UNITED STATES DISTRICT COURT
DISTRICT OF NEW JERSEY

ATLANTIC DENTAL, INC. d/b/a MIDATLANTIC ORTHO	§	
Plaintiff,	§	Civil Action No. 17-cv-12519-RBK-KMW
v.	§	
ORMCO CORPORATION	§	Jury Trial Demanded
Defendant.	§	

ORMCO CORPORATION'S ANSWER AND COUNTERCLAIMS

Defendant Ormco Corporation ("Ormco"), by and through its undersigned counsel, respectfully submits its Answer, Affirmative Defenses, and Counterclaims to the Complaint of Plaintiff Atlantic Dental, Inc. d/b/a MidAtlantic Ortho ("MidAtlantic") as follows:

ANSWER

NATURE OF THE ACTION

1. Ormco admits that the Complaint purports to state a claim for declaratory judgment of non–infringement of a patent, unfair competition under both state and federal statutes, unfair competition at common law, disparagement / trade libel, and tortious interference. Ormco otherwise denies the allegations in Paragraph 1 of the Complaint.

2. Ormco admits that what appears on its face to be a copy of U.S. Patent No. 7,267,545 ("the '545 Patent") is attached to the Complaint as Exhibit A.

THE PARTIES

3. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 3 of the Complaint, and, on that basis, denies them.

4. Ormco admits the allegations in Paragraph 4 of the Complaint.

5. Ormco admits that MidAtlantic and Ormco both market orthodontic products. Ormco otherwise denies the allegations in Paragraph 5 of the Complaint.

JURISDICTION AND VENUE

6. Ormco admits that this Court has subject matter jurisdiction over MidAtlantic's claims. Ormco denies that MidAtlantic is entitled to any relief on those claims.

7. Ormco admits that this Court has subject matter jurisdiction over MidAtlantic's claim for declaratory judgment of non–infringement of the '545 Patent. Ormco denies that MidAtlantic is entitled to such a declaration.

8. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 8 of the Complaint, and, on that basis, denies them.

9. Ormco admits it conducts business within this judicial district and admits, with respect to this action only, that it is subject to personal jurisdiction in this Court.

10. Ormco admits that venue in this judicial district is proper.

FACTUAL ALLEGATIONS

11. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 11 of the Complaint, and, on that basis, denies them.

12. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 12 of the Complaint, and, on that basis, denies them.

13. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 13 of the Complaint, and, on that basis, denies them.

14. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 14 of the Complaint, and, on that basis, denies them.

15. Ormco denies the allegations in Paragraph 15 of the Complaint.

16. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 16 of the Complaint, and, on that basis, denies them.

17. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 17 of the Complaint, and, on that basis, denies them.

18. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 18 of the Complaint, and, on that basis, denies them.

19. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 19 of the Complaint, and, on that basis, denies them.

20. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 20 of the Complaint, and, on that basis, denies them.

21. Ormco admits the allegations in Paragraph 21 of the Complaint, except that the title of the '545 Patent does not include a period.

22. Ormco denies the allegations in Paragraph 22 of the Complaint.

23. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 23 of the Complaint, and, on that basis, denies them.

24. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 24 of the Complaint, and, on that basis, denies them.

25. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 25 of the Complaint, and, on that basis, denies them.

26. Ormco admits that what appears on its face to be a copy of the June 22nd Letter is attached to the Complaint as Exhibit C. Ormco respectfully refers the Court to the June 22nd Letter itself as the best evidence of its contents. To the extent that the allegations in

Paragraph 26 of the Complaint differ from the actual contents of the June 22nd Letter, Ormco denies them.

27. Ormco admits that what appears on its face to be a copy of the July 18th Letter is attached to the Complaint as Exhibit D. Ormco respectfully refers the Court to the July 18th Letter itself as the best evidence of its contents. To the extent that the allegations in Paragraph 27 of the Complaint differ from the actual contents of the July 18th Letter, Ormco denies them.

28. Ormco admits that what appears on its face to be a copy of the September 20th Letter is attached to the Complaint as Exhibit E. Ormco respectfully refers the Court to the September 20th Letter itself as the best evidence of its contents. To the extent that the allegations in Paragraph 28 of the Complaint differ from the actual contents of the September 20th Letter, Ormco denies them.

29. Ormco respectfully refers the Court to the September 20th Letter itself as the best evidence of its contents. To the extent that the allegations in Paragraph 29 of the Complaint differ from the actual contents of the September 20th Letter, Ormco denies them.

30. Ormco admits that what appears on its face to be a copy of the October 10th Letter is attached to the Complaint as Exhibit F. Ormco respectfully refers the Court to the October 10th Letter itself as the best evidence of its contents. To the extent that the allegations in Paragraph 30 of the Complaint differ from the actual contents of the October 10th Letter, Ormco denies them.

31. Ormco respectfully refers the Court to the October 10th Letter itself as the best evidence of its contents. To the extent that the allegations in Paragraph 31 of the Complaint differ from the actual contents of the October 10th Letter, Ormco denies them.

32. Ormco lacks sufficient information to admit or deny the allegations in Paragraph 32 of the Complaint concerning MidAtlantic's analysis of the '545 Patent and, on that basis, denies them. Ormco respectfully refers the Court to the October 10th Letter itself as the best evidence of its contents and denies the allegations in Paragraph 32 of the Complaint to the extent they differ from the actual contents of the October 10th Letter. Ormco otherwise denies the allegations in Paragraph 32 of the Complaint.

33. Ormco admits the allegations in Paragraph 33 of the Complaint.

34. Ormco admits that, before June 22, 2017, Ormco knew that Claim 20 of the '545 Patent had been amended to specify that the receiving portion of the slide engagement track be a "closed–ended" receiving portion. Ormco otherwise denies the allegations in Paragraph 34 of the Complaint.

35. Ormco admits that, before June 22, 2017, Ormco knew that its patent prosecution counsel said "Georgakis fails to teach or suggest that channel (36) has a 'closed–ended receiving portion'" in response to a rejection of Claim 20 under 35 U.S.C. § 102(b) over U.S. Patent No. 6,193,508. Ormco otherwise denies the allegations in Paragraph 35 of the Complaint.

36. Ormco denies the allegations in Paragraph 36 of the Complaint.

37. Ormco denies the allegations in Paragraph 37 of the Complaint.

38. Ormco denies the allegations in Paragraph 38 of the Complaint, which appear to duplicate exactly the allegations in Paragraph 37 of the Complaint.

39. Ormco denies the allegations in Paragraph 39 of the Complaint.

40. Ormco denies the allegations in Paragraph 40 of the Complaint.

41. With respect to the actions of Teri Mills, Ormco denies the allegations in Paragraph 41 of the Complaint. Ormco otherwise lacks sufficient knowledge to admit or deny the allegations in Paragraph 41 of the Complaint, and, on that basis, denies them.

42. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 42 of the Complaint, and, on that basis, denies them.

43. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 43 of the Complaint, and, on that basis, denies them.

44. Ormco admits that, in a telephone call with Ormco on or about November 6, 2017, MidAtlantic alleged that Ormco sales representatives were making statements to MidAtlantic's customers about its FIT.20 products. Ormco otherwise denies the allegations in Paragraph 44 of the Complaint.

45. Ormco respectfully refers the Court to the November 9th Letter itself as the best evidence of its contents. To the extent that the allegations in Paragraph 45 of the Complaint differ from the actual contents of the November 9th Letter, Ormco denies them.

46. Ormco admits the allegations in Paragraph 46 of the Complaint as of the filing date of the Complaint. Ormco denies the allegations in Paragraph 46 of the Complaint today.

COUNT I
Declaratory Judgment of Non–Infringement of U.S. Patent No. 7,267,545

47. Ormco restates its response to Paragraphs 1 to 46 as though fully stated here.

48. Ormco admits the allegations in Paragraph 48 of the Complaint.

49. Ormco admits the allegations in Paragraph 49 of the Complaint.

50. Ormco denies the allegations in Paragraph 50 of the Complaint.

51. Ormco denies the allegations in Paragraph 51 of the Complaint.

52. Ormco denies the allegations in Paragraph 52 of the Complaint.

53. Ormco admits that it had access to the FIT.20 system before alleging that the FIT.20 system infringes the '545 Patent. Ormco otherwise denies the allegations in Paragraph 53 of the Complaint.

54. Ormco denies the allegations in Paragraph 54 of the Complaint.

55. Ormco denies the allegations in Paragraph 55 of the Complaint.

COUNT II
Unfair Competition under Section 43(a) of the Lanham Act

56. Ormco restates its response to Paragraphs 1 to 55 as though fully stated here.

57. Ormco denies the allegations in Paragraph 57 of the Complaint.

58. Ormco denies the allegations in Paragraph 58 of the Complaint.

59. Ormco denies the allegations in Paragraph 59 of the Complaint.

60. Ormco denies the allegations in Paragraph 60 of the Complaint.

61. Ormco denies the allegations in Paragraph 61 of the Complaint.

62. Ormco denies the allegations in Paragraph 62 of the Complaint.

COUNT III
Unfair Competition under the New Jersey Unfair Competition Act

63. Ormco restates its response to Paragraphs 1 to 62 as though fully stated here.

64. Ormco denies the allegations in Paragraph 64 of the Complaint.

65. Ormco denies the allegations in Paragraph 65 of the Complaint.

66. Ormco denies the allegations in Paragraph 66 of the Complaint.

COUNT IV
Common Law Unfair Competition

67. Ormco restates its response to Paragraphs 1 to 66 as though fully stated here.

68. Ormco denies the allegations in Paragraph 68 of the Complaint.

69. Ormco denies the allegations in Paragraph 69 of the Complaint.

COUNT V
Disparagement / Trade Libel

70. Ormco restates its response to Paragraphs 1 to 69 as though fully stated here.

71. Ormco denies the allegations in Paragraph 71 of the Complaint.

72. Ormco denies the allegations in Paragraph 72 of the Complaint.

73. Ormco denies the allegations in Paragraph 73 of the Complaint.

COUNT VI
Tortious Interference

74. Ormco restates its response to Paragraphs 1 to 73 as though fully stated here.

75. Ormco lacks sufficient knowledge to admit or deny the allegations in Paragraph 75 of the Complaint, and, on that basis, denies them.

76. Ormco denies the allegations in Paragraph 76 of the Complaint.

77. Ormco denies the allegations in Paragraph 77 of the Complaint.

78. Ormco denies the allegations in Paragraph 78 of the Complaint.

79. Ormco denies the allegations in Paragraph 79 of the Complaint.

PRAYER FOR RELIEF

Ormco denies that MidAtlantic is entitled to any of the relief it requests.

AFFIRMATIVE DEFENSES

Without admitting that its bears the burden of proof as to any of them and reserving the right to assert additional defenses as they become known through discovery, Ormco asserts the following affirmative defenses:

FIRST AFFIRMATIVE DEFENSE
Failure to State a Claim

The Complaint fails to state a claim upon which relief can be granted.

SECOND AFFIRMATIVE DEFENSE
No Irreparable Harm

MidAtlantic is not entitled to injunctive relief because it has not and will not suffer irreparable harm in the absence of an injunction.

THIRD AFFIRMATIVE DEFENSE
Unclean Hands

MidAtlantic's request for injunctive relief is barred, in whole in or in part, by the equitable doctrine of unclean hands.

FOURTH AFFIRMATIVE DEFENSE
Laches

MidAtlantic's request for injunctive relief is barred, in whole in or in part, by laches.

FIFTH AFFIRMATIVE DEFENSE
Commercial Freedom of Speech

MidAtlantic's request for injunctive relief is barred, in whole in or in part, by protections afforded to commercial speech by the First Amendment to the United States Constitution.

COUNTERCLAIMS

Nature of the Action

1. Contrary to the allegations in its Complaint, Atlantic Dental, Inc. ("MidAtlantic"), which does business under the "MidAtlantic Ortho" tradename, does not develop and market its own innovative orthodontic products. MidAtlantic manufactures and sells orthodontic products based on the intellectual property of others.

2. MidAtlantic occasionally buys the right to use that intellectual property, for example when it licensed the U.S. Patent No. 8,992,214 ("the '214 Patent") from MEM Dental Technology Co., Ltd. ("MEM"), as acknowledged in Paragraph 14 of its Complaint. MidAtlantic also relies on intellectual property relegated to the public domain, including the designs in some of pioneering but now–expired patents issued to Ormco Corporation ("Ormco").

3. The intellectual property embodied in MidAtlantic's FIT.20 orthodontic bracket system, however, is neither licensed nor in the public domain. MidAtlantic recognized the commercial success of Ormco's innovative Damon Q and Damon 3MX orthodontic brackets and began to manufacture and market its knock–off FIT.20 system without any regard for Ormco's intellectual property rights.

4. Ormco asks this Court to stop MidAtlantic from selling the infringing FIT.20 orthodontic bracket system and order MidAtlantic to pay damages to Ormco for the unauthorized use of its intellectual property.

The Parties

5. Ormco is a corporation organized under the laws of the State of Delaware with its principal place of business in Orange, California. With hundreds of issued patents and pending patent applications, Ormco has been a leading innovator of orthodontic products for more than 50 years. In 2016, Ormco and its commonly owned sister companies sold more than $2.7 billion in dental products, about 15% of global market share.

6. Upon information and belief, MidAtlantic is a corporation organized under the laws of the State of New Jersey with its principal place of business in West Berlin, New Jersey.

Jurisdiction and Venue

7. This Court has original jurisdiction over these Counterclaims under at least 28 U.S.C. § 1338(a) because they arise under acts of Congress relating to patents, including as codified at 35 U.S.C. § 271.

8. This Court has personal jurisdiction over MidAtlantic because, upon information and belief, MidAtlantic is organized under the laws of the State of New Jersey and is headquartered in New Jersey. MidAtlantic has consented to this Court's exercise of personal jurisdiction over it by initiating this action against Ormco here.

9. Venue in this judicial district is proper under 28 U.S.C. § 1400(b) because MidAtlantic resides, has a regular and established place of business, and has committed acts of infringement within this judicial district. MidAtlantic has consented to venue in this judicial district by initiating this action against Ormco here.

COUNTERCLAIM COUNT I
Infringement of U.S. Patent No. 7,267,545

10. Ormco repeats the allegations in Paragraphs 1–9 of these Counterclaims as through fully stated here.

11. The U.S. Patent and Trademark Office ("USPTO") duly and lawfully issued U.S. Patent No. 7,267,545 ("the '545 Patent") entitled "Self–Ligating Orthodontic Bracket" on September 11, 2007. A true and correct copy of the '545 Patent is attached hereto as Exhibit A.

12. The '545 Patent satisfies all of the conditions for patentability set forth in Title 35 of the United States Code, including Sections 101, 102, 103, and 112.

13. The '545 Patent has an effective filing date at least as early as January 11, 2005.

14. Ormco is the sole and exclusive owner of the '545 Patent and has the right to bring actions for infringement of the '545 Patent.

15. MidAtlantic has had actual notice of the ‘545 Patent since at least as early as June 22, 2017.

16. MidAtlantic, either directly or through its agents, makes the FIT.20 orthodontic bracket system and causes it to be imported into the United States.

17. MidAtlantic offers to sell, and has in fact sold, the FIT.20 orthodontic bracket system within the United States.

18. The FIT.20 orthodontic bracket system made, marketed, and sold by MidAtlantic infringes at least independent Claims 1 and 20 of the ‘545 Patent.

19. At least the U1, U4, U5, L4, and L5 brackets of the FIT.20 orthodontic bracket system include a bracket body having a translation plane acutely angled with respect to a base plane and a ligating slide that moves away from the tooth when opened, as recited in Claim 1 of the ‘545 Patent.

20. All of the brackets of the FIT.20 orthodontic bracket system include a bracket body with a closed–ended receiving portion and a ligating slide with a projecting portion that moves within the receiving portion, as recited in Claim 20 of the ‘545 Patent.

21. Ormco has suffered and continues to suffer damages resulting from MidAtlantic’s infringement of the ‘545 Patent. While no amount of money can fully compensate Ormco, Ormco is entitled to recover the greater of its lost profits or a reasonable royalty.

22. MidAtlantic’s infringement of the ‘545 Patent has been knowing and willful, entitling Ormco to treble damages under 35 U.S.C. § 284.

23. MidAtlantic’s calculated decision to knock–off Ormco’s commercially successful and patented self–ligating orthodontic brackets makes this an exceptional case, entitling Ormco to recover its attorneys’ fees under 35 U.S.C. § 285.

24. Ormco has no adequate remedy at law. MidAtlantic's ongoing infringement of the '545 Patent can only be remedied by entry of a permanent injunction.

COUNTERCLAIM COUNT II
Infringement of U.S. Patent No. 9,867,680

25. Ormco repeats the allegations in Paragraphs 1–24 of these Counterclaims as through fully stated here.

26. The USPTO duly and lawfully issued U.S. Patent No. 9,867,680 ("the '680 Patent") entitled "Orthodontic Bracket" on January 16, 2018. A true and correct copy of the '680 Patent is attached hereto as Exhibit B.

27. The '680 Patent satisfies all of the conditions for patentability set forth in Title 35 of the United States Code, including Sections 101, 102, 103, and 112.

28. The '680 Patent has an effective filing date at least as early as April 19, 2006.

29. Ormco is the sole and exclusive owner of the '680 Patent and has the right to bring actions for infringement of the '680 Patent.

30. The FIT.20 orthodontic bracket system made, marketed, and sold by MidAtlantic infringes at least independent Claim 1 of the '680 Patent.

31. All of the brackets of the FIT.20 orthodontic bracket system include a bracket body, a ligating slide, a resilient member, and a projection that cooperates with the resilient member to releasably restrain the ligating slide in the closed position, as recited in Claim 1 of the '545 Patent.

32. Ormco has suffered and continues to suffer damages resulting from MidAtlantic's infringement of the '680 Patent. While no amount of money can fully compensate Ormco, Ormco is entitled to recover the greater of its lost profits or a reasonable royalty.

33. MidAtlantic's infringement of the '680 Patent has been knowing and willful, entitling Ormco to treble damages under 35 U.S.C. § 284.

34. MidAtlantic's calculated decision to market a knock–off of Ormco's commercially successful and patented self–ligating orthodontic brackets makes this an exceptional case, entitling Ormco to recover its attorneys' fees under 35 U.S.C. § 285.

35. Ormco has no adequate remedy at law. MidAtlantic's ongoing infringement of the '680 Patent can only be remedied by entry of a permanent injunction.

PRAYER FOR RELIEF

WHEREFORE, Ormco requests entry of judgment in its favor and against MidAtlantic as follows:

A. Holding that the FIT.20 orthodontic bracket system made, marketed, and sold by MidAtlantic infringes the '545 Patent;

B. Holding that the FIT.20 orthodontic bracket system made, marketed, and sold by MidAtlantic infringes the '680 Patent;

C. Permanently enjoining MidAtlantic, its agents, and all those acting in concert with them from making, marketing, selling, and importing the FIT.20 orthodontic bracket system or any other orthodontic bracket that infringes the '545 and '680 Patents;

D. Awarding monetary damages to Ormco in an amount equal to the greater of its lost profits caused by MidAtlantic's infringement or a reasonable royalty for MidAtlantic's unauthorized use of Ormco's patented technologies;

E. Declaring MidAtlantic's infringement of the '545 and '680 Patents to be knowing and willful, and trebling the monetary damage award to Ormco pursuant to 35 U.S.C. § 284 accordingly;

F. Declaring this case to be exceptional and awarding Ormco its attorneys' fees pursuant to 35 U.S.C. § 285; and

G. Granting such other and further relief as the Court deems appropriate.

JURY DEMAND

Ormco hereby demands a trial by jury on all issues so triable.

Respectfully submitted,

Date: February 2, 2018

/s/ Tricia B. O'Reilly

WALSH PIZZI O'REILLY FALANGA LLP
Tricia B. O'Reilly, Esq.
toreilly@walsh.law
Katelyn O'Reilly, Esq.
koreilly@walsh.law
One Riverfront Plaza
1037 Raymond Boulevard, Suite 600
Newark, NJ 07102
Telephone: (973) 757-1100
Facsimile: (973) 757-1090

HUNTON & WILLIAMS LLP
Charles D. Ossola, Esq.
cossola@hunton.com
Matthew J. Ricciardi, Esq.
mricciardi@hunton.com
2200 Pennsylvania Avenue, NW
Washington, DC 20037
Telephone: (202) 955-1642
Facsimile: (202) 778-2201

Counsel for Defendant Ormco Corporation

RULE 11.2 CERTIFICATION

I certify that, to the best of my knowledge, the matter in controversy is not the subject of any other action pending in any court or of any pending arbitration or administrative proceeding.

Date: February 2, 2018

/s/ Tricia B. O'Reilly

WALSH PIZZI O'REILLY FALANGA LLP
Tricia B. O'Reilly, Esq.
toreilly@walsh.law
Katelyn O'Reilly, Esq.
koreilly@walsh.law
One Riverfront Plaza
1037 Raymond Boulevard, Suite 600
Newark, NJ 07102
Telephone: (973) 757-1100
Facsimile: (973) 757-1090

HUNTON & WILLIAMS LLP
Charles D. Ossola, Esq.
cossola@hunton.com
Matthew J. Ricciardi, Esq.
mricciardi@hunton.com
2200 Pennsylvania Avenue, NW
Washington, DC 20037
Telephone: (202) 955-1642
Facsimile: (202) 778-2201

Counsel for Defendant Ormco Corporation

RULE 201.1 CERTIFICATION

I certify that the above–captioned matter is not subject to compulsory arbitration because Defendant seeks, *inter alia*, injunctive relief.

Date: February 2, 2018

/s/ Tricia B. O'Reilly

WALSH PIZZI O'REILLY FALANGA LLP
Tricia B. O'Reilly, Esq.
toreilly@walsh.law
Katelyn O'Reilly, Esq.
koreilly@walsh.law
One Riverfront Plaza
1037 Raymond Boulevard, Suite 600
Newark, NJ 07102
Telephone: (973) 757-1100
Facsimile: (973) 757-1090

HUNTON & WILLIAMS LLP
Charles D. Ossola, Esq.
cossola@hunton.com
Matthew J. Ricciardi, Esq.
mricciardi@hunton.com
2200 Pennsylvania Avenue, NW
Washington, DC 20037
Telephone: (202) 955-1642
Facsimile: (202) 778-2201

Counsel for Defendant Ormco Corporation

EXHIBIT A

US007267545B2

(12) **United States Patent**
Oda

(10) **Patent No.: US 7,267,545 B2**
(45) **Date of Patent: Sep. 11, 2007**

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

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

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 134 days.

(21) Appl. No.: **11/032,977**

(22) Filed: **Jan. 11, 2005**

(65) **Prior Publication Data**

US 2006/0154196 A1 Jul. 13, 2006

(51) **Int. Cl.**
A61C 3/00 (2006.01)

(52) **U.S. Cl.** **433/10**

(58) **Field of Classification Search** 433/10–14, 433/17

See application file for complete search history.

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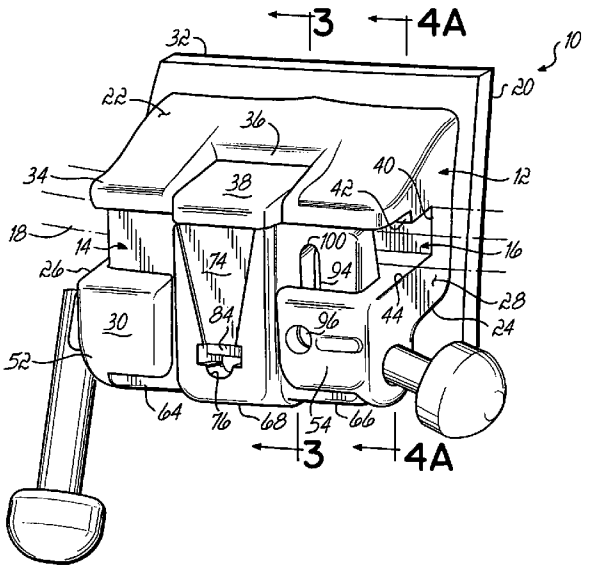
Primary Examiner—Cary E. O'Connor
(74) *Attorney, Agent, or Firm*—Wood, Herron & Evans, L.L.P.

(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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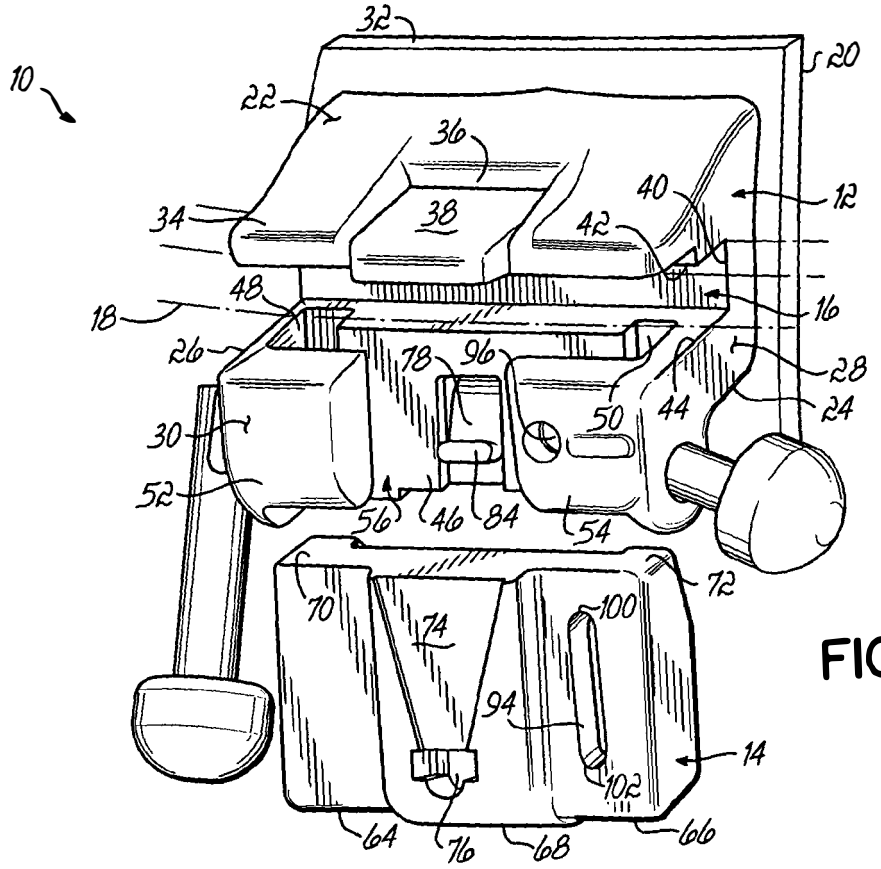
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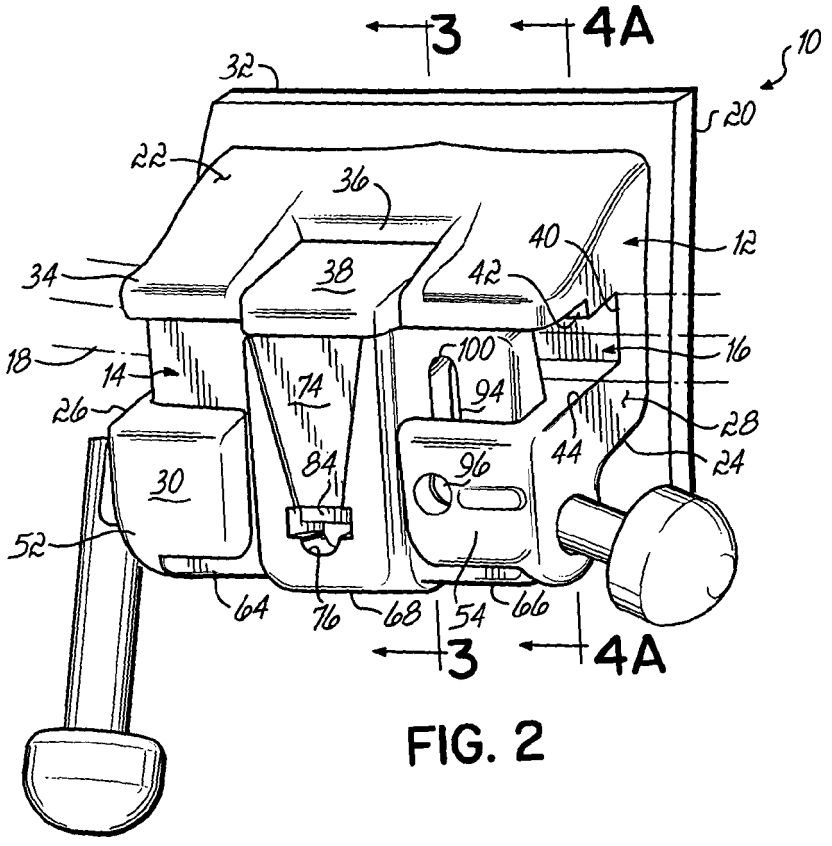
FIG. 1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4A

FIG. 2

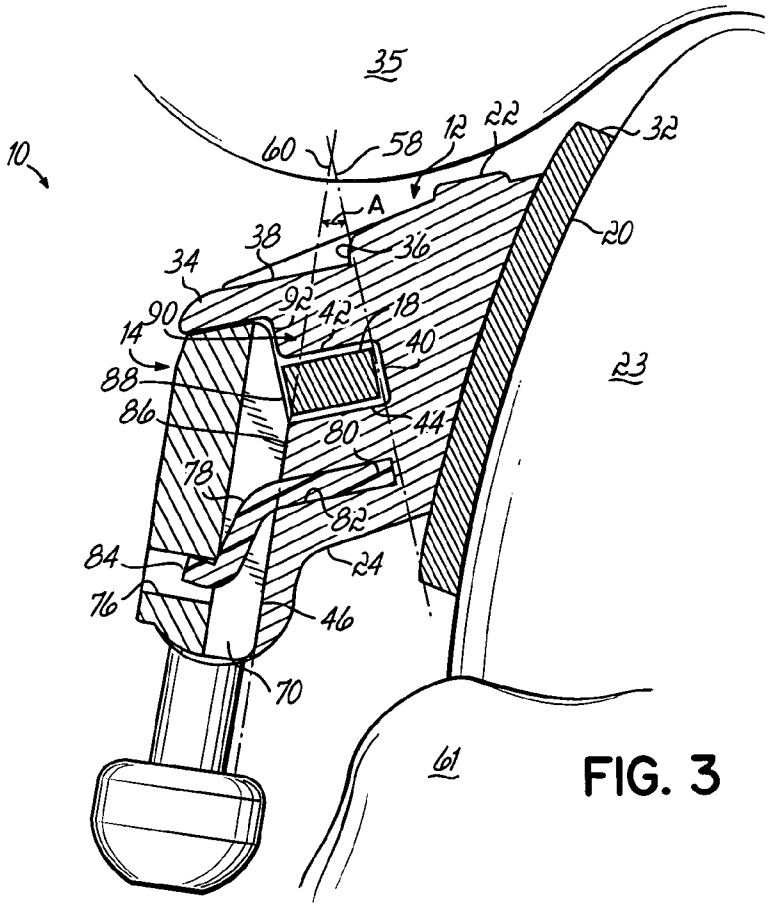

35
10
60
58
12
22
32
A
38
36
20
34
92
42
18
90
14
40
88
23
86
80
44
78
82
84
24
76
46
70
61

FIG. 3

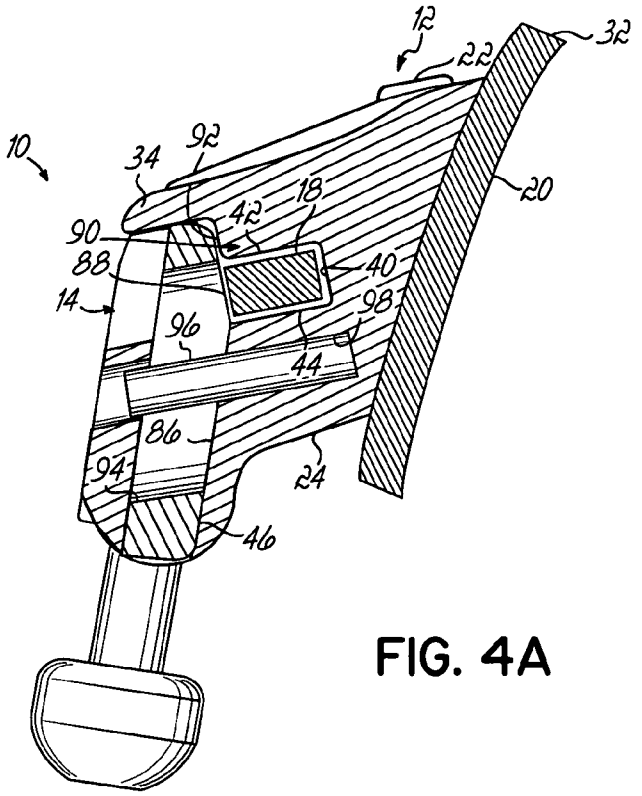

12
22
32
10
34
92
20
18
42
90
40
88
14
98
96
44
86
94
24
46

FIG. 4A

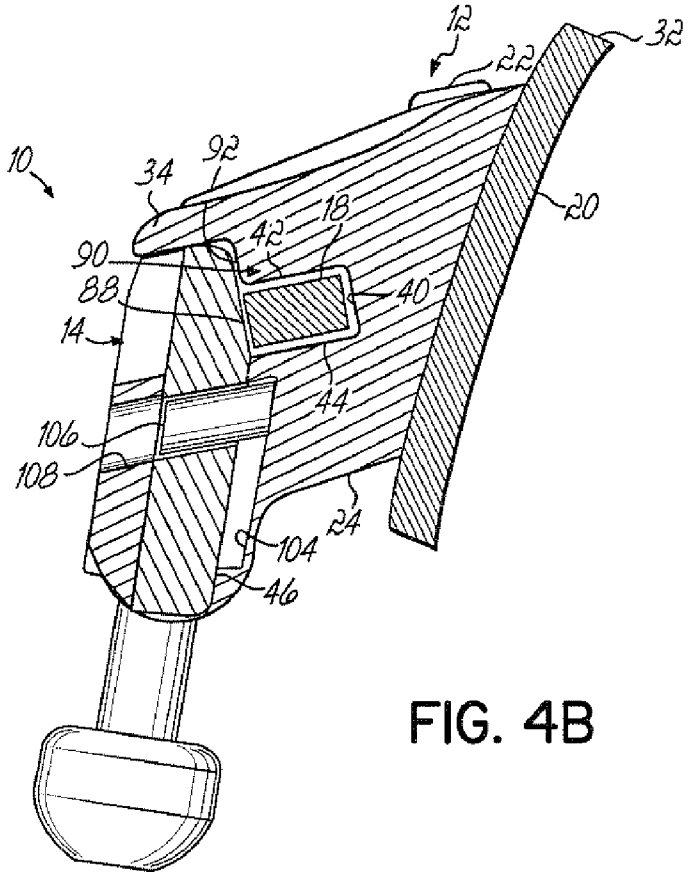

12
32
22
10
34
92
20
18
42
90
40
88
14
44
106
108
24
104
46

FIG. 4B

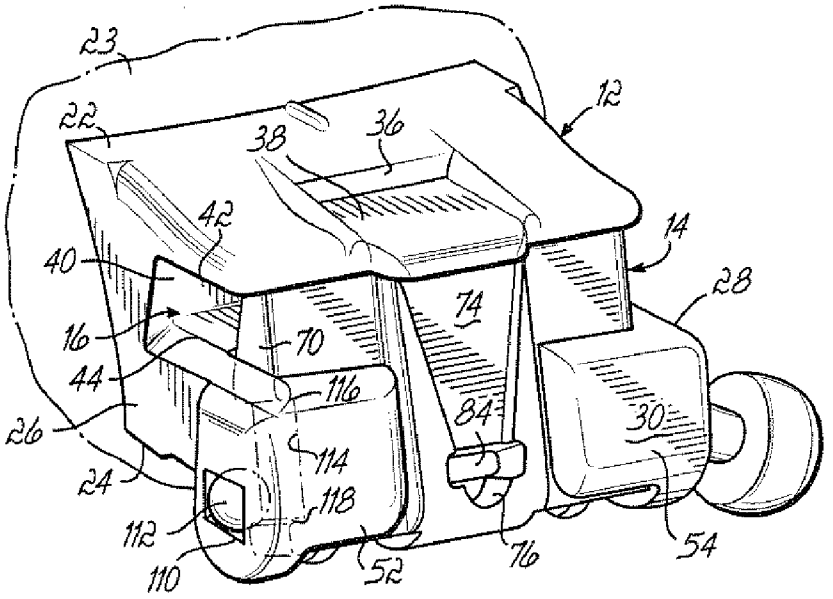

23
12
22
38
36
42
14
40
28
74
16
70
44
116
84
30
26
114
24
118
112
110
52
76
54

FIG. 5A

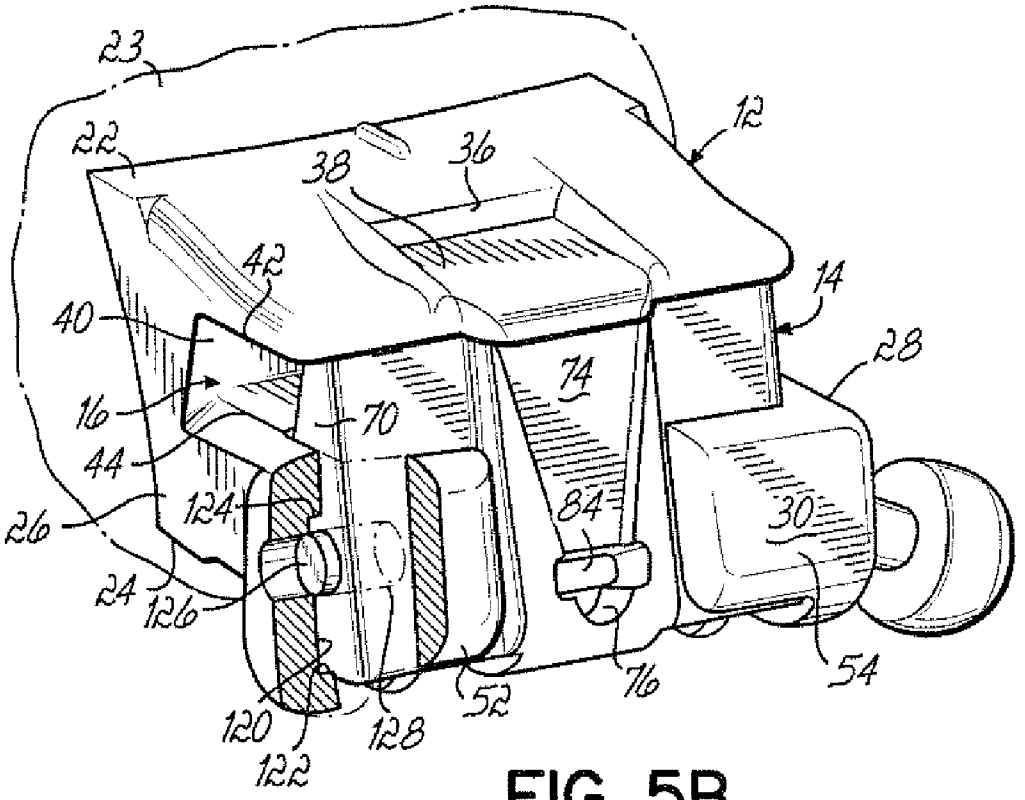

23
22
12
38
36
42
40
14
28
74
16
70
44
84
30
26
124
24
126
54
76
52
120
128
122

FIG. 5B

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

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

FIG. **5**A 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. **5**B is a broken away perspective view of an alternate embodiment of the self-ligating orthodontic bracket similar to FIG. **5**A 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-gingival direction from slot surface **44**. Support surface **46** may include a pair of slide grooves **48**, **50** extending in the occlusal-gingival 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-gingival 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-gingival 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-gingival 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**, **4**A and **4**B, 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 of the receiving portion. The projecting portion and receiving portion cooperate to regulate the movement of ligating slide **14**. For example, as shown in FIG. **4**A, ligating slide **14** includes a retaining slot **94** (FIG. **1**) through ligating slide **14** and extending generally in the occlusal-gingival 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-gingival direction.

Additionally, the length of retaining slot **94** limits the occlusal-gingival 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. **4**B, in which like reference numerals refer to like features in FIG. **4**A. 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-gingival 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. **4**B functions in substantially the same manner as the retaining pin/slot configuration shown and described above for FIG. **4**A.

In FIGS. **5**A and **5**B, in which like reference numerals refer to like features in FIGS. **1**-**4**A, 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. **5**A, 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-gingival 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 ligation 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. **4**A. For instance, the length of retaining groove **114** limits the occlusal-gingival 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. **5**A 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. **5**B, 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. **5**B functions in substantially the same manner as the retaining ball/groove configuration shown and described above for FIG. **5**A.

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. **4**B, **5**A and **5**B 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

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 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

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

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 movable portion covering a substantial portion of said archwire slot when in the closed position, wherein movement of said movable portion toward the closed position moves said movable portion toward the tooth and movement of said movable portion toward the opened position moves said movable 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 movable 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

PATENT NO. : 7,267,545 B2
APPLICATION NO. : 11/032977
DATED : September 11, 2007
INVENTOR(S) : Todd I. Oda

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--.

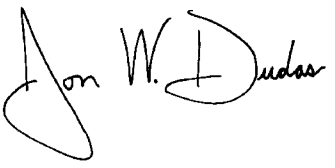
(Claim 4), line 64, delete "a".

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

EXHIBIT B

US009867680B2

(12) **United States Patent**
Damon

(10) **Patent No.: US 9,867,680 B2**
(45) **Date of Patent: *Jan. 16, 2018**

(54) **ORTHODONTIC BRACKET**

(71) Applicant: **Ormco Corporation**, Orange, CA (US)

(72) Inventor: **Dwight H. Damon**, Spokane, WA (US)

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

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **14/969,881**

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(51) **Int. Cl.**
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A61C 7/28 (2006.01)

(52) **U.S. Cl.**
CPC ***A61C 7/287*** (2013.01)

(58) **Field of Classification Search**
CPC A61C 7/287; A61C 7/12; A61C 7/14
See application file for complete search history.

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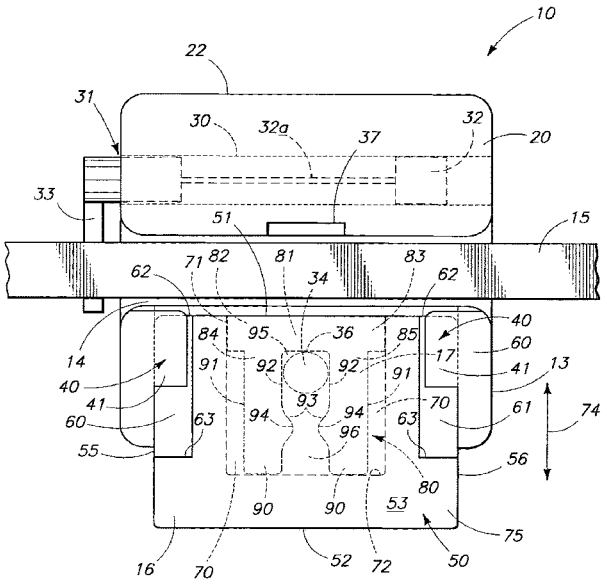
Primary Examiner — Heidi M Eide
(74) *Attorney, Agent, or Firm* — Wood Herron & Evans LLP

(57) **ABSTRACT**

An orthodontic bracket is described and which includes a base member defining an archwire slot having an opening, and at least one projection extending outwardly from the base member; a ligating slide moveable between a first position which is clear of the archwire slot, and second position where the ligating slide projects over the opening of the archwire slot; and a biasing member borne by the ligating slide, and resiliently cooperating with the projection, and wherein the biasing member has a first portion which receives the projection when the ligating slide is in the first position, and a second portion which receives the projection when the ligating slide is in the second position.

13 Claims, 24 Drawing Sheets



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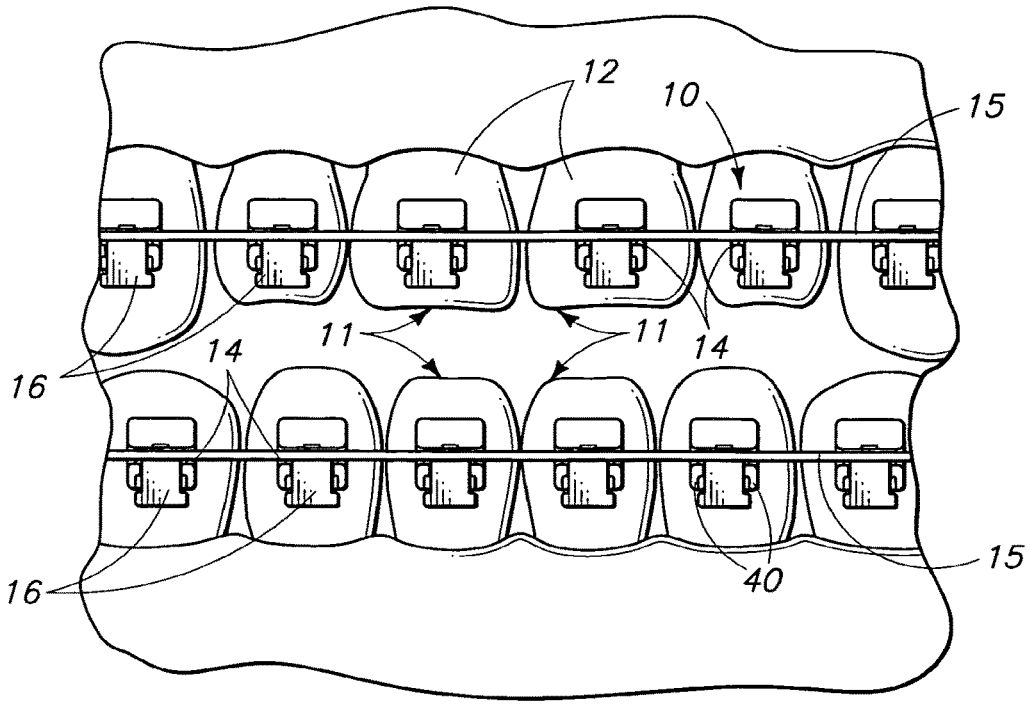
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Fig 1

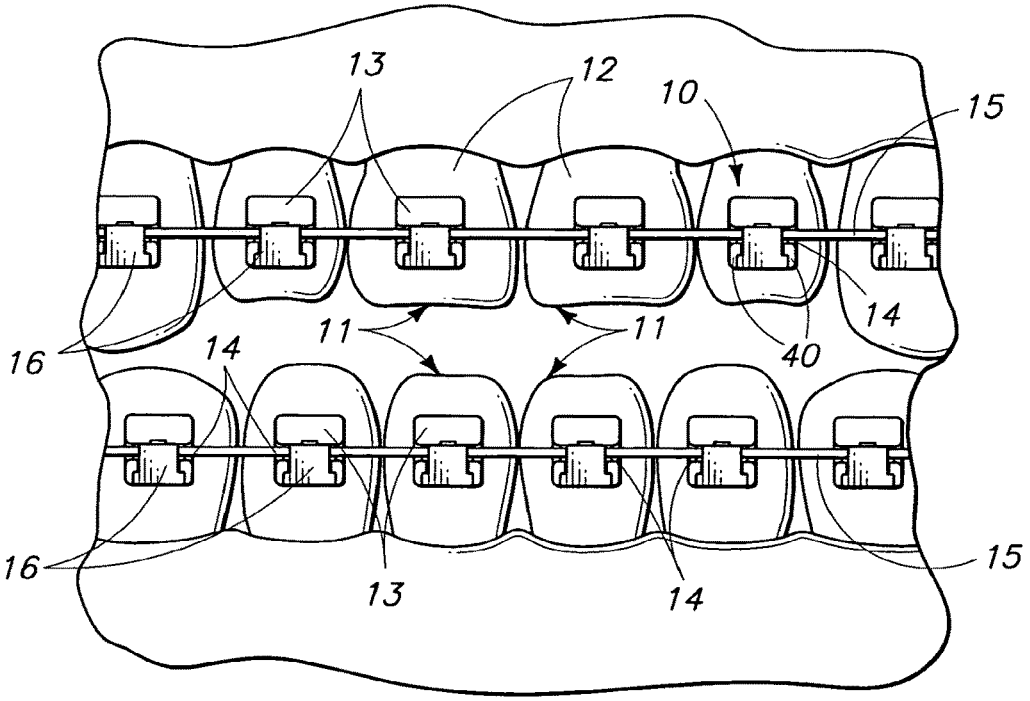
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Fig 2

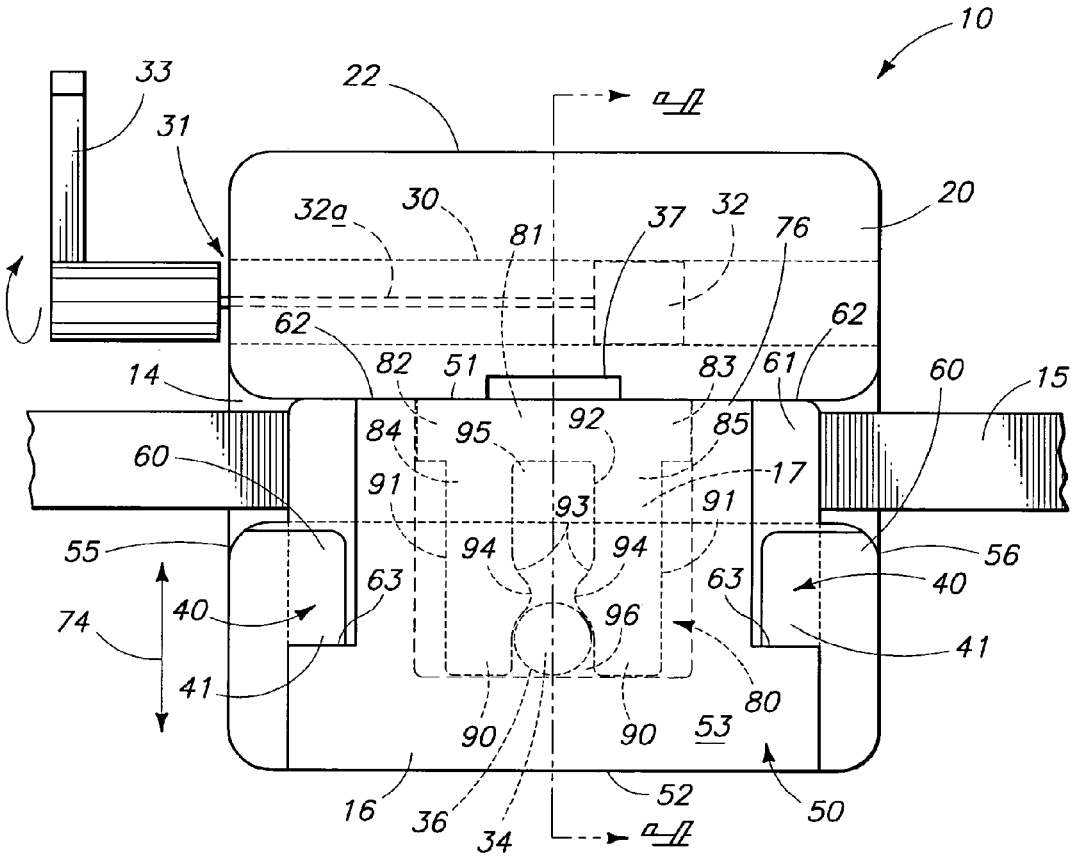
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FIG. 3

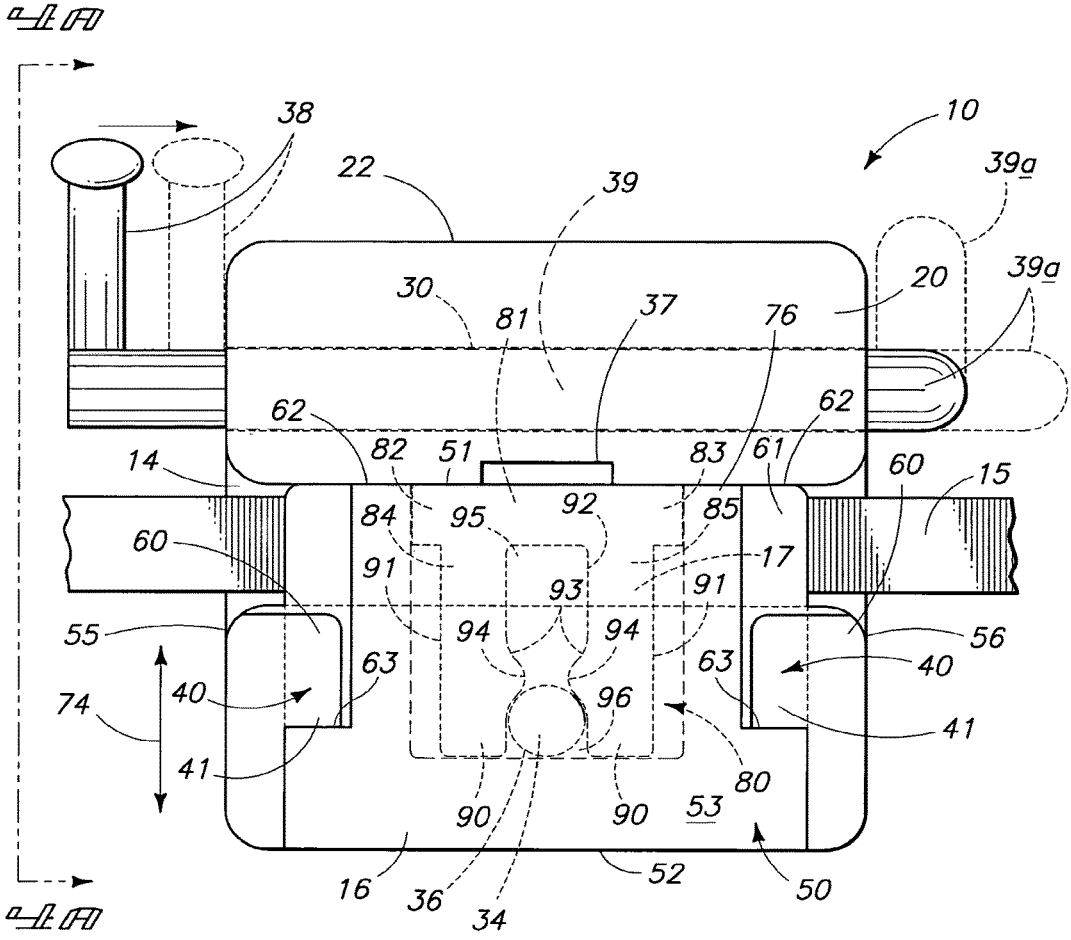
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Fig 3A

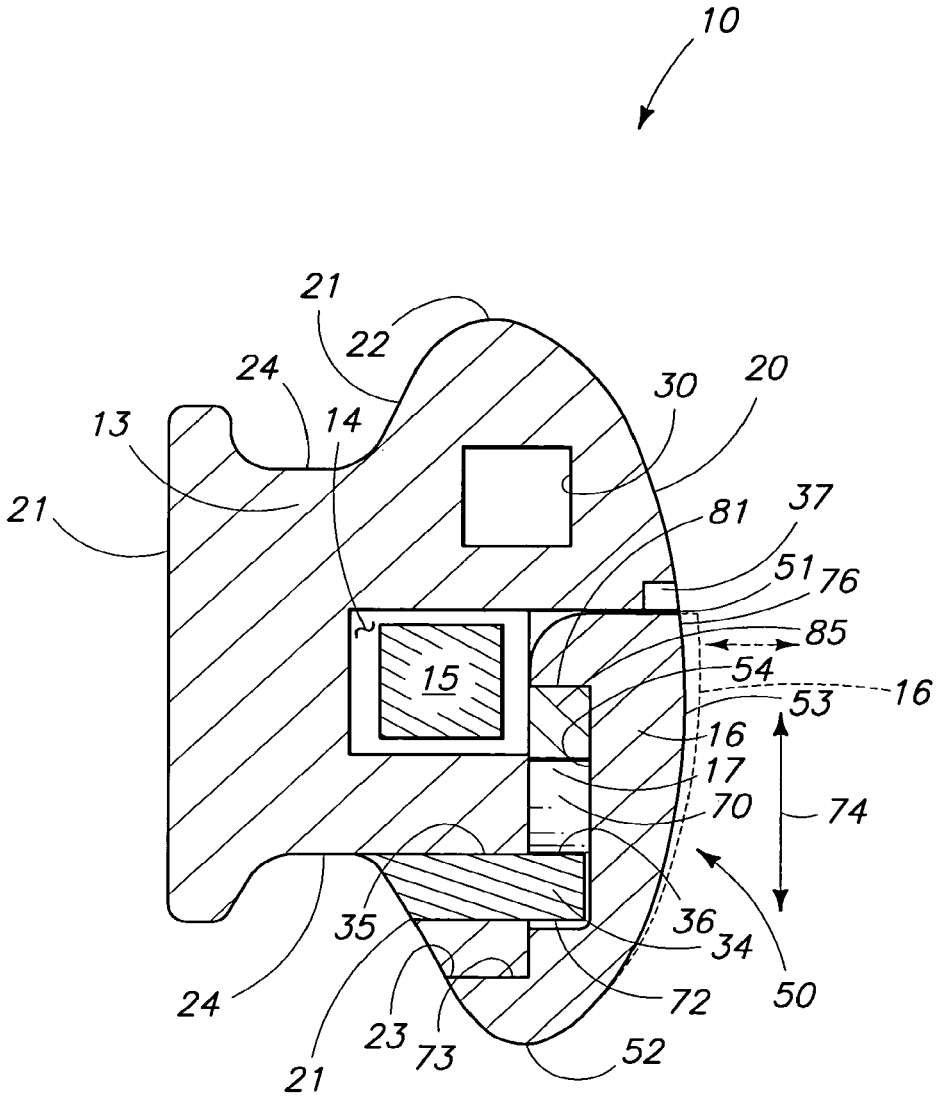
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Fig. 4

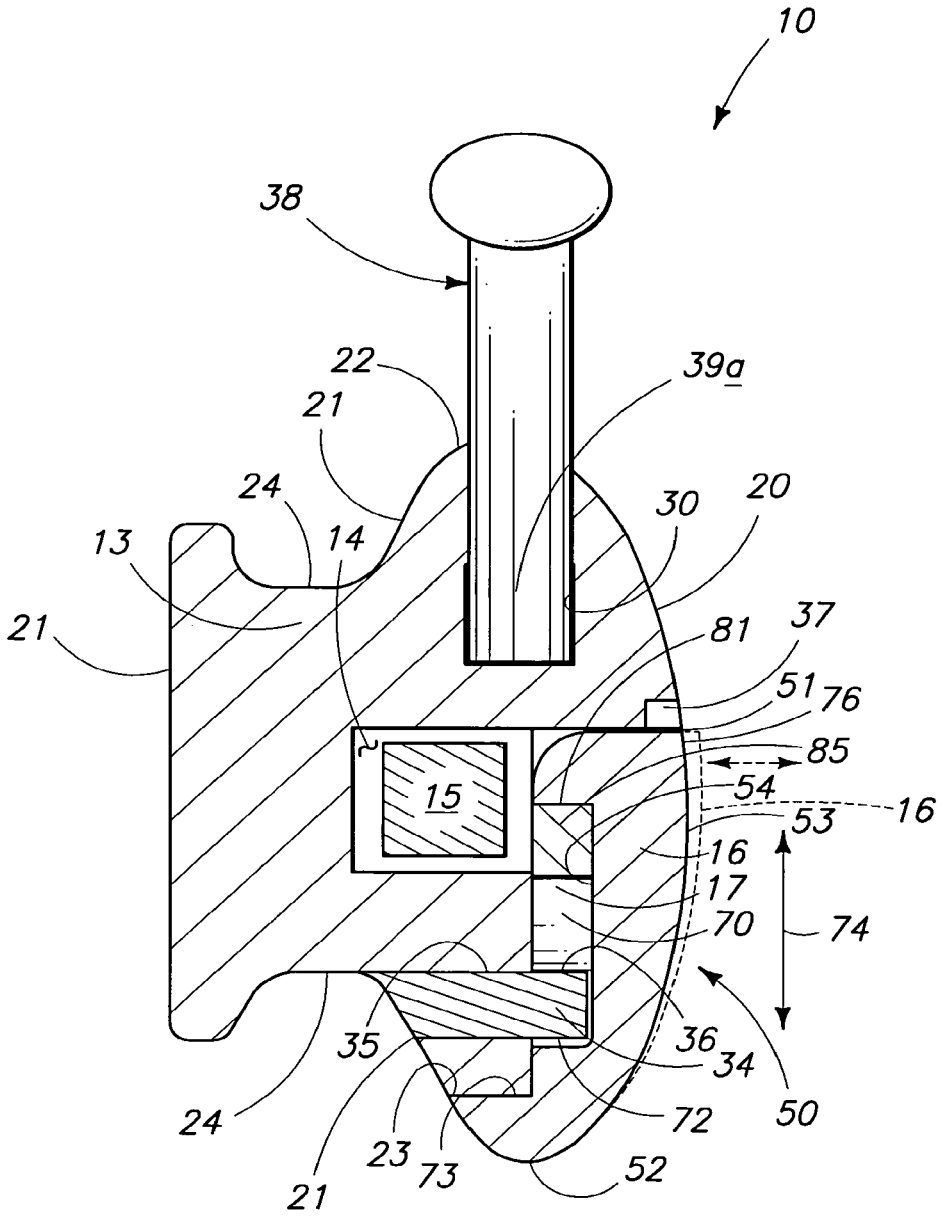
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Fig 4A

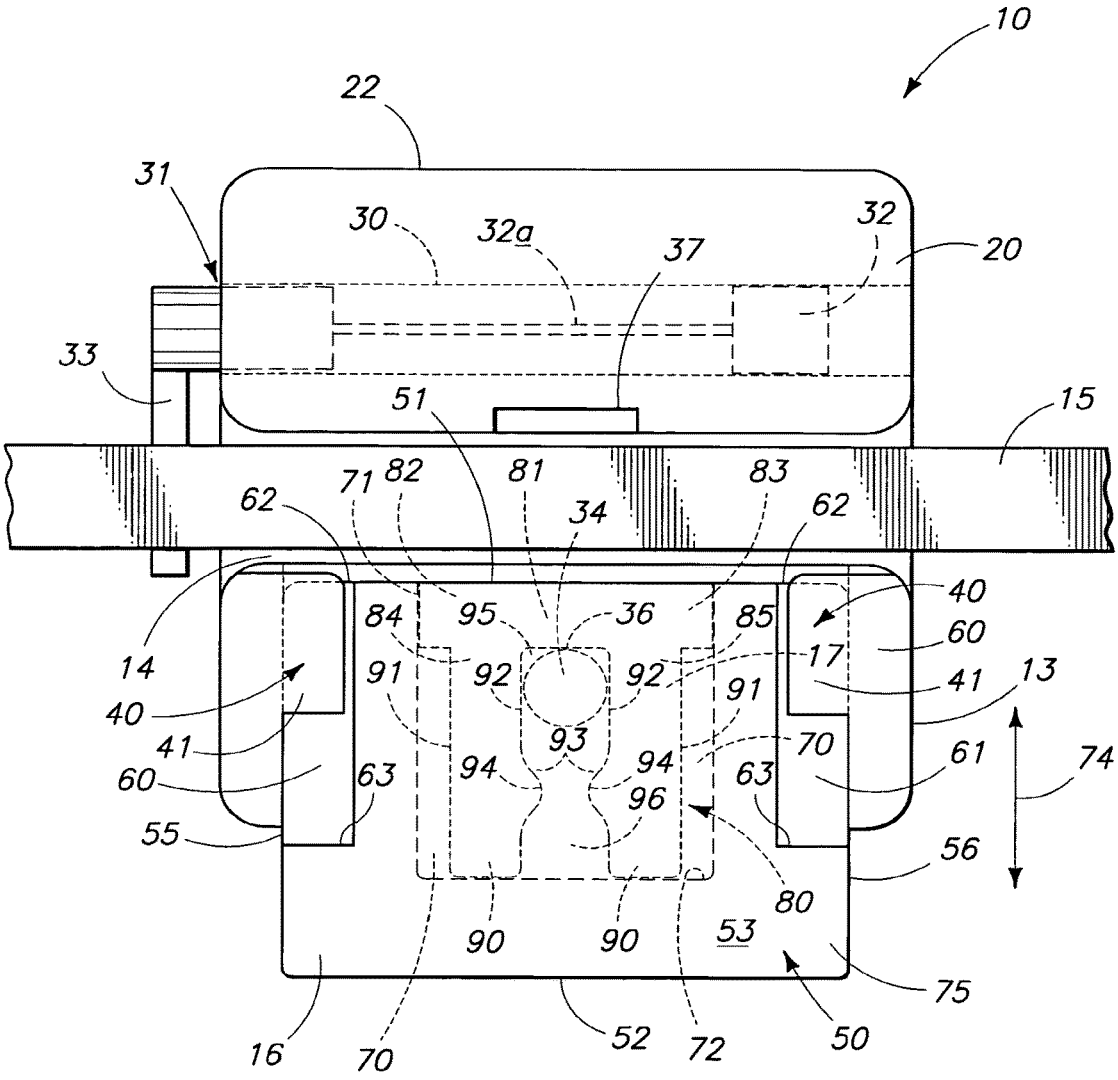
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Fig 5

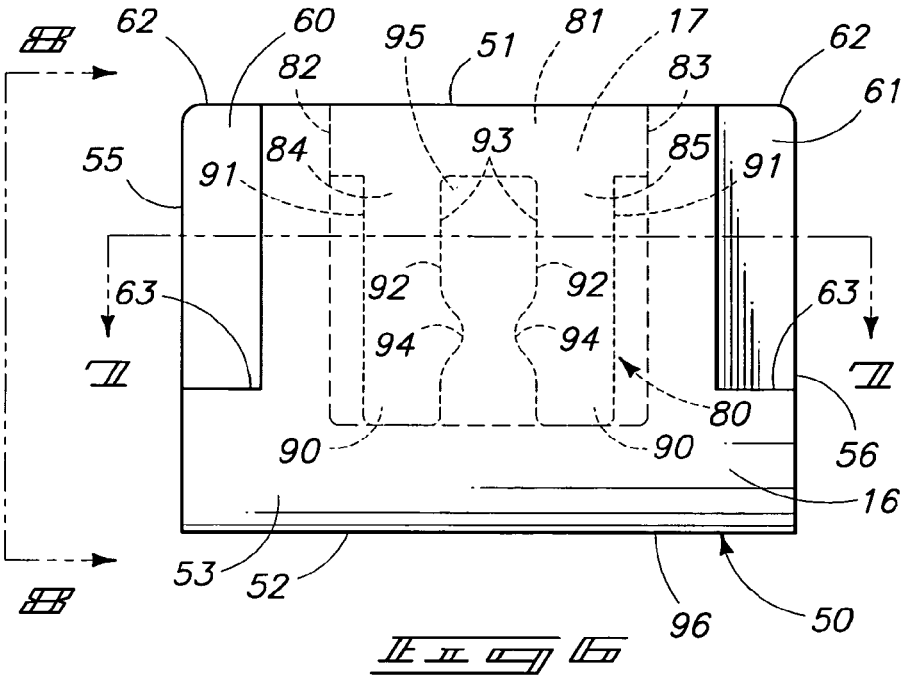
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FIG. 6

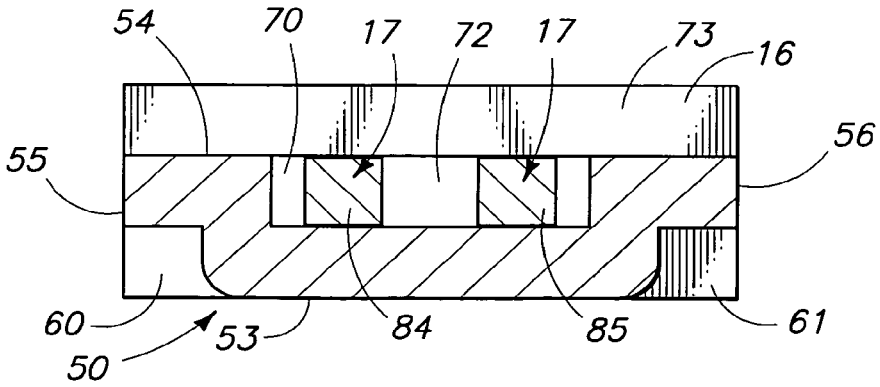
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FIG. 7

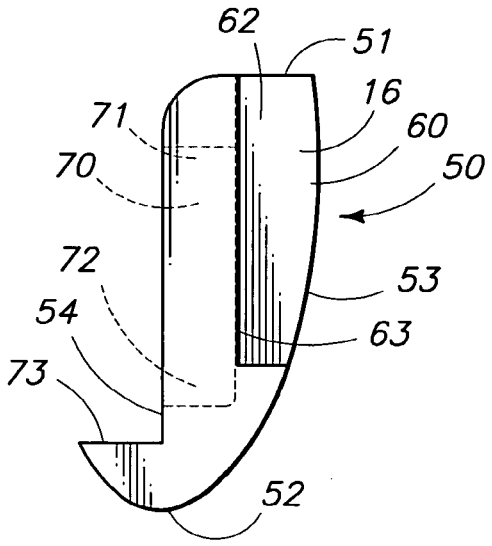
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Fig 8

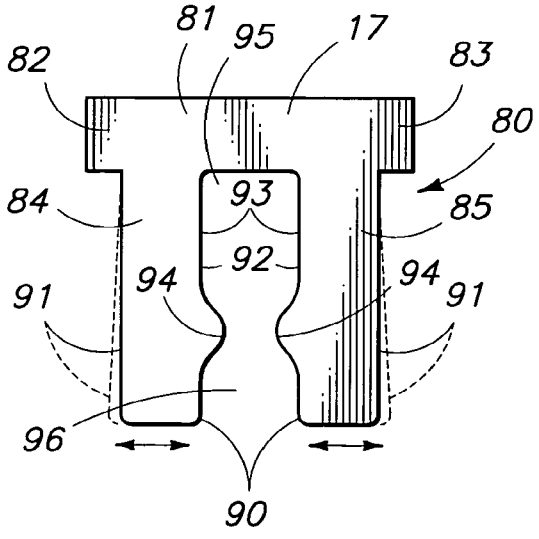
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Fig 9

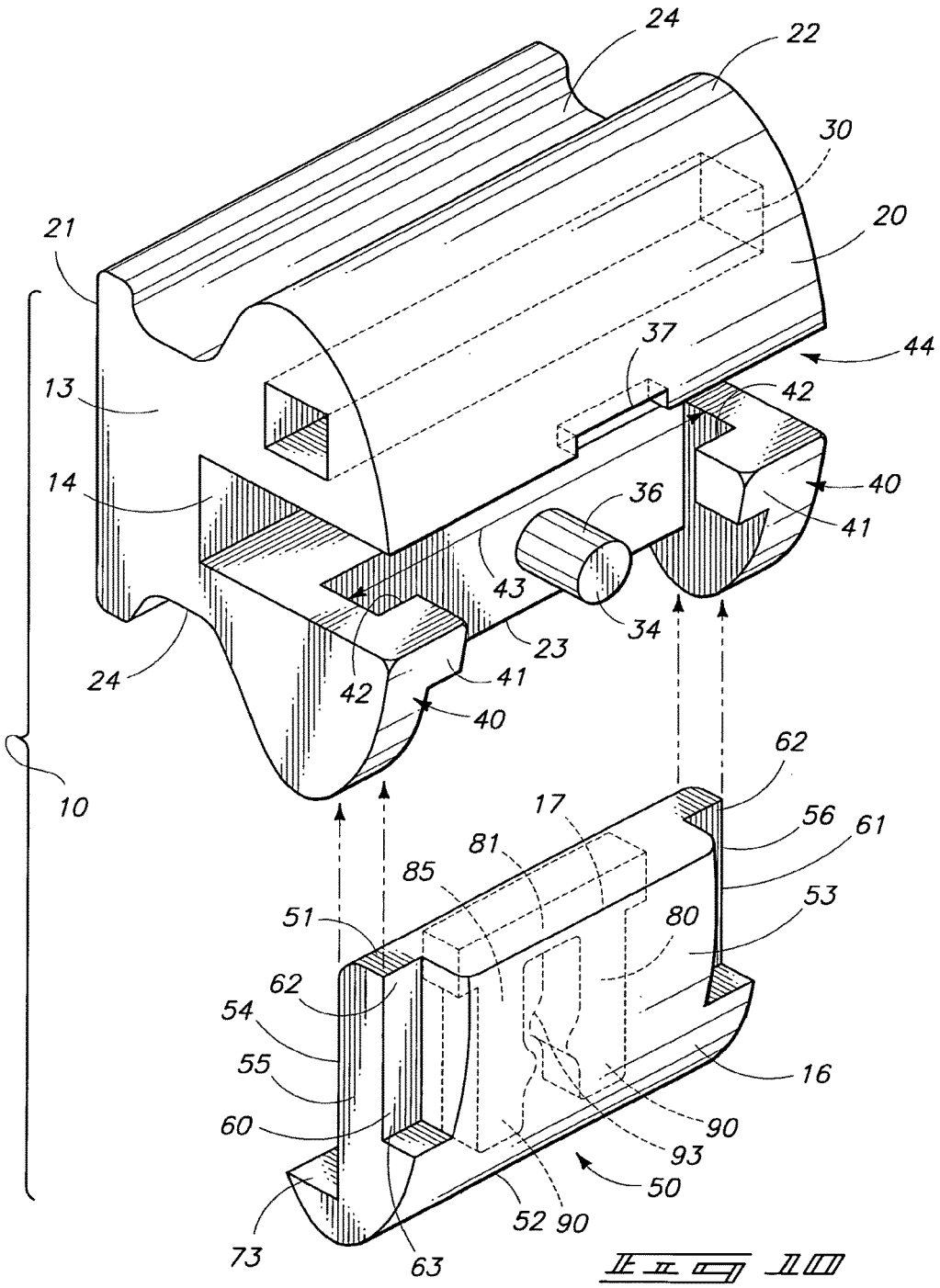
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Fig 10

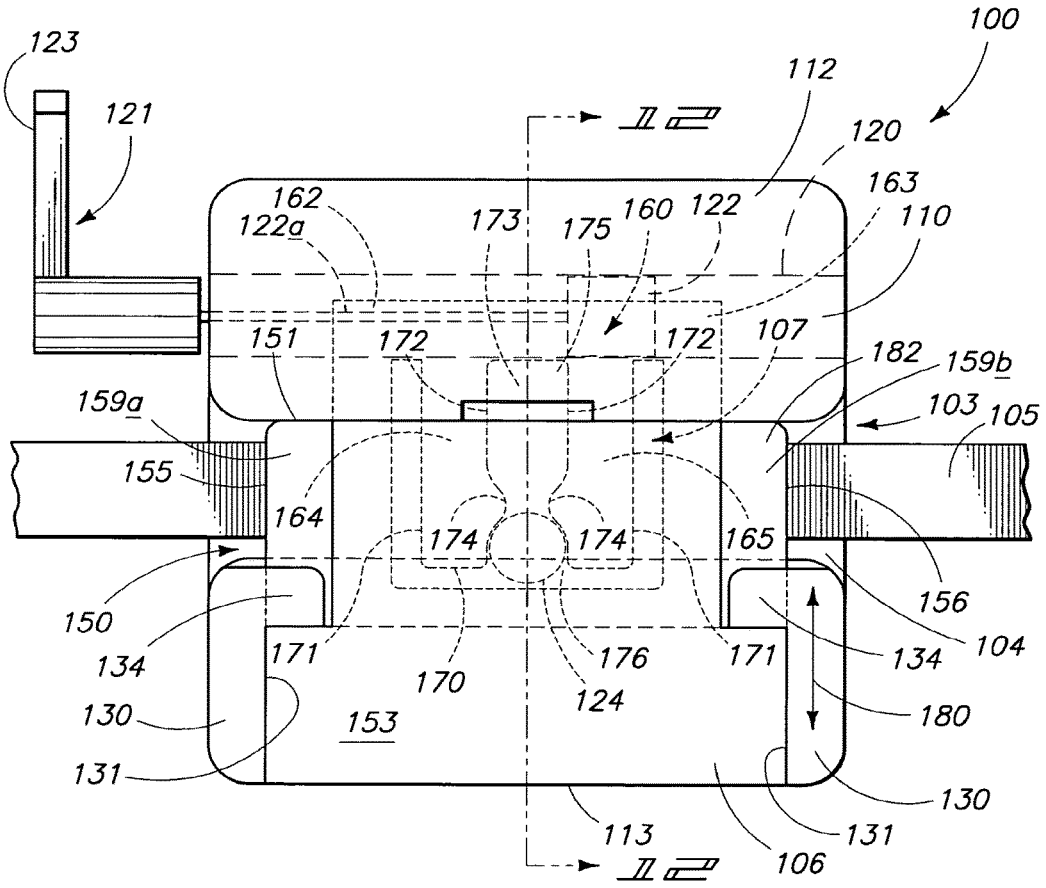
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Fig. 11

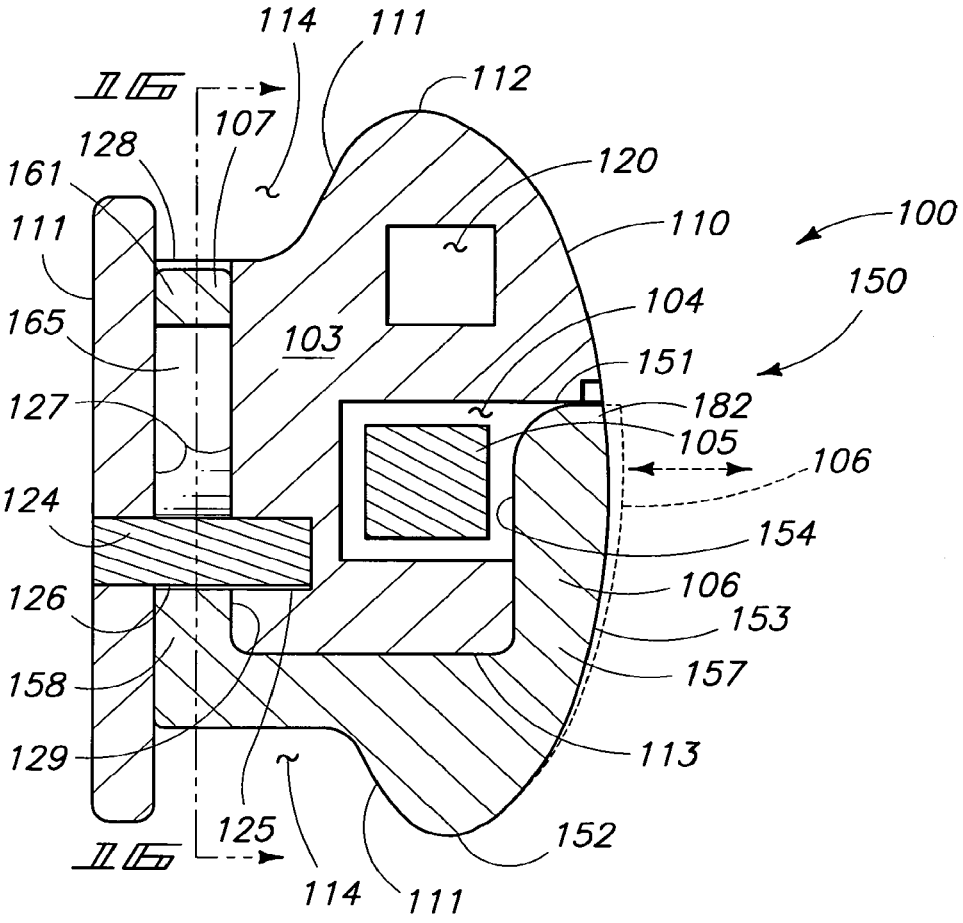
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Fig. 12

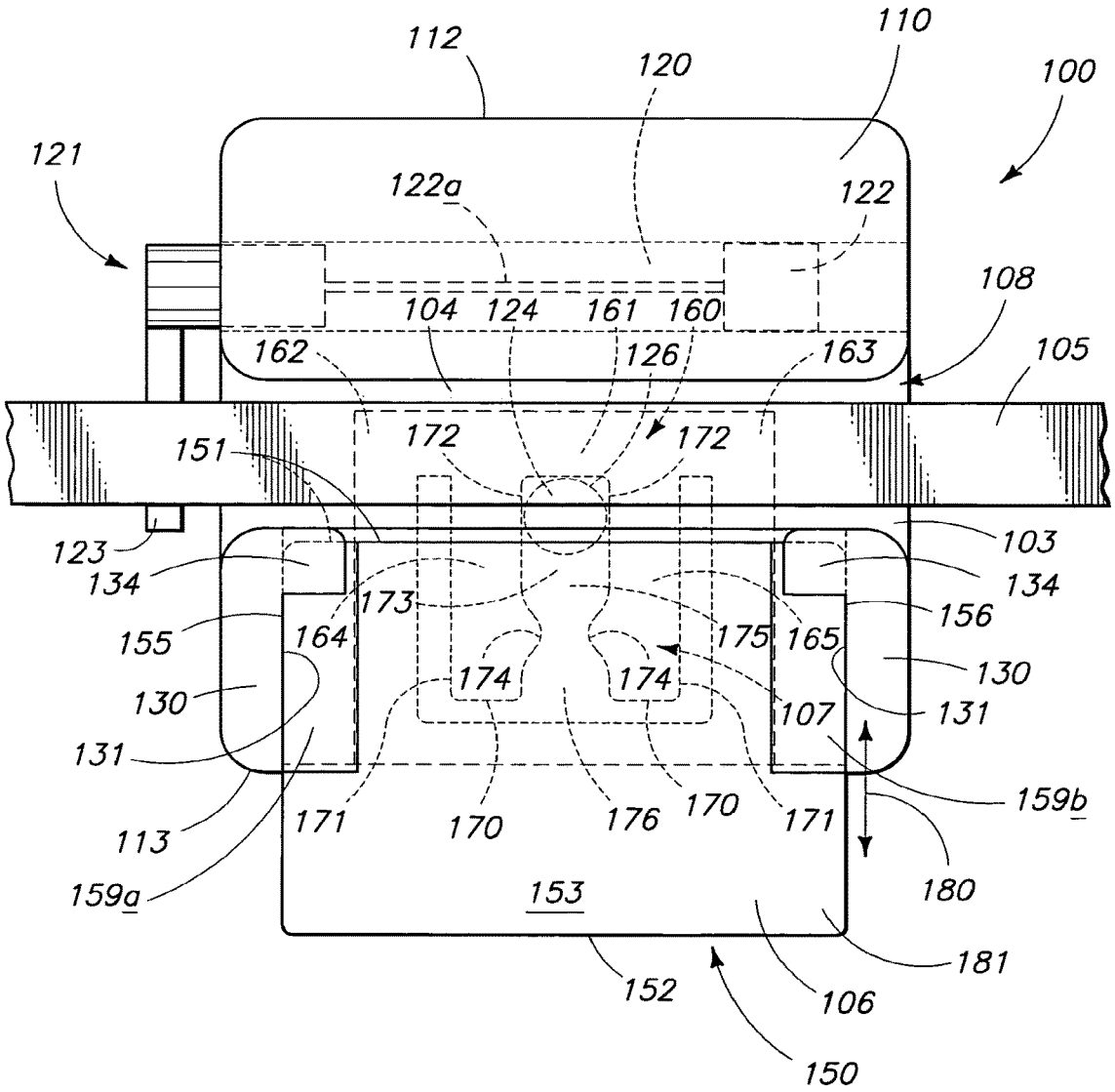
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Fig. 13

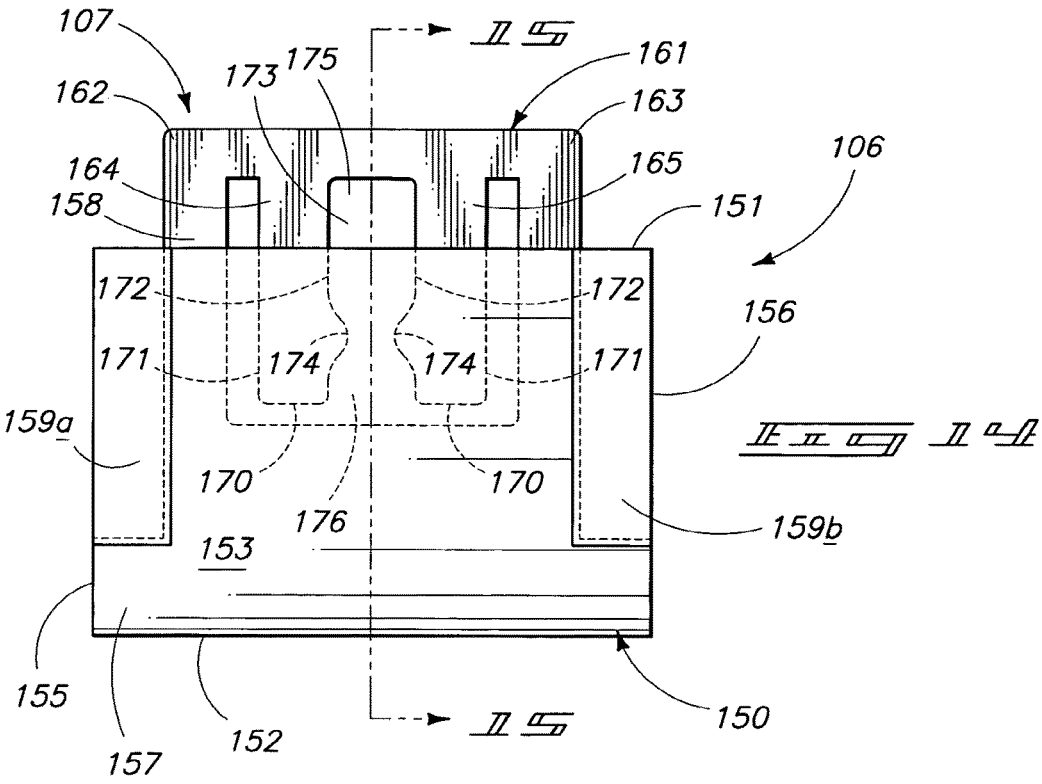
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Fig. 14

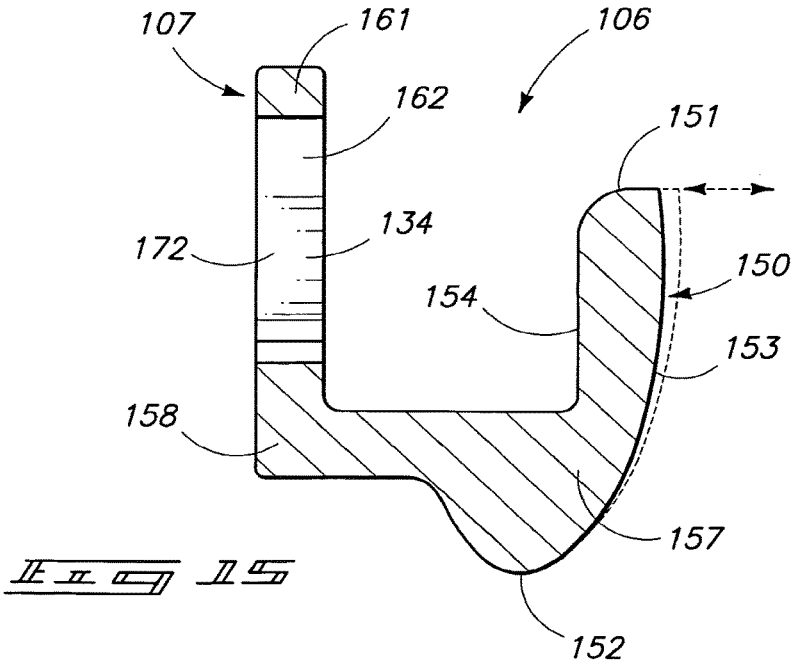
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Fig. 15

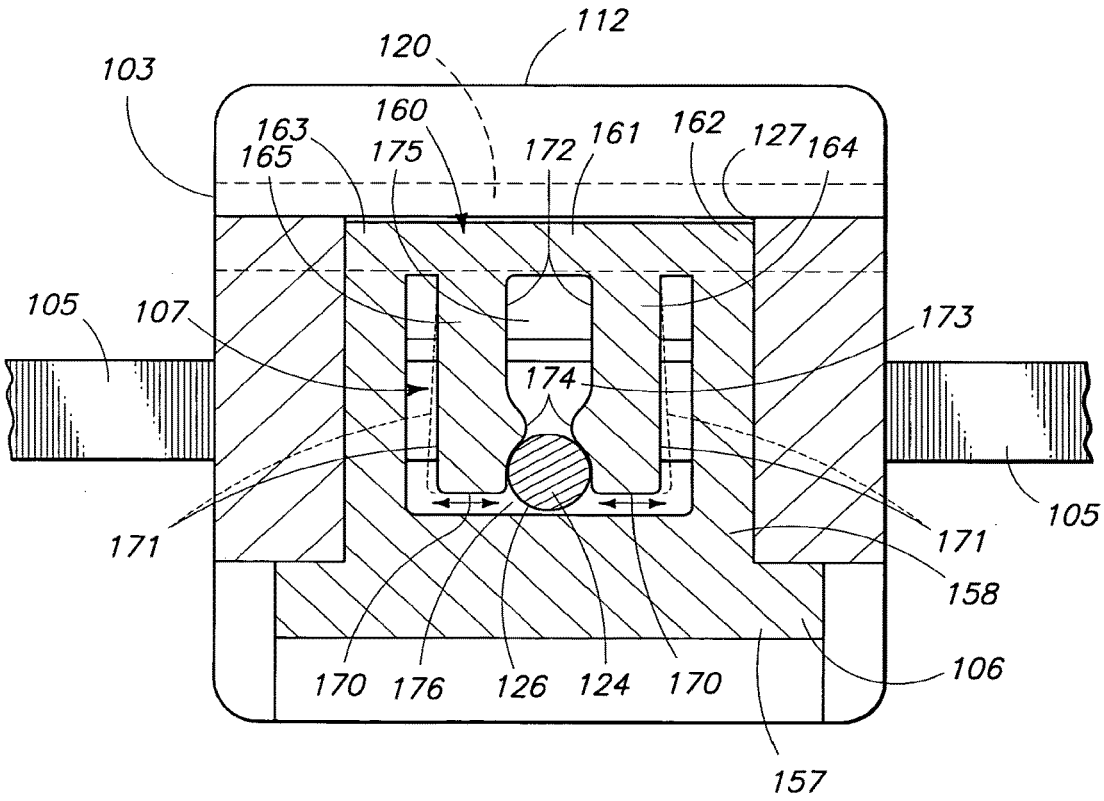
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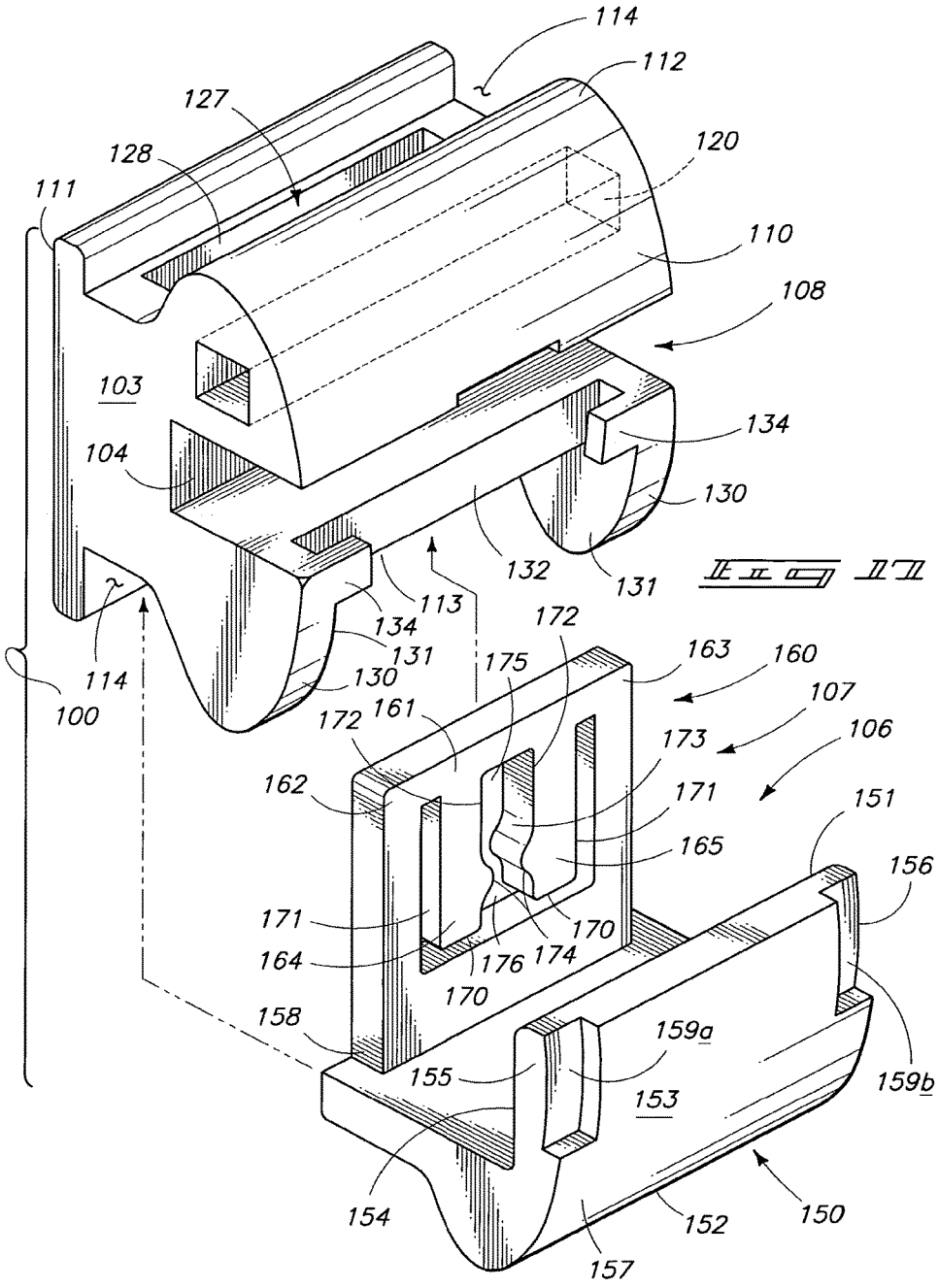
Fig 16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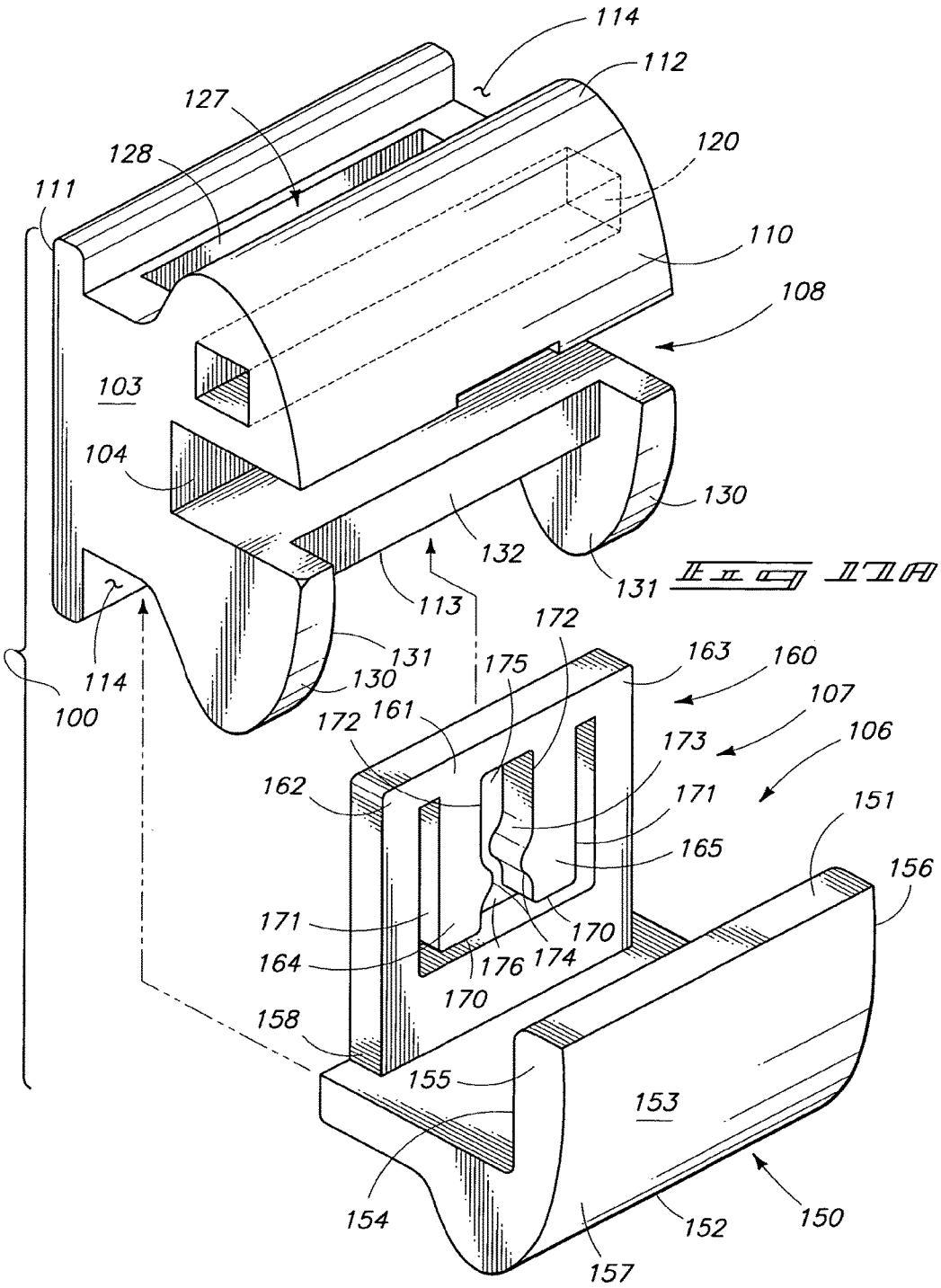
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Fig 11A

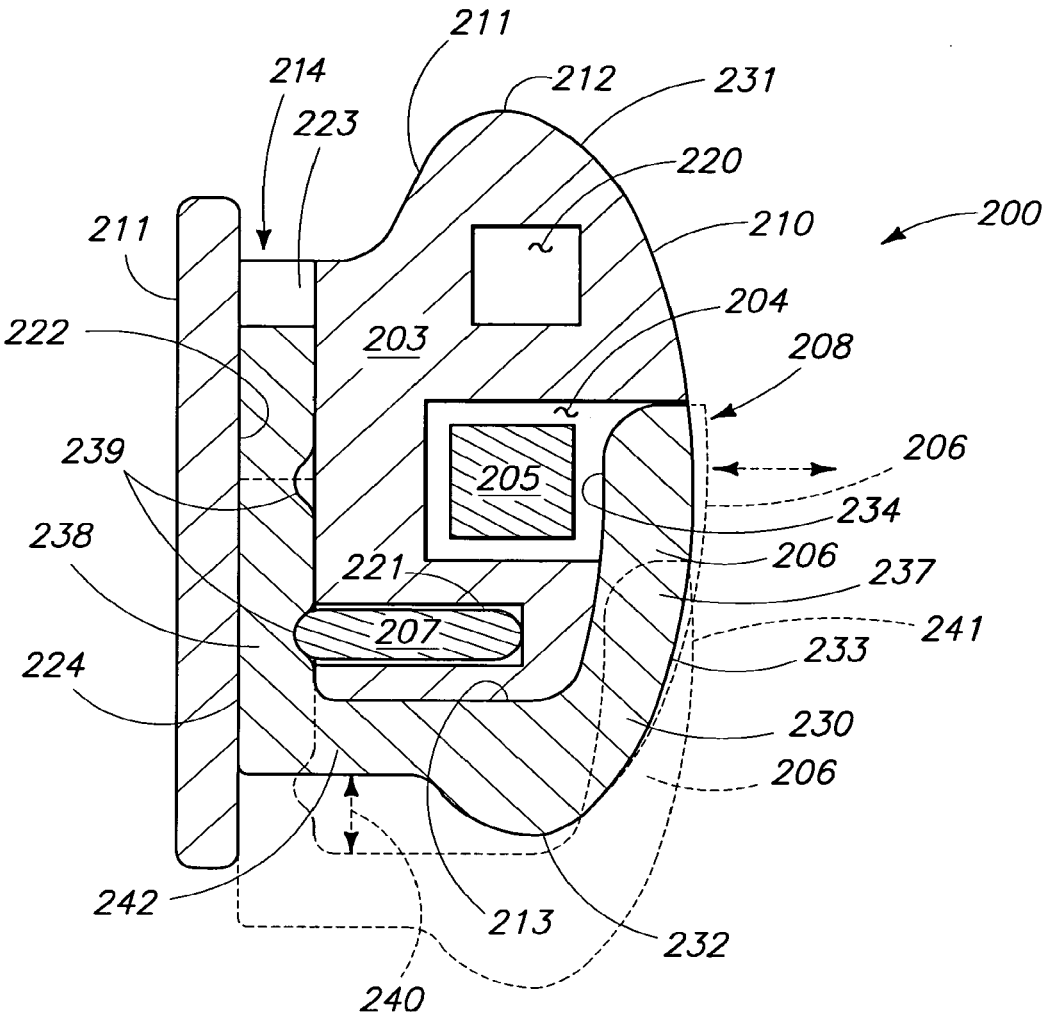
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Fig 18

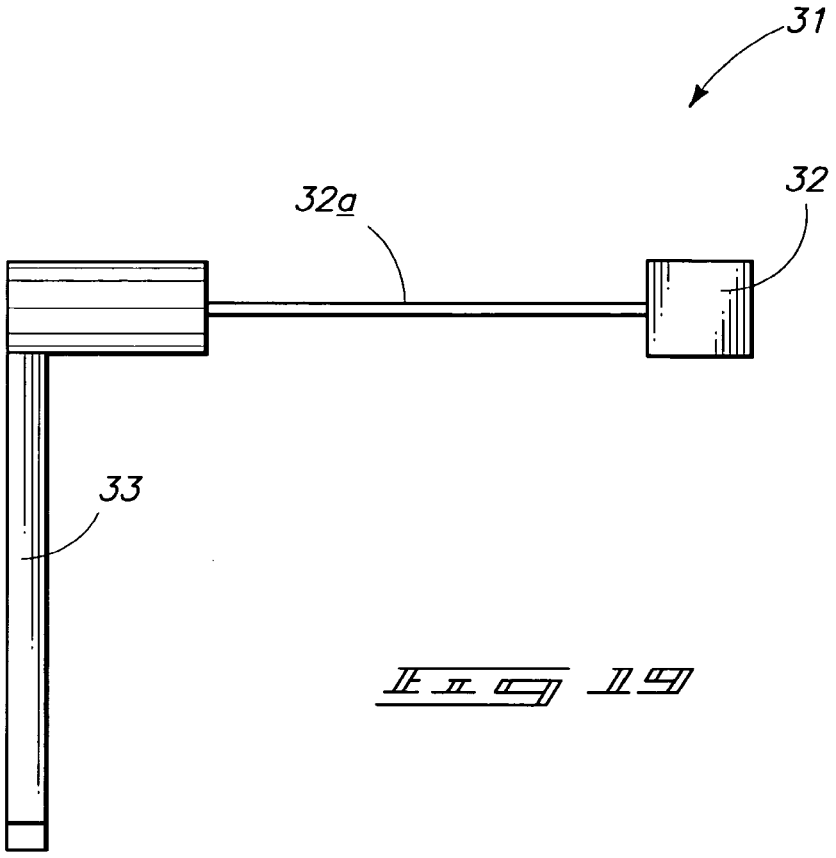
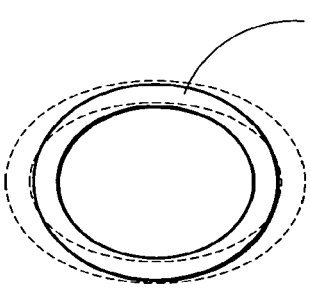


Fig 19



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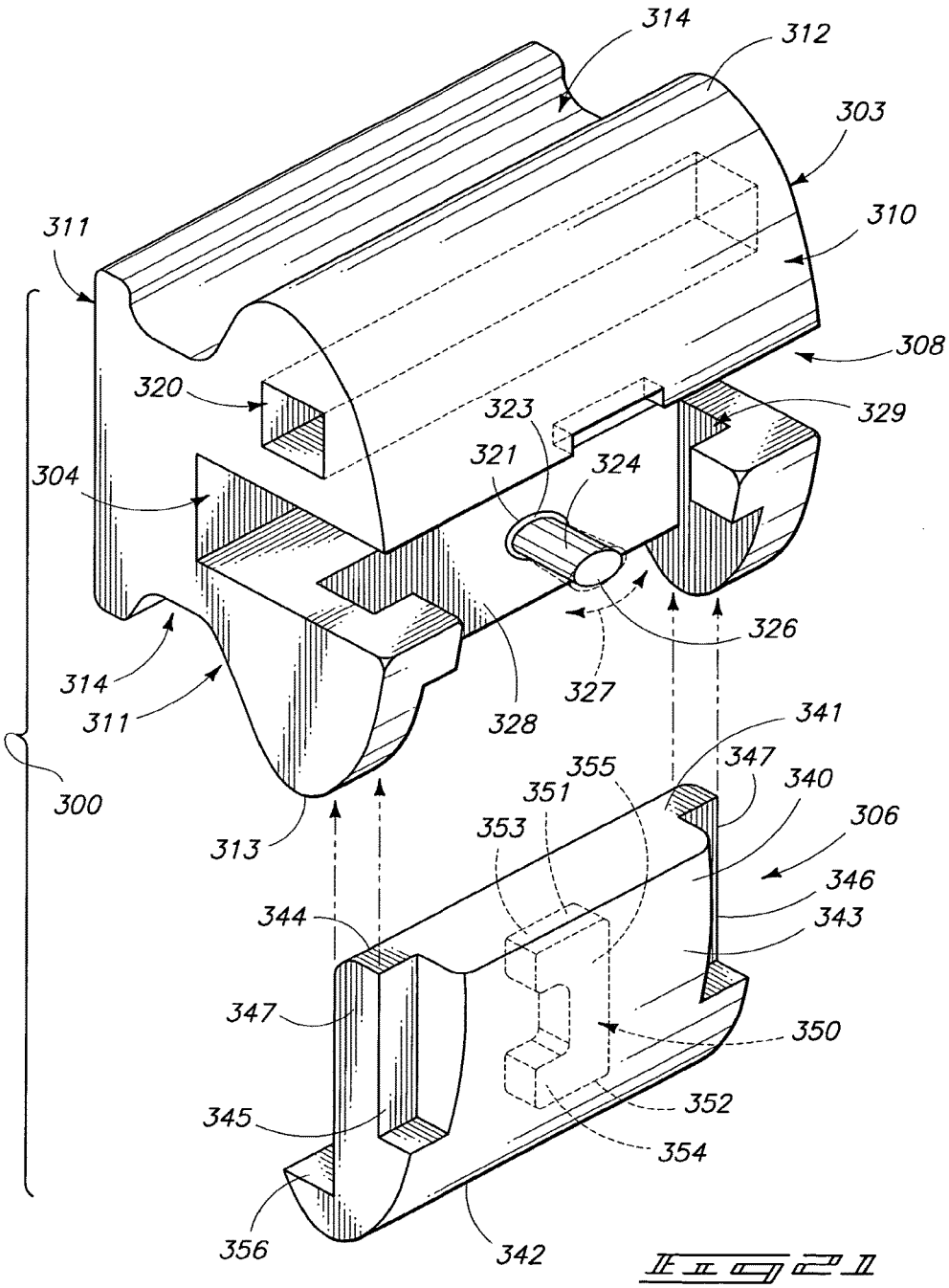
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Fig 21

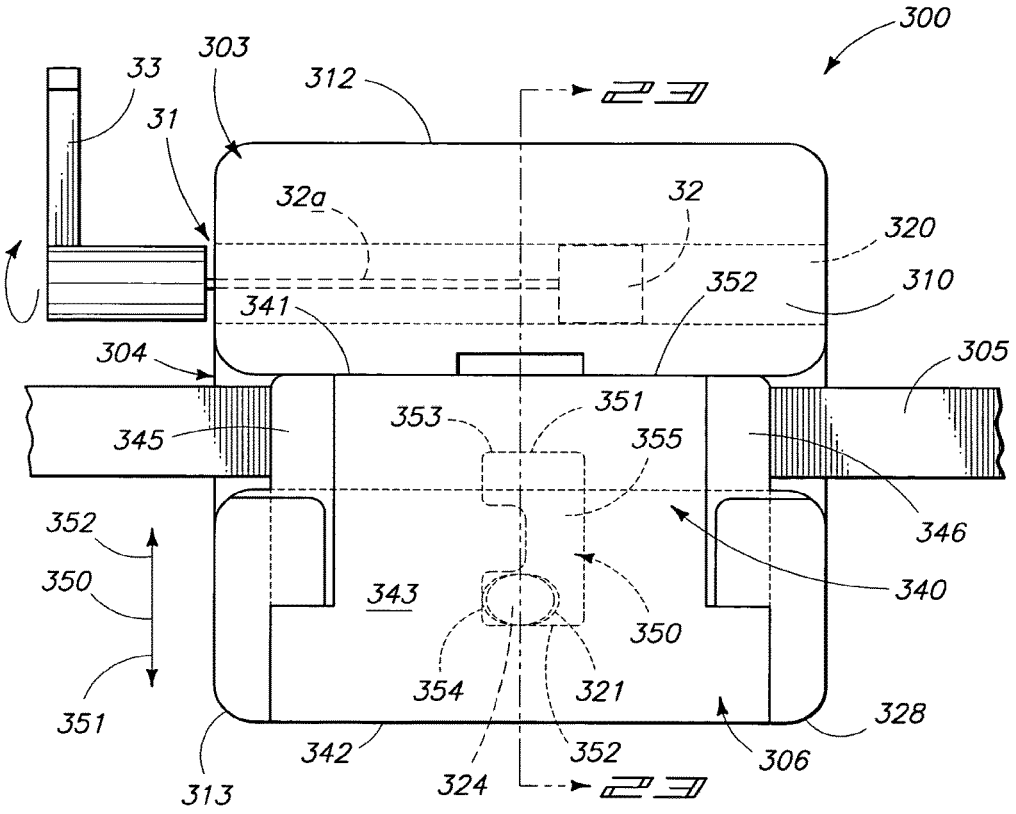
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Fig 22

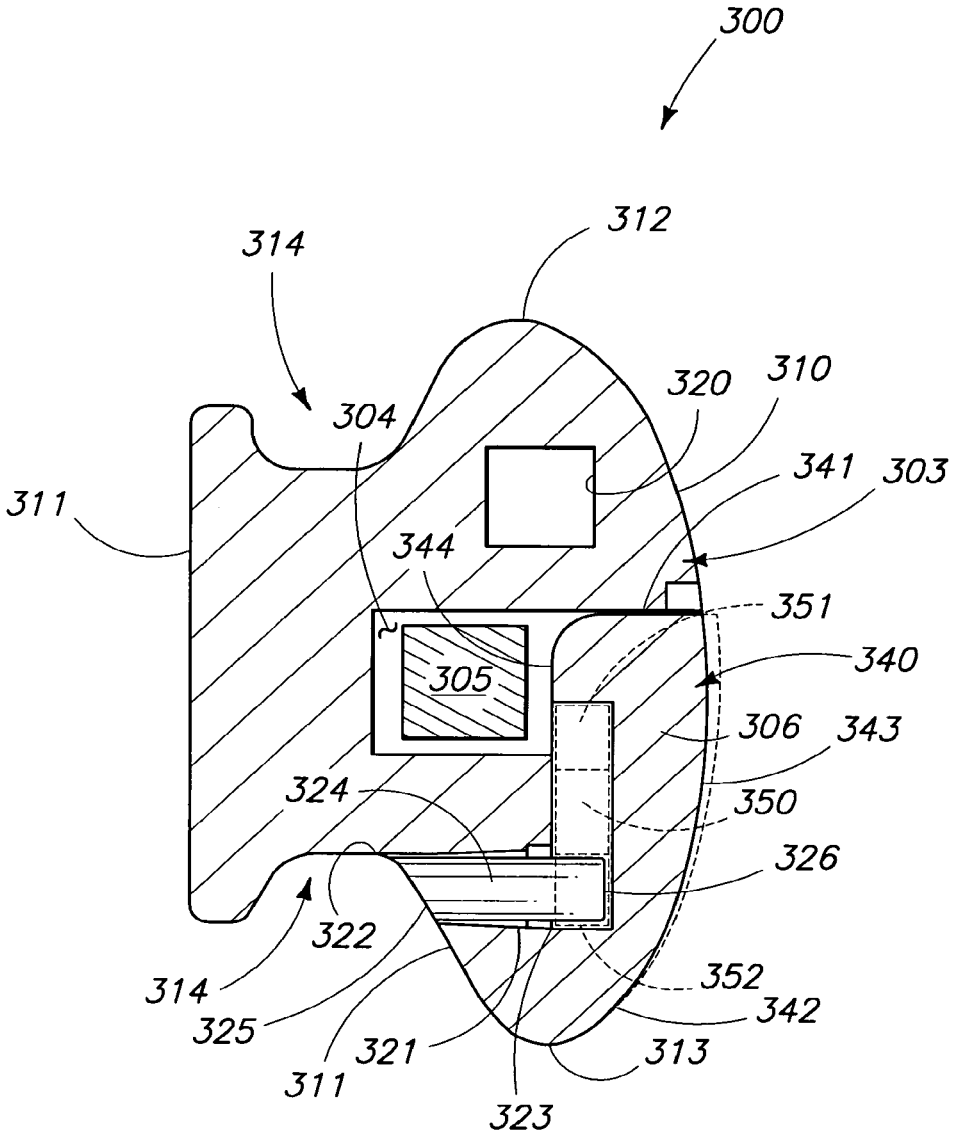
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Fig 23

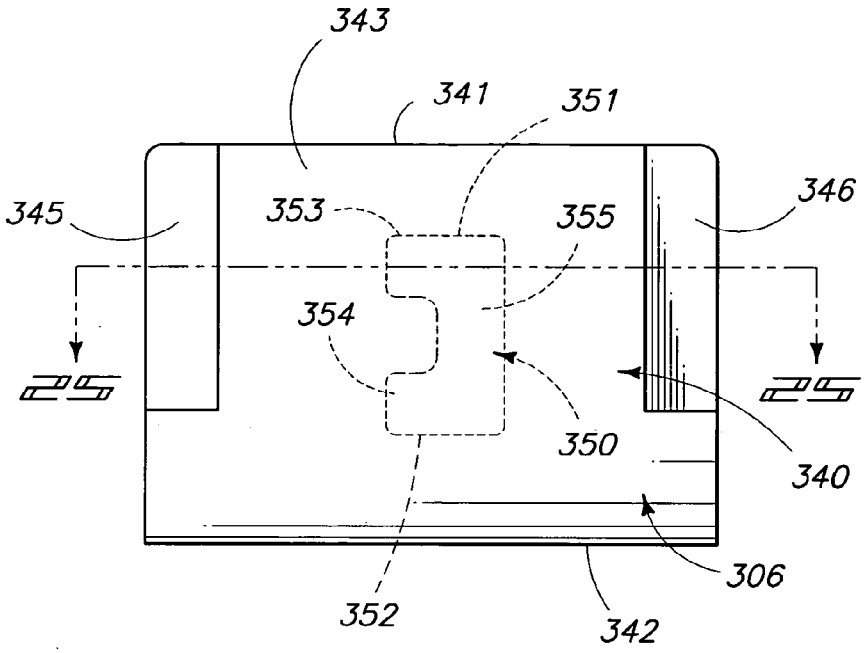
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Fig 24

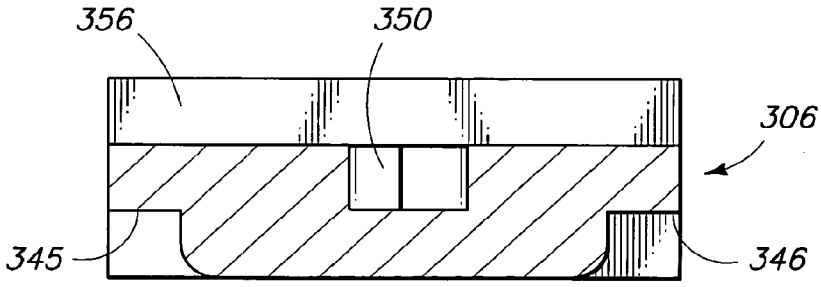
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Fig 25

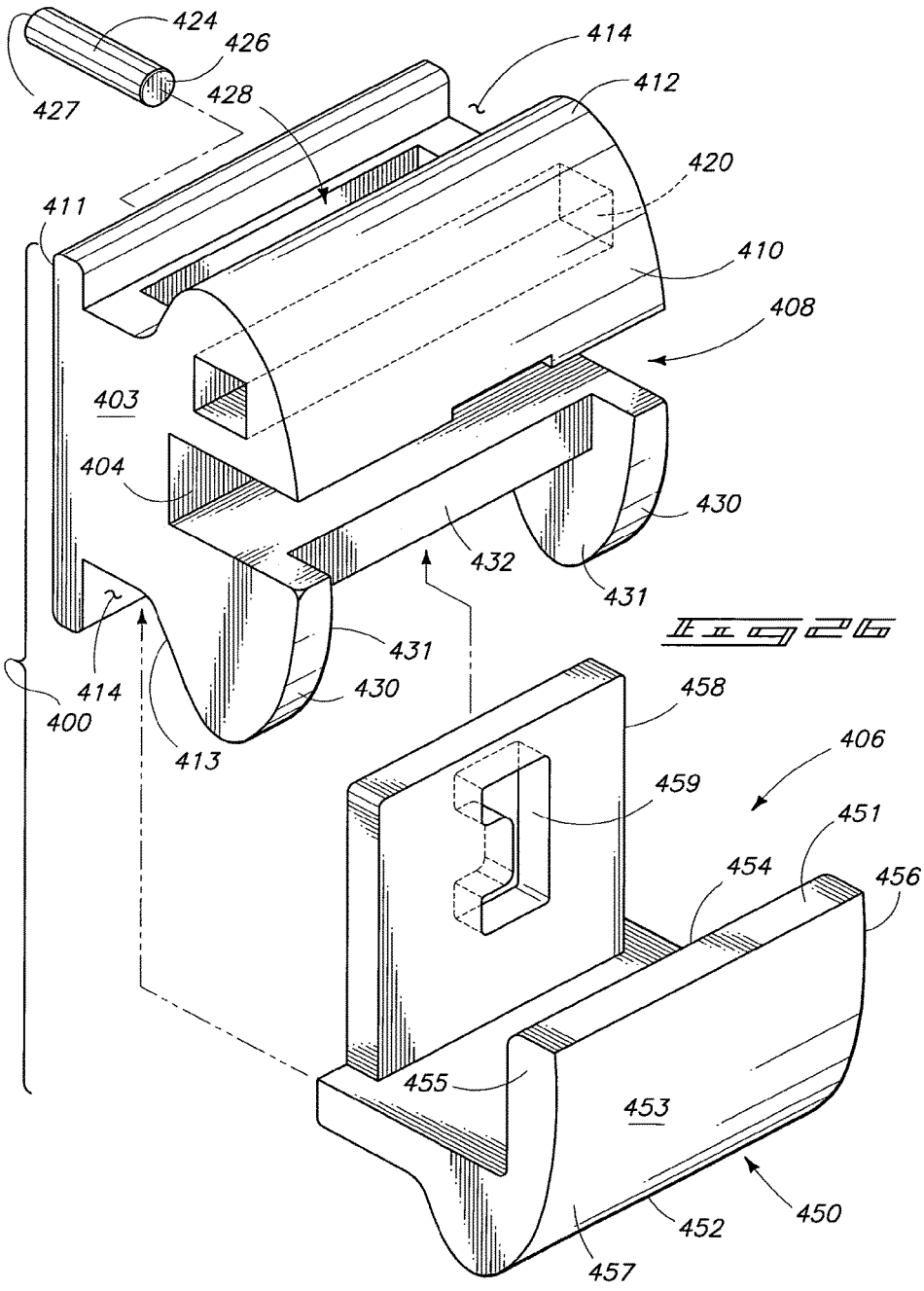
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Fig 26

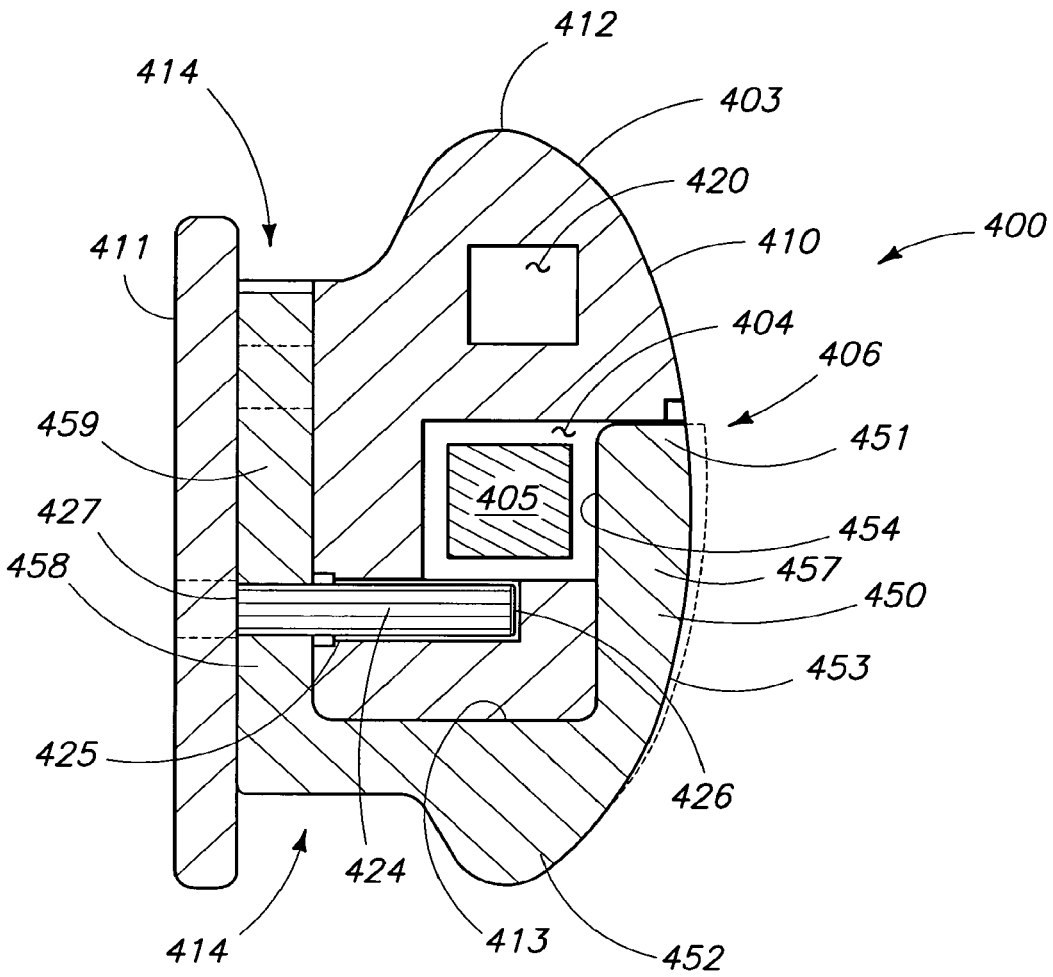
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Fig 27

ORTHODONTIC BRACKET

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. patent application Ser. No. 12/755,054 filed Apr. 6, 2010, which is a divisional of U.S. patent application Ser. No. 11/408,873 filed Apr. 19, 2006 (U.S. Pat. No. 7,704,072), and is related to U.S. patent application Ser. No. 14/968,065 filed Dec. 14, 2015, and U.S. patent application Ser. No. 14/971,012 filed Dec. 16, 2015, the disclosures of which are incorporated by reference herein in their entirety.

TECHNICAL FIELD

This disclosure pertains to an orthodontic bracket, and more specifically to biased ligating slides which are employed with same.

BACKGROUND OF THE INVENTION

Orthodontic brackets which are attached to the teeth of a patient, are designed to engage an archwire that exerts force upon the teeth to move the teeth into various clinically appropriate orientations. Such brackets typically include an archwire slot for reception of the archwire. Those skilled in the art will recognize that an archwire slot can have any desired cross-sectional configuration, or size, to match the size and shape requirements of the archwire or wires that are being received within the same slot.

Heretofore, many orthodontic brackets have been adhesively bonded to a tooth with the archwire slot being oriented in a substantially parallel orientation relative to the occlusal plane. However, those skilled in the art have long recognized that the archwire slot can also be angularly oriented across the bracket for certain clinical applications. Previously, orthodontic brackets have included various cleat-like extensions which have been referred to in the art as tie-wings or lugs. These structures project upwardly and downwardly, typically in pairs, at the top and bottom of the installed orthodontic bracket. In this regard, these extensions permit an archwire to be held within the archwire slot of the bracket by means of a twisted wire (a ligature) or an elastomeric o-ring which is releasably affixed by the respective lugs or tie-wings.

In U.S. Pat. No. 4,248,588 to Hanson, and which issued on Feb. 3, 1981, an orthodontic bracket, and archwire were disclosed and which included a moveable retainer member which, in one position, could be located in a position which facilitated access to the archwire slot, and in a second position, was useful for retaining the archwire within the archwire slot. Still further, this same reference disclosed a passageway **74** which is defined, at least in part, by the body of the bracket, and which is useful, in one embodiment, to pass a thin tie wire through, but which also was found advantageous, when fabricated in a rectangular cross-section, to receive a secondary archwire which could be employed to provide additional corrective forces to the tooth upon which the orthodontic bracket was attached.

In my U.S. Pat. No. 5,466,151, I disclosed a spring-locked orthodontic bracket having a ligating slide and which was acted upon by a biasing spring of various configurations which exerted an anteriorly outwardly biasing force thereagainst the moveable ligating gate in order to position or secure it in an appropriate orientation relative to the archwire slot.

In my U.S. Pat. No. 6,071,118, I disclosed a self-ligating orthodontic bracket having a transverse archwire slot and which further included a moveable, ligating slide which cooperated with the orthodontic bracket in order to achieve various benefits not possible, heretofore, in orthodontic brackets having a similar design.

In addition to the foregoing, the Carriere SLB orthodontic bracket which has recently been introduced by Class One Orthodontics includes a bracket body with a moveable cantilevered ligating slide. This orthodontic bracket further includes resilient members which form an integral portion of the ligating slide and which cooperate with the superior portion of the bracket body to releasably secure the ligating slide in a closed position. In this arrangement, the members forming an integral portion of the ligating slide exert a force on the ligating slide which is substantially coaxially aligned relative to the path of travel of the ligating slide. The resilient members otherwise do not support the distal end of the ligating slide when it is located in closed position over the archwire slot. Thus, the ligating slide remains cantilevered relative to the archwire slot.

While the brackets of the prior art have worked with varying degrees of success, assorted shortcomings have detracted from their usefulness. In particular, one of the chief difficulties with brackets having the designs as discussed, above, relates to the accurate manufacturing of same. Still further, another shortcoming attendant with such prior art devices relates to the dimensional size of such brackets. As should be understood, practitioners, as well as patients, have continually sought after smaller, and more inconspicuous brackets in order to acquire or achieve a more aesthetically acceptable appearance when the bracket has been installed in the mouth of a patient. As will be clear from reviewing the several earlier mentioned prior art references, the positioning of a biasing member within the bracket body in order to biasingly cooperate with the ligating gate has typically increased the dimensional size of the resulting bracket, and further increased the difficulty associated with fabricating and assembling orthodontic brackets of this type. Additionally, orthodontic bracket designs such as the Carriere SLB have additional shortcomings. For example, in brackets of this prior art design, if an archwire is not fully seated in the archwire slot, it becomes difficult if not impossible to fully engage the ligating slide with the bracket body thereby securing the ligating slide in the closed position over the archwire. More specifically, in a design such as seen in the Carriere SLB, and wherein the cantilevered ligating slide must releasably engage the base member in order to remain closed over the archwire slot, it will be readily apparent that an unseated archwire may deflect or deform the ligating slide sufficiently so that it may not effectively engage the base member, and therefore remain closed over the archwire. In this specific design, if the ligating slide does not effectively engage the base member, a clinician may cause the ligating slide to complete disengage from the base member with the result that the base member must now be removed from the patients tooth, and a new orthodontic bracket attached to the tooth to continue treatment. This is obviously a time consuming process for both the clinician as well as the patient.

An orthodontic bracket which avoids many of the shortcomings attendant with the prior art practices and orthodontic bracket designs utilized heretofore, is the subject matter of the present application.

SUMMARY OF THE INVENTION

A first aspect of the present invention relates to an orthodontic bracket which includes a ligating slide coupled

to a base member, and moveable along a path of travel relative thereto, and wherein a biasing member is borne by the ligating slide and cooperates with a portion of the base member to releasably position the ligating slide relative to the base member, and wherein the biasing member exerts a biasing force which acts in a direction which is substantially parallel to the path of travel.

Another aspect of the present invention relates to an orthodontic bracket which includes a base member defining an archwire slot having an opening, and at least one projection extending outwardly relative to the base member; a ligating slide moveably borne by the base member between a first position where the ligating slide is clear of the archwire slot, and a second position where the ligating slide projects over the opening of the archwire slot; and a biasing member borne by the ligating slide and slideably cooperating with the projection, and wherein the biasing member has a first portion which receives the projection when the ligating slide is in the first position, and a second portion which receives the projection when the ligating slide is in the second position.

Another aspect of the present invention relates to an orthodontic bracket which includes a base member defining a transverse archwire slot having an opening; a ligating slide borne by the base member and moveable along a path of travel relative to the archwire slot, and wherein the ligating slide is moveable between a first position where the ligating slide allows access to the archwire slot, and a second position, where the ligating slide projects over the opening, and restricts access to the archwire slot, and wherein a biasing member is mounted on the ligating slide and biasingly supports the ligating slide in at least one of the first or second positions, and wherein the biasing member exerts a biasing force in a direction relative to the base member which is substantially parallel and in non-coaxial alignment relative to the path of travel of the ligating slide.

Still further, another aspect of the present invention relates to an orthodontic bracket which includes a base member having a transverse archwire slot defining an opening, and at least one projection extending outwardly from the base member; a ligating slide moveable between a first position which is clear of the archwire slot, and a second position where the ligating slide projects over the opening of the archwire slot; and a substantially planar biasing member borne by the ligating slide and matingly cooperating with the projection, and wherein a first portion of the biasing member receives the projection when the ligating slide is in the first position, and a second portion of the biasing member receives the projection when the ligating slide is in the second position.

Another aspect of the present invention relates to an orthodontic bracket which includes a base member having a posterior facing surface, an anterior facing surface, and a projection extending outwardly from one of the posterior and/or anterior facing surfaces; and a ligating slide moveably borne by the base member along a path of travel, and further having a pair of members having opposing surfaces, and a channel defined therebetween the opposing surfaces, and wherein the pair of members resiliently cooperate with the projection to exert a biasing force on the ligating slide which is in substantially parallel spaced relation relative to the path of travel.

Yet another aspect of the present invention relates to an orthodontic bracket which includes a base member having a posterior facing surface, and an anterior facing surface, and wherein a projection extends outwardly from the posterior facing surface, and wherein the anterior facing surface of the base member defines, at least in part, an archwire slot having an opening; and a ligating slide is borne by the base member and is moveable between a first position, which allows access to the archwire slot through the opening, and a second position, which restricts access to the archwire slot through the opening, and wherein the ligating slide comprises a first portion extending to a second portion, and wherein the first portion forms, at least in part, a portion of the anterior facing surface of the base member, and the second portion is positioned in adjacent spaced relation relative to the posterior facing surface of the base member; and a resilient-biasing member is made integral with the second portion of the ligating slide and which resiliently cooperates with the projection.

Still further, another aspect of the present invention relates to an orthodontic bracket which includes a base member; an archwire slot traversing the base member, and wherein the archwire slot defines an opening within an anterior surface of the base member; a channel extending along the anterior surface of the base member from the archwire slot to a lowermost surface of the base member; a fixed projection extending laterally outwardly from the base member, and into a portion of the channel; a ligating slide which is slideably received in the channel; and a biasing member borne by the ligating slide and which resiliently cooperates with the fixed projection.

Still another aspect of the present invention relates to an orthodontic bracket which includes a ligating slide having a biasing member which is defined, in part, by a pair of members with opposing surfaces, and wherein the opposing surfaces define a channel therebetween, and wherein the members are spaced and resiliently moveable one relative to the other; and are operable to exert a biasing force on the ligating slide, and wherein the ligating slide is moveable along a path of travel, and the biasing force is substantially parallel and in spaced relation relative to the path of travel; and a biasing abutment is defined by one of the surfaces of one of the members, and wherein the biasing abutment at least partially occludes the channel.

Another aspect of the present invention relates to an orthodontic bracket which includes a base member having anterior and posterior facing surfaces, and further defining an archwire slot having an opening in the anterior facing surface; a ligating slide moveably borne by the base member, and which is moveable between a first position which is clear of the archwire slot, and a second position where the ligating slide projects over the archwire slot; and a biasing member borne by the base member and resiliently cooperating with the ligating slide, and wherein the biasing member exerts a biasing force which is directed posteriorly outwardly relative to the base member to position the ligating slide in the first and second positions.

Another aspect of the present invention relates to an orthodontic bracket which includes a base member defining an archwire slot; a ligating slide borne by the base member and moveable between a first, open position which allows access to the archwire slot, and a second, closed position which restricts access to the archwire slot, and wherein the ligating slide has an anterior and a posterior facing surface, and wherein a channel is formed in the posterior facing surface of the ligating slide; and an elongated flexible member is borne by the base member and which has a distal end which is received in the channel, and wherein the distal end is resiliently deformable along a substantially arcuately shaped path of travel, and wherein the flexible member cooperates with the channel to releasably secure the ligating slide in the first and second positions.

Yet still another aspect of the present invention relates to an orthodontic bracket which includes a base member defining an archwire slot; an elongated flexible member borne by the base member and which has a distal end which is moveable along an arcuately shaped path of travel; and a ligating slide moveably borne by the base member between a first position where the ligating slide is clear of the archwire slot, and a second position where the ligating slide restricts access to the archwire slot, and wherein the distal end of the elongated flexible member cooperates with the ligating slide and moves along the arcuately shaped path of travel as the ligating slide moves between the first and second positions.

A further aspect of the present invention relates to an orthodontic bracket which includes a base member having an anterior and posterior facing surfaces, and which further defines a transverse archwire slot having an opening; a ligating slide which is moveably borne by the base member between a first position, where the ligating slide is clear of the archwire slot, and a second position, where the ligating slide projects over the opening of the archwire slot, and wherein the ligating slide moves along a path of travel between the first and second positions; a resilient member borne by the base member and cooperating with the ligating slide to releasably restrain the ligating slide in the first and second positions, and wherein the resilient member is resiliently deformed, and moves along an arcuately shaped path of travel when the ligating slide moves between the first and second positions; a transverse passageway formed in the base member and disposed in spaced relation relative to the archwire slot; and an orthodontic appliance received, at least in part, in the transverse passageway and which facilitates passive self-ligation.

Yet still another aspect of the present invention relates to an orthodontic bracket which includes a base member defining an archwire slot, and which has anterior, posterior, superior and inferior facing surfaces, and where the base member defines a passageway which is located adjacent to the posterior facing surface and which extends therebetween the superior and inferior facing surfaces; an elongated flexible member borne by the base member and extending posteriorly outwardly relative to the base member and into the passageway, and wherein the elongated flexible member has a distal end which is moveable along an arcuately shaped path of travel; and a ligating slide which is received, at least in part, in the passageway, and which cooperates with the elongated flexible member, and wherein the ligating slide is moveable from a first position where the ligating slide is clear of the archwire slot, to a second position where the ligating slide restricts access to the archwire slot.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention are described below with reference to the following accompanying drawings.

FIG. **1** is a partial, greatly enlarged view of one form of the orthodontic bracket of the present invention, and where the invention is illustrated within a patient's mouth and having an archwire received in same, and further where the ligating slide is positioned so as to permit access to the archwire slot.

FIG. **2** is a partial, greatly enlarged view of one form of an orthodontic bracket of the present invention, and which shows the ligating slide associated with same in a position which restricts access to the archwire slot defined by the orthodontic bracket.

FIG. **3** is a greatly enlarged front elevation view of a first form of an orthodontic bracket of the present invention.

FIG. **3**A is a greatly enlarged front elevation view of a first form of an orthodontic bracket of the present invention, and which is utilized in combination with another orthodontic appliance.

FIG. **4** is a transverse, vertical, sectional view of one form of the orthodontic bracket of the present invention, and which is taken from a position along the line **4-4** of FIG. **3**.

FIG. **4**A is a transverse, vertical, sectional view of one form of the orthodontic bracket of the present invention, and which is taken from a position along the line **4**A-**4**A of FIG. **3**A.

FIG. **5** is a greatly enlarged, front elevation view of one form of an orthodontic bracket of the present invention, and which shows the ligating slide positioned so as to allow access to the archwire slot.

FIG. **6** is a fragmentary, front elevation view of a ligating slide which is useful in one form of the orthodontic bracket of the present invention.

FIG. **7** is a transverse, substantially horizontal, sectional view taken from a position along the line **7-7** of FIG. **6**.

FIG. **8** is a transverse, vertical, sectional view taken from a position along the line **8-8** of FIG. **6**.

FIG. **9** is a fragmentary, side-elevation view of a substantially planar biasing member which finds usefulness in one form of the orthodontic bracket of the present invention.

FIG. **10** is a perspective, exploded, front elevation view of the first form of the orthodontic bracket of the present invention, and with some underlying surfaces shown in phantom lines.

FIG. **11** is a front elevation view of a second form of an orthodontic bracket of the present invention.

FIG. **12** is a transverse, vertical, sectional view taken from a position along the line **12-12** of FIG. **11**.

FIG. **13** is a front elevation view of a second form of an orthodontic bracket of the present invention, and which shows a ligating slide associated with same and which is located in a first position which permits access to the archwire slot and which is defined by the orthodontic bracket.

FIG. **14** is a front elevation view of the ligating slide employed with the second form of the orthodontic bracket of the present invention.

FIG. **15** is a transverse, vertical, sectional view taken from a position along the line **15-15** of FIG. **14**.

FIG. **16** is a fragmentary, rear elevation view taken from a position along line **16-16** of FIG. **12**.

FIG. **17** is a perspective, exploded, front elevation view of the second form of the orthodontic bracket of the present invention.

FIG. **17**A is a perspective, exploded, front elevation view of yet another form of the orthodontic bracket of the present invention.

FIG. **18** is a transverse, vertical sectional view of a third form of the orthodontic bracket of the present invention.

FIG. **19** is a side elevation view of an orthodontic appliance employed with the various forms of the orthodontic bracket of the present invention.

FIG. **20** is a top plan view of one form of a biasing member which is useful in the third form of the orthodontic bracket of the present invention.

FIG. **21** is a perspective, exploded, front elevation view of fourth form of the orthodontic bracket of the present invention. Some underlying surfaces are shown in phantom lines.

FIG. **22** is a greatly enlarged, front elevation view of the fourth form of the orthodontic bracket of the present invention.

FIG. **23** is a transverse, vertical sectional view of the fourth form of the orthodontic bracket of the present invention, and which is taken from a position along line **23-23** of FIG. **22**.

FIG. **24** is a fragmentary, front elevation view of a ligating slide which is useful in the fourth form of the orthodontic bracket of the present invention.

FIG. **25** is a transverse, substantially horizontal, sectional view taken from a position along line **25-25** of FIG. **24**.

FIG. **26** is a perspective, exploded, front elevation view of a fifth form of the orthodontic bracket of the present invention.

FIG. **27** is a transverse, vertical sectional view of the fifth form of the orthodontic bracket as seen in FIG. **26**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

This disclosure of the invention is submitted in furtherance of the constitutional purposes of the U.S. Patent Laws "to promote the progress of science and useful arts" (Article 1, Section 8).

First Embodiment

Five forms of a self-ligating orthodontic bracket are illustrated in the drawings. A first embodiment is shown in FIG. **1-10**; a second form is illustrated in FIGS. **11-17**; a third form is shown at FIG. **18**; a fourth form is shown in FIGS. **21-25**; and a fifth form is shown in FIGS. **26** and **27**, respectively. Other inventive aspects of the present invention such as a novel orthodontic appliance to be employed in the various forms of invention (FIG. **19**) are also shown in the various views, and will be discussed in greater detail in the paragraphs hereinafter.

The illustrated details of the orthodontic bracket of the present invention may be used in many different combinations within the scope of this disclosure. For this reason, the details of the illustrated orthodontic brackets, as described hereinafter, are intended to be interpreted as merely illustrative, and should not be taken as restrictive of the practical combinations of such features within the scope of this disclosure and the appended claims as provided for, hereinafter. When referring to the illustrated forms of the bracket assemblies, and their component parts, the front surfaces, that is, directed outwardly from a supporting tooth shall be referred to as the anterior surface. Conversely, its rear surfaces, that is, those facing toward the tooth shall be termed the posterior surfaces. Directions along a bracket assembly generally parallel to the incisal or occlusal line or plane shall be referred to as having width and/or being transverse. Conversely, perpendicular directions extending in generally upright orientations between the gingival line, and the incisal, or occlusal line shall be referred to as the height of the bracket assembly. The upright surfaces across the bracket shall be termed its side surfaces, and surfaces along the top and bottom of the bracket assembly shall be termed the incisal or occlusal surfaces or the gingival surfaces, respectively. When referring to the directions of movement of the ligating slide of the present orthodontic bracket the terms inferior and superior shall be used in an anatomical sense, that is, oriented in relation to a patient wearing the bracket. Thus, if a ligating slide is moved inferiorly, it will be moved in a downward direction. Conversely, if it is moved superiorly, it will be moved in an upward direction.

The archwire slot shown in the attached drawings are aligned transversely across each bracket in a direction which is usually parallel to the incisal or occlusal surfaces for general illustration purposes, only. However, the archwire slot across each bracket can be oriented in any desired angular configuration relative to its incisal or occlusal surfaces to affect a desired degree of tipping to a supporting tooth. In addition, the bracket can be oriented angularly relative to a supporting pad thereby providing an angular force to the archwire slot, and engaged archwire, when secured to a supporting tooth.

In order to properly fit upon the exterior surface of a selected tooth, the posterior surface, across the pad for each bracket, must be molded or otherwise formed to conform to the tooth with the archwire slot at the desired angular relationship to the archwire upon installation. Various placement angles can be provided on selected brackets by rotating the anterior surface contour across the pads of the brackets within a set. Alternatively, the archwire slots, and a set of brackets can be arranged in selected angles by rotating the position of the protruding elements of each bracket relative to a pad having a properly contoured posterior surface. The archwire slot is then formed in the protruding portion of the bracket to match the amount of tipping to be imparted to a given tooth. While the illustrated archwire slot in the various forms of the invention is shown in a perpendicular orientation relative to the anterior surface of the bracket, it could be formed in any desired angle relative to the anterior surfaces, depending upon the desired torquing to which the supporting tooth is to be subjected. The illustrative brackets, as shown herein, are designed to be bonded directly to a tooth at either the facial or lingual tooth surfaces.

The present bracket can be made from any suitable material including metals, plastics and ceramics, as well as a combination of such materials. The brackets, as shown herein, are typically fabricated out of metal, but the choice of materials is not critical to the understanding or the subsequent clinical use of the invention. The only limitation with regard to the chosen materials is the ability to efficiently fabricate or mold the bracket, and the accompanying ligating slide as structures which are capable of movement one relative to the other, and which are operable to engage the archwire during an orthodontic procedure.

Referring now to FIGS. **1-10**, a first form of an orthodontic bracket of the present invention is generally indicated by the numeral **10** therein. As seen more specifically in FIG. **1**, the orthodontic bracket **10** finds usefulness when used in an orthodontic procedure which affects a plurality of teeth **11** within a patient's mouth. As well known to those skilled in the art, each of the teeth **11** have an exterior facing surface **12** upon which a bracket body or base member **13** is typically affixed by using an appropriate adhesive. With reference to FIGS. **1** and **3**, it will be seen that the base member or bracket body **13** defines a substantially transversely disposed archwire slot **14** which extends thereacross, and which is further operable to receive a suitable archwire **15** therein. The archwire is illustrated in an appropriate, seated position within the archwire slot. It will be recognized, however, under some circumstances and particularly when the archwire is first installed, it may not be appropriately positioned within the archwire slot. The present invention, as will be described below, is operable to facilitate passive self-ligation of the archwire in a fashion not possible, heretofore. For example, during the treatment of a patient, orthodontic brackets occasionally detach from the underlying tooth. Further, teeth occasionally move following this detachment. If his occurs, the various forms of the

orthodontic bracket as will be disclosed, herein, can be reattached to the tooth at its correct position, and the archwire **15** may be reinserted into the archwire slot **14**, and the ligating slide closed, without the need to replacing the archwire **15** with a smaller dimensioned archwire which is now the accepted practice. This feature of the invention is facilitated by the resiliency of the ligating slide **16** which will be described in greater detail, hereinafter. Additionally, the present invention provides significant time savings for the treatment of a patient. In the first form of the invention, the base member further cooperates with a moveable ligating slide or gate **16**, which in one position as seen in FIG. **5**, allows access to the archwire slot **14**; and in FIG. **3** restricts access to the archwire slot **14**. The ligating slide cooperates with a substantially planar, resilient biasing member **17** as seen in FIGS. **3** and **9**, and which defines, at least in part, the course of movement for the ligating slide **16**. Therefore, in its broadest aspect, the present invention relates to an orthodontic bracket **10** which includes a ligating slide **16** which is configured to be coupled to a base **13**, and wherein the ligating slide **16** further cooperates with a biasing member **17** which receives a portion of the base member **13**.

Referring now to FIG. **4**, it will be seen that the bracket body or base member **13** has an anterior facing surface or side **20**, and an opposite posterior facing surface or side **21** which is adhesively affixed to the exterior surface **12** of a tooth **11** of a patient. The base member **13** further has a top, or superior facing surface or portion **22**, and an opposite, lower, or inferior surface or portion **23**. As seen in FIG. **4**, opposite transversely oriented channels **24** are defined in the superior and inferior facing surfaces and are further located therebetween the anterior and posterior facing surfaces **20** and **21**. These channels may be useful for securing various other dental appliances therein. More specifically, the superior portion **22** and inferior or lowermost portion **23** define substantially continuous upper and lower tie wing projections which can be employed in various orthodontic treatment regimens.

Referring still to FIG. **4** and FIG. **10** it will be seen that the bracket body or base member **13** has a transverse, substantially square or rectangular shaped passageway **30** formed in the superior portion **22** of the base member. As illustrated in FIG. **10**, it will be seen that the transverse passageway extends completely through the base member, and further is disposed in substantially parallel, spaced relation relative to the archwire slot **14**. As should be understood, if the archwire slot **14** is located in an orientation other than the transverse orientation as seen in FIGS. **1-10**, then this parallel orientation would not exist. However, it should be understood that the transverse passageway **30** may receive or cooperate with another secondary archwire; post; and/or other orthodontic appliances as will be described, hereinafter, and which may be useful in treating various tooth anomalies. In this regard, and referring now to FIGS. **3**, **5** and **19**, a novel orthodontic appliance in the form of a torquing assembly **31** is provided, and which matingly cooperates with the transverse passageway **30** in a manner so as to supply force of various amounts, and directions to the underlying tooth **11**. In this regard, the torquing assembly **31** has a first portion **32** having a substantially square or rectangular shape, and which is dimensioned to be telescopingly received within the transverse passageway **30**. Still further, the torquing assembly **31** has a second portion **33** which is attached to the first portion **32**, by means of an intermediate portion **32**A. The intermediate portion is longitudinally, resiliently deformable by means of the second portion **33**, and which may be rotated thereabout the first portion **32**, and then left in engagement with the archwire **15** as seen in FIG. **5**. In this fashion, the torquing assembly **31** can produce a force of a given magnitude, and direction, on the tooth of a patient in order to further enhance the usefulness of the present orthodontic bracket **10**. As seen further in FIG. **4**, and in the other views, the present orthodontic bracket **10** includes at least one post or projection **34** which extends outwardly relative to the base member **13**, and which further is received within a bore **35** which is formed in the base member **13** and near the inferior portion or surface **23**. In the present invention, the post or projection **34** is received, at least in part, in the bore **35**, and extends anteriorly outwardly relative to the base member **13**. Further, and as will be discussed in the second form of the invention as seen in FIG. **12**, the post or projection **124** extends posteriorly outwardly relative to the base member **103**. As should be understood, the projection **34** is herein depicted as being substantially cylindrical (FIG. **10**), and further the projection **34** has an exterior facing surface **36**. As will be discussed in greater detail hereinafter, the projection **34** cooperates with the ligating slide **16** in order to define, at least in part, a course of movement for the ligating slide. This feature of the invention will be discussed, below. As earlier noted, the base member **13** has an anterior facing surface or side **20**; and a posterior facing surface or side **21**. In the first and second forms of the invention as described herein, the bore **35** is sized so as to matingly receive and secure the projection **34**. In the assembly of the present invention, it should be understood that the projection **34/124** will be inserted in the bore **35/125** from the posterior facing surface or side **21** of the base member **13/103**, respectively. As will be recognized from a study of the drawings, in some forms of the invention, the bore **35** may extend through the base member **13** (FIG. **4**); but in a second form of the invention, the bore **125** may not extend through the base member **103**.

As seen in FIGS. **3** and **4**, a recess **37** is formed in the anterior facing surface **20** and adjacent the archwire slot **14**. This recess is useful for inserting a dental tool or other instrument therein in order to affect downward or inferior movement of the ligating slide **16** as will be discussed in greater detail hereinafter.

As best seen in FIGS. **3**A and **4**A, the present invention can accommodate a second novel orthodontic appliance in the form of a removable horizontal hook **38**, and which can be inserted into the passageway **30**, and which can cooperate with elastic bands or other appliances of various sorts in order to be employed in desired orthodontic treatment regimens. The removable horizontal hook has a rectangular shaped main body **39** which is dimensioned for mating receipt with the passageway **30**. The main body has a distal end **39**A which may be bent or otherwise deformed, as illustrated by phantom lines, in order to secure the removable hook within the passageway **30**.

As seen in FIG. **10**, the anterior facing surface **20** of the base member **13** defines a pair of spaced, substantially inwardly extending, guide members which are generally indicated by the numeral **40**. The guide members **40** have an exterior facing surface **41**, and an opposite, interior facing surface **42** which defines, at least in part, a generally vertically oriented ligating slide channel which is generally indicated by the numeral **43**. As illustrated in FIG. **10**, the projection **34** extends anteriorly outwardly from the base member **13**, and into this ligating slide channel **43** for purposes of cooperating with the ligating slide **16** which will be described below. As seen in FIG. **10**, the bracket body or

base member **13** defines an opening **44** which allows access to the archwire slot **14** when the ligating gate is in one of its two operational positions. As seen in the drawings, the archwire slot **14** communicates with the channel **43**. The operation of the ligating slide or gate **16** will be described in greater detail in the paragraphs which follow.

Referring now to FIGS. **3-7**, it will be seen that the first form of the orthodontic bracket **10** includes a ligating slide **16** which is slideably borne by the base member **13** and reciprocally moveable along a path of travel relative to the archwire slot **14** in the fashion which will be described, hereinafter. The ligating slide has a main body **50** having a first, superior end **51**; a second inferior end **52**; an anterior facing surface **53**; and an opposite, posterior facing surface **54**. As seen, most clearly in FIGS. **4** and **10**, the superior end **51** may be beveled or otherwise rounded so as to facilitate passive self-ligation of the archwire **15**. Still further, the main body includes a first, vertically disposed peripheral edge **55**; and a second, opposite vertically disposed peripheral edge **56** which is disposed in substantially parallel, spaced relation relative to the first peripheral edge **55**. As will be seen by reference to FIG. **10**, for example, the guide members **40**, and the lowermost portion **23** of the base member **13** shields, at least in part, a portion of each of the opposite peripheral edges **55** and **56**, respectively. As further seen by reference to FIG. **4**, for example, the ligating slide **16** is resiliently deformable, as seen by the phantom lines of the ligating slide, to a position which is anteriorly outward relative to the base member **13**. This resiliently deformable ligating slide **16** facilitates passive self-ligation of the archwire inasmuch as the archwire **15** need not be fully seated in the archwire slot **14**, for the orthodontic bracket **10** to be effectively used. The beveled and/or rounded superior end allows the ligating slide to move past the bracket body or base member **13** when moving from a displaced, biased position, as seen in phantom lines in the drawings to an unbiased orientation.

Referring now to FIGS. **3-8** and **10**, it will be seen that a first recessed region **60**, and a second recessed region **61** are formed in the anterior facing surface **53** of the ligating slide **16**, and adjacent to the first and second vertically disposed edges **55** and **56**, respectively. These first and second recessed regions **60** and **61**, respectively, each have a first end **62**, which is positioned adjacent to the first, superior end **51** of the main body; and a second end **63**, which is spaced therefrom, and oriented in spaced relation relative to the second inferior edge **52**. As seen in the drawings, the first and second recessed regions have a thickness dimension which facilitates the positioning of the recessed regions in the area therebetween the interior facing surface **42** of the respective guide members **40**, and the base member **13** so as to permit the selective slideable movement of the ligating slide **16** in the channel **43**. As should be understood, this physical arrangement prohibits force which might be occasioned by a patients chewing, for example, from adversely influencing the ligating slide **16**. As will be appreciated from a study of FIGS. **7** and **8**, a cavity **70**, of predetermined dimensions, is formed in the posterior facing surface **54** of the main body **50**, and is operable to receive the planar resilient biasing member **17** which will be discussed in greater detail, below. The cavity **70** has an open, first or superior end **71** (FIG. **8**), and an opposite, closed, second or inferior end **72**. The cavity has a depth dimension which is greater than or equal to the thickness dimension of the substantially planar, resilient biasing member **17**. Still further, the posterior facing surface **54** defines an abutting edge **73** which is operable to limit the movement of the ligating slide **16** along the course or path of travel **74** (FIG. **3**). In this regard, the course of travel **74** is defined between a first position **75** where the ligating slide allows access to the archwire slot (this is best seen in FIG. **5**); and a second position **76** where the ligating slide **16** projects in a cantilevered fashion, at least in part, over the opening **44** and, at least partially restricts access to the archwire slot **14** (FIG. **3**). As earlier discussed, in other possible forms of the invention, the superior end **51** of the ligating slide may partially overlap and even releasably cooperate with the base member **13** to achieve the benefits provided by the present invention. In the arrangement as seen in the drawings, and as will be discussed below, the ligating slide **16** is biasingly supported in at least one of the first or second positions **75** and **76** respectively. As will become more apparent from the discussion which follows, the biasing force applied to the ligating slide **16** to support it in one of the first or second positions **75** and **76**, acts in a direction which is substantially parallel to the path of travel **74** of the ligating slide **16**. This is contrary to the prior art devices used heretofore, and wherein prior art biasing assemblies typically provided a biasing force which was directed anteriorly outwardly and in a direction which is generally normal to the ligating slide. As will be appreciated by a study of FIG. **4**, the first superior end, or edge **51** may be disposed in juxtaposed abutting relation relative to the base member **13** when the ligating slide **16** is in the second position **76**. In other possible forms of the invention, the same superior end or edge **51** may partially abut the base member **13**; or as discussed above, partially overlay the base member **13**. In still other arrangements, the superior end or edge **51** may releasably engage or otherwise cooperate with the base member when disposed in the second position where the ligating slide **16** extends over the archwire slot **14**. In still other forms of the invention as seen in the drawings, the superior end **51** may be beveled and/or rounded so as to facilitate passive self-ligation. This feature is common to the several exemplary forms of the invention as seen in the drawings.

Referring now to FIGS. **3-10**, it will be seen that the orthodontic bracket **10** of the present invention includes a substantially planar resilient biasing member **17** which is borne by the ligating slide **16**, and which slideably cooperates with the projection **34** to biasingly support the ligating slide **16** in at least one of the first or second positions **75** and **76**, respectively. In this regard, the resilient member **80** has a substantially planar main body **80** which is positioned in a generally parallel, spaced relationship relative to the anterior facing surface **53** of the ligating slide **16**. As seen in the drawings, the substantially planar main body **80** is received within the cavity **70** which is defined by the ligating slide, and is oriented in a fashion so as to resiliently cooperate with the projection **34** which extends anteriorly outwardly relative to the base member **13**. As illustrated, it will be appreciated that the resilient biasing member provides a resilient or biasing force which acts in a perpendicular or radial direction relative to the projection **34**, and substantially parallel relative to the path of movement of the ligating slide **16**. In this regard, and as seen in FIG. **9**, the planar main body includes a transverse portion **81** which has a first end **82**, and an opposite second end **83**. The transverse portion **81** has a length dimension which is less than about the width dimension of the cavity **70** thereby allowing the main body **80** to be securely received within the cavity **70**. Still further, the main body **80** includes first and second dependent, and resiliently moveable members **84** and **85**, respectively. The respective depending members extend substantially normally, downwardly relative to the trans-

verse portion **81**. Still further, each of the depending members has a distal end **90**; an outwardly facing edge **91**; and an inwardly facing edge **92**. The inwardly facing edges are disposed in predetermined, spaced relation one relative to the other. As seen in FIG. **9**, a channel **93** is defined therebetween the inwardly facing edges **92**. Still further, a portion of the inwardly facing edges **92**, each define, at least in part, an inwardly facing biasing abutment **94** which mechanically and slideably cooperates or otherwise engages the projection **34** in order to bias the ligating slide **16** in one of the first or second positions **75** and **76**, respectively. As understood from the drawings, the transverse portion **81** cooperates with the projection **34** to limit downward movement of the ligating slide **16**, and to prevent the ligating slide from disengaging from the base portion **13** when the ligating slide is in the first position **75**. As currently arranged, the respective biasing abutments **94** are operable to bias or otherwise releasably support the ligating slide **16** into the second position **76**, which as seen in FIG. **3**, substantially restricts access to the archwire slot **14** and thereby captures the archwire **15** therein. As seen in FIG. **9**, the channel **93** has a first portion **95**; and a second portion **96**. The first and second portions of the channel **93** are located on the opposite sides of the respective biasing abutments **94**. As seen, the respective biasing abutments are disposed in such an orientation so as to occlude, at least in part, or otherwise narrowly restrict, the channel **93**. As seen therefore, the resilient or biasing member **17** has a first portion **95** of the channel **93** which receives the projection **34** when the ligating slide is in the first position **75**; and a second portion of the channel **96** which receives the projection **34** when the ligating slide is in the second position **76**. Therefore, the pair of members **84** and **85** resiliently cooperate with the outwardly or exterior facing surface **36** of the projection **34** to appropriately position and releasably restrain the ligating slide **16** in either of the first or second positions **75** and **76**, respectively. The projection **34** passes along the channel when a clinician exerts sufficient force on the ligating slide **16** by means of an instrument, not shown, so as to cause projection **34** to biasingly move the members **84** and **85** apart so as to permit the projection **34** to pass along the passageway **93** to the appropriate location. As seen in FIGS. **3** and **5**, for example, the projection **34** is operable to move along the channel **93** and between the first and second portions **95** and **96** thereof, to appropriately position the ligating gate **16** as described earlier. This arrangement is particularly advantageous inasmuch as the overall thickness dimension of the resulting first form of the orthodontic bracket **10** can be reduced thereby making the bracket more aesthetically appealing, and easier to fabricate. In addition to the foregoing, and in another possible form of the invention, it should be understood that the biasing member **80** may be made integral with the ligating slide **16**. More specifically, the members **84** and **85** may be integrally molded with the ligating slide so as to provide the benefits discussed above.

Second Embodiment

The second embodiment of the orthodontic bracket of the present invention is generally indicated by the numeral **100** and is best seen by reference to FIGS. **11-17**A, respectively. As seen therein, the second embodiment of the orthodontic bracket **100** is defined by a bracket body or base member **103** and which further defines a transversely disposed archwire slot **104** which is operable to receive an archwire **105** of traditional design. As earlier discussed, the archwire slot is shown in a transverse orientation relative to the bracket body or base member **103**, however, it will be appreciated that the archwire slot **104** may be oriented in various orientations to achieve various clinical benefits for a patient. As seen in the drawings, the archwire slot **104** is substantially rectangular in shape, and is operable to receive a rectangular shaped archwire **105** of conventional design. The orthodontic bracket **100** includes a ligating slide **106** which moveably cooperates with the base member **103**, and is moveable along a path of travel from a first position which allows access to the archwire slot **105** through the opening **108**, and a second position where the moveable ligating slide **106** prevents access to the archwire slot. It will be appreciated by a study of FIG. **12** that the ligating slide **106** is resiliently deformable so as to facilitate passive self-ligation and the proper seating of the archwire **105** in the archwire slot **104**. As should be understood, the present resiliently deformable ligating slide **106** may be sufficiently deformed such that it may close over an archwire **105** which may be slightly protruding from the archwire slot **104**. Over time, however, the ligating slide **108** will assume its original shape to confine or otherwise enclose the archwire **105** within the archwire slot in the manner of passive self ligation, as earlier discussed. As seen by reference to FIG. **17**, a planar resilient biasing member **107** is made integral with the moveable ligating slide and which is operable to biasingly position the moveable ligating slide **106** in one of the aforementioned positions relative to the archwire slot **104**. As seen by reference to FIG. **12** and following, the base member **103** has an anterior facing surface or side **110**, and an opposite posterior facing surface or side **111** which may be adhesively affixed, at least in part, to an underlying tooth of a patient who is being treated. Still further, the base member **103** has a top or superior facing surface **112**, and a bottom or inferior facing surface **113**. As seen in FIG. **12**, the base member **103**, and a portion of the moveable ligating slide **106** define individually elongated channels **114** which may be utilized to engage other orthodontic appliances as is customary for the treatment of a patient. The base member and ligating slide each respectively define a substantially continuous tie wing.

As seen in FIGS. **11** and **12**, for example, and similar to the first form of the invention **10**, a transverse substantially rectangular cross-sectioned passageway **120** is formed in the base member **103**, and disposed in substantially parallel spaced relation relative to the archwire slot **104**. As earlier disclosed, this transverse passageway **120** may receive other orthodontic appliances, such as a secondary archwire, or further may utilize a novel torquing spring or assembly **121** which is similar to that earlier disclosed, and which was described by reference to FIG. **19**. In this regard, the torquing assembly **121** has a first portion **122** having a rectangular shape and which is dimensioned to be matingly received in the transverse passageway **120**; and a second portion **123** which is attached to the first portion by an intermediate portion **122**A. The intermediate portion is longitudinally, resiliently deformable by means of the second portion **123**, and which can be rotated in a given direction, and thereafter forcibly engage the archwire **123** as seen in FIG. **13** in order to provide a torquing force on same to facilitate the movement of a tooth in a given direction. As seen in the drawings, the second form of the orthodontic bracket **100** includes a projection **124** (FIG. **12**) which is received in a bore **125**, and which extends generally posteriorly outwardly relative to the base member **103**. The projection **124** has an exterior facing surface **126** which cooperates with the resilient biasing member **107** in order to achieve the benefits which will be discussed in greater detail hereinafter. As seen in FIG. **12**, the bore **125** does not extend through the base member **103**. Further, and when assembling

the second form of the invention, it should be clear from a study of FIG. **12** that the projection **124** is inserted in the bore **125** from the posterior facing surface or side **11** of the base member **103**. As seen by reference to FIGS. **12** and **17**, respectively, the base member **103** further defines a substantially vertically oriented passageway **127** which slideably receives a portion of the moveable ligating slide **106**, as will be discussed in greater detail, hereinafter. The vertically oriented passageway **127** has a first end **128**, which is adjacent to the superior side of the base member **103**, and a second end **129** which is adjacent to the inferior side of the orthodontic bracket **100**. As seen by reference to FIG. **12**, the projection **124** extends into and partially occludes the vertically oriented passageway **127**. The operation of the passageway, in combination with the moveable ligating slide **107**, will be discussed in greater detail, hereinafter.

As best seen by reference to FIGS. **17** and **17**A, the base member **103** includes a pair of anteriorly extending guide members **130** which are positioned in predetermined substantially parallel spaced relation one relative to the other. The guide members **130** are operable to cooperate with the ligating slide **106** as will be described below. Each of the guide members have an inwardly facing surface **131** which defines a passageway **132** therebetween, and which slideably receives a portion of the ligating slide **106**. Referring now to FIG. **17** and similar to the first form of the invention **10**, the guide members each have a portion **134** which is operable to slideably restrain, and otherwise shield, at least in part, the ligating slide **106**. This structural element is eliminated in the form of the invention as seen in FIG. **17**A. As seen in FIGS. **17** and **17**A, for example, the ligating slide **106** has a main body **150** having a first superior end **151**, and an opposite second inferior end **152**. The main body further has an anterior facing surface **153**, and an opposite posterior facing surface **154**. As seen in FIG. **12**, a portion of the posterior facing surface **154** defines, in part, the archwire slot when the ligating slide is positioned in covering relation relative to the archwire slot to restrict access to same. The main body **150** has opposite substantially vertically disposed edges **155** and **156**, respectively. Still further, the main body has a first portion **157** which forms, at least in part, a portion of the anterior facing surface **153** of the base member **103**; and further, a second portion **158** is positioned in adjacent spaced relation relative to the posterior facing surface **111** of the base member. As seen in FIGS. **17** and **17**A, the second portion **158** of the ligating slide **106** is disposed in spaced relation relative to the posterior facing surface **154**. Still further, the second portion **158** is dimensioned, in length, thickness and width, to be slideably received within the vertically oriented passageway **127** which is defined by the base member **103**. The second portion **158** of the ligating slide has integrally formed therewith, the planar resilient biasing member **107** as will be described in greater detail, hereinafter. As with the first form of the invention **10**, the resilient biasing member **107** defines a course of movement for the accompanying ligating slide **106** for the purposes which will be described below. As seen in FIGS. **14** and **17**, the ligating slide **106** further defines first and second recessed regions **159**A and B, respectively. As illustrated, these recessed regions have a thickness dimension which allows the ligating slide to be slideably received therebetween the portions **134** and base member **103** so as to facilitate the reciprocal sliding movement of the ligating slide **106**, as described below. As best see by reference to FIG. **17**A, an alternative second form of the invention is shown. In this regard, it will be seen that the ligating slide has been modified to eliminate the recessed regions **159**A and B, respectively. Further, and as noted above, the guide members **130** have been modified to eliminate the structural element **134**, (FIG. **17**) which was operable in the previous form of the invention, to restrain the movement of the ligating slide **106**.

Referring now, for example, to FIGS. **17** and **17**A, it will be understood that the second form of the orthodontic bracket **100** includes a substantially planar resilient biasing member **107** which is made integral with the second portion **158** of the ligating slide **106**, and which further resiliently cooperates, and receives, the projection **124** which extends posteriorly, rearwardly, and into the passageway **127** which is defined by the base member **103**. Similar to the resilient biasing member **80** as described with the first form of the invention **10**, the resilient biasing member **107** has a main body **160** which has a transverse portion **161**. The transverse portion has opposite first and second ends **162** and **163** which are made integral with the second portion **158** of the ligating slide **106**. The main body of the planar resilient biasing member **160** further includes first and second depending members **164** and **165** which are each disposed in predetermined, spaced relation one relative to the other. Each of the depending members **164** and **165** have a distal end **170**, and have an outwardly facing edge **171**, and an opposite, inwardly facing edge **172** which defines a channel **173**, therebetween. As seen in the drawings, a portion of each of the inwardly facing surfaces define a biasing abutment **174** which occludes, at least in part, the channel **173**. In this regard, the channel **173** is defined by a first portion **175** which, when the projection **124** is received therein, positions the ligating slide in a position whereby a practitioner can gain access to the archwire slot **104**, and a second portion **176**, whereby the resilient biasing members resiliently secures the ligating slide **106** in a substantially closed position thereby restricting access to the archwire slot **104** and capturing the archwire **105** therein. This is seen by a study of FIGS. **11** and **13**, respectively. As seen in FIG. **16**, the first and second depending legs are resiliently moveable laterally outwardly, one relative to the other to allow for the passage of the projection **124** therethrough, thereby locating the projection **124** in either the first or second portions **175** and **176** of the channel **173**. As seen from a study of FIGS. **11** and **13**, the ligating slide **106** is moveable along a course of travel or movement **180**, between a first position **181**, where the ligating slide **106** allows access to the archwire slot **104** (FIG. **13**), and wherein the projection **124** is in engagement thereagainst the transverse portion **161**; and a second position **182**, and where the ligating slide **106** projects over the opening **108** and restricts access to the archwire slot **104** (FIG. **11**). In this arrangement, the ligating slide **106** is biasingly supported in at least one of the first or second positions by the planar biasing member **107**. As seen by reference to FIGS. **11** and **13**, the first portion **175** of the channel **173** receives the projection **124** when the ligating slide is in the first position **181** (FIG. **13**), and the second portion **176** receives the projection **124** when the ligating slide **106** is in the second position **182**. As similarly described with respect to the first form of the invention, the biasing force applied to the biasing member **107** is substantially perpendicular relative to the projection **124** and substantially parallel to the path of movement **180** of the ligating slide **106**.

Third Embodiment

The third embodiment of the orthodontic bracket of the present invention is generally indicated by the numeral **200**, and is best seen by reference to FIG. **18**. As seen therein, the third embodiment of the orthodontic bracket **200** is defined

by a bracket body or base member **203** and which further defines a transversely disposed archwire slot **204** which is operable to receive an archwire **205** of traditional design. As earlier discussed with respect to the first and second forms of the invention, the archwire slot **204** is shown in a transverse orientation relative to the bracket body or base member **203**, however, it will be appreciated that the archwire slot **204** may be located in various orientations to achieve assorted clinical benefits for a patient. As seen in FIG. **18**, the archwire slot **204** is substantially rectangular and is operable to receive a rectangular shaped archwire **205** of conventional design. The orthodontic bracket **200** further includes a ligating slide **206** which moveably cooperates with the base member **203**, and is moveable along a path of travel from a first position which allows access to the archwire slot **204** through an opening **208**, and a second position, where the moveable ligating slide **206** prevents access to the archwire slot. Similar to that described with respect to the forms of the invention which were earlier described, it will be understood that the ligating slide **206** is resiliently deformable so as to facilitate passive self-ligation, and the proper seating of the archwire **205** in the archwire slot **204**, if necessary. The ligating slide is shown in phantom view in order to illustrate the relative resiliency and movement of the ligating slide relative to the bracket body or base member **203**. As seen in FIGS. **18** and **20**, the third embodiment or form of the invention **200** includes a biasing member **207** which is borne by the base member **203**, and which resiliently cooperates with a portion of the ligating slide **206**. As seen in FIG. **18**, the biasing member **207** exerts a biasing force which is directed posteriorly outwardly relative to the base member **203** to position the ligating slide **206** in the opposite first and second positions which are shown, alternatively, in solid as well as in phantom lines. As will be recognized from a study of FIG. **18**, the biasing member **207** is carried by, or otherwise positioned, mounted, or received within a portion of the base member **203** as will be described in further detail below. The biasing member **207** is operable to releasably biasingly position the moveable ligating slide **206** in one of the aforementioned positions relative to the archwire slot **204**. As seen in FIG. **18**, the base member **203** has an anterior facing surface or side **210**; and an opposite posterior facing surface or side **211** which may be adhesively affixed, at least in part, to an underlying tooth of a patient who is being treated. Still further, the base member **203** has a top or superior facing surface or portion **212**, and a bottom, lowermost or inferior facing surface **213**. Similar to that described with the first and second forms of the invention, the base member as well as the moveable ligating slide **206** define individual elongated channels **214** which may be utilized to engage other orthodontic appliances as is customary for the treatment of a patient. As earlier described, this arrangement results in an orthodontic bracket which has substantially continuous superior and inferior tie wings.

As seen in FIG. **18**, and similar to the earlier forms of the invention, a transverse, substantially rectangular cross-sectional passageway **220** is formed in the base member **203** and disposed in substantially parallel, spaced relation relative to the archwire slot **204**. This transverse passageway **220** may receive other orthodontic appliances such as a secondary archwire, or further may utilize a novel torquing spring assembly such as what is seen in FIG. **19** and which was earlier described with respect to the first and second forms of the invention. As seen in FIGS. **18** and **20**, and as discussed briefly above, the second form of the invention **200** includes a biasing member **207** which exerts a biasing force which is directed generally posteriorly outwardly relative to the base member **203** to position the ligating slide **206** in the first and second positions, as described earlier. In this regard, the biasing member **207** is carried or otherwise positioned or mounted on the base member **203** and is typically received within a cavity **221** that is formed therein. As seen from FIG. **18** it will be understood that the cavity **221** does not extend through the base member. Further, it should be appreciated that the biasing member **207** can take on a number of configurations. Some possible configurations are those which are illustrated in U.S. Pat. No. 5,466,151, the teachings of which are incorporated by reference herein. One possible form of the biasing member is seen in FIG. **20** where the biasing member is illustrated as a deformable, resilient o-ring which is fabricated of a metal and/or composite and which is received in the cavity **221**. As will be appreciated, force applied to the o-ring causes it to resiliently deform so as to permit the movement of the ligating slide **206**. As further seen by reference to FIG. **18**, the base member **203** further defines a substantially vertically oriented passageway **222** which slideably receives a portion of the moveable ligating slide **206** as will be discussed below. The vertically oriented passageway **222** has a first end **223** which is adjacent to the superior side of the base member **203**, and a second end **224** which is adjacent to the inferior side of the orthodontic bracket **200**. As illustrated in FIG. **19**, the biasing member **207** extends into and partially occludes the vertically oriented passageway **222**. The operation of this passageway in combination with the moveable ligating slide **206** will be discussed in greater detail, below.

As seen in FIG. **18**, the ligating slide **206** has a main body **230** having a first superior end **231**, and an opposite inferior end **232**. The main body further has an anterior facing surface **233**; and an opposite posterior facing surface **234**. In the drawing, it will be seen that a portion of the posterior facing surface defines, at least in part, the archwire slot **204** when the ligating slide **206** is positioned in covering relation relative to the archwire slot or opening **208** to restrict access to same. In addition to the foregoing, the main body **230** defines a first portion **237** which forms, at least in part, a portion of the anterior facing surface **233** of the base member **203**; and further a second portion **238** which is positioned in adjacent spaced relation relative to the posterior facing surface **211** of the base member **203**. As seen in FIG. **18**, the second portion **238** of the ligating slide **206** is disposed in spaced relation relative to the anterior facing surface **233** and the first portion **237**. Still further, the second portion **238** is dimensioned in length, thickness, and width so as to be slideably received within the vertically oriented passageway **222** which is defined by the base member **203**. As seen in the present drawing, the second portion **238** has formed therein a plurality of detents, cavities or receiving regions **239** and which receive or otherwise cooperate with a portion of the biasing member **207** so as to releasably position the ligating slide **206** in the first and second positions, as will be discussed below.

As seen from a study of FIG. **18**, the ligating slide **206** is moveable along a course of travel **240**, from a first position **241** and wherein the biasing member **207** is received, at least in part, and cooperates with one of the detents, cavities, or receiving regions **239**, and wherein the ligating slide (phantom lines) and more specifically the first portion **237** thereof allows access to the archwire slot **204**; and a second position **242** (solid lines) and wherein the ligating slide **206** and more specifically the first portion thereof projects over the opening **208** and otherwise substantially restricts access to the archwire slot **204**. In the second position **242**, again the

biasing member **207** is received in one of the detent or receiving regions **239** in order to releasably secure the ligating slide **206** in the appropriate position. To move the ligating slide between the second and first positions, a clinician would merely insert an instrument in the passageway **222** and more specifically at the first end **223** thereof and press downwardly on the second portion **238** of the ligating slide **206** which is slideably received within the passageway **222**.

Therefore in the third form of the invention, an orthodontic bracket **200** is described and which includes a base member **203** having anterior and posterior facing surfaces **210** and **211**, respectively and further defining an archwire slot **204** having an opening **208** in the anterior facing surface **210**. Still further, in this third form of the invention, a ligating slide **206** is movably borne by the base member **203** between a first position **241** which is clear of the archwire slot **204**; and a second position **242**, where the ligating slide **206** projects over the archwire slot. Still further, a biasing member **207** is provided, and which is borne by the base member **203**, and which resiliently cooperates with the ligating slide **206**. As illustrated, the biasing member **207** exerts a biasing force which is directed posteriorly outwardly relative to the base member **203** to position the ligating slide in the first and second positions **241** and **242**, respectively. As earlier noted, a cavity **221** is formed in the base member **203** and which receives, at least in part, the biasing member **207**. As with the other several forms of the invention as earlier described, the first portion **237** of the ligating slide **206** is resiliently deformable so as to further facilitate passive self-ligation if necessary.

Fourth Embodiment

The fourth embodiment of the orthodontic bracket of the present invention is generally indicated by the numeral **300**, and is best understood by a study of FIGS. **21-25**, respectively. As seen therein, the third embodiment of the orthodontic bracket **300** is defined by a bracket body or base member **303** and which further defines a transversely disposed archwire slot **304** which is operable to receive an archwire **305** of traditional design. As discussed with respect to the first, second and third forms of the invention, the archwire slot is shown in a transverse orientation relative to the bracket body or base member **303**. It will be appreciated, however, that the archwire slot **305** may be oriented in various orientations to achieve assorted clinical benefits for a patient. As will be appreciated from a study of FIG. **23**, the archwire slot **304** is substantially rectangularly shaped and is operable to receive a rectangular or square shaped archwire **305** of conventional design. The orthodontic bracket **300** further includes a ligating slide **306** which moveably cooperates with the base member **303**, and is moveable along a path of travel from a first position which allows access to the archwire slot **304** through an opening **308**; and a second position, where the moveable ligating slide **306** prevents access to the same archwire slot. Similar to that described with respect to the other forms of the invention, it will be understood that the ligating slide **306** is resiliently deformable so as to facilitate passive self-ligation and the proper seating of the archwire **305** in the archwire slot **304**, if necessary. As seen in FIG. **23**, the ligating slide is shown in phantom view in order to illustrate the relative resiliency and movement of the ligating slide relative to the bracket body or base member **303**.

As best seen by reference to FIG. **21**, the base member **303** has an anterior facing surface or side **310**, and an opposite posterior facing surface or side **311**. The posterior facing surface may be adhesively affixed, at least in part, to an underlying tooth of a patient who is being treated. Still further, the base member **303** has a top or superior facing surface or portion **312**, and a bottom, lowermost or inferior facing surface **313**. Similar to that described with respect to the first, second and third forms of the invention, the base member **303** as well as the moveable ligating slide **306** define individually elongated channels **314** which may be utilized to engage other orthodontic appliances as is customary for the treatment of a patient. As earlier described, this arrangement results in an orthodontic bracket which has substantially continuous superior and inferior tie-wings.

As seen in FIG. **21** and following, and similar to the earlier forms of the invention, a transverse, substantially rectangular cross-sectional shaped passageway **320** is formed in the base member **303** and is disposed in substantially parallel spaced relation relative to the archwire slot **304**. This transverse passageway **320** may receive other orthodontic appliances such as secondary archwire or further may utilize a novel torquing spring assembly as was previously described with respect to FIG. **19**; or a hook as seen in FIG. **3A** and which is generally designated by the numeral **38**.

As seen in FIG. **21** and following, it should be understood, that a bore **321** is formed in the base member **303**, and more specifically in the lowermost or inferior surface **313** thereof. The elongated bore has a first end **322** which is located adjacent to the posterior facing surface **311** of the base member **303**; and further has a second end **323** which is located adjacent to the anterior facing surface **310** as seen most easily by reference to FIG. **21**. As best understood by reference to FIG. **23**, it should be understood that the bore has a diametral dimension which generally increases when measured from the posterior facing surface **311** in the direction of the anterior facing surface **310**. More specifically, and as seen in FIG. **23**, it will be recognized, that the inside diametral dimension, at the second end **323**, is greater than the outside diametral dimension of an elongated flexible projection or member **324** which is received in same. This relationship allows the elongated flexible projection or member **324** to move relative to the bore. This will be discussed in greater detail below.

As seen in FIG. **23**, it will be appreciated that the fourth form of the invention **300** includes an elongated flexible projection or member **324** which has a proximal end **325** which is located near and otherwise affixed to the posterior facing surface **311** of the base member **303**. Still further, the flexible projection or member **324** has a distal end **326** which extends anteriorly, outwardly relative to the anterior facing surface **310** of the base member **303**. As illustrated most clearly to reference to FIG. **21**, the distal end **326** is operable to move along an arcuately shaped path of travel **327** when the ligating slide **306** moves between the first open position where the ligating slide **306** is clear of the archwire slot **304**; and the second position where the ligating slide restricts access or otherwise projects over the archwire slot. Therefore, in one aspect of the present invention, an orthodontic bracket **300** is disclosed and which includes a base member **303** defining an archwire slot **304**; and an elongated flexible member **324** is borne by the base member and which has a distal end **326** which is moveable along an arcuately shaped path of travel **327**. Still further in this form of the invention, a ligating slide **306** is moveably borne by the base member **303** between a first position where the ligating slide is clear of the archwire slot **304**; and a second position where the ligating slide restricts access to the archwire slot. In this regard, the distal end **326** of the elongated flexible member **324** cooperates with the ligating slide **306** and moves along

the arcuately shaped path of travel as the ligating slide moves between the first and second positions. As will be appreciated from a study of the drawings, the arcuately shaped path of travel **327** (which is greatly exaggerated to reveal this feature of the invention) is generally parallel to the anterior facing surface **310** of the base member **303**. In view of the arrangement of the bore **321**, as earlier described, the arcuately shaped path of travel **327** of the distal end **326** is generally facilitated. However, it should be understood that the flexible member **324** as herein described is not deformable or compressible in a longitudinal direction as was previous prior art assemblies. Rather, as seen in the drawings, the flexible member merely is operable to allow the distal end **326** thereof to move along the arcuately shaped path of travel for the benefits that will be described hereinafter. As illustrated most clearly by reference to FIG. **21**, the base member has a lowermost portion **328** which defines a channel **329** which extends from the archwire slot **304** to the lowermost portion. As seen in the drawings, and as appreciated from the various views, the ligating slide **306** is slideably received in the channel defined by the base member, and the elongated flexible projection or member **324** defines the path of travel for the ligating slide as it moves between the first open position which is clear of the archwire slot, to the second position where the ligating slide **306** projects over the archwire slot and restricts access to same.

As best illustrated by reference to FIG. **21**, the ligating slide **306** has a main body **340** having a first superior end **341**, and an opposite inferior end **342**. The main body further has an anterior facing surface **343** and an opposite posterior facing surface **344**. In the drawings as provided, it will be seen that a portion of the posterior facing surface defines, at least in part, the archwire slot **304**, and the ligating slide **306** is positioned in covering relation relative to the archwire slot or opening **308** to restrict access to same. In addition to the foregoing, the main body, and more specifically, the anterior facing surface **343** thereof has a first recessed region **345** and a second recessed region **346** formed therein. These recessed regions allow the ligating slide **306** to be matingly received in the channel **329**, and move along a course of travel which will be discussed in greater detail hereinafter. As best seen by reference to FIG. **21** and following, a channel **350** having a given nonlinear shape is formed in the posterior facing surface **344** of the main body **340** and is operable to receive the distal end **326** of the flexible projection or member **324**. As seen therein, the channel has a first end **351**, and a second, opposite end **352**. Still further, there is a first transversely disposed seat **353** formed at the first end **351**, and a second, transversely disposed seat **354** formed at the second end thereof. The channel includes an intermediate portion **355** which couples the first and second transverse seats **353** and **354** together. Still further, the main body **340** includes an abutting edge **356**. As should be understood, the ligating slide **306** is slideably borne by the base member **303**, and is moveable between a first, open position which allows access to the archwire slot **304** and a second closed position which restricts access to the archwire slot. The ligating slide **306** has an anterior and a posterior facing surface **343** and **344**, respectively, and wherein a channel **350** is formed in the posterior facing surface of the ligating slide and is operable to receive the elongated flexible member **324** therein. As earlier discussed, the flexible member has a distal end **326** which is received in the channel and wherein the distal end is resiliently deformed along a substantially arcuately shaped path of travel **327**. The flexible member cooperates with the channel **350** to releasably secure the ligating slide **306** in the first and second positions as will be described below. In the arrangement as seen in the drawings, the channel **350** includes first and second transverse seats **353** and **354**, respectively, which are located at the first and second ends **351** and **352** of the channel. These individual seats are each dimensioned to matingly receive the flexible projection or member **324** and wherein the flexible projection or member is not substantially deformed when received in the respective seats. As should be understood, the movement of the ligating slide **306** between the first and second positions causes the flexible projection or member to resiliently deform and move out of the respective seats and along the intermediate portion **355** of the channel. As will be recognized from a study of FIG. **23**, and similar to the previous forms of the invention, the ligating slide **306** is resiliently deformable and has a superior end **341** which is rounded or beveled, at least in part. Still further, the ligating slide **306** has opposite peripheral edges **347** and the base member **303** shields, at least in part, the opposite peripheral edges as best seen by reference to FIG. **22**.

As seen from a study of the drawings, the ligating slide **306** is moveable along a course of travel **350** from a first position **351** and wherein the distal end **326** of the elongated flexible projection or member is received in the first transverse seat **353** which is located at the first end of the channel **350**, and wherein the ligating slide is substantially clear of the archwire slot **304**; and a second position **352**, and wherein the distal end **326** is located at the second seat **354** and the ligating slide **306** is located in substantially covering relation over the archwire slot and thereby inhibits access to same.

Fifth Embodiment

The fifth embodiment of the orthodontic bracket of the present invention is generally indicated by the numeral **400**, and is best seen by reference to FIGS. **26** and **27**, respectively. As seen therein, the second embodiment of the orthodontic bracket **400** is defined by a bracket body or base member **403** and which further defines a transversely disposed archwire slot **404** which is operable to receive an archwire **405** of traditional design. As earlier discussed, the archwire slot **404** is shown in a transverse orientation relative to the bracket body or base member **403**, however, it will be appreciated that the archwire slot **404** may be oriented in various orientations to achieve various clinical benefits for a patient. As seen in the drawings, the archwire slot **404** is substantially rectangular in shape, and is operable to receive a rectangular or square shaped archwire **405** of conventional design. The orthodontic bracket **400** includes a ligating slide **406** which moveably cooperates with the base member **403**, and is moveable along a path of travel from a first position which allows access to the archwire slot **405** through the opening **408**, and a second position where the moveable ligating slide **406** prevents access to the archwire slot. It will be appreciated by a study of FIG. **27** that the ligating slide **406** is resiliently deformable so as to facilitate passive self-ligation, and the proper seating of the archwire **405** in the archwire slot **404**. As should be understood, the present resiliently deformable ligating slide **406** may be deformed sufficiently such that it may close over an archwire **405** which may be slightly protruding from the archwire slot **404**. Over time, however, the ligating slide **408** will assume its original shape to confine or otherwise enclose the archwire **405** within the archwire slot in the manner of passive self ligation, as earlier discussed. As seen by reference to FIGS. **26** and **27**, the base member **403** has an anterior facing surface or side **410**, and an opposite posterior facing surface or side **411**, which may be adhesively affixed, at least in part,

to an underlying tooth of a patient who is being treated. Still further, the base member **403** has a top or superior surface **412**, and a bottom or inferior surface **413**. As seen in FIG. **27**, the base member **403**, and a portion of the moveable ligating slide **406** define individually elongated channels **414** which may be utilized to engage other orthodontic appliances as is customary for the treatment of a patient. The base member and ligating slide each define a substantially continuous tie wing.

As seen in FIGS. **26** and **27**, for example, and similar to the other forms of the invention, a transverse substantially rectangular cross-sectioned passageway **420** is formed in the base member **403**, and is disposed in substantially parallel spaced relation relative to the archwire slot **404**. As earlier disclosed, this transverse passageway **420** may receive other orthodontic appliances, such as a secondary archwire, or further may utilize the novel torquing spring assembly **31** such as described in previous forms of the invention, and which is seen in FIG. **19**. As seen in the drawings, the fifth form of the orthodontic bracket **400** includes an elongated flexible member **424** which is received in a bore **425**, and which extends generally posteriorly outwardly relative to the base member **403**. The flexible member has a proximal end **426** which is secured in the base **425**, and a distal end **427** which cooperates with the ligating slide **406** in order to achieve the benefits which will be discussed in greater detail hereinafter. As seen in FIG. **27**, the bore **425** does not extend through the base member **403** and has variable diametral dimension which facilitates the movement of the distal end **427** along an arcuately shaped path of travel similar to that disclosed in the fourth form of the invention. Further, and when assembling the fifth form of the invention, it should be clear from a study of FIG. **27** that the flexible member **424** is inserted in the bore **425** from the posterior side **411** of the base member **403**. It is, of course, possible to fabricate a base member where the flexible member could be inserted from the anterior facing surface thereof. As seen by reference to FIGS. **26** and **27**, respectively, the base member **403** further defines a substantially vertically oriented passageway **428** which slideably receives a portion of the moveable ligating slide **406** as will be discussed in greater detail hereinafter. The vertically oriented passageway is located adjacent to the posterior facing surface **411** and extends from the superior surface **412** of the base member **403** to the inferior **413**. As seen by reference to FIG. **27**, the projection **424** extends into and partially occludes the vertically oriented passageway **428**. The operation of the passageway, in combination with the moveable ligating slide **406**, will be discussed in greater detail, hereinafter.

As best seen by reference to FIGS. **26** and **27**, the base member **403** includes a pair of anteriorly extending guide members **430** which are positioned in predetermined substantially parallel spaced relation one relative to the other. The guide members **430** are operable to cooperate with the ligating slide **406** as will be described below. Each of the guide members have an inwardly facing surface **431** which defines a passageway **432** therebetween, and which slideably receives a portion of the ligating slide **406**. Further, and similar to the other forms of the invention **10**, the guide members may further include a portion which is operable to slideably restrain, and otherwise shield, at least in part, the ligating slide **106** (not shown in FIG. **26**). As seen in FIGS. **26** and **27**, for example, the ligating slide **406** has a main body **450** having a first superior end **451**, and an opposite second inferior end **452**. The main body further has an anterior facing surface **453**, and an opposite posterior facing surface **454**. As seen in those drawings, a portion of the posterior facing surface defines, in part, the archwire slot **404** when the ligating slide is positioned in covering relation relative to the archwire slot to restrict access to same. Such as seen in FIG. **27**. The main body **450** has opposite substantially vertically disposed peripheral edges **455** and **456**, respectively. Still further, the main body has a first portion **457** which forms, at least in part, a portion of the anterior facing surface **453** of the base member **403**; and further, a second portion **458** which is positioned in adjacent spaced relation relative to the posterior facing surface **411** of the base member when the orthodontic bracket **400** is assembled. As seen in FIGS. **26** and **27**, the second portion **458** of the ligating slide **406** is disposed in spaced relation relative to the posterior facing surface **454**. Still further, the second portion **458** is dimensioned, in length, thickness and width, to be slideably received within the vertically oriented passageway **428** which is defined by the base member **403**. The second portion of the ligating slide defines a channel **459** similar in shape and in function as was previously described with respect to the earlier forms of the invention and which receives the distal end **427** of the flexible member **426**. The flexible member, in cooperation with the channel **459** defines a course of movement for the accompanying ligating slide **406** for the purposes which will be described, below.

As seen from a study of FIGS. **26** and **27**, the ligating slide **406** is moveable along a course of travel or movement between a first position, where the ligating slide **406** allows access to the archwire slot **404**, and wherein the flexible member **424** is at one end of the channel **459**, and a second position where the ligating slide **406** projects over the opening **408** and restricts access to the archwire slot **404** (FIG. **27**), and the flexible member **424** is at the opposite end of the channel **459**. As the flexible member moves along the channel, the distal end thereof moves along the arcuately shaped path of travel as was previously described in the earlier forms of the invention. In this arrangement, the ligating slide **406** is biasingly supported in at least one of the first or second positions by the flexible member **424**.

Operation

The operation of the described embodiments of the present invention are believed to be readily apparent and are briefly summarized at this point.

In its broadest aspect, the present invention relates to an orthodontic bracket **10**, **100**, which includes a ligating slide **16**, **106** which is configured to be coupled to a base member **13**, **103** and wherein the ligating slide further cooperates F with a biasing member **17**, **107** which receives, at least in part, a portion of the base. As illustrated, and in two forms of the invention **10** and **100**, the biasing member exerts a biasing force which is directed principally in a direction which is substantially parallel, and in spaced relation relative to the direction, or path of movement of the ligating slide. Still further, the present invention relates to an orthodontic bracket **10**, **100** which includes a base member **13**, **103** defining an archwire slot **14**, **104** having an opening **44**, **108**, and wherein at least one projection **34**, **124** extends outwardly from the base member **13**, **103**. The orthodontic bracket **10**, **100** further includes a ligating slide **16**, **106** which is moveable along a course of travel between a first position **75**, **181** which is clear of the archwire slot **14**, **104** and a second position **76**, **182** where the ligating slide **16**, **106** projects over the opening **44**, **108** of the archwire slot. Still further, the present invention includes a resilient biasing member **17**, **107** borne by the ligating slide **16**, **106** and slideably cooperating with a projection **34**, **124**, and wherein the resilient member has a first portion **95**, **175** which

receives the projection **34**, **124** when the ligating slide is in the first position **75**, **181** and a second portion **96**, **176** which receives the projection **34**, **124** when the ligating slide is in the second position **76**, **182**.

The orthodontic bracket **10**, **100** of the present invention includes a base member **13**, **103** defining a transverse archwire slot **14**, **104** having an opening **44**, **108**. A ligating slide **16**, **106** is borne by the base member **13**, **103** and is further moveable relative to the archwire slot **14**, **104**, and wherein the ligating slide is moveable between a first position **75**, **181** where the ligating slide allows access to the archwire slot, and a second position **76**, **182** where the ligating slide projects over the opening **44**, **108** and restricts access to the archwire slot **14**, **104**. In the present invention, the ligating slide **16**, **106** is biasingly supported in at least one of the first or second positions as described above. As was described earlier, the biasing force supplied by the biasing member is generally in a direction which is substantially parallel to the direction of movement of the ligating slide.

The orthodontic bracket **10**, **100** of the present invention further comprises, in one respect, a base member **13**, **103** having a transverse archwire slot **14**, **104** defining an opening **44**, **108** and at least one projection **34**, **124** extending outwardly from the base member **13**, **103**. The present invention further includes a ligating slide **16**, **106** moveable between a first position **75**, **181** which is clear of the archwire slot and a second position **76**, **182** projecting over the opening of the archwire slot. Still further in the present invention, a substantially planar resilient biasing member **17**, **107** is borne by the ligating slide **16**, **106** and matingly cooperates with the projection **34**, **124**. In the arrangement as seen in the drawings, a first portion of the biasing member **95**, **175** receives the projection when the ligating slide **16**, **106** is in the first position **75**, **181**, and a second portion **96**, **176** receives the projection **34**, **124** when the ligating slide is in the second position.

The orthodontic bracket **10**, **100** further comprises a base member **13**, **103** having an opening **44**, **108** and a transverse passageway **30**, **120**, which is oriented in substantially parallel spaced relation relative to the archwire slot **14**, **104**. Still further, the orthodontic bracket **10**, **100** includes a ligating slide **16**, **106** borne by the base member **13**, **103** and moveable relative to the archwire slot **14**, **104**, and wherein the ligating slide is moveable between a first position **75**, **181** where the ligating slide is clear of, and allows access to the archwire slot; and a second position **76**, **182** where the ligating slide projects over, and restricts access to, the archwire slot **14**, **104**. As earlier disclosed, the transverse passageway **30**, **120** is operable to cooperate with a torquing assembly **31**, **121** in order to exert force upon an archwire **15**, **105**.

Another aspect of the orthodontic bracket **10**, **100** of the present invention includes a base member **13**, **103** having a posterior facing surface **21**, **111** and an anterior facing surface **20**, **110** and a projection **34**, **124** extending outwardly from one or both of the posterior **21**, **111** and/or anterior facing surfaces **20**, **110**, and wherein the projection **34**, **124** has an outwardly facing surface **36**, **126**. A ligating slide **16**, **106** is borne by the base member **13**, **103**, and further has a pair of members **84**, **85**, **164**, **165** having opposing surfaces **92**, **172** and a channel **93**, **173** defined therebetween the opposing surfaces **92**, **172**. The channel defined by the biasing member is substantially parallel to the ligating slide. The pair of members **84**, **85**, **164**, **165** resiliently cooperate with the outwardly facing surface **36**, **126** of the projection **34**, **124** in order to exert a biasing force which is substantially parallel to the direction of movement of the ligating slide, and which positions the ligating slide **16**, **106** in an appropriate orientation relative to the archwire slot **14**, **104**. In this regard, the pair of members **84**, **85**, **164**, **165** are spaced, and resiliently moveable, one relative to the other. Still further, a biasing abutment **94**, **174** is defined by one of the surfaces **92**, **172** of the respective members. The biasing abutment at least partially occludes the channel **93**, **173**.

The present invention also relates to an orthodontic bracket **100** which has a base member **103** having a posterior facing surface **111**, and an anterior facing surface **110**, and wherein a projection **124** extends generally outwardly and in the direction of the posterior facing surface **111**, and wherein the anterior facing surface **110** of the base member **103** defines an archwire slot **104** having an opening **108**. In this second form of the invention **100**, a ligating slide **106** is borne by the base member **103** and is moveable along a course of travel **180** between a first position **181** which allows access to the archwire slot **104** through the opening **108**, and a second position **182**, which restricts access to the archwire slot **104** through the same opening **108**. In this arrangement, the ligating slide **106** includes a first portion **157** which extends to a second portion **158**. In this arrangement, the first portion **157** forms, at least in part, a portion of the anterior facing surface **110** of the base member **103**, and the second portion **158** is positioned in adjacent spaced relation relative to the posterior facing surface **111** of the base member **103**. In the arrangement as seen the second form of the invention **100**, a resilient biasing member **107** is coupled to the ligating slide **106** and which operatively mates with and or otherwise cooperates with the projection **124**. The resilient biasing member **107** exerts a biasing force relative to the projection **124** which is substantially perpendicular; and further substantially parallel and non-coaxial alignment relative to the path of travel **180**.

In another aspect of the present invention, an orthodontic bracket **10** includes a base member **13** defining an archwire slot **14** and which traverses the base member **13**, and wherein the archwire slot **14** defines an opening **44** within an anterior facing surface **20** of the base member **13**. Still further, in the first form of the invention **10**, a channel **43** extends along the anterior side **20** of the base member **13** from the archwire slot **14** to a lowermost surface **23** of the base member **13**. In this arrangement, a fixed projection **34** extends laterally outwardly from the base member **13** and into a portion of the channel **43**. Further, a biasing member **17** resiliently cooperates with the fixed projection **34**.

The present invention also relates to a method of forming an orthodontic bracket **10** which includes providing an orthodontic bracket base member **13** having an anterior surface **20** and a posterior surface **21**; providing an opening **44** within the anterior surface **20** of the base member **13**, and wherein the opening **44** traverses the width of the base member **13**, and further defines, at least in part, an archwire slot **14**. Still further, the present methodology includes a step of providing a channel **43** within the base member **13**, and which extends downwardly relative to the archwire slot **14**; and providing a projection **34** extending outwardly from the channel **43** and which is rigidly affixed to the base member **13**. The present methodology also relates to a method of forming an orthodontic bracket which includes the steps of providing a ligating slide **16**, **106** which is moveably borne by a base member **13**, **103**; and coupling a biasing member **17**, **107** to the ligating slide **16**, **106**, and wherein the biasing member is substantially parallel to the ligating slide.

Therefore, it will be seen that the present invention has been designed to meet the future needs of the orthodontic profession, and further addresses many of the shortcomings attendant with the prior art devices and practices which have been utilized heretofore. The present orthodontic bracket will result in a greater range of treatment options and the quality of the resulting orthodontic treatment will be greatly improved in view of the many features of the present invention.

In compliance with the statute, the invention has been described in language more or less specific as to structural and methodical features. It is to be understood, however, that the invention is not limited to the specific features shown and described, since the means herein disclosed comprise preferred forms of putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the proper scope of the appended claims appropriately interpreted in accordance with the doctrine of equivalents.

What is claimed is:

1. An orthodontic bracket for coupling an archwire with a tooth, comprising:

a bracket body that is configured to be mounted to the tooth and that includes an archwire slot adapted to receive the archwire, an anterior surface, a slide channel, and a recess that is formed in the anterior surface;

a ligating slide that includes a superior end and is movable relative to the bracket body in the slide channel between an opened position and a closed position;

a resilient member; and

a projection that cooperates with the resilient member to releasably restrain the heating slide in the closed position,

wherein during movement of the ligating slide toward the opened position, the projection cooperates with the resilient member to produce a force in a perpendicular direction relative to the projection,

wherein the recess includes a wall that opposes the superior end of the ligating slide in the closed position and receives a tool to contact the superior end of the ligating slide so as to move the ligating slide toward the opened position.

2. The bracket of claim **1**, wherein the recess is narrower in width than the width of the ligating slide.

3. The bracket of claim **1**, wherein the slide channel opens to the archwire slot opposite the recess.

4. The bracket of claim **3**, wherein a pair of opposed guide members define at least a portion of the slide channel, the ligating slide sliding between the pair of opposed guide members.

5. The bracket of claim **4**, wherein the pair of opposed guide members are generally L-shaped.

6. The bracket of claim **4**, wherein the ligating slide includes a mesial portion, a distal portion, and a raised central portion positioned intermediate to the mesial and distal portions.

7. The bracket of claim **6**, wherein the mesial portion, the distal portion, and the raised central portion define gingival-occlusal directed grooves that are engagable by the pair of opposed guide members.

8. The bracket of claim **6**, wherein the raised central portion projects in a labial direction such that a labial side of the raised central portion is substantially flush with a labial side of the pair of guides when the ligating slide is in the closed position.

9. The bracket of claim **1**, wherein the resilient member includes a channel and an edge of the channel defines an abutment and during movement of the ligating slide, the projection passes along the channel to slidably engage the abutment.

10. The bracket of claim **9**, wherein the abutment releasably supports the ligating slide in the closed position.

11. The bracket of claim **9**, wherein the abutment separates the channel into a first portion and a second portion, the first portion receives the projection when the ligating slide is in the opened position and the second portion receives the projection when the ligating slide in the closed position.

12. The bracket of claim **9**, wherein the abutment forms a restriction in the channel.

13. The bracket of claim **9**, wherein contact between the projection and the abutment causes the resilient member to resiliently deform in a direction that is perpendicular to the movement of the ligating slide.

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