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(54) **Closing hook for ski boot and other sporting footwear and manufacturing method thereof**

(57) The present invention relates to a closing device (10) for sports footwear, which comprises a rack (20) and a lever (40) suitable for engaging with the rack (20) in at least one position. The lever (40) consists of a lever arm (50) and a forked lug (60) which are connected together by means of a tie-piece (70).

The rack (20), the lever arm (50) and the forked lug

(60) are made of an aluminium alloy and have a surface hardness factor of at least 90 HB. A suitable material is a 7000 series aluminium alloy.

The invention also relates to a method for manufacturing the closing device (10).

The method involves extruding a 7000 series aluminium alloy billet, stamping the components of the fastener in a blanking press and boring the obtained component.

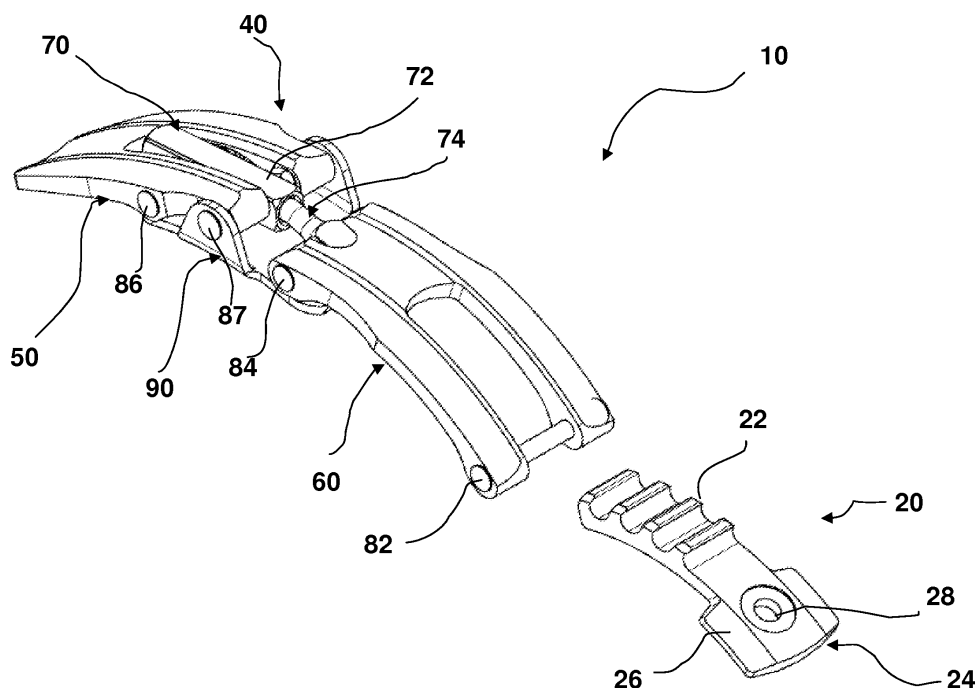


Fig. 1

Description

[0001] The present invention relates to a closing device for sports footwear, in particular for ski-boots. The invention also relates to a method for manufacturing said closing device.

[0002] Hitherto, the closing of sports footwear, such as ski-boots, is performed by means of ratchet devices which are mounted on oppositely arranged flaps.

[0003] A rack is mounted on one flap, and a lever on the other flap, said lever consisting of an arm and a forked lug able to engage with the teeth of the rack so as to ensure closing of the boot.

[0004] In order to improve the closing action and provide the user with an increasingly greater degree of comfort, during the last few years numerous devices have been developed with the aim of allowing the user to adjust both the position of the rack and the position of the lever.

[0005] Steps have also been taken to develop the design of the closing lever. In order to improve the design of the lever and increase its mechanical properties, in fact, increasing importance has been given to research into new forms, new materials and new manufacturing techniques.

[0006] At present, most of the closing fasteners for ski-boots are made using aluminium alloys of the 6000 series, in particular the 6060 and 6005A series.

[0007] Magnesium and silicon are the main components in an alloy. Other important components are copper, which plays a part in the ageing process, and manganese and chromium (only in the case of the 6005 A series) for control of recrystallization.

[0008] These categories of alloys have a high degree of hot deformability and may have an increased mechanical strength following suitable heat treatment which causes the formation of hardening phases which are homogeneously dispersed in the aluminium matrix.

[0009] These alloys, if produced by means of an extrusion process, may be used to obtain fasteners which are characterized by an average surface hardness of 60 HB (maximum 80 HB) and an average tensile breakage strength of 170 N/mm² (maximum 270 N/mm²).

[0010] This type of material, however, although widely used, is not without certain drawbacks. In particular, more expert skiers in fact require ski-boots which are characterized by closing levers which have increasingly smaller thicknesses and weight, while the mechanical properties of these alloys are such that it is not possible to reduce the thicknesses beyond a certain limit in order to guarantee their strength.

[0011] The object of the present invention is to provide a closing device which, at thicknesses smaller than those obtained with conventional aluminium alloys, has mechanical properties which are at least equivalent, if not superior to those of the known devices.

[0012] In particular, one object of the present invention is to provide a closing device which has, for the same thicknesses and cross-sections, a greater tensile strength than the devices obtained using conventional aluminium alloys.

[0013] A further object of the present invention is to provide a method for manufacturing closing devices according to the present invention which is able to reduce the manufacturing time and costs.

[0014] These objects, along with others, are achieved by a closing device for sports footwear according to Claim 1 and with a manufacturing method according to that claimed in Claim 6.

[0015] The characteristic features and further advantages of the invention will emerge from the description, hereinbelow, of a number of examples of embodiment provided by way of a non-limiting example, with reference to the accompanying drawings in which:

- Figure 1 shows an axonometric view of the device according to the invention;
- Figure 2 shows a side view of the device according to Figure 1;
- Figure 3 shows a top plan view of the device according to Figure 1;
- Figure 4 shows an exploded view of the device according to Figure 1;
- Figure 5 shows schematically a known machining method, with stock removal, for obtaining a lever arm from an extruded article made using a conventional aluminium alloy;
- Figure 6 shows schematically the machining method, using dies, for obtaining a lever arm according to the invention;
- Figures 7 and 8 are, respectively, a side view and a front view of the lever arm obtained by means of the machining method according to Figure 6;
- Figure 9 shows an axonometric view of the device according to Figures 7 and 8 after the boring operation has been performed;
- Figure 10 shows schematically the machining method for obtaining a forked lug according to the invention;
- Figure 11 shows schematically a side view of the forked lug obtained by means of the machining method according to Figure 10;
- Figure 12 shows an axonometric view of the device according to Figures 10 and 11 after the boring operation has been performed.

[0016] With reference to the accompanying figures, a device for closing sports footwear is indicated in its entirety by 10.

[0017] The closing device 10 comprises a rack 20 and a lever 40 suitable for engaging with the rack 20 in at least one position. The lever 40, by means of the fixing means 90, is permanently connected to a first flap of the footwear (not shown).

[0018] With reference to Figure 1, the rack element 20 comprises a toothed portion 22 and a flat portion 24 which terminates in a widened extension 26. Said rack element 20 can be fixed to a second flap of the footwear (not shown) by means of known fixing means, for example a rivet which engages inside a through-hole 28 formed in the extension 26 of the flat portion 24.

[0019] The lever 40 consists of a lever arm 50 and a forked lug 60 which are connected together by means of a tie-piece 70.

[0020] Said arm 50, which is substantially U-shaped, has a slightly curved profile in order to adapt better to the underlying upper or leg-piece of the boot. It is composed of a central body 52 and two wings 54 and 56 between which an opening 58 with parallel sides is formed. This opening 58 extends longitudinally along most of the length of the profile 50. A first hole 57 and a second hole 59 (Fig. 4), which have the same diameter and are coaxial with each other, are formed in the end part of the two wings 54 and 56. A further pair of holes, 51 and 53 (Fig. 4), which have the same diameter and are coaxial with each other, are positioned approximately midway between the ends of the opening 58.

[0021] Via the forked lug 60 the lever 40 is engaged with the rack element 20 when closing of the device 10 is performed. The forked lug 60, which is also substantially U-shaped and slightly curved, is composed of a central body 62 and two prongs 64 and 66 between which an opening 68 with parallel sides is formed. This opening 68 extends longitudinally along most of the length of the forked lug 60.

[0022] A first hole 67 and a second hole 69, which have the same diameter and are coaxial with each other (Fig. 4), are formed in the end part of the two prongs 64 and 66.

[0023] A cylindrical shaped pin 82 is arranged inside the holes 67 and 69 and is able to engage, when the device 10 is closed, with a recess in the toothed portion 22 of the rack element 20.

[0024] A first hole 61 and a second hole 63 (Fig. 4), which have the same diameter and are coaxial with each other, are formed in the forked lug 60 at the end diametrically opposite to the end where the pin 82 is fixed, a cylindrical pin 84 being arranged in said holes.

[0025] The tie-piece 70 has the function of connecting together the lever arm 50 and the forked lug 60. Said tie-piece consists of a threaded sleeve 72 and an adjusting pin 74. The threaded sleeve 72, which has a parallelepiped shape, is designed to be positioned inside the opening 58 of the lever arm 50 and has, about midway along its axial length, a transverse hole 77. The adjusting pin 74 has a first externally threaded end 75 by means of which it may be screwed or unscrewed into/from the threaded sleeve 72, and a second end 76, where the through-hole 78 is formed. Said end 76 is intended to be seated inside a recess 79 formed in the end of the forked lug 60 with the holes 61 and 63.

[0026] The cylindrical pin 84 is designed to engage, not only with the first hole 61 and the second hole 63, but also with the hole 78, connecting together the tie-piece 70 and the forked lug 60.

[0027] The tie-piece 70 is in turn connected to the lever arm 50 via the cylindrical pin 86. This cylindrical pin 86 engages with the first hole 51, the hole 77 and the second hole 53.

[0028] The abovementioned connection between lever arm 50 and forked lug 60 via the tie-piece 70 allows the user the possibility of adjusting the length of the lever 40 by screwing or unscrewing the adjusting pin 74 into the sleeve 72 and at the same time rotating the forked lug 60 with respect to the lever arm 50, making it easier to perform the operations of closing and opening the device 10.

[0029] A bracket 90 with a substantially rectangular shape and curved profile is fixed in a known manner, for example by means of rivets, via the through-holes 92 and 94 to the flap of the shoe or boot which is situated opposite to that on which the rack 20 is fixed. This bracket 90 has, along the two longer sides, two tapered flanges 96 and 98 which extend at right-angles to the plane of the bracket itself. Two holes 97 and 99, which have the same diameter and are coaxial with each other, are provided on these two flanges.

[0030] A first cylindrical pin 87 engages inside the first hole 97 of the bracket and the first hole 57 of the lever arm. A second cylindrical pin 89 engages inside the second hole 99 of the bracket and the second hole 59 of the lever arm.

[0031] By means of the pins 87 and 89 the lever 40 is fixed to a flap of the shoe or boot opposite to that where the rack 20 is situated. The lever 40, which is able to rotate about the axis coinciding with the axes of the two pins 87 and 89, may be easily fixed by the user to the rack 20.

[0032] A spring 100 is provided between the lever arm 50 and the bracket 90 and allows the device 10 to be kept in the closed position once the lever 40 has been fixed to the rack 20. The connection between lever 40 and rack 20 may in fact be released only by overcoming the opposing force exerted by the spring 100.

[0033] As already mentioned, aluminium alloys of the 6000 series, in particular the 6060 and 6005A series, are normally used for the production of closing levers for ski-boots.

[0034] Aluminium alloys of the 7000 series, such as the alloy 7003, are also known.

[0035] The sectors in which this type of alloy is used are the aerospace industry, motor industry and weapons industry.

[0036] The main characteristic component in this alloy is zinc. The alloy also contains magnesium and copper, which

have a significant effect on the ageing process, and chromium and manganese, which affect the recrystallization process.

[0037] These alloys are characterized by an excellent mechanical strength and a reasonable corrosion resistance.

[0038] It has now been found that by using aluminium alloys of the 7000 series it is possible to manufacture closing lever components which have an average surface hardness values of 100 HB and average tensile strength values of 335 N/mm².

[0039] The present invention therefore relates to the components of a closing device 40 such as the lever arm 50, forked lug 60 and rack 20 which are made of 7000 series, in particular 7003 series, aluminium alloy. It has in fact been found that it is possible to manufacture levers which, for the same mechanical strength, are thinner than those which are conventionally available in commerce or which, for the same resistant cross-section, are able to withstand higher stresses without the risk of breakage or deformation.

[0040] As mentioned above, the present invention also relates to an innovative method for manufacturing these closing levers.

[0041] In order to illustrate more clearly the characteristic steps of the new manufacturing method, below reference will be made initially to the known method for machining a lever arm 50 made of a conventional 6000 series alloy. Similar considerations are also applicable to the machining of the other components of a closing device 10, such as the forked lug 60 and rack 20.

[0042] With reference to Figure 5, the known method for machining the lever arm 50 envisages firstly the extrusion, through a suitably shaped die, of an aluminium billet which is made of a 6000 series alloy.

[0043] By means of this operation an extruded bar 50a is obtained. This extruded bar 50a, which may have a length also of several metres, has a width equal to the width of the finished component 50 which is to be obtained.

[0044] Owing to the mechanical properties of the 6000 series aluminium alloys, it is possible to obtain extruded bars already provided with holes.

[0045] Still with reference to Figure 5, it may be noted in fact how the extruded bar 50a, from which the lever arm 50 will be subsequently obtained, is provided with holes 51 a and 57a.

[0046] Once the component has been finished, the hinging pins 86, 87 and 89 of the lever arm 50 described above will be arranged inside these holes.

[0047] The extruded bars 50a are then machined automatically by means of milling cutters 110. These tools 110, which perform stock-removal machining operations, allow the finished component 50 to be cut from the extruded bar 50a. Once the finished component 50 has been cut, the milling cutters 110 cause feeding of the extruded bar 50a by the amount needed to perform cutting of the next component.

[0048] The components thus obtained may be already finished or, if required, may undergo further machining operations such as blanking, bending and coining.

[0049] These machining operations, which cannot be performed using the milling cutters 110 described above, necessarily require the use of different machine tools. Moreover, these operations may not be performed in the region of the holes in the lever arm since they would cause compression or deformation of the holes, resulting in the finished component being unusable.

[0050] The present invention relates to a method for manufacturing the individual components of a closing device 10, which are made of a 7000 series aluminium alloy, said method not involving the use of the milling/sawing operations described above.

[0051] It should be noted first of all that these 7000 series alloys, while on the one hand they may be used to obtain closing levers with superior mechanical properties compared to the known closing levers made of 6000 series aluminium alloys, on the other hand require a number of special measures during machining.

[0052] Owing to their high mechanical strength, in fact, it has been established that it is not possible to produce using 7000 series aluminium alloys extruded articles which are already bored.

[0053] Consequently, still with reference to the machining methods by means of which a lever arm 50 is obtained, the extruded bars 50a must be made, contrary to that described above, without bore-holes.

[0054] Advantageously, however, this forming the subject of the present invention, the semifinished parts obtained by means of extrusion of a 7000 series aluminium alloy may be blanked, bent and coined in a single operation using special dies 120 (see Figure 6).

[0055] With reference to Figures 6-12, the reference number 50b (Fig. 6) denotes the semifinished part from which a lever arm 50 is subsequently obtained, while 60b (Fig. 10) denotes the semifinished part from which a forked lug 60 is subsequently obtained.

[0056] It should be noted that the rack 20 is made by means of a method which is similar to that performed for the lever arm 50 and the forked lug 60.

[0057] The method according to the present invention envisages in detail the following steps:

- manufacturing a semifinished part 50b, 60b by means of extrusion of a 7000 series aluminium alloy billet;
- loading said semifinished article 50b, 60b into a stamping/blanking press fitted with the dies 120 reproducing the

profile and the shape of the component 20, 50, 60 which is to be made;

- blanking/stamping the component 20, 50, 60 by closing the blanking die 120;
- boring the component 20, 50, 60 obtained by means of the blanking step.

[0058] The manufacture of the semifinished parts 50b, 60b is performed in a manner which is substantially identical to that described for the known method for manufacturing closing levers.

[0059] The only difference consists in the fact that the extruded semifinished article 50b, 60b does not have holes.

[0060] By means of the loading operation, the semifinished part 50b, 60b obtained by means of extrusion is positioned on the blanking press (not shown).

[0061] Generally oil-hydraulic presses are used, these operating vertically and being fitted with the dies 120 which are generally made of steel.

[0062] The dies 120, which reproduce the profile and the shape of the component which must be produced, are formed by a bottom shell 123 and a top shell 122.

[0063] The bottom shell 123 during the stamping/blanking operation remains stationary, while the top shell 122 performs an alternating movement in a direction F_p which is perpendicular to the working plane of the blanking press.

[0064] During closing of the blanking die 120, the top shell 122, coming into contact with the bottom shell 123, deforms the part of the semifinished article 50b, 60b which is situated between the two shells 123, 122 and causes blanking and separation of the finished product 50, 60 from the semifinished part 50b, 60b.

[0065] Usually the components to be machined are lubricated with suitable oils in order to facilitate machining and prevent the stamped/blanked components from getting stuck inside the die 120.

[0066] It should be noted that, by means of the die 120, the finished component 50, 60 is not only blanked, but, if required and obviously if the die 120 is suitably shaped, may also be bent and shaped.

[0067] With reference to Figures 7 to 9, it can therefore be seen how it is possible to obtain, automatically and by means of a single blanking operation, lever arms which have a perimetral profile s which is shaped with curved lines or obtain eyelets 152 in the region of the central body 52 of the lever arm. Said eyelets 152 may have both a weight-reducing function and aesthetic function for the finished component.

[0068] It should be noted, therefore, how it is no longer necessary to perform separately, as instead occurs in the known manufacturing methods, the blanking, bending and coining operations.

[0069] Moreover, it should be emphasized how the working time needed to perform the blanking operation by means of the die 120 is decidedly shorter, also in the case of simple components for which shaping is not required, compared to the working time needed to perform the milling operations using the known milling cutters 110.

[0070] Finally, a further advantage of the use of the moulds 120 consists in the fact that there is a significant reduction in the amount of waste material.

[0071] With reference to Figure 5, in fact, it should be noted how the known milling cutters 110 are able to work solely in planes arranged in a direction F_t perpendicular to the direction of feeding F_a of the extruded bar 50a.

[0072] Therefore, in the case where components with marked concave or convex perimetral profiles must be produced, it is evident that it will not be possible to perform, using the milling cutters 110, a cut which follows these curved profiles. In this case an initial outermost cut must be necessarily followed by various finishing operations.

[0073] On the other hand, by using the dies 120 and by suitably loading the extruded bars 50b, 60b onto the blanking press, it is also possible to cut in between the shapes of the parts to be blanked, thereby reducing the amount of waste material and amount of raw material used.

[0074] The amount of raw material used is, however, also reduced in the case where it is required to produce components which have an external profile without a concave or convex form.

[0075] By means of the blanking operation, in fact, it is possible to reduce the distance p_a between the shapes of two successive parts. This distance p_a is smaller than the distance p used in the case of the known milling cutters 110, since the thickness of the cutting tool does not allow the distance p to be reduced beyond a certain amount.

[0076] As described above, once the stamping/blanking operation has been completed, the component 50, 60 thus obtained is bored so as to form the holes for receiving the various hinging pins.

[0077] This boring operation, which in the case where the known 6000 series aluminium alloys are used is carried out directly during the extrusion step, must instead be performed at the end of the production cycle in the case of the 7000 series alloys.

[0078] However, it should be noted how the method according to the present invention, despite the presence of this additional step, compared to the conventional machining methods, is able to achieve a reduction in the machining time.

[0079] If the cycle times of the blanking and boring steps carried out on the devices made of a 7000 series aluminium alloy are added together, machining times which are shorter than the machining times for the devices made using conventional aluminium alloys are obtained.

[0080] The milling, blanking, bending and coining operations, in fact, which must be performed in the case where blanking of the individual parts by means of the dies 120 is not used, result in a longer production times.

[0081] Therefore, by using the 7000 series alloys it is possible not only to obtain components with improved mechanical properties, but also to simplify the entire production cycle.

[0082] Finally, it should be noted that, in the case where it is required to further improve the mechanical properties of the components produced using this method, it is possible to perform, at the end of the boring step, a subsequent heat treatment step.

[0083] This treatment step consists in carrying out conventional T5 and T6 heat treatment operations on the individual components.

[0084] T5 heat treatment consists in heating to the extrusion temperature followed by artificial ageing, while T6 heat treatment consists in solution tempering followed by artificial ageing.

[0085] Test data are provided below solely by way of a non-limiting illustration of the present invention, these data clearly showing how use of the 7000 series alloys is advantageous compared to the conventional 6000 series alloys.

Example 1

Same resistant cross-section

[0086] In this example, two levers 40 are made using the same extrusion die.

[0087] The first lever, referred to below as L1, is made using the aluminium alloy 6005A and is subject, once the machining operations have been completed, to T6 heat treatment.

[0088] The second lever, referred to below as L2, is made using the aluminium alloy 7003 and is subject, once the machining operations have been completed, to T6 heat treatment.

[0089] By means of a finite element structural analysis (FEM) the behaviour of L1 and L2 was simulated at the moment when subjected to tensile stresses. During this step the torsional stresses were ignored.

[0090] Considering that the forked lug 60 is the "weakest" component of the lever 40, the resistant cross-section referred to is the cross-section of the forked lug along the centre plane.

[0091] This cross-section has a resistant surface area of 70 mm².

[0092] The tests were used to determine firstly the load at which the forked lug 60 of the lever L1 starts to deform (yield point with flattening of the curvature) and then the load at which complete elongation of said forked lug 60 occurred, with values close to breakage.

[0093] A similar test was then carried out on the lever L2, for which the respective yield point and breakage loads were calculated.

[0094] The results obtained are summarized in Table 1.

Table 1: Tensile test carried out on fasteners having the same resistant cross-section (Example 1)

Load(N)	L1	L2
1300	initial yielding of forked lug (yield point)	no structural yielding
1630	complete elongation of forked lug (breakage)	no structural yielding
1890	---	starting yielding of forked lug (yield point)
2280	---	complete elongation of forked lug (breakage)
Note: L1 = fastener with 6005A T6 alloy components - resistant cross-section 70 mm ² L2 = fastener with 7003 T6 alloy components - resistant cross-section 70 mm ²		

[0095] The above data show that the stress value which causes yielding of L1 (1630 N) does not cause any structural yielding of L2.

[0096] This confirms that, for the same resistant cross-section, a lever made using a 7000 series aluminium alloy is stronger than a 6000 series aluminium alloy.

Example 2*Yield point load*

[0097] In this example, by means of a finite element analysis (FEM), constant-load tensile tests were simulated on levers 40 which are made respectively of a series 6005 T6 alloy (L1) and a series 7003 T6 alloy (L2).

[0098] Firstly a tensile load T to be applied to the two components was determined, in this case T=1800 N, followed by calculation of the value of the resistant cross-section of L1 and L2 at which, for this load T, structural yielding started to occur.

[0099] The resistant cross-section referred to is the cross-section of the forked lug 60 along the centre plane and, in the table shown below, this cross-section will be defined as being "critical".

[0100] The aim of these tests is to check how much the resistant cross-section of L1 must be increased compared to the similar cross-section of L2 in order to withstand the same yield point load T.

[0101] The results obtained are summarized in Table 2.

Table 2: Tensile test carried out on fasteners with the same load applied (Example 2)

	Load (N)	"Critical" cross-section (mm ²)
L1	1800	81.0
L2	1800	67.5

Note: L1 = fastener with 6005A T6 alloy components

L2 = fastener with 7003 T6 alloy components

[0102] The above enclosed data show that the cross-section of a lever which is made of 6005A aluminium alloy, in order to withstand the same yield point load T withstood by a lever made of 7003 aluminium alloy, must be increased by about 20%.

[0103] From this it can be deduced that, having defined during the design stage the minimum tensile strength value which must be withstood by the lever, using the 7000 series aluminium alloys it is possible to reduce the resistant cross-section of the lever, thereby obtaining closing devices with a smaller thickness and weight.

[0104] For example, using the 7000 series alloys, for the same tensile strength, it is possible to manufacture closing levers with a flattened form, thereby advantageously reducing the risk of impacts and accidental opening of the device.

[0105] Alternatively smaller-size levers may be made, combining the technical advantage of a lower weight with the possibility of design variations which are not permitted by the use of conventional aluminium alloys.

[0106] By way of conclusion, the above description clearly shows that the device according to the present invention has features which provide an advantageous solution to the problems and drawbacks of the devices according to the prior art.

[0107] The same is also true, *mutatis mutandis*, for the manufacturing method according to the invention.

[0108] With regard to the embodiments of the device described above, the person skilled in the art may, in order to satisfy specific requirements, make modifications to and/or replace elements described with equivalent elements, without thereby departing from the scope of the accompanying claims.

Claims

1. Device (10) for closing sports footwear, comprising:

- a rack (20) connected to a first flap of the footwear
- a lever (40) which is able to engage with the rack (20) in at least one position and comprises a lever arm (50) and a forked lug (60)
- fixing means (90) for connecting the lever (40) to a second flap of the footwear **characterized in that** said rack (20), said lever arm (50) and said forked lug (60) are made of an aluminium alloy and have a surface hardness value of at least 90 HB.

2. Device (10) according to Claim 1, wherein said rack (20), said lever arm (50) and said forked lug (60) have a surface hardness value equal to or greater than 100 HB.

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3. Device (10) according to any one of the preceding claims, wherein said rack (20), said lever arm (50) and said forked lug (60) are made of an aluminium alloy chosen from the group of 7000 series aluminium alloys.
- 5 4. Device (10) according to any one of the preceding claims, wherein said device (10) has a tensile strength value of at least 335 N/mm².
5. Device (10) according to any one of the preceding claims, wherein said lever arm (50) and said forked lug (60) are connected together by means of a tie-piece (70).
- 10 6. Method for manufacturing a rack (20), a lever arm and a forked lug (60) of a closing device (10) according to any one of the preceding claims, comprising the following steps:
- manufacturing a semifinished part (50b, 60b) by means of extrusion of a 7000 series aluminium alloy billet;
 - 15 - loading said semifinished part (50b, 60b) into a blanking press fitted with a die (120) comprising a bottom shell (123) and a top shell (122);
 - blanking the component (20, 50, 60) by closing the die (120) ;
 - boring the component (20, 50, 60) obtained by means of the blanking step.
- 20 7. Method according to Claim 6, **characterized in that**, at the end of the boring step, a heat treatment step is performed where the components (20, 50, 60) undergo the T5 and T6 heat treatment.
- 25 8. Method according to Claim 6, **characterized in that** said bottom shell (123) and/or top shell (122) of said die (120) is shaped in a manner corresponding to surface-shaping of the component to be made so that, at the same time as blanking, surface-shaping of the components to be made is also performed.

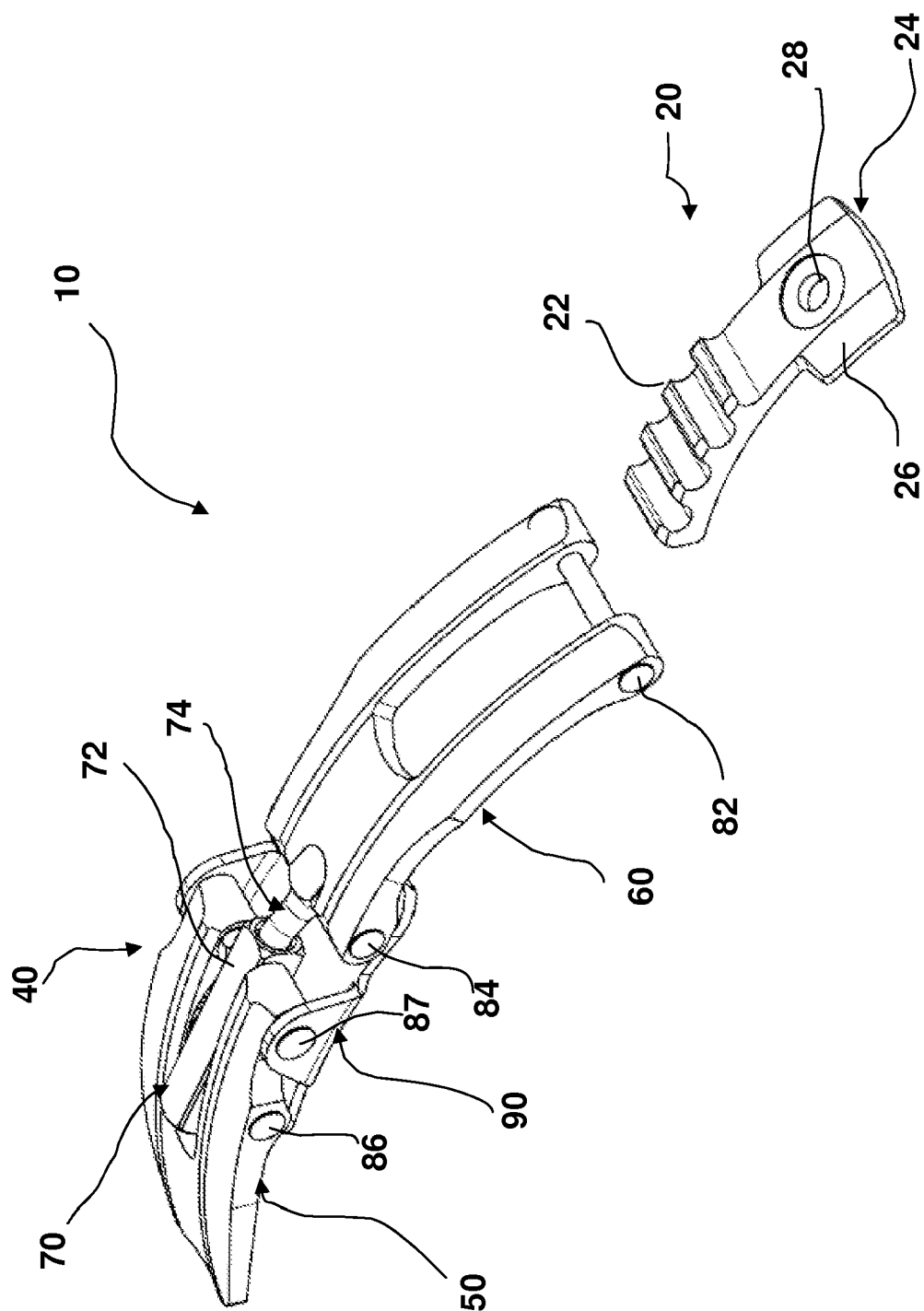
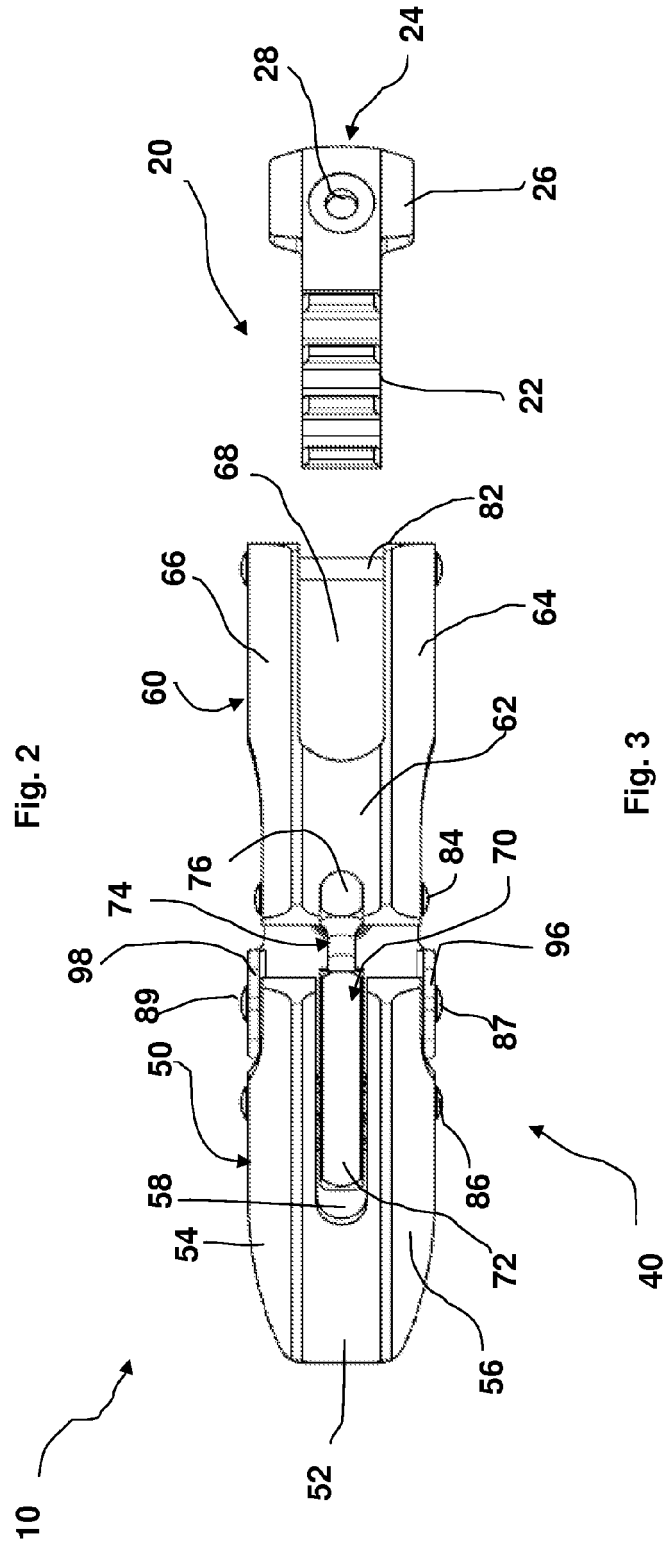
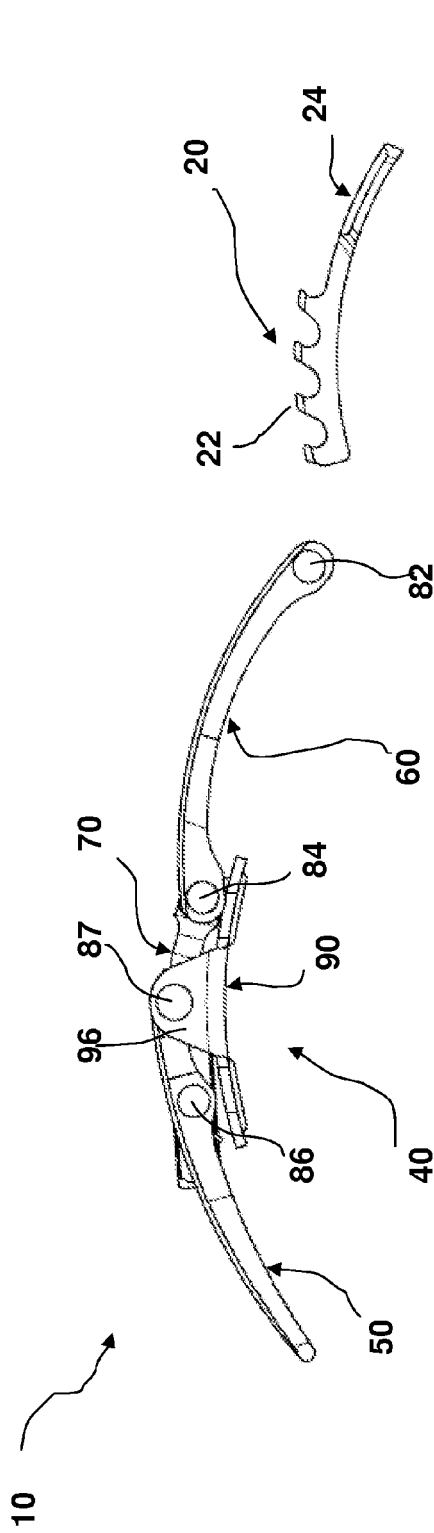


Fig. 1



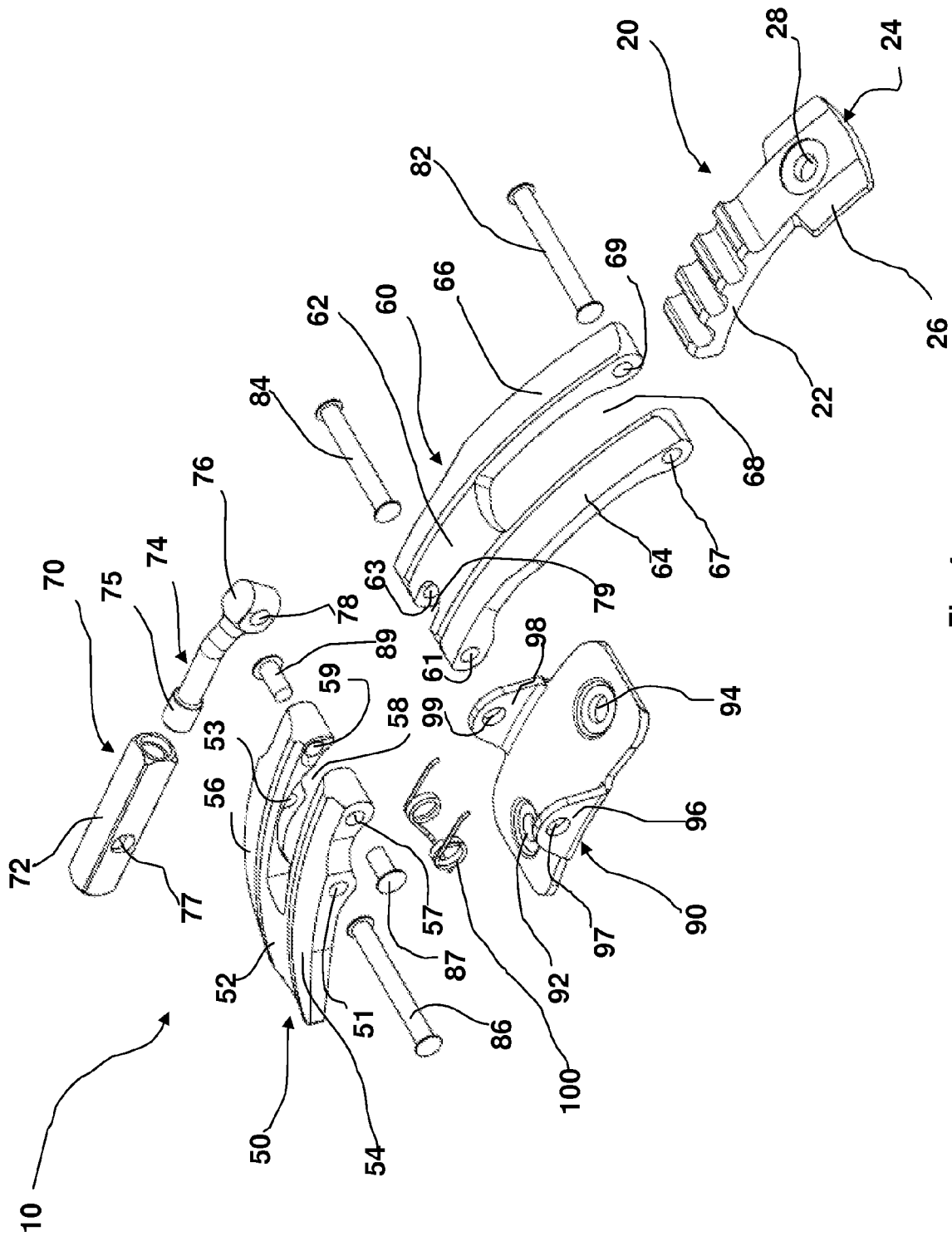


Fig. 4

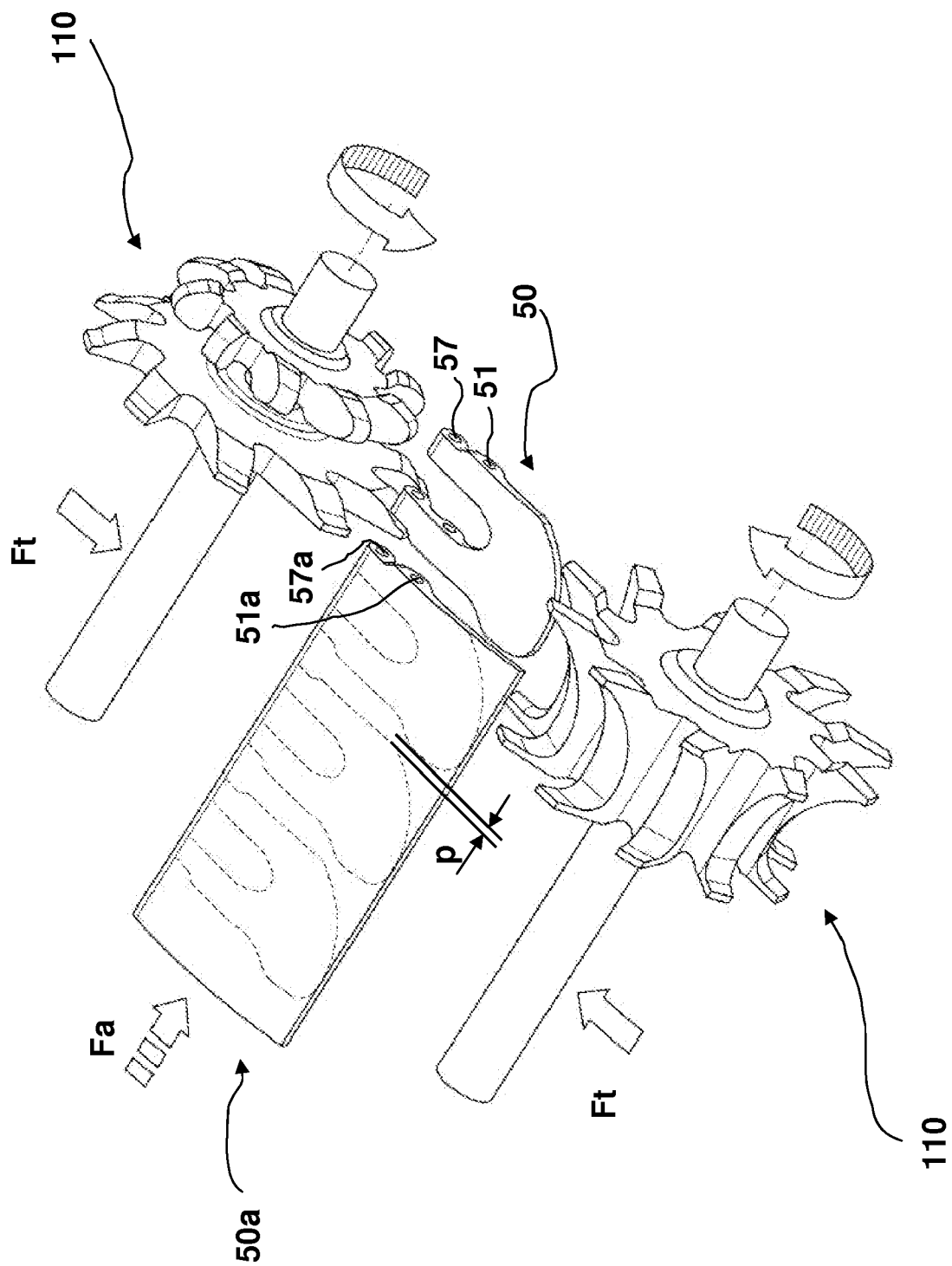


Fig. 5

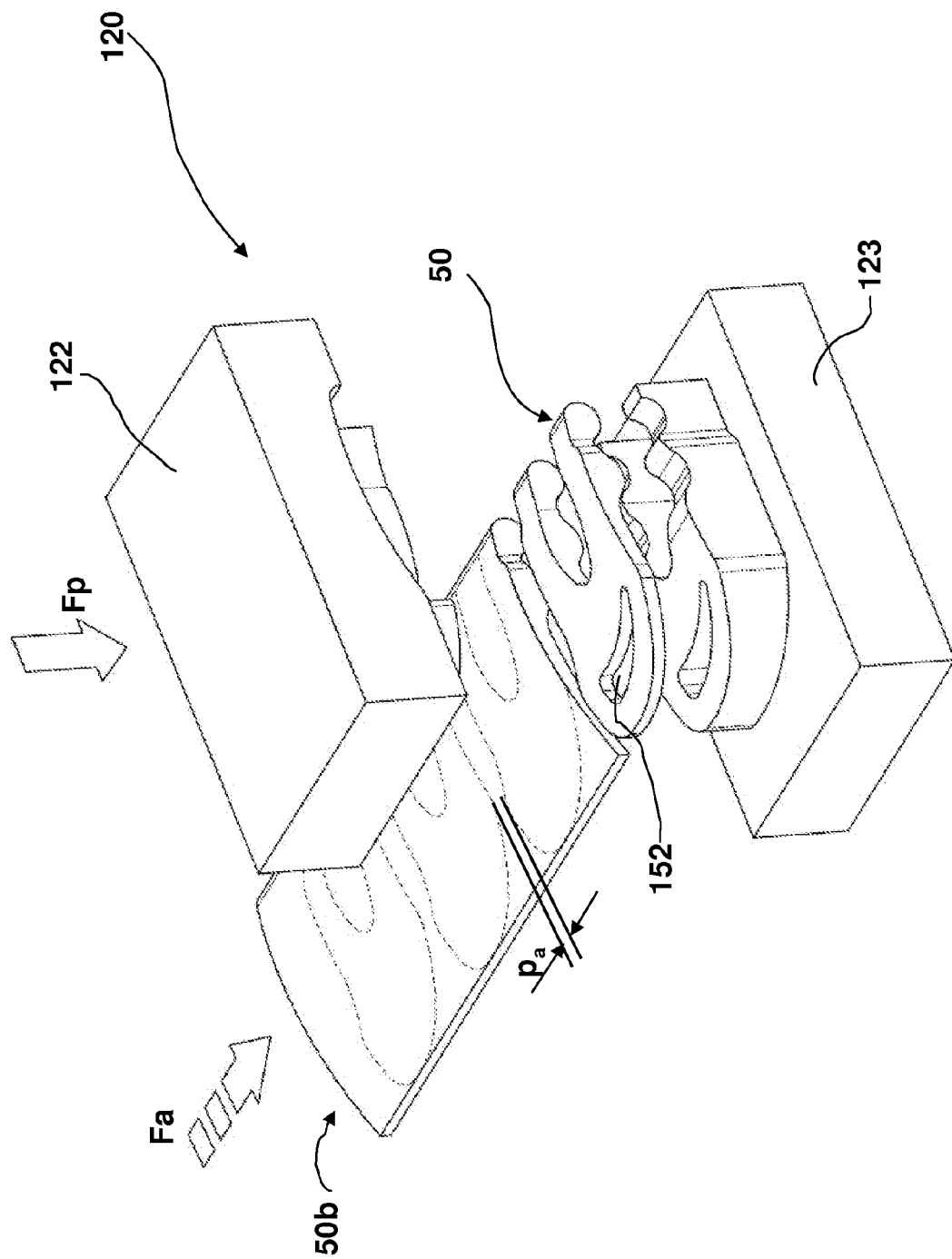


Fig. 6

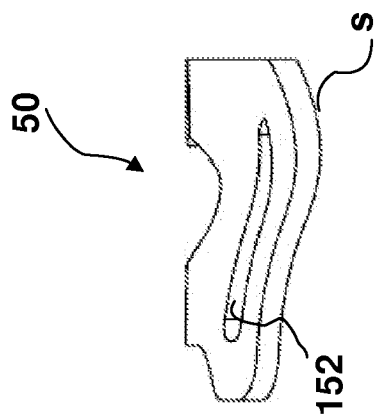


Fig. 8

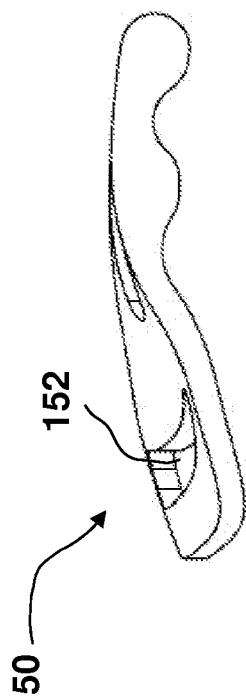


Fig. 7

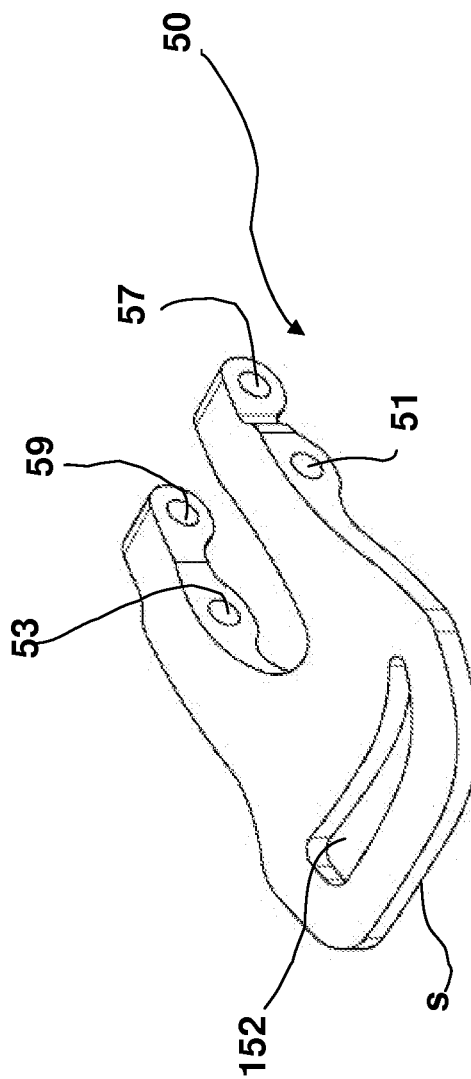
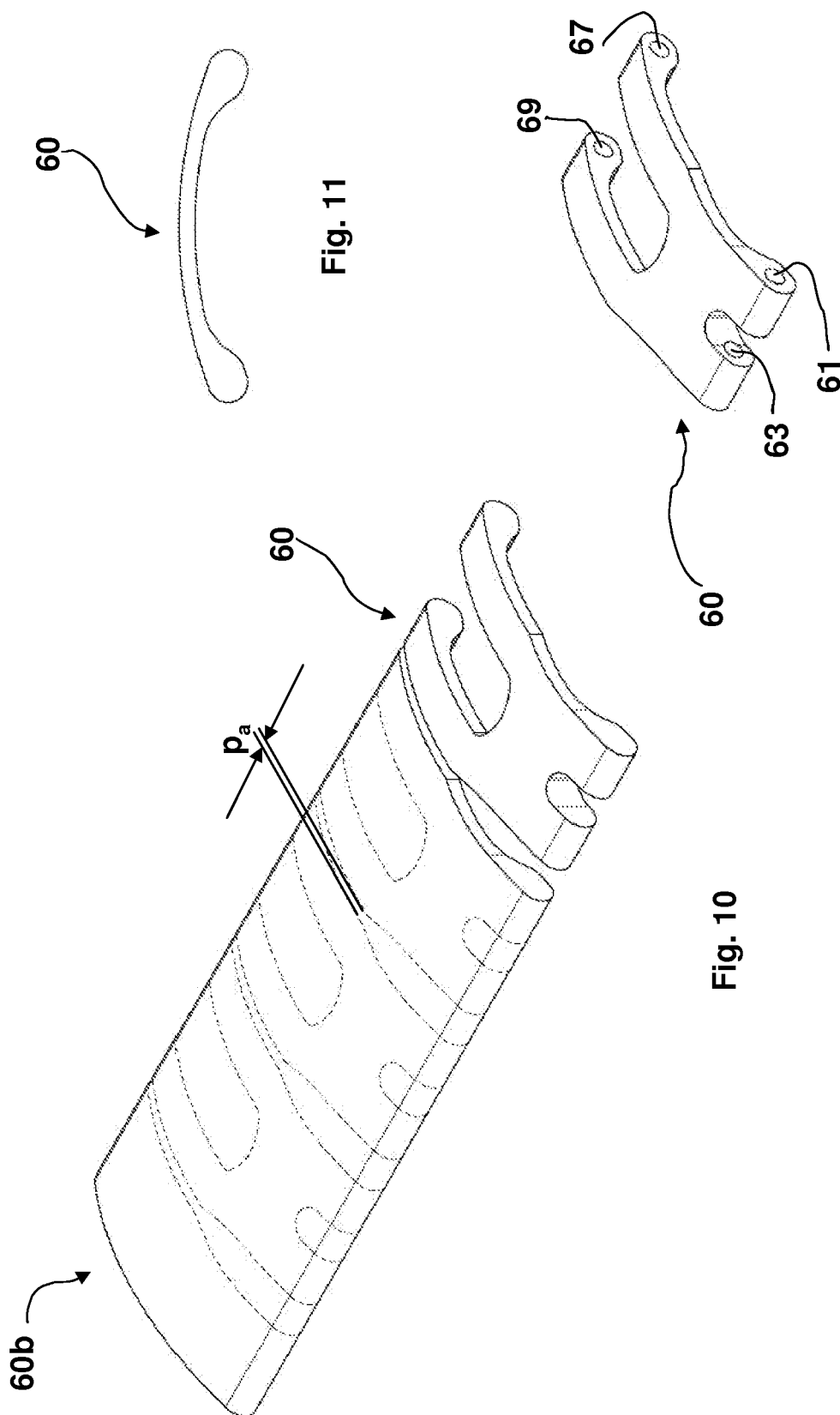


Fig. 9





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Application Number
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