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(54) Method for grinding and contouring the sliding surface of the sliding element of an ice skate and a device suitable for applying the said method

(57) The present invention pertains to a method and device for grinding and contouring a sliding surface (50) of a sliding element (5) of an ice-skate, the grinding device having a grinding element and a positioning member with a stop element (2a), the method comprising positioning a template (3) against the stop element (2a), positioning the sliding surface (50) against the same stop element (2a), fixating the template (3) with respect to the sliding surface (50) and moving the grinding element with respect to the sliding surface (50) while grinding this surface, during which moving the grinding element follows a reference profile of the template (3).

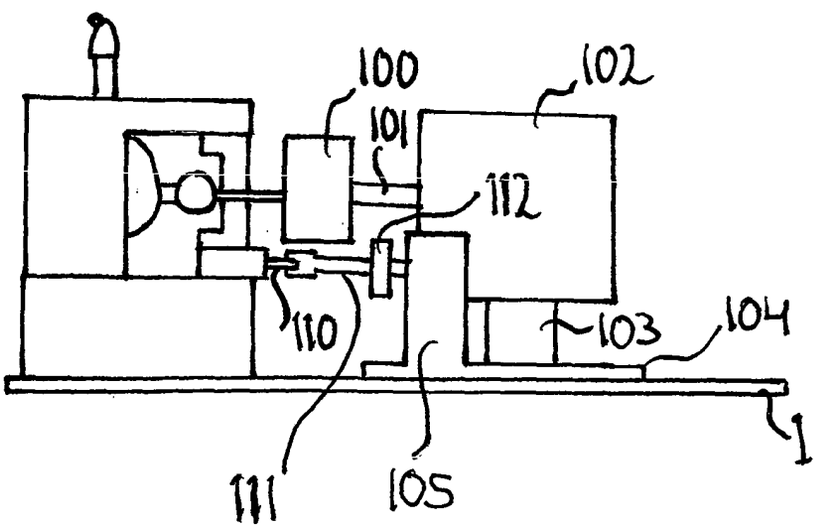

Fig. 3

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Description

[0001] The present invention pertains to a method for grinding and contouring a sliding surface of a sliding element of an ice-skate applying a grinding device having a grinding element, and a template with a reference profile, the method comprising fixating the template with respect to the sliding surface and moving the grinding element with respect to the sliding surface while grinding this surface, during which moving the grinding element follows the reference profile of the template. The invention also pertains to a device which is devised for applying the said method.

[0002] The above-described method is known from United States patent 5,897,428. In this method a grinding device is being used having a fixture for positioning and holding the ice skate and a template. The method starts off with clamping the skate into the fixture, and then moving a grinding wheel to the fixture. After that, the sliding surface of the sliding element of the ice skate is grinded while the fixture follows a reference profile of the template. This way, the sliding surface is provided with a contour that is in agreement with the reference profile.

In particular, the fixture in the known device has clamping plates for clamping the sliding element, i.e. the ice skate blade. The fixture slides along the top surface of a table with the fixture being movable into and away from the grinding wheel. Before the fixture is actually moved to the grinding wheel for grinding the sliding surface of the blade, the position of the fixture is adjusted with respect to the grinding wheel. This way, the sliding surface can be grinded and contoured in one step with high accuracy. Optionally, the sliding surface is whetted after grinding and contouring.

[0003] A grinding method of this kind is also known from Dutch patent 1014647, namely clamping the sliding element of an ice skate in a fixture of a grinding device, and moving the clamped skate with respect to a grinding wheel while the clamped skate follows the reference profile of a template.

[0004] By applying the known methods accurate grinding and contouring can be achieved, however, this is at the cost of complicated devices and time consuming adjustments of the sliding element with respect to the grinding element and template. A particular disadvantage next to the above-identified ones is that for attaining the necessary high accuracy, often a relative large amount of material has to be grinded away from the sliding element. As a result, the ice skates can only be grinded a very limited number of times before they have to be replaced. In particular for speed skating this is highly undesirable as is commonly known in that particular art of skating.

[0005] The purpose of the present invention is to mitigate all the above-described disadvantages. For this, a method has been devised using a positioning member, the method comprising positioning the template against the positioning member, then positioning the sliding surface against the same positioning member, where-after the template is fixated with respect to the sliding surface. Ultimately, as is known from the prior art, the grinding element is moved with respect to the sliding surface while grinding and contouring this surface, during which moving the reference profile of the template is followed.

[0006] This method is based on the recognition that for accurate grinding while at the same time removing as less material as possible, the to-be-grinded-surface, i.e. the sliding surface of the sliding element of the ice skate, needs to be accurately positioned with respect to the template. In the prior art, the skate is clamped at its sliding element in the fixture of the grinding device, and then, the position of the fixture or the skate is adjusted such that the sliding surface gets the appropriate position. With the present invention, by making use of the same positioning member against which both the sliding surface and the template are positioned, a very simple method has been invented for accurately positioning these elements with respect to each other. It is no longer necessary to adjust the position of the skate itself with respect to the template since the relevant part of the skate, i.e. the sliding surface of the skate, is already highly accurately positioned merely by using the same positioning member against which the template is also placed. In practice, it appears that only minimum amounts of the sliding element have to be grinded away. Depending on the initial accuracy of the sliding surface, typical amounts in the order of tens of micrometers are grinded away to get a very good grinding and contouring result. An additional advantage of the method according to the present invention appears to be that the device itself can be made fairly compact without losing its accuracy. This is also a very important feature because this way it becomes readily possible to take along the grinding device to a speed skating match.

[0007] In an embodiment of the invention the template is positioned against the positioning member such that the reference profile is in abutting relationship with the said positioning member. This embodiment has the advantage that the template needs only to be made with accurate dimensions where pertaining to the reference profile itself. The other sides can be made which less accuracy, thus contributing to a more simple method and less expensive device. Next to the above, since the sliding surface as well as the reference profile are in abutting relationship with the positioning member, a higher accuracy of contouring can be achieved while grinding away even less material. This is due to the fact that the two surfaces that need to be brought in agreement, i.e. the sliding surface and the reference profile, can be positioned in nearly perfect relationship with almost no spacial tolerances interfering in the said relationship.

[0008] In another embodiment of the present invention the sliding surface and the template are positioned against the same side of the positioning member. In this

embodiment the positioning of both elements can be more accurate even though the procedure of positioning takes minor effort and skill. Also, as an additional advantage it appears that this way a more compact device can be devised, thus contributing to an important advantage of the invention in its widest scope. In a further embodiment of this method, an intermediate element is placed between the sliding element and template abutting both the sliding element and template. In this embodiment an elongate intermediate element can be used which is sandwiched between the template and the sliding element of the ice skate, which latter mentioned elements are essentially in parallel with this intermediate element.

[0009] In another embodiment the positioning member comprises the grinding element. In this embodiment the grinding element is part of the positioning member. This embodiment has the advantage that there is no need for using an additional positioning element for positioning the sliding surface of the ice skate and/or the template against. In this embodiment the sliding surface of the ice skate as well as the template can be positioned directly against the grinding element (being part of the positioning member).

[0010] In another embodiment of the present invention wherein the stop element is removably connected to the positioning member, the stop element is removed after fixating the template with respect to the sliding surface, at least where this stop element was previously abutting the sliding surface. This embodiment provides for a method wherein each part of the sliding surface can be grinded and contoured in one grinding step.

[0011] In yet another embodiment of the method according to the present invention, wherein the stop element comprises two separate sub-elements, the sliding surface and template are positioned against these sub-elements. This embodiment appears to be of particular advantage when a contour has to be given to the sliding surface that is substantially equal to the arc of a circle. In ice skating, in particular speed skating, this arc has to be grinded into the sliding element with the highest possible accuracy.

Typical *radii* of these arcs are 5 - 15 metres for short track skating and 15 - 35 metres for speed skating. In this embodiment the two sub-elements can for example be placed at a distance which is substantially equal to a little bit less than the length of the sliding surface of the ice skate. This way, when abutting the curved sliding surface and reference profile against the two sub-elements, an immediate and good agreement of both the respective arcs is provided for without the need of any additional adjusting step.

[0012] In another embodiment of the present invention the sliding element and the template are laterally positioned against another stop element. This embodiment is of particular advantage for example when a contour has to be brought into the sliding surface that does not equal the arc of a circle, for example because it is composed of two or more arcs, or an arc and a straight part, etc. In such or other cases, lateral positioning of the template and sliding surface with respect to each other is conveniently provided for when a lateral stop element is used against which both elements can be placed.

[0013] The present invention is also directed to the device for grinding and contouring the sliding surface of the sliding element of the ice skate, wherein the device comprises placing means for positioning the sliding surface and the template against the stop element. In a particular embodiment of this device, the placing means are such that the template is positioned against the stop element with the reference profile in abutting relationship with this stop element. In yet another embodiment, the placing means are such that the sliding surface and the template are positioned against the same side of the stop element.

[0014] The invention will now be explained in more detail with regard to a particular embodiment which is described in the examples given herebeneath.

Figure 1 represents a front view of a part of the grinding device.

Figure 2 is a side view of the device as depicted in figure 1.

Figure 3 is a side view of the device including the grinding element.

Figure 4 is a top view of the main parts of he device according to figure 3.

Figure 5 is a schematic drawing showing the lateral relationship of the reference profile and sliding surface when positioned in the device according to figure 1.

Figure 1

[0015] Figure 1 represents a front view of a part of the grinding device. The device is placed on base 1, which in this case is an aluminium profile. On this base 1 a positioning member is placed, which member is constituted by supporting parts 21 a and 21 b and a stop element, which element in this particular embodiment consists of two separate sub-elements 2a and 2b. These sub-elements are removably connected to the supporting parts 21 a and 21 b by use of bolts 13 and 12 respectively. In this view, front faces 20a and 20b of these stop sub-elements are shown, located at reference locations x and y respectively. Placed on top of the supporting elements 21 a and 21 b is template 3, of which in this view reference profile 30 is shown. Placed on top of template 3 is intermediate element 4. This element carries the sliding element 5 of the ice skate, of which sliding element sliding surface 50 and a small part of the ice skate shoe 7 is shown in this front view. Placed on top of the sliding element 5 is elongate element 6. Template and sliding surface are fixated with relative to one another by clamping the elements 3, 4, 5 and 6 together,

by applying screws 10 and 11.

Figure 2

[0016] Figure 2 is a side view of the device as depicted in figure 1. In this view it is made clear that sliding surface 50 as well as the reference profile 30 of template 3 are positioned against the positioning member, in particular against stop element 2a of this member. When installing all elements in order to grind and contour the sliding surface of the ice skate, firstly, at least in the shown embodiment, the stop element 2a is connected to supporting member 21 a by using bolt 13. The same way, but not visible in this side view, stop element 2b is connected to supporting element 21 b by using bolt 12. This way, the positioning member is provided for.
After that, template 3 is placed onto the supporting members 21 a and 21 b, whereby the reference profile 30 is positioned against the stop sub-elements 2a and 2b. Then, intermediate element 4 is placed on top of the template (in an alternative embodiment, element 4 is formed integrally with template 3). After that, the ice skate is placed with its sliding element on top of the intermediate element 4, such that the sliding surface 50 is positioned against the stop sub-elements. Note that the stop sub-elements are profiled in order to provide for a shift in horizontal direction between the sliding surface and the reference profile. On top of the sliding element, elongate element 6 is placed (in an alternative embodiment element 6 is formed integrally with part 221). For clamping all elements together, two clamping pieces, of which only piece 221 is shown in this side view, are placed on the supporting elements 21 a and 21 b respectively. Although not shown in the schematic figure, in this embodiment there is a small gap between element 221 and element 5 in order to prevent distortion of the stop element 2a with respect to the sliding element 5 and template 3. By screwing in screws 10 and 11, this pieces force the collection of elements 3, 4, 5 and 6 down onto supporting elements 21 a and 21 b. Just before the template and sliding element are fixated, these elements are positioned again against stop sub-elements 2a and 2b, to ensure a proper and adequate relationship between the reference profile of the template and the sliding surface of the sliding element of the ice skate.

Figure 3

[0017] Figure 3 is a side view of the device including the grinding element. The grinding element consists in this embodiment of various parts of which some can be seen in this side view. The grinding element has a base part 104 which is slidably carried by base 1 of the grinding device. Connected to the base part 104 via carrying part 103 is drive motor 102. To this motor is rotatably connected a cup grinding wheel 100 via shaft 101. Cup wheel 100 is positioned against the sliding surface 50 of the sliding element 5 of the ice skate. In order to properly contour the sliding surface, the grinding element is in slidable connection with reference profile 30. For this, spacer elements are used of which element 111 is shown. This element ends with a small guiding wheel 110 which is able to rotate while following reference profile 30. For adjusting the position of the grinding element with respect to the sliding surface 50, adjustment screws are comprised in the spacer elements. For element 111, adjustment screw 112 is shown. In an alternative embodiment the grinding element is used as the positioning member. In this embodiment, when installing all elements in order to grind and contour the sliding surface of the ice skate, firstly the grinding element is moved to one side of the grinding device, e.g. near reference location x (see figure 1). Then the first end of the template (in this embodiment formed integrally with element 4) is abutted against the guiding wheel 110. After this, the ice skate is put on top of element 4 and the sliding surface of the skate is positioned against the grinding wheel 100. Then, these elements are fixed with respect to each other (at least, at their ends corresponding to the first side of the grinding device) as indicated here-above, but in a way that rotation of both elements about a vertical axis at reference location x is still possible. After that, the grinding element is moved to the second side of the device near location y (see figure 1). There, the other end of the template is positioned against the guiding wheel, and the corresponding side of the sliding surface is positioned against the grinding wheel (while doing this both elements, if needed, rotate about the mentioned axis). After that, also these other ends of the template and sliding surface are fixed with respect to each other. A final check can be made (after moving the grinding element back to the first side of the grinding device) whether or not the firstly positioned ends of the template and sliding surface are still in good spacial relation with respect to each other. This way, the sliding surface of the ice skate and the template are brought in perfect aligned with each other and the grinding wheel, without the need of an additional positioning member next to the grinding element itself. For actual grinding, the adjustment screws (element 112 and its equivalent at the other side of the grinding element) can be used to move the grinding wheel in the direction of the sliding surface.

Figure 4

[0018] Figure 4 is a top view of the main parts of he device according to figure 3. Schematically shown are sliding surface 50 and the shifted reference profile 30 of the template, which latter element is shown in dashed line. It can be seen that the grinding element is positioned against the reference profile by use of two spacer elements that abut the profile with respective wheels. By adjusting the effective length of the spacer elements by applying the adjustment screws, the grinding element is properly positioned with respect to the sliding surface

50 of the sliding element of the ice skate. In this embodiment the grinding wheel 100 is slightly tilted with respect to the sliding surface such that grinding takes place essentially at the single point of contact between the cup wheel 100 and the sliding surface. The distance between the small wheel abutting the reference profile of the template and the said point of contact is denoted as "d" in figure 4. During the grinding process, the grinding element is shifted in the direction denoted F in figure 4, while properly engaging the reference profile with its wheels at the end of the spacer elements. This way, the grinding element follows the reference profile of template 3 while grinding the sliding surface of the ice skate. This means that at the same time, the sliding surface attains a contour that is equal to the contour of the reference profile 30. It needed, the grinding element can be shifted backwards to grind the sliding surface a second time.

Figure 5

[0019] Figure 5 is a schematic drawing showing the lateral relationship of the reference profile and sliding surface when positioned in the device according to figure 1. For means of clarity, the curvature of both surfaces is extremely exaggerated in this figure. It can be seen that the sliding surface 50 and the reference profile 30 are slightly shifted with respect to each other in order to compensate for the distance "d" as depicted in figure 5. This provides for better grinding and contouring. The small shift can be introduced by providing corresponding profiles in the surface of the stop sub-elements against which the sliding surface and reference profile are positioned. Note that the shift as depicted in figure 5 compensates for a grinding element that is tilted such that the other end (near wheel 110) of the cup wheel is positioned against the sliding surface. When a grinding wheel would be used of which its point of contact would be right in the middle between the two small supporting wheels that contact the reference profile 30, essentially the same grinding and contouring result can be provided for without compensating for the distance "d".

[0020] It may be clear that the above-described examples are mere embodiments of the present invention and are in no way limiting the scope of the appended claims. For example, although not shown, the device may be constructed in order to grind two sliding surfaces of two separate ice skates at a time. Also, contours that differ substantially from a single curved arc may be advantageously grinded into ice skates using the method and device according to the present invention. Templates can be used having two or more reference profiles such that one template can be used to grind different *radii* in sliding surfaces. Other types of grinding wheels than the exemplified cup wheel, or other orientations of the grinding wheel with respect to the sliding surface can also be successfully applied in the method and device according to the present invention.

Claims

1. Method for grinding and contouring a sliding surface of a sliding element of an ice-skate applying a grinding device having a grinding element, the method comprising positioning a template against a positioning member, positioning the sliding surface against the same positioning member, fixating the template with respect to the sliding surface and moving the grinding element with respect to the sliding surface while grinding and contouring this surface, during which moving the grinding element follows a reference profile of the template.

2. Method according to claim 1, **characterised in that** the template is positioned against the positioning member such that the reference profile is in abutting relationship with the said member.

3. Method according to any of the previous claims, **characterised in that** the sliding surface and the template are positioned against the same side of the positioning member.

4. Method according to any of the preceding claims, **characterised in that** the positioning member comprises the grinding element.

5. Method according to any of the claims 1 to 3, wherein the positioning member comprises a removably connected stop element, **characterised in that** after the said fixating the stop element is removed, at least where previously abutting the sliding surface.

6. Method according to claim 5, wherein the stop element comprises two separate sub-elements, **characterised in that** the sliding surface and template are positioned against the sub-elements.

7. Method according to any of the previous claims, **characterised in that** the sliding element and the template are laterally positioned against another stop element.

8. Device for grinding and contouring a sliding surface of a sliding element of an ice skate, comprising a grinding element, a positioning member, a template having a reference profile, placing means for positioning the sliding surface and the template against the positioning member, fixating means for fixating the positioned sliding surface with respect to the positioned template and driving means for moving the grinding element with respect to the sliding surface for grinding and contouring the said surface, such that the grinding element follows the reference profile during grinding.

9. Device according to claim 8, **characterised in that**

the placing means are such that the template is positioned against the positioning member with the reference profile in abutting relationship with this stop element.

10. Device according to any of the claims 8 and 9, **characterised in that** the positioning member comprises the grinding element.

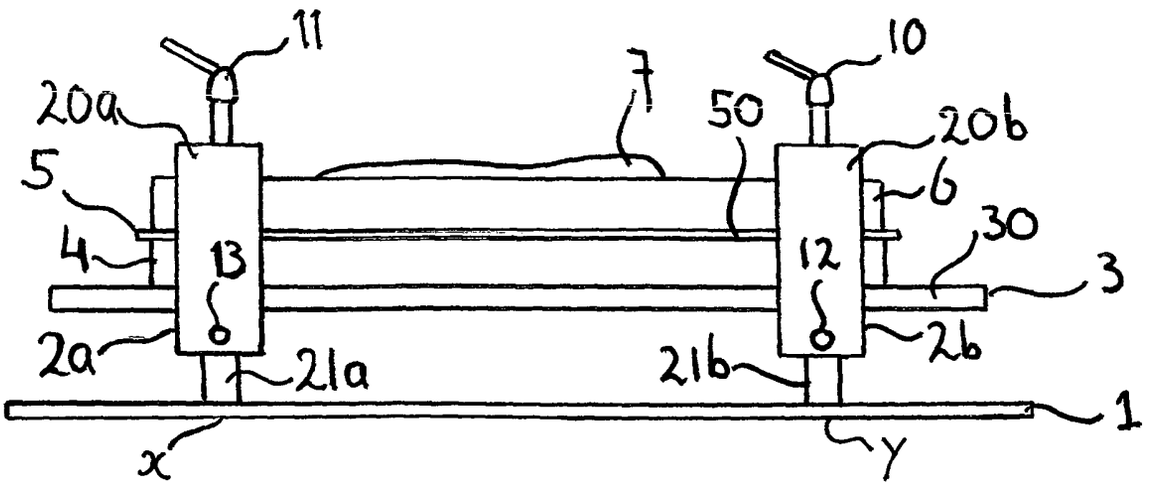
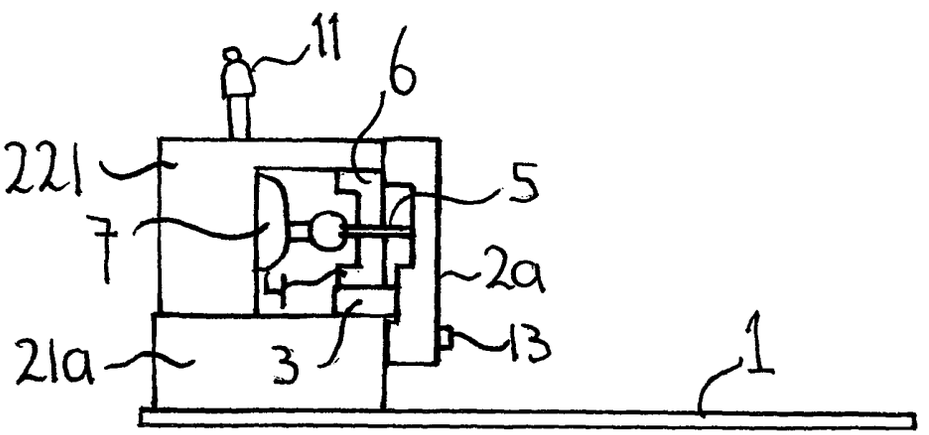

11
10
20a
7
50
20b
5
6
4
13
12
30
3
2a
21a
21b
2b
1
x
y

Fig. 1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221
5
7
2a
21a
3
13
1

Fig. 2

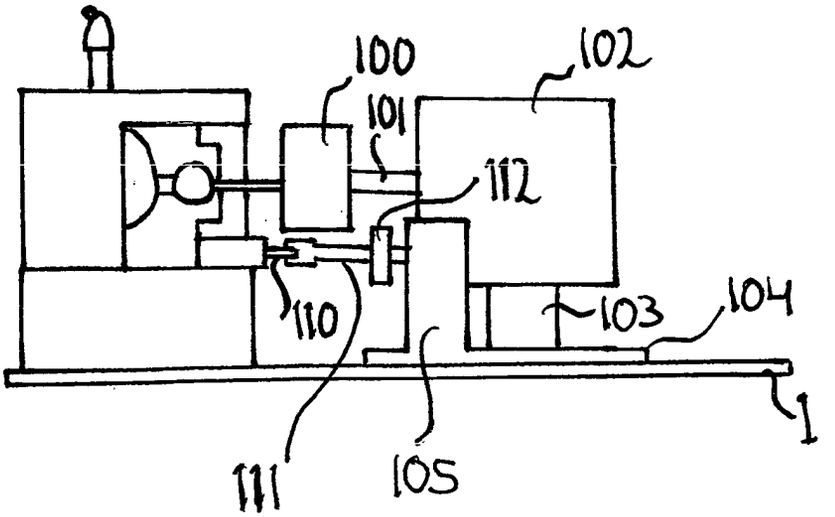
100
102
101
112
110
103
104
1
111
105

Fig. 3

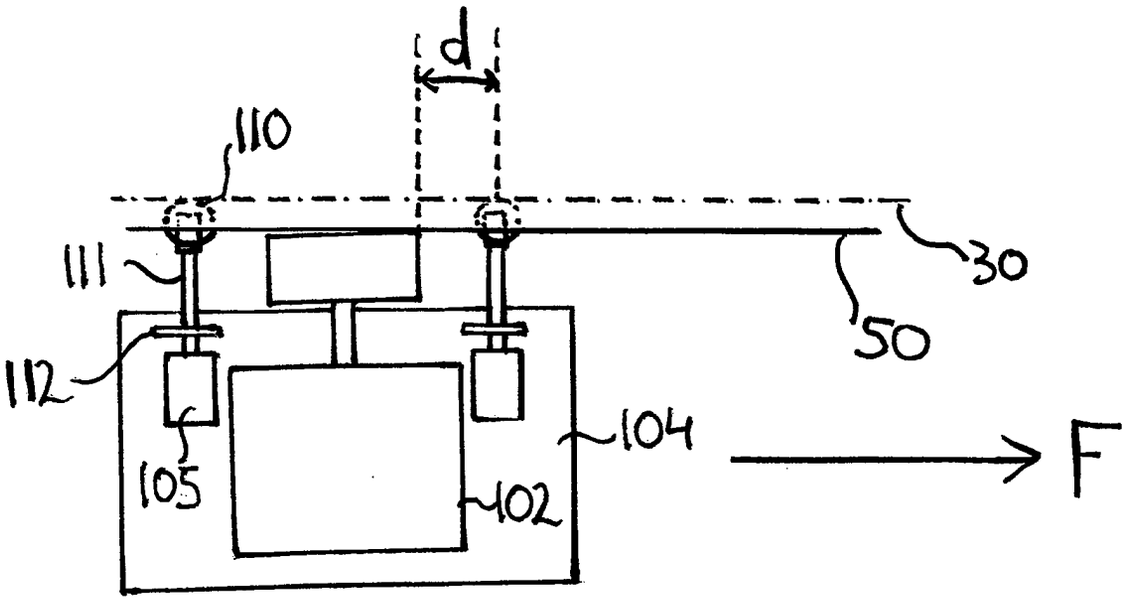
d
110
111
30
50
112
104
F
105
402

Fig. 4

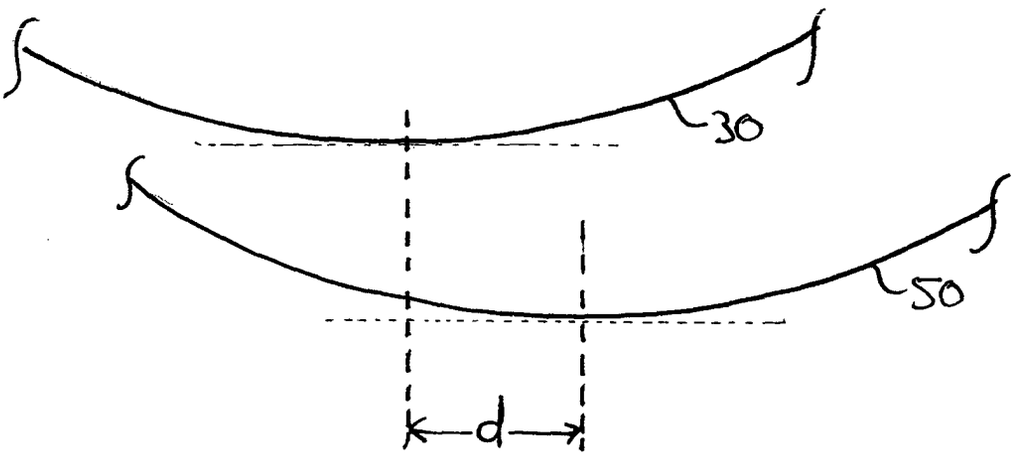

FIG. 5