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(54) **SELF-LIGATING ORTHODONTIC BRACKET**

(75) Inventor: **Todd I. Oda**, Torrance, CA (US)

(73) Assignee: **Ormco Corporation**, Orange, CA (US)

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433/17

See application file for complete search history.

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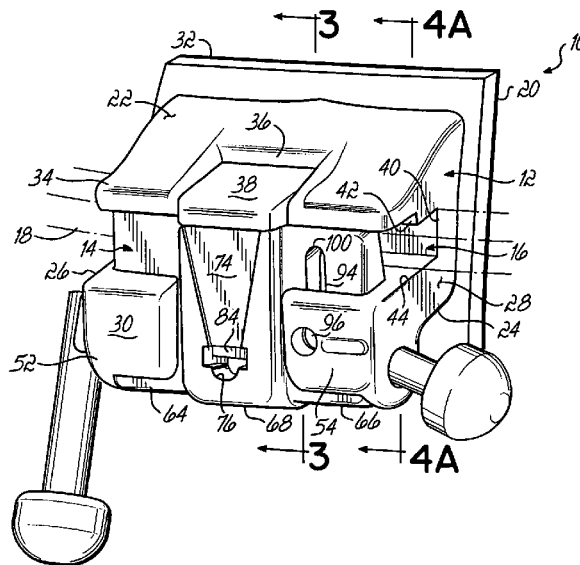
*Primary Examiner*—Cary E. O'Connor

(74) *Attorney, Agent, or Firm*—Wood, Herron & Evans, L.L.P.

(57) **ABSTRACT**

An orthodontic bracket having a bracket body configured to be mounted to a tooth includes an archwire slot having a base surface defining a base plane and a slide engagement track defining a translation plane. The translation plane is angled with respect to the base plane. A ligating slide is engaged with the slide engagement track of the bracket body and movable along the slide engagement track and parallel to the translation plane between an opened position, in which an archwire is insertable into the archwire slot, and a closed position, in which the archwire is retained within the archwire slot. The translation plane is angled with respect to the base plane so as to prevent the ligating slide from contacting the gingiva surrounding the tooth when the ligating slide is moved to the opened position.

**28 Claims, 4 Drawing Sheets**



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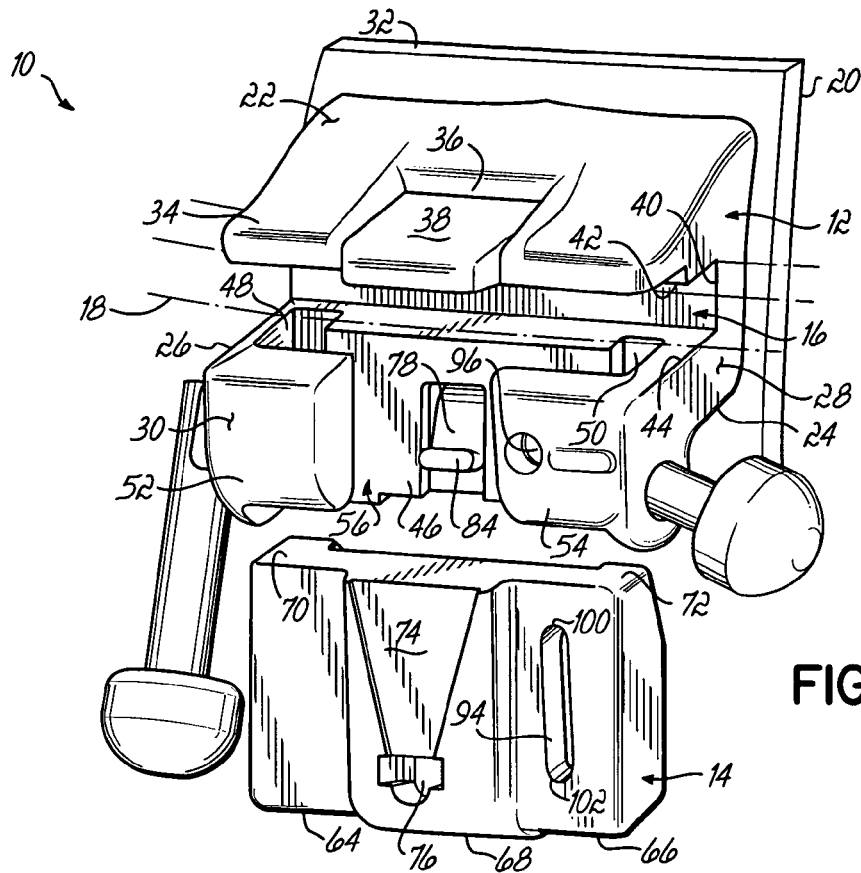


FIG. 1

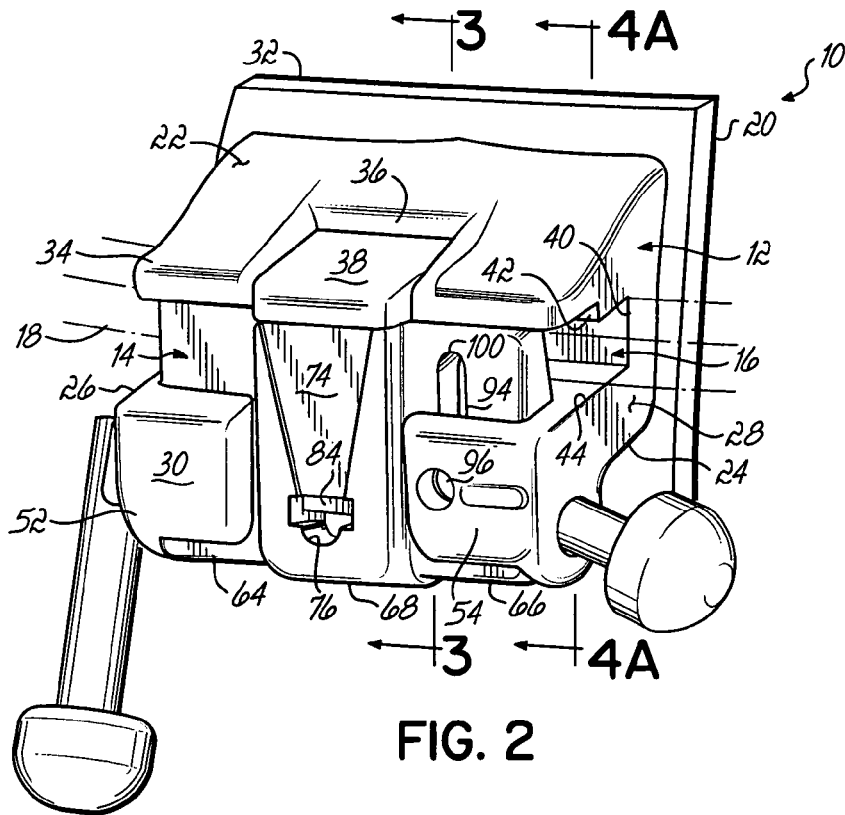


FIG. 2



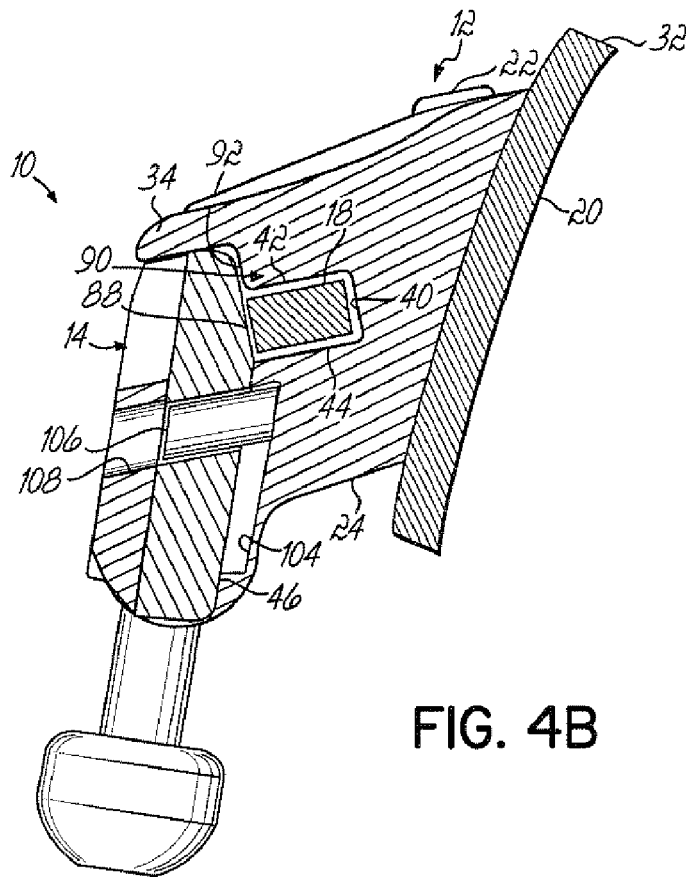


FIG. 4B

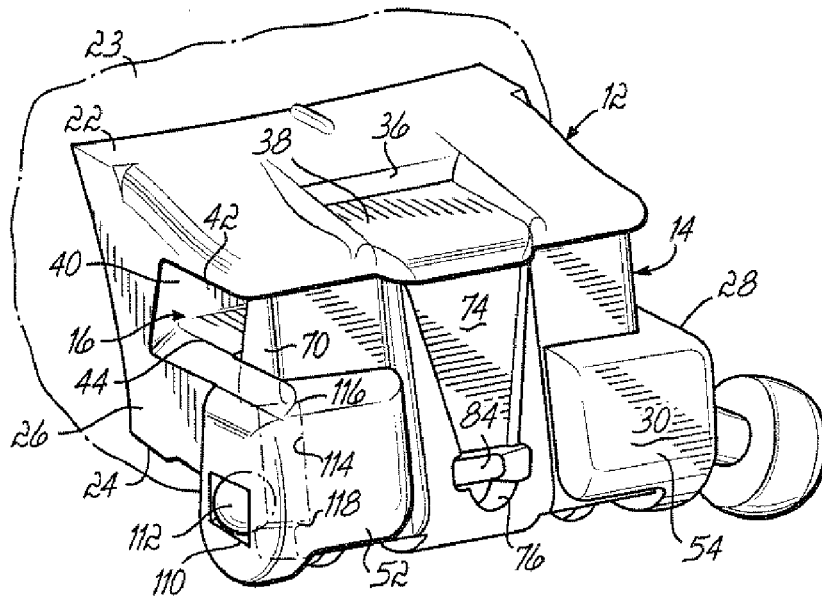


FIG. 5A



**SELF-LIGATING ORTHODONTIC BRACKET**

## FIELD OF THE INVENTION

The invention relates generally to orthodontic brackets and, more particularly, to self-ligating orthodontic brackets.

## BACKGROUND OF THE INVENTION

Orthodontic brackets represent a principal component of all corrective orthodontic treatments devoted to improving a patient's occlusion. In conventional orthodontic treatments, an orthodontist or an assistant affixes brackets to the patient's teeth and engages an archwire into a slot of each bracket. The archwire applies corrective forces that coerce the teeth to move into correct positions. Traditional ligatures, such as small elastomeric O-rings or fine metal wires, are employed to retain the archwire within each bracket slot. Due to difficulties encountered in applying an individual ligature to each bracket, self-ligating orthodontic brackets have been developed that eliminate the need for ligatures by relying on a movable portion or member, such as a latch or slide, for captivating the archwire within the bracket slot.

Conventional orthodontic brackets for the first and second molar teeth typically include a bracket in the form of a buccal tube that provides an anchor for the archwire. The buccal tube is typically secured to a tooth or to a molar band, which is in turn cemented to the first or second molar teeth. A terminal end of a conventional archwire is then fitted into the tube to facilitate orthodontic treatment. In some orthodontic treatments, a severely rotated molar makes it difficult to insert the end of the archwire into both the first and second molar tubes. In these severely rotated cases, a convertible buccal tube is often used on the first molar tooth to overcome the difficulty encountered with conventional buccal tubes.

In some orthodontic treatments, however, it is undesirable to fix the archwire and prevent movement of the archwire, as is done when traditional ligatures secure the archwire to a convertible buccal tube. To overcome this limitation of current molar brackets it would be desirable to use self-ligating brackets on the first and/or second molars. Nevertheless, their use has heretofore presented some undesirable drawbacks. For instance, one problem in using self-ligating brackets on the molar teeth is that their size often creates occlusion problems between the bracket and teeth on the opposing jaw. As the upper and lower teeth are brought together, such as for example, during chewing, the upper teeth may contact the brackets on the lower molars and may break or dislodge the brackets therefrom.

Furthermore, under normal conditions the gingival-occlusal height of molar teeth provides a limited surface on which to mount an orthodontic bracket. Prior self-ligating brackets have slides that engage the bracket body from below and travel along guides in the bracket body that are substantially parallel to the gingival-occlusal plane. Moreover, when in an opened position, the bottom edge of the slide extends below the bracket body. Thus, if traditional self-ligating brackets were attached to the bottom molar teeth, the bottom edge of the slide would contact gum tissue (gingiva) causing patient discomfort. Moreover, because gingival interference with the slide would be significant, the slide could not be fully opened to accept an archwire thus defeating an advantage of self-ligating brackets.

Yet another problem often encountered with traditional direct bonded self-ligating brackets is with applying the brackets to teeth. To apply a self-ligating bracket to a tooth,

a medical practitioner will use a tool, such as tweezers, to grasp the bracket and manipulate the bracket within the oral cavity. Traditional self-ligating brackets, however, typically do not provide convenient gripping points so that the medical practitioner may securely grasp the bracket. Consequently, it is difficult to manipulate the bracket within the oral cavity without the bracket disengaging from the tweezers and falling on the floor or in a patient's mouth. This problem would be exacerbated when attempting to apply self-ligating brackets to molar teeth at the rear of the oral cavity.

There is a need for a self-ligating orthodontic bracket attachable to molar teeth that overcomes these and other deficiencies of conventional self-ligating orthodontic brackets.

## SUMMARY OF THE INVENTION

In one aspect of the invention, an orthodontic bracket includes a bracket body configured to be mounted to a tooth and includes an archwire slot having a base surface generally defining a base plane. The bracket body further includes a slide engagement track generally defining a translation plane. The translation plane is acutely angled with respect to the base plane. A ligating slide is engaged with the slide engagement track of the bracket body and movable along the slide engagement track and parallel to the translation plane between an opened position, in which an archwire is insertable into the archwire slot, and a closed position, in which the archwire is retained within the archwire slot. The translation plane may be angled between approximately 10 degrees and approximately 25 degrees, and preferably approximately 20 degrees, with respect to the base plane. The angled relation between the translation plane and the base plane is configured to prevent the ligating slide from contacting the gingiva surrounding the tooth when the ligating slide is moved to the opened position.

To provide a close fit between the archwire and the archwire slot, the ligating slide includes a surface confronting the slide engagement track having a first and second portion. The first portion engages the slide engagement track. The second portion covers the archwire slot when the ligating slide is in the closed position and is angled with respect to the first portion so that the second portion is generally parallel to the base plane.

In another aspect of the invention, the bracket body includes a confronting side adapted to face teeth on an opposite jaw. The confronting side has a contoured shape such that as the jaws are closed and the upper and lower teeth are brought together, there is no occlusal interference between the orthodontic bracket and the teeth in the opposite jaw. The confronting side may include a recess adjacent an outer end that defines a generally planar surface which is substantially orthogonal to the base plane. The planar surface is adapted to provide a gripping point for an orthodontic tool, such as tweezers, used to apply the bracket to the tooth.

In yet another aspect of the invention, the movement of the ligating slide relative to the bracket body may be restricted so as to prevent the ligating slide from disengaging the bracket body. The bracket body may include one of a projecting portion or a receiving portion and the ligating slide may include the other of the projecting portion and the receiving portion, wherein the projecting portion or receiving portion moves relative to the other as the ligating slide moves along the slide engagement track between the opened and closed positions. The receiving portion includes a first end configured such that the projecting portion engages the

first end when the ligating slide is in the opened position. In this way, the ligating slide is prevented from accidentally or inadvertently disengaging from the bracket body.

In one embodiment, a retaining pin projects from the slide engagement track and the ligating slide includes a retaining slot extending through the ligating slide and oriented in a direction along which the ligating slide moves between the opened and closed positions. The retaining pin is received within the retaining slot and the retaining slot moves relative to the retaining pin as the ligating slide moves between the opened and closed positions. Another embodiment further shows the retaining pin associated with the ligating slide and a retaining groove associated with the bracket body that operates in a similar manner as described above. Other configurations are also possible for restricting the movement of the ligating slide relative to the bracket body. For instance, in other embodiments of the invention, the slide engagement track is bounded by at least one side wall having one of a projecting portion or a receiving portion and the ligating slide includes a peripheral edge that confronts the side wall. The peripheral edge includes the other of the projecting portion or the receiving portion. The projecting portion may be, for example, a retaining pin or a retaining ball and the receiving portion may be a retaining groove.

The above and other objects and advantages of the invention shall be made apparent from the accompanying drawings and the description thereof.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and, together with a general description of the invention given above, and the detailed description of the embodiments given below, serve to explain the principles of the invention.

FIG. 1 is a perspective view of a self-ligating orthodontic bracket according to the invention in which the ligating slide is removed from the assembly for clarity;

FIG. 2 is a perspective view of the self-ligating orthodontic bracket of FIG. 1 with the ligating slide in the closed position;

FIG. 3 is a cross-sectional view of the self-ligating orthodontic bracket of FIG. 2 generally taken along line 3-3;

FIG. 4A is a cross-sectional view of the self-ligating orthodontic bracket of FIG. 2 generally taken along line 4A-4A showing a retaining pin in the bracket body and a retaining slot through the ligating slide;

FIG. 4B is a cross-sectional view of an alternate embodiment of the self-ligating orthodontic bracket similar to FIG. 4A showing a retaining groove in the bracket body and a retaining pin in the ligating slide;

FIG. 5A is a perspective view of an alternate embodiment of the self-ligating orthodontic bracket showing a retaining ball in the bracket body and a retaining groove in the ligating slide; and

FIG. 5B is a broken away perspective view of an alternate embodiment of the self-ligating orthodontic bracket similar to FIG. 5A showing a retaining groove in the bracket body and a retaining pin in the ligating slide.

#### DETAILED DESCRIPTION

Although the invention will be described next in connection with certain embodiments, the invention is not limited to practice in any one specific type of self-ligating orthodontic bracket. The description of the embodiments of the

invention is intended to cover all alternatives, modifications, and equivalent arrangements as may be included within the spirit and scope of the invention as defined by the appended claims. In particular, those skilled in the art will recognize that the components of the embodiments of the invention described herein could be arranged in multiple different ways.

With reference to FIGS. 1 and 2, an orthodontic bracket, generally indicated by reference numeral 10, includes a bracket body 12 and a movable ligating slide 14 slidably coupled with the bracket body 12. The bracket body 12 includes an archwire slot 16 formed therein adapted to receive an archwire 18 (shown in phantom). The ligating slide 14 is moveable between an opened position in which the archwire 18 is insertable into the archwire slot 16 and a closed position in which the archwire 18 is retained within the archwire slot 16. The bracket body 12 and ligating slide 14 collectively form an orthodontic bracket 10 structure for use in corrective orthodontic treatments. The invention is advantageous for self-ligating brackets placed on the first and/or second molar teeth, although not so limited.

More particularly, the invention is advantageous for self-ligating brackets placed on the first and/or second molar teeth of the lower jaw. For this reason, the orthodontic bracket 10 of the invention is described herein using a reference frame attached to a molar tooth of the lower jaw. Consequently, and as used herein, terms such as labial, lingual, mesial, distal, occlusal, and gingival used to describe bracket 10 are relative to the chosen reference frame. The invention, however, is not limited to the chosen reference frame and descriptive terms, as the orthodontic bracket 10 of the invention may be used on other teeth and in other orientations within the oral cavity. By way of example, the orthodontic bracket 10 may be used on the molar teeth in the upper jaw and oriented so that the ligating slide 14 opens in either the occlusal or gingival direction. Those of ordinary skill in the art will recognize that the descriptive terms used herein may not directly apply when there is a change in reference frame. Nevertheless, the invention is intended to be independent of location and orientation within the oral cavity and the relative terms used to describe orthodontic bracket 10 are to merely provide an adequate description of the invention. As such, the relative terms labial, lingual, mesial, distal, occlusal, and gingival are in no way limiting the invention to a particular location or orientation.

The bracket body 12 has a lingual side 20, an occlusal side 22 when mounted to a tooth 23 carried by the patient's lower jaw, a gingival side 24, a mesial side 26, a distal side 28, and a labial side 30. The lingual side 20 of the bracket body 12 is configured to be secured to tooth 23 in any conventional manner, for example, by an appropriate orthodontic cement or adhesive or by a band around an adjacent tooth. The lingual side 20 may further be provided with a pad 32 that is secured to the outer surface of tooth 23.

In one advantageous aspect of the invention, the occlusal side 22 is profiled or contoured by including a labial portion 34 that projects generally in the gingival-labial direction. For instance, the occlusal side 22 may include a convex portion adjacent the lingual side 20 with a concave portion extending therefrom in the labial direction. In this way, the thickness of the bracket body 12 between the archwire slot 16 and occlusal side 22 is relatively thicker along the convex portion and thins or is reduced along the concave portion. Many traditional self-ligating brackets have an occlusal side that projects primarily in the labial direction. Consequently, when traditional self-ligating brackets are positioned on



molar teeth, teeth on the opposing jaw often contact the occlusal side of the brackets when the teeth are brought together, such as for example during chewing. To avoid the undesirable contact of teeth with the orthodontic bracket, the self-ligating bracket **10** of the invention includes an occlusal side **22** with a labial portion **34** that projects in the gingival direction as well. This profiling moves the occlusal side **22** away from the teeth on the opposing jaw, shown schematically at **35**, so that as the teeth **23**, **35** are brought together, the teeth **35** on the opposing jaw do not contact the occlusal side **22** of the orthodontic bracket **10**, thereby preventing occlusal interference (FIG. 3).

Occlusal side **22** may further include recess **36** in labial portion **34**. Recess **36** may be advantageously configured to include a generally planar surface **38** adapted to be a gripping point for a tool (not shown), such as tweezers, for manipulating the orthodontic bracket **10** within the oral cavity. As discussed below, planar surface **38** is generally orthogonal to the base plane defined by the base of the archwire slot **16**. This is particularly advantageous when attaching orthodontic brackets to molar teeth at the back of the oral cavity, where it can be difficult to manipulate the bracket **10** so as to properly attach the bracket **10** to the molar tooth **23**. Many traditional self-ligating brackets include occlusal sides that are irregular and thus are not conducive to gripping by an instrument such as tweezers. To aid the medical practitioner in applying the self-ligating bracket **10** of the invention, planar surface **38** is provided within recessed area **36**. Planar surface **38** provides an enhanced surface for securely gripping the orthodontic bracket **10** so that the medical practitioner may easily position the bracket **10** on the molar tooth **23**.

With continued reference to FIGS. 1 and 2, the bracket body **12** includes a base surface **40** and a pair of opposed slot surfaces **42**, **44** respectively, projecting labially from the base surface **40** that collectively define the archwire slot **16** extending in a mesial/distal direction from mesial side **26** to distal side **28**. The slot surfaces **42**, **44** and base surface **40** are substantially encapsulated or embedded within the material of the bracket body **12**. The archwire slot **16** of the bracket body **12** is designed to receive the orthodontic archwire **18** in the same manner as typical prior art self-ligating orthodontic brackets.

The bracket body **12** further includes a generally planar support surface **46** projecting in a generally labial-lingual direction from slot surface **44**. Support surface **46** may include a pair of slide grooves **48**, **50** extending in the occlusal-lingual direction at opposed mesial-distal ends of support surface **46**. A pair of opposed guides **52**, **54** are carried by support surface **46** and are positioned on respective mesial and distal sides **26**, **28** thereof. The guides **52**, **54** are generally L-shaped each having a first leg projecting from support surface **46** in the labial direction. Guide **52** has a second leg projecting in the distal direction while guide **54** has a second leg projecting in the mesial direction so that collectively, guides **52**, **54** partially overlie support surface **46**. Planar support surface **46** including grooves **48**, **50** and guides **52**, **54** collectively define a slide engagement track **56** for supporting and guiding ligating slide **14** within bracket body **12**.

In another advantageous aspect of the invention, the slide engagement track **56** and the archwire slot **16** generally have a non-orthogonal relationship. In particular, the base surface **40** of the archwire slot **16** generally defines a base plane **58** and the slide engagement track **56** generally defines a translation plane **60** along which the ligating slide **14** moves between the opened and closed positions. It should be

recognized that base surface **40** and slide engagement track **56** need not be precisely planar but be configured such that base plane **58** and translation plane **60** may be generally defined. The base plane **58** and translation plane **60** are acutely angled with respect to each other by an angle A, as shown in FIG. 3. In this way, as the ligating slide **14** is moved from the closed position to the opened position along slide engagement track **56** and parallel to translation plane **60**, the ligating slide **14** moves generally in the labial-lingual direction so that the edge of the ligating slide **14** does not make contact with the gingiva **61** adjacent orthodontic bracket **10** when mounted to molar tooth **23**. To prevent the ligating slide **14** from contacting the gingiva **61**, the base plane **58** and translation plane **60** have an angle A between approximately 10 degrees and approximately 25 degrees, and preferably approximately 20 degrees. The invention, however, is not so limited and, as recognized by those of ordinary skill in the art, other angles suitable for a particular application are possible.

The ligating slide **14** is a generally planar structure comprising a mesial portion **64**, a distal portion **66**, and a central portion **68** intermediate the mesial portion **64** and distal portion **66**. Mesial and distal portions **64** and **66** include integral slide rails **70**, **72** extending in the occlusal-lingual direction and adapted to engage slide grooves **48**, **50** of bracket body **12** when ligating slide **14** is engaged with bracket body **12**. Additionally, guides **52**, **54** overlie mesial and distal portions **64**, **66** respectively, and central portion **68** projects in the labial direction such that the labial surface of central portion **68** is substantially flush with the labial side **30** of bracket body **12**. The labial surface of central portion **68** may include a channel **74** that tapers or narrows in the occlusal-lingual direction and includes an aperture **76** located near the apex of channel **74**. As will be explained below, aperture **76** helps secure ligating slide **14** in the closed position.

A resilient engagement member **78** operates to secure the ligating slide **14** in the closed position. The resilient engagement member **78** is generally L-shaped and included a lingually-extending prong **80** that is received in a recess **82** formed in support surface **46**. The free end of the resilient engagement member **78** is provided with an labially-extending detent or projection **84**, which corresponds generally in cross section with the cross section of aperture **76** in ligating slide **14**. The projection **84** extends into aperture **76** in ligating slide **14** when ligating slide **14** is in the closed position. The engagement between the projection **84** and the aperture **76** holds the ligating slide **14** in the closed position against movement that would otherwise open the slide **14**. As a result, ligating slide **14** is unlikely to be unintentionally moved from the closed position to the opened position.

The free end of resilient engagement member **78** carrying projection **84** is elastically compressed when ligating slide **14** is in an opened position and projection **84** engages the lingual surface of ligating slide **14**. Consequently, the free end of resilient engagement member **78** is capable of resiliently flexing or deforming in the labial direction and toward ligating slide **14** when the projection **84** is aligned with aperture **76**, for selectively engaging the projection **84** with the aperture **76** so as to lock the ligating slide **14** in the closed position. To that end, resilient engagement member **78** is biased in the labial direction to force projection **84** away from the tooth **23** and toward ligating slide **14**.

In another advantageous aspect of the invention, it is desirable to provide an archwire slot **16** that provides a close fit with the archwire **18** being inserted therein. Thus as shown in FIGS. 3, 4A and 4B, the archwire slot **16** typically

has a generally rectangular configuration. The mutual arrangement of the base surface **40** and the side slot surfaces **42**, **44** is generally rectangular and provides a close fit to a generally rectangular archwire **18**. Nevertheless, because the base plane **58** of the archwire slot **16** and the translation plane **60** along which ligating slide **14** travels are angled with respect to each other, the ligating slide **14** has to be modified in order to provide a close fit to the labial surface of archwire **18**. To this end, the lingual surface of slide rails **70**, **72** includes a first and second portion **86**, **88** respectively. First portion **86** engages the slide grooves **48**, **50** of slide engagement track **56**. The second portion **88** is angled with respect to first portion **86** such that second portion **88** is generally parallel to base plane **58**. Second portion **88** covers the archwire slot **16** when ligating slide **14** is in the closed position. The second portion **88** is angled by an amount substantially equal to the angle **A** between the base plane **58** and translation plane **60**. In this way, ligating slide **14** provides a close fit to the labial surface of archwire **18**.

In yet another advantageous aspect of the invention, the labial portion **34** of occlusal side **22** extends in the labial direction beyond the archwire slot **16** to define a ledge, generally shown at **90**, extending in the mesial-distal direction. Ledge **90** includes a labial surface **92** that is generally parallel to base plane **58**. When the ligating slide **14** is moved to the closed position, the occlusal end of the second portion **88** on slide rails **70**, **72** abuts the labial surface **92** of ledge **90** and is covered by labial portion **34** of occlusal side **22**. In this way, food or other material in the oral cavity is prevented from contacting the occlusal edge of ligating slide **14** and inadvertently dislodging slide **14** to the opened position. Furthermore, labial portion **34** provides a stop so as to prevent ligating slide **14** from overshooting the closed position as the ligating slide is being moved from the open position to the closed position.

To regulate the movement of the ligating slide **14** relative to bracket body **12**, the bracket body **12** may include one of a projecting portion or a receiving portion, and ligating slide **14** may include the other of the projecting portion or the receiving portion. The projecting portion and receiving portion cooperate to regulate the movement of ligating slide **14**. For example, as shown in FIG. 4A, ligating slide **14** includes a retaining slot **94** (FIG. 1) through ligating slide **14** and extending generally in the occlusal-lingual direction. Retaining slot **94** may be formed in the distal portion **66** of ligating slide **14**, as shown in FIGS. 1 and 2, but may also be formed in the mesial portion **64**. A retaining pin **96** includes a lingual portion received within a recess **98** formed in support surface **46** that aligns with the slot **94** in ligating slide **14**. The retaining pin **96** projects in the labial direction and is received in slot **94** so that as the ligating slide **14** moves between opened and closed positions, retaining slot **94** moves relative to retaining pin **96**, as shown in FIG. 2. The retaining pin/slot configuration prevents accidental or unintentional detachment of the ligating slide **14** from the bracket body **12** during use when the ligating slide **14** is positioned in the opened position. It should be realized that the retaining pin/slot configuration does not lock the ligating slide **14** in any position, as does engagement member **78**, but regulates the movement of the ligating slide **14** in the occlusal-lingual direction.

Additionally, the length of retaining slot **94** limits the occlusal-lingual range of movement of ligating slide **14**. The retaining slot **94** may be configured lengthwise so that in the fully opened position, the archwire **18** may be inserted into archwire slot **16**. For instance, the retaining pin **96** may abut a first slot end **100** when the occlusal edge of ligating

slide **14** is approximately flush with archwire slot surface **44**. In this way, the archwire **18** may be easily inserted into the archwire slot **16**. A second slot end **102** may be configured so that the projection **84** of resilient engagement member **78** is permitted to align with aperture **76** in ligating slide **14** so as to lock the ligating slide **14** in the closed position. Retaining pin **96** may abut second slot end **102** when ligating slide **14** is in the closed position.

An alternate embodiment of the self-ligating orthodontic bracket **10** is shown in FIG. 4B, in which like reference numerals refer to like features in FIG. 4A. In this embodiment, the receiving portion is included on the bracket body **12** and the projecting portion is included on the ligating slide **14**. In particular, bracket body **12** includes a retaining groove **104** in the support surface **46** extending generally in the occlusal-lingual direction. The retaining groove **104** may be formed in support surface **46** adjacent the distal side **28** of bracket body **12**, but may also be formed adjacent the mesial side **26**. A retaining pin **106** includes a labial portion received within a recess **108** in ligating slide **14** that aligns with retaining groove **104** in bracket body **12**. The retaining pin **106** projects in the lingual direction and is received in retaining groove **104** so that as the ligating slide **14** moves between opened and closed positions, retaining pin **106** moves relative to retaining groove **104**. In operation, the retaining pin/slot configuration shown in FIG. 4B functions in substantially the same manner as the retaining pin/slot configuration shown and described above for FIG. 4A.

In FIGS. 5A and 5B, in which like reference numerals refer to like features in FIGS. 1-4A, the projecting portion and receiving portion have an alternate configuration and/or location for regulating the movement of ligating slide **14** relative to bracket body **12**. For example, in the embodiment shown in FIG. 5A, one of the guides, such as guide **52**, of bracket body **12** includes an aperture **110** in the mesial side **26** which extends therethrough. A retaining ball **112** is pressed into aperture **110** with an interference fit so that a portion of retaining ball **112** extends into the space between guide **52** and support surface **46**. The mesial surface of rail **70** includes a retaining groove **114** (shown in phantom) extending generally in the occlusal-lingual direction and defining a first end and second end **116**, **118**, respectively. The retaining ball **112** projects in the distal direction and is received in retaining groove **114** so that as ligating slide **14** moves between the opened and closed positions, retaining groove **114** moves relative to retaining ball **112**. Those of ordinary skill in the art will recognize that the retaining ball **112** and corresponding retaining groove **114** may also be located in the distal side **28** of bracket body **12** and ligating slide **14**.

The retaining ball/groove configuration prevents accidental or unintentional detachment of the ligating slide **14** from bracket body **12** during use when the ligating slide **14** is positioned in the open position and functions in substantially the same manner as the retaining pin/slot configuration shown and described above for FIG. 4A. For instance, the length of retaining groove **114** limits the occlusal-lingual range of movement of ligating slide **14**. The retaining groove **114** is configured so that in the fully open position, the archwire **18** may be inserted into archwire slot **16**. The retaining ball **112** may abut first groove end **116** when the occlusal end of the ligating slide **14** is approximately flush with archwire slot surface **44**. In this way, the archwire **18** may be easily inserted into the archwire slot **16**. Furthermore, the second groove end **118** is configured so that the projection **84** of resilient engagement member **78** may be permitted to align with aperture **76** in ligating slide **14** so as

to lock the ligating slide **14** in the closed position. Retaining ball **112** may abut second groove end **118** when ligation slide **14** is in the closed position.

Although the embodiment shown in FIG. **5A** shows the projecting portion associated with the bracket body **12** and the receiving portion associated with the ligating slide **14**, the invention is not so limited as the receiving portion may be associated with the bracket body **12** and the projecting portion may be associated with the ligating slide **14**. In the alternate embodiment of the self-ligating orthodontic bracket **10** shown in FIG. **5B**, bracket body **12** includes a retaining groove **120** in the distal surface of guide **52** extending generally in the occlusal-gingival direction and defining first and second groove ends **122**, **124**, respectively. A retaining pin **126** includes a distal portion received within a recess **128** in ligating slide **14** that aligns with retaining groove **120** in guide **52**. The retaining pin **126** projects in the mesial direction and is received in retaining groove **120** so that as the ligating slide **14** moves between opened and closed positions, retaining pin **126** moves relative to retaining groove **120**. In operation, the retaining pin/slot configuration shown in FIG. **5B** functions in substantially the same manner as the retaining ball/groove configuration shown and described above for FIG. **5A**.

In these embodiments, the bracket body **12** may be made by any suitable forming technique, such as metal injection molding (MIM), from a biocompatible metal, such as a stainless steel and, more specifically, a 17-4 stainless steel. The resilient engagement member **78** may be made from any suitable material, including stainless steels, titanium alloys and Ni/Ti type superelastic materials. The ligating slide **14** may be formed by any suitable process, such as MIM, from any biocompatible material, including metals such as stainless steel.

With reference to FIG. **2**, the ligating slide **14** in the closed position blocks the entrance to the archwire slot **16** to capture the archwire **18** therein and the engagement between projection **84** and aperture **76** provides a latched condition. The ligating slide **14** may be unlocked using an end of a tool (not shown) designed to press the projection **84** inwardly (i.e., lingually) toward the tooth **23** with a force sufficient to overcome the bias applied by resilient member **78** and disengage the projection **84** from the aperture **76** in the ligating slide **14** to provide an unlatched condition. When the projection **84** is moved by the tool inwardly (i.e., lingually) by a distance adequate to substantially clear the plane of the lingual surface of the ligating slide **14**, the ligating slide **14** is freely movable using a force applied by the tool occlusal-gingivally toward the opened position in a slidable manner and guided by guides **52**, **54**. The motion of the ligating slide **14** may be positively stopped in the opened position by contact between the retaining pin **96** and the first slot end **100** of retaining slot **94**.

To place the ligating slide **14** in the closed position, slide **14** is moved occlusal-gingivally until the projection **84** springs outwardly under the bias applied by resilient member **78** and is received in the aperture **76**. The ligating slide **14** is then securely locked in the closed position. The engagement of the projection **84** into the aperture **76** may create a tactile effect which is perceptible to a clinician and/or emits an audible sound, such as a click, that is likewise perceptible by a clinician. The alternate embodiments shown in FIGS. **4B**, **5A** and **5B** may be operated in a similar manner.

The self-ligating bracket of the invention provides a number of advantages over traditional molar brackets, such as buccal tubes or convertible buccal tubes. In particular, the

self-ligating bracket may be used in severely rotated cases without constraining the movement of the archwire. Traditional self-ligating brackets, however, have some problems when applied to molar teeth. The self-ligating bracket of the invention overcomes these limitations. In particular, self-ligating bracket of the invention provides a slide engagement track for the ligating slide that is angled so that the edge of the ligating slide does not contact the gingiva surrounding a molar tooth when the slide is opened. The bracket also provides a contoured-shaped surface that prevents occlusal interference with teeth on the opposite jaw. The bracket further provides a mechanism for regulating the movement of the ligating slide so as to prevent the ligating slide from disengaging from the bracket body.

While the invention has been illustrated by a description of various embodiments and while these embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. For example, as shown in the figures, the self-ligating orthodontic bracket **10** may include mesial and/or distal hooks that aid in the orthodontic treatment of teeth. The invention in its broader aspects is therefore not limited to the specific details, representative apparatus and methods, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of applicant's general inventive concept.

What is claimed is:

1. A self-ligating orthodontic bracket for coupling an archwire with a tooth, comprising:
  - a bracket body configured to be mounted to the tooth, said bracket body including an archwire slot having a base surface generally defining a base plane and a slide engagement track generally defining a translation plane, said translation plane being acutely angled with respect to said base plane; and
  - a ligating slide engaged with said slide engagement track and moveable relative to said slide engagement track and parallel to said translation plane between an opened position in which the archwire is insertable into said archwire slot and a closed position in which said ligating slide retains the archwire in said archwire slot, said ligating slide covering a substantial portion of said archwire slot when in the closed position, wherein movement of said ligating slide relative to said slide engagement track toward the closed position moves said ligating slide toward the tooth and movement of said ligating slide relative to said slide engagement track toward the opened position moves said ligating slide away from the tooth.
2. The self-ligating orthodontic bracket of claim **1**, wherein said translation plane is angled between approximately 10 degrees and 25 degrees with respect to said base plane.
3. The self-ligating orthodontic bracket of claim **2**, wherein said translation plane is angled approximately 20 degrees with respect to said base plane.
4. The self-ligating orthodontic bracket of claim **1**, wherein said ligating slide comprises a surface confronting said slide engagement track and having a first and second portion, said first portion engaging said slide engagement track and said second portion angled with respect to said first portion such that said second portion is generally parallel to

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said base plane, wherein said second portion covers said archwire slot when said ligating slide is in the closed position.

5. The self-ligating orthodontic bracket of claim 1, wherein said ligating slide includes an aperture extending through said ligating slide, said orthodontic bracket further comprising:

a resilient engagement member coupled to said bracket body and having a free end adapted to engage said aperture when said ligating slide is in the closed position, wherein said engagement member constrains movement of said ligating slide relative to said bracket body when engaged with said aperture.

6. A self-ligating orthodontic bracket for coupling an archwire with a tooth in a first jaw, comprising:

a bracket body configured to be mounted to the tooth, said bracket body including an archwire slot having a base surface generally defining a base plane and a slide engagement track, said bracket body further including a confronting side projecting from said base surface and adapted to confront teeth on an opposite jaw, said confronting side having a contoured shape so as to prevent occlusal interference with teeth in the opposite jaw; and

a ligating slide engaged with said slide engagement track and moveable relative to said slide engagement track between an opened position in which the archwire is insertable into said archwire slot and a closed position in which said ligating slide retains the archwire in said archwire slot.

7. The self-ligating orthodontic bracket of claim 6, wherein said confronting side includes a recess defining a generally planar portion which is substantially orthogonal to said base plane, said generally planar portion adapted to provide a gripping point for a tool used to apply said bracket to the tooth.

8. The self-ligating orthodontic bracket of claim 6, wherein said confronting side includes an outer portion that overlies a leading edge of said ligating slide, said outer portion adapted to deflect objects in a patient's oral cavity away from said leading edge when said ligating slide is in the closed position, said outer portion further adapted to prevent said ligating slide from overshooting the closed position.

9. A self-ligating orthodontic bracket for coupling an archwire with a tooth, comprising:

a bracket body configured to be mounted to the tooth, said bracket body including an archwire slot and a slide engagement track, said slide engagement track including a projecting portion; and

a ligating slide engaged with said slide engagement track and moveable relative to said slide engagement track between an opened position in which the archwire is insertable into said archwire slot and a closed position in which said ligating slide retains the archwire in said archwire slot, said ligating slide including a retaining slot extending through said ligating slide, wherein said projecting portion is received within said retaining slot and said retaining slot moves relative to said projecting portion when said ligating slide is moved along said slide engagement track between the opened and closed positions.

10. The self-ligating orthodontic bracket of claim 9, wherein said ligating slide includes an aperture therein, said self-ligating orthodontic bracket further comprising:

a resilient engagement member coupled to said bracket body and having a free end adapted to engage said

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aperture in said ligating slide when said ligating slide is in the closed position, said engagement member constraining movement of said ligating slide relative to said bracket body when engaged with said aperture.

11. The self-ligating orthodontic bracket of claim 9, wherein said retaining slot terminates at a first end, said projecting portion engaging said first end when said ligating slide is in the opened position thereby preventing said ligating slide from disengaging from said bracket body.

12. The self-ligating orthodontic bracket of claim 9, wherein said projecting portion is selected from the group consisting of a retaining pin and a retaining ball.

13. The self-ligating orthodontic bracket of claim 9, wherein said retaining slot generally extends in a direction along which said ligating slide moves between said opened and closed positions.

14. The self-ligating orthodontic bracket of claim 9, wherein said slide engagement track comprises a support surface and opposed sides connected by said support surface, said ligating slide positioned between and engaged with said opposed sides, said projecting portion coupled to said support surface.

15. A self-ligating orthodontic bracket for coupling an archwire with a tooth, comprising:

a bracket body configured to be mounted to the tooth, said bracket body including an archwire slot and a slide engagement track bounded in part by a side wall, said side wall including one of a projecting portion or a receiving portion; and

a ligating slide engaged with said slide engagement track and moveable relative to said slide engagement track between an opened position in which the archwire is insertable into said archwire slot and a closed position in which said ligating slide retains the archwire in said archwire slot, said ligating slide having a peripheral edge confronting said side wall, said peripheral edge including the other of said projecting portion or said receiving portion, said projecting portion received within said receiving portion, wherein said projecting portion and said receiving portion move relative to each other when said ligating slide is moved along said slide engagement track between the opened and closed positions.

16. The self-ligating orthodontic bracket of claim 15, wherein said ligating slide includes an aperture therein, said self-ligating orthodontic bracket further comprising:

a resilient engagement member coupled to said bracket body and having a free end adapted to engage said aperture in said ligating slide when said ligating slide is in the closed position, said engagement member constraining movement of said ligating slide relative to said bracket body when engaged with said aperture.

17. The self-ligating orthodontic bracket of claim 15, wherein said receiving portion terminates at a first end, said projecting portion engaging said first end when said ligating slide is in the opened position thereby preventing said ligating slide from disengaging from said bracket body.

18. The self-ligating orthodontic bracket of claim 15, wherein said projecting portion is selected from the group consisting of a retaining pin and a retaining ball.

19. The self-ligating orthodontic bracket of claim 15, wherein said receiving portion is configured as a retaining groove.

20. A self-ligating orthodontic bracket for coupling an archwire with a tooth, comprising:

a bracket body configured to be mounted to the tooth, said bracket body including an archwire slot and a slide

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engagement track, said slide engagement track including a closed-ended receiving portion; and  
 a ligating slide engaged with said slide engagement track and moveable relative to said slide engagement track between an opened position in which the archwire is insertable into said archwire slot and a closed position in which said ligating slide retains the archwire in said archwire slot, said ligating slide including a projecting portion received within said receiving portion, wherein said projecting portion moves within said receiving portion during the entire travel of said ligating slide between the opened and closed positions.

21. The self-ligating orthodontic bracket of claim 20, wherein said ligating slide includes an aperture extending through said ligating slide, said self-ligating orthodontic bracket further comprising:

a resilient engagement member coupled to said bracket body and having a free end adapted to engage said aperture in said ligating slide when said ligating slide is in the closed position, said engagement member constraining movement of said ligating slide relative to said bracket body when engaged with said aperture.

22. The self-ligating orthodontic bracket of claim 20, wherein said receiving portion terminates at a first end, said projecting portion engaging said first end when said ligating slide is in the opened position thereby preventing said ligating slide from disengaging from said bracket body.

23. The self-ligating orthodontic bracket of claim 20, wherein said projecting portion is selected from the group consisting of a retaining pin and a retaining ball.

24. The self-ligating orthodontic bracket of claim 20, wherein said receiving portion is configured as a retaining groove.

25. A self-ligating orthodontic bracket for coupling an archwire with a molar tooth surrounded by gingiva, comprising:

a bracket body configured to be mounted to the molar tooth, said bracket body including an archwire slot; and

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a moveable portion engaged with said bracket body, said moveable portion moveable relative to said bracket body between an open position in which the archwire is insertable into said archwire slot and a closed position in which said moveable portion retains the archwire in said archwire slot, said moveable portion covering a substantial portion of said archwire slot when in the closed position, wherein movement of said moveable portion toward the closed position moves said moveable portion toward the tooth and movement of said moveable portion toward the opened position moves said moveable portion away from the tooth so as to avoid contact with the gingival when in the opened position.

26. The self-ligating orthodontic bracket of claim 25, wherein said moveable portion includes an aperture extending through said moveable portion, said self-ligating orthodontic bracket further comprising:

a resilient engagement member coupled to said bracket body and having a free end adapted to engage said aperture in said moveable portion when said moveable portion is in the closed position, said engagement member constraining movement of said moveable portion relative to said bracket body when engaged with said aperture.

27. The self-ligating orthodontic bracket of claim 25, wherein said archwire slot includes a base surface generally defining a base plane and said bracket body includes a slide engagement track generally defining a translation plane, said translation plane being acutely angled with respect to said base plane.

28. The self-ligating orthodontic bracket of claim 27, wherein said translation plane is angled between approximately 10 degrees and 25 degrees with respect to said base plane.

\* \* \* \* \*

UNITED STATES PATENT AND TRADEMARK OFFICE  
**CERTIFICATE OF CORRECTION**

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APPLICATION NO. : 11/032977  
DATED : September 11, 2007  
INVENTOR(S) : Todd I. Oda

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

**Column 6**

Line 39, change “included” to --includes--.

Line 42, change “an” to --a--.

**Column 7**

Line 39, change the second occurrence of “of” to --or--.

**Column 10**

Line 10, change “contoured” to --contour--.

Line 18, change “applicants” to --applicant--.

(Claim 4), line 64, delete “a”.

**Column 14**

Claim 25, line 13, change “gingival” to --gingiva--.

Signed and Sealed this

Seventeenth Day of June, 2008



JON W. DUDAS  
*Director of the United States Patent and Trademark Office*