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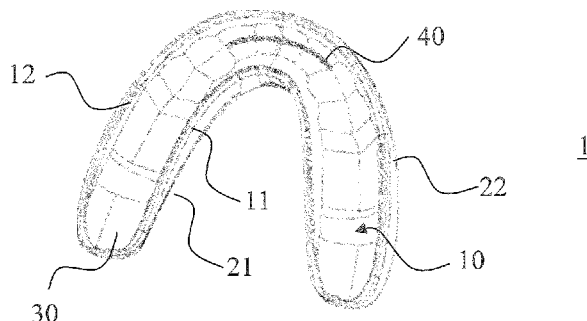


Fig. 1

(57) Abstract: The invention concerns an orthodontic appliance made of elastic material and comprising arch-shaped upper and lower concaves (10, 20) for teeth of upper and lower jaw, the concaves (10, 20) being separated by an occlusally extending arch-shaped isthmus (30) and comprising inner (11, 21) and outer walls (12, 22) extending vertically from the edges of the isthmus (30). The appliance includes a volume (40) within the frontal section of the arch-shaped isthmus (30) of material harder than said elastic material and extending vertically in the isthmus (30) so as to form at least one section of a surface of the isthmus (30), so as to make up a biting surface (41, 42) on the upper side and the lower side of the isthmus (30).

## ORTHODONTIC APPLIANCE

## FIELD OF INVENTION

5 The present invention concerns orthodontic appliances as defined in the preamble of Claim 1 for guiding the occlusion of an individual.

## BACKGROUND OF INVENTION

10 Orthodontic appliances typically comprise U-shaped or arch-shaped concaves for teeth of both upper and lower jaw. The upper and lower concaves of the appliance are typically separated by an occlusally extending isthmus, from which the inner and outer walls of the concaves extend vertically. The isthmus may comprise recesses, or  
15 blanks, for individual teeth. Typical materials these appliances are made of include thermoplastic elastomers, plasticized (softened) plastics, rubber, and similar elastic materials.

The orthodontic appliances of the prior art include various designs  
20 which may include details aimed, for example, to aid in the overall function of the appliance or in curing an individual malocclusion problem.

Due to the properties of elastic materials, the appliances of the  
25 prior art do not always work as well as intended, due to the wear and tear of the material. Further, an elastic material does not necessarily always provide optimal properties in view of one or another intended function of the appliance. Thus, e.g. prior art  
30 publications US 3,510,964 and WO 2009/026659 teach including structures in an appliance of other than the elastic material the appliance as such is made of.

## BRIEF DESCRIPTION OF INVENTION

35 The invention according to this application is based on an idea of arranging to the appliance, in the frontal area of the appliance where a person's incisors tend to bite during use of the appliance, a reinforcement element or a volume comprising harder material than the

elastic material the appliance is made of. This makes the appliance more durable in use, especially in cases when the user of the appliance is in a habit of biting on it. Such habit is prone to break the appliance due the user, ultimately, biting through it. The volume  
5 of harder material or the reinforcement element is to be arranged inside the isthmus separating the upper and lower concaves of the appliance and such that it will make up a section of a surface of the isthmus.

10 A structure of an orthodontic appliance according to the invention will make the appliance more durable in use. Further, in case one happens to bite on the appliance, arranging hard material to form a surface of the appliance on which one's incisors will touch is also prone to eliminate such biting, due to discomfort the biting on a  
15 hard object causes.

#### BRIEF DESCRIPTION OF FIGURES

The invention and its preferable embodiments are described below,  
20 also by referring to the attached figures out of which

Fig. 1 shows an orthodontic appliance according to one preferable embodiment of the invention,

25 Fig. 2 shows a top view of the appliance of Fig. 1,

Fig. 3 shows a side view of a cross section along line A-A of the appliance according to Fig. 2 and

30 Fig. 4 shows, as an example, an embodiment of a reinforcement element applicable for use in an orthodontic appliance according to the invention.

#### DETAILED DESCRIPTION OF INVENTION

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An orthodontic appliance (1) according to Figs. 1-3 includes arch-shaped concaves (10, 20) for teeth of both upper and lower jaw, i.e. an upper concave (10) and a lower concave (20). The upper and lower

5 concaves (10, 20) of the appliance (1) are separated by an occlusally extending isthmus (30), from which the upper and lower inner walls (11, 21) and the upper and lower outer walls (12, 22) of the concaves (10, 20) extend vertically. Inside the isthmus (30), within the area receiving incisors of a user of the appliance (1), is arranged a reinforcement element (40) of material harder than that of which the actual appliance (1) is made.

10 In the embodiment of Figs. 1-3, the reinforcement element (40) is arranged to extend inside the isthmus (30) of the appliance (1) vertically so as to form sections on the surface of the isthmus (30) for individual incisors. It is possible to arrange the reinforcement element (40) to extend to the surface on just either of the upper and lower sides of the isthmus (30), or to both.

15 In Figs. 1-2, the reinforcement element (40) is arranged to cover the very areas of the isthmus (30) which will meet the four upper incisors of a person. Benefits of the invention may also be reached, though, in case the reinforcement element (40) is arranged to cover a lesser number of such areas or in case such areas are arranged to be narrower than the area an individual incisor will meet. Further, while in Figs. 1-2 the reinforcement element (40) is arranged to cover the very areas of the isthmus (30) which will meet the incisors of a person, it is also possible to arrange the reinforcement element (40) to form a wider surface which will cover an area of more than one incisor, even to cover the area of all the incisors.

30 An example of a reinforcement element (40) according to the invention is shown in Fig. 4. In this embodiment, a curvilinear reinforcement element (40) includes an even biting surface (41, 42) on both its upper and lower sides. The reinforcement element (40) further includes curvilinear extension structures (43, 44), which as for their overall shape follow the local shape of the arch shaped concaves (10, 20), extending from the outermost edges of the reinforcement element (40). These extension structures (43, 43) serve, when the reinforcement element (40) is arranged inside the appliance (1) of thermoplastic material, in making the appliance (1) less prone to break during use because of creating a larger contact

surface between the reinforcement element (40) and the actual  
appliance (1). In addition, the extension structures (43, 44) serve  
as stiffening elements making the appliance (1) more rigid and thus  
helping in maintaining its original arch form, when an outer force  
5 acts upon it.

It is possible to design the reinforcement element (40) different as  
for its upper and lower surfaces (41, 42). For example, the upper  
surface (41) may be arranged to cover the whole area from the upper  
10 outermost incisor to another upper outermost incisor while the lower  
surface (42) may be arranged to create four individual surface areas,  
separated from each other, for all the four lower incisors.

The surface areas of the isthmus (30) of the appliance (1) which are  
15 to be of harder material may also be formed by using more than one  
reinforcement element (40).

In the reinforcement element (40) of Fig. 4, the front and back  
surfaces of the reinforcement element (40) are presented as smooth.  
20 While these surfaces of the reinforcement element (40) need not to be  
arranged to extend to any labial or lingual surface of the appliance,  
forms such as through holes or pot holes, ribs etc. can be arranged  
to the reinforcement element (40), which can help in manufacture of  
an appliance according to the invention and, also for their part, in  
25 making the appliance less prone to break during use.

Hence, a reinforcement element (40) according to the invention may be  
arranged to include one or more pin recesses for attaching the  
reinforcement element temporarily onto pins associated with the  
30 manufacturing process, such as injection moulding manufacturing  
process or liquid silicone rubber manufacturing process. The pin of  
an injection moulding machine or of a mould may be e.g. cylindrical  
or rectangular and the pin recess correspondingly shaped, essentially  
as the inverse of the pin. The recess may be slightly narrower than  
35 the pin in order to provide slight tension that holds the  
reinforcement element (40) in place on the pin during the injection  
moulding process.

Benefits of using these pin recesses include that they enable accurate positioning of the reinforcement element (40) within the orthodontic appliance (1) during the manufacturing process, simplify the manufacturing process, improve time and cost efficiency, and  
5 increase process reliability by reducing its complexity.

A further benefit of such recesses is that they may be arranged to form breathing holes for a person wearing the appliance.

10 According to one embodiment of the invention, the volume or the reinforcement element (40) of harder material is arranged to cover areas of the isthmus (30) which will meet the four upper and lower incisors as well as the canines of a person.

15 According to another embodiment of the invention, the volume or the reinforcement element (40) of harder material is arranged to cover only those areas of the isthmus (30) which will meet the two upper and lower central incisors of a person.

20 According to yet another embodiment of the invention, the volume or the reinforcement element (40) of harder material is arranged to cover different areas of the isthmus (30) on the upper and lower surface, for example so that the upper surface meets the four upper incisor and the lower surface meets two lower central incisor.

25

To sum up, the orthodontic appliance according to the invention is made of elastic material and comprises arch-shaped upper and lower concaves for teeth of upper and lower jaw, which concaves are separated by an occlusally extending arch-shaped isthmus and comprise  
30 inner and outer walls extending vertically from the edges of the isthmus. The appliance includes a volume or a reinforcement element within the frontal section of the arch-shaped isthmus of material harder than said elastic material and extending vertically in the isthmus so as to form at least one section of a surface of the  
35 isthmus, so as to make up a biting surface on the isthmus, particularly, on both the upper and lower side of the isthmus.

As an example, the volume or the reinforcement element of material harder than the elastic material may be arranged to form sections of the surface of the isthmus of different lengths on the upper and lower sides of the isthmus, such as to form at least one section which will meet at least one incisor of a person using the appliance on at least either of the upper side and the lower side of the isthmus. At least one of said at least one section meeting at least one incisor may be made wider than the width of an individual incisor, or at least twice as wide as the width of an individual incisor. The volume or the reinforcement element of material harder than said elastic material may also be arranged to form a single section which meets all incisors of a person using the appliance on at least either of the upper side and the lower side of the isthmus. The volume or the reinforcement element of material harder than said elastic material may extend from an outermost edge of a first outermost incisor to an outermost edge of a second outermost incisor, or from an outermost edge of a first canine to an outermost edge of a second canine, on at least either of the upper side and the lower side of the isthmus.

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According to one embodiment, more than one volume or reinforcement element of material harder than the elastic material is arranged in the isthmus so as to form, in combination, subsections of the at least one section of the surface of the isthmus on at least either of the upper and lower sides of the isthmus of material harder than said elastic material.

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Preferably, the at least one volume or reinforcement element of material harder than the elastic material is arranged, as for its shape, to follow the shape of the arch-shaped concaves.

30

According to one embodiment, the at least one volume or reinforcement element of material harder than the elastic material comprises of a single reinforcement element having a width essentially corresponding to the total width of the upper incisors of a person.

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According to one embodiment, extension structures are arranged at the ends of a single reinforcement element having a width essentially

corresponding to the total width of the upper incisors of a person using the appliance. Such extension structures as for their overall shape may follow the shape of the arch-shaped concaves of the appliance.

5

Further, the at least one reinforcement element of material harder than said elastic material may be arranged with at least one pin recess for temporary attachment of the reinforcement element to at least one pin of a moulding machinery or a mould during manufacture of the appliance.

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While incisors tend to cause more mechanical stress on an orthodontic appliance than posterior teeth, the appliance according to the invention provides a tactile stimuli specifically to the incisors and also provides a more durable surface in the region of the incisors of the appliance.

15

Further, while an orthodontic appliance with a generally uniform elasticity throughout the surface of the appliance tends to stimulate biting the appliance or playing with it in a manner similar to chewing on a chewing gum, the increased stimuli provided by the reinforcement element according to the invention actually tends to modulate the biting force applied on the appliance to a more moderate level. Thus, considering behavioural psychology, the orthodontic appliance incorporating a reinforcement element according to the invention, providing tactile stimuli of greater magnitude to the incisors of the patient than to the posterior teeth, provides an antecedent stimulus for a reinforcing behaviour to press the teeth onto the appliance with a more suitable force, discourages chewing and playing with the appliance, and prevents excessive biting on the appliance.

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Above, various details of an appliance according to invention have been discussed which details may vary, depending on the embodiment of the invention. Combinations of those details, also other combinations than those literally discussed above, may be arranged in the appliance without separating from the scope of invention.

35

## CLAIMS

1. An orthodontic appliance made of elastic material and comprising arch-shaped upper and lower concaves (10, 20) for teeth of upper and lower jaw, the concaves (10, 20) being separated by an occlusally extending arch-shaped isthmus (30) and comprising inner (11, 21) and outer walls (12, 22) extending vertically from the edges of the isthmus (30), said isthmus (30) being configured to include at least one biting surface (41, 42) of material harder than said elastic material, characterized in that the appliance includes a volume (40) within the frontal section of the arch-shaped isthmus (30) of material harder than said elastic material, said volume extending vertically in the isthmus (30) so as to form at least one biting surface (41, 42) of material harder than said elastic material on both the upper and lower side of the isthmus (30).

2. The orthodontic appliance according to claim 1, characterized in that said volume (40) within the frontal section of the arch-shaped isthmus (30) is arranged to consist of a reinforcement element (40) made of material harder than said elastic material.

3. The orthodontic appliance according to claim 1 or 2, characterized in that said volume or reinforcement element (40) of material harder than said elastic material is arranged to form sections of the surface of the isthmus (30) of different lengths on the upper and lower sides of the isthmus (30).

4. The orthodontic appliance according to claim any of the claims 1 to 3, characterized in that said volume or reinforcement element (40) of material harder than said elastic material is arranged to form at least one section which will meet at least one incisor of a person using the appliance (1) on at least either of the upper side and the lower side of the isthmus (30).

5. The orthodontic appliance according to claim 4, characterized in that at least one of said at least one

section meeting at least one incisor is wider than a width of an individual incisor.

5 6. The orthodontic appliance according to claim 5, characterized in that at least one of said at least one section meeting at least one incisor is at least twice as wide as the width of an individual incisor.

10 7. The orthodontic appliance according to any of the claims to 1 to 6, characterized in that said volume or reinforcement element (40) of material harder than said elastic material is arranged to form a single section which meets all incisors of a person using the appliance on at least either of the upper side and the lower side of the isthmus (30).

15

8. The orthodontic appliance according to claim 7, characterized in that said volume or reinforcement element (40) of material harder than said elastic material is arranged to extend from an outermost edge of a first outermost incisor to an outermost edge of a second outermost incisor, or from an outermost edge of a first canine to an outermost edge of a second canine, on at least either of the upper side and the lower side of the isthmus (30).

25 9. The orthodontic appliance according to any of the claims 1 to 8, characterized in that more than one volume or reinforcement element (40) of material harder than said elastic material is arranged in the isthmus (30) so as to form, in combination, subsections of said at least one section of the surface of the isthmus (30) on at least either of the upper and lower sides of the isthmus (30).

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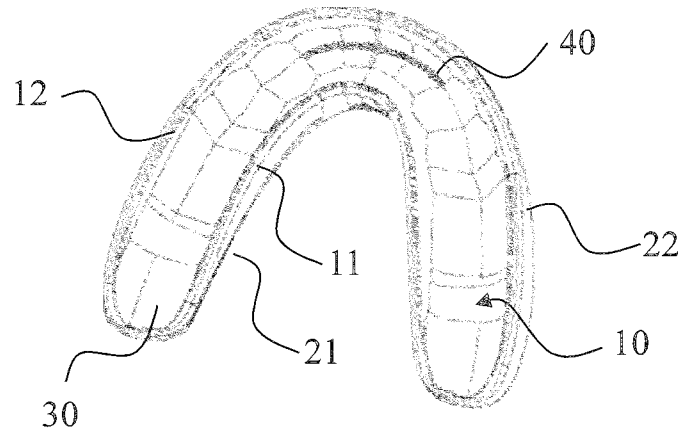
10. The orthodontic appliance according to any of the claims 1 to 9, characterized in that said at least one volume or reinforcement element (40) of material harder than said elastic material is arranged as for its shape to follow the shape of the arch-shaped concaves (10, 20).

35

11. The orthodontic appliance according to claim 10, characterized in that said at least one volume or reinforcement element (40) of material harder than said elastic material comprises of a single reinforcement element (40) having a width essentially corresponding to the total width of the upper incisors of a person.

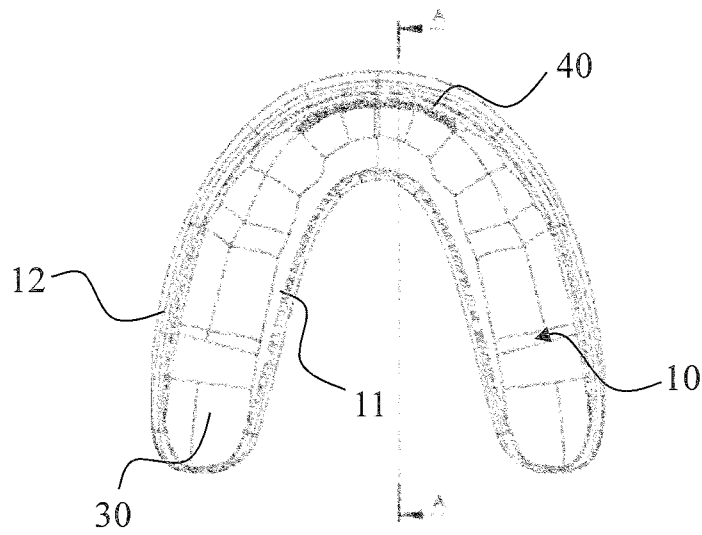
12. The orthodontic appliance according to claim 11, characterized in that extension structures (43, 44) are arranged at the ends of said single reinforcement element (40) having a width essentially corresponding to the total width of the upper incisors of a person, which extension structures (43, 44) as for their overall shape follow the shape of the arch-shaped concaves (10, 20) of the appliance.

13. The orthodontic appliance according to any of the claims 2 to 12, characterized in that said at least one reinforcement element (40) of material harder than said elastic material includes at least one pin recess for temporary attachment of the reinforcement element (40) to at least one pin of a moulding machinery or a mould during manufacture of the appliance.



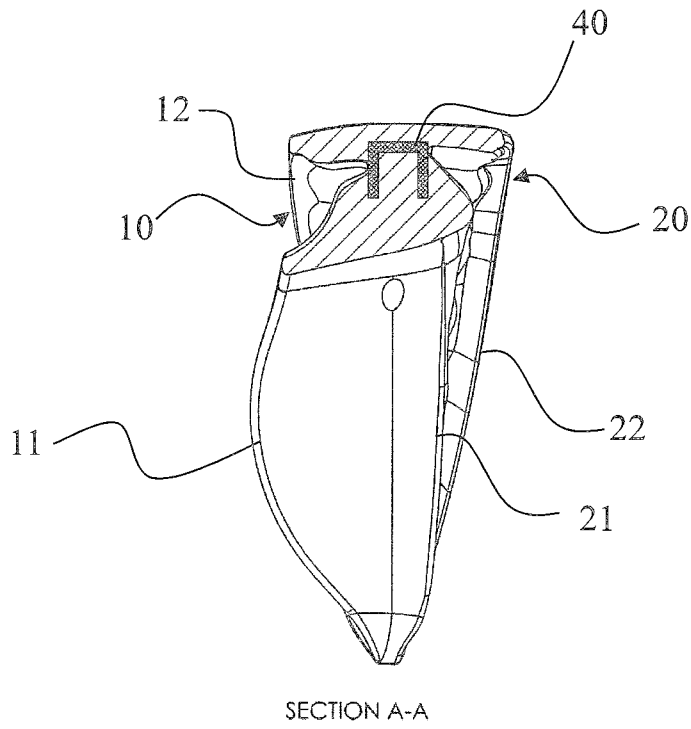
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Fig. 1



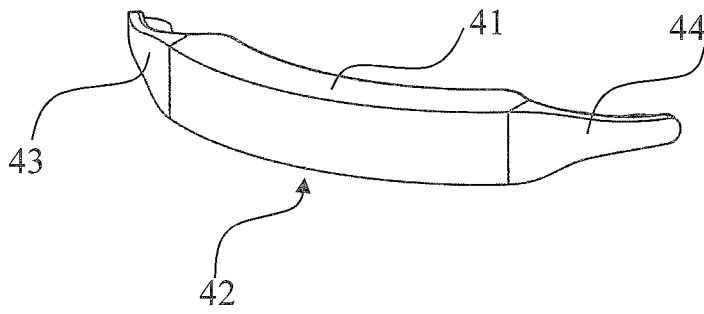
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Fig. 2



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Fig. 3



40

Fig. 4

## INTERNATIONAL SEARCH REPORT

International application No.

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<b>A. CLASSIFICATION OF SUBJECT MATTER</b>		
See extra sheet		
According to International Patent Classification (IPC) or to both national classification and IPC		
<b>B. FIELDS SEARCHED</b>		
Minimum documentation searched (classification system followed by classification symbols)		
IPC: A61C		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
FI, SE, NO, DK		
Electronic data base consulted during the international search (name of data base, and, where practicable, search terms used)		
EPO-Internal, WPIAP		
<b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4448735 A (HUGE GERALD W [US]) 15 May 1984 (15.05.1984) abstract; paragraph 2, lines 5-15; paragraph 2, line 62 - paragraph 3, line 14; figures 3, 6	1-13
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A	US 5406962 A (ADELL LOREN S [US]) 18 April 1995 (18.04.1995) the whole document	1-13
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**Information on Patent Family Members**

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