thus independent of the handedness of the closure member.

[0069] An embodiment of the present invention is characterized in that the hinge comprises at least four, preferably at least eight, fastening members.

[0070] At least four fastening member allows to fasten each hinge member in two separate locations thus en-

sureing a secure connection. Furthermore, this allows retaining the desired symmetry upon rotation of the hinge.

[0071] Further increasing the number of fastening members allows to bear and actuate heavier gates. In order to maintain the desired symmetry upon rotation of the hinge, the number of fastening members is best increased in multiples of four.

[0072] An embodiment of the present invention is characterized in that the support hinge member and the gate hinge member are both mainly formed from at least one hollow profile, the profile being preferably made from metal particularly aluminium, the profile preferably being extruded.

[0073] The use of metal, in particular aluminium, is common in outdoor applications. Aluminium has many advantages as a material, as it is at the same time robust and light-weight, it can withstand bad weather conditions and requires little maintenance. However, other metals are also suitable and their advantages or disadvantages are assumed to be known by the skilled person. The hinge members can be produced using various techniques depending on the material, including extrusion, cutting, setting, casting, welding, etc. The appropriate production technique is assumed to be known by the skilled person. Preferably, the hinge members are manufactured by means of an extrusion process in view of the economic benefits thereof. After the extrusion, various parts can be removed due to milling for example in order to provide the required spaces.

[0074] Naturally, in other embodiment, different materials and/or manufacturing techniques may be used. Noteworthy in this respect is the use of a thermoplastic material in injection moulding the hinge members in the context of smaller gates, e.g. pedestrian gates.

[0075] The advantages described above are also achieved by means of a closure system comprising a support and a closure member, such as a gate, hingedly connected to the support by a hinge as described above.

[0076] An embodiment of the present invention is characterized in that the support and the gate both comprise a hollow metal profile, the metal particularly being aluminium or (stainless) steel.

[0077] The use of hollow metal profile is commonly known in outdoor closure systems. The advantages thereof are: robustness, strength, ease of production, etc.

[0078] An embodiment of the present invention is characterized in that the support and the gate each comprise a same pattern of fixation openings.

[0079] This avoids that a different stock of parts is required for left-handed and right-handed closure members. Furthermore, it even allows to use the same metal profiles for gates and supports if desired.

[0080] An embodiment of the present invention is characterized in that the support comprises a cable receiving opening configured for allowing a power cable and/or a communication cable to pass therethrough.

[0081] Providing a pre-made cable opening avoids that an installer has to make this on site during assembly thus improving user friendliness. Furthermore, this also allows to make the opening before finishing the support or closure member so that there is no risk of damaging the finish coating. Likewise, the fixation openings are also preferably pre-made in the gate and support.

[0082] An embodiment of the present invention is characterized in that the hinge is mounted on a front or rear side of the closure system.

[0083] The hinge is thus not a nose hinge, but rather mounted in front or rear the closure system. The gate-support separation is thus minimal improving security.

[0084] It will be readily appreciated that, as will also become evident from the further description, that the above mentioned aspects of the invention and the various embodiments (incl. preferred, more preferred, advantageous, more advantageous, alternative, etc. embodiment and/or other optionally indicated features) should not be limited to individual elements, but may be combined with one another to achieve even other embodiments than those already described, which embodiments may also be part of the present invention as defined in the appended claims.

Brief description of the drawings

[0085] The invention will be further explained by means of the following description and the appended figures. Other particularities and advantages of the invention will become apparent from the following description of some particular embodiments of a mortice lock and of a keep according to the present invention. The reference numerals used in this description relate to the annexed drawing.

Figure 1 shows a perspective view of a closure system according to the present invention.

Figure 2 shows an exploded view of a hinge according to the present invention.

Figure 3A shows a longitudinal cross-section through a hinge according to the present invention.

Figure 3B shows a detail of figure 3A.

Figure 4A shows a longitudinal cross-section through a hinge according to the present invention in the upside down mounting position.

Figure 4B shows a detail of figure 4A.

Figure 5A shows a detail of the lower part of a hinge according to the present invention.

Figure 5B shows a cross-section along the line 'I' denoted in figure 5A.

Description of the invention

[0086] The present invention will be described with respect to particular embodiments and with reference 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. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes. The dimensions and the relative dimensions do not necessarily correspond to actual reductions to practice of the invention.

[0087] 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 sequential or chronological order. The terms are interchangeable under appropriate circumstances and the embodiments of the invention can operate in other sequences than described or illustrated herein.

[0088] Moreover, the terms top, bottom, over, under and the like in the description and the claims are used for descriptive purposes. The terms so used are interchangeable under appropriate circumstances and the embodiments of the invention described herein can operate in other orientations than described or illustrated herein.

[0089] Furthermore, the various embodiments, although referred to as "preferred" are to be construed as exemplary manners in which the invention may be implemented rather than as limiting the scope of the invention.

[0090] The term "substantially" includes variations of $\pm 5\%$ or less, preferably $\pm 3\%$ or less, more preferably $\pm 1\%$ or less, and more preferably $\pm 0.1\%$ or less, of the specified state, in so far the variations are applicable to function in the present invention. It is to be understood that the term "substantially A" is intended to also include "A".

[0091] Figure 1 shows a perspective view of a double wing gate 1 using hinges according to the present invention. The double wing gate 1 comprises a lock gate wing 2 and a striker gate wing 3. The lock gate wing 2 may be provided with a lock assembly and the striker gate wing 3 may be provided with a striker assembly. However, in the illustrated embodiment, no lock assembly and striker assembly are provided. Each gate wing 2, 3 is hingedly connected to a support 4 by means of an upper hinge 5 and a lower hinge 6. The upper hinge 5 will be described in detail below and is an electrically operated hinge according to the present invention. The lower hinge 6 is a commonly known hinge which adds additional support to the closure system 1. Naturally, the placement of the hinges may be reversed with the lower hinge being electrically operated.

[0092] More generally, the present invention relates to a closure system having first member and a second member that are hingedly attached to one another by means of one or more hinges 5. The first member is typically a fixed support 4, such as a wall or a post, while the second member is typically a moveable closure member 2, 3, such as a gate or a door.

[0093] The general directions and orientations are also indicated in figure 1. More specifically, there is the upright direction 15, the width direction 16 and the depth direction

17. These three directions 15, 16, 17 are generally substantially perpendicular to one another. The upright direction 15 in practice substantially coincides with the vertical direction. The width and depth directions 16, 17 together form a substantially horizontal plane.

[0094] In figure 1, both hinges 5 are identical to one another. It is only their orientation that is different. More specifically, closure member 2 is a left-handed gate and closure member 3 is a right-handed gate. The hinges 5 both extend in the upright direction 15 with the left hinge and the right hinge being turned upside down with respect to one another.

[0095] Figure 2 shows a partially exploded view of the electrically actuated hinge 5. The hinge 5 generally comprises a support hinge member 8 to be mounted on the support 4 and a gate hinge member 12 to be mounted on the closure member 2, 3. The support hinge member 8 includes a support leaf 7 and a central knuckle 6 which extends in a longitudinal direction 18 between a first end 6a and a second end 6b. In use, the longitudinal direction 18 coincides with the upright direction 15. The gate hinge member 12 includes a gate leaf 9, a first knuckle 10 adjacent the first end 6a of the central knuckle 6, and a second knuckle 11 adjacent the second end 6b of the central knuckle 6. The illustrated hinge 5 is thus a butterfly hinge, which is advantageous in the context of heavy duty hinges. In particular, it allows the central knuckle 6 to bear the weight of the gate 2 directly via the upper knuckle 10, 11 (depending on the orientation of the hinge 5).

[0096] Generally, the support 4 and closure member 2 are formed by hollow tubular members. Such a hollow tubular member is common in outdoor applications (e.g. as part of a fence) and usually has square or rectangular cross-sections with external dimensions of 4 cm, 5 cm or 6 cm (e.g. a rectangular cross-section of 3x6 cm or 4x6 cm). The dimensions of the support 4 and the closure member 2 may be the same. However, often the support 4 is wider than the closure member 2 as in the illustrated embodiment shown in figure 1.

[0097] In order to attach the hinge 5 to the closure system, use is made of fixture sets 23, 24. Suitable fixture sets 23, 24 are disclosed in EP 1907712 or EP 3575617 or WO2024156376 which are incorporated herein by reference. Each fixture set 23, 24 is pre-mounted on the rear side of the hinge 5 with fixture sets 23 being on the support hinge member 8 and fixture sets 24 being on the gate hinge member 12. For each fixture set 23, 24, a fixation opening is provided in the closure system 1. The pattern of fixation openings is preferably identical in the support 4 and the closure member 2. This aids in easily placing the hinge 5 in the required orientation for both left-handed and right-handed gates 2, 3.

[0098] In the unmounted state of the hinge 5, the fixture sets 23, 24 are insertable into the fixation openings. Each fixture set 23, 24 generally includes a threaded bolt, a splitter having a non-circular cross-section so that it is not rotatable with respect to the hinge 5, and a nut member disposed on the threaded bolt. Once the hinge 5 is

correctly placed on the closure system 1 with the nut members inside the hollow tubular profiles, the bolts are rotated. To this end, the bolt heads (not shown) are accessible from the front side of the hinge 5. This rotation of the bolts urges the nut members towards the hinge 5 and onto the splitter which thus expand the arms of the nut members. In this way, the expanded arms engage against the inner wall of the hollow tubular profiles 2, 4 to fix the hinge 5 to the closure system 1. It will be readily appreciated that more or fewer fixture sets may be used to fix the hinge 5 to the closure system 1. Moreover, other fastening means may also be used.

[0099] Any opening may be provided during production of the closure member 2 and/or support 4. Often, the hollow tubular members are produced by an extrusion process. The openings can then be applied by removing material, e.g. cutting, milling, grinding, etc. After the material removal, the tubular members can be provided with the desired finish, e.g. coating.

[0100] As shown in figure 5A, each fixture set 23, 24 is positioned within an elongated slots present in the hinge members 8, 12. More specifically, the fixture sets 23 are located in elongated slots 28 provided in the support hinge member 8, which slots extend in the width direction 16 and the fixture sets 24 are located in elongated slots 30 provided in the gate hinge member 12, which slots extend in the upright direction 15. This allows the placement of the fixture sets 23, 24 to vary with respect to the hinge 5 in both the upright direction 15 and the width direction 16. This adjustment thus allows placing the gate 2 closer to or farther from the support 4 in the width direction 16 and/or to move the gate 2 closer to or farther away from the ground surface.

[0101] In the illustrated embodiment, the width adjustment is done via the support hinge member 8 and the height adjustment is done via the gate hinge member 12. Naturally, these roles may be reversed if desired.

[0102] The hinge 5 according to the present invention generally comprises an electric actuator 14 integrated within the central knuckle 6 as shown in figures 3A and 3B. The electric actuator 14 is preferably a brushless DC motor and the person skilled in the art is assumed familiar with the characteristics and requirements thereof. In the illustrated embodiment, the electric actuator 14 is coupled with a reduction 90 which may be comprised between 1:100 and 1:1000, for example 1:200, 1:300 or 1:400. The reduction 90 could also be part of the electric actuator 14 or be absent. The electric actuator 14 generally has an output shaft 91. This may be, as in the illustrated embodiment, the output shaft from the reduction 90 or it may be an output directly from the electric actuator if there is no reduction. For the purposes of the present invention, further details regarding the electric actuator 14 and reduction 90 are not relevant.

[0103] The base constructional element which forms the support hinge member 8 is largely hollow. In this way, a hollow central knuckle 6 is formed which acts as a cylinder barrel 80. Likewise, the base constructional

element which forms the support hinge member 7 is largely hollow and provides space 81 for placing an electronic control module (not shown). A connection 36 (see figure 5A) is formed between the hollow interiors 80, 81 of the support leaf 7 and the cylinder barrel 6. This connection is better shown in figure 5B and is formed by a U-shaped passage 82 have an first opening 81 into the support leaf space 81 and a second opening 82b into the cylinder barrel 80. Via this U-shaped passage 82, a cable (not shown) can be routed between the electronic control module present in space 81 and the electric actuator 14 in space 80. As illustrated in figure 5B, this U-shaped passage 82 is sealed off by a cover 65. This cover 65 may be fixed to the support leaf 7 by threaded fasteners. A curable sealant (not shown) may also be poured into the U-shaped passage 82 to form a permanent and substantially impenetrable seal once all cables are placed.

[0104] The support leaf 7 is also provided with a front access opening 37 to allow placing the electronic control module inside the support leaf 7. This access opening 38 is eventually closed by a cover 49 as illustrated in figure 5B. This cover 49 is clicked onto the support leaf 7 and, in the illustrated embodiment, also seals the upper end face of the support leaf 7.

[0105] As already described, the hinge 5 is identical for both left-handed and right-handed gates 2. This is achieved by mounting the hinge 5 in different vertical orientations. Both orientations are shown in figures 3A and 4A. The constructional details of the connection between the hinge members 8, 12 and the actuator 14 will be described with respect to figures 2, 3B and 4B.

[0106] According to the present invention, the central knuckle 6 comprises a first internal support 105 near the first end 6a and a second internal support 106 near the second end 6b. The first internal support 105 is annular so as to allow the output shaft 91 to extend therethrough. The first internal support 105 may be integrally formed with the central knuckle 6. The second internal support 106 is disc-shaped and substantially closes of the second end 6b of the central knuckle 6. As shown in figure 4B, a seal 102 is present between the outer surface of the disc-shaped support 106 and the inner side of the central knuckle 6. This seal 102 prevents water infiltration.

[0107] The actuator 14 (and reduction 90 if present) is located between the internal supports 105, 106. On the other sides of the internal supports 105, 106 than the actuator 14, roller bearings 93, 98 are provided. The first roller bearing 93 has an outer race 93a which directly engages the outer wall of the central knuckle 6 and the internal support 105 as shown in figure 3B. The second roller bearing 98 has an outer race 98a which directly engages the outer wall of the central knuckle 6 and the internal support 106 as shown in figure 4B.

[0108] As shown in figure 2, various elements are present in the hinge knuckles 10, 11. The first hinge knuckle 10 is hollow to allow placing a cylindrical plug 73 therein, which plug 73 has a protruding section 71. The

plug 73 is fixed by means of transversally extending pin 76 that is slid through the gate hinge member 12 into an opening 72 in the plug 73. A cover 75 closes of the top of the first knuckle 10 and a sealing ring 74 is provided between the cover 75 and the plug 73.

[0109] Referring to figure 3B, a groove 94 is provided in the top of the first knuckle 10. The sealing ring 74 is disposed in this groove 74. To fasten the top cover 75 to the first knuckle 10, use is made of a click-fit ring 95 which is located in the circumferential groove 96 provided in the top cover 75. A corresponding groove is present in the inner wall of the first knuckle 10. The expanding click-fit ring 95 expands into the inner wall groove thereby fixing the cover 75 to the knuckle 10.

[0110] The protruding section 71 of the plug 73 extends towards the output shaft 91 and forms a gear hole 92 to cooperate with the output shaft 91 that acts as the gear shaft. Actuation of the actuator 14 is thus transferred to a pivoting motion of the gate hinge member 12. Naturally, the mechanic inversion with the gear hole on the actuator and the gear shaft formed by the cylindrical plug is also possible.

[0111] The first roller bearing 93 has an inner race 93b which directly engages the outer wall of the protruding section 71 of the plug 73. In the orientation of the hinge 5 shown in figure 3A, the roller bearing 93 thus bears the weight of the gate 2 via the inner race 93b and transfers this to the support hinge member 8 via the outer race 93a.

[0112] In order to reduce or avoid water infiltration, a seal 97 is placed between the first internal support 105 and the protruding section 71 of the plug 73 as shown in figure 3B.

[0113] Returning to figure 2, the second hinge knuckle 11 is hollow to allow placing a cylindrical plug 79 therein, which plug 78 has a protruding section 70. The plug 78 is fixed by means of transversally extending pin 77 that is slid through the gate hinge member 12 into an opening 79 in the plug 78. A cover 85 closes of the top of the second knuckle 11 and a sealing ring 84 is provided between the cover 85 and the plug 78.

[0114] Referring to figure 4B, a groove 101 is provided in the bottom of the second knuckle 11. The sealing ring 84 is disposed in this groove 101. To fasten the bottom cover 85 to the second knuckle 11, use is made of a click-fit ring 99 which is located in the circumferential groove 100 provided in the bottom cover 85. A corresponding groove is present in the inner wall of the second knuckle 11. The expanding click-fit ring 99 expands into the inner wall groove thereby fixing the cover 85 to the knuckle 11.

[0115] The second roller bearing 98 has an inner race 98b which directly engages the outer wall of the protruding section 70 of the plug 78. In the orientation of the hinge 5 shown in figure 4A, the roller bearing 98 thus bears the weight of the gate 2 via the inner race 98b and transfers this to the support hinge member 8 via the outer race 98a. Due to the disc-shaped support 106, there is no need for an additional seal between the plug 78 and the support 106.

[0116] Although aspects of the present disclosure have been described with respect to specific embodiments, it will be readily appreciated that these aspects may be implemented in other forms within the scope of the invention as defined by the claims.

Claims

1. An electrically operated hinge (5) for hinging a closure member (2), such as a gate, to a support (4), the hinge comprising:

- a support hinge member (8) comprising:

- a support leaf (7) configured to be fixed to the support; and
- a central knuckle (6) which extends between a first end (6a) and a second end (6b) in a longitudinal direction (18),

- a gate hinge member (12) pivotably mounted on the support hinge member and comprising:

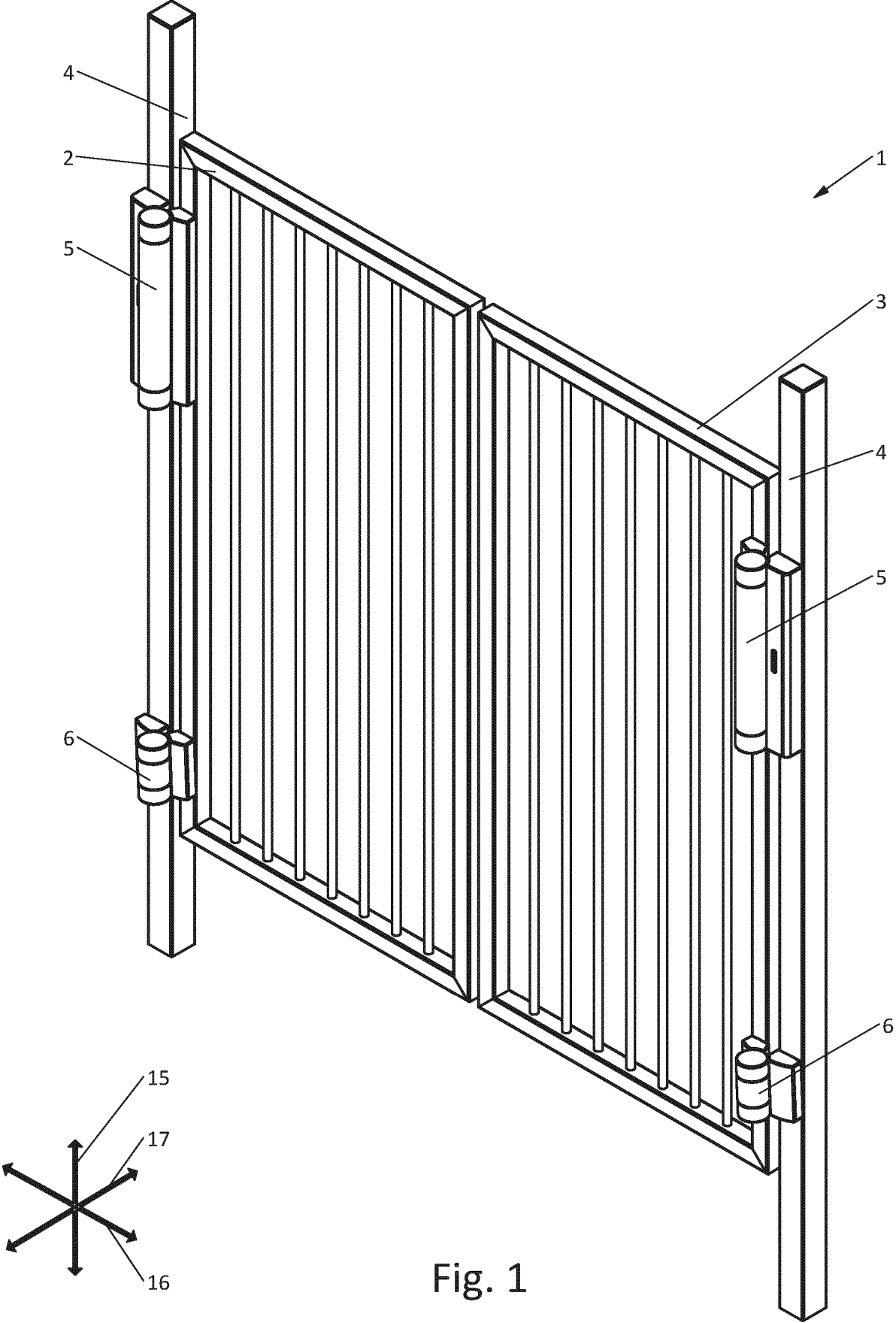
- a gate leaf (9) configured to be fixed to the closure member;
- a first knuckle (10) of the hinge situated adjacent the first end of the central knuckle; and
- a second knuckle (11) of the hinge situated adjacent the second end of the central knuckle,

- an electrically operated actuator (14) integrated within the knuckles of the hinge, **characterized in that:**

- the actuator is situated substantially entirely within the central knuckle;
- the first end of the central knuckle is provided with a first internal support (105) and the second end of the central knuckle is provided with a second internal support (106), the actuator being located between the internal supports in the longitudinal direction;
- the first end of the central knuckle is provided with a first roller bearing (93) adjacent the first internal support on an opposite side than the actuator and the second end of the central knuckle is provided with a second roller bearing (98) adjacent the second internal support on an opposite side than the actuator, the central knuckle engaging, either directly or indirectly, an outer side of the roller bearings; and
- the first knuckle has a first cylindrical protrusion (71) engaging, either directly or indirectly, an inner side of the first roller bearing and the second knuckle has a second cylindrical protrusion (70) engaging, either directly or indirectly,

an inner side of the second roller bearing.

2. The hinge according to claim 1, **characterized in that** the actuator is provided with an output member (91), such as an output shaft, and the first cylindrical protrusion engages the output member. 5
3. The hinge according to claim 2, **characterized in that** the first internal support is substantially annular with the output member and/or the first cylindrical protrusion extending therein. 10
4. The hinge according to claim 3, **characterized in that** a sealing ring (97) is provided between the first internal support and the first cylindrical protrusion. 15
5. The hinge according to any one of the preceding claims, **characterized in that** the second internal support is substantially disc-shaped thereby substantially closing the second end of the central knuckle. 20
6. The hinge according to any one of the preceding claims, **characterized in that** the first knuckle and the second knuckle both have a proximal end adjacent the central knuckle and a distal end facing away from the central knuckle, the first cylindrical protrusion extending beyond the proximal end of the first knuckle into the central knuckle and the second cylindrical protrusion extending beyond the proximal end of the second knuckle into the central knuckle. 25 30
7. The hinge according to claim 6, **characterized in that** the distal end of the first knuckle and the second knuckle are provided with a cover (75, 85), a seal (74, 84) preferably being located between the cover and its respective knuckle. 35
8. The hinge according to claim 6 or 7, **characterized in that** each cylindrical protrusion is fixed to its respective knuckle, in particular by means of a transversely extending pin (76, 77). 40
9. The hinge according to any one of the preceding claims, **characterized in that** the support hinge member is configured to be irrotatably fixed to the support with its longitudinal axis in a first orientation for a right-handed closure member and in a second orientation, opposite to the first orientation, for a left-handed closure member. 45 50
10. The hinge according to claim 9, **characterized in that** the first knuckle and the second knuckle both have a proximal end adjacent the central knuckle and a distal end facing away from the central knuckle, the first cylindrical protrusion extending beyond the proximal end of the first knuckle into the central knuckle and the second cylindrical protrusion extending beyond the proximal end of the second knuckle into the central knuckle, and 55
11. The hinge according to any one of the preceding claims, **characterized in that** the hinge further comprises an electronic control module configured for controlling the actuator, and **in that** the support leaf comprises a hollow free space which forms an electrical enclosure in which said electronic control module is housed.
12. The hinge according to claim 11, **characterized in that** a connection (82) extends between the hollow free space and an interior of the central knuckle along which one or more cables may extend.
13. The hinge according to claim 12, **characterized in that** said connection is mainly U-shaped and/or is sealed by a curable sealant.
14. A closure system (1) comprising: a support (4) and a closure member (2,3), such as a gate, hingedly connected to the support by a hinge according to any one of the preceding claims.
15. The closure system according to claim 14, **characterized in that** the hinge is mounted on a front or rear side of the closure system.



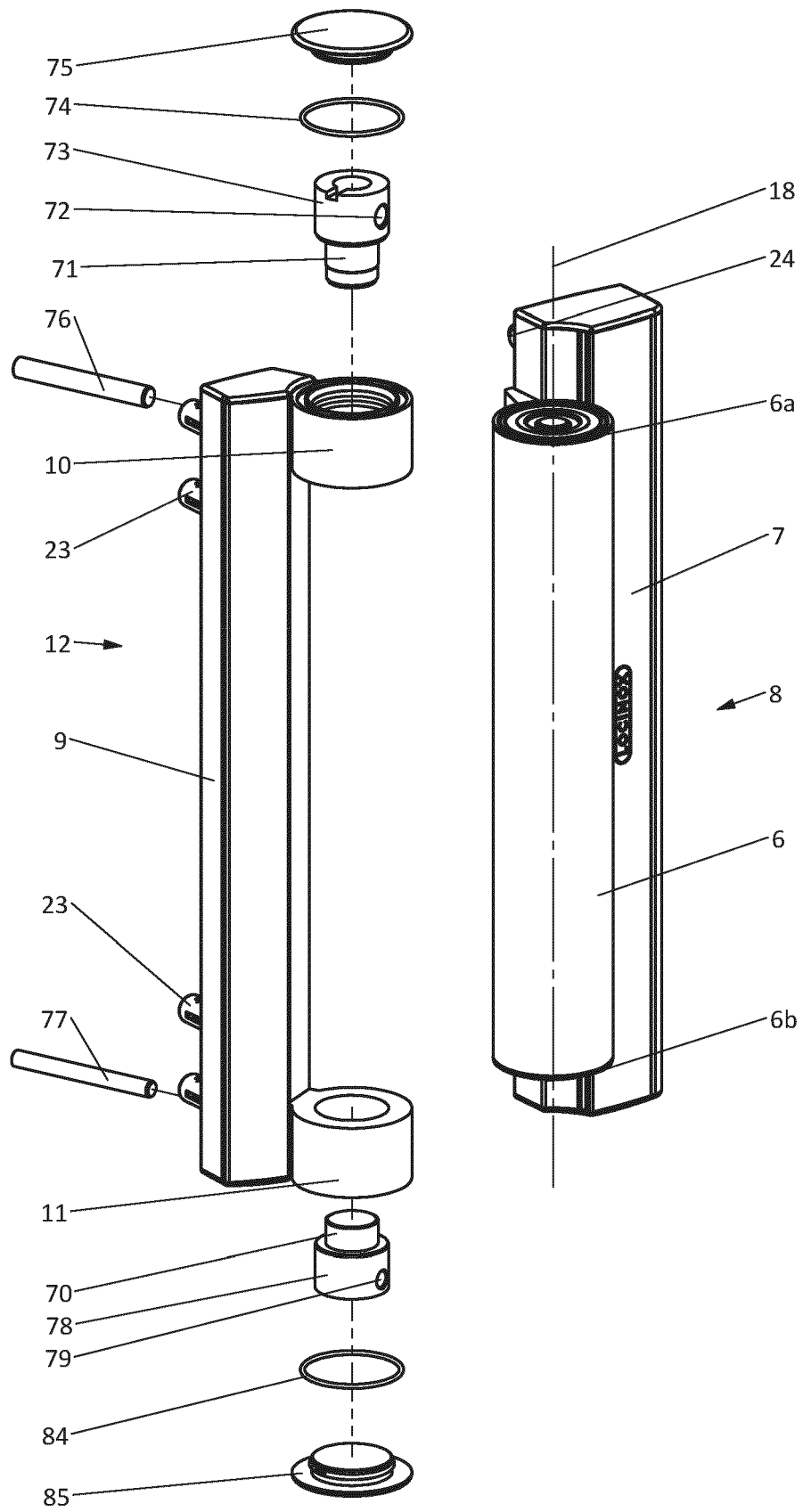


Fig. 2

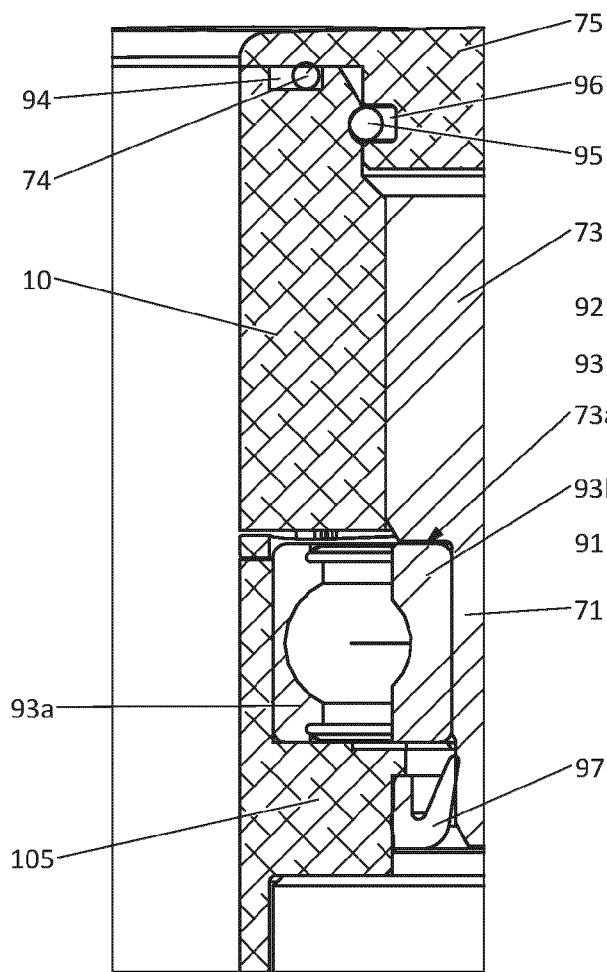


Fig. 3B

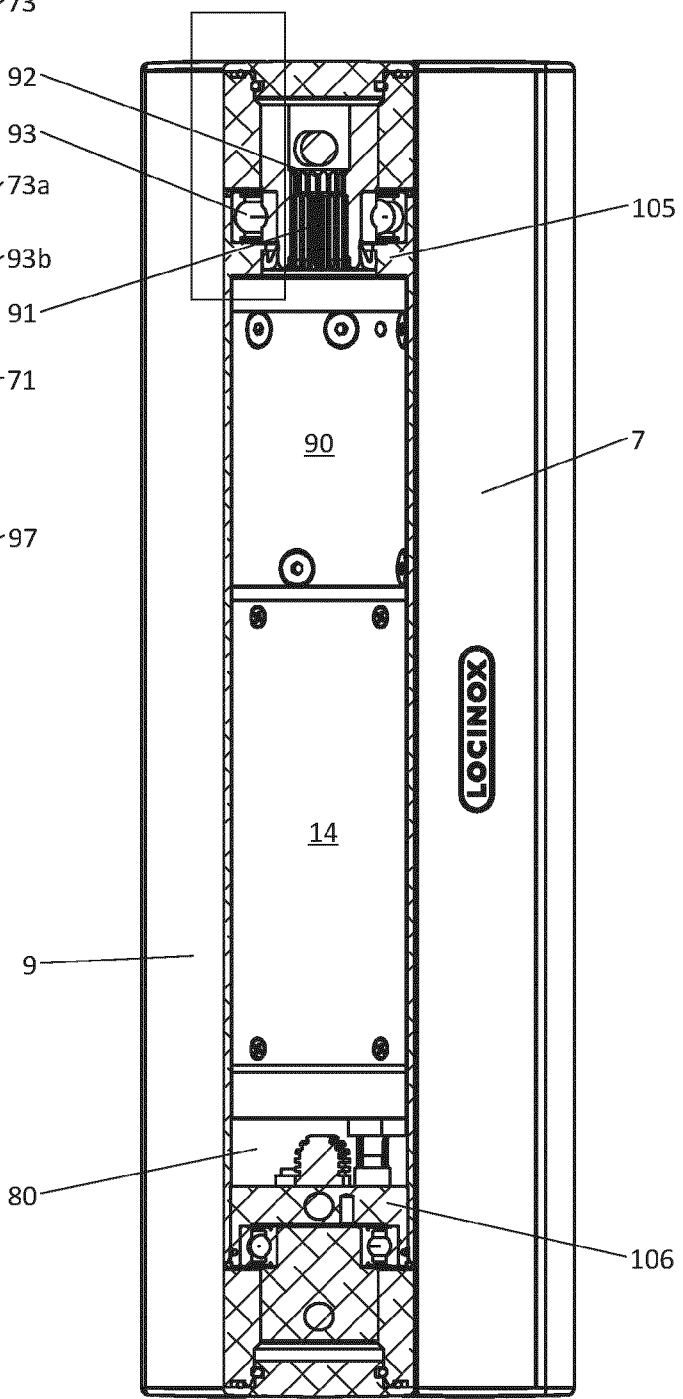
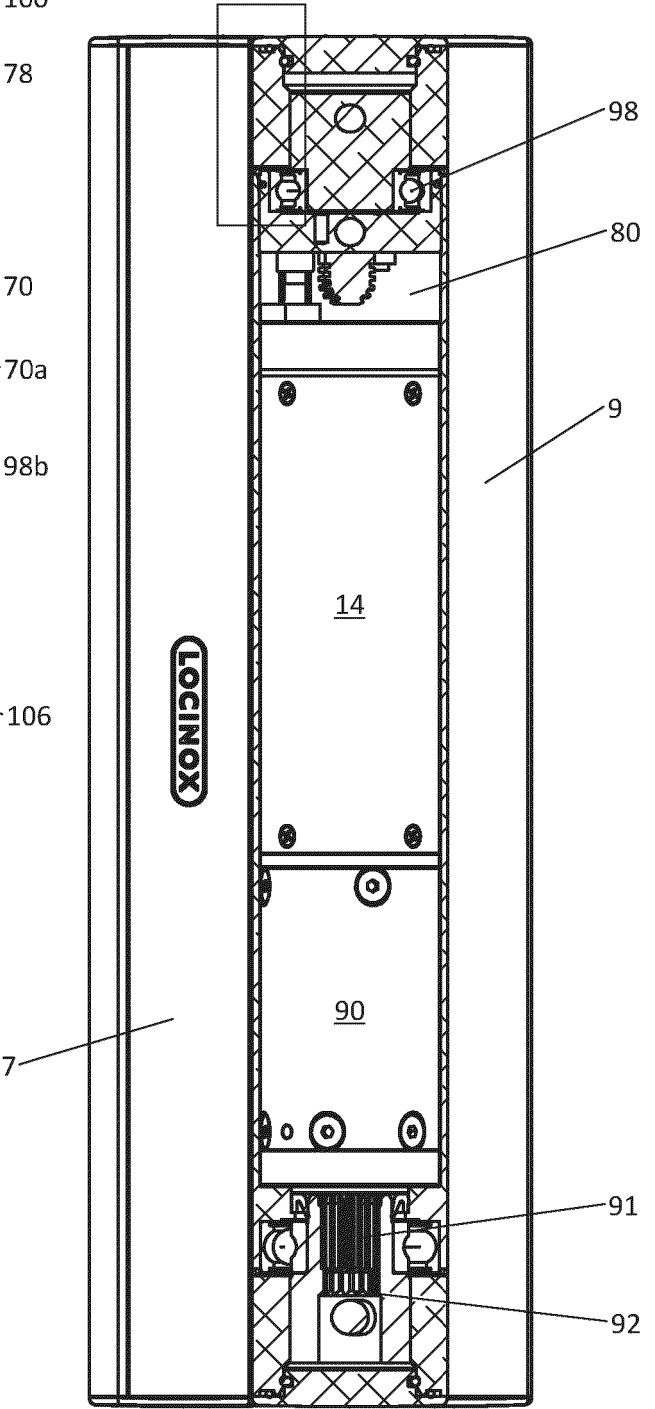
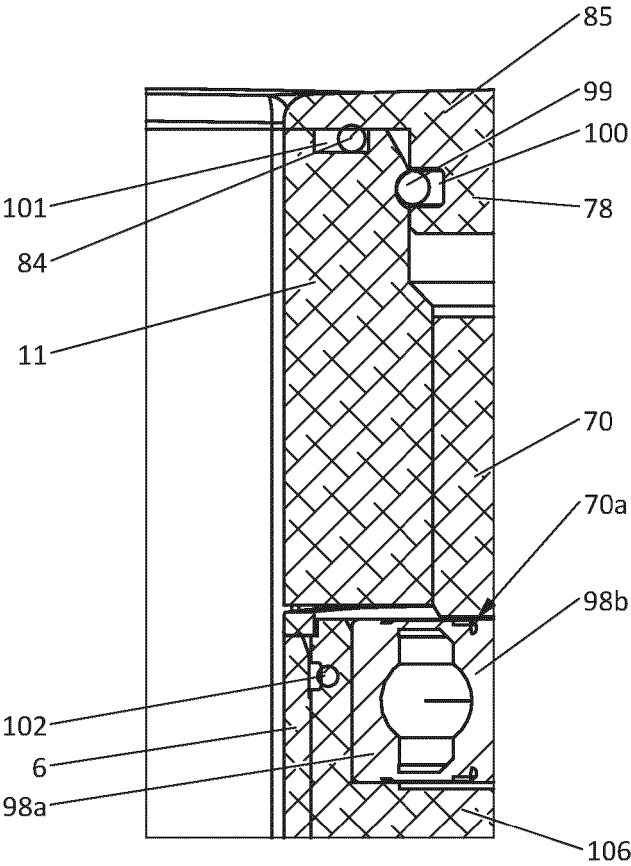


Fig. 3A



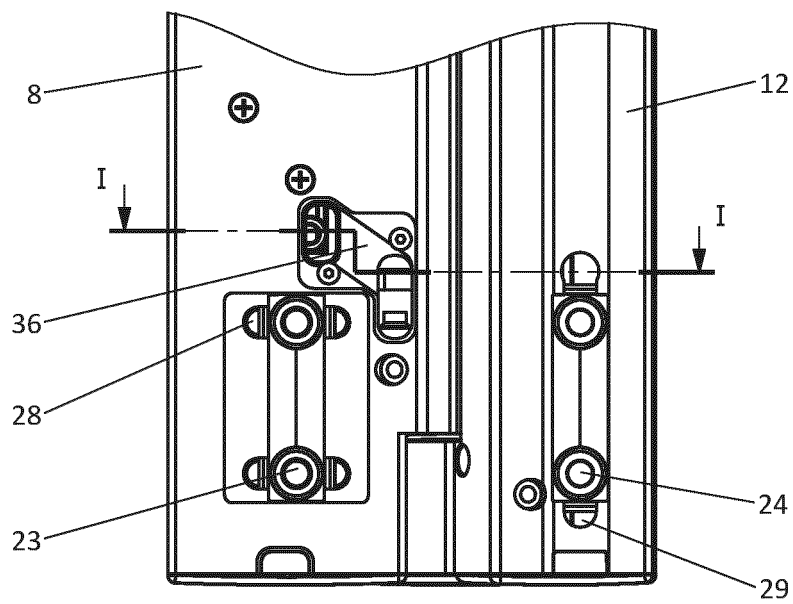


Fig. 5A

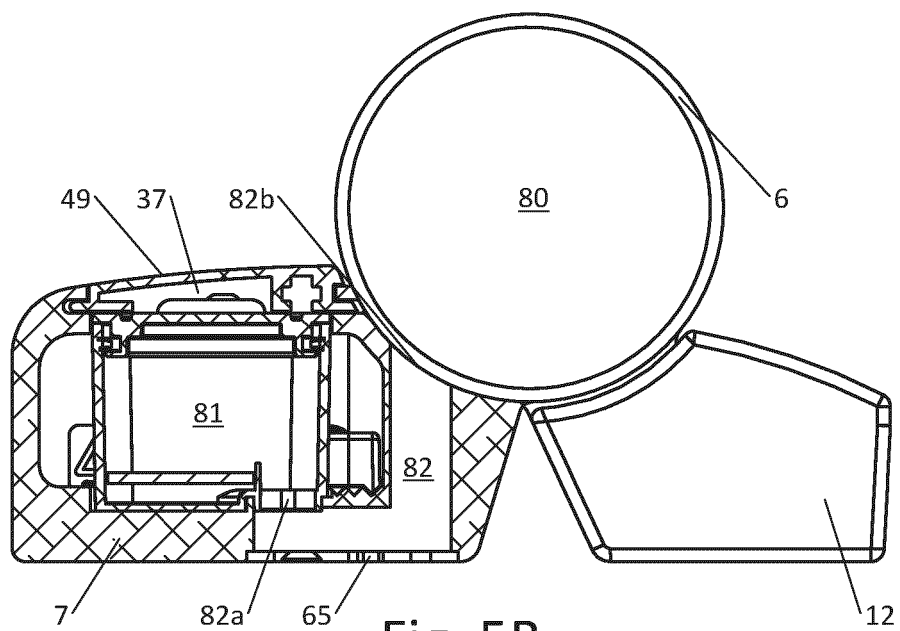


Fig. 5B



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Application Number

EP 25 16 7972

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A	* column 11, line 40 - column 12, line 52; figures 1,2,3,6,7,11,18 *	10-13	E05F15/614
Y	US 2023/146774 A1 (TALPE JOSEPH [BE]) 11 May 2023 (2023-05-11) * paragraph [0155] - paragraph [0158]; figures 11,12 *	1-9,14, 15	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC)
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Place of search		Date of completion of the search	Examiner
The Hague		29 July 2025	Loverdou, Lefki
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