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(54) Title: OSTEOTOMY SET WITH INTERCONNECTABLE AND EXPANDABLE COMPONENTS

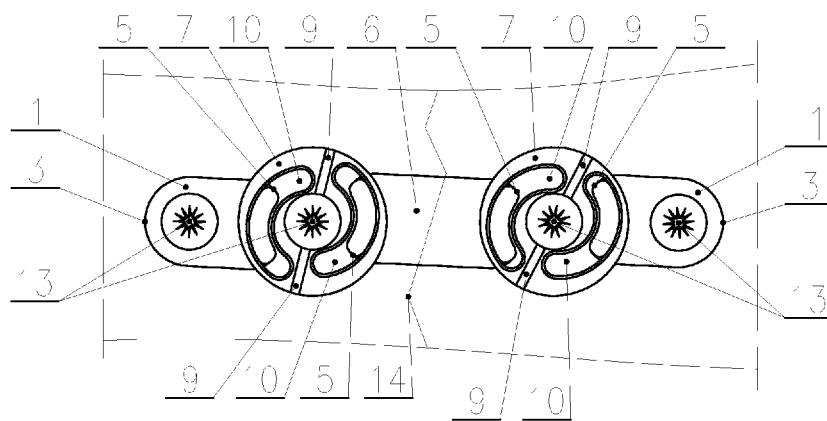


Fig.6b

(57) Abstract: Osteotomy set comprising at least two base plates (1) with a through hole (2) made at the end (3) of the base plate (1), having a shape similar to a semicircle, facing outward the base plate (1), at least two eccentrics (7) and at least one short plate (6) without through holes, where the other end (4) of the base plate (1), the opposite ends (4) of the short plate (6) have a shape similar to a semicircle facing inward the said plate (1, 6) and are terminated with tabs (5), the upper surface of which has a shape similar to a semicircle, facing inward the said plate (1, 6), extending above the front surface of said plate (1, 6), and the eccentric (7) has a central through hole (8), axial grooves (9) made in the front surface of the eccentric (7) on both sides of the central through hole (8), and through indentations (10) made along the perimeter of the eccentric (7) on both sides of the grooves (9) with a shape similar to a semicircle, corresponding to the shape of the upper surface of the tabs (5) of the base plate (1) and short plate (6).



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Description

Title of Invention: Osteotomy set with interconnectable and expandable components

- [0001] The subject of the invention is an osteotomy set with interconnectable and expandable components for fracture compression.
- [0002] The well-known osteotomy plates for fracture treatment are widely used in various types of fractures of both short and long bones. The osteotomy plates used to date have a number of advantages, but none of them have the ability to compress, i.e., minimize the gap between the bones being anastomosed. As a rule, a different individualized plate is used for each fracture, requiring the hospital to have a fairly wide assortment of plates. In modern medicine, there are no universal plates used for osteotomy, which would be used for all types of bone fractures, and which would make it possible to minimize the gap between the bones being anastomosed.
- [0003] The Polish patent description Pat.234637 shows a single or double interconnectable osteotomy plate. It contains at least one tab and/or at least one connector connected to the plate by a joint and one or two threaded holes for fixation, connected by a joint pin. Preferably, the plate is of cylindrical, square, triangular, pentagonal, heptagonal, octagonal or nonagonal shape. Preferably, the plate has a cutout. Preferably, the plate is made of metal alloys, biomaterials and biodegradable materials.
- [0004] Since it is interconnectable in various combinations, the plate according to the invention makes it possible to create stabilizing constructs individually for each case of treated bone fracture. The advantage of the invention is that the shape of the osteotomy plate can be independently created from individual units. In addition, the ability to adjust and arrange the modules in relation to each other will allow the surgeon to define the shape of the plates without the need to bend or trim the components as it is with other osteotomy plates, which often results in breaching the passive layer of the plate. Micro fractures of the passive layer lead to corrosion on the plate in the human body, inflammation and the need for reoperation to replace the plate. An additional advantage of the solution is the possibility of attaching plate units at any time, even during surgery. Also, there is minimal interference with the healed wound in case of the need to remove the plate due to the occurrence of bone calcification, which may happen when the plate, instead of bone, carries mechanical loads for too long. The single or double osteotomy plate proposed in the solution allows the plates to be inter-connected allowing any combination to be designed into a larger plate. The double plate can connect two bone fragments by itself or by attaching additional units at the ends to stiffen the construct.

- [0005] The application description US2006149255A1 shows a surgical set containing one or more bone plates for stabilizing adjacent vertebrae and several different connectors for penetrating and fixing the plate(s) to the bone, connected together in a package. The plates and connectors have holes. Each plate contains two brackets located at opposite ends, with either one or two connectors placed between them. The brackets have a slot in which there are two holes each for standard screws or locking screws, as well as a hole made between them with an eccentric cam. A wedge is placed between the holes. The set, thanks to the use of connectors and brackets of the above-mentioned design, can be expanded.
- [0006] The invention is aimed at solving the technical problem of providing a universal osteotomy set containing plates of various sizes that are expandable and adaptable to a specific bone fracture, allowing precise bone anastomosis by compression, i.e., minimizing the gap between the bones to be anastomosed, while minimizing the plates and screws used for osteotomy and minimizing the number of elements that remain in the patient's body after anastomosis.
- [0007] The osteotomy set with interconnectable and expandable components, containing at least one plate with at least one through hole for a bone screw and at least one bone screw and at least one connecting element, according to the invention, is characterized in that it contains at least two base plates with a through hole made at the end of the base plate, having a shape similar to a semicircle, facing outward the base plate, at least two eccentrics and at least one short plate without through holes, or at least one long plate with a narrowing in the middle and at least two through holes, with the two through holes being made at both sides of the narrowing of the long plate, where the other end of the base plate, the opposite ends of either the short plate or the long plate have a shape similar to a semicircle facing inward the said plate and are terminated with tabs, the upper surface of which has a shape similar to a semicircle, facing inward the said plate, extending above the front surface of said plate, and the eccentric has a central through hole, axial grooves made in the front surface of the eccentric on both sides of the central through hole, and through indentations made along the perimeter of the eccentric on both sides of the grooves with a shape similar to a semicircle, corresponding to the shape of the upper surface of the tabs of the base plate, short plate and long plate, where the length of the indentations is greater than the length of the upper surface of the tabs of the base plate, short plate and long plate seated in the indentations, and the height of the eccentric corresponds to the height of the tabs of these plates.
- [0008] In this variant, the osteotomy set additionally contains at least one short plate with two through holes.
- [0009] Preferably, the base plate, the short plate, the long plate and the eccentric are made of

metal alloys, biomaterials and biodegradable materials.

[0010] Preferably, the base plate, the short plate, the long plate and the eccentric are made during a 3D printing process.

[0011] The advantage of the invention is that it is possible to independently create a mounting assembly consisting of the set components. In addition, it is possible to adjust and arrange individual components of the set in relation to each other, which makes it possible to simultaneously minimize the gap, i.e., compression between the bones being anastomosed.

[0012] For the set according to the invention, it is possible to use the short plate and the long plate at the same time or interchangeably, as well as to use eccentrics of any size, i.e. pitch, which, in turn, makes it possible to configure the set of plates freely, without the necessity of bending or trimming the elements, as in the case of standard osteotomy plates, and to obtain a very precise bone anastomosis, which, in turn, can translate into a faster osteointegration process – bone fusion.

[0013] The set according to the invention based on the eccentric performs two functions. The first one is a tension function allowing precise bone anastomosis through compression, i.e., minimizing the gap between the bones to be anastomosed, and the second is the possibility of expanding the anastomosis system, depending on the type of fracture, e.g. stable or comminuted fracture. This solution eliminates the need for multiple plates to fit a specific bone fracture.

[0014] The base plate constitutes a place – a stop point, based on which compression is possible, i.e., minimizing the gap between the bones being anastomosed. It is an element, based on which the other components of the set are fixed. The short or long plate is the main component for stabilizing a fracture of different lengths, such as 10, 15, 20, 25, 30 mm. The eccentric makes it possible to minimize the size of the gap between the bones being anastomosed and is the element that bases and determines the extremes of the entire set fixation. The short or long plate acts as the main scaffolding on which the entire set rests.

[0015] The first step in assembling the set is the need for the surgeon performing anastomosis to assess the dimensions of the gap between the bones during the standard fracture reduction, enabling the selection of the type of eccentric needed, with a specific pitch. The surgeon then chooses a plate - either short or long, and selects an eccentric – type and size, i.e. diameter. The next step, if it is necessary to configure the set in this way, is the selection of a second eccentric – also by type and size, i.e., diameter, and base plates. It may also be necessary to select another short or long plate.

[0016] The type of eccentric is defined by the maximum size of the slot (pitch) equal to 1; 2; 3 mm, respectively. Such eccentric design gives the possibility of very precise compression of fractured bones, which is impossible in other solutions. It is possible to use

eccentrics of different size, depending on the geometric dimensions of the gaps between the fractured bones. The design of the eccentric is an essential protection against spontaneous unscrewing of eccentrics, which would cause an undesirable reduction in the compensation of the bones being anastomosed. The spontaneous unscrewing of eccentrics is prevented by the frictional force on the contact surface between the tapered part of the head of the bone screw and the tapered surface of the socket in the eccentric, as well as the frictional force between the lower flat contact surface of the eccentric and the bone.

- [0017] The set also contains a well-known bone screw that allows plates to be attached to the bones being anastomosed. Depending on the type of fracture, with or without bone pieces, it is possible to use two types of plates – without or with holes.
- [0018] The use of a certain plate length depends on the type of fracture and the number of bones to be anastomosed.
- [0019] The invention is shown in the drawing, where figures 1a-1c show the base plate; fig. 2a-2c show the short plate; fig. 3a-3c show the short plate with holes; fig. 4a-4c show the eccentric; fig. 5a-5c show the long plate; fig. 6a-6c show the set containing two base plates, one short plate without holes, and two eccentrics; fig. 7a-7c show the set containing two base plates, one long plate, two eccentrics; fig. 8a-8c show the set containing two base plates, one long plate with two through holes, one short plate without through holes, and three eccentrics, fig. 9a-9c show the set containing two base plates, two long plates with two through holes, and three eccentrics.
- [0020] Fig. 1a-1c show the base plate 1 with a through hole 2 made at one end 3 of the base plate 1, having a shape similar to a semicircle facing outward the base plate 1, and the other end 4 of the base plate 1 has a shape similar to a semicircle facing inward the base plate 1 and is terminated with the tab 5, the upper surface of which has a shape similar to a semicircle, facing inward the base plate 1, extending above the front surface of the base plate 1.
- [0021] The short plate 6, shown in fig. 2a-2c, has two opposite ends 4 having a shape similar to a semicircle facing inward the short plate 6, terminated with the tabs 5, the upper surface of which has a shape similar to a semicircle directed inward the short plate 6, exceeding above the front surface of the short plate 6.
- [0022] The short plate 6, shown in fig. 3a-3c, has two opposite ends 4 having a shape similar to a semicircle facing inward the short plate 6, terminated with the tabs 5, the upper surface of which has a shape similar to a semicircle facing inward the short plate 6, extending above the front surface of the short plate 6. The short plate 6 has two through holes 2 made in one axis.
- [0023] The eccentric 7, shown in fig. 4a-4c, has a central through hole 8, axial grooves 9 made in the front surface of the eccentric 7 on both sides of the central through hole 8,

and through indentations 10 made along the perimeter of the eccentric 7 on both sides of the grooves 9 with a shape similar to a semicircle, corresponding to the shape of the upper surface of the tabs of the base plate, the long plate and the short plate. The length of the indentations 10 is greater than the length of the upper surface of the tabs of the base plate, long plate and short plate seated in the indentations 10, and the height of the eccentric 7 corresponds to the height of the tabs of the base plate, long plate and short plate.

[0024] The entrance of the central through hole 8 is conical in shape. The grooves 9 are used to rotate the eccentric with a known wrench and allow for obtaining the anastomosis angle. The indentations 10 are used to perform compression, i.e. to minimize the gap between the bones being anastomosed. The design of eccentric 7 allows the plates to rotate up to 35 degrees and position the anastomosis perpendicular to the gap, i.e., the fracture. The maximum angle of positioning the anastomosis between the plates while maintaining compression capability should be less than 60 degrees.

[0025] The long plate 11, shown in fig. 5a-5c, has a narrowing 12 in the middle and has two through holes 2 made in one axis on both sides of the narrowing 12. The opposite ends 4 of the long plate 11 have a shape similar to a semicircle facing inward the long plate 11 and are terminated with the tabs 5, the upper surface of which has a shape similar to a semicircle facing inward the long plate 11, extending above the front surface of the long plate 11.

[0026] In the examples, the base plate 1, the short plate 6, the long plate 11 and the eccentric 7 are made of biomaterials or biodegradable materials during a 3D printing process.

[0027] The osteotomy set, shown in fig. 6a-6c, contains two base plates 1, one short plate 6 without holes, and two eccentrics 7 and bone screws 13. Each base plate 1 has a through hole 2, not shown in the figure. One end 3 of the base plate 1 has a shape similar to a semicircle facing outward the base plate 1, and the other end 4 of the base plate 1, not shown in the figure, has a shape similar to a semicircle facing inward the base plate 1 and is terminated with the tab 5, the upper surface of which has a shape similar to a semicircle, facing inward the base plate 1, extending above the front surface of the base plate 1. The short plate 6 has two opposite ends 4, not shown in the figure, having a shape similar to a semicircle facing inward the short plate 6, terminated with the tabs 5, the upper surface of which has a shape similar to a semicircle, facing inward the short plate 6, extending above the front surface of the short plate 6. Each eccentric 7 has a central through hole 8, not shown in the figure, axial grooves 9 made in the front surface of the eccentric 7 on both sides of the central through hole 8, and through indentations 10 made along the perimeter of the eccentric 7 on both sides of the grooves 9 with a shape similar to a semicircle, corresponding to the shape of the upper surface of the tabs 5 of the base plate 1 and the short plate 6.

The length of the indentations 10 is greater than the length of the upper surface of the tabs 5 of the base plate 1 and the short plate 6 seated in the indentations 10, and the height of the eccentric 7 corresponds to the height of the tabs 5 of the base plate 1 and the short plate 6. The entrance of the central through hole 8 is conical in shape.

[0028] The first step in assembling the set, using the well-known surgical instruments, is the need for the surgeon performing the anastomosis to assess the dimensions of the gap 14 between the bones to be anastomosed during the classic fracture reduction, enabling the selection of the type of eccentric 7 needed, with a specific pitch. Then, the short plate 6 and the eccentric 7 of appropriate size, i.e. diameter, are selected. Afterwards, a second suitable eccentric 7 and two base plates 1 are selected.

[0029] The short plate 6 is applied on the gap 14 created by the fracture, so that the gap 14 is in the geometric center of the short plate 6. Then, the first base plate 1 is applied on the left side of the short plate 6, and the maximally rotated first eccentric 7 is applied between the short plate 6 and the base plate 1, after which the base plate 1 is fixed by a known method with the bone screw 13 screwed into the through hole 2 of the base plate 1. The second base plate 1 is applied on the right side of the short plate 6, and the maximally rotated second eccentric 7 is applied between the short plate 6 and the second base plate 1, after which the base plate 1 is fixed by a known method with the bone screw 13 screwed into the through hole 2 of the base plate 1. Then, the gaps 14 are minimized by adjusting and tightening-turning the eccentrics 7, and finally the eccentrics 7 are tightened with the bone screw screwed into the central through hole 8 of the eccentric 7.

[0030] The tabs 5 of the base plates 1 and the short plate 6 are seated in the indentations 10 of the eccentrics 7 with neutral on both sides.

[0031] It is the surgeon who decides about the order of steps in the osteotomy procedure in each case, including the order of rotation of the eccentrics 7.

[0032] The entire set of plates remains in the body for the duration of fracture healing.

[0033] The configuration of the set shown in fig. 6a-6c is based on the possibility of compression using two simultaneous eccentrics 7 and very precise tightening, i.e., compression, of the two bones being anastomosed. This configuration does not require the use of bone screws on the short plate 6 or the need to screw the screws in close proximity to the fracture site – the gap.

[0034] fig. 7a-7c show the set containing the long plate 11, two base plates 1, two eccentrics 7 and bone screws 13.

[0035] The base plate 1 has a through hole 2, not shown in the figure, made at one end 3 of the base plate 1, having a shape similar to a semicircle facing outward the base plate 1, and the other end 4 of the base plate 1, not shown in the figure, has a shape similar to a semicircle facing inward the base plate 1 and is terminated with the tab 5, the upper

surface of which has a shape similar to a semicircle facing inward the base plate 1, extending above the front surface of the base plate 1. Each eccentric 7 has a central through hole 8, not shown in the figure, axial grooves 9 made in the front surface of the eccentric 7 on both sides of the central through hole 8, and through indentations 10 made along the perimeter of the eccentric 7 on both sides of the grooves 9 with a shape similar to a semicircle, corresponding to the shape of the upper surface of the tabs 5 of the base plate 1 and the long plate 11. The length of the indentations 10 is greater than the length of the upper surface of the tabs 5 of the base plate 1 and the long plate 11 seated in the indentations 10, and the height of the eccentric 7 corresponds to the height of the tabs 5 of the base plate 1 and the long plate 11. The entrance of the central through hole 8 has a conical shape. The long plate 11 has a narrowing 12 in the middle and has two through holes 2, not shown in the figure, made in one axis on both sides of the narrowing 12. The opposite ends 4 of the long plate 11, not shown in the figure, have a shape similar to a semicircle facing inward the long plate 11 and are terminated with the tabs 5, the upper surface of which has a shape similar to a semicircle, facing inward the long plate 11, extending above the front surface of the long plate 11.

- [0036] The first step in assembling the set, using the well-known surgical instruments, is the need for the surgeon performing anastomosis to assess the dimensions of the gap 14 between the bones to be anastomosed during the classic fracture reduction, enabling the selection of the type of eccentric 7 needed, with a specific pitch. Then, the long plate 11 and the eccentric 7 of appropriate size, i.e., diameter, are selected. Afterwards, a second suitable eccentric 7 and two base plates 1 are selected.
- [0037] The long plate 11 is applied on the gap 14 created by the fracture so that the gap 14 is in the geometric center of the long plate 11, and the bone screw 13 is pre-screwed through the left through hole 2 of the long plate 11 by a known method. Then, the base plates 1 are applied on both sides of the long plate 11, and the maximally rotated eccentric 7 is applied between the long plate 11 and each base plate 1, after which each base plate 1 is fixed by a known method with the bone screw 13 screwed into the through hole 2 of each base plate 1. The gap 14 is minimized by adjusting and tightening-turning the eccentrics 7, and finally the bone screw 13 is tightened into the left through hole 2 of the long plate 11, the bone screw 13 is screwed into the second through hole 2 of the long plate 11, and the eccentric 7 is tightened with the bone screw screwed into the central through hole 8 of the eccentric 7.
- [0038] The tabs 5 of the base plates 1 and the long plate 11 are seated in the indentations 10 of the eccentrics 7 with neutral on both sides.
- [0039] It is the surgeon who decides about the order of steps in the osteotomy procedure in each case, including the order of rotation of the eccentrics 7.

- [0040] After fixing the long plate 11 with two bone screws 13, it is possible to completely remove both the base plate 1 and the eccentrics 7.
- [0041] This configuration of the set can be used for compression anastomosis of long bone fractures with the simultaneous possibility of moving the screw fixation site away from the gap 14 between the bones being anastomosed. Then, essentially only one long plate 6 and two bone screws 13 are used for anastomosis.
- [0042] fig. 8a-8c show the set containing two base plates 1, one long plate 11, one short plate 6 without through holes, and three eccentrics 7 and bone screws 13.
- [0043] Each base plate 1 has a through hole 2, not shown in the figure, one end 3 of the base plate 1 has a shape similar to a semicircle facing outward the base plate 1, and the other end 4 of the base plate 1, not shown in the figure, has a shape similar to a semicircle facing inward the base plate 1 and is terminated with the tab 5, the upper surface of which has a shape similar to a semicircle, facing inward the base plate 1, extending above the front surface of the base plate 1. The short plate 6 has two opposite ends 4, not shown in the figure, having a shape similar to a semicircle facing inward the short plate 6, terminated with the tabs 5, the upper surface of which has a shape similar to a semicircle, facing inward the short plate 6, extending above the front surface of the short plate 6. Each eccentric 7 has a central through hole 8, not shown in the figure, axial grooves 9 made in the front surface of the eccentric 7 on both sides of the central through hole 8, and through indentations 10 made along the perimeter of the eccentric 7 on both sides of the grooves 9 with a shape similar to a semicircle, corresponding to the shape of the upper surface of the tabs 5 of the base plate 1, the short plate 6 and the long plate 11. The length of the indentations 10 is greater than the length of the upper surface of the tabs 5 of the base plate 1, the short plate 6 and the long plate 11 seated in the indentations 10, and the height of the eccentric 7 corresponds to the height of the tabs 5 of the base plate 1, the short plate 6 and the long plate 11. The entrance of the central through hole 8 is conical in shape. The long plate 11 has a narrowing 12 in the middle and has two through holes 2 made in one axis on both sides of the narrowing 12. The opposite ends 4 of the long plate 11, not shown in the figure, have a shape similar to a semicircle facing inward the long plate 11 and are terminated with the tabs 5, the upper surface of which has a shape similar to a semicircle, facing inward the long plate 11, extending above the front surface of the long plate 11.
- [0044] The first step in assembling the set, using the well-known surgical instruments, is the need for the surgeon performing anastomosis to assess the dimensions of the gaps 14 between the bones to be anastomosed, enabling the selection of the types of eccentrics 7 needed, with a specific pitch. This is followed by the selection of the long plate 11, the short plate 6 and two base plates 1.

- [0045] The long plate 11 is applied on the first gap 14 created by the fracture, so that the gap 14 is in the geometric center of the long plate 11, and the bone screw 13 is screwed through the right through hole 2 of the long plate 11 by a known method. Then, the base plate 1 is applied on the left side of the long plate 11, and the maximally rotated eccentric 7 is applied between them. Then, the base plate 1 is fixed by a known method with the bone screw 13 screwed into the through hole 2 of the base plate 1 and the first gap 14 is minimized by adjusting and tightening-turning the eccentric 7, after which the eccentric 7 is tightened with the bone screw screwed into the central through hole 8 of the eccentric 7. Then, the short plate 6 is applied on the second gap 14 created by the fracture, so that the gap 14 is in the geometric center of the short plate 6. The maximally rotated second eccentric 7 is applied between the long plate 11 and the short plate 6. The second base plate 1 is applied and the maximally rotated third eccentric 7 is applied between the short plate 6 and the base plate 1, after which the bone screw 13 is screwed through the left through hole 2 of the long plate 11 by a known method. Then, the bone screw 13 is screwed through the through hole 2 of the second base plate 1 by a known method, the second gap 14 is minimized, and finally the second and third eccentrics 7 are tightened with the bone screw screwed into the central through hole 8 of the eccentric 7.
- [0046] The tabs 5 of the base plates 1, the short plate 6 and the long plate 11 are seated in the indentations 10 of the eccentrics 7 with neutral on both sides.
- [0047] It is the surgeon who decides about the order of steps in the osteotomy procedure in each case, including the order of rotation of the eccentrics 7. This configuration will also find application in the case of a single fracture.
- [0048] fig. 9a-9c show the set containing two base plates 1, two long plates 11 with two through holes, and three eccentrics 7 and bone screws 13.
- [0049] Each base plate 1 has a through hole 2, not shown in the figure, made at one end 3 of the base plate 1 having a shape similar to a semicircle facing outward the base plate 1, and the other end 4 of the base plate 1, not shown in the figure, has a shape similar to a semicircle facing inward the base plate 1 and is terminated with the tab 5, the upper surface of which has a shape similar to a semicircle, facing inward the base plate 1, extending above the front surface of the base plate 1. Each long plate 11 has a narrowing 12 in the middle and has two through holes 2, not shown in the figure, made in one axis, on both sides of the narrowing 12. The opposite ends 4 of the long plate 11, not shown in the figure, have a shape similar to a semicircle facing inward the long plate 11 and are terminated with the tabs 5, the upper surface of which has a shape similar to a semicircle, facing inward the long plate 11, extending above the front surface of the long plate 11. Each eccentric 7 has a central through hole 8, not shown in the figure, axial grooves 9 made in the front surface of the eccentric 7 on both sides

of the central through hole 8, and through indentations 10 made along the perimeter of the eccentric 7 on both sides of the grooves 9 with a shape similar to a semicircle, corresponding to the shape of the upper surface of the tabs 5 of the base plate 1 and the long plate 11. The length of the indentations 10 is greater than the length of the upper surface of the tabs 5 of the base plate 1 and the long plate 11 seated in the indentations 10, and the height of the eccentric 7 corresponds to the height of the tabs 5 of the base plate 1 and the long plate 11. The entrance of the central through hole 8 is conical in shape.

[0050] The first step in assembling the set, using the well-known surgical instruments is the need for the surgeon performing anastomosis to assess the dimensions of the gaps 14 between the bones to be anastomosed, enabling the selection of the types of eccentrics 8 needed, with a specific pitch. Then, two long plates 11 and two base plates 1 are selected.

[0051] On the first gap 14 formed by the fracture, the first long plate 11 is applied, so that the gap 14 is in the geometric center of the long plate 11 and the bone screw 13 is screwed through the right through hole 2 of the long plate 11 by a known method. Then, the base plate 1 is applied on the left side of the long plate 11, and the maximally rotated eccentric 7 is applied between them. Then, the base plate 1 is fixed by a known method with the bone screw 13 screwed into the through hole 2 of the base plate 1, and the first gap 14 is minimized by adjusting and tightening-turning the eccentric 7, after which the eccentric 7 is tightened with the bone screw screwed into the central through hole 8 of the eccentric 7, and then the bone screw 13 is screwed into the left through hole 2 of the long plate 11 by a known method. Then, the second long plate 11 is applied on the second gap 14 formed by the fracture so that the gap 14 is in the geometric center of the long plate 11. The maximally rotated second eccentric 7 is applied between the long plates 11, the second base plate 1 is applied and the maximally rotated third eccentric 7 is applied between the second long plate 11 and the base plate 1, after which the bone screw 13 is screwed through the left through hole 2 of the second long plate 11 by a known method. Then, the bone screw 13 is screwed through the second through hole 2 of the first base plate 1 by a known method, and the second gap 14 is minimized. Then, the bone screw 13 is screwed into the right through hole 2 of the long plate 11 by a known method, and finally the second and third eccentrics 7 are tightened with the bone screw screwed into the central through hole 8 of the eccentric 7.

[0052] The tabs of the 5 base plates 1 and the long plate 11 are seated in the indentations 10 of the eccentrics 7 with neutral on both sides.

[0053] It is the surgeon who decides about the order of steps in the osteotomy procedure in each case, including the order of rotation of the eccentrics 7.

[0054] After fixing the long plate 11 with two bone screws 13, it is possible to completely remove both the base plate 1 and the eccentrics 7.

[0055] In the case of a single fracture, the same configuration can be used for medical reasons involving weakened bone fragments due to osteoporosis.

Claims

- [Claim 1] The osteotomy set with interconnectable and expandable components, containing at least one plate with at least one through hole for a bone screw and at least one bone screw and at least one connecting element, characterized in that it contains at least two base plates (1) with a through hole (2) made at the end (3) of the base plate (1), having a shape similar to a semicircle, facing outward the base plate (1), at least two eccentrics (7) and at least one short plate (6) without through holes, or at least one long plate (11) with a narrowing (12) in the middle and at least two through holes (2), with the two through holes being made at both sides of the narrowing of the long plate (11), where the other end (4) of the base plate (1), the opposite ends (4) of either the short plate (6) or the long plate (11) have a shape similar to a semicircle facing inward the said plate (1,6,11) and are terminated with tabs (5), the upper surface of which has a shape similar to a semicircle, facing inward the said plate (1,6,11), extending above the front surface of said plate (1,6,11), and the eccentric (7) has a central through hole (8), axial grooves (9) made in the front surface of the eccentric (7) on both sides of the central through hole (8), and through indentations (10) made along the perimeter of the eccentric (7) on both sides of the grooves (9) with a shape similar to a semicircle, corresponding to the shape of the upper surface of the tabs (5) of the base plate (1), short plate (6) and long plate (11), where the length of the indentations (10) is greater than the length of the upper surface of the tabs (5) of the base plate (1), short plate (6) and long plate (11) seated in the indentations (10), and the height of the eccentric (7) corresponds to the height of the tabs (5) of these plates (1,6,11).
- [Claim 2] The osteotomy set according to claim 2 characterized in that it additionally contains at least one short plate (6) with two through holes (2).
- [Claim 3] The osteotomy set according to claims 1 or 2 characterized in that the base plate (1), the short plate (6), the long plate (11) and the eccentric (7) are made of metal alloys, biomaterials and biodegradable materials.
- [Claim 4] The osteotomy set according to any of the claims 1 to 3 characterized in that the base plate (1), the short plate (6), the long plate (11) and the eccentric (7) are made during a 3D printing process.

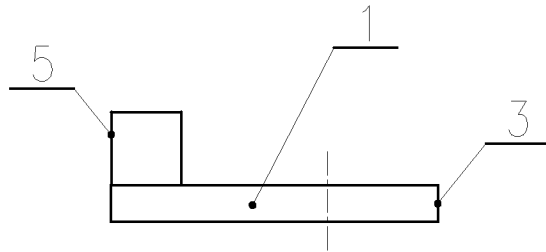


Fig. 1a

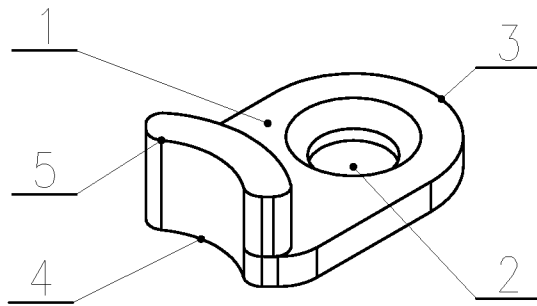


Fig. 1b

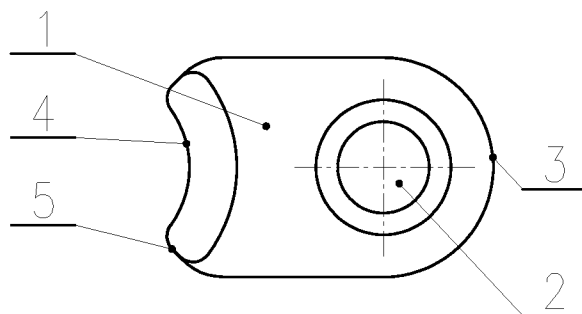


Fig. 1c

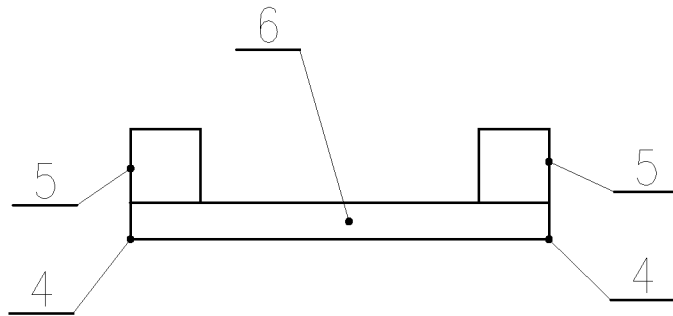


Fig. 2a

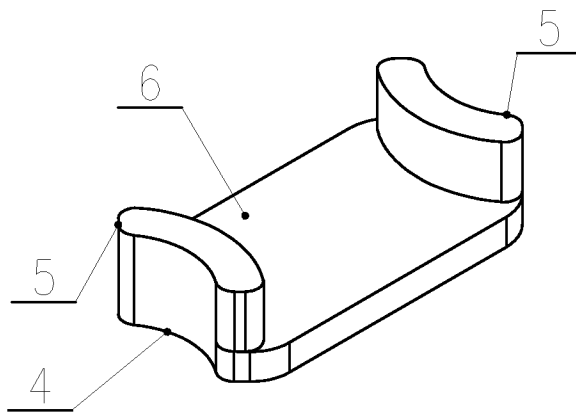


Fig. 2b

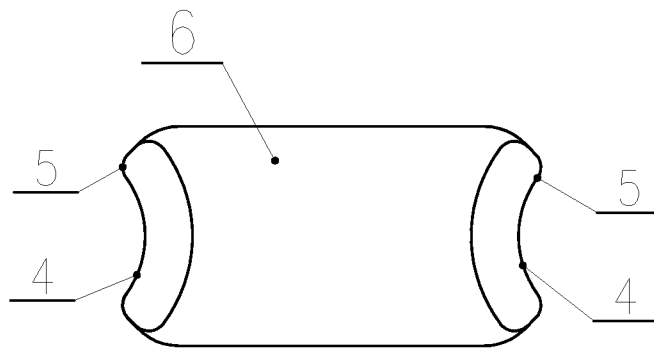


Fig. 2c

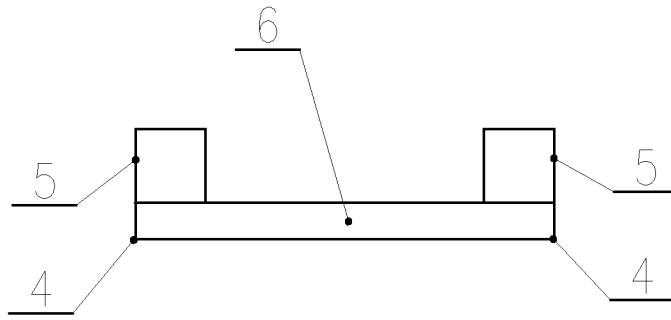


Fig.3a

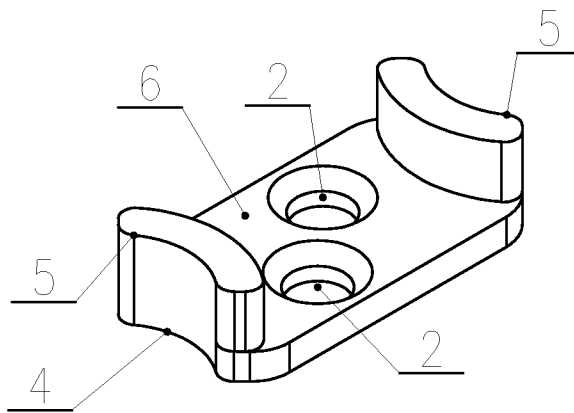


Fig.3b

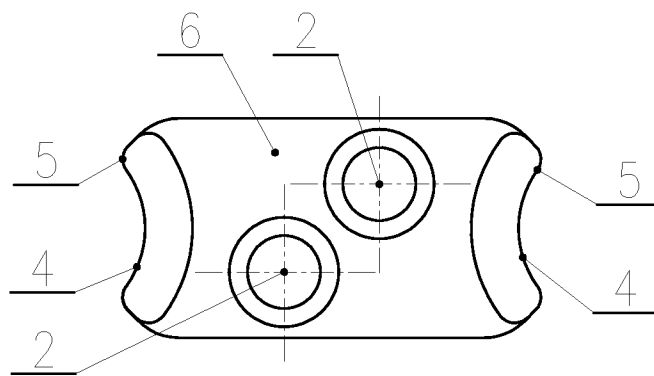


Fig.3c

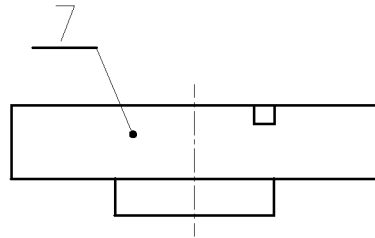


Fig. 4a

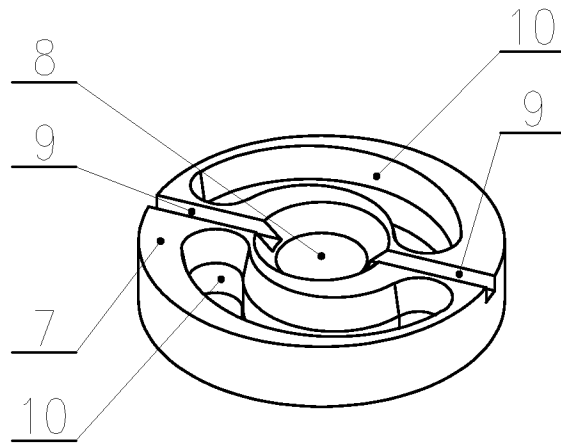


Fig. 4b

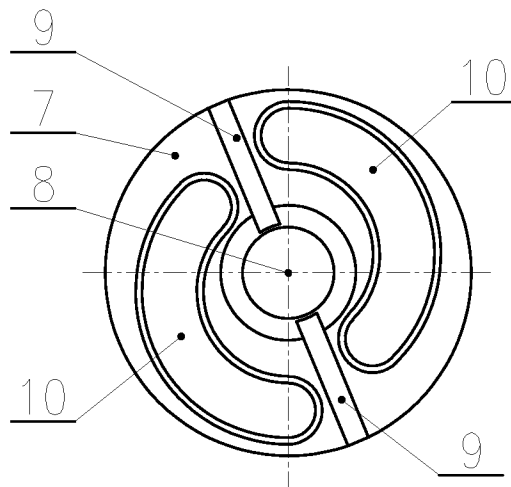


Fig. 4c

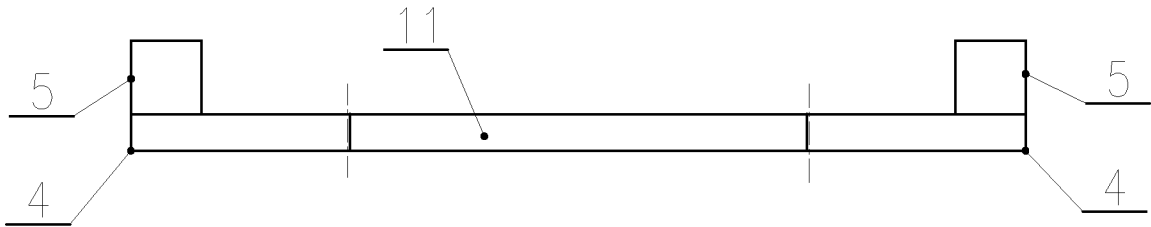


Fig.5a

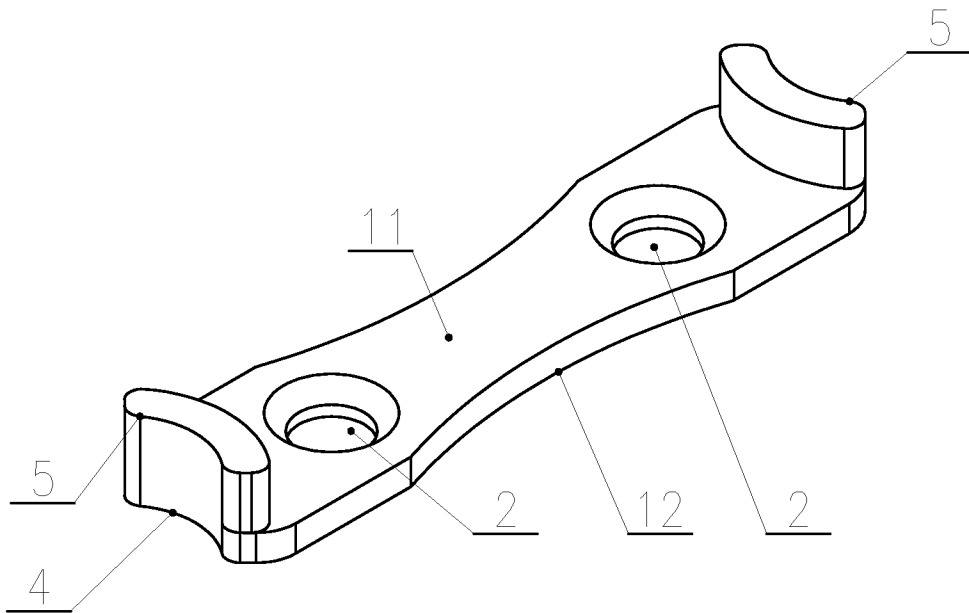


Fig.5b

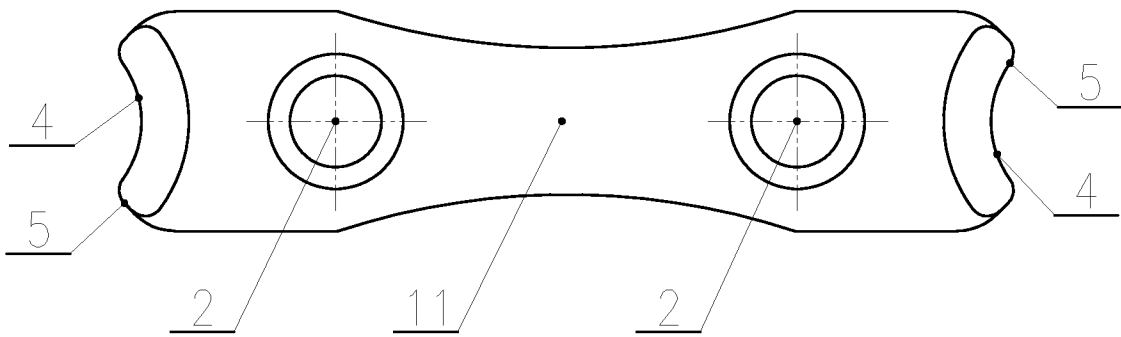


Fig.5c

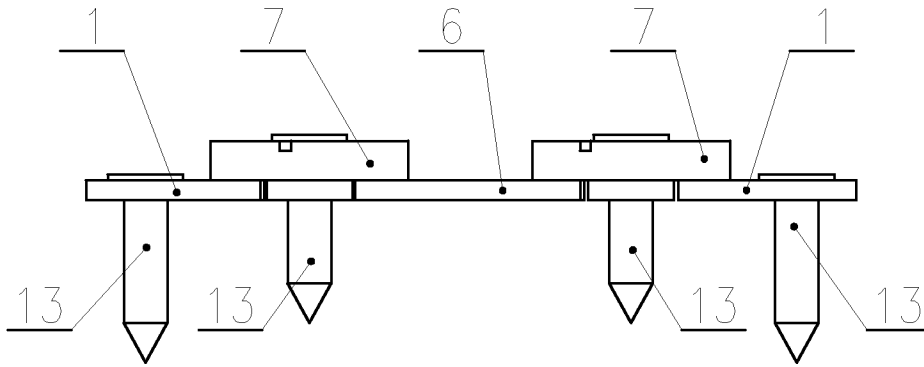


Fig. 6a

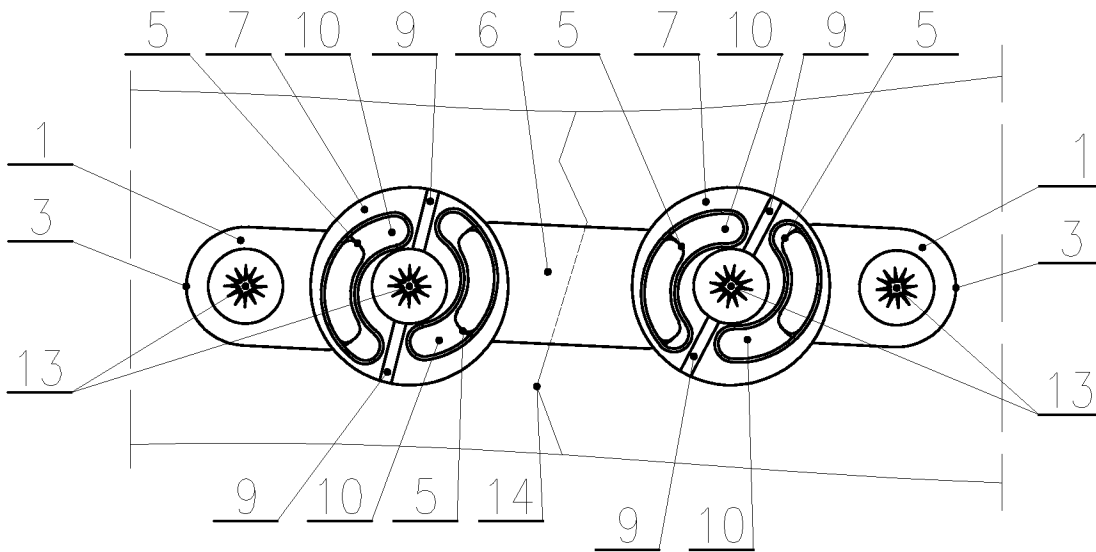


Fig. 6b

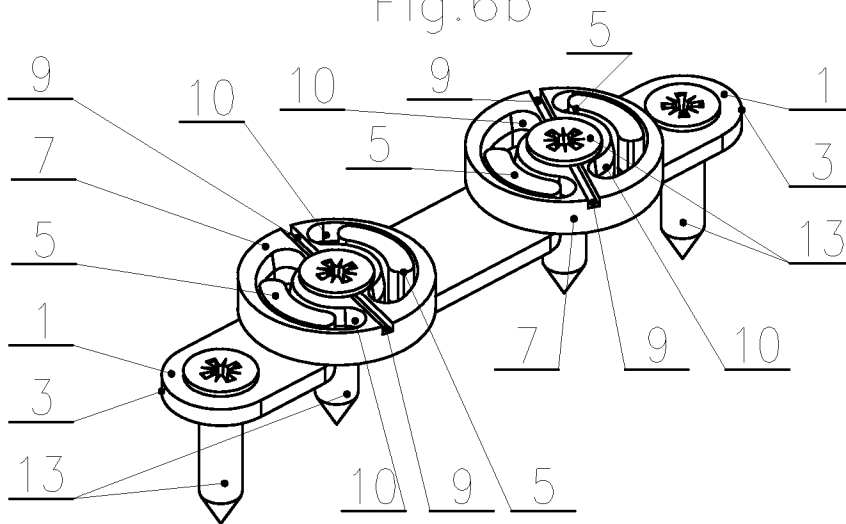


Fig. 6c

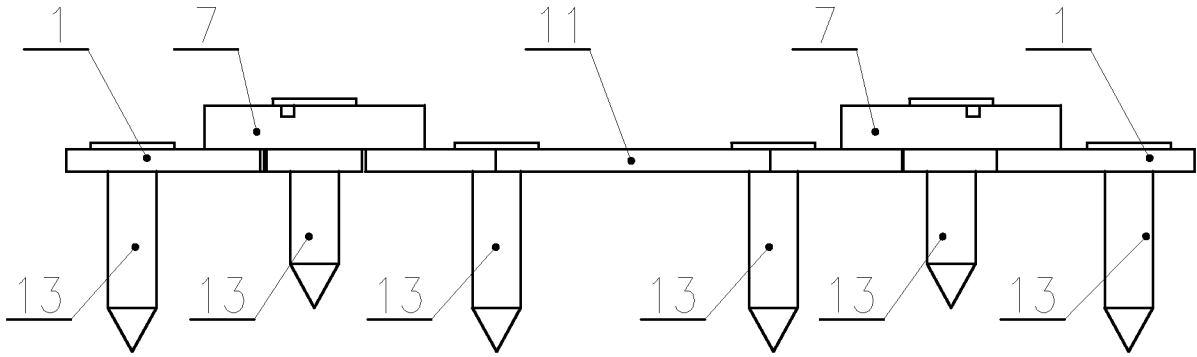


Fig. 7a

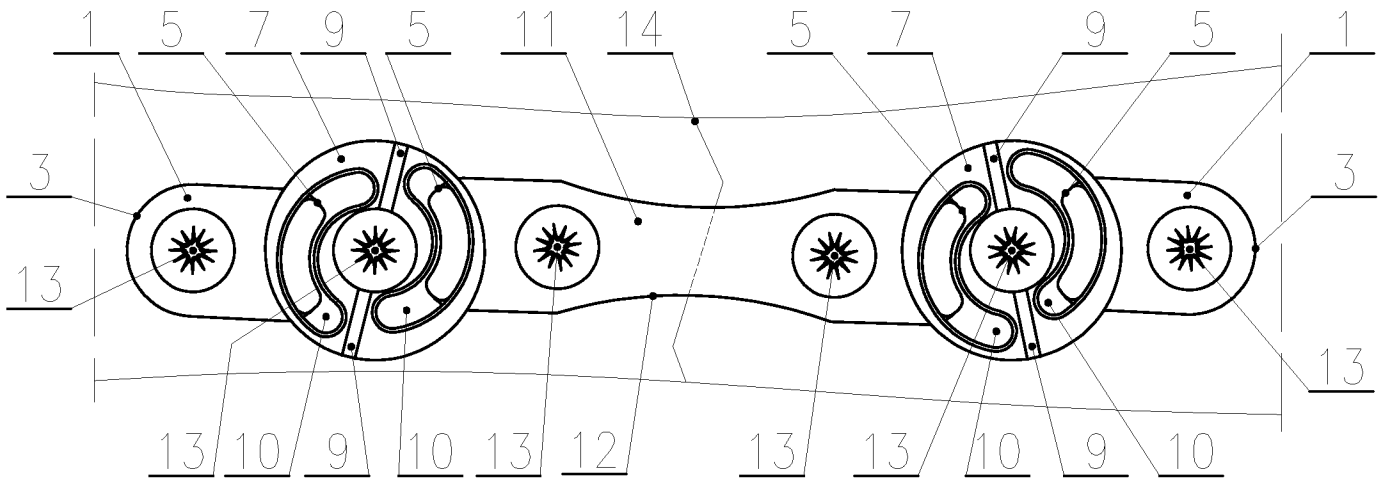


Fig. 7b

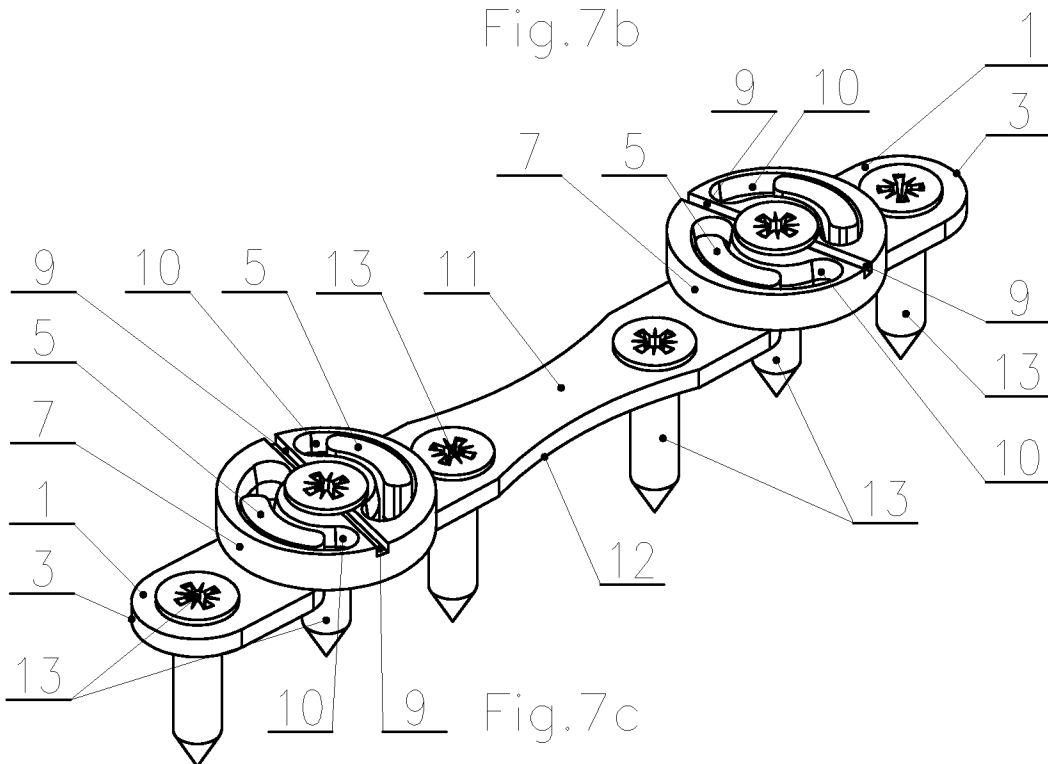


Fig. 7c

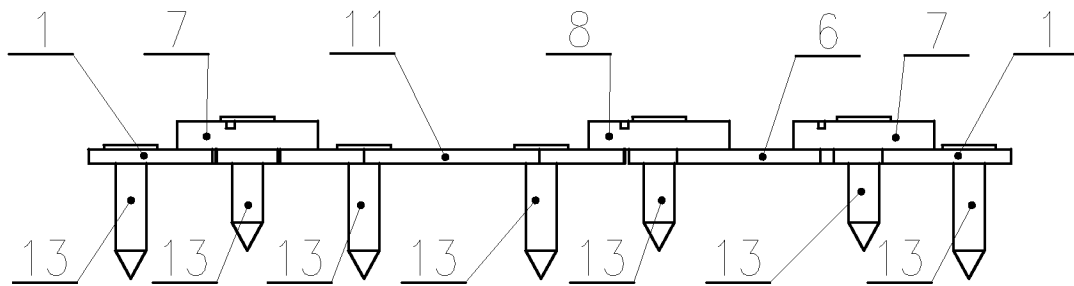


Fig. 8a

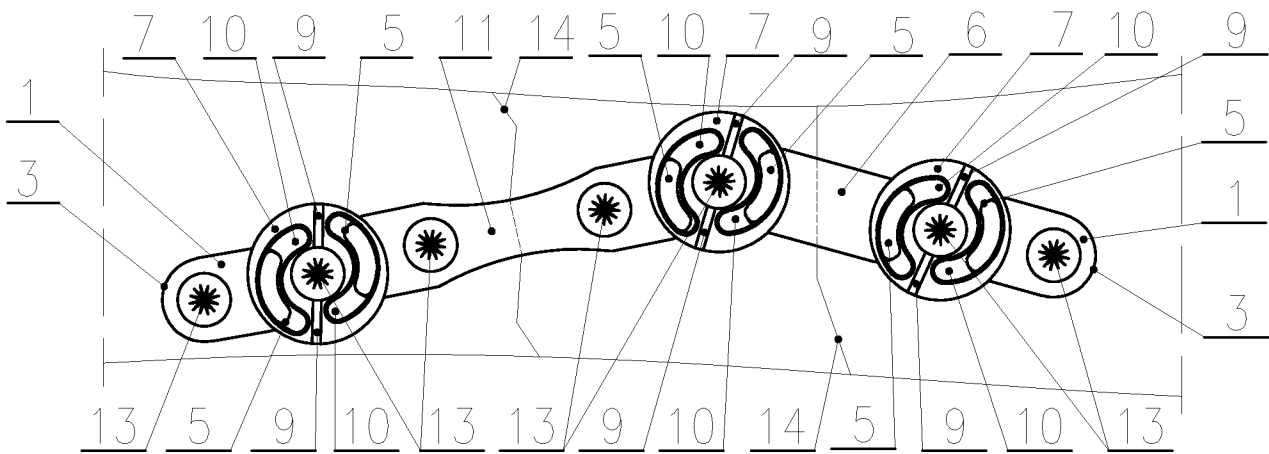


Fig. 8b

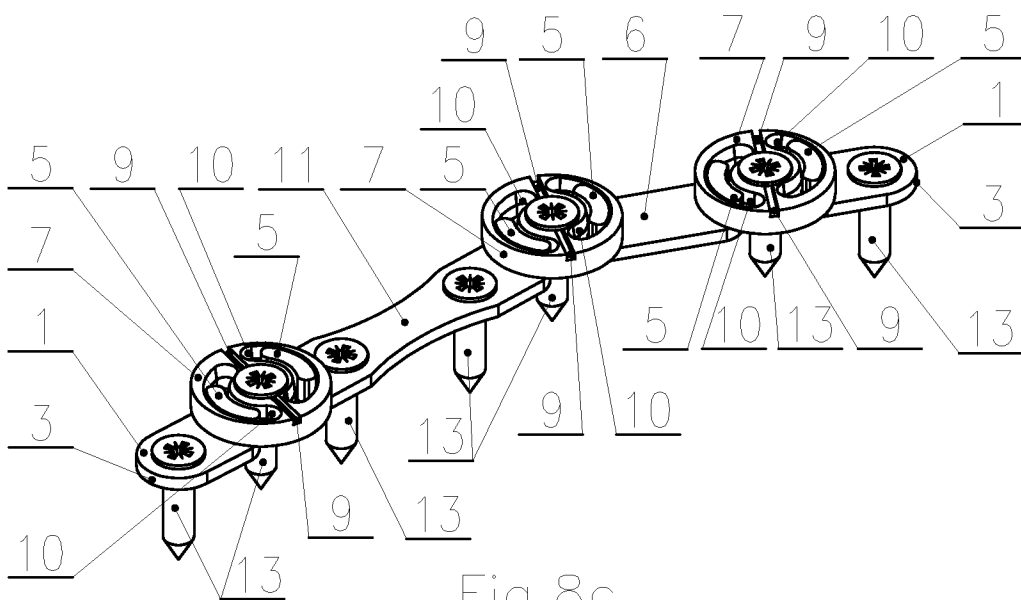


Fig. 8c

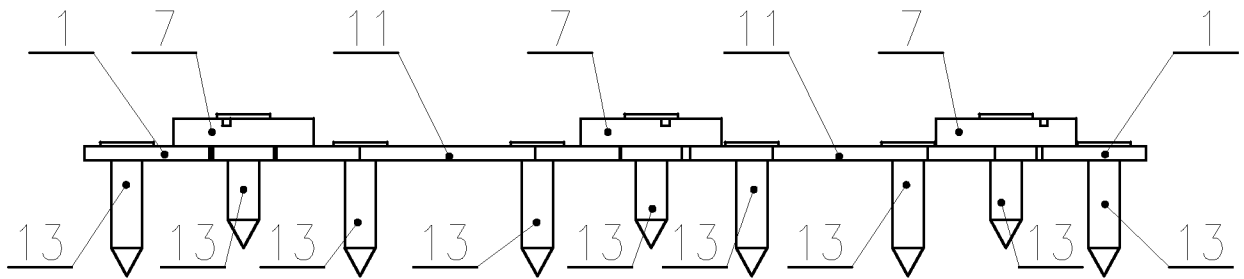


Fig. 9a

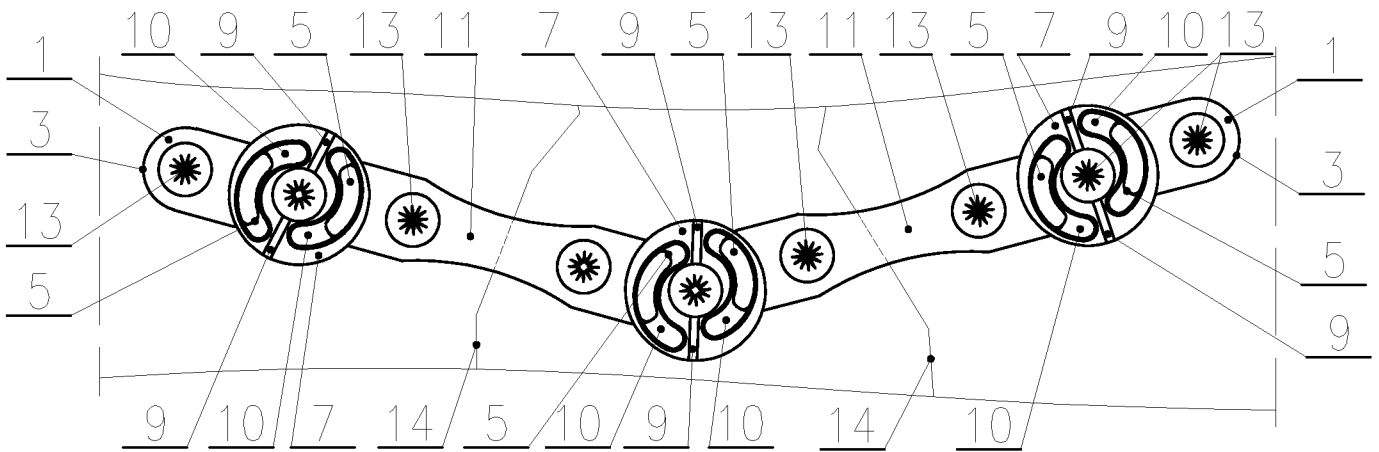


Fig. 9b

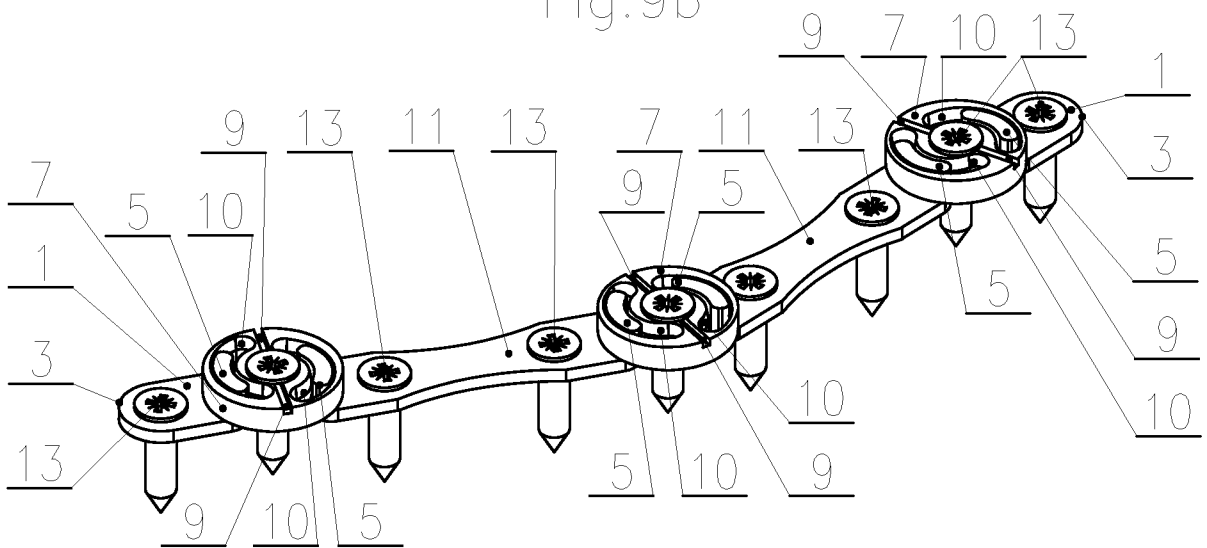


Fig. 9c

INTERNATIONAL SEARCH REPORT

International application No
PCT/PL2022/050049

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/80
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 3 446 651 A1 (ZIMMER GMBH [CH]) 27 February 2019 (2019-02-27) paragraph [0037] paragraph [0043] paragraph [0054] - paragraph [0059] figures 5a, 5b, 24, 28, 29A-29B -----	1
A	EP 3 320 867 A1 (BIEDERMANN TECHNOLOGIES GMBH [DE]) 16 May 2018 (2018-05-16) paragraph [0013] - paragraph [0025] figures 1, 2 -----	1
	-/--	

Further documents are listed in the continuation of Box C.

See patent family annex.

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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

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Date of the actual completion of the international search

Date of mailing of the international search report

30 November 2022

12/12/2022

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 Fax: (+31-70) 340-3016

Authorized officer

Kakoullis, Marios

INTERNATIONAL SEARCH REPORT

International application No
PCT/PL2022/050049

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

International application No

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