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PLASTIC MOUTHPIECE WITH BREAK-AWAY STRAP

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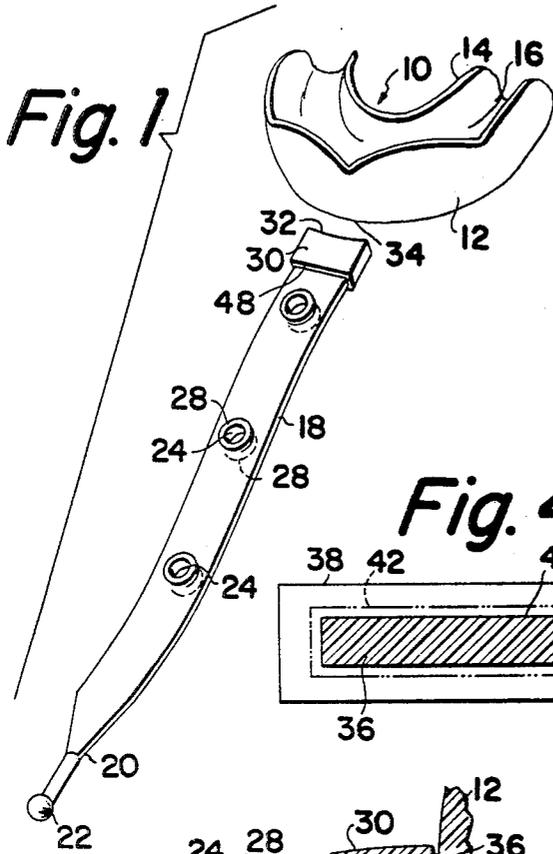


Fig. 1

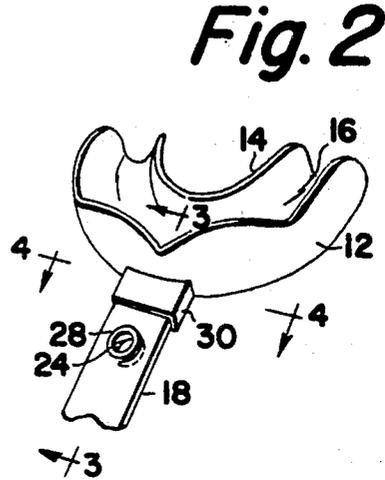


Fig. 2

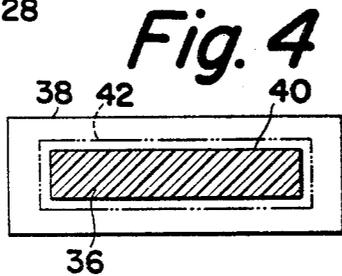


Fig. 4

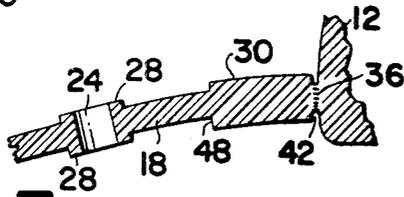


Fig. 3

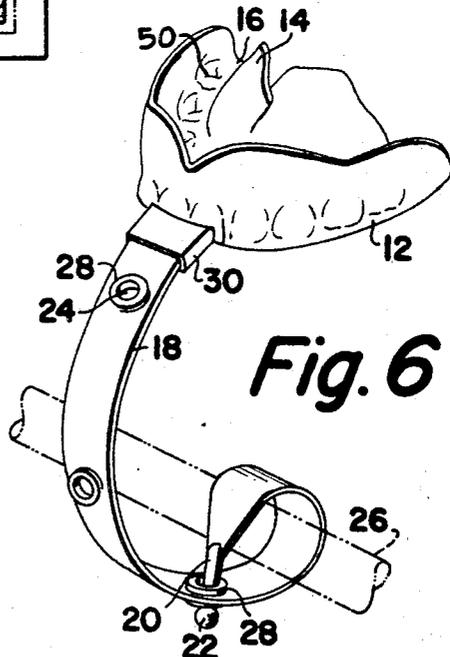


Fig. 6

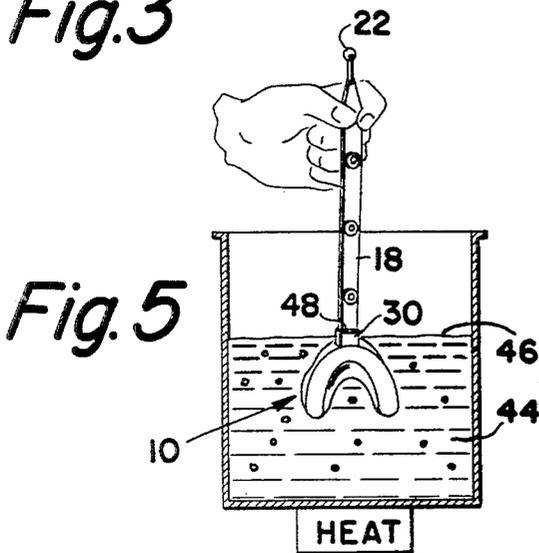


Fig. 5

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**PLASTIC MOUTHPIECE WITH  
BREAK-AWAY STRAP**

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Commerce Drive, Montgomeryville, Pa. 18936)  
Continuation-in-part of application Ser. No. 531,123,  
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U.S. Cl. 128—136

12 Claims

**ABSTRACT OF THE DISCLOSURE**

A mouthpiece made of a tough flexible plastic pre-  
molded in the form of a saddle that can be rapidly soft-  
ened and inserted in the mouth to comfortably take and  
fix the impression of the teeth therein and a strap for at-  
tachment to a face guard or chin strap so bonded to the  
mouthpiece that it will break away from the mouthpiece  
upon substantial impact exerting a pulling force thereon.

This is a continuation-in-part of my copending applica-  
tion Ser. No. 531,123 filed Mar. 2, 1966, now Patent No.  
3,411,501.

Among other things, said parent application discloses  
a plastic mouthpiece of the type and thickness adapted  
to take and fix therein the impressions of the upper and  
the lower teeth and a strap for removable attachment to  
a face guard or chin strap which has a generally spherical  
member at its end that enters a recess in the mouthpiece  
to form a break-away connection thereby minimizing  
damage which can occur to the teeth due to an impact  
upon or the exertion of a pulling force on the strap if it  
were fixedly secured to the mouthpiece.

The primary object of this invention is to provide a  
plastic mouthpiece adapted to take and fix teeth impres-  
sions therein and in which the strap is connected to the  
mouthpiece by a bond of such character that it will re-  
main intact until a substantial jarring impact of predeter-  
mined magnitude is applied to the strap which exerts a  
pulling force thereon, of the type but somewhat less in  
magnitude than that encountered in sports events which  
can loosen or even extract teeth, at which point the bond  
will break freeing the strap from the mouthpiece and  
thereby preventing damage to the teeth. Such an impact,  
in football for example, occurs when a player pulls on  
the helmet of an opponent or strikes him snapping his  
head back to produce a whiplash.

Another object of the invention is to provide a mouth-  
piece of the character described which is thinner and  
lighter than the one contemplated in said parent applica-  
tion and hence is adapted to take and fix therein only the  
impressions of one set of teeth, upper or lower, and a  
strap welded to the mouthpiece to provide a break-away  
connection without using a ball and socket or similar me-  
chanical connection which is difficult to incorporate in  
the thinner mouthpiece.

Another object is to provide a mouthpiece of the  
character described in which the welded break-away con-  
nection of the strap to the mouthpiece is effected in such  
a manner that the strap will not become distorted at its  
point of connection due to the heat to which the mouth-  
piece is subjected to soften it prior to insertion in the  
mouth to take and fix the teeth impressions therein.

Another object of the invention is to provide an im-  
pressionable plastic mouthpiece and a strap attached  
thereto with a break-away connection and improved  
strengthened means to effect adjustable attachment of the  
strap to the face guard or chin strap.

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These and other objects of the invention will become  
more apparent as the following description proceeds in  
conjunction with the accompanying drawings, wherein:

FIG. 1 is a group perspective view of the standard sad-  
dle and the strap ready to be attached thereon;

FIG. 2 is a fragmentary perspective view of the saddle  
with the strap detachably secured in place;

FIG. 3 is a sectional view taken on the line 3—3 of  
FIG. 2;

FIG. 4 is a sectional view taken on the line 4—4 of  
FIG. 2;

FIG. 5 is an elevational diagrammatic view illustrating  
the softening stage; and

FIG. 6 is a perspective view of the final mouthpiece  
with the strap detachably secured thereto.

Specific reference is now made to the drawings where-  
in similar reference characters are used for corresponding  
elements throughout.

The saddle indicated generally at 10, is a substantially  
U or horseshoe shaped member of channel cross-section  
having an outer flange or buckle 12 and a preferably  
lower inner or lingual flange 14 connected by a web por-  
tion 16. Its outer surface tapers upwardly at its distal ends  
while the posterior ends of the inner and outer flanges  
taper anteriorly. A relatively flat strap 18 is provided  
which is attached to the saddle by a break-away connec-  
tion soon to be described. The saddle is readily and easily  
made by conventional injection molding techniques or, if  
desired, by a casting technique wherein the sheet of the  
resin is softened by placing it in boiling water, inserting  
it in a female metal mold of shape and cross-section con-  
forming to that described above, closing and pressing a  
male mold therein and removing the saddle after about  
one minute as the mold cools. The strap is made in a sim-  
ilar fashion.

The saddle and strap are made of high molecular  
weight binary or pure ethylene-vinyl acetate copolymers  
which are tough, have a rubber-like flexibility or resil-  
ience and have high stress crack resistance even at low  
temperatures. The average properties which these resins  
possess are as follows: a melt index of 3.5–15 dg./min.,  
a density of 23° C. of 0.95 g./cc., a tensile strength at  
73° F. of 1550–2000 lb./sq. in., an elongation at 73° of  
800–900%, a stiffness at 73° F. of 1550–1770 lbs./sq. in.,  
a tensile impact at 73° F. of 228–330, a softening point,  
Vicat, of 120–127° F. and an index of refraction of  
1.482–1.485, all determined by ASTM methods. They are  
also odorless, tasteless and non-toxic. Two such resins  
are commercially available from Du Pont as Alathon  
3175 and Alathon 3180.

It is preferred that the saddle be made of Alathon 3180  
which has a melt index of about 15 dg./min. and a softening  
point of about 120° F. whereas the strap is preferably  
made of the tougher Alathon 3175 which has a melt index  
of about 3.5 dg./min. and a softening point of about 127°  
F. The saddle is preferably about 3 mm. thick whereas  
the strap is a substantially flat rectangular member which  
is preferably about 17 mm. wide and about 2.5 mm. thick.

One end of the strap is tapered to form a neck 20  
which terminates in a ball 22. Spaced apertures 24 are  
provided through the strap which are slightly smaller in  
diameter than ball 22. By looping the strap over the bar  
26 of the face guard or chin strap, as seen in FIG. 6, and  
then inserting the ball 22 through a selected aperture  
24 after preferably wetting the ball until the neck 20  
is positioned in the aperture, the guard can be adjustably  
retained on the face guard or chin strap. As the aper-  
tured areas of the strap are the weakest portions thereon  
and children have shown a tendency to play with the  
strap while looped in the aperture to the point where the

strap has torn through, the strap is molded with an annular reinforcing ridge 28 around each aperture which extends outwardly from one or both of the opposite faces of the strap.

In athletic events, such as football, the athlete wearing the mouthpiece may encounter impacts of such magnitude as to loosen or even extract teeth if the strap were affixed to the mouthpiece. Such impacts, in football for example, come from pulling on a helmet or snapping the head back, which impacts exert a pulling force on the strap. If the strap is attached to a face guard, the impact is transmitted generally along a path substantially in alignment with the point of attachment of the strap to the mouthpiece. If it is attached to a chin strap, it is applied generally as an upward pulling force. In either case, to avoid damage to the teeth a break-away connection is effected between the strap and the mouthpiece, i.e. a connection which will break off long before the strap itself will give way and at a predetermined magnitude less than that which will act to loosen the teeth of the wearer.

Then end 30 of the strap opposite the ball 22 maintains a generally rectangular cross-section but is enlarged relative to the body of the strap. Thus it is preferably about  $\frac{3}{8}$ " long, about 20 mm. wide as compared to 17 mm. for the strap and is about 5 mm. thick as compared to about 2.5 mm. for the strap. It has an outer edge 32 which is curved to conform with that of the front of the buckle 12 centrally of the mouthpiece and adjacent its lower edge. By means of an appropriate heating element or ultrasonically, the edge 32 of the enlarged end 30 of the strap and/or the outer face of the mouthpiece where the buckle 12 forms a lower edge with the web 16 as at 34 are heated until they are rendered sufficiently tacky to form a weld, fusion area or bond 36 when joined, see FIG. 3. It is within the purview of the invention that such a bond can be formed with an appropriate adhesive or cementitious material.

To permit the strap to remain firmly attached to the mouthpiece during normal use but to break away due to a substantial impact acting to exert a pull of not less than about 14 pounds nor greater than about 24 pounds on the strap, the area of the weld joint or bond 36 is less than the area encompassed within the periphery of the enlarged end 30 of the strap. It has been found that when the periphery 38 of the end 30 is 20" wide by 5" thick, if the weld joint area contains a periphery 40 which is about 2 mm. in from the periphery 38 of the strap end 30, leaving an unsecured peripheral area 42, the weld joint will break upon exertion of the aforementioned impact acting to exert about 14 pounds of pull on the weld joint. If this weld joint area is reduced to a smaller area the strap will not remain attached to the mouthpiece with sufficient strength for normal use. On the other hand, if the periphery 42 of the weld joint is extended to within about 1 mm. of the periphery 38 of the strap end 30, the weld joint will still break upon impact acting to exert about 24 pounds of pull on the weld joint. An extension of the weld joint area beyond this periphery 42 will act to prevent such break-away action from occurring. In terms of area, the weld joint will appropriately secure the strap to the mouthpiece yet permit it to break the strap away from the mouthpiece under an applied force of 14-24 pounds if the weld joint occupies about  $\frac{1}{3}$  to  $\frac{1}{2}$  of the cross-sectional area of the strap end 30.

In use, the saddle 10 with the attached strap 18 is immersed in boiling water 44, see FIG. 5, with the strap held upright and the level 46 of the water not extending beyond the upper or outer edge 48 of the enlarged strap end 30. Thus the strap is kept out of the boiling water and will not tend to soften to the degree that the saddle does. Moreover, the fact that the strap is made of a plastic of higher softening point than that of the saddle also militates against softening and possible distortion of the strap end adjacent the saddle. After about ten seconds, the guard is removed because it has retained its essen-

tial shape but is soft enough to accept teeth impressions in the mouth. The water is shaken off and the saddle quickly placed over the upper teeth (or lower teeth in the case of a jutting jaw problem). The tongue is placed against the roof of the mouth and with a sucking motion the excess water and air are drawn out for about 5 to 10 seconds, in which time the impressions 50 of the upper teeth are formed in the inner surfaces of the buckle 12 and the web 16 where it joins the buckle and the saddle takes the molded form shown generally in FIG. 6. When the guard is removed from the mouth and placed in cold water the teeth impressions become fixed therein. To fasten the strap around the chin strap or face guard, the ball end 22 of the strap is moistened before it is inserted in a selected aperture 24. It should be noted that impacts encountered in athletic contests which produce a force component along the strap in the order of magnitude of 14-24 pounds will break the weld joint or bond 36 but will not pull the ball 22 out of the aperture 24 of the strap.

While preferred embodiments of the invention have been shown and described, it will be understood that skilled artisans may make variations without departing from the spirit of the invention and the scope of the appended claims.

I claim:

1. A combined saddle and strap for use in making a mouthpiece comprised of a saddle of substantial U-shape and of channel cross-section made of a resilient thermoplastic resin capable of being softened without losing its essential shape so that it can comfortably take and fix teeth impressions therein in the mouth, an elongated strap made of a thermoplastic resin for removable attachment to a face guard, chin strap or similar support and means bonding one end of said strap to an exterior portion of said saddle so that an impact exerting a pull on said strap in the order of magnitude of about 14 to 24 pounds will cause the bonding means to break and thereby free the strap from the saddle and thus prevent damage to the teeth.

2. The combination of claim 1 wherein the resin from which said saddle and strap are made comprises a binary ethylenevinyl acetate copolymer having a melt index of about 3.5-15 dg./min., a softening point of about 120-127° F. and an index of refraction of about 1.482-1.485.

3. The combination of claim 2 wherein said bonding means is a weld joint whose cross-sectional area is from one-third to one-half that of said one end of said strap.

4. The combination of claim 2 wherein said one end of said strap is generally rectangular and is about 20 mm. wide and about 5 mm. thick and said bonding means is a weld joint whose periphery is spaced about 1 mm. to 2 mm. inwardly from that of said one end of said strap.

5. The combination of claim 1 and means to adjustably and detachably loop said strap about a face guard, chin strap or similar support, said means including spaced apertures in said strap, said other end of said strap including a neck of diameter less than that of said apertures and a protuberance thereon somewhat larger in area than that of said aperture but capable of being pushed therethrough when moistened, each aperture including an annular reinforcing rib extending outwardly from at least one face of said strap.

6. The combination of claim 1 wherein said strap includes a main body portion, said one end being enlarged to form a portion which is wider and thicker than said main body portion and which extends a predetermined length along said main body portion so that when said saddle and said one end of said strap are placed in boiling water to soften the saddle prior to insertion in the mouth, said one end of said strap will not distort and will also serve as a marker beyond which said saddle and strap should not be exposed to the boiling water.

7. The combination of claim 1 wherein said saddle is made of an ethylene-vinyl acetate copolymer having a melt index of about 15 dg./min. and a softening point of

about 120° F. and said strap is made of an ethylene-vinyl acetate copolymer having a melt index of about 3.5 dg./min. and a softening point of about 127° F.

8. A combined saddle and strap for use in making a mouthpiece comprised of a saddle of substantial U-shape and of channel cross-section made of a resilient thermoplastic resin capable of being softened without losing its essential shape so that it can comfortably take and fix teeth impressions therein in the mouth, an elongated strap made of a thermoplastic resin for removable attachment to a face guard, chin strap or similar support, bonding means securing one end of said strap to an exterior portion of said saddle, and means to detachably loop said strap about a face guard, chin strap or similar support, said means including at least one aperture in said strap, said other end of said strap including a neck of width less than that of said aperture and a ball protuberance thereon somewhat larger in area than that of said aperture but capable of being pushed therethrough when moistened, said neck and protuberance extending longitudinally of said strap.

9. The combination of claim 8 and a plurality of apertures spaced longitudinally of the strap to adjustably loop said strap about a face guard, chin strap or similar support.

10. The combination of claim 9 and an annular reinforcing rib around each aperture.

11. The combination of claim 1 wherein said bonding means is an adhesive.

12. A combined saddle and strap for use in making a mouthpiece comprised of a saddle of substantial U-shape and of channel cross-section made of a resilient thermoplastic resin capable of being softened without losing its essential shape so that it can comfortably take and fix teeth impressions therein in the mouth, an elongated strap made of a thermoplastic resin for removable attachment to a face guard, chin strap or similar support and means bonding one end of said strap to an exterior portion of said saddle so that a substantial impact exerting a pull on said strap will cause the bonding means to break and thereby free the strap from the saddle and thus prevent damage to the teeth, said bonding means being less resistant to shear than the strap itself.

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