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(54) LOCK ASSEMBLY FOR AN ARTICLE OF JEWELLERY SUCH AS A BRACELET

VERSCHLUSSANORDNUNG FÜR EINEN SCHMUCKGEGENSTAND WIE EIN ARMBAND

ENSEMBLE DE VERROUILLAGE POUR UN ARTICLE DE JOAILLERIE TEL QU'UN BRACELET

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Description

Field of the invention

[0001] The present invention relates to a lock assembly for an article of jewellery having two free ends to be connected to each other, such as a bracelet, necklace, etc.

Background art

[0002] International patent publication WO2012/155914 discloses a locking device for connecting two end loops of a jewellery strand such as a bracelet or necklace. The locking device comprises a strand retainer with retainer loops for engaging with the jewellery strands, and a separate clip member having two half shells hinged together and snap lockable for forming a through hole.

[0003] Document US 2009/199367 A1 discloses a lock assembly for an article of jewellery having two free ends to be connected to each other according to the preamble of claim 1.

Summary of the invention

[0004] The present invention seeks to provide an improved lock assembly for a bracelet or necklace, which is lockable once and easy to apply using a single hand.

[0005] According to the present invention, a locking assembly as defined above is provided, comprising a first base part and a second base part, the first base part and/or second base part comprising a first end attachment part and a second end attachment part. Furthermore, a pivotal connection assembly is present for pivotally connecting the first base part and the second base part, comprising a pivot pin extending substantially perpendicular from a major surface of one of the first and second base part, and a pivot aperture in the other one of the first and second base part, a diameter of the pivot pin and a diameter of the pivot aperture being substantially equal. Also, a fixation assembly is provided for locking the first base part and second base part in a fixed mutual position, comprising a locking extension on a major surface of one of the first and second base part, and a locking aperture in a major surface of the other one of the first and second base part, a diameter of the locking extension being equal to or larger than a diameter of the locking aperture.

[0006] Such a locking assembly, having both a pivotal connection assembly, and a fixation assembly allows to operate the lock assembly with a single hand, to connect and fix the two free ends of the article of jewellery.

Short description of drawings

[0007] The present invention will be discussed in more detail below, with reference to the attached drawings, in which

Fig. 1 shows a perspective view of two base parts of a locking assembly according to an embodiment of the present invention;

Fig. 2A-C show a perspective view of a locking assembly according to an embodiment of the present invention in subsequent locking steps; and

Fig. 3A-C show a further perspective view of the locking assembly embodiment of Fig. 2 in subsequent locking steps.

Description of embodiments

[0008] Articles of jewellery such as bracelets, necklaces and the like, are often in the form of a chain, band or chord, with two open ends which are connected together using a locking assembly. The present invention embodiments are directed at a locking assembly for an article of jewellery, which can be handled and operated using only a single hand, which is especially advantageous for connecting together ends of a bracelet. Furthermore, the present invention embodiments are arranged to be able to be locked only once, after which the bracelet or necklace can only be unlocked by forced opening, destroying the locking assembly.

[0009] Fig. 1 shows a perspective view of two base parts 2, 3 of a locking assembly 1 according to an exemplary embodiment of the present invention. The locking assembly 1 may be used for an article of jewellery having two free ends to be connected to each other, such as a bracelet, necklace, etc. and comprises a first base part 2 shown in Fig. 1 having a thickness t1 and a second base part 3 shown in Fig. 1 having a thickness t2. Exemplary values are e.g. t1=0.55mm and t2=1.25mm. In general, the first base part 2 and/or second base part 3 comprise a first end attachment part 4 and a second end attachment part 5 for attaching the two free ends of the article of jewellery. In the embodiment shown in Fig. 1, the second base part 3 comprises both the first and second end attachment parts 4, 5.

[0010] From the view of Fig. 1, it is clear that the locking assembly 1 further comprises a pivotal connection assembly 6 for pivotally connecting the first base part 2 and the second base part 3. As shown in the embodiment of Fig. 1, the pivotal connection assembly 6 comprises a pivot pin 7 extending substantially perpendicular from a major surface of one of the first and second base part 2; 3, and a pivot aperture 8 in the other one of the first and second base part 3; 2. In the exemplary embodiment shown in Fig. 1, the pivot pin 7 is provided as part of the first base part 2, having a height h1, and the pivot aperture 8 is provided as part of the second base part 3. A diameter of the pivot pin 7 and a diameter of the pivot aperture 8 are substantially equal, allowing mutual rotation of the first base part 2 with respect to the second base part 3. The diameters of pivot pin 7 and pivot aperture are e.g. in the order of magnitude of 0.5mm.

[0011] Furthermore, the locking assembly 1 comprises a fixation assembly 9 for locking the first base part 2 and

second base part 3 in a fixed mutual position. The fixation locking assembly 9 comprises a locking extension 10 on a major surface of one of the first and second base part 2; 3, and a locking aperture 11 in a major surface of the other one of the first and second base part 3; 2. In the exemplary embodiment shown in Fig. 1, the locking extension 10 is provided as a rounded column on the major surface of first base part 1, having a height h2. A diameter of the locking extension 10 is equal to or (slightly) larger than a diameter of the locking aperture 11, which allows to lock the first and second base part 2, 3 together by pressing. Exemplary values are e.g. h1=1.15mm and h2=0.6mm, and the associated diameters are in the order of magnitude of e.g. 1mm.

[0012] It is noted that in the exemplary embodiment shown in Fig. 1, the first base part 2 and the second base part 3 are congruent, with both having a corresponding major surface, and a congruent outer shape, in this example a rectangle with rounded corners. In further embodiments, different shapes of the first base part 2 and/or second base part 3 are possible, such as a square, triangular, round, ellipsoid, multi-angular shape, etc.

[0013] The first end attachment part 4 is arranged for fixed connection of one of the free ends of the article of jewellery in a further embodiment. In the exemplary embodiment shown in Fig. 1, the first end attachment part 4 is a cavity provided in a side surface of the second base part 3, allowing to connect the free end e.g. using (laser) welding, soldering, gluing, knotting, or other connection techniques.

[0014] The second end attachment part 5 comprises a cavity 15 in a major surface of one of the first and second base part 2; 3 with an external access aperture 16 in a further embodiment. The cavity 15 is accessible for the other one of the free ends of the article of jewellery when the first base part 2 and second base part 3 are pivoted into an initial non-locked position. In the embodiment shown in Fig. 1, the cavity 15 is circular shaped, and the external access aperture 16 is provided in a side wall of the second base part 3, opposite to the first end attachment part 4. In an embodiment, not shown in the figures, the cavity 15 may be rectangular, e.g. square.

[0015] Fig. 2A-C each show a perspective view of a locking assembly according to an embodiment of the present invention in subsequent locking steps, and Fig. 3A-C each show a further perspective view of the locking assembly embodiment of Fig. 2 in the subsequent locking steps from the other side.

[0016] In the perspective views of Fig. 2A-C and 3A-C, a further embodiment of the present invention is shown, wherein the one of the free ends of the article of jewellery comprises an end body 17 having a shape congruent with the cavity 15, e.g. having a circular shape congruent with a circular cavity 15 or having a rectangular shape congruent with a rectangular cavity 15. This allows the locking assembly 1 to be provided as a part of an article of jewellery having two free ends to be connected to each other, with one of the free ends attached to the first end attachment part 4 and the second end connected to the end body 17. The sequence of views in Fig. 2 and 3 then show how the locking assembly can be operated for a one-time locking operation: First, the first body part 2 and second body part 3 (with one of the ends of the article of jewellery attached) are pivotally connected by having the pivot pin 7 enter the pivot cavity 8. By proper mutual positioning, the cavity 15 is open for receiving the end body 17, and once the end body 17 is positioned in the cavity 15, the first base part 2 and second base part 3 are pivoted until the locking extension 10 is aligned with the locking aperture 11. Note that the mutual orientation and positioning of the end body 17 and cavity 15 may be simplified by having a circular cavity 15 and a congruent circular end body 17, wherein the circular shape allows for some rotational freedom between the end body 17 and the cavity 15 parallel to the major surface of the second base part 3 for example. Alternatively, having a rectangular cavity 15 and a congruent rectangular end body 17 may provide less rotational freedom but may improve strength, (rotational) stability and fixation of the rectangular end body 17 when positioned inside the rectangular cavity 15.

[0017] The first base part 2 and second base part 3 are then pressed together, and because of the slightly differing diameter of the locking extension 10 and locking aperture 11, the locking assembly 1 is fixed and locked. Note that the various steps can be performed using a single hand, which especially for bracelets is very advantageous.

[0018] In a further embodiment, the locking extension 10 has a height h2 which is less than a thickness t2; t1 of the other one of the first and second base part 3; 2. In the embodiment shown in Fig. 1, the height h2 of the locking assembly is less than a thickness t2 of the second base part 3, allowing the locking extension 10 to be operable within the thickness of the second base part 3, i.e. invisible from the outside once locked.

[0019] In the lock assembly 1 of a further embodiment, the fixation assembly 9 further comprises a locking extension guide 12. The locking extension guide 12 allows mutual pivoting of the first and second base part 2, 3 around the pivotal connection assembly 6, as shown in the sequential steps of Fig. 2A-C.

[0020] In order to have a proper pivoting of the first base part 2 and the second base part 3, in a further embodiment, the locking extension guide 12 has a curvature r corresponding to a radius from a pivot point of the pivotal connection assembly 6.

[0021] In an even further embodiment, the locking extension guide 12 has a depth from the major surface of less than a height h2 of the locking extension 10. This ensures the first base part 2 and second base part 3 are pivoting at a pre-set distance from each other in the sequence of steps in Fig. 2 and 3, allowing a smooth and well defined manner. To further enhance this effect, in an even further embodiment, the locking extension guide 12 has a cross sectional shape congruent with a shape

of an (upper) end of the locking extension 10. In the exemplary embodiments shown herein, the locking extension 10 has a half dome shaped (upper) end.

[0022] It is noted that the material of the locking assembly 1 may be any metal or plastic material suitable for the intended use as part of an article of jewellery. All components and parts of the locking assembly 1 are such that these are easy to manufacture, depending on the choice of material.

[0023] In a further exemplary embodiment, the pivot aperture 8 extends entirely through the other one of the first and second base part 3; 2. Although not really necessary for providing a proper pivoting action, in this exemplary embodiment, use is made of the maximum possible length of the pivoting aperture 8 in order to have a well-defined and properly functioning pivot assembly 6.

[0024] In the exemplary embodiments shown in the Figs. 1, 2 and 3, the pivot pin 7 and locking extension 10 are provided in the first base part 2, and the pivot aperture 8 and locking aperture 11 are provided in the second base part 3. This arrangement of the locking assembly 1 components allows to make the first base part 2 thinner than the second base part 3, resulting in a smaller total thickness of the locking assembly 1 once locked.

[0025] Advantageously, the pivot pin 7 and locking extension 10 are an integral part of the first base part 2. This may be accomplished by selecting a proper manufacturing technique (e.g. milling, welding or 3D printing), and provides a maximum strength of the combination of components.

[0026] In an alternative embodiment, the pivot pin 7 and locking aperture 11 are provided in the first base part 2, and the pivot aperture 8 and locking extension 10 are provided in the second base part 3. This alternative positioning of pivot pin 7 and locking extension 10 can also provide additional benefits such as ease of manufacturing, etc.

[0027] The present invention has been described above with reference to a number of exemplary embodiments as shown in the drawings. Modifications and alternative implementations of some parts or elements are possible, and are included in the scope of protection as defined in the appended claims.

Claims

1. A lock assembly (1) for an article of jewellery having two free ends to be connected to each other, comprising

a first base part (2) and a second base part (3), the first base part (2) and/or second base part (3) comprising a first end attachment part (4) and a second end attachment part (5),
a pivotal connection assembly (6) for pivotally connecting the first base part (2) and the second base part (3), comprising a pivot pin (7) extending substantially perpendicular from a major surface of one of the first and second base part (2; 3), and a pivot aperture (8) in the other one of the first and second base part (3; 2), a diameter of the pivot pin (7) and a diameter of the pivot aperture (8) being substantially equal,
a fixation assembly (9) for locking the first base part (2) and second base part (3) in a fixed mutual position, comprising a locking extension (10) on a major surface of one of the first and second base part (2; 3), and a locking aperture (11) in a major surface of the other one of the first and second base part (3; 2), a diameter of the locking extension (10) being equal to or larger than a diameter of the locking aperture (11),
characterized in that
the second end attachment part (5) comprises a cavity (15) in a major surface of one of the first and second base part (2; 3) with an external access aperture (16), the cavity (15) being accessible for one of the free ends of the article of jewellery when the first base part (2) and second base part (3) are pivoted into an initial non-locked position.

2. The lock assembly according to claim 1, wherein the locking extension (10) has a height (h2) which is less than a thickness (t2; t1) of the other one of the first and second base part (3; 2).

3. The lock assembly according to claim 1 or 2, wherein the fixation assembly (9) further comprises a locking extension guide (12).

4. The lock assembly according to claim 3, wherein the locking extension guide (12) has a curvature (r) corresponding to a radius from a pivot point of the pivotal connection assembly (6).

5. The lock assembly according to claim 3 or 4, wherein the locking extension guide (12) has a depth from the major surface of less than a height (h2) of the locking extension (10).

6. The lock assembly according to any one of claims 3-5, wherein the locking extension guide (12) has a cross sectional shape congruent with a shape of an end of the locking extension (10).

7. The lock assembly according to any one of claims 1-6, wherein the locking extension (10) has a half dome shaped end.

8. The lock assembly according to any one of claims 1-7, wherein the pivot aperture (8) extends entirely through the other one of the first and second base part (3; 2).

9. The lock assembly according to any one of claims 1-8, wherein the pivot pin (7) and locking extension (10) are provided in the first base part (2), and the pivot aperture (8) and locking aperture (11) are provided in the second base part (3).

10. The lock assembly according to claim 9, wherein the pivot pin (7) and locking extension (10) are an integral part of the first base part (2).

11. The lock assembly according to any one of claims 1-8, wherein the pivot pin (7) and locking aperture (11) are provided in the first base part (2), and the pivot aperture (8) and locking extension (10) are provided in the second base part (3).

12. The lock assembly according to any one of claims 1-11, wherein the first end attachment part (4) is arranged for fixed connection of one of the free ends of the article of jewellery.

13. The lock assembly according to any one of claims 1-12, wherein the one of the free ends of the article of jewellery comprises an end body (17) having a shape congruent with the cavity (15).

14. The lock assembly according to claim 13, wherein the cavity (15) has a circular shape and wherein the end body (17) has a circular shape congruent with the circular cavity (15).

15. The lock assembly according to claim 13, wherein the cavity (15) has a rectangular shape and wherein the end body (17) has a rectangular shape congruent with the rectangular cavity (15).

Patentansprüche

1. Verschlussanordnung (1) für einen Schmuckgegenstand mit zwei miteinander zu verbindenden freien Enden, die Folgendes umfasst:

ein erstes Basisteil (2) und ein zweites Basisteil (3), wobei das erste Basisteil (2) und/oder das zweite Basisteil (3) einen ersten Endbefestigungsteil (4) und einen zweiten Endbefestigungsteil (5) umfassen,
eine Schwenkverbindungsanordnung (6) für die schwenkbare Verbindung des ersten Basisteils (2) und des zweiten Basisteils (3), umfassend einen Drehzapfen (7), der im Wesentlichen senkrecht von einer großen Oberfläche des ersten oder des zweiten Basisteils (2; 3) verläuft, und eine Schwenköffnung (8) in dem anderen des ersten oder zweiten Basisteils (3; 2), wobei ein Durchmesser des Drehzapfens (7) und ein Durchmesser der Schwenköffnung (8) im Wesentlichen gleich sind,
eine Befestigungsanordnung (9) zum Verschluss des ersten Basisteils (2) und des zweiten Basisteil (3) in einer festen gegenseitigen Position, umfassend einen Verschlussfortsatz (10) auf einer großen Oberfläche des ersten oder des zweiten Basisteils (2; 3) und eine Verschlussöffnung (11) in einer großen Oberfläche des anderen des ersten oder des zweiten Basisteils (3; 2), wobei ein Durchmesser des Verschlussfortsatzes (10) gleich oder größer als ein Durchmesser der Verschlussöffnung (11) ist,
dadurch gekennzeichnet, dass
der zweite Endbefestigungsteil (5) in einer großen Oberfläche des ersten oder zweiten Basisteils (2; 3) einen Hohlraum (15) mit einer äußeren Zugangsöffnung (16) umfasst, wobei der Hohlraum (15) für eines der freien Enden des Schmuckgegenstandes zugänglich wird, wenn das erste Basisteil (2) und das zweite Basisteil (3) in eine nicht verriegelte Ausgangsposition geschwenkt werden.

2. Verschlussanordnung nach Anspruch 1, wobei der Verschlussfortsatz (10) eine Höhe (h2) aufweist, die geringer als eine Dicke (t2; t1) des anderen des ersten oder zweiten Basisteils (3; 2) ist.

3. Verschlussanordnung nach Anspruch 1 oder 2, wobei die Befestigungsanordnung (9) ferner eine Verschlussfortsatzführung (12) umfasst.

4. Verschlussanordnung nach Anspruch 3, wobei die Verschlussfortsatzführung (12) eine Krümmung (r) aufweist, die einem Radius von einem Schwenkpunkt der Schwenkverbindungsanordnung (6) entspricht.

5. Verschlussanordnung nach Anspruch 3 oder 4, wobei die Verschlussfortsatzführung (12) eine Tiefe von der großen Hauptfläche von weniger als einer Höhe (h2) des Verschlussfortsatzes (10) aufweist.

6. Verschlussanordnung nach einem der Ansprüche 3-5, wobei die Verschlussfortsatzführung (12) eine Querschnittsform aufweist, die mit einer Form eines Endes des Verschlussfortsatzes (10) übereinstimmt.

7. Verschlussanordnung nach einem der Ansprüche 1-6, wobei der Verschlussfortsatz (10) ein halbkuppelförmiges Ende aufweist.

8. Verschlussanordnung nach einem der Ansprüche 1-7, wobei sich die Schwenköffnung (8) vollständig durch das andere des ersten oder des zweiten Basisteils (3; 2) erstreckt.

9. Verschlussanordnung nach einem der Ansprüche 1-8, wobei der Drehzapfen (7) und der Verschlussfortsatz (10) im ersten Basisteil (2) vorgesehen sind und die Schwenköffnung (8) und die Verschlussöffnung (11) im zweiten Basisteil (3) vorgesehen sind.

10. Verschlussanordnung nach Anspruch 9, wobei der Drehzapfen (7) und der Verschlussfortsatz (10) ein integrales Bestandteil des ersten Basisteils (2) sind.

11. Verschlussanordnung nach einem der Ansprüche 1-8, wobei der Drehzapfen (7) und die Verschlussöffnung (11) im ersten Basisteil (2) vorgesehen sind und die Schwenköffnung (8) und der Verschlussfortsatz (10) im zweiten Basisteil (3) vorgesehen sind.

12. Verschlussanordnung nach einem der Ansprüche 1-11, wobei der erste Endbefestigungsteil (4) zur festen Verbindung eines der freien Enden des Schmuckgegenstandes angeordnet ist.

13. Verschlussanordnung nach einem der Ansprüche 1-12, wobei das eine der freien Enden des Schmuckgegenstandes einen Endkörper (17) umfasst, dessen Form mit dem Hohlraum (15) übereinstimmt.

14. Verschlussanordnung nach Anspruch 13, wobei der Hohlraum (15) eine kreisförmige Form aufweist und wobei der Endkörper (17) eine kreisförmige Form aufweist, die mit dem kreisförmigen Hohlraum (15) übereinstimmt.

15. Verschlussanordnung nach Anspruch 13, wobei der Hohlraum (15) eine rechteckige Form aufweist und wobei der Endkörper (17) eine rechteckige Form aufweist, die mit dem rechteckigen Hohlraum (15) übereinstimmt.

Revendications

1. Ensemble de verrouillage (1) pour un article de joaillerie ayant deux extrémités libres pour être connectées l'une à l'autre, comprenant

une première partie de base (2) et une deuxième partie de base (3), la première partie de base (2) et/ou la deuxième partie de base (3) comprenant une première partie de fixation d'extrémité (4) et une deuxième partie de fixation d'extrémité (5),
un ensemble de connexion pivotant (6) pour connecter de manière pivotante la première partie de base (2) et la deuxième partie de base (3), comprenant un axe de pivot (7) s'étendant sensiblement perpendiculaire à partir d'une surface majeure de l'une parmi la première et la deuxième partie de base (2, 3), et une ouverture de pivot (8) dans l'autre parmi la première et la deuxième partie de base (3, 2), un diamètre de l'axe de pivot (7) et un diamètre de l'ouverture de pivot (8) étant sensiblement égal,
un ensemble de fixation (9) pour verrouiller la première partie de base (2) et la deuxième partie de base (3) dans une position mutuelle fixe, comprenant une extension de verrouillage (10) sur une surface majeure de l'une parmi la première et la deuxième partie de base (2, 3), et une ouverture de verrouillage (11) dans une surface majeure de l'autre parmi la première et la deuxième partie de base (3, 2), un diamètre de l'extension de verrouillage (10) étant égal à ou supérieur à un diamètre de l'ouverture de verrouillage (11),
caractérisé en ce que
la deuxième partie de fixation d'extrémité (5) comprend une cavité (15) dans une surface majeure de l'une parmi la première et la deuxième partie de base (2, 3) avec un ouverture d'accès externe (16), la cavité (15) étant accessible pour l'une des extrémités libres de l'article de joaillerie lorsque la première partie de base (2) et la deuxième partie de base (3) sont pivotées dans une position initiale non verrouillée.

2. Ensemble de verrouillage selon la revendication 1, où l'extension de verrouillage (10) a une hauteur (h2) qui est inférieure à une épaisseur (t2, t1) de l'autre parmi la première et la deuxième partie de base (3, 2).

3. Ensemble de verrouillage selon la revendication 1 ou 2, où l'ensemble de fixation (9) comprend en outre un guide d'extension de verrouillage (12).

4. Ensemble de verrouillage selon la revendication 3, où le guide d'extension de verrouillage (12) a une courbure (r) correspondant à un rayon d'un point de pivot de l'ensemble de connexion pivotant (6).

5. Ensemble de verrouillage selon la revendication 3 ou 4, où le guide d'extension de verrouillage (12) a une profondeur à partir de la surface majeure inférieure à une hauteur (h2) de l'extension de verrouillage (10).

6. Ensemble de verrouillage selon l'une quelconque des revendications 3 à 5, où le guide d'extension de verrouillage (12) a une forme de section transversale congruente avec une forme d'une extrémité de l'extension de verrouillage (10).

7. Ensemble de verrouillage selon l'une quelconque des revendications 1 à 6, où l'extension de verrouillage (10) a une extrémité en forme de demi-dôme.

8. Ensemble de verrouillage selon l'une quelconque des revendications 1 à 7, où l'ouverture de pivot (8) s'étend entièrement à travers l'autre parmi la première et la deuxième partie de base (3, 2).

9. Ensemble de verrouillage selon l'une quelconque des revendications 1 à 8, où l'axe de pivot (7) et l'extension de verrouillage (10) sont prévus dans la première partie de base (2), et l'ouverture de pivot (8) et l'ouverture de verrouillage (11) sont prévues dans la deuxième partie de base (3).

10. Ensemble de verrouillage selon la revendication 9, où l'axe de pivot (7) et l'extension de verrouillage (10) sont une partie intégrale de la première partie de base (2).

11. Ensemble de verrouillage selon l'une quelconque des revendications 1à 8, où l'axe de pivot (7) et l'ouverture de verrouillage(11) sont prévus dans la première partie de base (2), et l'ouverture de pivot (8) et l'extension de verrouillage (10) sont prévues dans la deuxième partie de base (3).

12. Ensemble de verrouillage selon l'une quelconque des revendications 1 à 11, où la première partie de fixation d'extrémité (4) est conçue pour une connexion fixe de l'une des extrémités libres de l'article de joaillerie.

13. Ensemble de verrouillage selon l'une quelconque des revendications 1 à 12, où l'une des extrémités libres de l'article de joaillerie comprend un corps d'extrémité (17) ayant une forme congruente avec la cavité (15).

14. Ensemble de verrouillage selon la revendication 13, où la cavité (15) a une forme circulaire et où le corps d'extrémité (17) a une forme circulaire congruente avec la cavité circulaire (15).

15. Ensemble de verrouillage selon la revendication 13, où la cavité (15) a une forme rectangulaire et où le corps d'extrémité (17) a une forme rectangulaire congruente avec la cavité rectangulaire (15).

Fig. 1

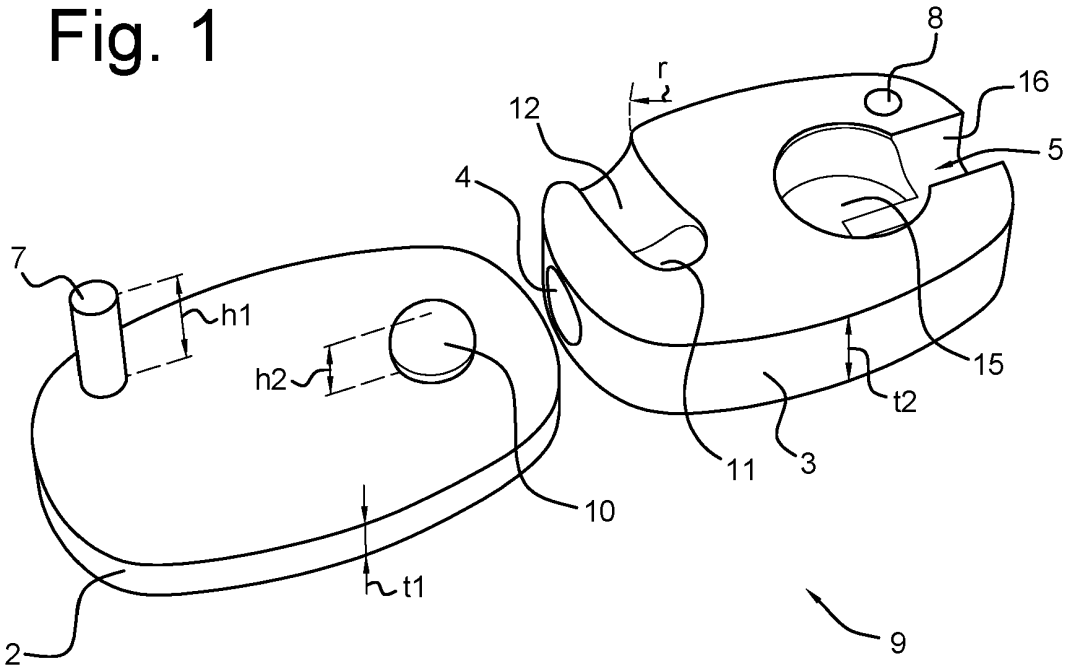


Fig. 2A

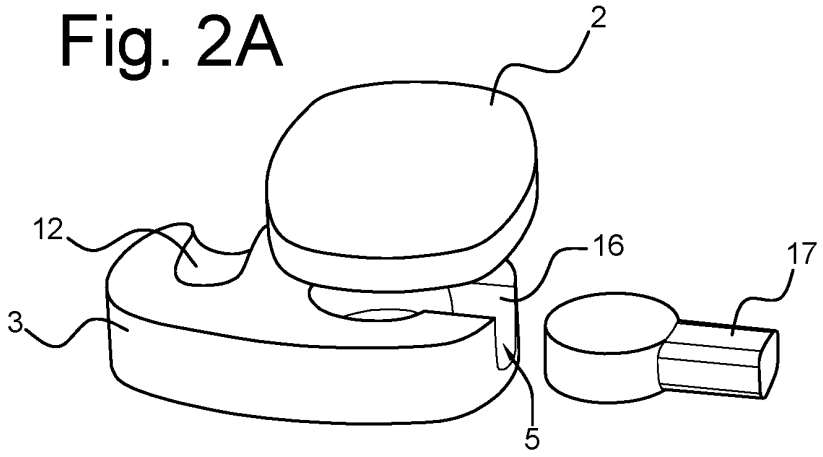


Fig. 2B

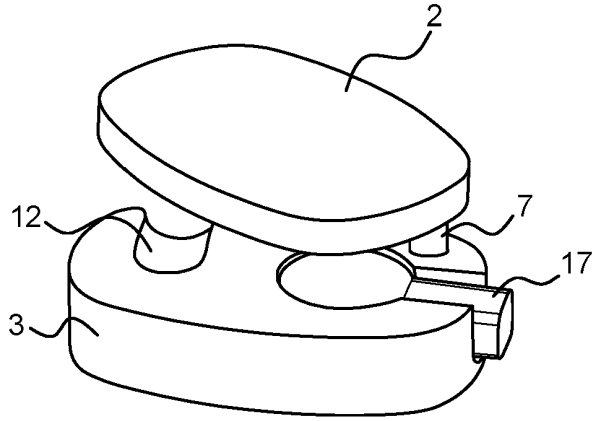


Fig. 2C

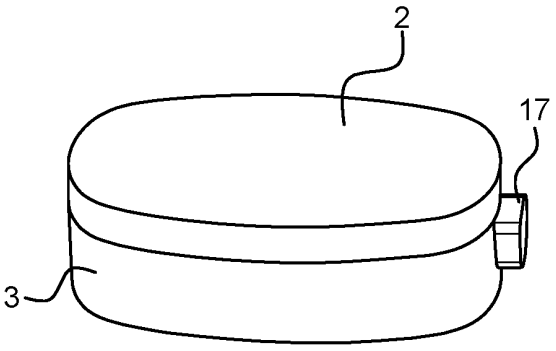


Fig. 3A

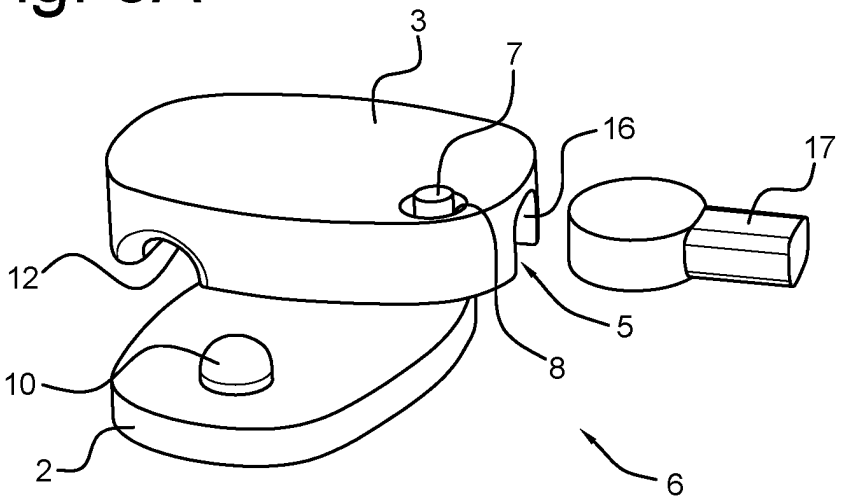


Fig. 3B

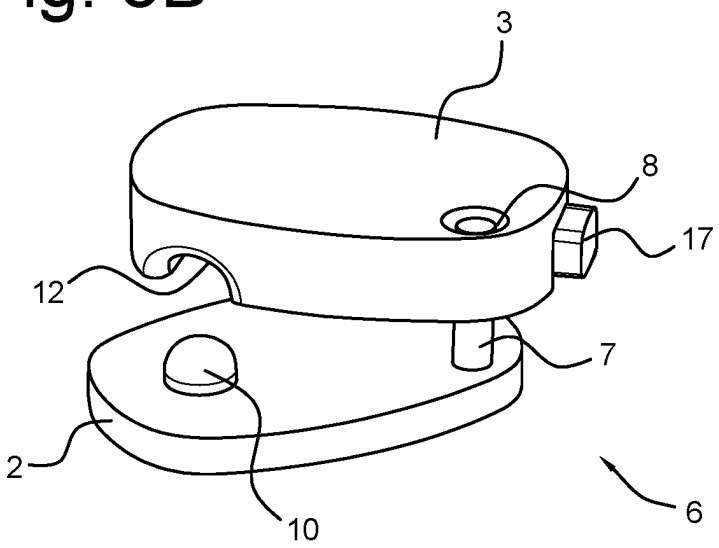
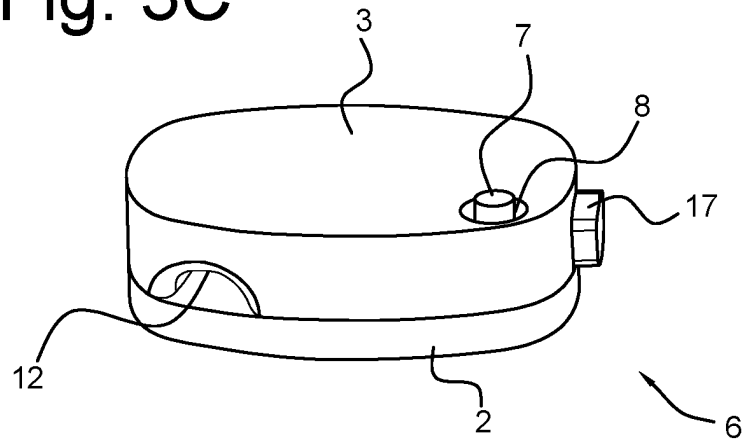


Fig. 3C



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2012155914 A **[0002]**
- US 2009199367 A1 **[0003]**