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Biedermann

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(54) **MODULAR BONE PLATE AND MEMBER OF SUCH A MODULAR BONE PLATE**

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A61B 17/80 (2006.01)
A61B 17/70 (2006.01)

(52) **U.S. Cl.**
CPC ***A61B 17/8023*** (2013.01); ***A61B 17/7059*** (2013.01); ***A61B 17/80*** (2013.01); ***A61B 17/8042*** (2013.01); ***A61B 17/8061*** (2013.01)

(58) **Field of Classification Search**
CPC A61B 17/58; A61B 17/7059; A61B 17/80; A61B 17/8023; A61B 17/8033;
(Continued)

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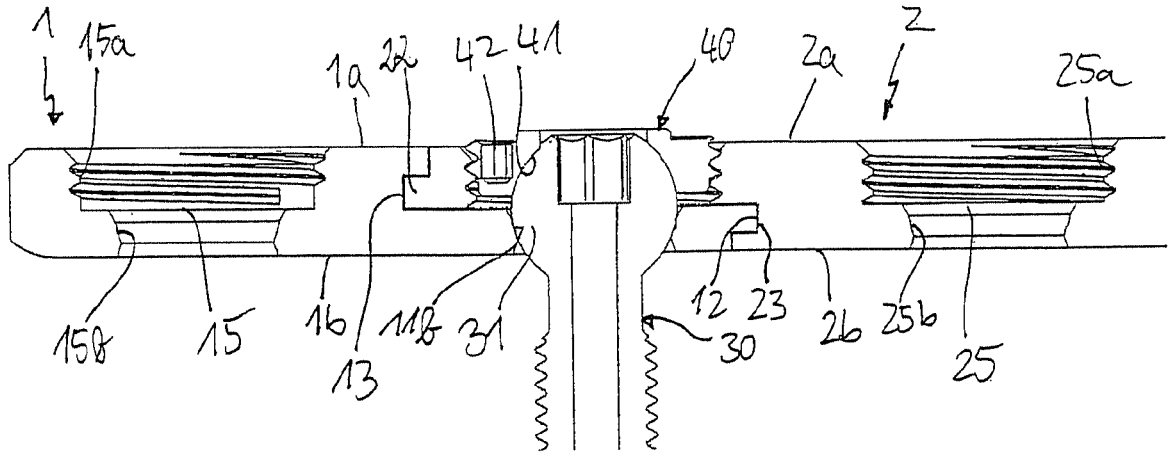
(57) **ABSTRACT**

A member of a modular bone plate is provided, the member comprising a top surface defining a top plane; a bottom surface defining a bottom plane; a connection portion including a hole with a center axis that intersects the top plane and the bottom plane; wherein a first portion of the edge of the hole is provided with a projection forming a first free end of the member and wherein a second portion of the edge of the hole is provided with a groove that is configured to accommodate a projection of a connection portion of a second member of the modular bone plate. Furthermore, a modular bone plate having at least two such members is provided.

3 Claims, 12 Drawing Sheets



(58) **Field of Classification Search**
CPC A61B 17/8042; A61B 17/8047; A61B 17/8052; A61B 17/8057; A61B 17/8061
See application file for complete search history.

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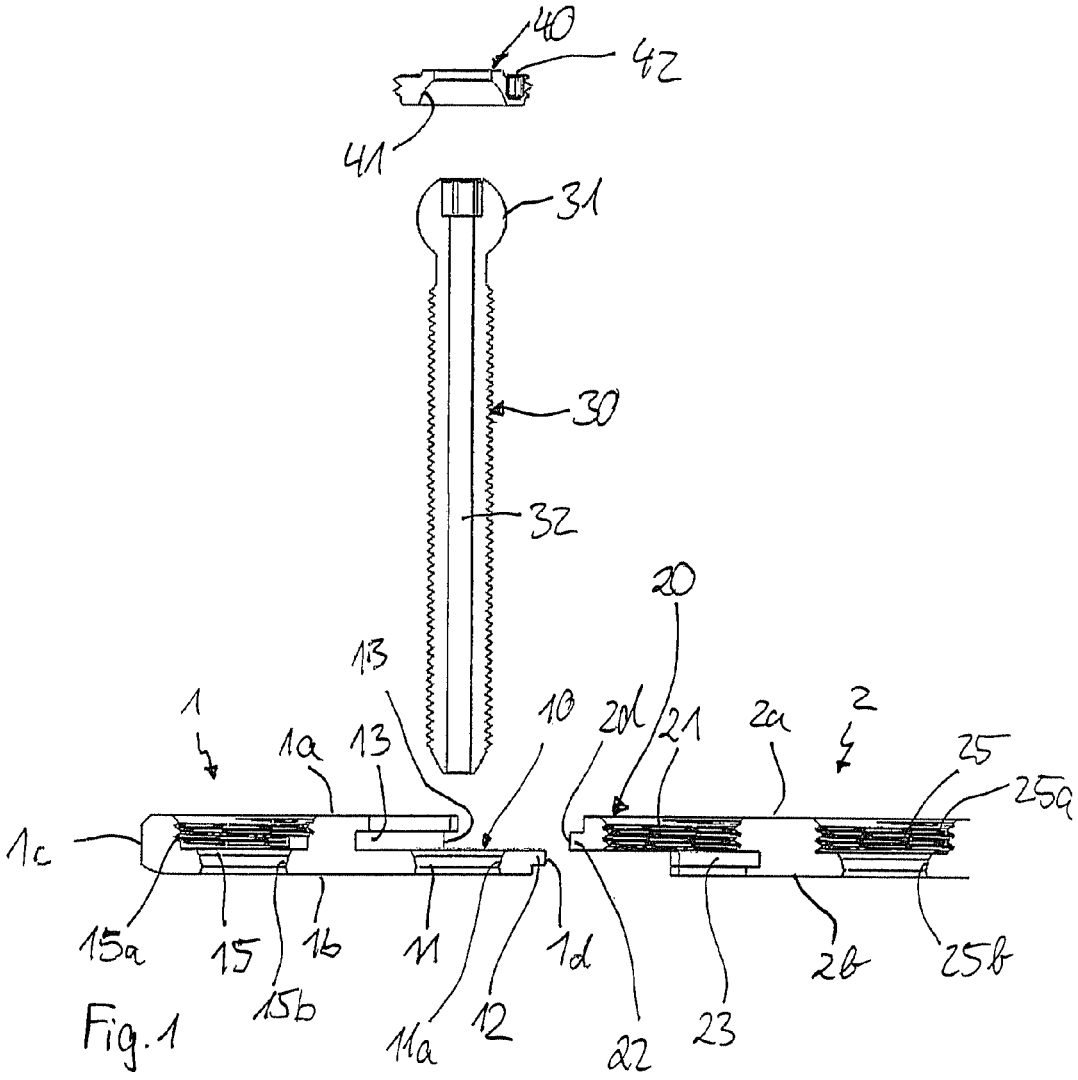
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16
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22
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Fig. 1

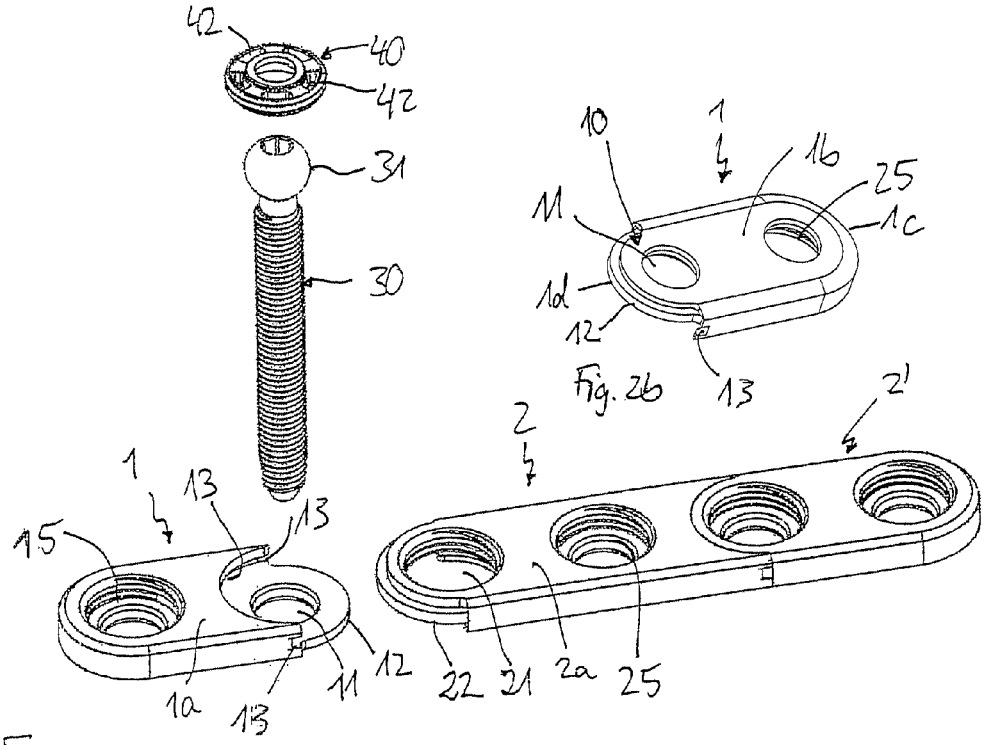


Fig.2a

Fig. 2b

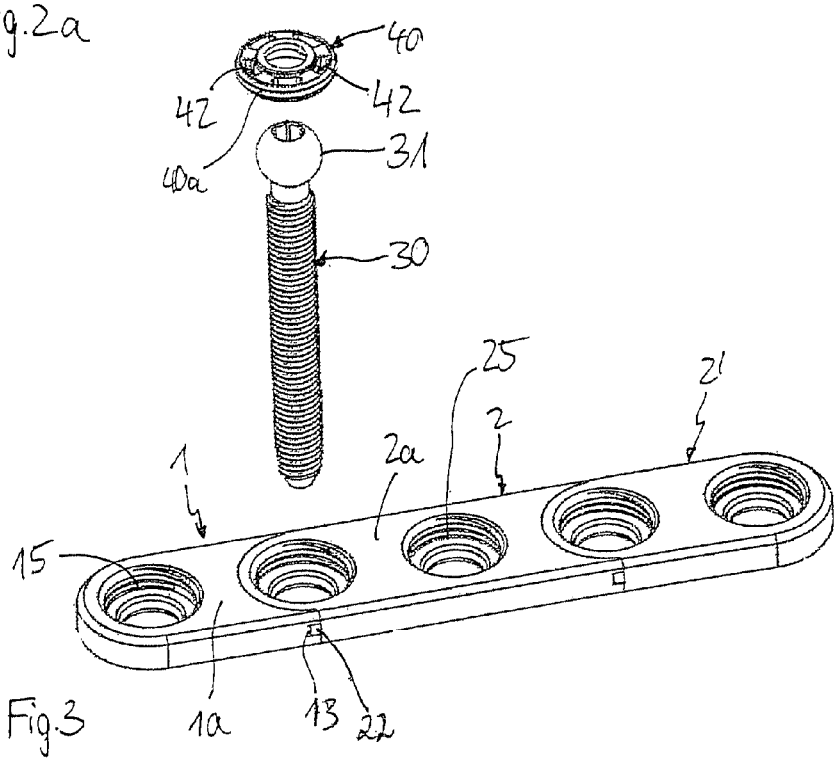
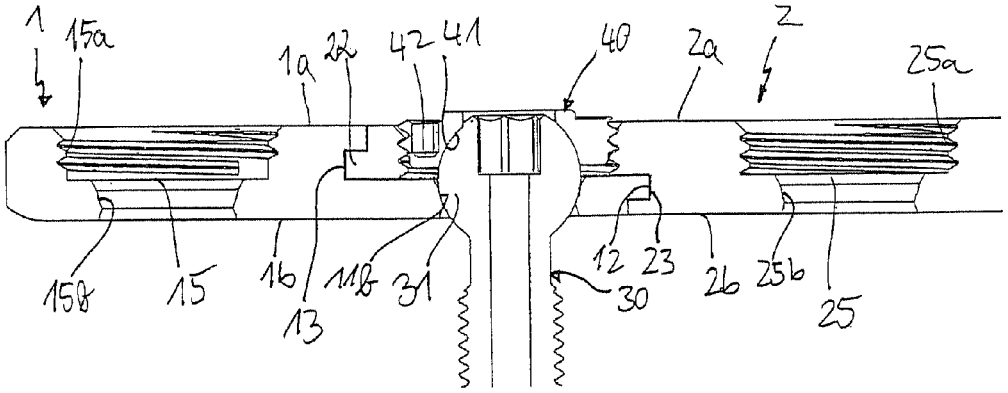


Fig.3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15a
1a
22
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25a
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26
256
30
25

Fig.4

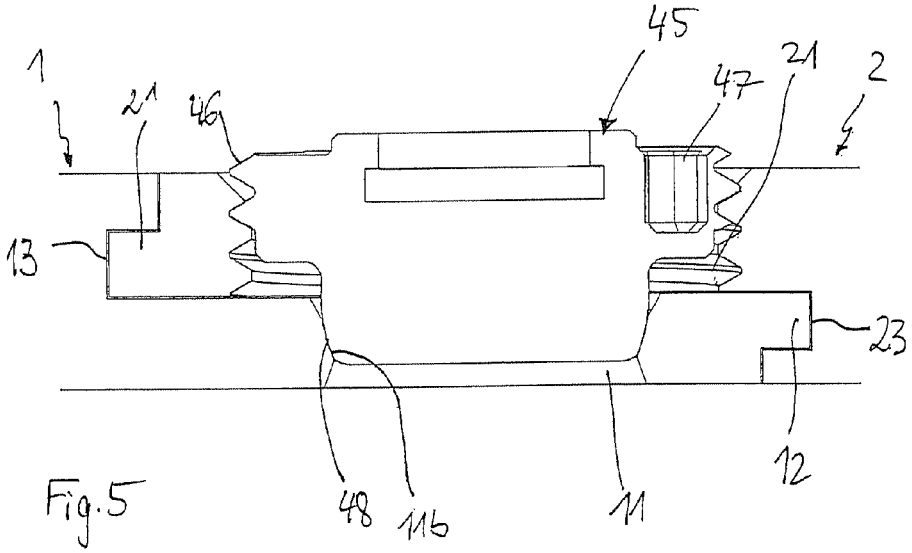
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Fig.5

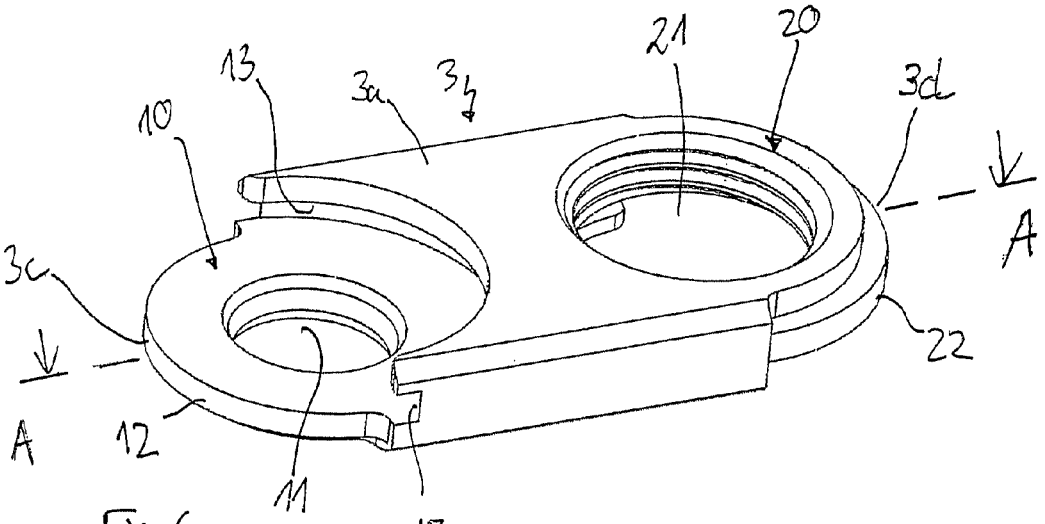
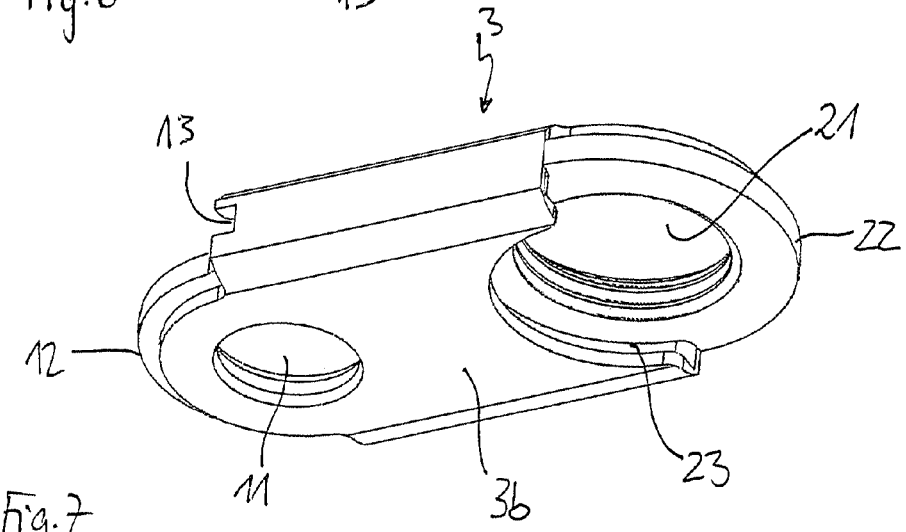


Fig.6



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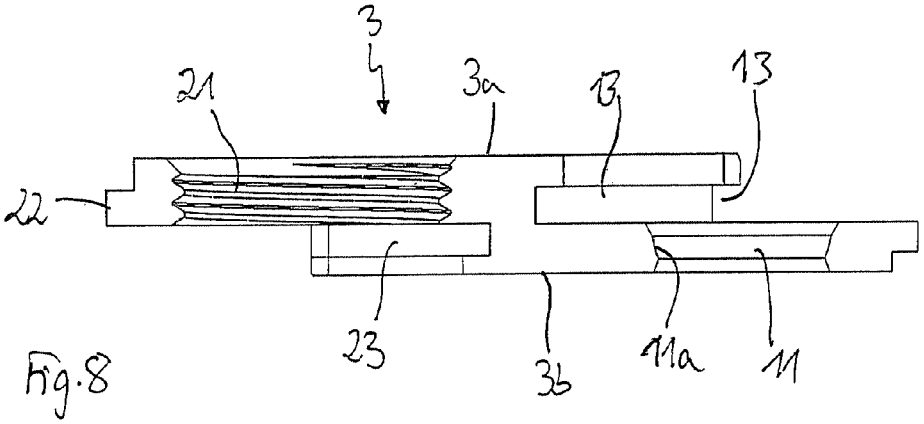

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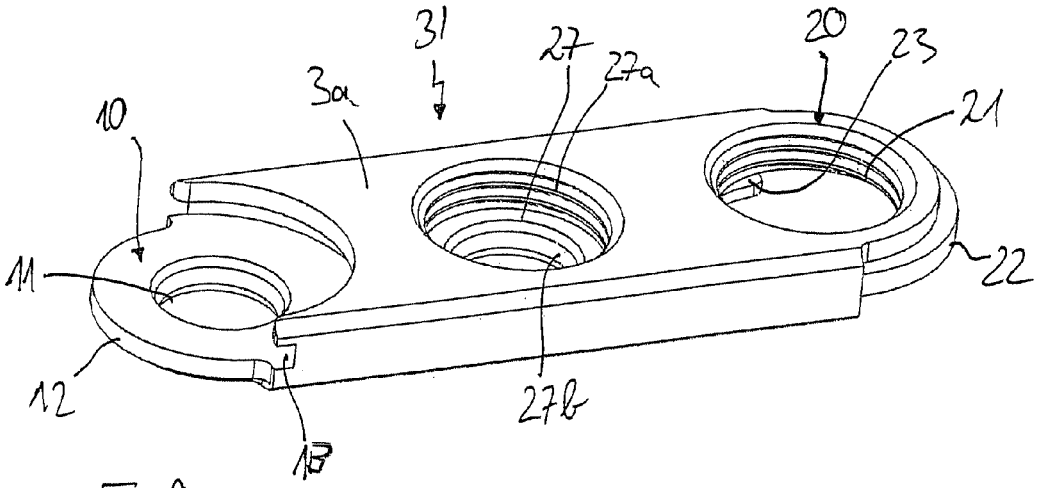
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27b
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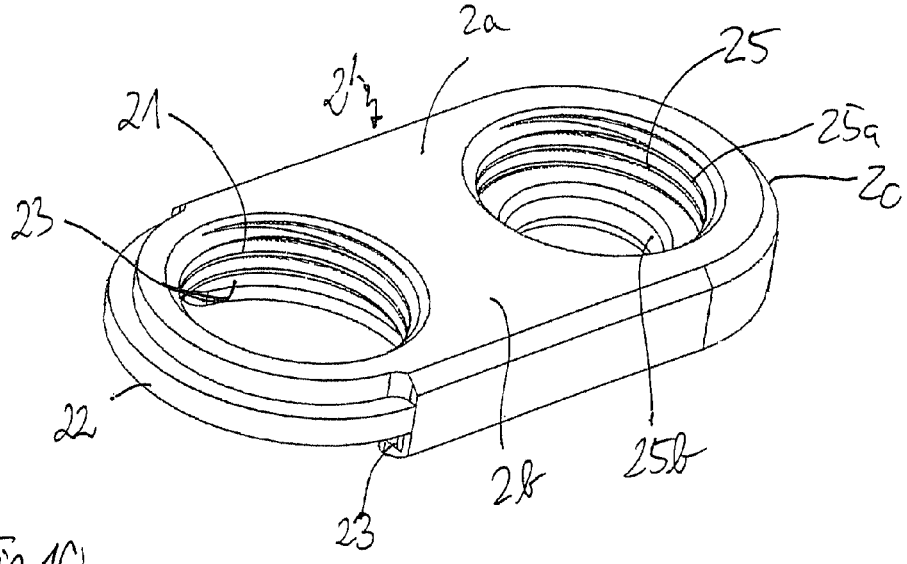
Fig. 9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2b
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Fig. 10

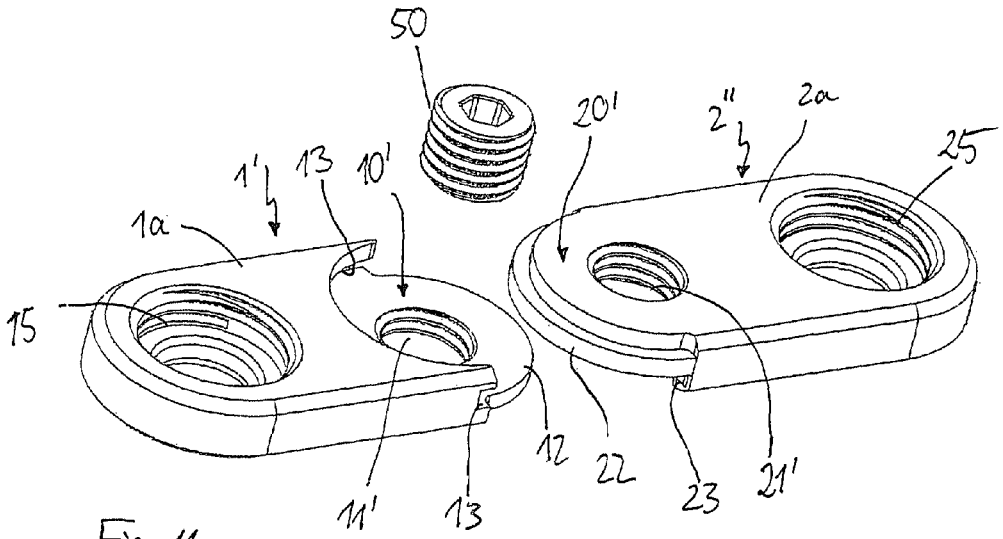
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Fig. 11

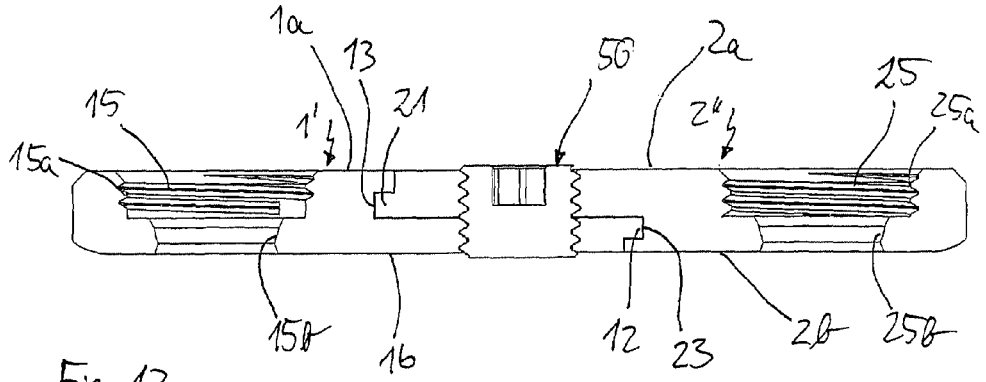
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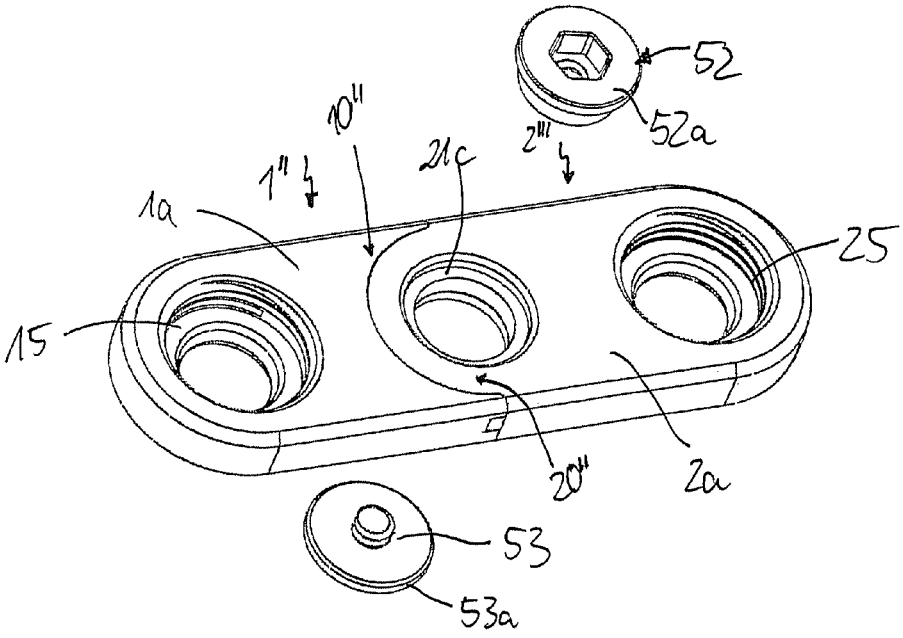
Fig. 12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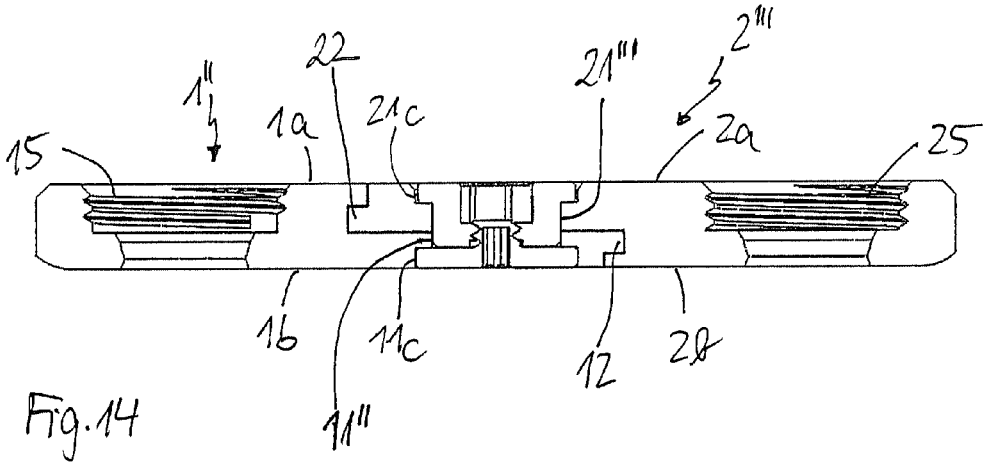
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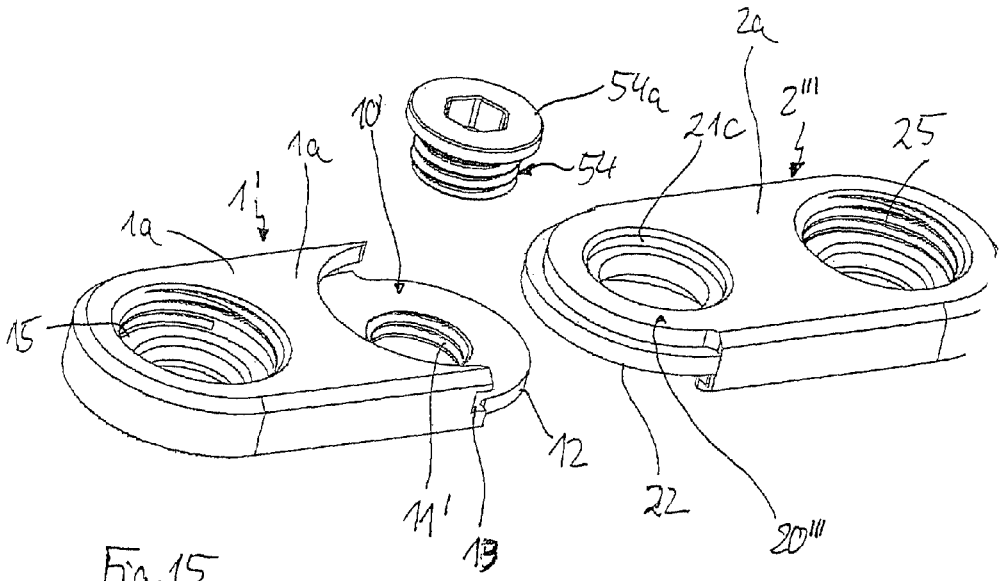
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Fig. 15

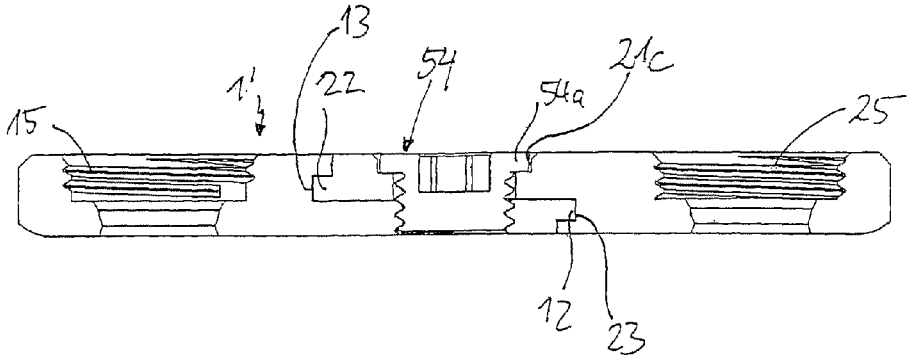
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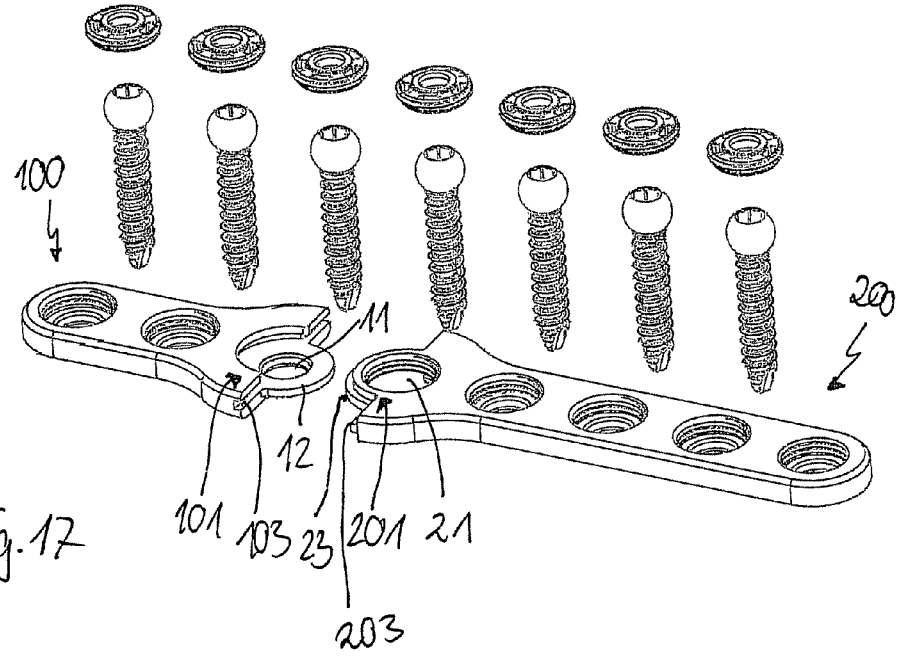
Fig. 16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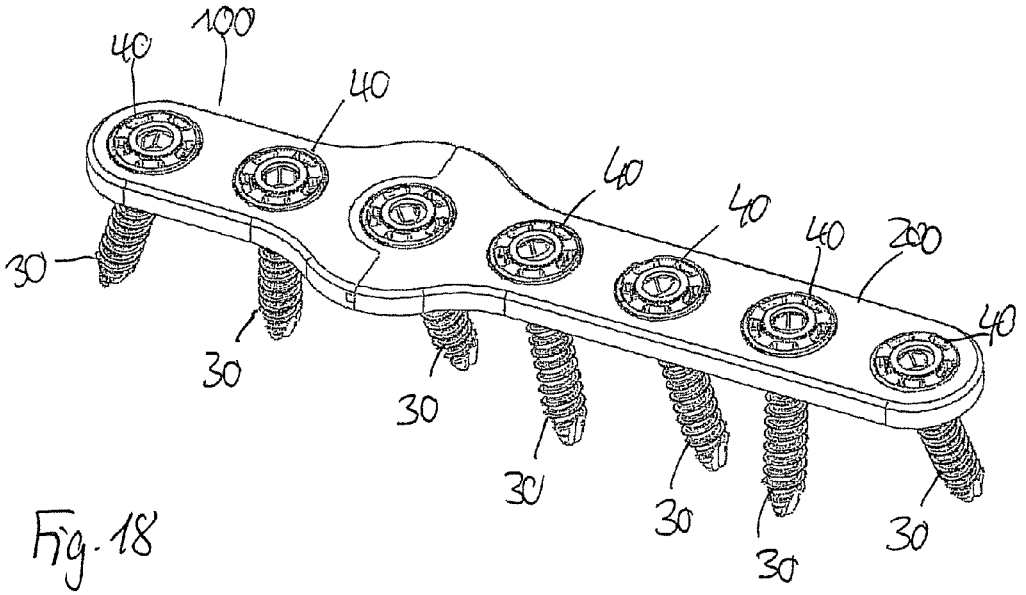
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Fig. 18

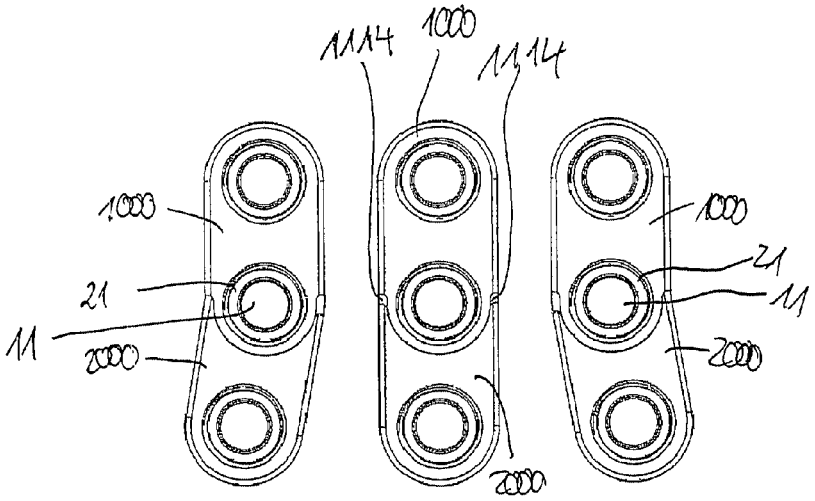


Fig. 19a) b) c)

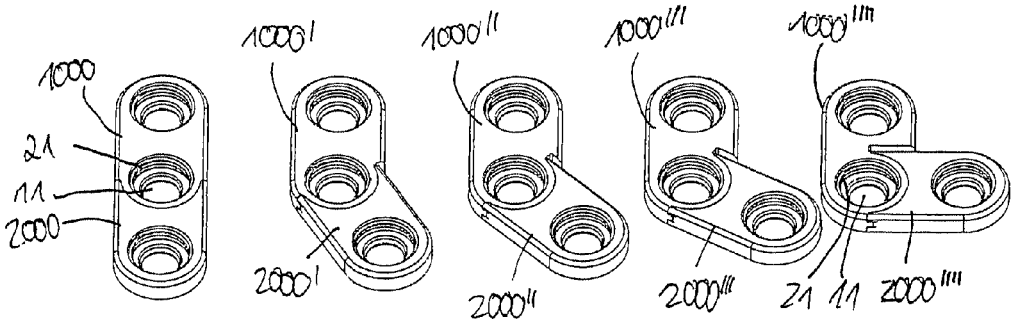


Fig. 20a) b) c) d) e)

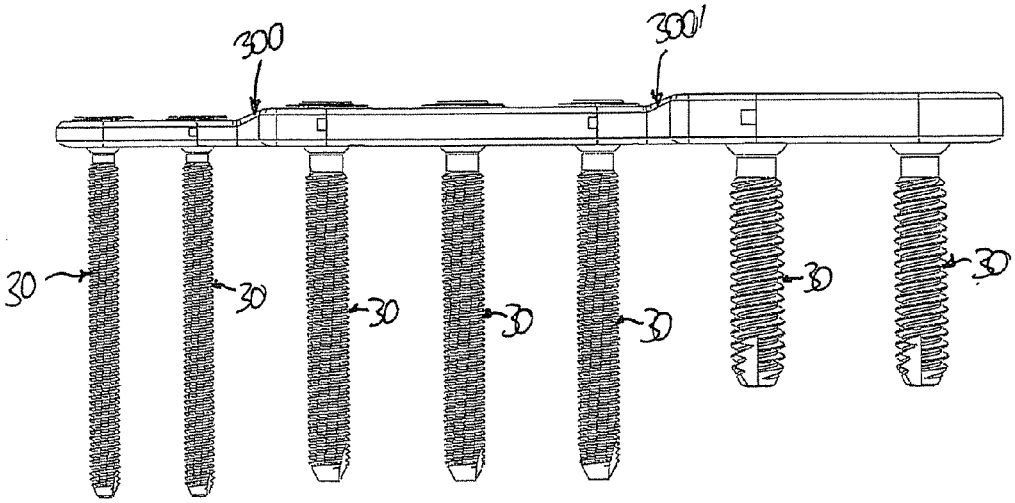
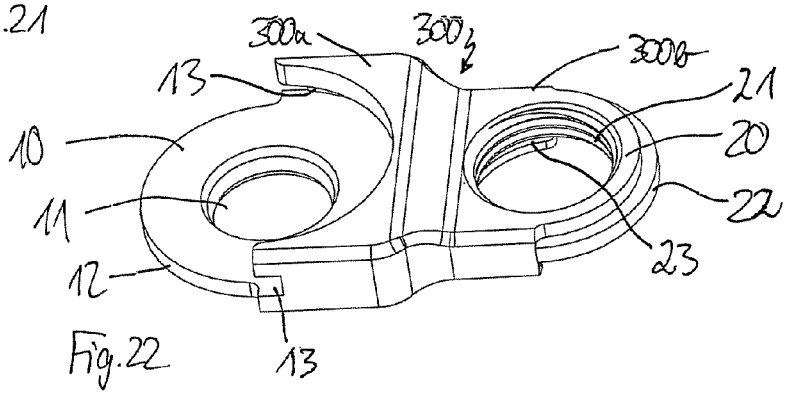


Fig.21



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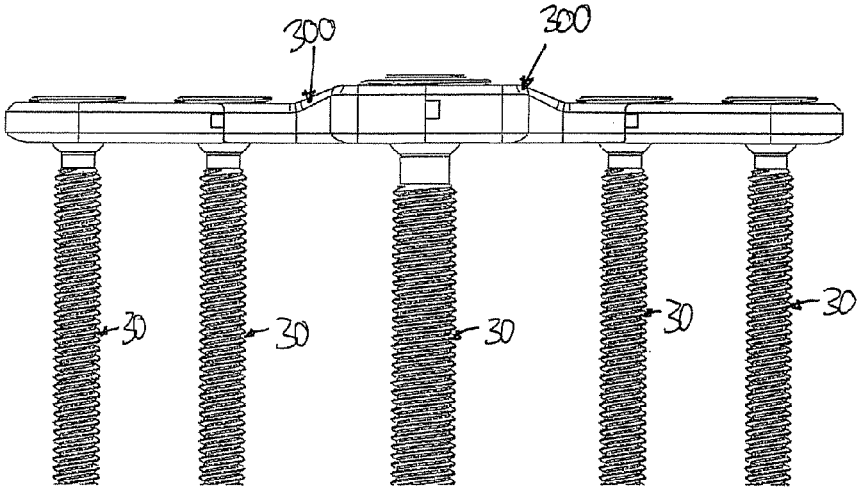

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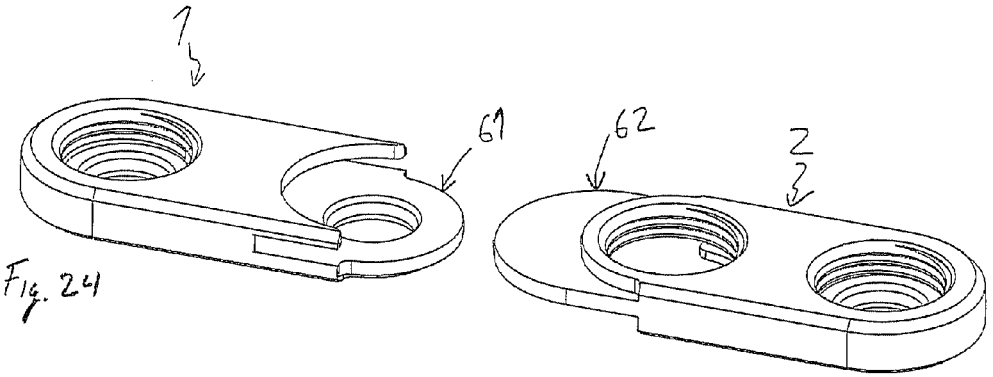

Fig. 24

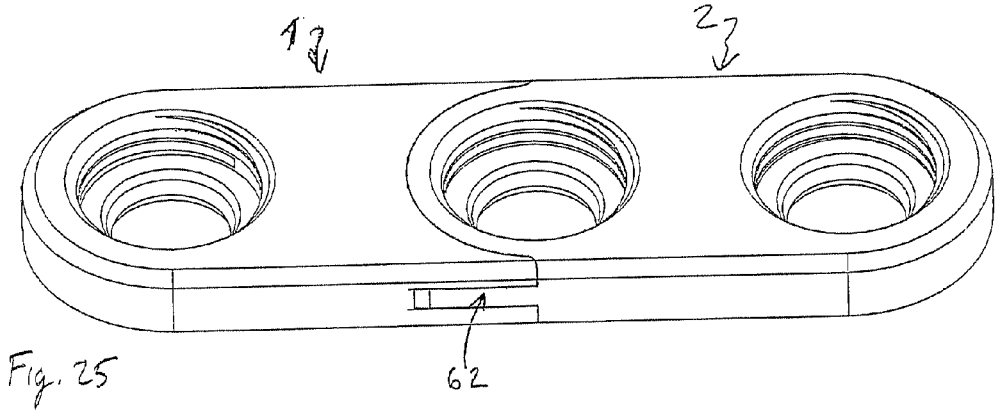

Fig. 25

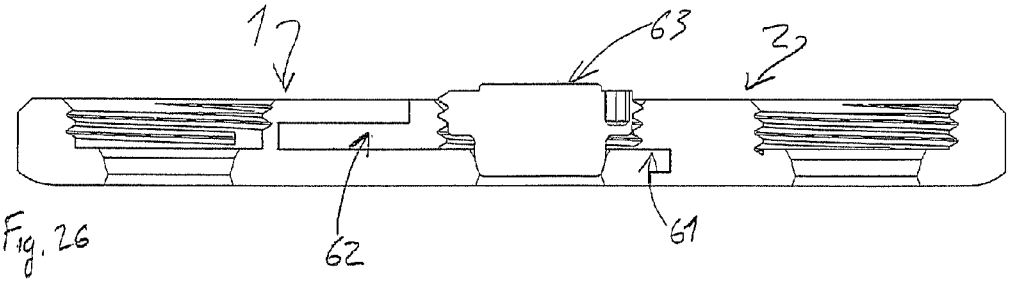

Fig. 26

MODULAR BONE PLATE AND MEMBER OF SUCH A MODULAR BONE PLATE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a National Phase Patent Application and claims priority to and benefit of International Patent Application Number PCT/IB2012/053037, filed on Jun. 15. 2012, which claims priority to and the benefit of, and wholly incorporates by reference U.S. provisional application number 61/497,972 to Biedermann filed on Jun. 17, 2011.

FIELD OF THE INVENTION

The invention relates to a modular bone plate and to a member of such a modular bone plate.

BACKGROUND OF THE INVENTION

Various shapes and types of bone plates to be used for osteosynthesis of fragmented bones and for stabilization of bones are known. The shape, size and type of a bone plate are usually adapted to the bones that shall be stabilized or immobilized. Hence, a large inventory of bone plates is typically necessary to be able to treat many different kinds of fractures or other defects at different locations.

There exist also modular bone plate systems that allow construction of a bone plate adapted to a specific application and to the individual patient by combining single members to form a whole bone plate. For example, US 2009/0082813 A1 describes a modular bone plating system including a plurality of bone plates including a male coupling portion, a female coupling portion and a shaft extending between the male coupling portion and the female coupling portion, wherein each of the male coupling portions of each of the plurality of bone plates is configured to couple with each of the female coupling portions of each of the other of the plurality of bone plates.

U.S. Pat. No. 5,484,439 describes a modular femur fixation device. The device comprises an upper side plate with a widened head and an angled barrel, and a lower side plate adapted to be engaged with the upper side plate in a tongue and groove configuration.

SUMMARY OF THE INVENTION

It is the object of the invention to provide a modular bone plate and a member of such a modular bone plate that is simplified in terms of handling and manufacturing while exhibiting a strength that is comparable to single part bone plates.

The object and further developments are addressed by the various embodiments of the invention.

The modular bone plate is assembled by connecting at least two members of the modular bone plate at their respective connection portions such that the projection of the connection portion of a first member is introduced into the groove of a connection portion of the second member. In the assembled configuration the holes of both connection portions are arranged concentrically, on top of each other. The assembly is quickly and easily performed and the resulting construct is prevented from disassembling by the form locking connection between the projection and the groove. Hence, the surgeon can take the pre-assembled bone plate and place it on to the bone parts or fragments or bones that need to be connected or stabilized without using further elements or tools for keeping together the bone plate members.

Due to modularity, lower inventory may be required and it may be possible to reduce the bone plate set price. Also, custom plates may be assembled to meet specific patient needs, on a case-by-case basis. A great variety of modular bone plate members can be provided and the members can be combined in various manners. For example, the modular bone plate can be used with bone anchors with spherical heads that allow for an angled configuration of the bone anchor relative to the bone plate, with set screws, with plugs to close the holes etc. or with combinations thereof. This opens a great field of clinical applications. Because of this easy and secure assembly and the resulting strong construct, the surgeon can select different modular pieces and assemble a custom bone plate directly in the operating room, used for a specific application.

Modifications of the design of the modular bone plate member allow the surgeon to connect the members to form an angled configuration with a variable angle that can be selected by the surgeon. Further modifications allow for modular bone plate members of different thicknesses to be combined to form bone plate constructs of variable thickness."

BRIEF DESCRIPTION OF THE DRAWINGS

Further features and advantages will become apparent from the description of embodiments and means of the accompanying drawings.

In the drawings:

FIG. **1**: shows a schematic exploded cross-sectional view of a first embodiment of the modular bone plate with a bone anchor and a cap to secure the bone anchor.

FIG. **2***a*): shows a perspective exploded view of the modular bone plate according to the first embodiment.

FIG. **2***b*): shows a perspective view from the bottom of the first plate member of the modular bone plate of FIG. **1**.

FIG. **3**: shows a perspective exploded view of the modular bone plate according to the first embodiment wherein the bone plate members have been connected.

FIG. **4**: shows a cross-sectional view of the modular bone plate according to the first embodiment wherein the bone plate members have been connected and the bone anchor and the cap have been inserted.

FIG. **5**: shows an enlarged cross-sectional view of the modular bone plate according to the first embodiment with an inserted plug to close the hole.

FIG. **6**: shows a perspective view from the top of a connector member of the modular bone plate according to the first embodiment.

FIG. **7**: shows a perspective view from the bottom of the connector member according to FIG. **6**.

FIG. **8**: shows a schematic cross-sectional view of the connector member according to FIG. **6**, wherein the cross-section is taken along line A-A in FIG. **6**.

FIG. **9**: shows a perspective view from the top of a second member of the modular bone plate according to the first embodiment.

FIG. **10**: shows a perspective view from the top of a third member of the modular bone plate according to the first embodiment.

FIG. **11**: shows a perspective exploded view of the modular bone plate according a modification of the first embodiment.

FIG. **12**: shows a schematic cross-sectional view of the assembled modular bone plate according to FIG. **11**.

FIG. **13**: shows a perspective partially exploded view of a further modification of the modular bone plate according to the first embodiment.

FIG. **14**: shows a schematic cross-sectional view of the assembled modular bone plate according to FIG. **13**.

FIG. **15**: shows an exploded perspective view of a further modification of the modular bone plate according to the first embodiment.

FIG. **16**: shows a schematic cross-sectional view of the modular bone plate of FIG. **15** in an assembled state.

FIG. **17**: shows an exploded perspective view of a further modification of the modular bone plate according to the first embodiment.

FIG. **18**: shows a perspective view from the top of the modular bone plate of FIG. **17** in an assembled state.

FIG. **19***a*) to *c*): shows a top view of a modular bone plate according to a second embodiment in different angular positions of the bone plate members relative to each other.

FIG. **20***a*) to *e*): shows a perspective view of the modular bone plate according to a modification of the second embodiment in different angular relationships of the bone plate members.

FIG. **21**: shows a third embodiment of the modular bone plate in side view.

FIG. **22**: shows a perspective view from the top of a member of the bone plate according to the third embodiment.

FIG. **23**: shows a further modification of the modular bone plate according to the third embodiment.

FIG. **24**: shows a fourth embodiment of the modular bone plate in perspective view from the top and in a disassembled state and without a connector piece.

FIG. **25**: shows a perspective view of the modular bone plate of the fourth embodiment in an assembled state and without a connector piece.

FIG. **26**: shows a longitudinal section view of the modular bone plate of the fourth embodiment in an assembled state and with a connector piece.

DETAILED DESCRIPTION OF THE INVENTION

As shown in FIGS. **1** to **4**, the modular bone plate according to the first embodiment includes at least a first member **1** and a second member **2** that are to be connected to each other. The first member is shaped in the form of an elongated plate and comprises a top surface **1***a* and a bottom surface **1***b* that are substantially parallel to each other and define the height of the first member **1**. The first member **1** further has a first free end **1***c* and a second free end **1***d* opposite to the first free end **1***c*. Furthermore, the first member **1** comprises a connection portion **10** that serves for connecting the first member **1** to the second member **2**. The connection portion **10** extends from the second free end **1***d* to a distance therefrom in a longitudinal direction of the first member **1**. It comprises a hole **11** that is a through-hole as can be seen in particular in FIGS. **2***a*) and **2***b*). The edge of the hole **11** that extends to the second free end **1***d* is substantially semi circular and comprises a projection **12** that forms the free end **1***d*. The projection **12** is located at a distance, in particular a small distance, from the bottom surface **1***b* at substantially the middle of the height between the top surface **1***a* and the bottom surface **1***b*. Further, the connection portion **10** comprises a recess by means of which an upper portion adjacent the top surface **1***a* of the first member is cut out. The recess extends into the first member to a distance from the edge of the hole **11** so as to form a groove **13**. The groove **13** has a distance from the top surface **1***a* that corresponds substantially to the distance of the projection **12** from the bottom surface **1***b*. The size and the shape of the grooves correspond to the size and shape of the projection **12**. Hence, the groove **13** is semi-circular. At both free ends of the groove **13** a substantially rectangular recess is provided, as can be seen in particular in FIGS. **2***a* and **2***b*.

The hole **11** comprises a section **11***a* that is shaped as a segment of a sphere with the smaller diameter oriented towards the bottom surface **1***b*. This hollow spherically-shaped portion **11***a* serves as a seat for a spherically-shaped head **31** of a bone anchor **30**.

The first member **1** comprises a further hole **15** extending from the top surface **1***a* to the bottom surface **1***b*. The hole **15** has a first portion **15***a* that is at least partially threaded and is configured to receive a locking cap **40** to be placed onto a spherical head of another bone anchor. The hole **15** further comprises a spherically-shaped portion **15***b* for receiving the spherical head of the bone anchor.

The second member **2** is also formed as an elongated plate and comprises a top surface **2***a* and a bottom surface **2***b*. The distance between the top surface **2***a* and the bottom surface **2***b* defines the height of the member **2** that is identical to the height of the plate member **1**. The second member **2** has a first free end (not shown in FIG. **1**) and an opposite second free end **2***d*.

Similar to the first member **1**, the second member **2** has a connection portion **20** that is to be connected to the connection portion **10** of the first member **1**. The connection portion **20** comprises a hole **21**. The edge of the hole **21** extending to the second free end **2***d* comprises a projection **22** that is semi-circular and sized and arranged so that it fits into the groove **13** of the first connection portion **10**. Further, the second member **2** comprises a recess that cuts out a portion from the bottom surface **1***b* up to substantially the middle of the height of the member **2** and extends to the edge of the hole in a direction to the first end **2***c* so as to form a groove **23**. The groove **23** is sized and arranged to receive the projection **12** of the first member **1**. The hole **21** is at least partially threaded and configured to receive the cap **40** that secures the head of the bone anchor **30**.

The second member **2** comprises at least a second hole **25** with an at least partially threaded portion **25***a* adjacent the top surface **2***a* and a spherically-shaped portion **25***b* in the lower part to receive a spherical head of another bone anchor.

In one embodiment, the modular bone plate includes a third piece, such as a cap or screw, for example, to connect and/or hold (compress and/or lock) the two members (the first member **1** and the second member **2**) together. The third piece functions to maintain the assembly of the plate, after it is placed on the bone.

The assembly of the modular bone plate will now be described with reference to FIGS. **3** and **4**. To connect the members **1** and **2** to each other, the members are oriented with their second free ends **1***d*, **2***d* facing towards each other as shown in FIG. **1**. Then, the projection **22** of the second member is inserted into the groove **13** of the first member. Because of the substantially symmetrical design, the projection **12** of the first member is simultaneously introduced into the groove **23** of the second member **2**. When the projections are fully introduced into the grooves, they abut against the inner wall of the grooves and the holes **11** and **21** overlap. The bottom surface **1***b* of the first member and the bottom surface **2***b* of the second member are substantially

flush as can be seen in particular in FIG. **4**. Due to the recess resulting from groove **13** of the first member, the side faces of the plate members are substantially flush as shown in FIG. **3**. It is possible to dimension the groove **13** of the first member substantially semi-circular so that the side faces of the plate members are substantially flush as shown in FIG. **3**.

The dimensions of the connection portions are such that once connected, the projections fit tightly into the grooves such that the assembled bone plate can be placed onto the bone without the members falling apart. Once the modular bone plate has been placed onto the bone, the bone anchor **30** can be inserted so that the spherical head **31** is seated in the spherically-shaped portion **15***b* of the hole **11**. The bone anchor **30** may have a coaxial through hole **32** for injection of substances or bone cement and/or for guiding through a guide wire that may be used to place the bone anchor into the bone. The bone anchor **30** may assume different angular positions with respect to the plate because the head **31** is accommodated in the spherically-shaped portion **15***b* in the manner of a ball and socket joint.

The locking cap **40** has a threaded outer surface **40***a* and a spherically-shaped recess **41** oriented towards the spherical head **31** of the bone anchor **30**. On the opposite side, the cap comprises a plurality of pockets **42** for engagement with a driver. The locking cap **40** is screwed into the at least partially threaded hole **21** to secure the bone anchor in the plate and prevent backing out of the bone anchor.

The connection between the connection portions provides a substantially uniform load distribution between the two plate members.

In FIG. **5** the first member **1** and the second member **2** are assembled and the holes **11**, **21** are closed by a closure plug **45** that is similar to the locking cap **40** in that it has a threaded section **46** cooperating with the threaded hole **21** and pockets **47** for a driver. In the lower part, the closure plug **45** has a spherically-shaped section **48** that fits into the spherically-shaped portion **15***b* of the hole **11**. By means of this, two members can be connected without using a bone anchor.

FIGS. **6** to **8** show a further member of the modular bone plate. The member **3** is a connector member that has a top surface **3***a*, a bottom surface **3***b*, a first free end **3***c* and a second free end **3***d*. The connector piece comprises two connection portions **10**, **20**. The first connection portion **10** is arranged at the first free end **3***c* and the second connection portion **20** is arranged at the second free end **3***d*. The first connection portion **10** is identical to the first connection portion **10** of the first member **1** and the second connection portion **20** is identical to the second connection portion **20** of the second member **2** described above. Therefore, all details of the first and second connection portion **10**, **20** are indicated with the same reference numerals as for the first member **1** and the second member **2**. The description thereof will not be repeated.

The connector member **3** serves as an intermediate member that may connect to other members of the type of the first member **1** and the second member **2**. The distance between the first and the second connection portion may vary so that a plurality of connector pieces in the form of the third member **3** can be provided that have different length.

FIG. **9** shows a modified third member **3'** that differs from the third member **3** shown in FIGS. **6** to **8** in that a further hole **27** is provided between the first connection portion **10** and the second connection portion **20**. The hole **27** has an at least partially threaded portion **27***a* adjacent the top surface **3***a* and a spherically-shaped portion **27***b* for accommodating the spherical head **31** of a bone anchor that is similar to the bone anchor **30**. It may be envisaged that several additional holes can be provided between the first connection portion **10** and the second connection portion **20**.

FIG. **10** shows an end member **2'**, similar to the first member **1**. Preferably, the end member has a rounded free end **2***c*.

FIGS. **11** and **12** show a further modification of the modular bone plate according to the first embodiment. The plate members **1'**, **2"** differ from the plate members **1** and **2'** described before in the connection portion **10'**, **20'**, respectively. The connection portions **10'**, **20'** each have a threaded hole of the same size. When the plate members **1'**, **2"** are connected to each other a set screw **50** can be screwed-in to connect the plate members. All details that are identical to that of the previous embodiments are indicated with the same reference numerals and the description thereof is not repeated.

FIGS. **13** and **14** show a further modification of the modular bone plate shown in FIGS. **11** and **12**. The plate members **1"** and **2'"** comprise connection portions **10"** and **20""**. The holes **11"** and **21"** are threadless and comprise recesses **11***c*, **21***c* for accommodating a flange **52***a* of nut **52** and a flange **53***a* of a screw **53**, respectively. The nut **52** and the screw **53** cooperate to fix the connection as shown in FIG. **14**.

FIGS. **15** and **16** show a further modification of the plate members and the connection thereof. The plate member **1'** is substantially identical to the first plate member **1'** of FIGS. **11** and **12**. The plate member **2'"** corresponds substantially to the plate member **2'"** of FIGS. **13** and **14**. Hence, a screw **54** with a flange **54***a* can be used to connect the plate members together as shown in FIG. **16**.

A further modification of the first embodiment is shown in FIGS. **17** and **18**. The first plate member **100** has a first connection portion **101** and the second plate member **200** has a second connection portion **201**. The first connection portion **101** and the second connection portion **201** have a greater width than in the previous embodiments. The width may be greater than the remainder of the first member **100** and the second member **200**. However, dependent on the application, the width may also be the same over the length of the plate member. On both sides of the projection **12** in the width direction, there is a groove **103** that extends substantially perpendicular to the length direction of the plate member **100**. The second plate member **200** has a corresponding projection **203** extending perpendicular to the length direction of the plate member **200** that cooperates with the groove **103**. Hence, the groove **13** is enlarged by the groove **103** and the projection **23** is enlarged by the projection **203**. As shown in FIG. **18** this provides larger contact area of the two plate members **100**, **200** and simultaneously a greater width of the bone plate. This provides a strengthened connection.

FIG. **19** shows a still further embodiment of the modular bone plate. The first plate member **1000** and the second plate member **2000** can assume an angled position with respect to each other as shown in FIGS. **19***a*) and **19***c*). To achieve this, first plate member **1000** has a recess **1114** at both ends of the groove **13** so that, when the second plate member **2000** is inserted with its projection **22** into the groove **13**, there is a gap between the end of the groove **13** and the second plate member **2000** as can be seen in particular in FIG. **19***b*). This allows for pivoting of the second plate member **2000** with respect to the first plate member **1000** around the axes of the holes **11**, **21** to a certain angle that may be up to around 10° or 15° (soft angle).

In a still further embodiment shown in FIGS. **20***a*) to **20***e*) the groove **13** in the first plate member **1000** is provided at a rotated position with respect to the axes of the holes **11**, **21**. Positions between around 15°, shown in FIG. **20***b*) and 90° in FIG. **20***e*) are possible (hard angle). Because the groove is part of the first connection member **1000** the angle is fixed and can not be changed as in the embodiment of FIG. **19**. Those having ordinary skill in the art will appreciate that a combination of hard and soft angles may be utilized, according to the above.

In a further embodiment shown in FIGS. **21** to **23** a modular bone plate can have different thicknesses along the length of the modular bone plate. To achieve this, a connector piece **300** as shown in FIG. **22** is provided that has a first portion **300***a* that comprises the first connection portion **10** and a second portion **300***b* that comprises the second connection portion **20**. The bottom surface of portions **300***a* and **300***b* is on the same level. However, the thickness of the portion **300***a* is greater than the thickness of the portion **300***b*. Hence, the connector piece can be used to connect plate members having different thicknesses. FIG. **21** shows a cascaded configuration wherein the thickness is increasing from one end to the other end of the modular bone plate in steps and FIG. **23** shows an application wherein the thickness is greatest in the center part of the bone plate.

Referring now to FIGS. **24-26**, schematic diagrams of a further embodiment are shown in which longer flanges or tongues **61** and **62** are provided. The longer flanges may enable more stable connections between members **1** and **2**, due to better distribution of forces, for example. In FIG. **26**, a locking cap **63** is shown for fastening together members **1** and **2**. The embodiment described with respect to FIGS. **24-26** may otherwise function similarly to earlier-described embodiments.

The members of the modular bone plate can be made of any bio-compatible material. Preferably, the members are made of titanium, stainless steel, bio-compatible alloys or bio-compatible plastic materials, such as, for example PEEK (polyetheretherketone). The members can be made all of the same material or can be made of different materials so that the modular bone plate has different materials in one portion thereof compared to another portion.

It should be clear from the above that plate members can be designed in many configurations and are not limited to the specific embodiments shown above. For example, plate members can have less or more holes as shown. The contour of the plate members may vary. The holes may be threaded and provided with spherically-shaped sections for an angled insertion of the bone anchor or may have only threads for straight and fixed angle insertion of the bone anchor. The holes may even have an axis that is not perpendicular to the top and the bottom surface but includes an angle with the top and the bottom surface. The features of all the embodiments described above can be combined among each other to provide a specific plate member needed for a specific application. Therefore, the necessary inventory can be reduced.

By means of the modularity and the simplicity of handling while ensuring sufficient strength, the field of applications of the modular bone plate is enlarged. Plate members can be produced in all sizes so that the modular bone plate can be used in pediatric orthopedics, cervical spine surgery, hand surgery, long bone treatment and many other applications.

The invention claimed is:

1. A member of a modular bone plate, the member comprising:

a top surface defining a top plane;

a bottom surface defining a bottom plane; and

a connection portion defining a hole with a center axis that intersects the top plane and the bottom plane;

wherein a first part of the connection portion comprises a wall that extends around and faces away from the center axis of the hole, and a projection that extends away from the wall of the first part and forms a first free end of the member;

wherein a second part of the connection portion comprises a wall that is spaced apart from the hole and that extends around and faces towards the center axis of the hole, and wherein a groove is formed in the wall of the second part and extends away from the center axis of the hole to accommodate a projection of a connection portion of a second member of the modular bone plate; and

wherein a length of the groove in a circumferential direction corresponds substantially to a length of the projection in a circumferential direction.

2. A member of a modular bone plate, the member comprising:

a top surface defining a top plane;

a bottom surface defining a bottom plane;

a connection portion defining a hole with a center axis that intersects the top plane and the bottom plane, wherein a first part of the connection portion comprises a wall that extends around and faces away from the center axis of the hole, and a projection that extends away from the wall of the first part and forms a first free end of the member, wherein a second part of the connection portion comprises a wall that is spaced apart from the hole and that extends around and faces towards the center axis of the hole, and wherein a groove is formed in the wall of the second part and extends away from the center axis of the hole to accommodate a projection of a connection portion of a second member of the modular bone plate; and

a second connection portion defining a second hole with a center axis that intersects the top plane and the bottom plane, wherein a first part of the second connection portion comprises a wall that extends around and faces away from the center axis of the second hole, and a projection that extends away from the wall of the first part of the second connection portion and forms a second free end of the member opposite to the first free end, and wherein a second part of the second connection portion comprises a wall that is spaced apart from the second hole and that extends around and faces towards the center axis of the second hole, and wherein a groove is formed in the wall of the second part of the second connection portion and extends away from the center axis of the second hole to accommodate a projection of a connection portion of the second member of the modular bone plate.

3. A modular bone plate comprising:

a first member comprising a top surface defining a top plane, a bottom surface defining a bottom plane, and a connection portion defining a hole with a center axis that intersects the top plane and the bottom plane, wherein a first part of the connection portion of the first member comprises a wall that extends around and faces away from the center axis of the hole, and a projection that extends away from the wall of the first part of the

first member and forms a first free end of the member, wherein a second part of the connection portion of the first member comprises a wall that is spaced apart from the hole and that extends around and faces towards the center axis of the hole, and wherein a groove is formed in the wall of the second part of the first member and extends away from the center axis of the hole to accommodate a projection of a connection portion of a second member of the modular bone plate; and

the second member comprising a top surface defining a top plane and a bottom surface defining a bottom plane, wherein the connection portion of the second member defines a second hole with a center axis that intersects the top and bottom planes of the second member, wherein a first part of the connection portion of the second member comprises a wall that extends around and faces away from the center axis of the second hole, wherein the projection of the second member extends away from the wall of the first part of the second member to form a first free end of the second member, wherein a second part of the connection portion of the second member comprises a wall that is spaced apart from the second hole and that extends around and faces towards the center axis of the second hole, and wherein a groove is formed in the wall of the second part of the second member and extends away from the center axis of the second hole to accommodate the projection of the connection portion of the first member;

wherein the first member is configured to be coupled to the second member when the projection of the first member is inserted into the groove of the second member and the projection of the second member is inserted into the groove of the first member; and

wherein the first member and the second member are configured to pivot relative to one another when the first member is coupled to the second member.

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