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Remarks:
This application was filed on 19-07-2011 as a divisional application to the application mentioned under INID code 62.

(54) **Device for forming a closure between fabrics and/or other materials**

(57) Fastening systems include one or more fastening members, sliders, stop blocks and/or top stops. Fastening members described include a variety of features, including structures associated with the head portion,

transition portion, and tail portion. Sliders include friction reducing structures and locking features. Stop blocks provide bottom stops for various articles, and serve to anchor a fastening member. Top stops provide a containment structure for limiting slider travel.

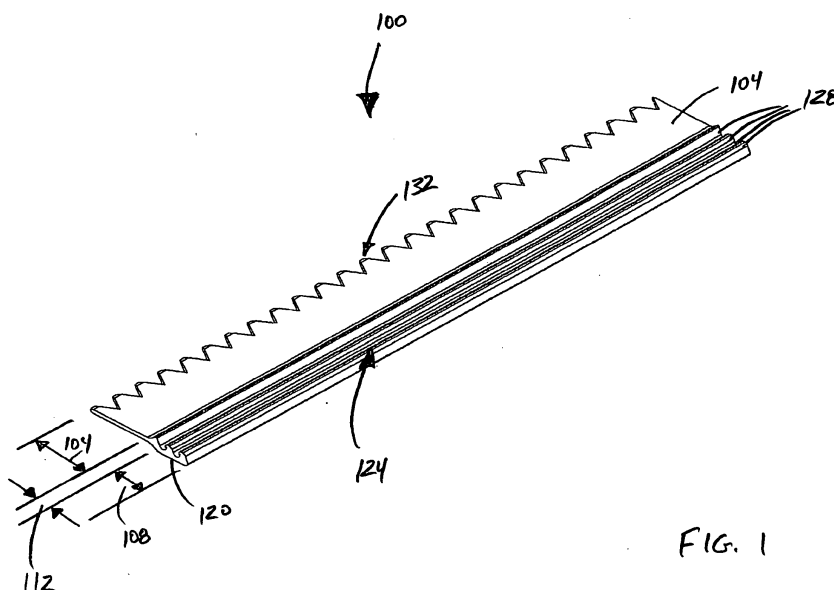


FIG. 1

Description

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application cross-references U.S. Provisional Patent Application Serial No. 60/866,427 filed on November 19, 2006, the content of which is incorporated herein by reference in its entirety. 5

FIELD 10

[0002] The present inventions relates to devices and methods of forming a closure between fabrics and/or other materials. 15

BACKGROUND

[0003] Fastening devices typically include two flexible elongated components having teeth that are forced to interlock and separate by moving a zipper pull along the components. Although such fastening devices have long been used to close and open various articles, such as clothing and bags, such devices suffer from allowing liquids and gases within the fastener, and are therefore, not useful for conditions in which a fluid/wind resistant, wind-proof, gas-tight and/or waterproof closure is desirable. Furthermore, existing closure systems may be perceived as being old style, and thus, there is a need for alternative devices that can provide a closure for various types of articles. Accordingly, there is further need for additional devices and/or assemblies for forming a closure. There is also the need for additional methods that provide a closure. 20 25 30

SUMMARY 35

[0004] Among other things, one or more novel fastening members, sliders, stop blocks and/or top stops are provided for forming a closure and/or a component thereof. Closures described herein include a variety of features, and the Detailed Description describes a number of inventions. In addition, the present inventions include novel methods of manufacture and methods of using the closures and/or components thereof. 40

[0005] Various embodiments of the present inventions are set forth in the attached figures and in the detailed description of the invention as provided herein and as embodied by the claims. It should be understood, however, that this Summary does not contain all of the aspects and embodiments of the present inventions, is not meant to be limiting or restrictive in any manner, and that the inventions as disclosed herein is and will be understood by those of ordinary skill in the art to encompass obvious improvements and modifications thereto. Other aspects and embodiments of the invention are set out in the numbered clauses which follow: 45 50 55

1. A fastening system, comprising:

a first fastening member including a first mating surface, the first fastening member having a first longitudinal end and a second longitudinal end, wherein the first mating surface extends a first longitudinal length between the first and second longitudinal ends of the first fastening member; a second fastening member including a second mating surface, the second fastening member having a first longitudinal end and a second longitudinal end, wherein the second mating surface extends a second longitudinal length between the first and second longitudinal ends of the second fastening member, and wherein said second mating surface is adapted for being positioned generally opposite said first mating surface for releasably interlocking said first mating surface;

a slider comprising a slider body including an opening end and a closing end, said closing end having a confining portion wherein said first mating surface of said first fastening member is placed into interlocking engagement with said second mating surface of said second fastening member, wherein when said slider is moved in a closing direction the first fastening member and said second fastening member pass within said slider from said opening end to said closing end and said slider places said first mating surface into interlocking engagement with said second mating surface, at least a portion of the slider body including a sloping engagement surface at its closing end;

a stop block comprising a first housing portion and a second housing portion, wherein the first housing portion is hingedly interconnected to the second housing portion, wherein one of the first and second housing portions is fixedly secured to at least one of the first and second longitudinal ends of one of said first and second fastening members, the stop block having at least a first closed position and a second open position, wherein when the sloping engagement surface of the slider body contacts a receiving surface of at least one of the first and second housing portions of the stop block the slider urges the stop block from the first closed position to the second open position, wherein the stop block releasably secures at least a grasp portion of another of the at least one of the first and second longitudinal ends of one of said first and second fastening members within the stop block when the grasp portion is fed into the stop block in the second open position and the slider is then advanced in the closing direction away from the stop block placing the stop block in the first closed position.

2. The fastening system of Clause 1, wherein the

closing end of the slider body comprises a wedge shape.

3. The fastening system of Clause 2, wherein the stop block comprises an internal surface including a plurality of ribbed engaging surfaces.

4. The fastening system of Clause 1, further comprising a top stop fixedly secured to at least one of the first and second longitudinal ends of one of said first and second fastening members.

5. The fastening system of Clause 4, wherein the top stop comprises a mating surface, wherein the slider comprises a tongue and groove portion, and wherein the mating surface of the top stop is adapted to engage the tongue and groove portion of the slider.

6. The fastening system of Clause 4, further comprising an electrical wire located within at least one of the first fastening member, the second fastening member, the stop block and the top stop.

7. A fastening system, comprising:

a first fastening member including a first mating surface, the first fastening member having a first longitudinal end and a second longitudinal end, wherein the first mating surface extends a first longitudinal length between the first and second longitudinal ends of the first fastening member; a second fastening member including a second mating surface, the second fastening member having a first longitudinal end and a second longitudinal end, wherein the second mating surface extends a second longitudinal length between the first and second longitudinal ends of the second fastening member, and wherein said second mating surface is adapted for being positioned generally opposite said first mating surface for releasably interlocking said first mating surface;

a slider comprising a slider body including an opening end and a closing end, said closing end having a confining portion wherein said first mating surface of said first fastening member is placed into interlocking engagement with said second mating surface of said second fastening member, wherein when said slider is moved in a closing direction the first fastening member and said second fastening member pass within said slider from said opening end to said closing end and said slider places said first mating surface into interlocking engagement with said second mating surface;

a stop block fixedly secured to at least one of the first and second longitudinal ends of one of said first and second fastening members, wherein a receiving channel is located within the stop block, and a rotatable brake is located within at least a portion of the receiving channel, wherein the stop block releasably secures at least a grasp portion of another of the at least

one of the first and second longitudinal ends of one of said first and second fastening members within the stop block when the grasp portion is fed into the stop block and the rotatable brake engages the grasp portion.

8. The fastening system of Clause 7, wherein the rotatable brake comprises a cam.

9. The fastening system of Clause 7, wherein the rotatable brake comprises a roller having a rotation axis oriented substantially perpendicular to a longitudinal axis of the stop block.

10. The fastening system of Clause 7, wherein the rotatable brake comprises release mechanism for disengaging the rotatable brake from the grasp portion.

11. The fastening system of Clause 7, further comprising a top stop fixedly secured to at least one of the first and second longitudinal ends of one of said first and second fastening members.

12. A fastening system, comprising:

a first fastening member including a first mating surface, the first fastening member having a first longitudinal end and a second longitudinal end, wherein the first mating surface extends a first longitudinal length between the first and second longitudinal ends of the first fastening member; a second fastening member including a second mating surface, the second fastening member having a first longitudinal end and a second longitudinal end, wherein the second mating surface extends a second longitudinal length between the first and second longitudinal ends of the second fastening member, and wherein said second mating surface is adapted for being positioned generally opposite said first mating surface for releasably interlocking said first mating surface;

a slider comprising a slider body including an opening end and a closing end, said closing end having a confining portion wherein said first mating surface of said first fastening member is placed into interlocking engagement with said second mating surface of said second fastening member, wherein when said slider is moved in a closing direction the first fastening member and said second fastening member pass within said slider from said opening end to said closing end and said slider places said first mating surface into interlocking engagement with said second mating surface;

a stop block comprising a first block member fixedly secured to at least one of the first and second longitudinal ends of one of said first and second fastening members, and a second block member fixedly secured to another of the at least one of the first and second longitudinal ends of

one of said first and second fastening members, wherein the first block member releasably engages the second block member to form a connected block member.

13. The fastening system of Clause 12, further comprising a top stop fixedly secured to at least one of the first and second longitudinal ends of one of said first and second fastening members.

14. A fastening system for use with a slider, comprising:

a first fastening member including a first mating surface, the first fastening member having a first longitudinal end and a second longitudinal end, wherein the first mating surface extends a first longitudinal length between the first and second longitudinal ends of the first fastening member; a second fastening member including a second mating surface, the second fastening member having a first longitudinal end and a second longitudinal end, wherein the second mating surface extends a second longitudinal length between the first and second longitudinal ends of the second fastening member, and wherein said second mating surface is adapted for being positioned generally opposite said first mating surface for releasably interlocking with said first mating surface when the slider places the first mating surface into interlocking contact with the second mating surface; and at least one communication element comprising at least one of an electrical wiring and optical fiber extending along at least a portion of the longitudinal length of at least one of the first fastening member and second fastening member.

15. The fastening system of Clause 14, wherein the communication element is located within a material of the at least one of the first fastening member and second fastening member.

16. The fastening system of Clause 14, wherein the communication element is located along a surface of a tongue and groove portion of the first mating surface and second mating surface.

17. A slider for use with a first fastening member and a second fastening member, the first and second fastening members comprising mating surfaces oriented along a longitudinal axis and adapted for releasably interlocking upon translation of the slider longitudinally along a longitudinal length of the first and second fastening members, the slider comprising:

a slider body comprising a plurality of portions adapted for interconnection using a fastening mechanism.

18. The slider of Clause 17, wherein the fastening mechanism interconnects an intermediate portion of the slider body, the intermediate portion separating the mating surfaces upon translation of the slider in an opening direction.

19. A slider for use with a first fastening member and a second fastening member, the first and second fastening members comprising mating surfaces oriented along a longitudinal axis and adapted for releasably interlocking upon translation of the slider longitudinally along a longitudinal length of the first and second fastening members, the slider comprising:

a slider body including a roller interconnected to the slider body, the roller located for contacting at least one of the first and second fastening members upon the translation of the slider.

20. The slider of Clause 19, wherein the roller comprises a rotational axis oriented substantially perpendicular to the longitudinal axis.

21. A fastening system, comprising:

a first fastening member including a head portion having a first mating surface and a backside, the backside of the head portion comprising at least one receptacle;

a second fastening member including a second mating surface, wherein said second mating surface is adapted for being positioned generally opposite said first mating surface for releasably interlocking with said first mating surface when the first mating surface is placed into interlocking contact with the second mating surface; and

at least one insert adapted for insertion within the at least one receptacle.

22. The fastening system of Clause 21, wherein the insert is retained within the receptacle by a tongue and groove configuration.

23. The fastening system of Clause 21, wherein the insert comprises at least one of a reflector, a fluid conveyance conduit, a wire, a communication element, a bumper, and a decorative insert.

24. The fastening system of Clause 21, further comprising a slider for placing the first mating surface into interlocking contact with the second mating surface.

25. A fastening system, comprising:

a first fastening member including a head portion having a primary mating surface on a front side and a secondary mating surface on a backside; a second fastening member including a forked head portion wherein a first interior side of said forked head portion includes a first interior mat-

ing surface and an opposing second interior side of said forked head portion includes a second interior mating surface;

wherein said head portion of said first fastening member is adapted for being releasably interlocked in said forked head portion of said second fastening member such that said primary mating surface releasably interlocks with said first interior mating surface, and said secondary mating surface releasably interlocks with said second interior mating surface.

26. The fastening system of Clause 25, wherein a void space is formed within the forked head portion of the second fastening member when said first head portion is releasably interlocked within said second fastening member.

27. The fastening system of Clause 26, wherein the void space comprises a fluid conduit.

28. The fastening system of Clause 26, wherein the void space may be pressure tested.

29. A slider for use with at least a first fastening member and a second fastening member, the first fastening member including a first mating surface and the second fastening member including a second mating surface, wherein the first and second mating surfaces are oriented along a longitudinal axis and adapted for releasably interlocking upon translation of the slider longitudinally along a longitudinal length of the first and second fastening members, the slider comprising:

a slider body including an opening end and a closing end, said opening end having an upper portion and a lower portion, and an intermediate portion between the upper and lower portions, the intermediate portion positioned generally at the opening end for locating between the first mating surface of the first fastening member and the second mating surface of the second fastening member when the slider is moved in an opening direction;

a pull tab connected to the intermediate section of the slider body, wherein the pull tab may be rotated from a first position when pulling the slider in the opening direction to a second position when pulling the slider in a closing direction.

30. The slider of Clause 29, wherein the pull tab is interconnected to the intermediate portion by a rotatable pin oriented substantially perpendicular to the longitudinal axis of the first and second mating surfaces.

31. The slider of Clause 30, wherein the rotatable pin is substantially circular in cross section.

32. The slider of Clause 30, wherein the pin comprises a contacting portion having a non-circular cross-section, wherein the contacting portion con-

tacts at least one of the first and second mating surfaces as the slider is translated along the longitudinal axis of the first and second mating surfaces.

33. The slider of Clause 32, wherein the non-circular cross section is substantially wedge shaped.

34. A slider for use with a first fastening member and a second fastening member, the first and second fastening members comprising mating surfaces oriented along a longitudinal axis and adapted for releasably interlocking upon translation of the slider longitudinally along a longitudinal length of the first and second fastening members, the slider comprising:

a slider body including an opening end and a closing end, said opening end having an upper portion and a lower portion, and an intermediate portion between the upper and lower portions, the intermediate portion positioned generally at the opening end for locating between the first mating surface of the first fastening member and the second mating surface of the second fastening member when the slider is moved in an opening direction, the intermediate portion having a first side releasably interconnectable to the upper portion and a second side releasably interconnectable to the lower portion, wherein the intermediate portion can be separated from the upper portion and lower portion.

35. The slider of Clause 34, wherein the intermediate portion is replaceable with removal from the upper and lower portions, and insertion of a replacement intermediate portion.

36. A fastening system, comprising:

a first fastening member including a first head portion having a first mating surface, the first head portion including at least one of a magnet and a ferromagnetic material extending along a longitudinal length of the first mating surface; a second fastening member including a second head portion having a second mating surface, wherein said second mating surface is adapted for being positioned generally opposite said first mating surface for releasably interlocking with said first mating surface when the first mating surface is placed into interlocking contact with the second mating surface; and

a slider comprising a slider body including an opening end and a closing end, said opening end and said closing end having an upper portion and a lower portion, wherein at least one of the upper portion and the lower portion of the opening end include at least one of a slider magnet and a slider ferromagnetic material, and wherein a magnetic force is applied between the first head portion and the at least one of the up-

per portion and lower portion of the opening end.

37. The fastening system of Clause 36, wherein the second head portion comprises at least one of a magnet and a ferromagnetic material.

38. The fastening system of Clause 36, wherein the closing end of the slider body does not comprise at least one of a magnet and a ferromagnetic material.

39. The fastening system of Clause 36, wherein the first head portion and the second head portion are magnetically attractive.

40. A multi-layer fastening system, comprising:

a first fastening member including a first head portion having a first primary mating surface on a front side and a first secondary mating surface on a backside, the first head portion having a first extension including first tertiary mating surface;

a second fastening member including a second head portion having a second primary mating surface on a front side and a second secondary mating surface on a backside, the second head portion having a second extension including second tertiary mating surface, wherein said second tertiary mating surface is adapted to releasably interlock with said first tertiary mating surface of said first fastening member to form an intermediate seal;

a cap member having a first cap mating surface and a spaced apart second cap mating surface, the first cap mating surface adapted to releasably interlock with said first primary mating surface of said first fastening member, and the second cap mating surface adapted to releasably interlock with said second primary mating surface of said second fastening member;

a base member having a first base mating surface and a spaced apart second base mating surface, the first base mating surface adapted to releasably interlock with said first secondary mating surface of said first fastening member, and the second base mating surface adapted to releasably interlock with said second secondary mating surface of said second fastening member;

wherein, upon assembly, the cap member bounds the intermediate seal on a first side and the base member bounds the intermediate seal on a second side.

41. The fastening system of Clause 40, wherein, upon assembly, a first void space is formed between the intermediate seal and an interior side of the cap member, and wherein a second void space is formed between the intermediate seal and an interior side of the base member.

42. The fastening system of Clause 41, wherein at

least one of the first void space and second void space may be pressure tested.

43. A first fastening member for use in combination with a second fastening member, wherein the first and second fastening members are adapted to releasably interlock, the first fastening member comprising:

a head portion including a front side and a backside, the front side having a mating surface comprising a plurality of tongue and groove structures, wherein an outermost tongue of the plurality of tongue and groove structures includes a rotational preventer comprising an extension having a sloping terminal surface, wherein a plane extending from the sloping terminal surface intercepts a backside plane at an angle Φ , where the backside plane is coplanar with the exterior surface of the backside, and wherein Φ is between about 55 to 75 degrees.

44. The first fastening member of Clause 43, wherein the head portion is interconnected to a tail portion, and wherein the tail portion comprises a planar surface that is substantially parallel to the backside plane.

45. The first fastening member of Clause 43, wherein the head portion is interconnected to the tail portion by a transitional portion, the transitional portion comprising an interior transitional surface, wherein the interior transitional surface is substantially parallel to the sloping terminal surface.

46. A first fastening member for use in combination with a second fastening member, wherein the first and second fastening members are adapted to releasably interlock, the first fastening member comprising:

a tail portion comprising a tail upper surface and a tail lower surface, wherein the tail upper surface is substantially parallel to the tail lower surface, and wherein the tail upper surface is spaced apart from the tail lower surface to define a tail thickness T;

a head portion interconnected to the tail portion by a transition portion, the transition portion including an interior transitional surface having a height H, wherein height H is greater than the tail thickness T, the head portion including a front side and a backside, the front side having a mating surface comprising a plurality of tongue and groove structures, wherein the interior transitional surface corresponds to an innermost groove surface of the plurality of tongue and groove structures, wherein an outermost tongue of the plurality of tongue and groove structures includes a sloping terminal surface, wherein a lower tail plane coplanar with the tail lower sur-

face and extending from the tail lower surface through the head portion intercepts the sloping terminal surface at an angle Φ , where Φ is defined as above the lower tail plane, wherein Φ is less than about 90 degrees, and wherein the interior transitional surface is substantially parallel to the sloping terminal surface.

47. The first fastening member of Clause 46, wherein the outermost tongue has at least one tip, and wherein a tip plane coplanar with an underside surface of the at least one tip intersects the sloping terminal surface at an angle θ when the tip plane is extended through the outermost tongue, wherein θ is measured below the tip plane, and wherein θ is between about 85 to 95 degrees.

48. The first fastening member of Clause 46, wherein Φ is between about 55 to 75 degrees.

49. The first fastening member of Clause 46, wherein the backside of the head portion comprises a backside surface, and wherein the backside surface is substantially parallel to the lower tail plane.

50. A fastening system, comprising:

a first fastening member including a first mating surface, the first fastening member having a first longitudinal end and a second longitudinal end, wherein the first mating surface extends a first longitudinal length between the first and second longitudinal ends of the first fastening member; a second fastening member including a second mating surface, the second fastening member having a first longitudinal end and a second longitudinal end, wherein the second mating surface extends a second longitudinal length between the first and second longitudinal ends of the second fastening member, and wherein said second mating surface is adapted for being positioned generally opposite said first mating surface for releasably interlocking said first mating surface;

a slider comprising a slider body including an opening end and a closing end, said closing end having a confining portion wherein said first mating surface of said first fastening member is placed into interlocking engagement with said second mating surface of said second fastening member, wherein when said slider is moved in a closing direction the first fastening member and said second fastening member pass within said slider from said opening end to said closing end and said slider places said first mating surface into interlocking engagement with said second mating surface; and

a closure stop comprising:

a first end member fixedly secured to the first longitudinal end of said first fastening

member; and

a second end member fixedly secured to the first longitudinal end of said second fastening member;

wherein when the slider is advanced in the closing direction to the first end member and the second end member, the first end member and the second end member combine to form the closure stop, and wherein the slider is prevented from further travel in the closing direction.

51. A fastening system, comprising:

a first fastening member including a first mating surface, the first fastening member having a first longitudinal end and a second longitudinal end, wherein the first mating surface extends a first longitudinal length between the first and second longitudinal ends of the first fastening member; a second fastening member including a second mating surface, the second fastening member having a first longitudinal end and a second longitudinal end, wherein the second mating surface extends a second longitudinal length between the first and second longitudinal ends of the second fastening member, and wherein said second mating surface is adapted for being positioned generally opposite said first mating surface for releasably interlocking said first mating surface;

a slider comprising a slider body including an opening end and a closing end, said closing end having a confining portion wherein said first mating surface of said first fastening member is placed into interlocking engagement with said second mating surface of said second fastening member, wherein when said slider is moved in a closing direction the first fastening member and said second fastening member pass within said slider from said opening end to said closing end and said slider places said first mating surface into interlocking engagement with said second mating surface; and

a closure stop fixedly secured to the first longitudinal end of said first fastening member, and fixedly secured to the first longitudinal end of said second fastening member;

wherein when the slider is advanced in the closing direction to the closure stop, the slider is prevented from further travel in the closing direction.

52. The fastening system of Clause 51, wherein:

the slider comprises a slider interior structure that interlocks with said first mating surface of said first fastening member, and interlocks with said second mating surface of said second fas-

tening member; and

wherein the closure stop comprises a mating structure that interlocks with said first mating surface of said first fastening member, and interlocks with said second mating surface of said second fastening member, said mating structure of said closure stop interlocking with said slider interior structure when the slider is advanced in the closing direction to the closure stop.

53. The fastening system of Clause 52, wherein the first fastening member, second fastening member, slider, and closure stop form a closure that is one or more of airtight and waterproof.

54. A slider for use with a first fastening member and a second fastening member, the first and second fastening members comprising mating surfaces oriented along a longitudinal axis and adapted for releasably interlocking upon translation of the slider longitudinally along a longitudinal length of the first and second fastening members, the slider comprising:

a slider body including at least one rotating member interconnected to an interior surface of the slider body, the at least one rotating member adapted for contacting at least one of the first and second fastening members upon the translation of the slider.

55. The slider of Clause 54, wherein the at least one rotating member comprises at least one roller having a rotational axis oriented substantially perpendicular to the longitudinal axis.

56. The slider of Clause 54, wherein the at least one rotating member comprises at least one wheel.

57. A slider for use with a first fastening member and a second fastening member, the first and second fastening members comprising mating surfaces oriented along a longitudinal axis and adapted for releasably interlocking upon translation of the slider longitudinally along a longitudinal length of the first and second fastening members, the slider comprising:

a slider body including means for rotatably engaging at least one of the first and second fastening members upon the translation of the slider.

58. The slider of Clause 57, wherein the means for rotatably engaging comprises one or more of a roller, a wheel, and a spherical bearing.

59. A fastening system, comprising:

a first fastening member including a first mating surface;
a second fastening member including a second

mating surface, wherein said second mating surface is adapted for being positioned generally opposite said first mating surface for releasably interlocking said first mating surface;
a slider for releasably interlocking the first mating surface with the second mating surface;
a stop block fixedly secured to a first longitudinal end of said first fastening member, the stop block having at least a first grip position and a second release position, wherein when the slider body contacts a receiving surface of the stop block the slider urges the stop block from the first grip position to the second release position, wherein the stop block releasably secures at least a grasp portion of a first longitudinal end of the second fastening member within the stop block when the grasp portion is feed into the stop block in the second release position and the slider is then advanced in the closing direction away from the stop block placing the stop block in the first grip position.

60. The fastening system of Clause 59, wherein a closing end of the slider comprises a wedge shape.

61. The fastening system of Clause 59, wherein the stop block comprises an internal surface including a plurality of ribbed engaging surfaces.

62. A slider for use with at least a first fastening member and a second fastening member, the first fastening member including a first mating surface and the second fastening member including a second mating surface, wherein the first and second mating surfaces are oriented along a longitudinal axis and adapted for releasably interlocking upon translation of the slider longitudinally along a longitudinal length of the first and second fastening members, the slider comprising:

a slider body including an opening end and a closing end, said opening end having an upper portion and a lower portion, and an intermediate portion between the upper and lower portions, the intermediate portion positioned generally at the opening end for locating between the first mating surface of the first fastening member and the second mating surface of the second fastening member when the slider is moved in an opening direction, the slider body prescribing pathways through which the fastening members slide during the opening or closing movement of the slider, wherein the pathway for at least one of the fastening members is straight along the longitudinal axis.

63. A fastening system, comprising:

a first fastening member including a first mating surface;

a second fastening member including a second mating surface, wherein said second mating surface is adapted for being positioned generally opposite said first mating surface for releasably interlocking said first mating surface;
 a slider for releasably interlocking the first mating surface with the second mating surface;
 a top stop attached to the second fastening member, the top stop comprising a top stop mating surface for releasably interlocking with the first mating surface of the first fastening member;

wherein the slider places the first mating surface of the first fastening member into mating alignment with the top stop mating surface when the slider is advanced to the top stop.

[0006] Additional advantages of the present inventions will become readily apparent from the following discussion, particularly when taken together with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Several figures have been developed to assist with understanding the present inventions. Following is a brief description of the figures that illustrate the present inventions and their various embodiments:

Fig. 1 is a perspective view of a fastening member in accordance with at least one embodiment of the present inventions;
 Fig. 2 is a plan view of a fastening member in accordance with at least one embodiment of the present inventions;
 Fig. 3 is a perspective view of the device shown in Fig. 2;
 Fig. 4 is an end side elevation view of a fastening member in accordance with at least one embodiment of the present inventions;
 Fig. 5 is a perspective view of the device shown in Fig. 4;
 Figs. 6A-6Q are end side elevation views of mated fastening members in accordance with embodiments of the present inventions;
 Fig. 7 is a perspective view of a fastening member in accordance with at least one embodiment of the present inventions;
 Fig. 8 is a perspective view of a fastening member in accordance with at least one embodiment of the present inventions;
 Fig. 9 is a perspective view of a fastening system in accordance with at least one embodiment of the present inventions;
 Fig. 10A is a perspective view of a fastening member in accordance with at least one embodiment of the present inventions;

Fig. 10B is a perspective view of a fastening member in accordance with at least one embodiment of the present inventions;

Fig. 11A is a lateral side elevation view of the device shown in Fig. 10A;

Fig. 11B is a lateral side elevation view of the device shown in Fig. 10B;

Fig. 12 is an end side elevation view of mated fastening members in accordance with at least one embodiment of the present inventions;

Fig. 13 is a perspective view of the mated fastening members of Fig. 12;

Fig. 14 is an end side elevation view of mated fastening members in accordance with at least one embodiment of the present inventions;

Fig. 15 is a perspective view of the mated fastening members of Fig. 14;

Fig. 16 is an end side elevation view of a fastening member in accordance with at least one embodiment of the present inventions;

Fig. 17 is a perspective view of the device shown in Fig. 16;

Fig. 18 is an end side elevation view of mated fastening members in accordance with at least one embodiment of the present inventions;

Fig. 19 is an end side elevation view of mated fastening members in accordance with at least one embodiment of the present inventions;

Fig. 20 is a perspective view of the mated fastening members of Fig. 19;

Fig. 21 is a perspective view of one of the fastening members of Fig. 19;

Fig. 22 is a perspective view of an insert shown in Fig. 19;

Fig. 23 is a perspective view of mated fastening members in accordance with at least one embodiment of the present inventions;

Fig. 24 is an end side elevation view of one of the fastening members of Fig. 23;

Fig. 25 is a perspective view of the device shown in Fig. 24;

Fig. 26 is an end side elevation view of the other fastening member of Fig. 23;

Fig. 27 is a perspective view of the device shown in Fig. 26;

Fig. 28 is a perspective view of mated fastening members in accordance with at least one embodiment of the present inventions;

Fig. 29 is an end side elevation view of one of the fastening members of Fig. 28;

Fig. 30 is a perspective view of the device shown in Fig. 29;

Fig. 31 is a perspective view of a slider for use with at least the fastening members shown in Fig. 23;

Fig. 32 is an end side elevation view of a multi-layer fastening system in accordance with at least one embodiment of the present inventions;

Fig. 33 is a perspective view of the multi-layer fastening system of Fig. 32;
 Fig. 34 is a perspective view of a fastening member shown in Figs. 32 and 33;
 Fig. 35 is a perspective view of another fastening member shown in Figs. 32 and 33;
 Fig. 36 is a perspective view of stacked mating surfaces in accordance with at least one embodiment of the present inventions;
 Fig. 37 an end side elevation view of one of the fastening members of Fig. 36;
 Fig. 38 is a perspective view of the device shown in Fig. 37;
 Fig. 39 is a perspective view of a slider in accordance with at least one embodiment of the present inventions;
 Fig. 40 is a perspective view of a slider and fastening members in accordance with at least one embodiment of the present inventions;
 Fig. 41 is an end side elevation view of the devices shown in Fig. 40;
 Fig. 42 is a perspective view of a slider in accordance with at least one embodiment of the present inventions;
 Fig. 43 is a perspective view of separated slider portions of the slider shown in Fig. 42;
 Fig. 44 is a perspective view of a slider in accordance with at least one embodiment of the present inventions;
 Fig. 45 is a perspective view of a slider in accordance with at least one embodiment of the present inventions;
 Fig. 46 is a perspective view of a slider in accordance with at least one embodiment of the present inventions;
 Fig. 47 is an end side elevation view of the device shown in Fig. 46;
 Fig. 48 is a perspective view of an insert member for use with the slider shown in Figs. 46 and 47;
 Fig. 49 is an end side elevation view of the device shown in Fig. 48;
 Figs. 50 and 51 are perspective views of a slider and pull tab system in accordance with at least one embodiment of the present inventions;
 Fig. 52 is a perspective view of a pin for use with the device shown in Figs. 50 and 51;
 Fig. 53 is a perspective view of another pin for use with the device shown in Figs. 50 and 51;
 Fig. 54 is a side elevation view of a slider and stop block in accordance with at least one embodiment of the present inventions;
 Figs. 55 and 56 are perspective views of the devices shown in Fig. 54;
 Figs. 57-59 are perspective views of a fastening system, including a slider, stop block, and fastening members in accordance with at least one embodiment of the present inventions;
 Figs. 60-62 are side cross-sectional views of the slid-

er, stop block and portion of one fastening member of the fastening system shown in Figs. 57-59;
 Fig. 63 is a perspective view of one of the fastening members shown in Figs. 60-62;
 Figs. 64 and 65 are perspective views of a stop block and fastening member in accordance with at least one embodiment of the present inventions;
 Fig. 66 is a perspective view of a stop block in accordance with at least one embodiment of the present inventions;
 Figs. 67 and 68 are perspective views of a stop block in accordance with at least one embodiment of the present inventions;
 Fig. 69A is a perspective view of a stop block in accordance with at least one embodiment of the present inventions;
 Fig. 69B is a detailed side elevation view of a rotatable locking cam of the stop block shown in Fig. 69A;
 Fig. 70 is a perspective view of a fastening system that includes a stop block having separable portions in accordance with at least one embodiment of the present inventions;
 Fig. 71 is a perspective view of a fastening system that includes a top stop having separable portions in accordance with at least one embodiment of the present inventions;
 Fig. 72 is a perspective view of a fastening system in accordance with at least one embodiment of the present inventions;
 Figs. 73 and 74 are perspective views of a portion of the fastening system shown in Fig. 72;
 Figs. 75 and 76 are perspective views of a fastening system in accordance with at least one embodiment of the present inventions;
 Fig. 77 is an end side elevation view of a fastening system in accordance with at least one embodiment of the present inventions;
 Fig. 78 is a perspective view of the fastening system shown in Fig. 77; and
 Fig. 79 is a perspective view of a motorized slider in accordance with at least one embodiment of the present inventions.

[0008] While the following disclosure describes the inventions in connection with those embodiments presented, one should understand that the inventions are not strictly limited to these embodiments. Furthermore, one should understand that the drawings are not necessarily to scale, may include exaggerated features, and that in certain instances, the disclosure may not include details which are not necessary for an understanding of the present inventions, such as conventional details of fabrication and assembly.

DETAILED DESCRIPTION

[0009] This Detailed Description, in combination with the associated drawings, describes numerous inven-

tions. It is to be understood that aspects of one or more embodiments of the various inventions described herein may be combined, and such combinations are encompassed by this description and are considered within the scope of the present inventions.

[0010] Referring now to Fig. 1, a fastening member 100 is shown, wherein the fastening member 100 includes a tail portion 104, a head portion 108, and a transition portion 112 located between the tail portion 104 and the head portion 108. The head portion 108 includes a front side 116 and a backside 120. The front side 116 includes a mating surface 124 that typically includes one or more tongue and groove structures 128 for releasably interlocking with corresponding tongue and groove structures of another mating surface (not shown). In accordance with at least one embodiment of the present inventions, the tail portion 104 includes an uneven edge 132. For example, the uneven edge 132 may be crenulated, scalloped, etc. An uneven edge 132 at least provides for a more flexible closure once the fastening member is attached to an article, such as by gluing, sewing, welding, etc.

[0011] Referring now to Figs. 2 and 3, and in accordance with at least one embodiment of the present inventions, a fastening member 200 is shown that includes perforations 204 in its tail portion 104. In addition, if desired, the head portion 108 may also include perforations 204. The perforations 204 preferably penetrate the material forming the fastening member 200 in an orientation that is substantially perpendicular to a longitudinal axis LA-LA of the fastening member 200. Although shown as substantially circular in shape, the perforations 204 may be different shapes, such as oval, rectangular, etc. Furthermore, the perforations 204 may be slits. Fastening members 200 having perforations 204 are suitable for use in a variety of articles, including closures for gym bags, closures for scuba equipment bags, closures for beach gear bags, etc. The perforations 204 in the tail portion 104 improve closure flexibility, and bonding of the tail portion 104 to the article. In addition, perforations 204 in head portion 108 can allow the article to drain, thereby reducing the weight of the article, and/or improving the drying capacity of the article and/or the contents within the article.

[0012] Referring now to Figs. 4 and 5, and in accordance with at least one embodiment of the present inventions, a fastening member 400 is shown that includes one or more longitudinally extending lumens or longitudinal voids 404. The longitudinal voids 404 may be different shapes, such as oval, rectangular, triangular, hexagonal, etc. The longitudinal voids 404 are preferably extruded or molded into the profile or fastening member 400 as the fastening member 400 is made. The longitudinal voids 404 can improve flexibility of the closure. Alternatively, the longitudinal voids 404 can be used to apply air or hydraulic pressure or fluids to the mating surface 124 and/or other portions of the fastening member. For example, a small hand pump could be used to provide

air pressure to the mating surface 124. As another example, a warm fluid can be pumped through the longitudinal voids to maintain thermal properties of one or more portions of the fastening member 400 in cold conditions. Alternatively, one of the longitudinal voids 404 can be used to provide fluids for hydration of a person, or to provide a cooling liquid to a portion of a person's body. In addition, the longitudinal voids 404 can be used to introduce other materials into the fastening member 400, such as fibers for strength, wiring, fiber optics, etc.

[0013] The longitudinal voids 404 can be formed through extrusion; however, injection molding and other processes can also be used to form the voids 404. In addition, to the voids 404, pultrusion techniques may be used to introduce and/or assist in the incorporation of a different longitudinally oriented material (e.g., fibers) within the fastening member 400.

[0014] Referring now to Figs. 6A-6Q, a series of interlocked fastening members are shown that include a variety of inventive transition portion features. As noted above, the transition portion 112 is located between the tail portion 104 and the head portion 108. In at least some embodiments, the transition portion provides a spring-like device that assists in preventing accidental or unwanted separation of the mating surfaces of the interlocked fastening members. Such structure increases the crosswise pull strength of the interlocked fastening members, thereby decreasing the likelihood that the mating surfaces will experience unwanted disengagement when the interlocked mating surfaces are twisted, pulled, and/or pushed during normal usage conditions. In addition, in at least some embodiments, the transition portion includes functional structure for diverting fluid flow from the mating surfaces. In addition, in at least some embodiments, the fastening members include one or more spatial features for improving the quality of the extruded fastening member.

[0015] Referring now to Fig. 6A, a pair of interlocked fastening members 604 is shown. The transition portions 112 of the fastening members 604 include a substantially crenellated pattern 608, including one or more substantially arced rectangular teeth 612 and substantially arced rectangular gaps 616. When a tensile force T_F is applied to each fastening member 604, the transition portion 112 flexes before the interlocking mating surfaces 124 begin to disengage, thereby improving the performance of the closure when in use. Similarly, when a compression force C_F is applied to each fastening member, the transition portion flexes inward, again improving the performance of the interlocking mating surfaces when in use. In addition, the substantially rectangular arced teeth 612 and substantially arced rectangular gaps 616 are sized to have a similar unit thickness D_t , wherein the incorporation of these unit thickness D_t within the transition portion improve the extrusion process to provide a more even manufacturing process. That is, in general, an extrusion process is conducted by extruding molten plastic from a die. Because of the lack of flow restrictions, areas within

the die of larger cross-sectional openings typically behave such that more molten plastic is extruded from the larger cross-sectional areas as compared to the areas having relatively smaller cross-sectional areas. By maintaining a substantially similar unit thickness D_t within the transition zone, a higher quality and/or more cost effective extrusion process is realized. The unit thickness D_t can also be used for elements of the tail portion 104 and head portion 108.

[0016] Referring now to Fig. 6B, another embodiment of a pair of interlocked fastening members 620 is shown, wherein the fastening members include a longitudinal transition void 624. The longitudinal transition void 624 extends substantially the longitudinal length of the fastening members 620 within the transition portion 112, and serves, at least in part, to provide a similar unit thickness D_t to the elements forming the transition portion 112. For the embodiment shown in Fig. 6B, the longitudinal transition void 624 comprises a substantially triangular shape in cross-section.

[0017] Referring now to Fig. 6C, another embodiment of a pair of interlocked fastening members 628 is shown, wherein the fastening members 628 include a longitudinal transition void 624, and a set of gaps 616 to assist in isolating the mating surfaces from a tensile force T_F , compression force C_F , or fluid flow.

[0018] Referring now to Fig. 6D, another embodiment of a pair of interlocked fastening members 632 is shown, wherein the fastening members 632 include a plurality of longitudinal transition voids 624, and a set of gaps 616 to assist in isolating the mating surfaces from a tensile force T_F , compression force C_F , or fluid flow. For the embodiments shown in Fig. 6D, the longitudinal transition voids 624 vary in cross-sectional size and are substantially circular in cross-sectional shape, although as those skilled in the art will appreciate, other shapes can be used and are considered to be encompassed within the scope of the inventions and this description.

[0019] Referring now to Fig. 6E, another embodiment of a pair of interlocked fastening members 636 is shown, wherein the fastening members include a longitudinal transition void 624, the longitudinal transition void 624 comprising a substantially circular shape in cross-section.

[0020] Referring now to Fig. 6F, another embodiment of a pair of interlocked fastening members 640 is shown, including a plurality of substantially arced rectangular teeth 612 and substantially arced rectangular gaps 616. The plurality of substantially arced rectangular teeth 612 and substantially arced rectangular gaps 616 of Fig. 6F are oriented in a first direction, such as in a forward facing direction similar to the tongue and groove structures 128 of the respective head portions 108.

[0021] Referring to Fig. 6G, another embodiment of a pair of interlocked fastening members 644 are shown, including a plurality of substantially arced rectangular teeth 612 and substantially arced rectangular gaps 616. The sizing and number of the plurality of substantially

arced rectangular teeth 612 and substantially arced rectangular gaps 616 of fastening member 644 varies from that of fastening member 640. Accordingly, the embodiments of the present inventions include all possible modifications encompassed within the scope of the disclosure and/or claims.

[0022] Referring now to Fig. 6H, another embodiment of a pair of interlocked fastening members 648 is shown. The fastening members 648 include a longitudinally extending split 652 that passes from the exterior 656 of the transition portion 112 to an enlarged interior area 660. As with the fastening members shown in Figs. 6A, 6C, 6D, 6F, and 6G, the fastening members 648 accommodate the application of a tensile force T without necessarily causing the mating surfaces 124 to disengage.

[0023] Referring now to Fig. 6I, another embodiment of a pair of interlocked fastening members 664 is shown. The transition portion 112 of the fastening member 664 includes a curved portion 668 that can elongate in a direction perpendicular to the longitudinal axis of the fastening members 664. The amount of possible extension can be adjusted by using more curves or a sharper angled curved portion 668. For example, the amount of possible elongation available to fastening members 664 is less than the amount shown in fastening members 672 of Fig. 6J. Furthermore, stiffening of the curved portion 668 can be provided by forming the curved portion 668 of blocked portions 676, as shown in fastening members 678 of Fig. 6K. It is further noted that by comparison of Figs. 6I and 6J, the curved portion 668 of the transition portion 112 can be seen engaging a top 680 of foot member 684, as shown in Fig. 6I, or a base 688 of foot member 684, as shown in Fig. 6J, where the foot member 684 includes an interior side 692 that contacts a tongue of the tongue and groove structures 128. The difference in location of the connection between the curved portion 668 and the foot member 684 influences the point of where the tensile force is applied at the mating surface 124. It is further noted that the valleys within the curved portions 668 provide a flow diversion for fluids around the mating surfaces 124.

[0024] Referring now to Fig. 6L, another embodiment of a pair of interlocked fastening members 696 is shown. Fastening member 696 includes a more rounded substantially arced rectangular teeth 612 and substantially arced rectangular gaps 616 as compared to those shown in Fig. 6G. Similarly, for fastening members 700 shown in Fig. 6M, the cross members 704 are more rounded than those shown in Fig. 6H.

[0025] Referring now to Figs. 6N-6Q, additional fastening members 708, 712, 716 and 720 are shown, wherein the substantially arced rectangular gaps 616 of the transition portions 112 provide flow diversion from the mating surfaces 124. For fastening member 708 and 712 shown in Fig. 6N and 6O, respectively, the substantially arced rectangular teeth 612 on a front side 116 of the fastening member are located opposite the substantially arced rectangular gaps 616 on the backside 120 of

fastening member 708. For fastening members 716 shown in Fig. 6P and fastening members 720 shown in Fig. 6Q, the substantially arced rectangular teeth 612 on a front side 116 of the fastening member are located opposite the substantially arced rectangular teeth 612 on the backside 120 of fastening member 716. In addition, for fastening member 720 of Fig. 6Q, the transition portion 112 connects to the foot member 684 near a base 688 of the foot member 684, while for fastening member 716 of Fig. 6P, the transition portion 112 connects to the foot member 684 in line with the tail portion 104.

[0026] Referring now to Fig. 7, and in accordance with at least one embodiment of the present inventions, a fastening member 740 is shown that includes at least two different finishes on its exterior surface 744. More particularly, a glossy surface texture is preferably used within the area of the mating surface 124, while a matte finish is used at the tail portion 104, the transition portion 112, and/or another area of the head portion 108. Varying the surface texture at different portions of the fastening member 740 provides greater performance for the overall closure. For example, a glossy surface texture along the surface of the tongue and groove structures 128 of the mating surface 124 provides added protection against water/gas leakage, while having a matte finish along the backside 120 of the head portion 108 provides improved frictional interaction between a slider and the head portion 108.

[0027] Referring now to Fig. 8, and in accordance with at least one embodiment of the present inventions, a fastening member 800 is shown that includes tractioning features to provide increased engagement between opposing mating surfaces 124 of two interlocked fastening members 800. More particularly, and by way of example and not limitation, ridge and valleys 804 are provided along at least a portion of the mating surfaces 124 for frictional engagement between two fastening members 800. As shown in Fig. 8, the ridge and valleys 804 are shown along substantially the top 808 of the tongues 812 of the tongue and groove structures 128. The ridge and valleys 804 are aligned with their long axis preferably substantially perpendicular to the longitudinal axis LA-LA of the fastening member 800. When two mating surfaces of fastening members 800 are interlocked, the ridge and valleys 804 of a first fastening member 800 engage the tongue and groove structures 128 of the second fastening member 800, thereby preventing or limiting longitudinal movement or slipping of the first fastening member 800 relative to the second fastening member 800. The ridge and valleys 804 may extend along the entire longitudinal length of the mating surfaces 124, or only extend along a portion of the longitudinal length of the mating surfaces. For example, areas having ridge and valleys 804 may be spaced apart. In accordance with at least one embodiment, the grooves of a second fastening member include ridge and valleys 804 that engage the ridge and valleys along the top 808 of the tongues 812 of a first fastening member 800. In accordance with at

least one embodiment, a first fastening member includes one or more tongue and groove structures 128 that comprise a glossy surface finish, and one or more tongue and groove structures 128 that comprise the ridge and valleys 804. For such a configuration, a second fastening member preferably includes one or more tongue and groove structures 128 that comprise a glossy surface for contacting the tongue and groove structures 128 of the first fastening member that have a corresponding glossy surface finish. In addition, one or more tongue and groove structures 128 of the second fastening member preferably comprise ridge and valleys 804 for contacting and frictionally engaging the tongue and groove structures 128 of the first fastening member that have corresponding ridge and valleys 804 surface texturing. Thus, a variety of configurations are possible and are encompassed within the scope of the present inventions.

[0028] Referring now to Fig. 9, and in accordance with at least one embodiment of the present inventions, fastening members 900 are shown that include a surface texturing 904 on the backside 120 of the head portion 108. In at least one embodiment, the surface texturing enhances interaction or gripping of the fastening member 900 within a stop block 908. Thus, a textured surface 904 applied to the backside 120 of fastening member 900 interacts with the stop block 908 and provides gripping action that may otherwise only be provided by the stop block itself. In at least one embodiment, the surface texturing 904 comprises ridge and valleys 912 having a long axis oriented preferably substantially perpendicular to the longitudinal axis LA-LA of the fastening member 900. The surface texturing 904 may extend down the entire longitudinal length of the backside 120 of the head portion 108, or only extend down a portion of the longitudinal length of the backside 120 of the head portion 108. For example, the backside 120 of the head portion 108 having surface texturing 904 may be only located in area near the end of one of the fastening member 900 to engage the stop block 908, as shown in Fig. 9. The surface texturing 904 may be formed when the fastening member 900 is extruded, or alternatively, it may be formed after extrusion, such as by using a tool that is applied to the backside 120 of the head portion 108. In yet another alternative, the surface texturing 904 may be added by applying (such as by gluing or welding) a separate member to the head portion 104, wherein the separate member comprises the surface texturing 904.

[0029] Referring now to Figs. 10A and 11A, and in accordance with at least one embodiment of the present inventions, fastening member 1000 includes a plurality of transversely oriented penetrating slits 1004; that is, at least some of the slits 1004 fully penetrate at least one of the tail portion 104, head portion 108 or transition portion 112. In at least one embodiment, the slits 1004 are oriented substantially perpendicular to the longitudinal axis LA-LA of the fastening member 1000. The slits 1004 increase the flexibility of the fastening member 1000. In addition, for the slits 1004 that are allowed to fully pen-

etrate at least one of the tail portion 104, head portion 108 or transition portion 112, then those slits also will provide a means for ventilating the article to which the fastening member 1004 is associated with. In at least one embodiment, the slits 1004 in the fastening member may be cut completely through the tail portion 104, head portion 108 and transition portion 112, and then the fastening member is restructured during the installation of the fastening member 1000 in the article to which it is associated with.

[0030] Referring now to Figs. 10B and 11B, fastening member 1000' includes a plurality of transversely oriented partially penetrating slits 1004'; that is, none of the slits 1004' fully penetrate the tail portion 104, head portion or transition portion 112. Furthermore, the slits 1004' may be limited to only certain portions of the fastening member 1000'. For example, as shown in Fig. 10B, the slits 1004' are limited to the head portion 108 and transition portion 112, and are not extended into the tail portion 104. The slits 1004' increase the flexibility of the fastening member 1000'.

[0031] Referring now to Figs. 12 and 13, and in accordance with at least one embodiment of the present inventions, fastening members 1200a and 1200b are shown that include one or more wires or electrical contacts 1204a and 1204b, respectively, extending at least a portion of the longitudinal length L of the fastening members 1200a and 1200b. As shown in Figs 12 and 13, the contacts 1204a and 1200b are located along a surface the tongue and groove structures 128 of the mating surfaces 124. When the two fastening members 1200a and 1200b are interlocked, the contacts 1204a from a first fastening member 1200a communicate with counterpart contacts 1204b from the second fastening member 1200b. Thus, when the fastening members 1200a and 1200b are interlocked, the contacts 1204a and 1204b allow for electromagnetic radiation (e.g., electrical energy, radio waves, light, etc.) to be transferred from one fastening member 1200a to another fastening member 1200b.

[0032] Referring now to Figs. 14 and 15, a modified version of the previously described fastening members 1200a, 1200b is shown. More particularly, fastening members 1220a and 1220b include one or more wires or electrical contacts 1224a and 1224b, respectively, extending within at least a portion of the longitudinal length L of the fastening members 1220a and 1220b. As seen in Figs. 14 and 15, the electrical contacts 1224a and 1224b reside within the head portion 104, such as within a tongue of the tongue and groove structures 128. For such an arrangement, a contact bar can be provided in a stop block or other structure for interconnecting the electrical contacts 1224a and 1224b. Thus, wiring or another electromagnetic radiation conveyance structure can be incorporated within or surificially exposed into one or more the interlocking fastening members. As but one example, the tail portion 104 of a fastening member can have a woven fiber inlayed invisibly under its surface to

provide strength, while the mating surface has wiring mounted above or within the tongue and groove structures 128 to provide a direct wiring contact that electromagnetically communicates with corresponding wiring from the interlocking fastening member. As another example of a military or law enforcement application, ballistic protective fabrics can be used within the article, with fiber optics or other communication elements residing within the mating surfaces 124 of the closure of the article to provide a communication link between a soldier's headset and a communication system or other device attached or interconnected elsewhere to the soldier's body.

[0033] Referring now to Figs. 16 and 17, and in accordance with at least one embodiment of the present inventions, fastening member 1600 is shown that comprises structure for resisting disengagement from a corresponding fastening member 1600 when under the influence of tensile or compression forces in a direction transverse to the longitudinal axis LA-LA of the fastening members 1600. The fastening member 1600 is intended to be used with an identical fastening member 1600, or with a fastening member whose mating surface 124 is similar in geometry to fastening member 1600. In general, the mating surface 124 of fastening member 1600 has relatively larger tongue and groove structures 128 that help stabilize and prevent premature disengagement of the mating surfaces 124. In addition, the fastening member 1600 includes a rotation preventer that assists in maintaining the interlocked position of the mating surfaces 124 when the interlocked mating surfaces experience a tensile force or compression force that is transverse to the longitudinal axis LA-LA of the fastening members 1600, because the geometry of the mating surfaces 124 tend to keep the tips of the tongues of the tongue and groove structures 128 interlocked.

[0034] The fastening member 1600 includes a head portion 108 including a front side 116 and a backside 120. The front side 116 includes mating surface 124 comprising a plurality of tongue and groove structures 128, wherein an outermost tongue 1604 includes a rotational preventer 1608 comprising an extension 1612 having a sloping terminal surface 1616. In at least one embodiment, the sloping terminal surface 1616 defines a sloping terminal surface plane 1620 extending from the sloping terminal surface 1616, wherein the sloping terminal surface plane 1620 intercepts a backside plane 1624 at an angle Φ , where the backside plane 1624 is coplanar with the exterior surface 1628 of the backside 120. In accordance with at least one embodiment, Φ is preferably less than 90 degrees, and more preferably, Φ is between about 55 to 75 degrees, and more preferably yet, Φ is between about 60 to 70 degrees. It is noted that a number of embodiments of the present inventions described herein may optionally include the rotational preventer 1608, and this feature has been identified by its reference number in the various figures. Accordingly, the rotational preventer 1608 and the geometry described within this

paragraph are applicable as an option and/or in combination with numerous other inventive aspects described herein.

[0035] In at least one embodiment, the tail portion 104 comprises a planar surface 1632 that is substantially parallel to the backside plane 1624. In addition, in at least one embodiment, the transitional portion 112 includes an interior transitional surface 1636 having a height H, wherein the interior transitional surface 1636 is substantially parallel to the sloping terminal surface 1616. The interior transitional surface 1636 corresponds to an innermost groove surface of the plurality of tongue and groove structures 128. In at least one embodiment, the tail portion 104 includes a tail upper surface 1640 and a tail lower surface 1644. The tail upper surface 1640 is substantially parallel to the tail lower surface 1644. In addition, the tail upper surface 1640 is spaced apart from the tail lower surface 1644 to define a tail thickness T, where the tail thickness T is less than the height H of the interior transitional surface 1636.

[0036] For the embodiment shown in Figs. 16 and 17, a lower tail plane 1648 coplanar with the tail lower surface 1644 and extending from the tail lower surface 1644 through the head portion 108 intercepts the sloping terminal surface 1616 at the angle Φ , where Φ is defined as above the lower tail plane 1648 (that is, toward the front side 116 of the head portion 108). In at least one embodiment, the backside plane 1624 is substantially parallel to the lower tail plane 1648. As best seen in Fig. 16, the outermost tongue 1604 has at least one tip 1652, and a tip plane 1656 coplanar with an underside surface 1660 of the at least one tip 1652 intersects the sloping terminal surface 1616 at an angle θ when the tip plane 1656 is extended through the outermost tongue 1604, wherein θ is measured below the tip plane 1656. In at least one embodiment, θ is preferably between about 85 to 95 degrees.

[0037] Referring still to Fig. 16, and in accordance with at least one embodiment of the present inventions, the tail portion 104 of the fastening members 1600, as well as the other fastening members described herein, may optionally include a tapered terminal surface 1664. The tapered terminal surface 1664 may face up or down. As shown in Fig. 16, the tapered terminal surface 1664 allows for an even integration of the fastening member 1600 with a panel 1668 of the article to which the fastening member 1600 is to be attached. For example, the tapered terminal surface 1664 may be bonded to panel 1668, thereby providing a smooth transition between the tail portion 104 and the panel 1668, particularly if the panel includes a matching slope surface 1672 for attachment to the tapered terminal surface 1664 of fastening member 1600. As those skilled in the art will appreciate, other techniques may be used to attach fastening members to various articles, including but not limited to, gluing, welding, fastening, molding, etc. The tapered terminal surface 1664 provides advantages for at least some of these techniques.

[0038] As shown in Fig. 17, the tail portion 104 of the various fastening members described herein may alternatively comprise a tip 1676 that includes twin sloped surfaces 1680. Again, the twin sloped surfaces 1680 of tip 1676 can aid in the installation of the fastening member into various articles, such as garments.

[0039] Referring now to Fig. 18, and in accordance with at least one embodiment of the present inventions, a fastening member is shown as an interlocked pair comprising identical fastening members 1800a and 1800b. Each fastening member includes a plurality of tongues that further include a plurality of tips. By way of example and not limitation, for fastening member 1800a, first tongue 1804a includes upper tip 1812a and lower tip 1816a. Similarly, second tongue 1808a includes upper tip 1820a and lower tip 1824a. These structure interlock with fastening member 1800b. Fastening member 1800b includes first tongue 1804b that includes upper tip 1812b and lower tip 1816b. Similarly, second tongue 1808b includes upper tip 1820b and lower tip 1824b. By providing more than one tip on each tongue, there is an increased travel path for fluid leakage to occur through the interlocked mating surfaces 124. In addition, there is an increase in the interlocking strength of the mating surface 124 when experiencing an unwanted disengagement force, such as a tensile force applied in a direction transverse to the longitudinal axis of the fastening member 1800.

[0040] Referring now to Figs. 19-22, and in accordance with at least one embodiment of the present inventions, a fastening system 1900 is shown that comprises a first fastening member 1600 and a second fastening member 1904. The second fastening member 1904 includes a mating surface 124 that releasably interlocks with mating surface 124 of fastening member 1600. In addition, second fastening member 1904 includes a backside 120 that features a receptacle 1908 for receiving an insert 1912. In accordance with at least one embodiment of the invention, the receptacle 1908 comprises a groove 1916 that is adapted for interlockingly receiving a tongue 1920 of the insert 1912. The insert 1912 may be a variety of structures. By way of example and not limitation, the insert 1912 may comprise one or more of a reflector, a fluid conveyance conduit, a wire, a communication element, a bumper, and a decorative insert. Such inserts 1912 have application for use with a closure that is associated with an article, such as a jacket. When used with a jacket or other applicable article, the closure may be opened and closed with a slider.

[0041] Referring now to Figs. 23-27, and in accordance with at least one embodiment of the present inventions, a fastening system 2300 is shown that includes a plurality of releasably interlocking mating surfaces. More particularly, as best seen in Figs. 24 and 25, the fastening system 2300 includes a first fastening member 2304 including a head portion 2308 having a primary mating surface 2312 on a first or front side 2316 and a secondary mating surface 2320 on a second or backside 2324. In addition, as best seen in Figs. 26 and 27, the first fasten-

ing member 2304 is received within a second fastening member 2328 that includes a forked head portion 2332. The forked head portion 2332 includes a first interior side 2336 having a first interior mating surface 2340 and an opposing second interior side 2344 having a second interior mating surface 2348. The head portion 2308 of the first fastening member 2304 is adapted for being releasably interlocked in the forked head portion 2332 of the second fastening member 2328. In so doing, the primary mating surface 2312 of the head portion 2308 releasably interlocks with the first interior mating surface 2340 of the forked head portion 2332, and the secondary mating surface 2320 of the head portion 2308 releasably interlocks with the second interior mating surface 2348 of the forked head portion 2332.

[0042] Referring now to Figs. 28-30, and in accordance with at least one embodiment of the present inventions, a fastening system 2800 is shown that includes first fastening member 2304 and a second fastening member 2804 having a forked head portion 2308 that includes a void space 2812. Similar to forked head portion 2332 of second fastening member 2328, and as best seen in Figs. 29 and 30, the forked head portion 2808 of second fastening member 2804 includes a first interior side 2336 having a first interior mating surface 2340 and an opposing second interior side 2344 having a second interior mating surface 2348. In addition, an interior pocket 2816 is located adjacent the first and second interior mating surfaces 2340, 2348. When the head portion 2308 is interlocked within the forked head portion 2808, the interior pocket 2816 is bound by lateral head surface 2820 of head portion 2308 to form the void space 2812. The void space 2812 of the fastening system 2800 can serve several purposes, including providing increased bending qualities and flexibility to the interlocked first and second fastening members 2304, 2804. In addition, the void space 2812 may be pressure tested to document an airtight (or liquid tight) closure, and/or monitored for liquid or gas leakage. In addition, the void space 2812 can serve as a conduit for a fluid.

[0043] Referring now to Fig. 31, a slider 3100 for use with the fastening system 2300 and 2800 is shown. The slider 3100 generally includes an opening end 3104 and a closing end 3108. In use, and as described for fastening system 2300, the head portion 2308 of first fastening member 2304 is inserted into a first side 3112 of the slider 3100, and the forked head portion 2332 of the second fastening member 2328 is inserted into a second side 3116 of the slider 3100. As the head portion 2308 and forked head portion 2332 pass through the interior 3120 of the slider 3100, the mating surfaces of the first and second fastening members 2304 and 2328 are brought into interlocking engagement when the slider 3100 is moved in a closing direction. Similarly, when the slider 3100 is moved in an opening direction, the first fastening member 2304 is disengaged from the second fastening member 2328.

[0044] Referring now to Figs. 32-35, and in accordance

with at least one embodiment of the present inventions, a multi-layer fastening system 3200 is shown that includes a plurality of releasably interlocking mating surfaces. More particularly, the multi-layer fastening system 3200 includes first and second fastening members 3400a, 3400b, as well as cap member 3500a and base member 3500b.

[0045] As best seen in Fig. 34, the first and second fastening members 3400 include a head portion 3404 having a primary mating surface 3408 on a front side 3412, and a secondary mating surface 3416 on a backside 3420. In addition, the head portion 3404 also has an extension 3424 that includes a tertiary mating surface 3428.

[0046] As best seen in Fig. 35, the cap member and base member 3500 have a first cap/base mating surface 3504 and a spaced apart second cap/base mating surface 3508.

[0047] With reference again to Figs. 32 and 33, the first cap mating surface 3504a is adapted to releasably interlock with the first primary mating surface 3408a of the first fastening member 3400a, and the second cap mating surface 3508a adapted to releasably interlock with the second primary mating surface 3408b of the second fastening member 3400b. The base member 3500b includes a first base mating surface 3504b adapted to releasably interlock with the first secondary mating surface 3416a of the first fastening member 3400a, and the second base mating surface 3508b is adapted to releasably interlock with the second secondary mating surface 3416b of the second fastening member 3400b. Finally, the tertiary mating surface 3428a of the first fastening member 3400a is adapted to releasably interlock with the tertiary mating surface 3428b of the second fastening member 3400b, thereby forming an intermediate seal 3204. Upon assembly, the cap member 3500a bounds the intermediate seal 3204 on a first side 3208, and the base member 3500b bounds the intermediate seal 3204 on a second side 3212. Furthermore, upon assembly, a first void space 3216 is formed between the intermediate seal 3204 and an interior side 3220 of the cap member 3500a. In addition, a second void space 3224 is formed between the intermediate seal 3204 and an interior side 3228 of the base member 3500b. The void spaces 3216 and 3224 of the fastening system 3200 can serve several purposes, including allowing one or both of the void spaces 3216 and 3224 to be pressure tested to document an airtight (or liquid tight) closure, and/or monitored for liquid or gas leakage. In addition, one or both the void spaces 3216 and 3224 can serve as a conduit for a fluid, such as water, or one or both the void spaces 3216 and 3224 can receive another material, such as a sealant.

[0048] Referring now to Figs. 36-38, and in accordance with at least one embodiment of the present inventions, another multi-layer fastening system 3600 is shown that includes a plurality of releasably interlocking mating surfaces. More particularly, the multi-layer fastening system 3600 includes a plurality of members having interlocking

mating surfaces that can be arranged in a stacked manner.

[0049] As depicted in Fig. 36, the multi-layer fastening system 3600 includes two fastening members 2304 that are stacked and interconnected by fastening member 3700. As best seen in Figs. 37 and 38, fastening member 3700 includes a forked head portion 3704 that includes a first fork member 3708 having a first interior side 3712 and an exterior side 3716, wherein the first interior side 3712 includes a first interior side mating surface 3720, and the exterior side 3716 includes an exterior side mating surface 3724. In addition, the forked head portion 3704 includes a second fork member 3728 having a second interior side 3732 including a second interior side mating surface 3736. The backside 3738 of the second forked member 3728 does not have a mating surface, although if desired, a mating surface can be provided on the backside 3738 for allowing an additional fastening member to be attached to the backside 3738. For the embodiment depicted in Figs. 36-38, an interior pocket 3740 is also present (although such a feature is optional) that allows for formation of a void space 3604 when assembled as shown in Fig. 36.

[0050] For the multi-layer fastening system 3600 shown in Fig. 36, the two tail portions 104 that are aligned on the right side of the page are associated with fastening members 1904 and 3700, and the two tail portions 104 aligned on the left side of the page are associated with fastening members 2304. Such a configuration at least has application for jackets or bags with various liners and/or exterior shells.

[0051] As those skilled in the art will appreciate, the fastening members and/or their associated features shown in Figs. 1-38 may be combined in a variety of different manners, and such configurations are considered within the scope of the present inventions. That is, the ability to stack and/or combine fastening members and/or combine inventive aspects can be appreciated, and thus, one or more aspects of one embodiment may be combined with one or more aspects of one or more other embodiments.

[0052] Referring now to Fig. 39, and in accordance with at least one embodiment of the present inventions, a slider 3900 is shown that includes a slider body 3904 having an opening end 3908 and a closing end 3912. The slider 3900 is used to open and close two fastening members that each have a mating surface. In general, the slider 3900 forces the mating surfaces together when the slider 3900 is moved in its closing direction, and the slider 3900 separates the mating surfaces when the slider is moved in its opening direction.

[0053] Still referring to Fig. 39, the opening end 3908 of slider 3900 includes an upper portion 3916 and a lower portion 3920, and an intermediate portion 3924 located between the upper and lower portions 3916, 3920. The intermediate portion 3924 is positioned generally at the opening end 3908 for locating between a first mating surface of a first fastening member and a second mating

surface of a second fastening member when the slider 3900 is moved in an opening direction. The slider body 3904 comprises pathways through which the fastening members slide during the opening or closing movement of the slider 3900. For the second fastening member pathway shown in Fig. 39, the slider 3900 provides a pathway that is substantially straight along the longitudinal axis LA-LA of the mating surface of the second fastening member. Slider 3900 has application for use where the second fastening member is relatively stiff (e.g., metal, hard plastic, etc.) while the other fastening member is flexible. By way of example and not limitation, such an application may include an awning or cover for a boat. In such an application, the interlock shape or mating surface for the second fastening member for the boat portion can be hard and molded directly to the boat, and the flexible cover or awning comprising the flexible first fastening member can be interlocked to the boat by translation of the slider 3900 around the applicable portion of the boat, thereby interlocking the first flexible fastening member to the relatively hard and stiff second fastening member.

[0054] Referring now to Figs. 40 and 41, and in accordance with at least one embodiment of the present inventions, a fastening system 4000 is shown that includes a slider 4004 that uses magnetism to interact with fastening members 4008a and 4008b. The fastening system 4000 includes a first fastening member 4008a having a first head portion 108a that includes a first mating surface 124a. In addition, in at least one embodiment, the first head portion 108a includes a ferromagnetic material extending along a longitudinal length of the first mating surface 124a. The fastening system 4000 also includes a second fastening member 4008b having a second head portion 108b that includes a second mating surface 124b, wherein the second mating surface 124b is adapted for releasably interlocking with the first mating surface 124a. To facilitate locking and unlocking the mating surfaces 124a and 124b, the slider 4004 is moved along the longitudinal axis LA-LA of the head portions 108a and 108b. The slider 4004 comprises a slider body 4012 having an opening end 4016 and a closing end 4020. The opening end 4016 has an upper portion 4024 and a lower portion 4028. Similarly, the closing end 4020 has an upper portion 4032 and a lower portion 4036. In at least one embodiment, the upper portion 4024 and the lower portion 4028 each include a slider magnet wherein a magnetic force is applied between the first head portion 108a and the upper portion 4024, and between the second head portion 108b and the lower portion 4028 at the opening end 4016 to pull the mating surfaces 124a and 124b apart. The slider magnets preferably extend along at least a portion of the length of the slider body 4012 so that when pulled in the opening direction, the slider magnets initiate separation of the mating surfaces 124a and 124b within the interior region of the slider body 4012.

[0055] As seen in Figs. 40 and 41, the slider 4004 may include an intermediate portion 4040, and in at least one

embodiment, the intermediate portion 4040 is discontinuous across the width of the slider body 4012, such that a first intermediate portion 4044 is situated opposite a second intermediate portion 4048. As the slider 4004 is moved, the head portion 108a of the first fastening member 4008a resides between the intermediate portion 4040 and the upper portion 4024 at the opening end 4016, and the head portion 108b of the second fastening member 4008b resides between the intermediate portion 4040 and the lower portion 4028. The intermediate portion 4040 may also optionally include at least one magnet or ferromagnetic material.

[0056] As those skilled in the art will appreciate, different types of magnets and ferromagnetic materials are available for use, and they may be used at various locations within the head portions 108a and 108b, as well as at various locations within the slider body 4012. For example, the orientation of magnets within the slider body 4012 may include magnets to induce separation of the head portions 108a and 108b within the middle interior of the slider body 4012 and toward the opening end 4016 of the slider body, while magnets may be used to push together the mating surfaces 124a and 124b within the middle interior of the slider body 4012 and toward the closing end 4020. Alternatively, in at least one embodiment the closing end 4020 of the slider body 4012 may not comprise a magnet and/or a ferromagnetic material. As another example, the head portions 108a and 108b may use magnets and/or ferromagnetic materials to improve the interaction with not only the slider 4004, but also with each other, such that the first head portion 108a and the second head portion 108b are magnetically attractive. Without being limited by examples, magnets and/or ferromagnetic materials can be extruded directly into the head portions 108a and 108b, and/or they may be attached as an insert 1912, or they may be attached by an adhesive. At least part of one of the head portions 108a and 108b can be removed at a longitudinal end of the fastening member to provide an airtight and/or water tight closure.

[0057] Referring now to Figs. 42 and 43, and in accordance with at least one embodiment of the present inventions, a multi-piece slider 4200 is shown that at least has application for repair situations where a slider has broken and a replacement one-piece slider cannot be inserted into the fastening members. The slider 4200 is generally anticipated for use with a first fastening member and a second fastening member that each include a mating surface. In at least one embodiment, the slider 4200 includes a slider body 4204 having a plurality of portions adapted for interconnection using a fastening mechanism 4210. By way of example and not limitation, the slider body 4204 may include an intermediate portion 4208 that is separable and interconnectable, such as by a rod, latch, screw, bolt, etc. As best seen in Fig. 43, a first portion 4212 of the slider body 4204 is interconnected to a second portion 4216 of the slider body 4204. A fastening mechanism 4210 serves to join the first interme-

mediate portion 4208a of the first portion 4212 to the second intermediate portion 4208b of the second portion 4216. Similar to sliders described above, when assembled, the intermediate portion 4208 serves to separate the mating surfaces upon translation of the slider in an opening direction. When assembling the slider 4200 to repair a broken slider, the broken slider is first removed from the first and second fastening members. The slider 4200 is then attached to the first and second fastening members by inserting the head portion of the first fastening member above the first intermediate portion 4208a, then inserting the head portion of the second fasten member below the intermediate portion 4208b, and then securing the first portion 4212 of the slider body 4204 to the second portion 4216 of the slider body 4204 by engaging the fastening mechanism 4210 to interconnect the first intermediate portion 4208a to the second intermediate portion 4208b.

[0058] Referring now to Fig. 44, and in accordance with at least one embodiment of the present inventions, a slider 4400 is shown that includes a slider body 4404 having at least one roller that eases friction between at least one fastening member and the slider 4400. More particularly, one or more rollers 4408 are operatively associated with the slider body 4404 and serve to assist in reducing friction as the slider 4400 is moved to close or open the mating surfaces of the fastening members. With reference to Fig. 44, a roller 4408 is located on an inside surface 4412 of an intermediate portion 4416 of the slider body 4404. Among it possible shapes, the roller 4408 may comprise a cylindrical shaped device, a more narrow wheel-shaped device, or a spherical shaped device, such as a ball bearing. In at least one embodiment, the rollers 4408 are located to contact both the first and second fastening members. In at least one embodiment, the roller 4408 has a rotational axis RA-RA oriented substantially perpendicular to the longitudinal axis LA-LA.

[0059] Referring now to Fig. 45, and in accordance with at least one embodiment of the present inventions, a slider 4500 is shown that comprises exterior rollers 4504 for engaging the tail portions 104 of the fastening members. The exterior rollers 4504 assist with limiting frictional interaction of the fastening members as the slider 4500 is moved longitudinally. The slider 4500 may also optionally include one or more rollers 4408, such as the roller 4408 shown at the top of the intermediate portion 4416.

[0060] Referring now to Figs. 46-49, and in accordance with at least one embodiment of the present inventions, a slider 4600 is shown that is configured for receiving inserts to provide additional functionality. More particularly, the slider 4600 includes a section slider insert system that allows for different materials to be incorporated into the slider for various reasons. One such reason is to add self-lubricating plastic inserts, such as Teflon inserts to provide a combination of strength and ease of slider interaction with the head portions of the fastening members as the head portions pass through the slider. Alternatively, the insert or inserts may comprise a magnet for interaction with appropriate fastening members. Ad-

ditionally, the interconnectivity of the various components allows for a complex multi-piece slider to be more easily manufactured. The sections of the slider 4600 can be snapped together, glued together, or interconnected using fasteners, such as screws. Inserts can also be added to other devices described herein, such as stop blocks. For example, a new or alternative gripping element can be added to a stop block.

[0061] Referring again to Figs. 46-49, the slider 4600 includes a slider body 4604 having an upper portion 4608, a lower portion 4612, and an intermediate portion 4616 between the upper portion 4608 and lower portion 4612. The intermediate portion 4616 at the opening end 4620 of the slider body 4604 is located between the pathways which the fastening members slide during the opening or closing movement of the slider 4600. In at least one embodiment, the intermediate portion has a first side 4624 that is releasably interconnectable to the upper portion 4608, and a second side 4628 that is releasably interconnectable to the lower portion 4612. Accordingly, the intermediate portion 4616 can be separated from the upper portion 4608 and lower portion 4612. Thus, in at least in one embodiment, the intermediate portion 4616 is replaceable with removal from the upper and lower portions 4608, 4612, and insertion of a replacement intermediate portion. For such a configuration, the new intermediate portion 4616 may include a self-lubricating element for contacting at least one of the fastening members. Referring now to Figs. 48 and 49, an insert member 4800 is shown that can be inserted into slider 4600 to form a portion of the slider body 4604.

[0062] Referring now to Figs. 50 and 51, and in accordance with at least one embodiment of the present inventions, a slider 5000 is shown that includes pull tab system 5004. The Pull tab system 5004 comprises a rotatably mounted pull tab 5008 that is interconnected to the slider body 5012 at the intermediate portion 5016. The location of the interconnection at the intermediate portion 5016 allows the pull tab 5008 to be drawn in both the opening direction and closing direction such that the forces applied are more in-line with the longitudinal axis of the fastening members, thereby more effectively moving the slider 5000 and also lessening unnecessary forces from acting on the mating surfaces of the fastening members.

[0063] In at least one embodiment, the rotatably mounted pull tab 5008 is interconnected to the intermediate portion 5016 by a pin 5020 located at the opening end 5024 of the slider body. Fig. 52 illustrates an example embodiment of pin 5020, which generally comprises a cylindrical shaped rod. However, and in accordance with at least one embodiment of the present inventions, the pin 5020 of the pull tab system 5004 may optionally include a wedge 5300 as shown in Fig. 53, wherein the wedge 5300 is fixedly attached to the pin 5020. In one embodiment, the wedge 5300 is preferably located within the interior of the slider 5000, wherein the wedge 5300 is able to contact and frictionally engage at least a portion

of least one of the fastening members, such as a head portion of one of the fastening members. In use, rotation of the pull tab 5008 down also rotates the wedge 5300 against a fastening member to force the fastening member against an interior surface of the slider body 5012, thereby releasably locking the longitudinal position of the slider 5000 against at least one of the fastening members. To release the wedge 5300, the pull tab 5008 is lifted up and then pulled in the desired direction. In another alternative embodiment, an upper wedge may be situated in the upper portion of the slider body, wherein rotation of a connected tab rotates the upper wedge downward against the fastening member to releasably lock the fastening member, such as by forcing the fastening member in contact with an interior upper surface of the intermediate portion.

[0064] Referring now to Figs. 54-56, and in accordance with at least one embodiment of the present inventions, a slider and stop block combination 5400 is shown that includes a slider 5404 and a stop block 5408. This combination of devices is particularly useful for articles such as jackets; however, it may also be used in other articles, including but not limited to, sleeping bags, removable pant legs, removable hoods, etc.

[0065] The slider 5404 comprises a slider body 5412 including an opening end 5416 and a closing end 5420. The closing end 5420 includes a confining portion 5424 that functions to confine the first mating surface 124 of a first fastening member into interlocking engagement with a second mating surface 124 of a second fastening member. In at least one embodiment, the closing end 5420 of the slider body 5412 includes an upper sloping surface 5428 and a lower sloping surface 5432 that resemble a truncated wedge when viewed from the side, as seen in Fig. 54.

[0066] The stop block 5408 includes structural features to hold and release a fastening member, and to interact with the slider 5404. In at least one embodiment, the stop block 5408 includes a first housing portion or upper housing portion 5436 and a second housing portion or lower housing portion 5440. In at least one embodiment, the lower housing portion 5440 is permanently secured to one of the first and second fastening members, such as at a longitudinal end of a fastening member. The upper housing portion 5436 is preferably movably connected to the lower housing portion 5440, and more preferably, the upper housing portion 5436 is hingedly interconnected to the lower housing portion 5440 by hinge 5444. For interaction with the slider 5404, the upper housing portion 5436 includes an upper sloping receiving surface 5448, and the lower housing portion 5440 includes a lower sloping receiving surface 5452.

[0067] The stop block 5408 has a first closed position (as shown in Fig. 54) and a second open position. When the upper and lower sloping surfaces 5428 and 5432 of the slider 5404 contact the upper and lower sloping receiving surfaces 5448 and 5452 of the stop block 5408, the slider 5404 urges the stop block 5408 from the first

closed position to the second open position. That is, the upper housing portion 5436 moves along arrow A to rotate its front end 5450 upward to the second open position. In so doing, the stop block 5408 allows at least a grasp portion of the unsecured fastening member to be fed into the stop block 5408 while the stop block is in the second open position. After doing so, the slider 5404 is then advanced in the closing direction away from the stop block 5408 placing the stop block 5408 back in the first closed position. The stop block 5408 automatically closes because the upper portion 5436 is normally biased in its closed position, such as by a spring. As best seen in Fig. 56, when the slider 5404 moves away from the stop block 5408, the grasp portion of the inserted fastening members is held in place by the stop block 5408, such as by use of gripping elements 5456 located within the interior 5460 of the stop block 5408. An optional latch 5464 (shown with dashed lines in Fig. 54) may be provided to selectively lock the upper housing portion 5436 to the lower housing portion 5440 when the stop block 5408 is closed, thereby locking the stop block in its closed position. Thus, in use, when the user slides the slider 5404 to the bottom of the fastening members, the closing end 5412 of the slider 5404 contacts the forward end 5416 of the stop block 5408, thereby allowing the user to insert the fastening member that is not permanently attached to the stop block 5408 into the stop block interior 5420. The user then moves the slider 5404 away from the stop block 5408 in the closing direction to releasably interlock the mating surfaces 124 of the first and second fastening members.

[0068] Referring now to Figs. 57-63, and in accordance with at least one embodiment of the present inventions, another slider and stop block combination is shown as fastening system 5700 that includes a slider 5704 and a stop block 5708, as well as fastening members 5702a and 5702b. Slider 5704 comprises a slider body 5712 including an opening end 5716 and a closing end 5720. The closing end 5720 includes a confining portion 5724 that functions to confine the first mating surface 124 of a first fastening member 5702a into interlocking engagement with a second mating surface 124 of a second fastening member 5702b.

[0069] As best seen in Fig. 58, in at least one embodiment the stop block 5708 is permanently attached to one of the fastening members 5702a, 5702b, such as by one or more screws 5710 that engage fastening member 5702a and fasten it to the stop block 5708. As those skilled in the art will appreciate, other methods of fixedly securing a fastening member to the stop block 5708 are possible, such as by gluing, welding, molding, and/or using other fasteners.

[0070] As best seen in Fig. 60, the stop block 5708 also includes a button 5728 having a sloped front portion 5732, a rear portion 5736, a sloped bottom 5740 and an underside projection 5744. In one embodiment, the button 5728 is held within the stop block 5708 by a button pin 5746. When the closing end 5720 of the slider 5704

abuts the sloped front portion 5732 of the button 5728, the button tips, wherein the rear portion 5736 depresses a return biasing member 5748, such as a spring, while the underside projection 5744 lifts up. Assuming that the fastening system 5700 is associated with a jacket, and that the jacket is open, while the underside projection 5744 is in an upward position, unsecured fastening member 5702b can be inserted into the stop block 5708, to be releasably secured therein. More particularly, and with reference now to Fig. 63, in at least one embodiment, the unsecured fastening member 5702b includes a hole 6300 within its head portion 108 for receiving the underside projection 5744 of the button 5728. With reference again to Figs. 60 and 61, while the underside projection 5744 has been lifted up, the unsecured fastening member 5702b can be inserted into the top slot 5750 of the slider 5704 and into the stop block 5708. After the unsecured fastening member 5702b has been inserted into the stop block 5708, the slider 5704 is moved away from the stop block 5708 and then button 5728 is released to its resting position because return biasing member 5748 pushes up on the rear portion 5736 of the button 5728. With the button 5728 in its resting position, the underside projection 5744 engages the hole 6300 in the fastening member 5702b, thereby holding the fastening member 5702b within the stop block 5708. The slider 5704 can then be moved up the longitudinal axis of the mating surfaces 124 of the fastening members 5702a and 5702b to releasably interlock the mating surfaces 124. In at least one embodiment, slider 5704 is moved by pulling the rotatable pull tab 5752 that is interconnected to the intermediate portion 5756 of the slider 5704. Referring to Fig. 62, to open the fastening system 5700, the slider 5704 is moved back down to contact the stop block 5708, wherein the slider 5704 once again presses against front portion 5732 of the button 5728. The button 5728 then once again tips up, releasing the underside projection 5744 from the hole 6300 of fastening member 5702b. The fastening member 5702b can then be pulled freely from the stop block 5708 and the top slot 5750 of the slider 5704 to allow the jacket closure to be fully opened. Thus, whenever the slider 5704 is located at the bottom of the jacket and contacting the stop block 5708, the button 5728 is situated in its open position, and ready to either insert or remove the fastening member 5702b from the stop block 5708.

[0071] Referring now to Figs. 64 and 65, and in accordance with at least one embodiment of the present inventions, another fastening system 6400 is shown that includes a stop block 6404 that is injection molded directly to one of the fastening members 6408. For stop block 6404, the user slides the slider down the fastening member 6408 until the slider meets the stop block 6404, at which time the user can insert the other fastening member through the front of the slider and into the stop block 6404. The inserted fastening member is held within the stop block 6404 by frictional engagement with the interior of the stop block, or the inserted fastening member is

simply held in place by the user when the slider is moved upward. Thus, after the fastening member is inserted into the stop block 6404, the slider can be moved up the head portion 108 of the fastening members to releasably interlock their mating surfaces. To open the closure, the slider is moved back to the stop block 6404, and the releasable fastening member is pulled out of the stop block 6404 and the slider.

[0072] Referring now to Fig. 66, and in accordance with at least one embodiment of the present inventions, another stop block 6600 is shown that crimps or clamps into place on at least one fastening member. Stop block 6600 includes an interior 6604 that features a plurality of gripping surfaces 6608 to frictionally engage at least one fastening member. In addition, stop block 6600 may be opened using hinge 6612 to allow the upper housing portion 6616 to rotate relative to the lower housing portion 6620. Stop block 6600 also optionally includes a snap 6624 that secures the upper housing portion 6616 to the lower housing portion 6620. The snap 6624 features a frictionally engaging head 6628 that engages a receptacle 6632 within the opposing housing portion. The frictionally engaging head 6628 is preferably biased in a locking position, but can be moved to release the upper housing portion 6616 from the lower housing portion 6620, thereby allowing adjustment of the stop block 6600 if desired. Accordingly, stop block 6600 serves to provide easy attachment to at least one fastening member because the stop block 6600 can be installed after production of a fastening member. In addition, stop block 6600 also allows for adjustment, and further allows for adjustment when inserting a fastening member within the stop block 6600. After the stop block 6600 is attached and engaged with the fastening members, a slider can be used to close the fastening members.

[0073] Referring now to Figs. 67 and 68, and in accordance with at least one embodiment of the present inventions, another stop block 6700 is shown for allowing insertion of a fastening member. The stop block 6700 is preferably fixedly attached to a first fastening member, and further includes an interior 6704 for frictionally engaging a second fastening member. More particularly, the interior 6704 includes a receiving channel 6708 having a rotatable brake 6712. The rotatable brake 6712 serves to releasably secure at least a grasp portion of a second fastening member when the grasp portion is fed into the stop block 6700 and the rotatable brake 6712 engages the grasp portion. In use, the second fastening member is slid into the receiving channel 6708 of the stop block 6700, and the rotatable brake 6712 is self-actuating to contact a surface of the second fastening member and allow rotation in a first direction corresponding to the insertion direction, but resist counter-rotation, thereby holding the second fastening member in place within the stop block 6700. When the user desires to open the closure, a release mechanism is activated, such as a push button release 6716 that allows counter-rotation of the brake 6712 and removal of the second fastening mem-

ber. As an alternative to a push button release, an automatic release trigger may be incorporated into the stop block 6700 for interaction with a slider, such as the button 5728 shown in fastening system 5700. For stop block 6700, the slider would engage a trigger that releases the brake 6712 and allows the second fastening member to be released. For such a configuration, the second fastening member need not include the hole 6300.

[0074] Referring now to Figs. 69A and 69B, and in accordance with at least one embodiment of the present inventions, another stop block 6900 is shown for allowing insertion of a fastening member. The stop block 6900 is similar to stop block 6700 discussed above, but stop block 6900 includes a rotatable locking cam 6904. Fig. 69B shows a detail view of the rotatable locking cam 6904 and its push button release 6908. As with rotatable brake 6712, the rotatable locking cam 6904 allows the fastening member to be inserted and resists counter-rotation unless the user activates a release mechanism.

[0075] From the foregoing, one skilled in the art will appreciate that a number of different ways are available for providing a rotatable element for securing a second fastening member within a stop block, and such variations and other modifications are encompassed by embodiments of the present inventions. It is further noted that different material types and textures can be used for the rotatable brake 6712 and rotatable locking cam 6904, or other gripping elements 6608 and 5456, including soft plastics or rubber for enhanced gripping, as well as textured or angled elements for grabbing the inserted fastening member.

[0076] Referring now to Fig. 70, and in accordance with at least one embodiment of the present inventions, fastening system 7000 and stop block 7002 are shown for allowing insertion of a fastening member. Stop block 7002 includes two separable portions, a right portion 7004a and a left portion 7004b, wherein the right portion 7004a is fixedly attached to a first fastening member 7008a and the left portion 7004b is fixedly attached to a second fastening member 7008b. In use, the user aligns the right portion 7004a for releasable engagement with the left portion 7004b, such as by aligning the respective coupling members 7012a and 7012b of the respective right and left portions 7004a and 7004b. The coupling members 7012a and 7012b are then engaged, which joins the first longitudinal ends 7016a and 7016b of the respective fastening members 7008a and 7008b together. A slider 7020 can then be moved up the longitudinal axis LA-LA of the fastening members 7008a and 7008b to releasably interlock the mating surfaces 124 of each fastening member 7008a and 7008b. This process is then reversed to open the closure.

[0077] Referring now to Fig. 71, and in accordance with at least one embodiment of the present inventions, fastening system 7100 is shown that includes top stop 7104. In general, to stops are used to prevent the slider from leaving the end (or top) of the closure. Fastening system 7100 includes first fastening member 7108a and second

fastening member 7108b. For the embodiment shown in Fig. 71, top stop 7104 includes two separable portions, a right top stop portion 7112a and a left top stop portion 7112b, wherein the right top stop portion 7112a is fixedly attached to the first fastening member 7108a, and the left top stop portion 7112b is fixedly attached to the second fastening member 7108b. When the slider 7116 is advanced to the upper end or top of the fastening members 7108a and 7108b, the right top stop portion 7112a is brought together with the left top stop portion 7112b. Such a configuration not only serves to keep the slider 7116 from leaving the fastening members 7108a and 7108b, but also serves to provide a structurally smooth and visually appealing end to the closure. The structurally smooth finish improves user satisfaction, because for a jacket the top stop 7104 prevents possible irritation or chaffing of the user's chin or neck from the end of the closure. The top stop 7104 may optionally include a frictionally engaging clasp for releasably securing the slider 7116 to the top stop 7104.

[0078] Referring now to Figs. 72-74, and in accordance with at least one embodiment of the present inventions, fastening system 7200 is shown that includes a top stop 7204, slider 7208 and first and second fastening members 7212a and 7212b. As seen in Fig. 72, the slider 7208 can be advanced to the top stop 7204 for releasably interlocking with the top stop 7104. With reference now to Fig. 73 and 74, the top stop 7204 is shown without the slider 7208 and without the first fastening member 7212a. The top stop 7204 includes a top stop mating surface 7216 that mates with the mating surface 7220 of the first fastening member 7212a when the slider 7208 is advanced to the top stop 7204. As the slider 7208 reaches the top stop 7204, the slider 7208 brings the mating surface 7220 of the first fastening member 7212a into contact with the top stop mating surface 7216 by overlying the top stop 7204. In at least one embodiment, the top stop mating surface 7216 includes tongue and groove structures 7224 for releasably engaging the mating surface 7220 of the first fastening member 7212a.

[0079] The slider 7208 of fastening system 7200 may optionally include tongue and groove structures for mating with the tongue and groove structures 7224 of the top stop 7204. Such configuration can prevent air, water, or gas penetration through the closing mating surfaces that are formed around the slider 7208, as well as prevent leakage around the first and second fastening members 7212a and 7212b, and top stop 7204.

[0080] Referring now to Figs. 75 and 76, and in accordance with at least one embodiment of the present inventions, fastening system 7500 is shown that includes a top stop 7504, slider 7508, first and second fastening members 7512a and 7512b, and stop block 7516. The top stop 7504 is located on only one fastening member, that is, fastening member 7512b. Such a top stop 7504 can be a piece of material, such as plastic, that is molded and permanently attached to the longitudinal end 7520 of the second fastening member 7512b.

[0081] Referring now to Figs. 77-78, and in accordance with at least one embodiment of the present inventions, fastening system 7700 is shown that includes a slider garage 7704 for receiving the slider 7708 when the slider is located at a longitudinal end 7712 of the fastening members 7716a and 7716b. The slider garage 7704 can be a variety of materials, including a molded plastic or metal hood, or a portion of the article to which the closure is attached, such as a flap of material.

[0082] Referring now to Fig. 79, and in accordance with at least one embodiment of the present inventions, a motorized slider 7900 is shown. The motorized slider 7900 preferably includes a motor 7904 operatively associated with a slider body 7908. The motor can be used to power the slider body 7908 and/or rotate drums 7912 for advancing the fastening members within the slider body 7908. The motorized slider 7900 can be used to automatically close fastening members, including fastening members that are associated with waterproof field covers for stadiums. In use, the user would line up the large rolls of material for covering the field and activate the motorized sliders 7900 to traverse the field to automatically join the large panels with watertight closures while simultaneously unrolling the covers into position. Other applications or possibilities include joining lagoon/pond/lake liner panels and joining panels used for protecting concrete, such as in pavement and building construction. Sidewalk seams can also benefit from having a watertight joint between sidewalk sections, and the motorized slider 7900 can assist construction workers in joining such seal systems.

[0083] Any of the stop blocks and/or top stops described herein may include magnets or ferromagnetic materials for interaction with the head portions 108 of the fastening members. Furthermore, the stop blocks and top stops described herein may further include electronic elements, such as wiring, fiber optics, and/or a battery for forming part of the operable elements associated with appropriate fastening members and/or certain of their components, such as fastening members 1200a, 1200b, 1220a, and 1220b shown in Figs. 12-15. As those skilled in the art will appreciate, the materials forming the stop blocks and top stops can comprise plastic, metal, glass, ceramic, combinations thereof, etc. Such structures may also include inserts, such as reflective features.

[0084] The disclosures of the following documents are incorporated herein by reference in their entirety: U.S. Pat. No. 5,991,980, U.S. Pat. No. 6,721,999, and U.S. Pat. App. Pub. No. 2006/0107500.

[0085] The present invention, in various embodiments, includes components, methods, processes, systems and/or apparatus substantially as depicted and described herein, including various embodiments, subcombinations, and subsets thereof. Those of skill in the art will understand how to make and use the present invention after understanding the present disclosure. The present invention, in various embodiments, includes providing devices and processes in the absence of items

not depicted and/or described herein or in various embodiments hereof, including in the absence of such items as may have been used in previous devices or processes, e.g., for improving performance, achieving ease and/or reducing cost of implementation.

[0086] It is to be noted that the term "a" or "an" entity refers to one or more of that entity. As such, the terms "a" (or "an"), "one or more" and "at least one" can be used interchangeably herein. It is also to be noted that the terms "comprising", "including", and "having" can be used interchangeably.

[0087] The foregoing discussion of the invention has been presented for purposes of illustration and description. The foregoing is not intended to limit the invention to the form or forms disclosed herein. In the foregoing Detailed Description for example, various features of the invention are grouped together in one or more embodiments for the purpose of streamlining the disclosure. This method of disclosure is not to be interpreted as reflecting an intention that the claimed invention requires more features than are expressly recited in each claim. Rather, as the following claims reflect, inventive aspects lie in less than all features of a single foregoing disclosed embodiment. Thus, the following claims are hereby incorporated into this Detailed Description, with each claim standing on its own as a separate preferred embodiment of the invention.

[0088] One of skill in the art will appreciate the various different applications of the present invention with respect to the variety of articles, all of which are intended to be included herein.

[0089] Moreover, though the description of the invention has included description of one or more embodiments and certain variations and modifications, other variations and modifications are within the scope of the invention, e.g., as may be within the skill and knowledge of those in the art, after understanding the present disclosure. It is intended to obtain rights which include alternative embodiments to the extent permitted, including alternate, interchangeable and/or equivalent structures, functions, ranges or steps to those claimed, whether or not such alternate, interchangeable and/or equivalent structures, functions, ranges or steps are disclosed herein, and without intending to publicly dedicate any patentable subject matter.

Claims

1. A fastening system, comprising:

a first fastening member including a first mating surface, the first fastening member having a first longitudinal end and a second longitudinal end, wherein the first mating surface extends a first longitudinal length between the first and second longitudinal ends of the first fastening member; a second fastening member including a second

mating surface, the second fastening member having a first longitudinal end and a second longitudinal end, wherein the second mating surface extends a second longitudinal length between the first and second longitudinal ends of the second fastening member, and wherein said second mating surface is adapted for being positioned generally opposite said first mating surface for releasably interlocking said first mating surface;

at least one slider comprising a slider body including an opening end and a closing end, said closing end having a confining portion wherein said first mating surface of said first fastening member is placed into interlocking engagement with said second mating surface of said second fastening member, wherein when said slider is moved in a closing direction the first fastening member and said second fastening member pass within said slider from said opening end to said closing end and said slider places said first mating surface into interlocking engagement with said second mating surface, at least a portion of the slider body including a sloping engagement surface at its closing end; and at least one stop block.

2. The fastening system of claim 1, wherein the first fastening member and the second fastening member comprise tractioning features to provide increased engagement between opposing mating surfaces of the fastening members when interlocked.

3. The fastening system of claim 2, wherein the tractioning features are ridges and valleys.

4. The fastening system of claim 3, wherein the ridges and valleys are aligned substantially perpendicular to the longitudinal length of the fastening members.

5. A product comprising the fastening system of claim 1, wherein said product is an article of clothing or a bag.

6. The product of claim 5, wherein said product is waterproof.

7. The product of claim 5, wherein said product is airtight.

8. The fastening system of claim 1, wherein the stop block fixedly is secured to at least one of the first and second longitudinal ends of one of said first and second fastening members, wherein a receiving channel is located within the stop block, and a rotatable brake is located within at least a portion of the receiving channel, wherein the stop block releasably secures at least a grasp portion of another of the at

least one of the first and second longitudinal ends of one of said first and second fastening members within the stop block when the grasp portion is fed into the stop block and the rotatable brake engages the grasp portion.

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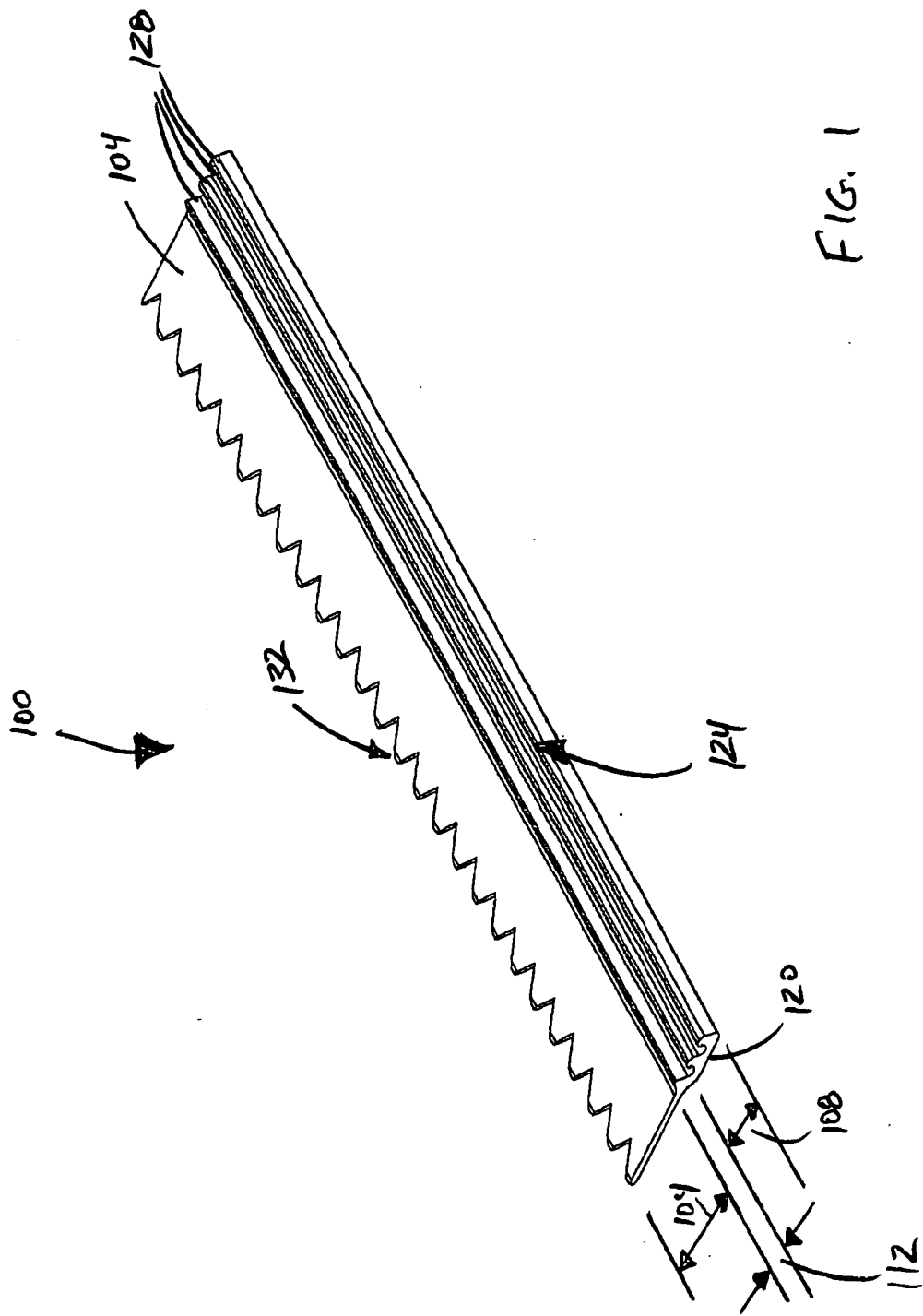
9. The fastening system of Claim 8, wherein the rotatable brake comprises a cam.
10. The fastening system of Claim 8, wherein the rotatable brake comprises a roller having a rotation axis oriented substantially perpendicular to a longitudinal axis of the stop block. 10
11. The fastening system of Claim 8, wherein the rotatable brake comprises release mechanism for disengaging the rotatable brake from the grasp portion. 15
12. The fastening system of Claim 8, further comprising a top stop fixedly secured to at least one of the first and second longitudinal ends of one of said first and second fastening members. 20
13. The fastening system of claim 1, wherein the stop block comprises a first block member fixedly secured to at least one of the first and second longitudinal ends of one of said first and second fastening members, and a second block member fixedly secured to another of the at least one of the first and second longitudinal ends of one of said first and second fastening members, wherein the first block member releasably engages the second block member to form a connected block member. 25
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14. The fastening system of Claim 13, further comprising a top stop fixedly secured to at least one of the first and second longitudinal ends of one of said first and second fastening members. 35

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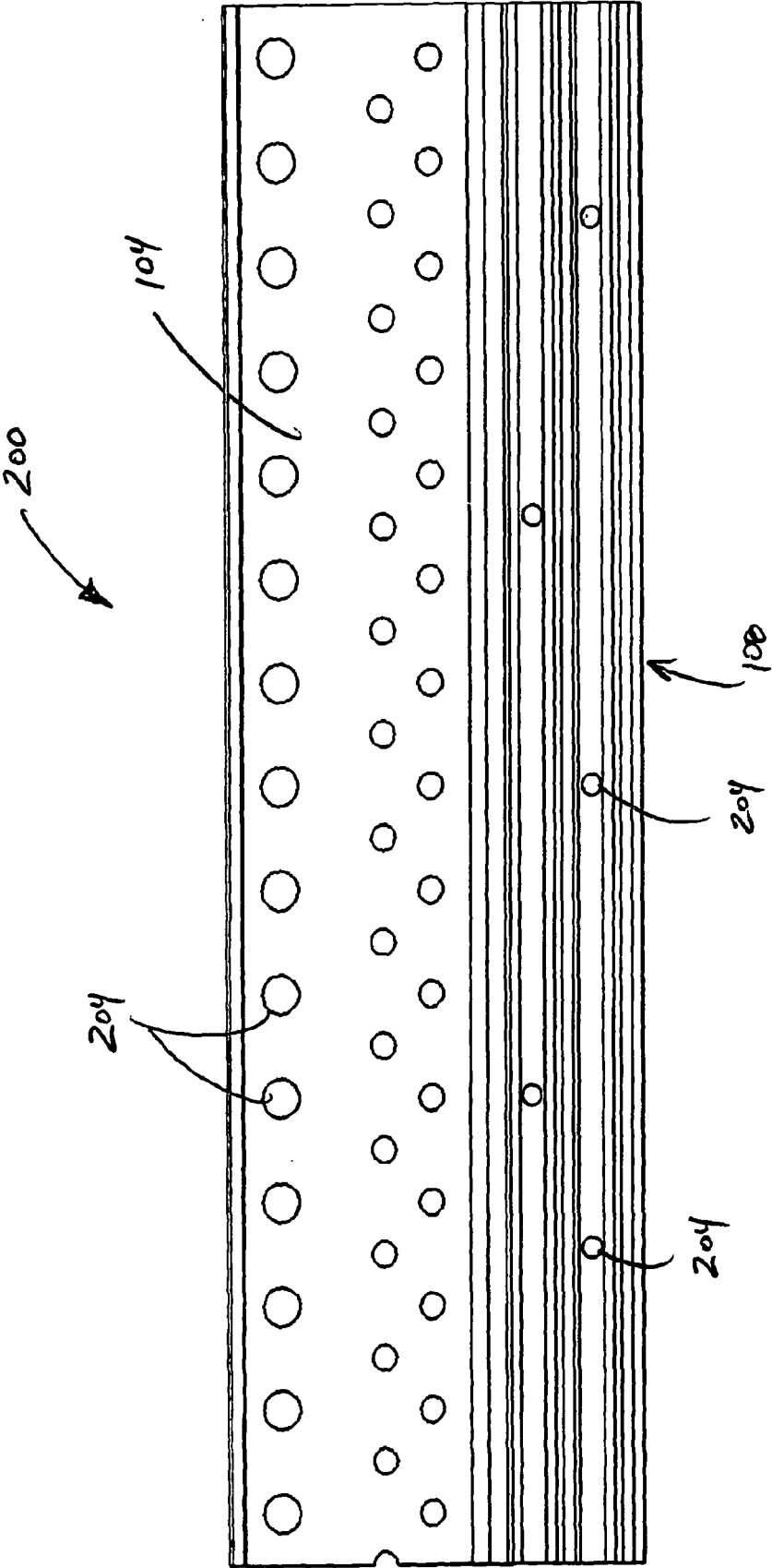


FIG. 2

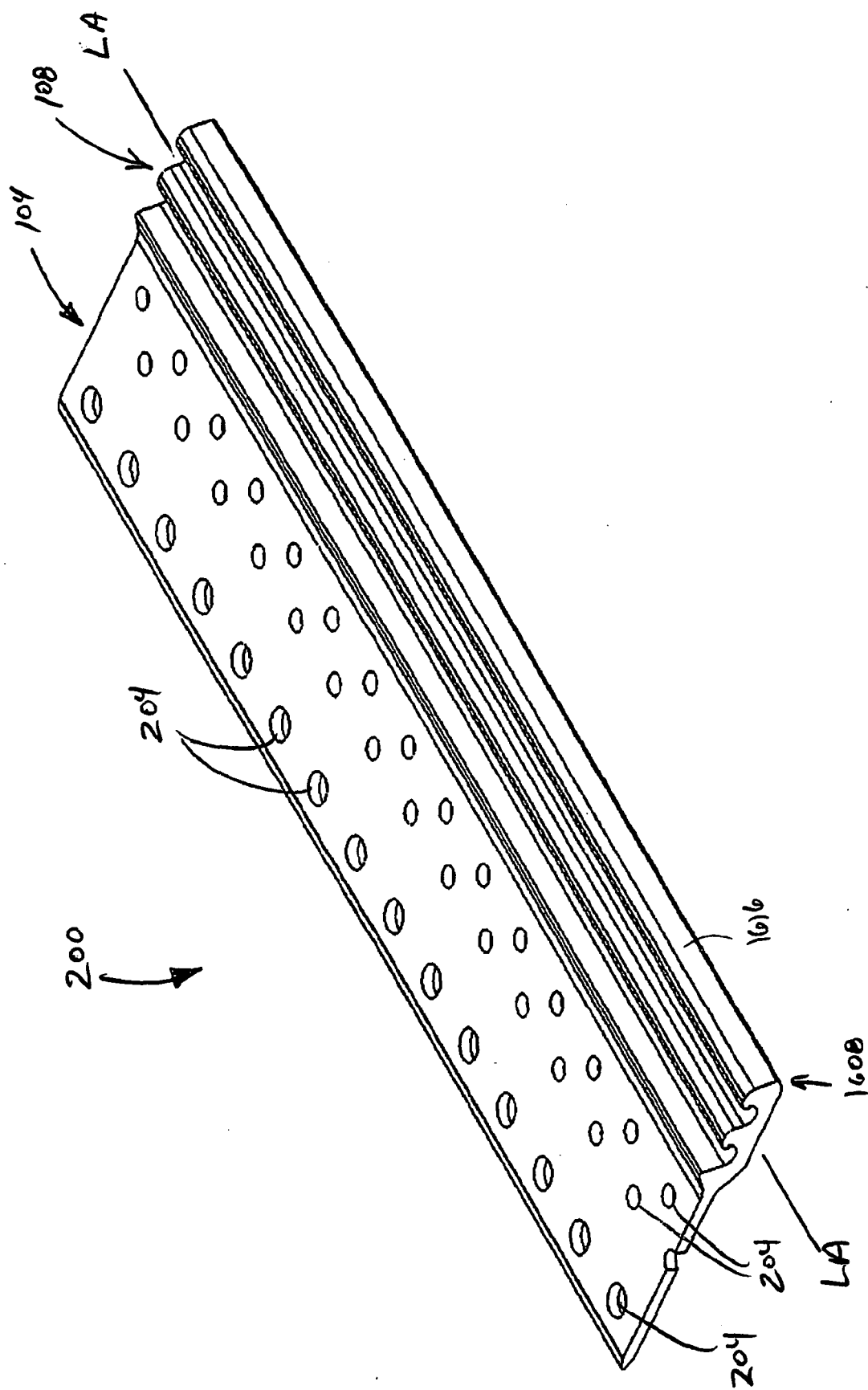


FIG. 3

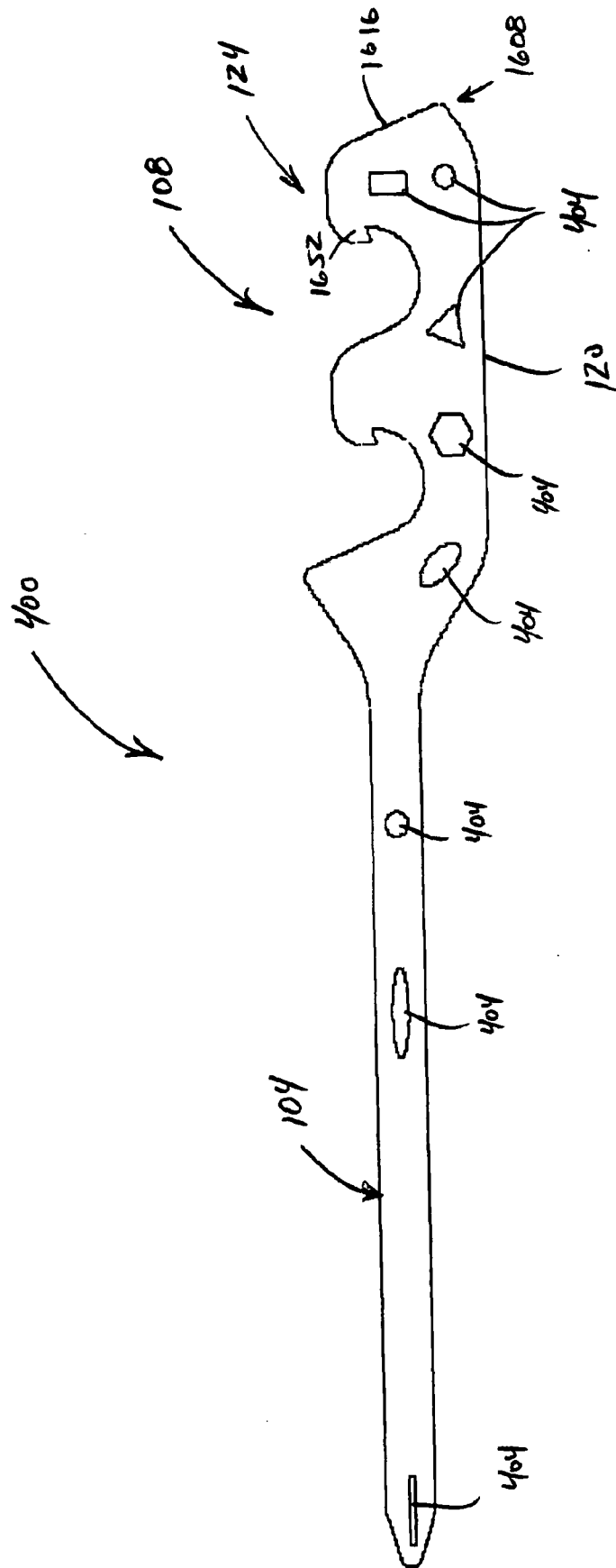
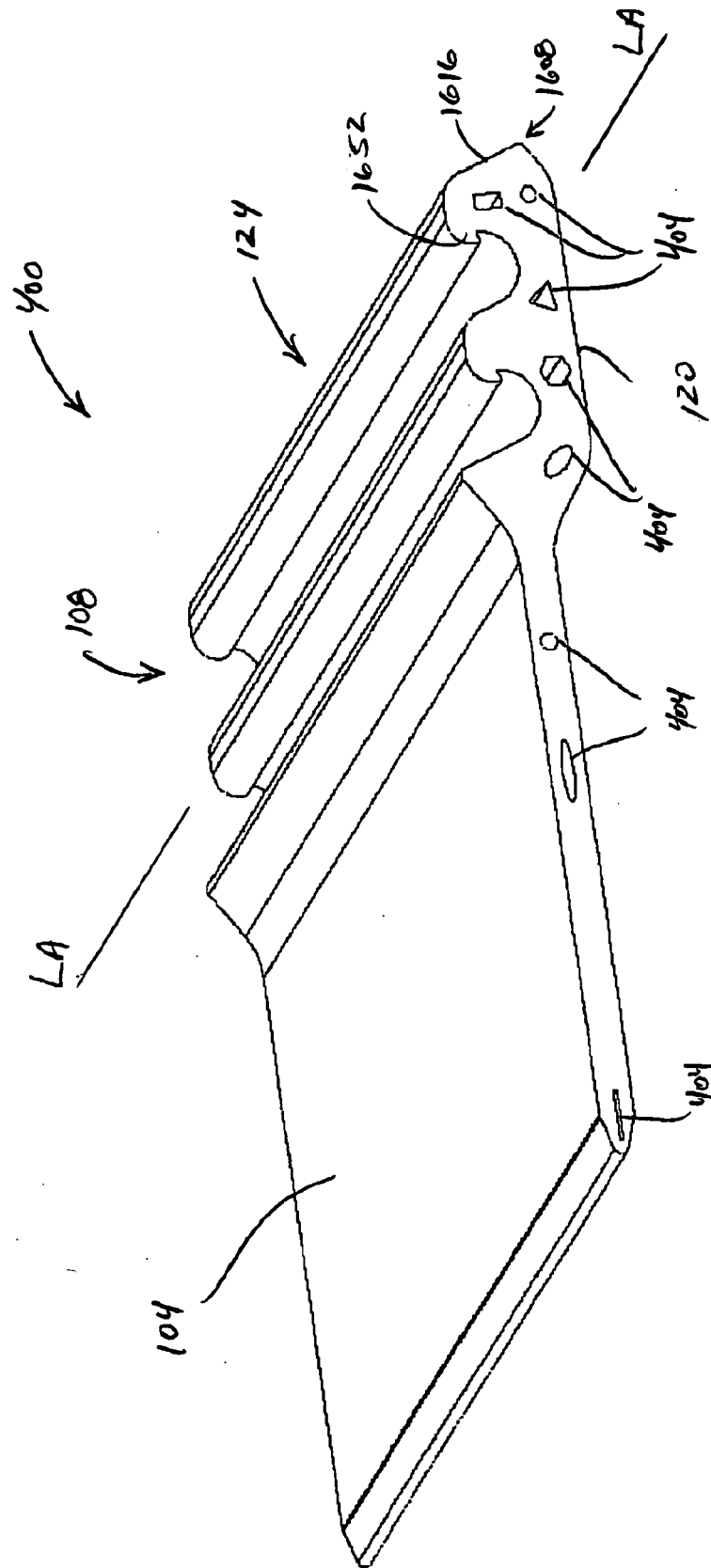


FIG. 4



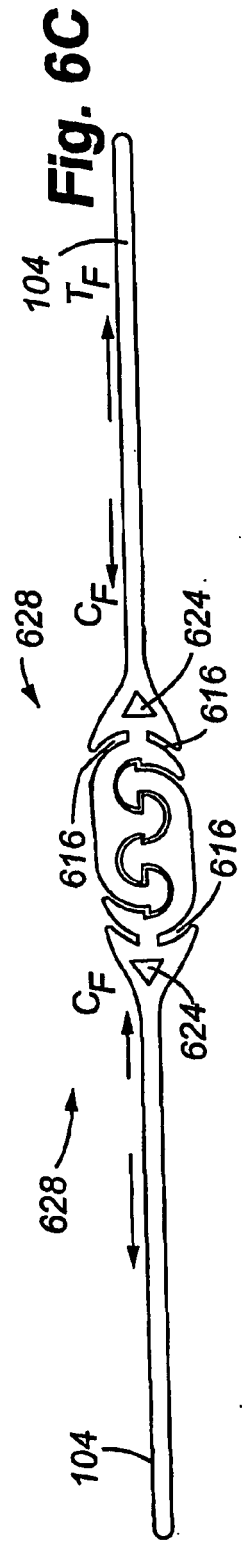
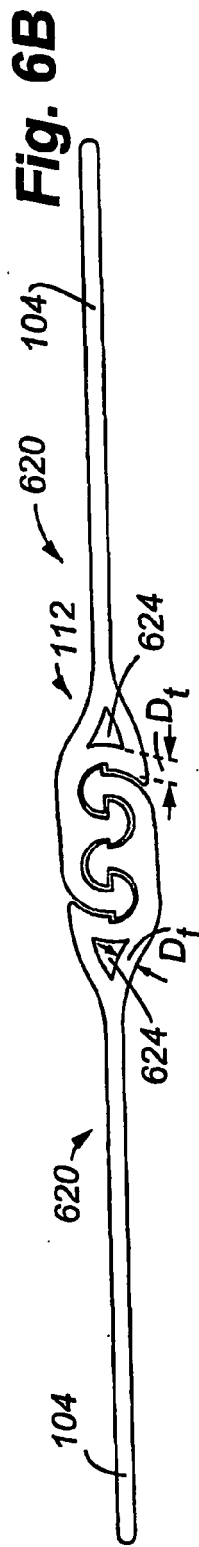
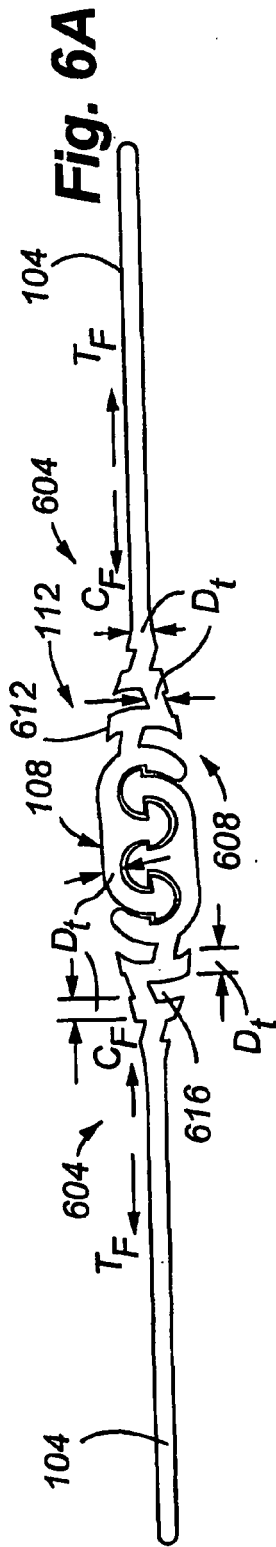


Fig. 6D

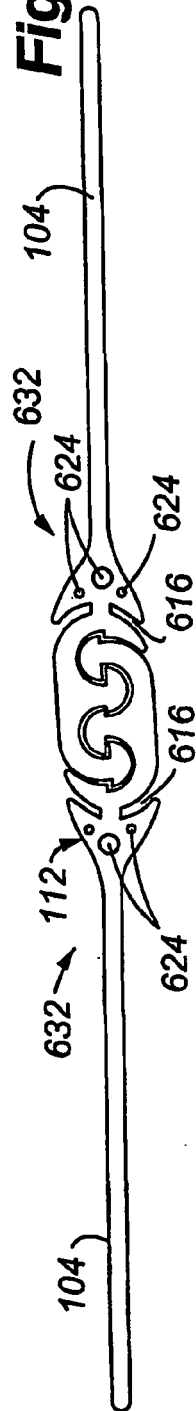


Fig. 6E

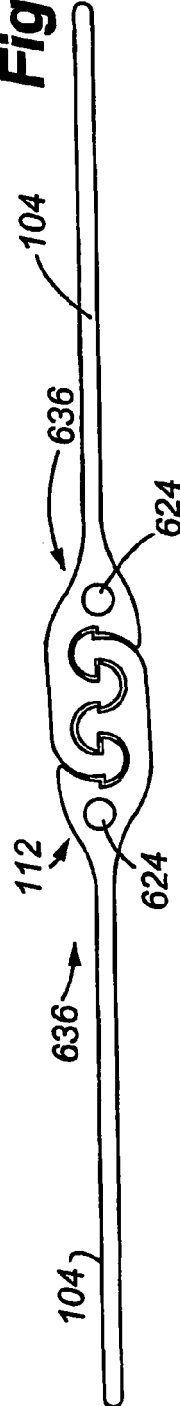
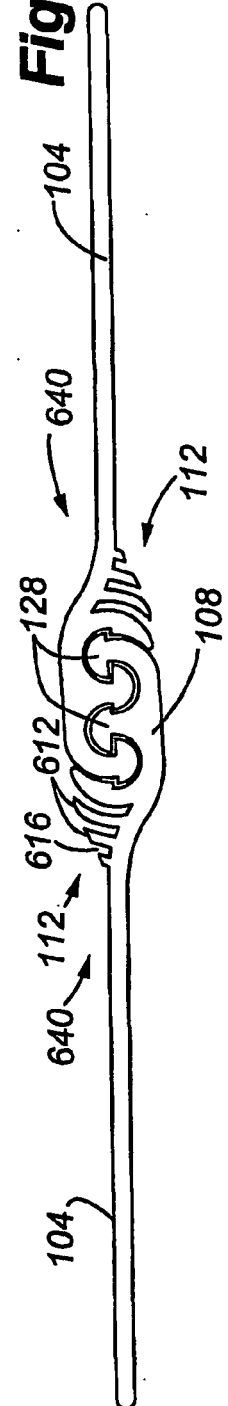
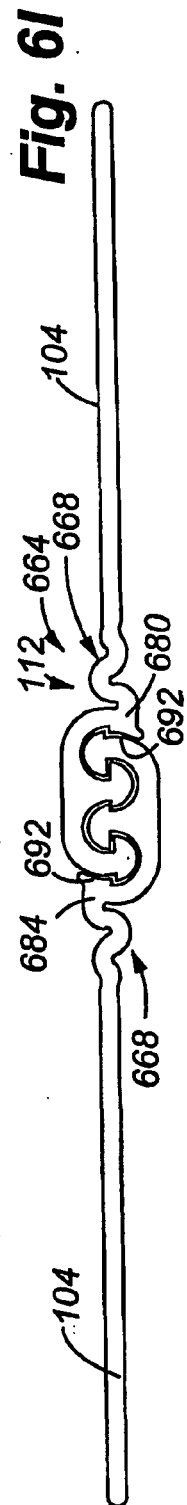
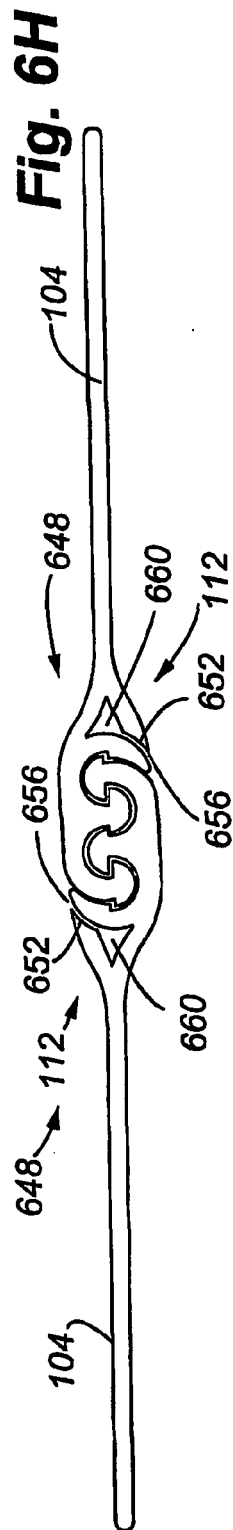
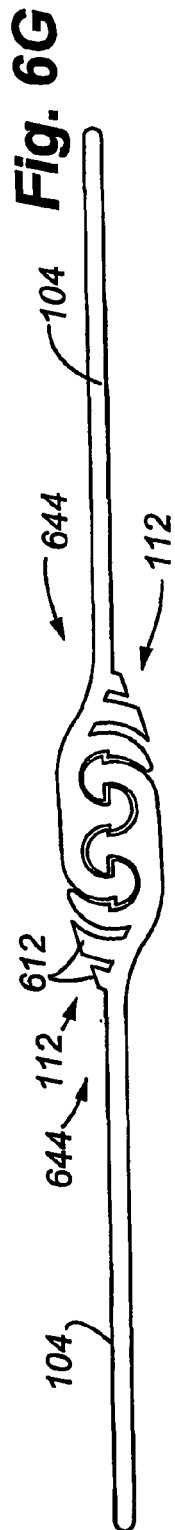


Fig. 6F





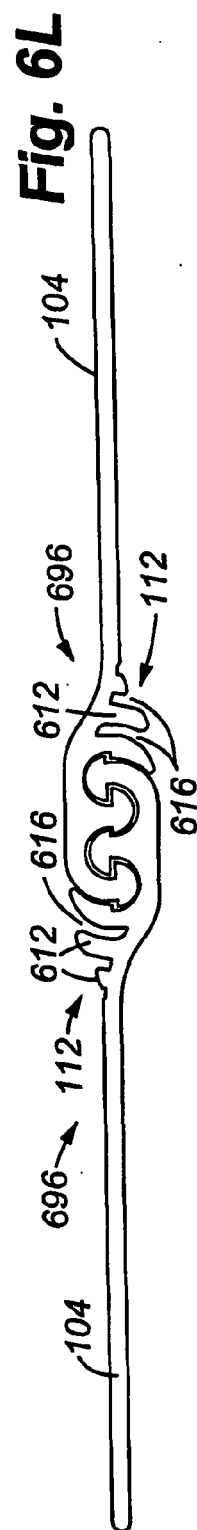
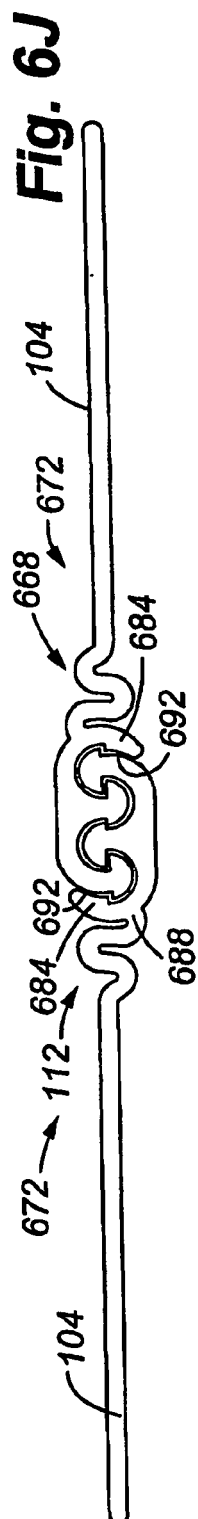


Fig. 6M

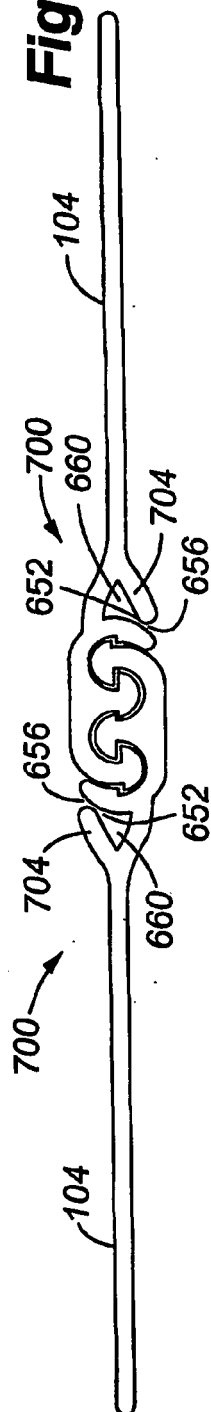


Fig. 6N

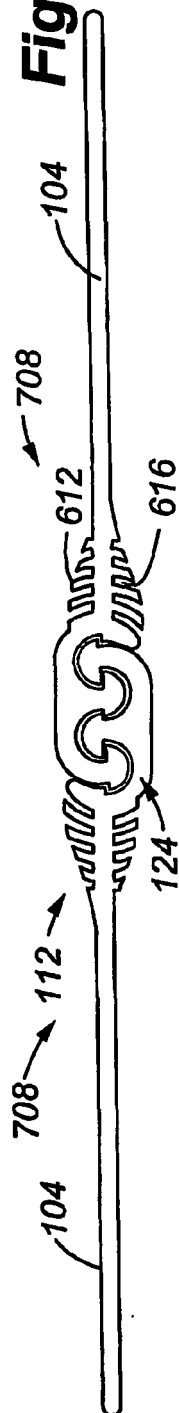
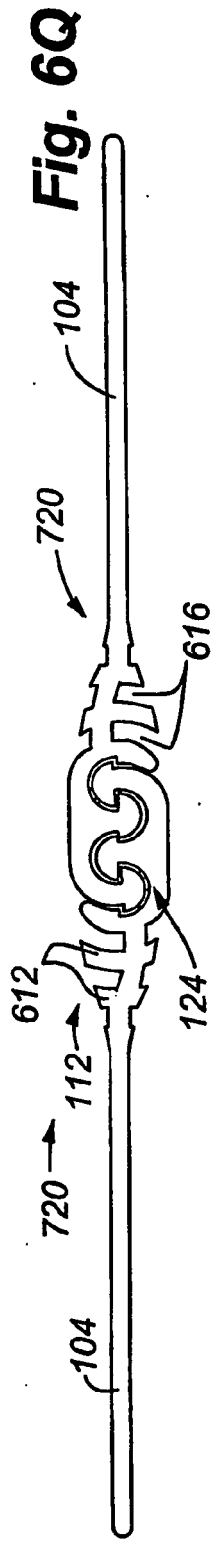
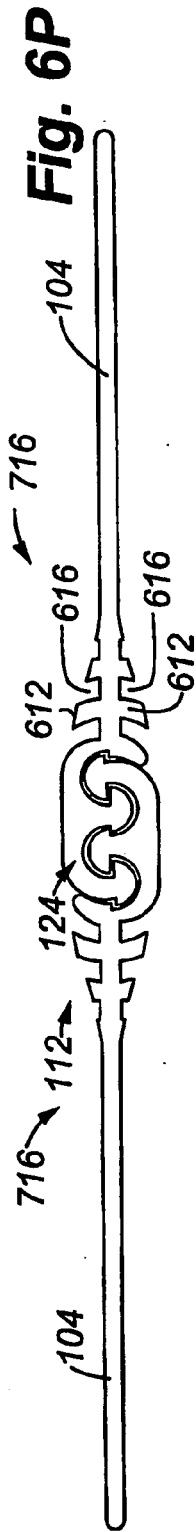


Fig. 6O





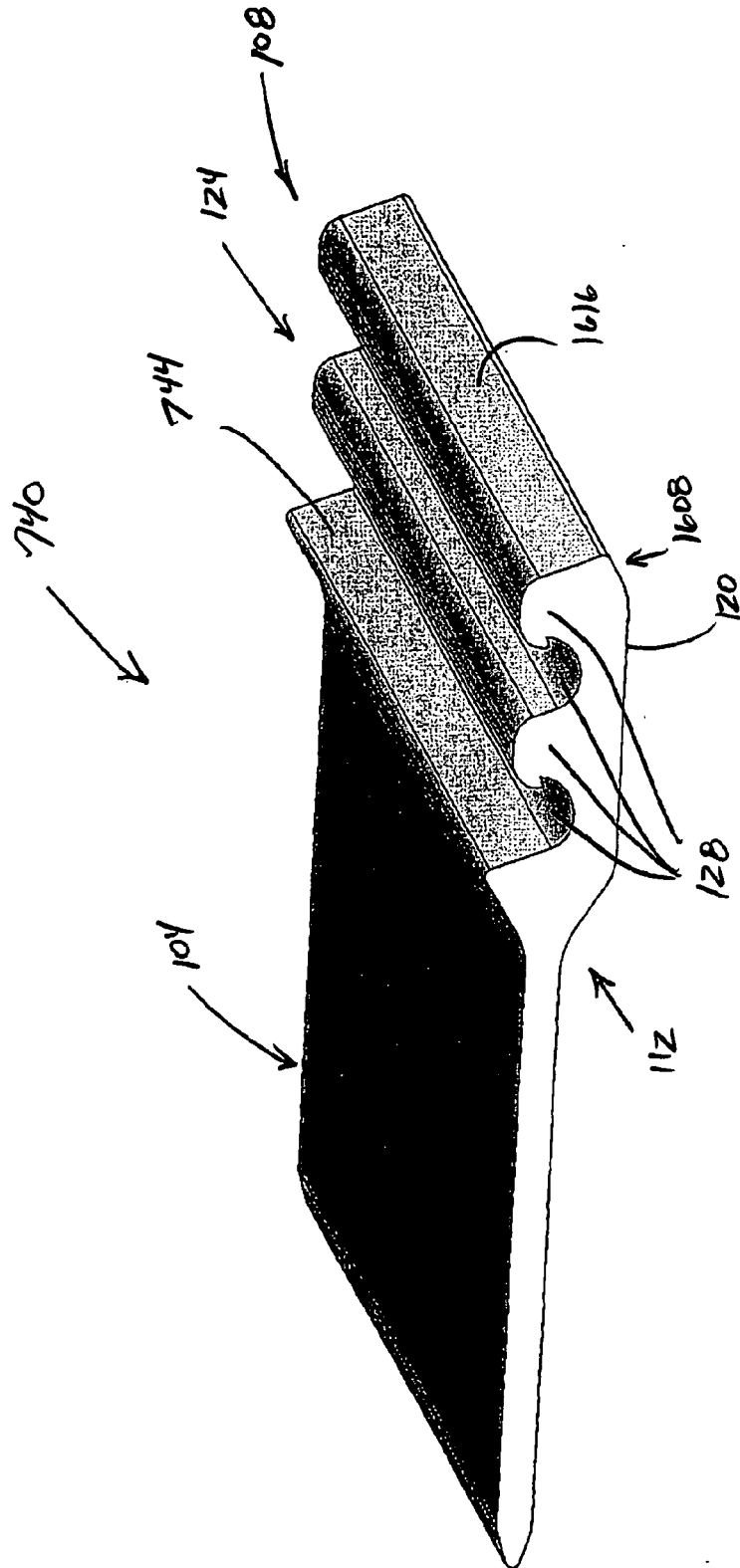


FIG. 7

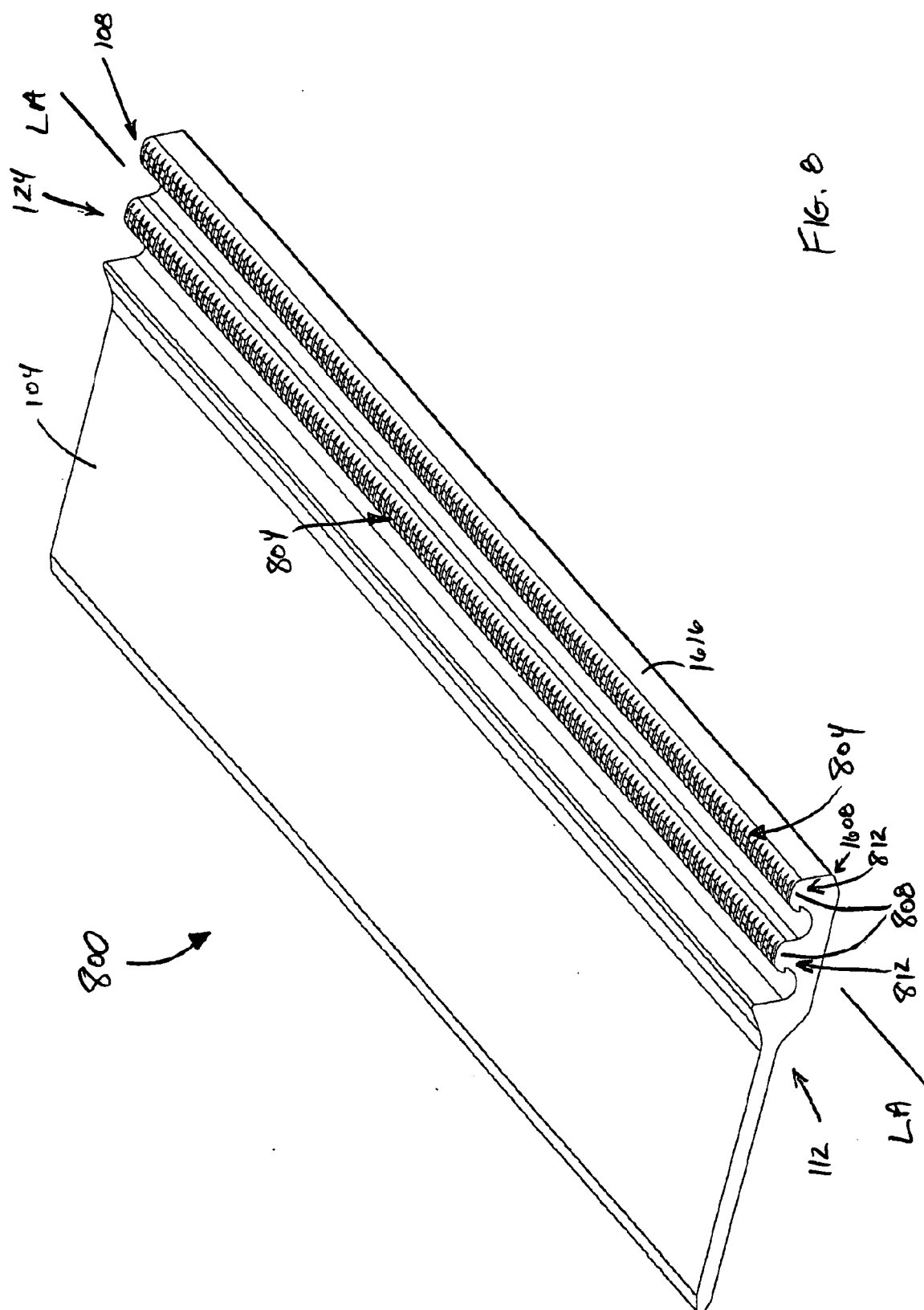
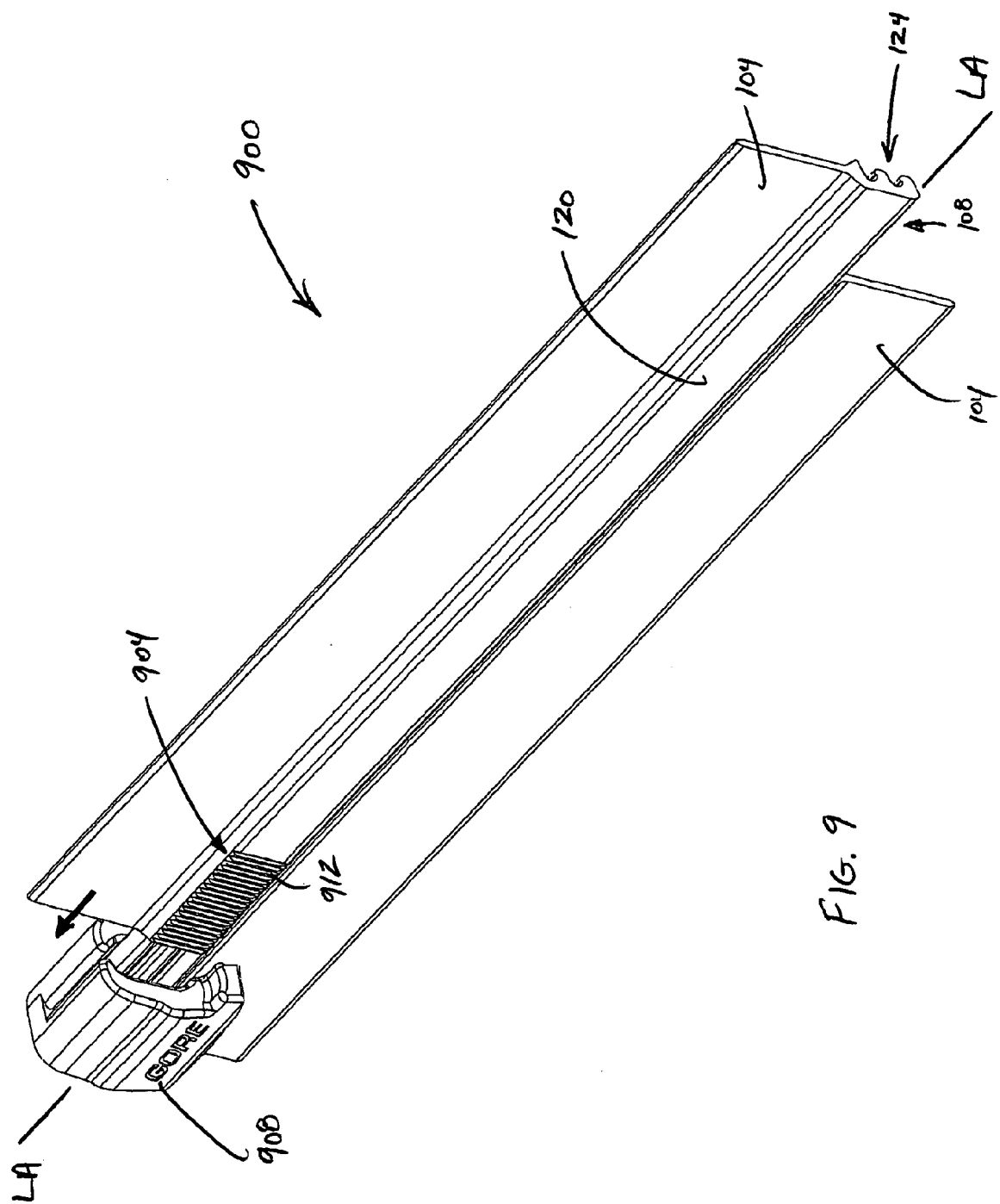
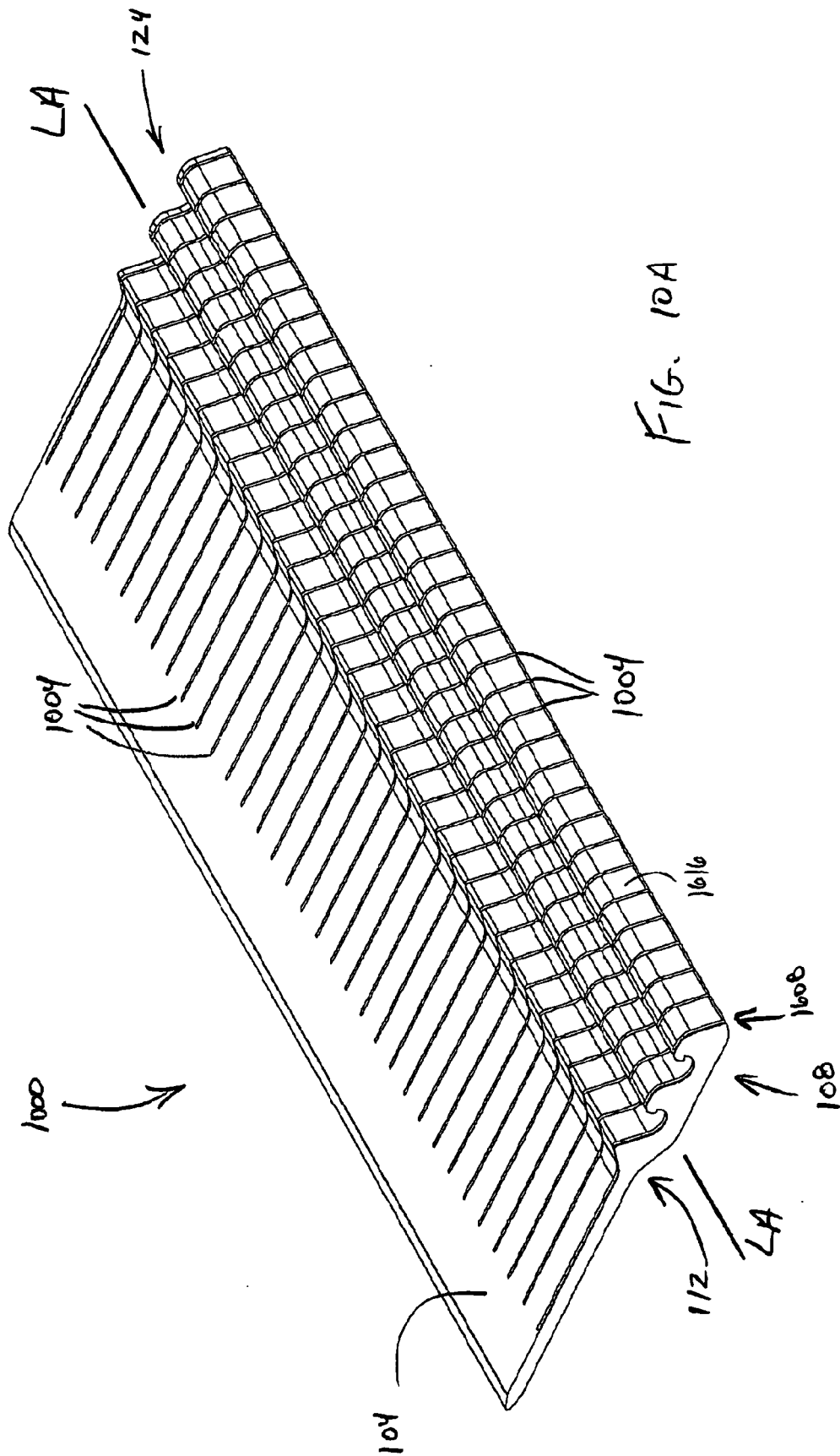
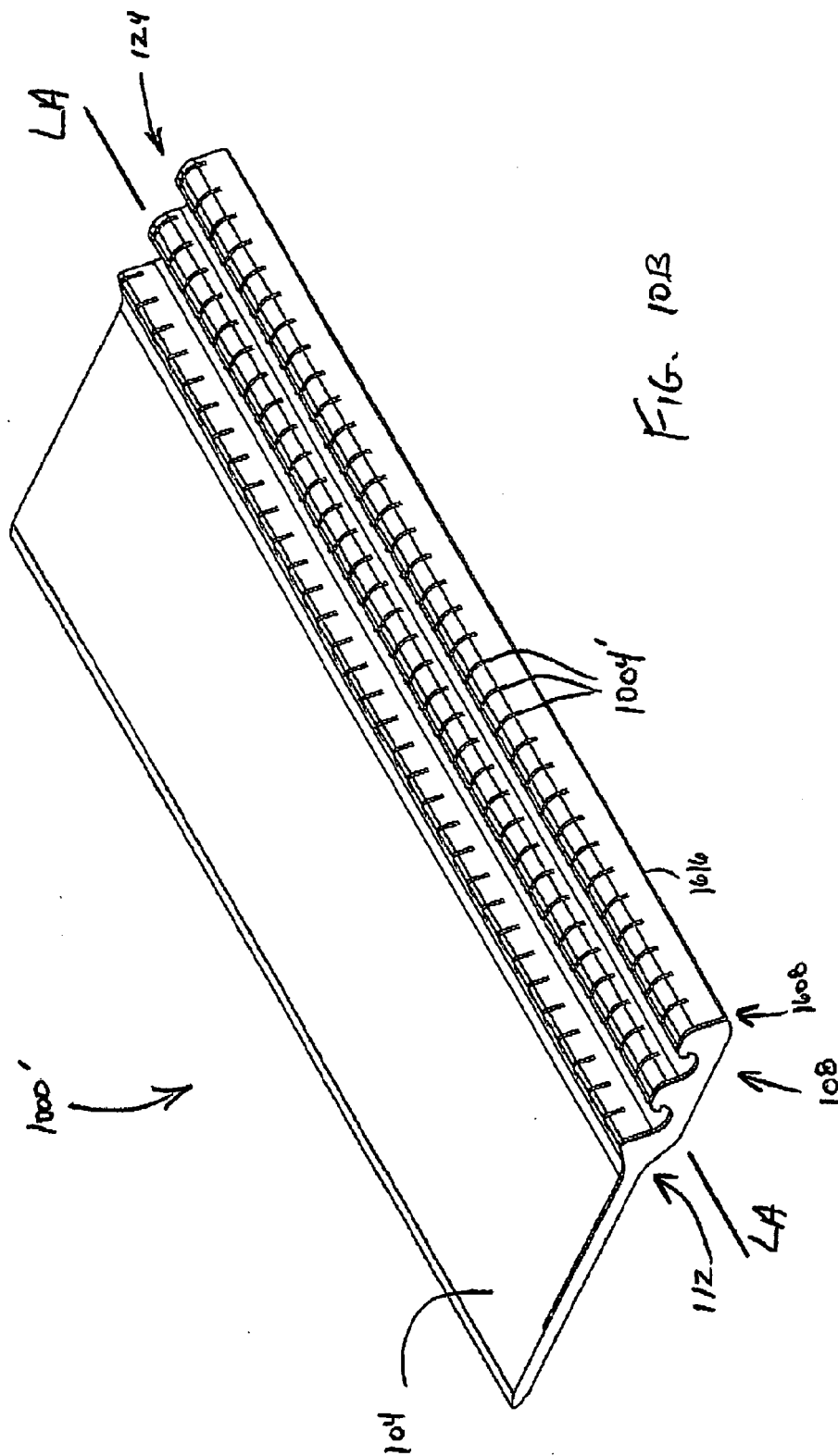


Fig. 8







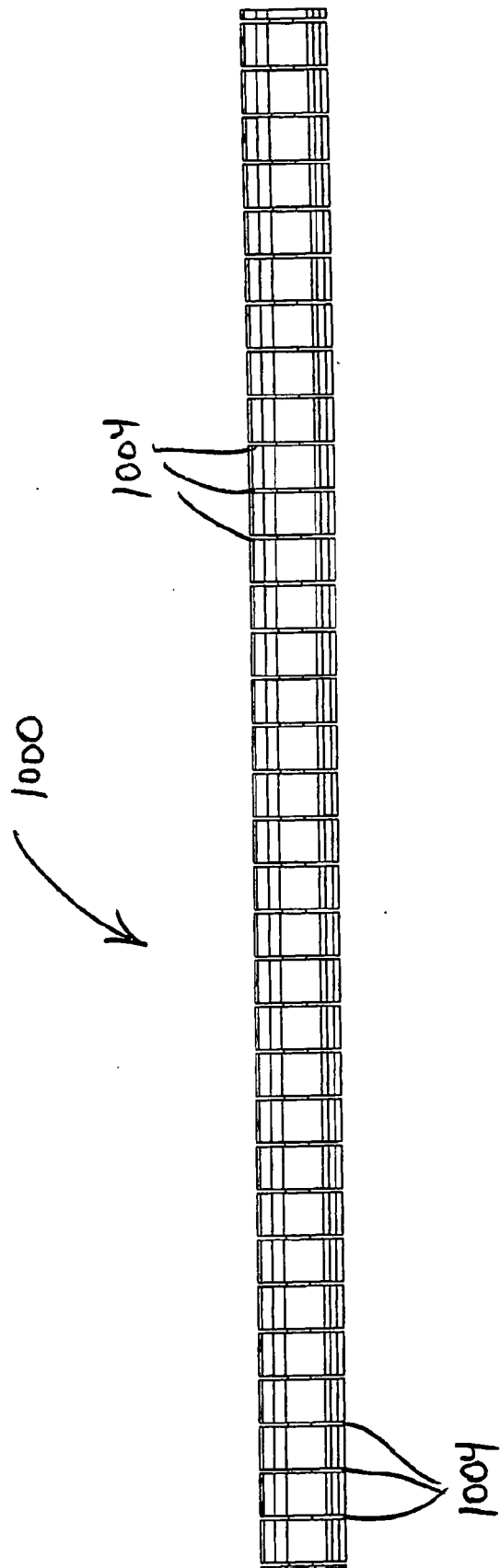


FIG. 11A

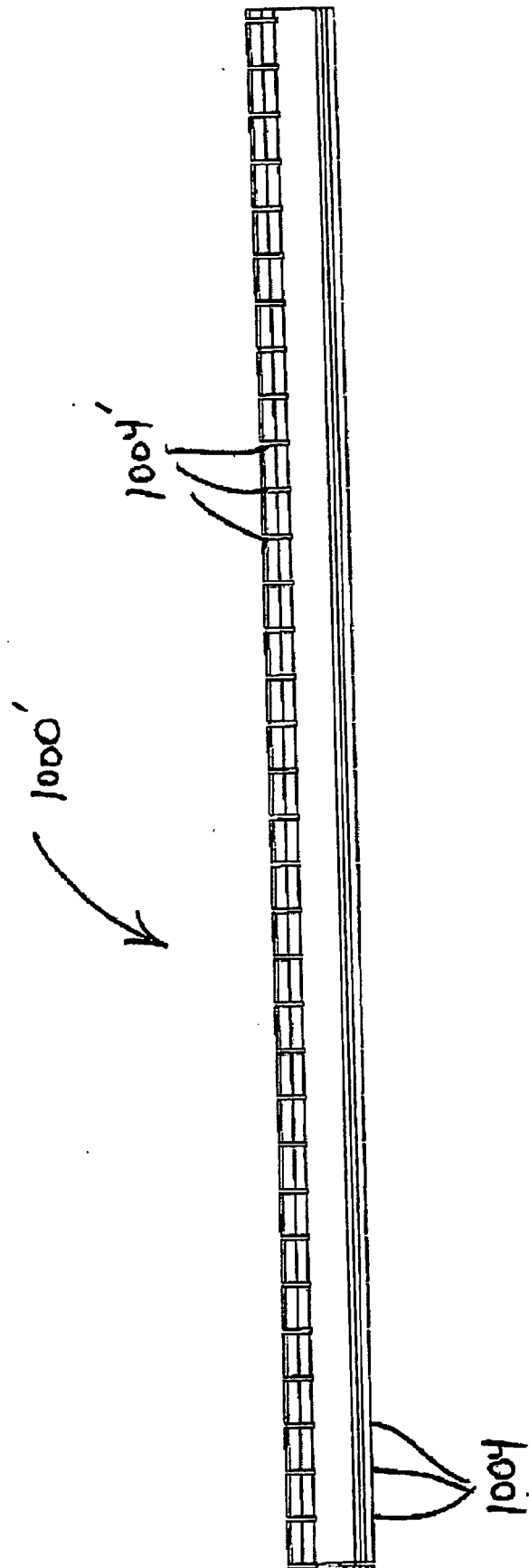


FIG. 11B

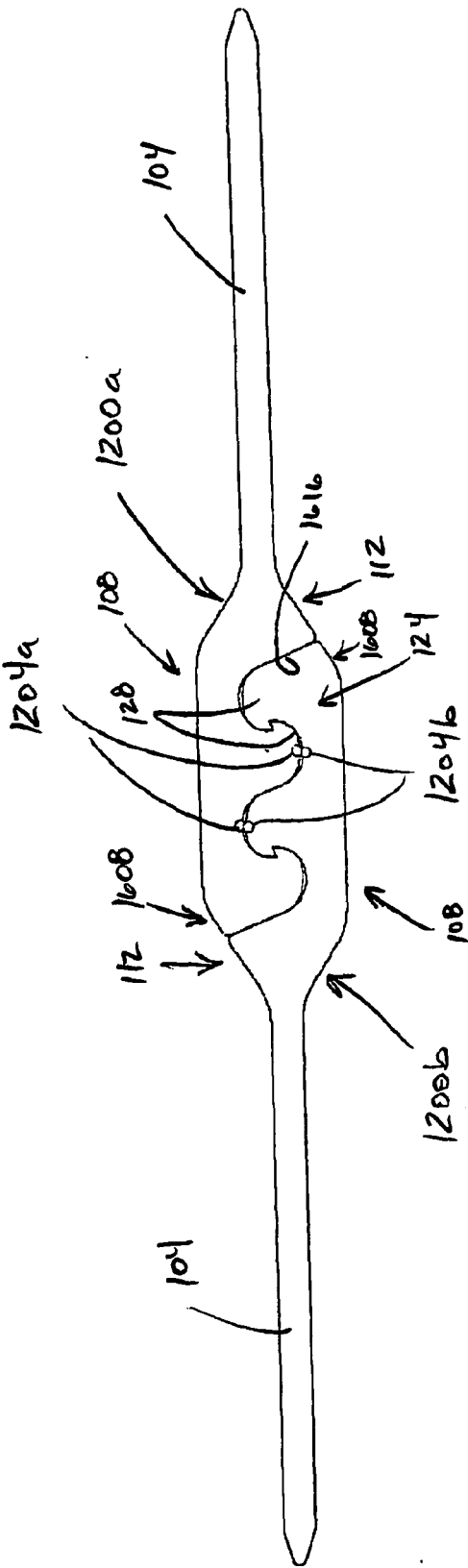


FIG. 12

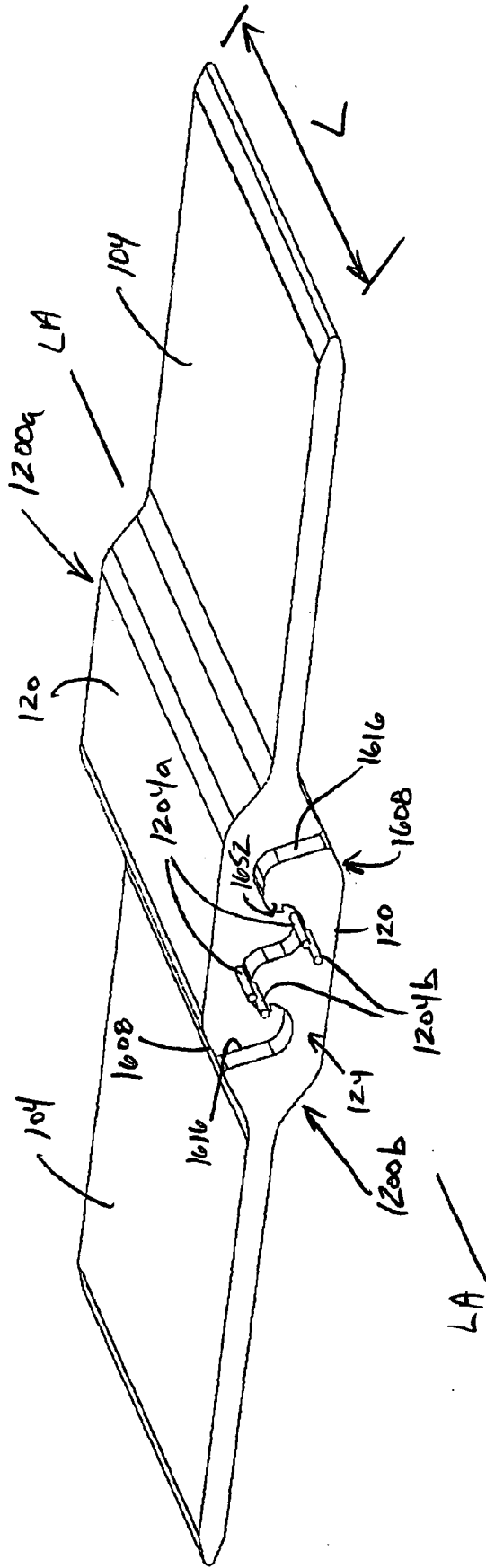


FIG. 13

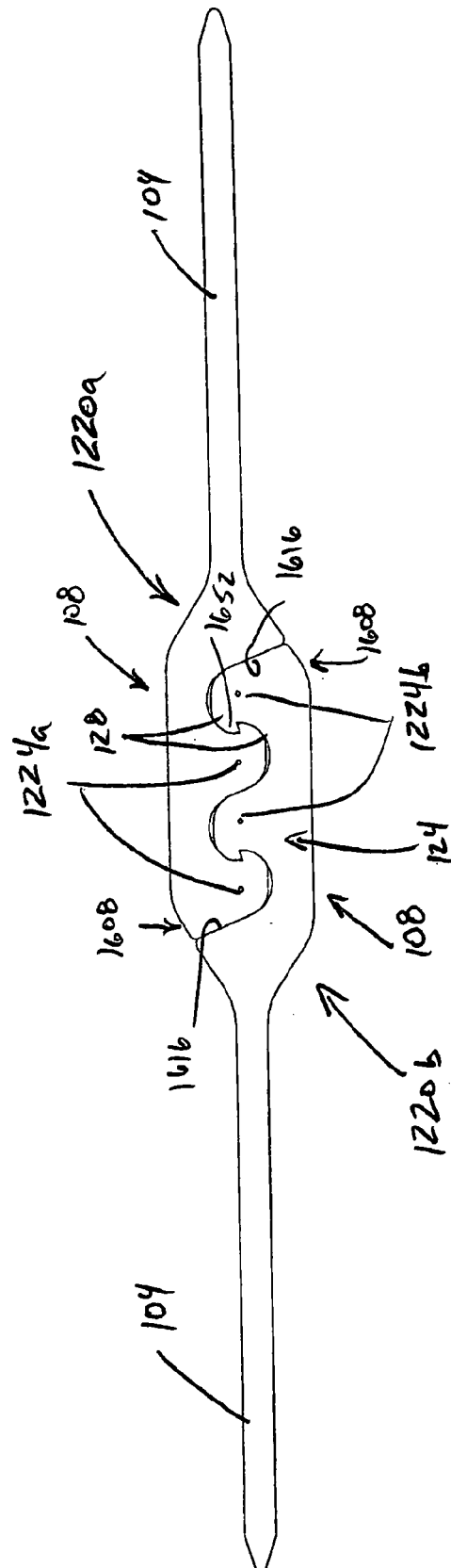


FIG. 14

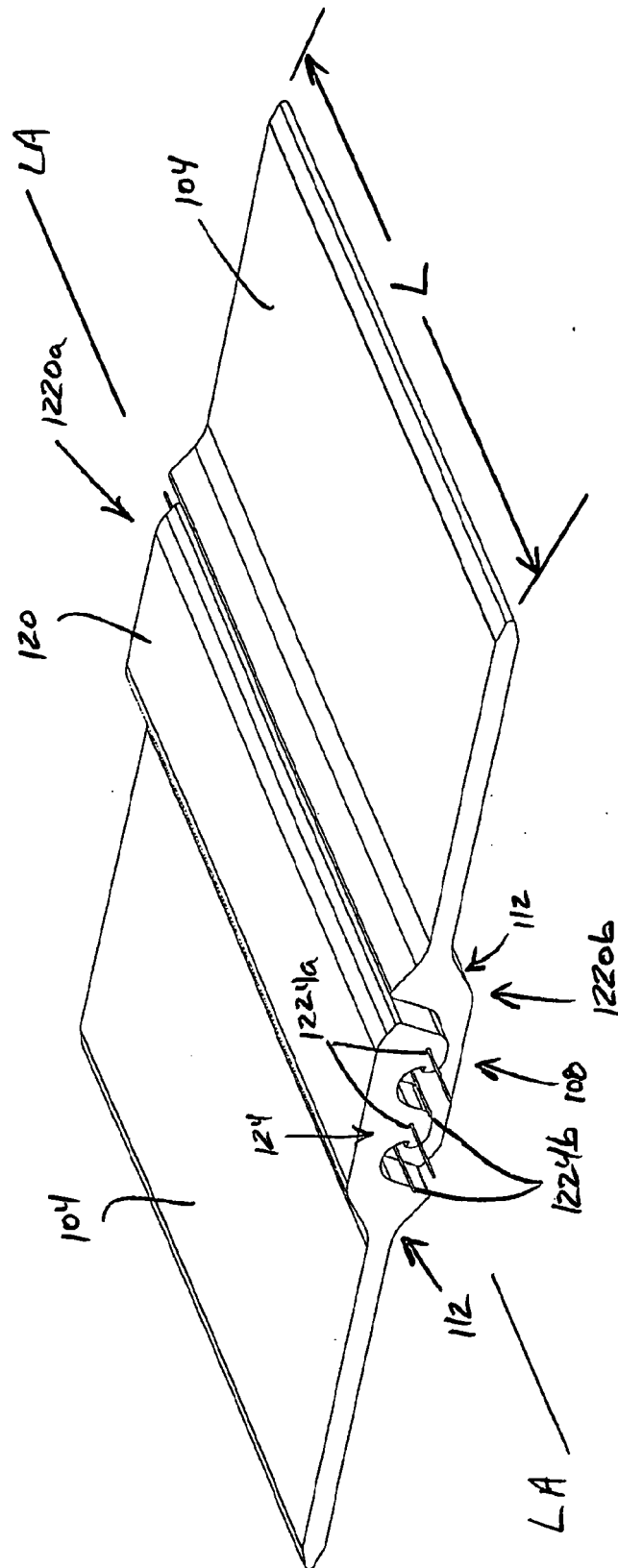
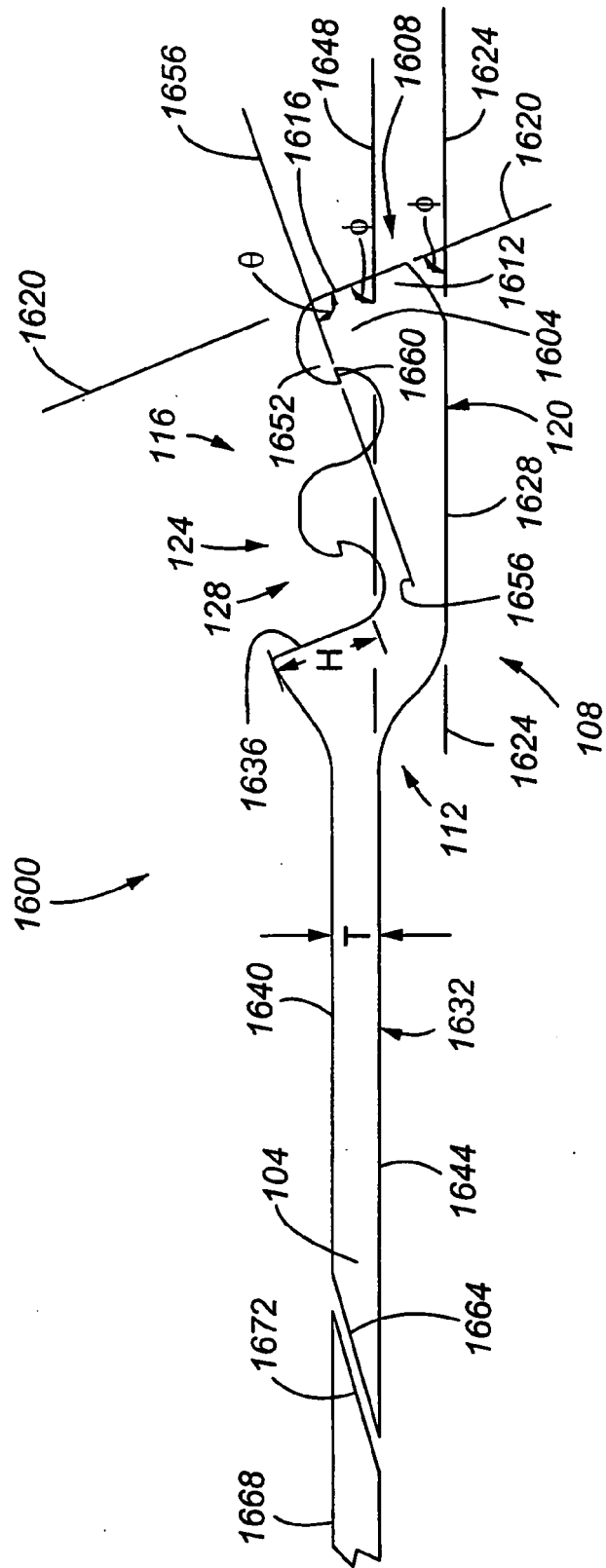


FIG. 15



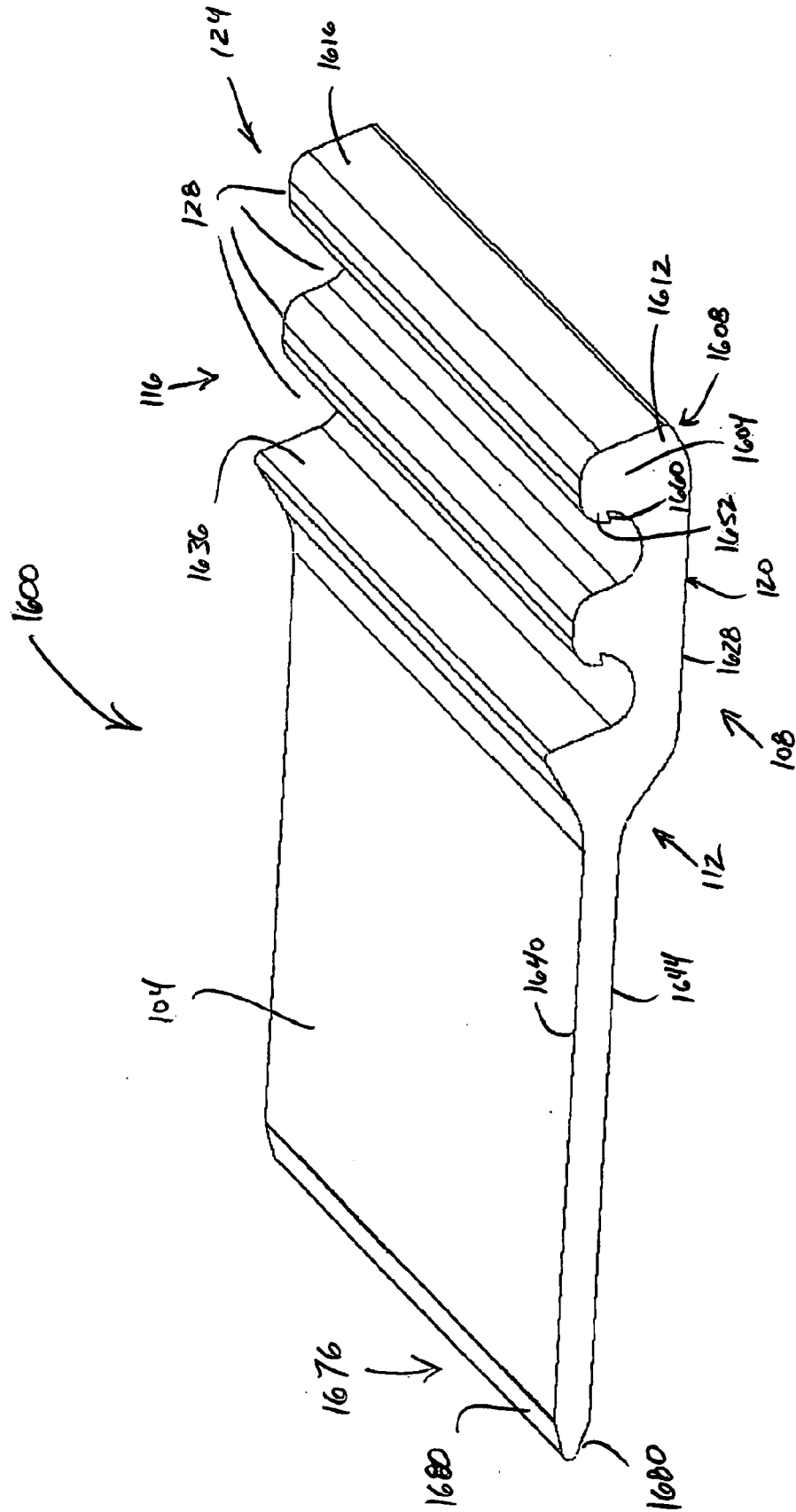


FIG. 17

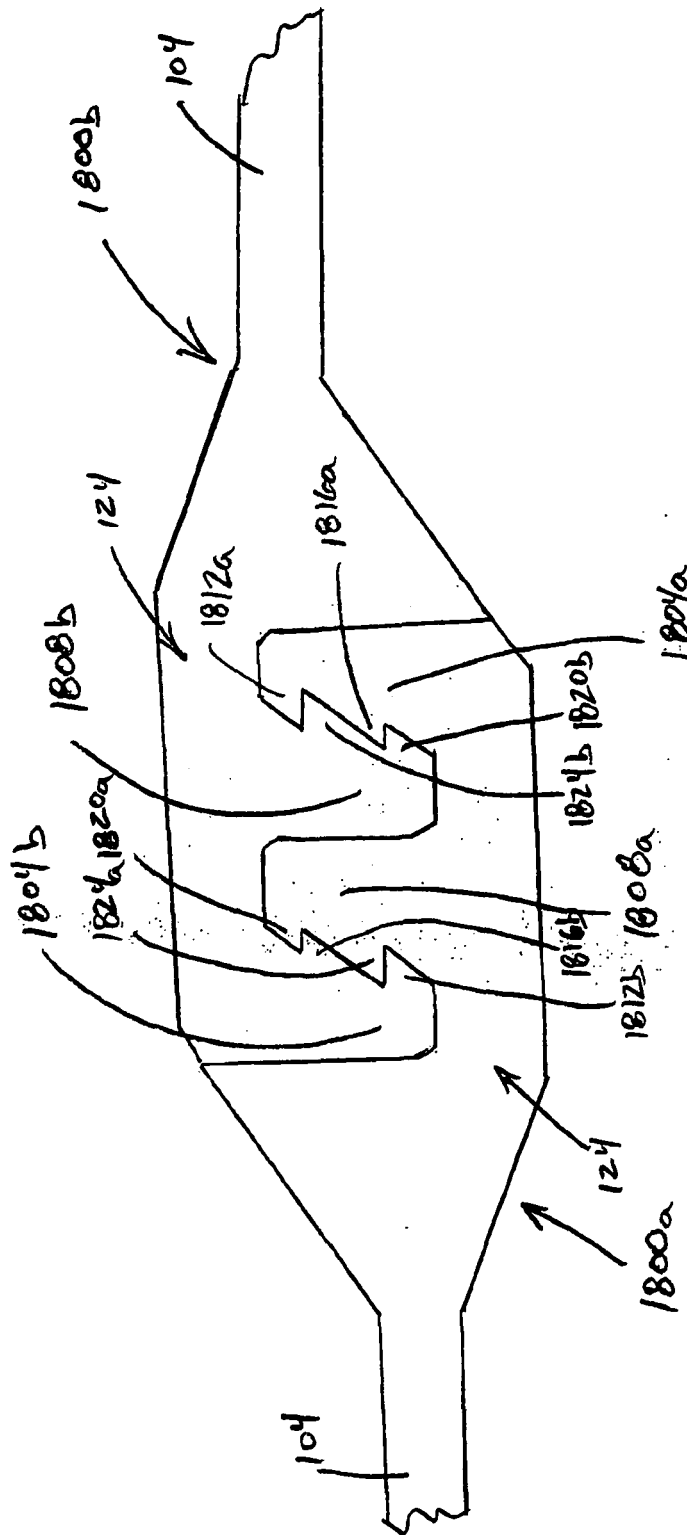
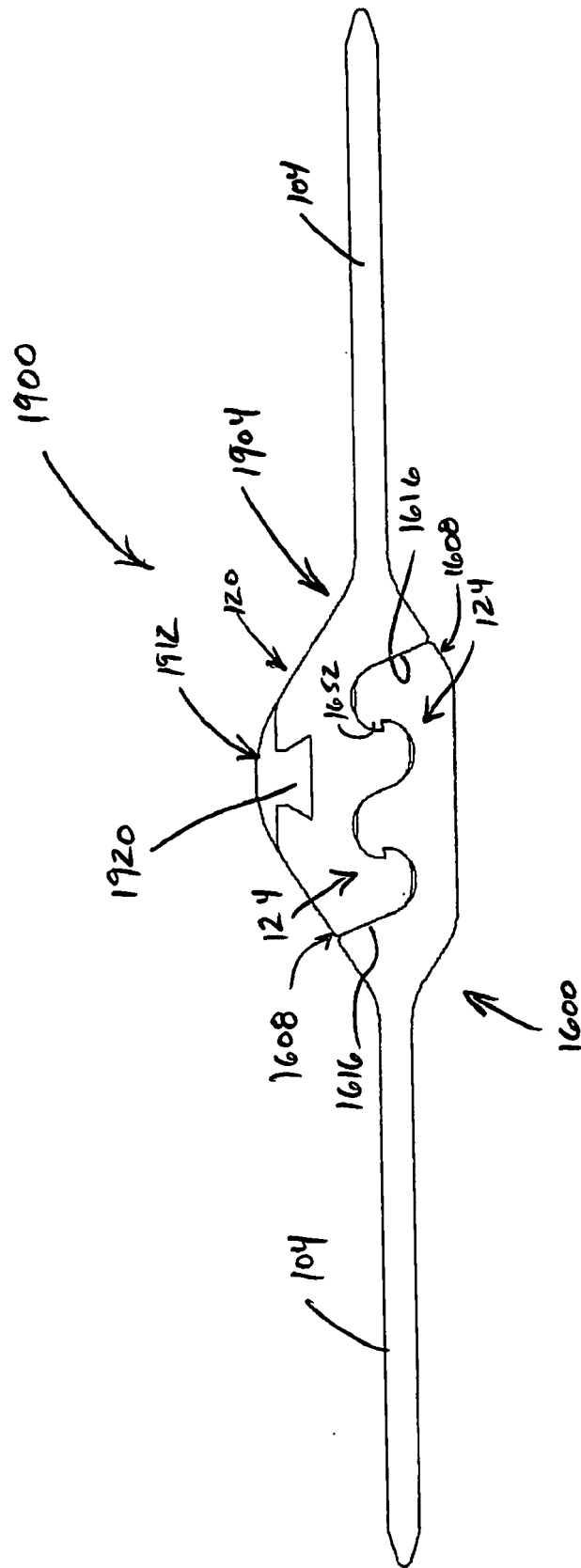


FIG. 18



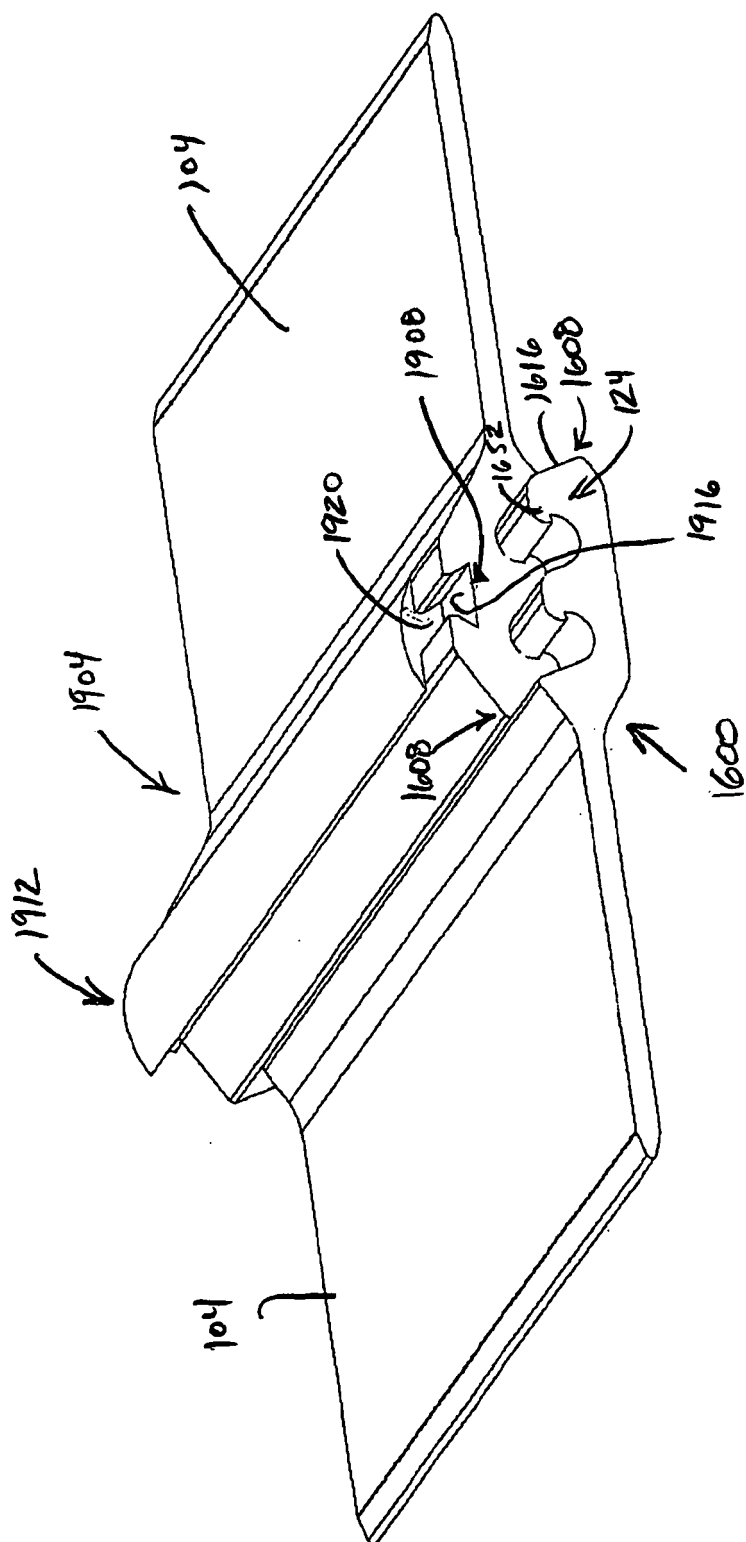


FIG. 20

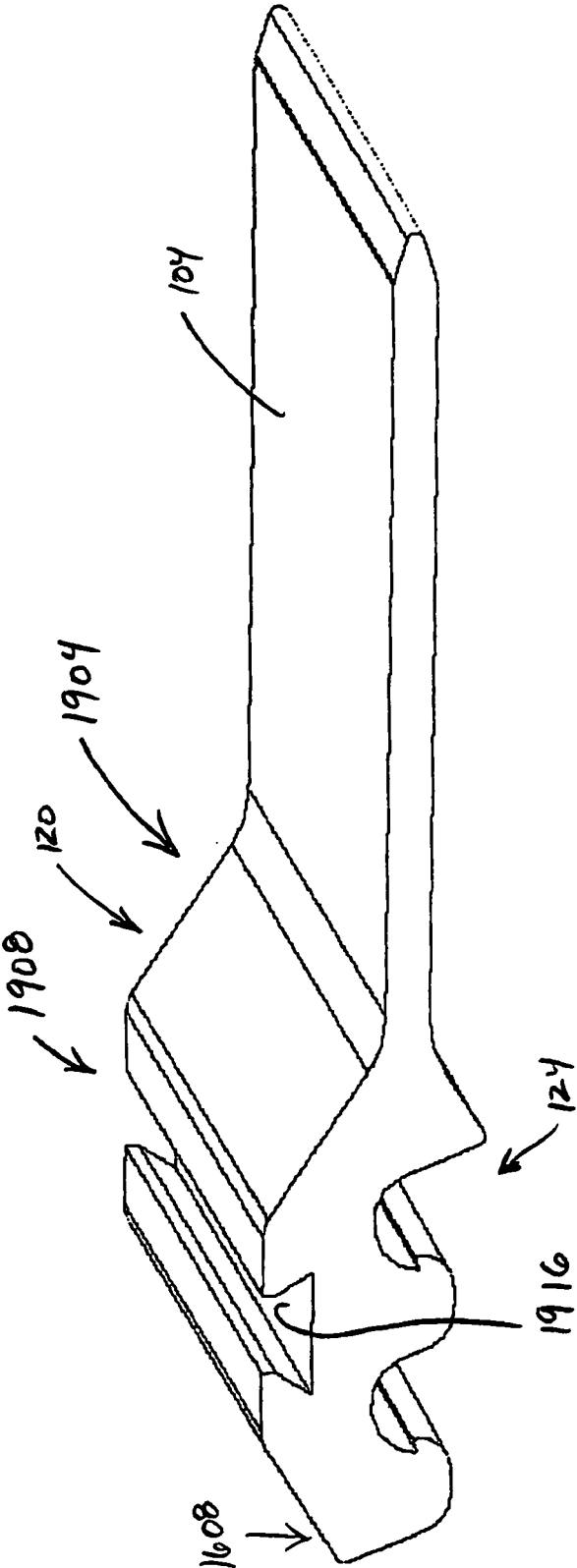


FIG. 21

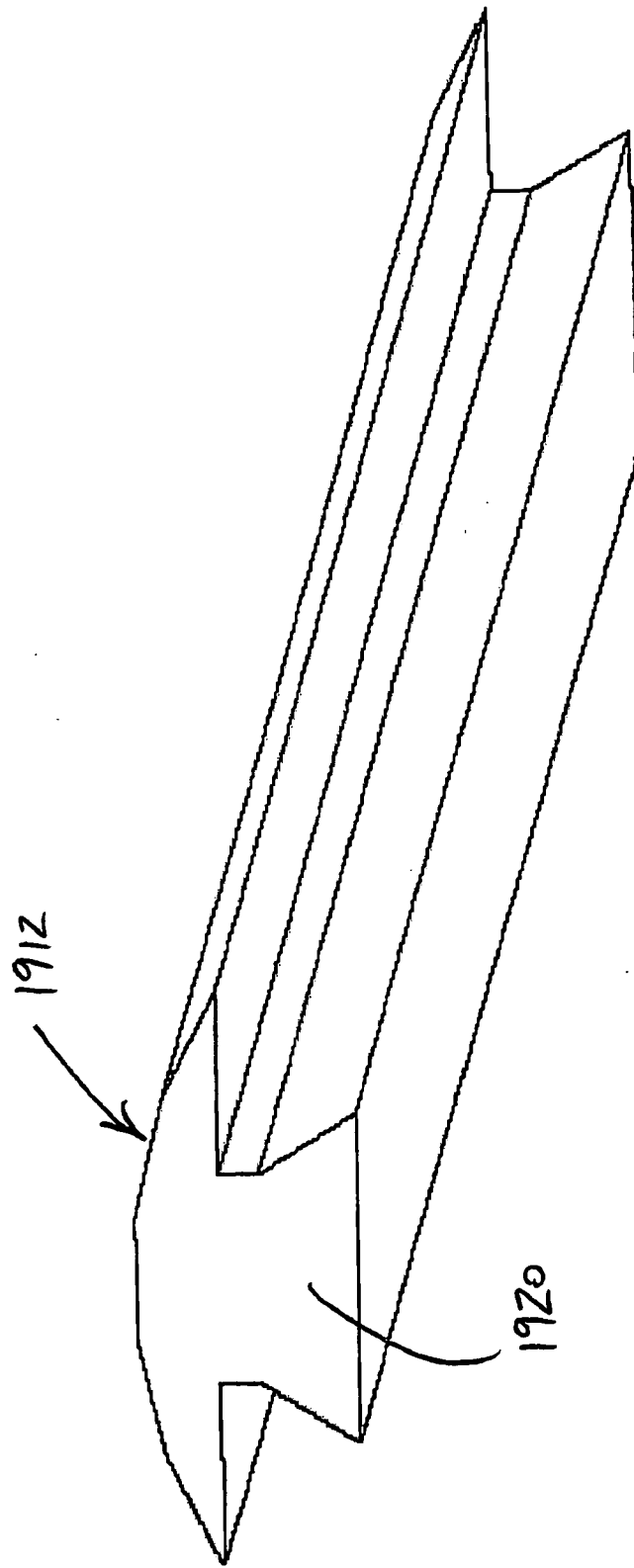


FIG. 22

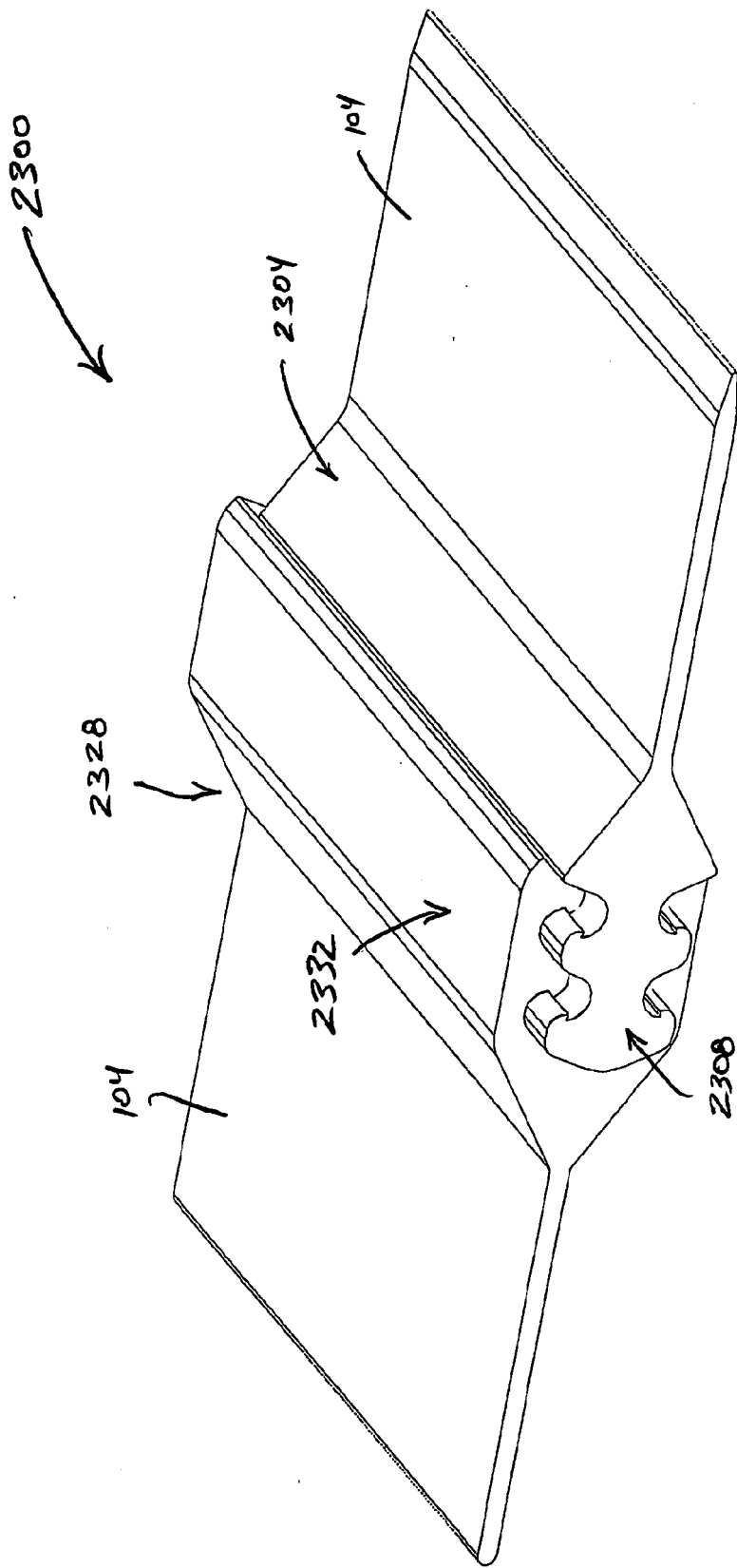


FIG. 23

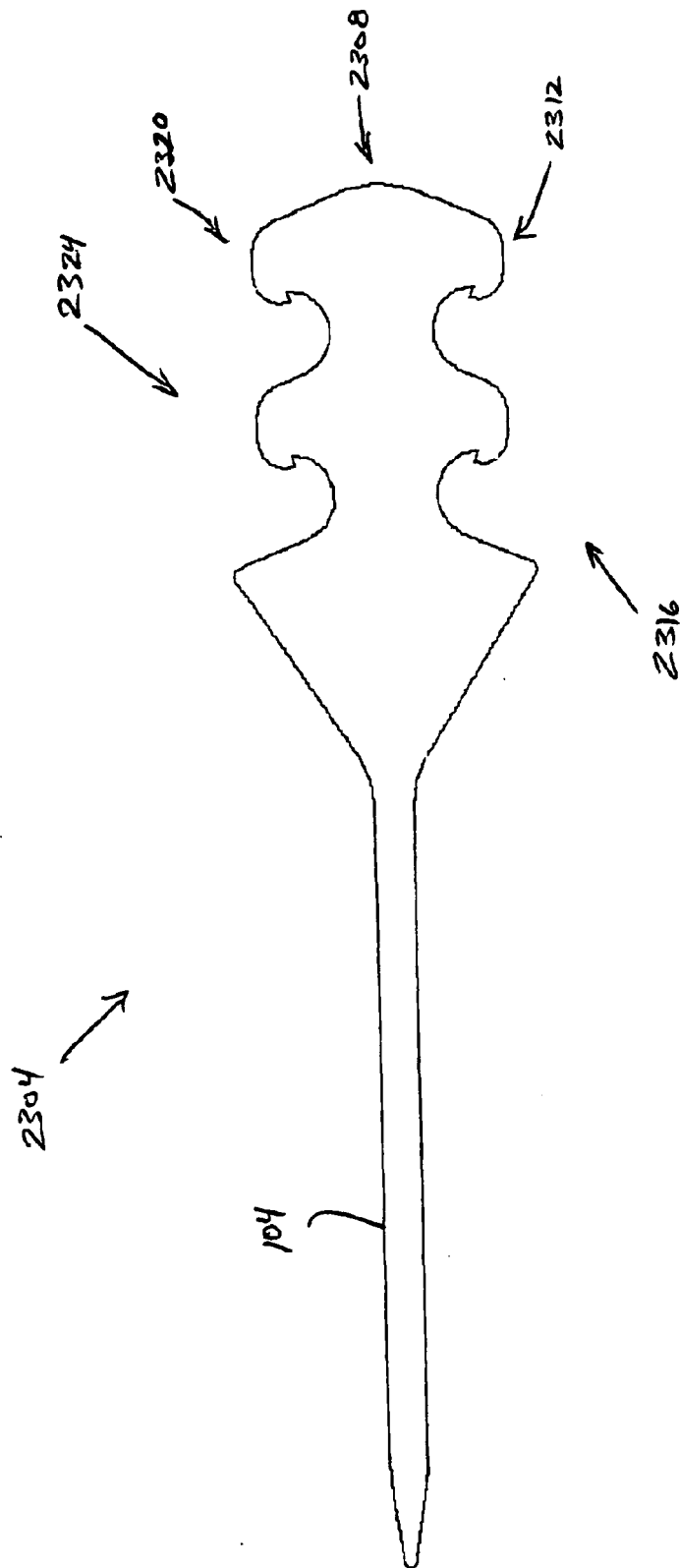


FIG. 24

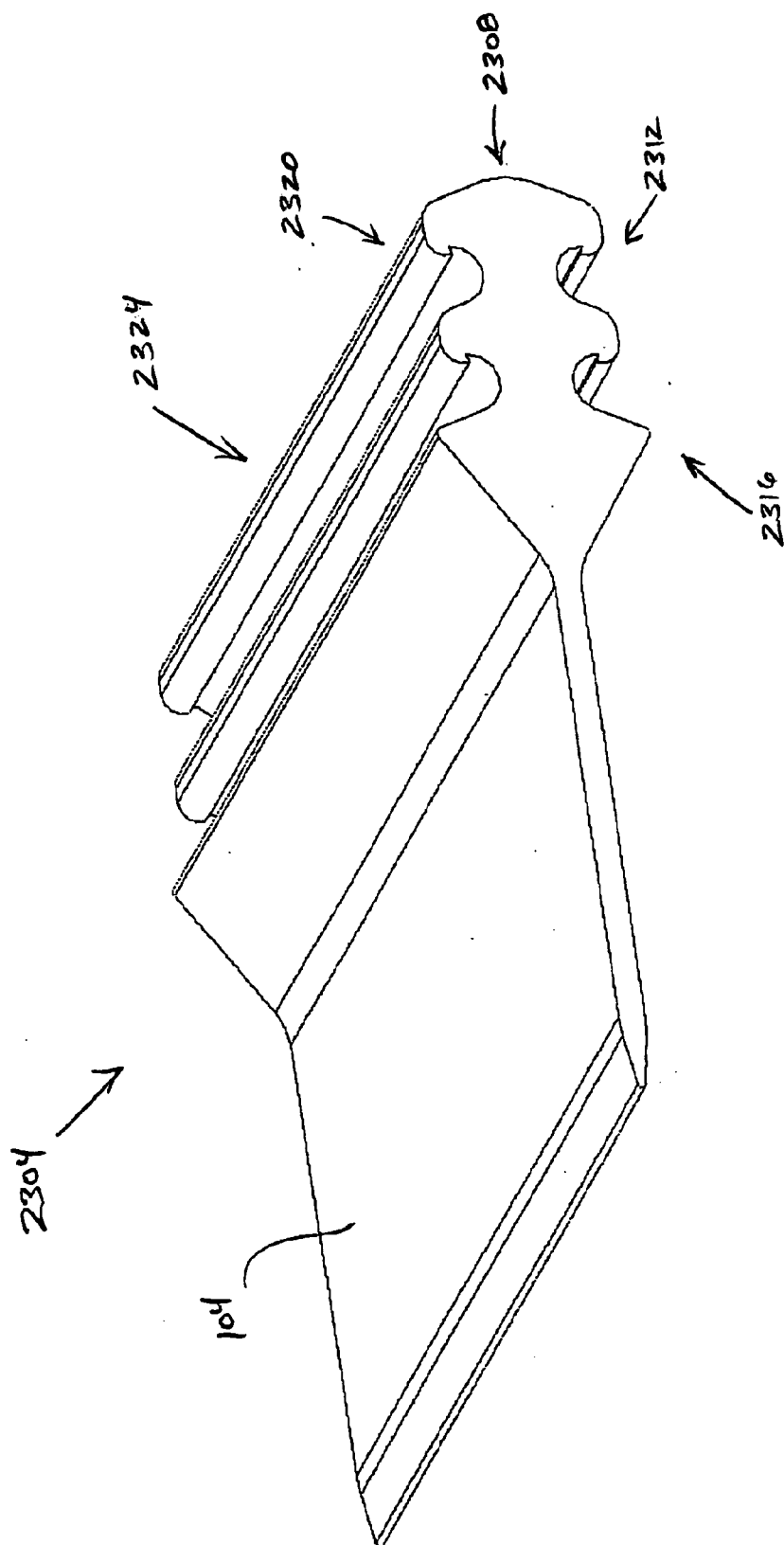


FIG. 25

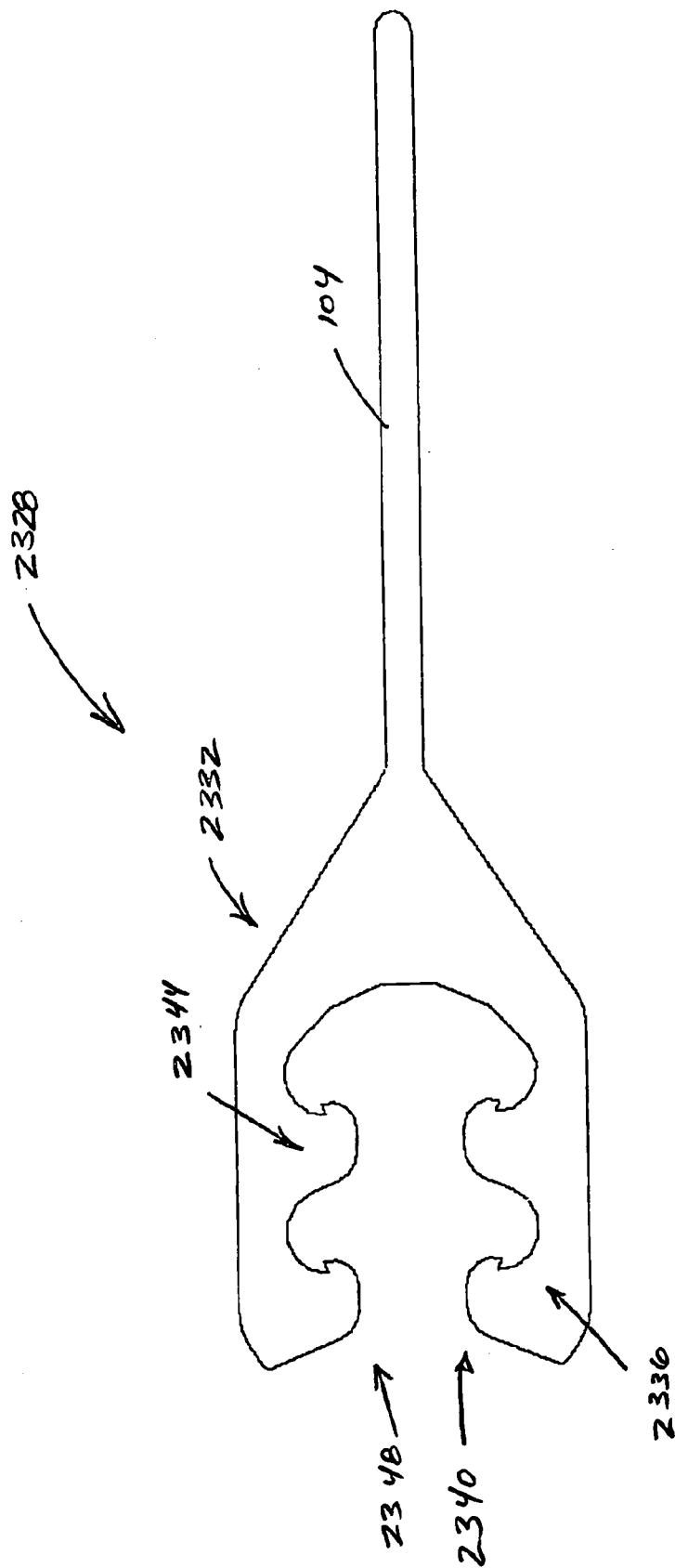


FIG. 26

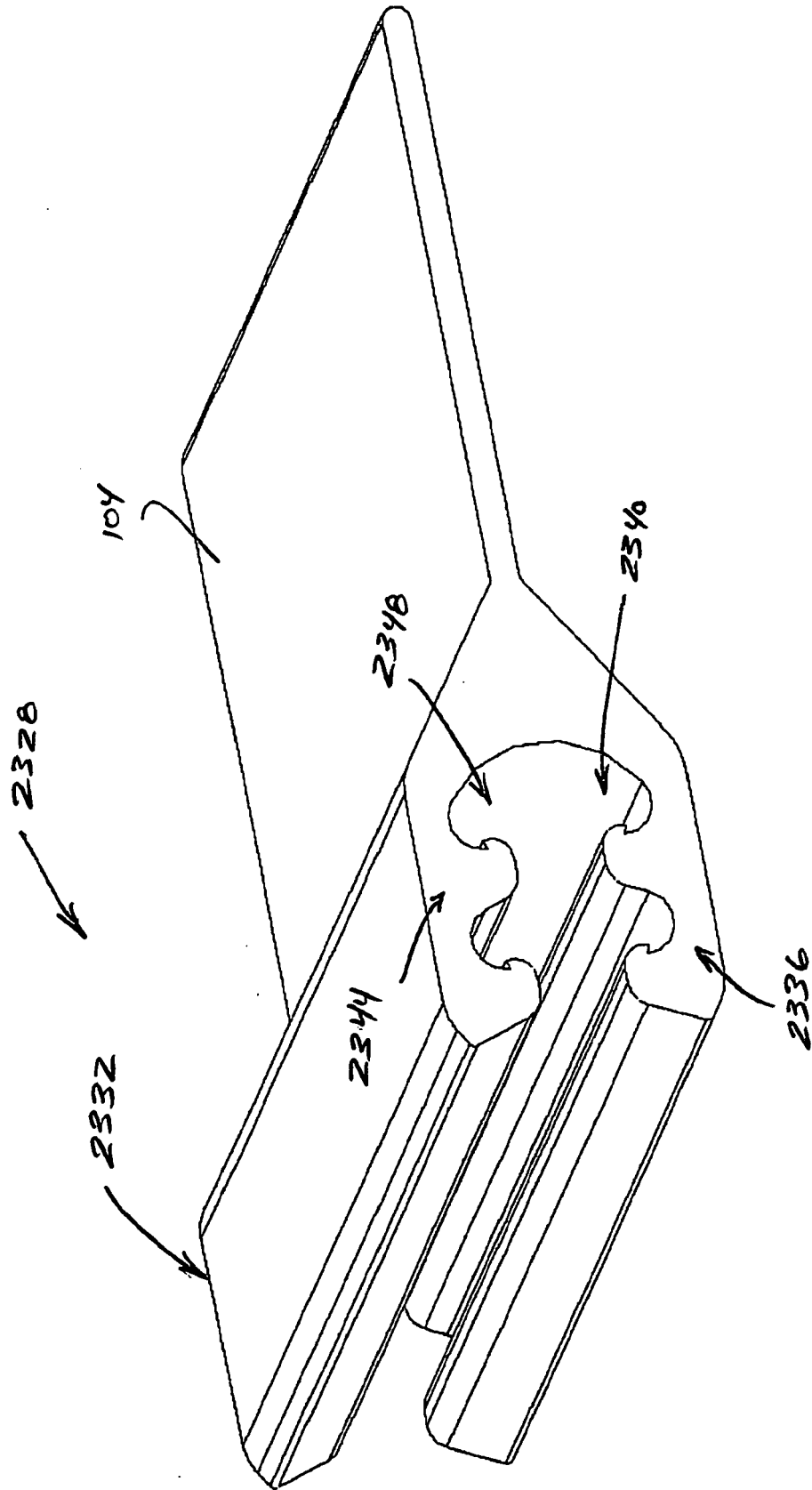


FIG. 27

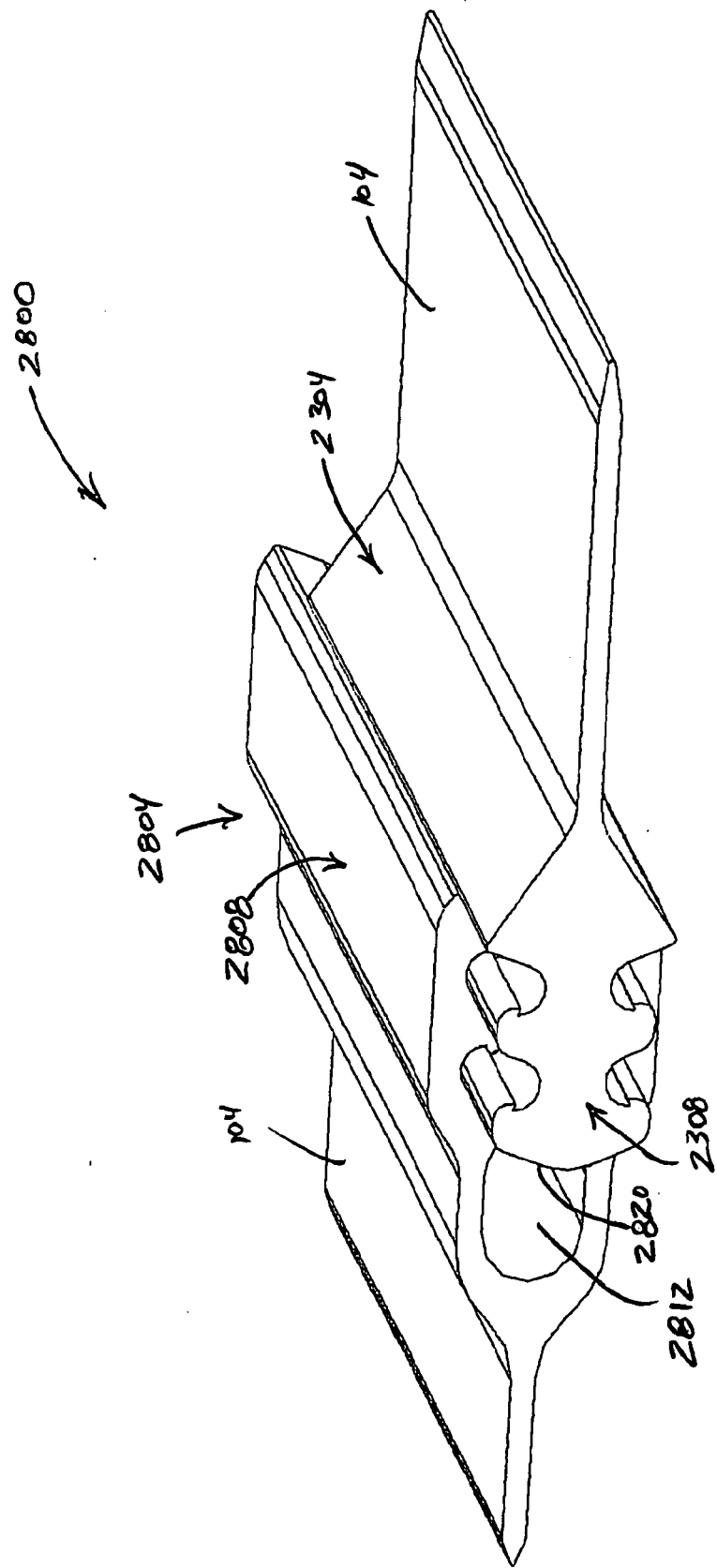


FIG. 28

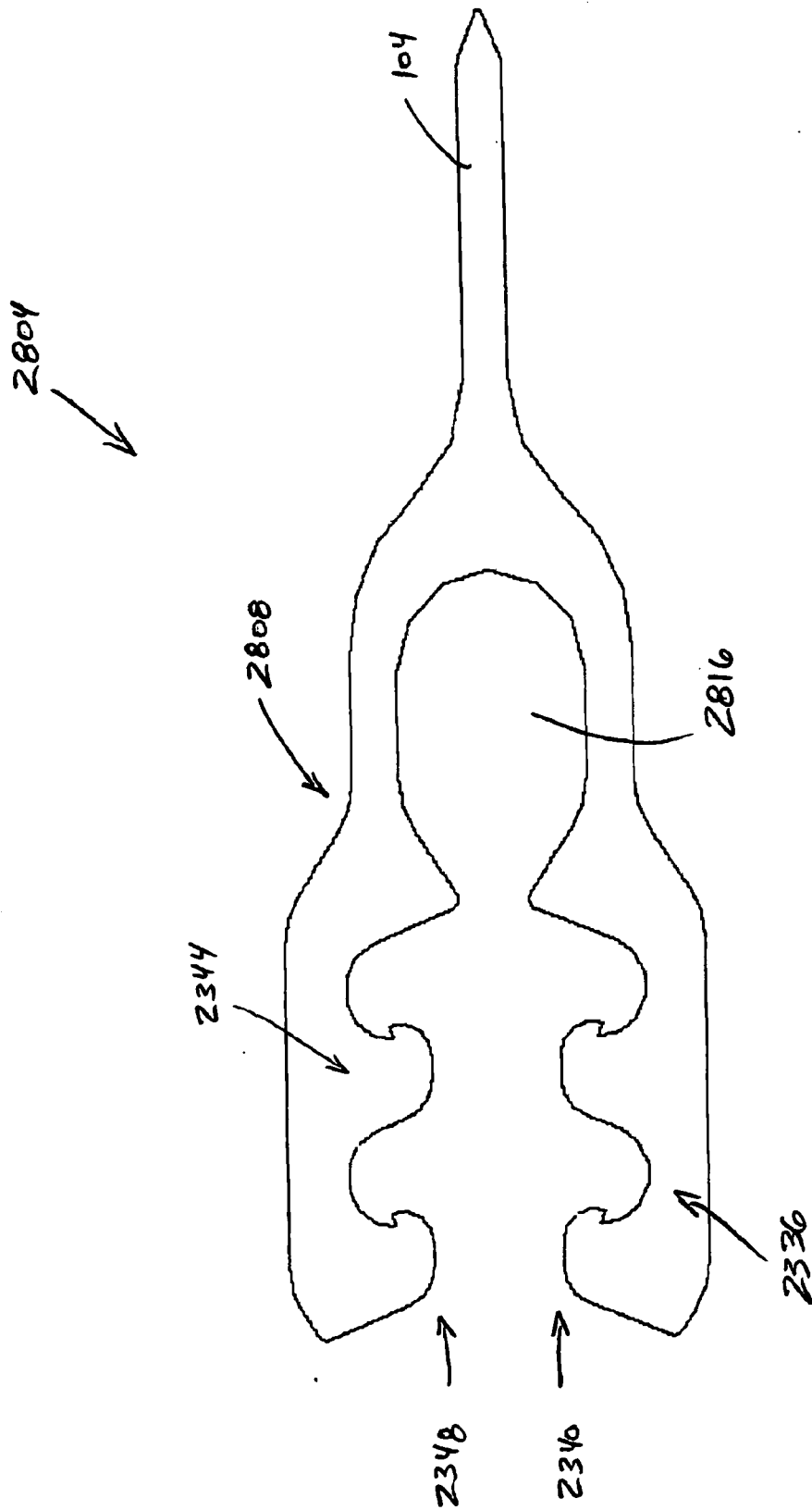


FIG. 29

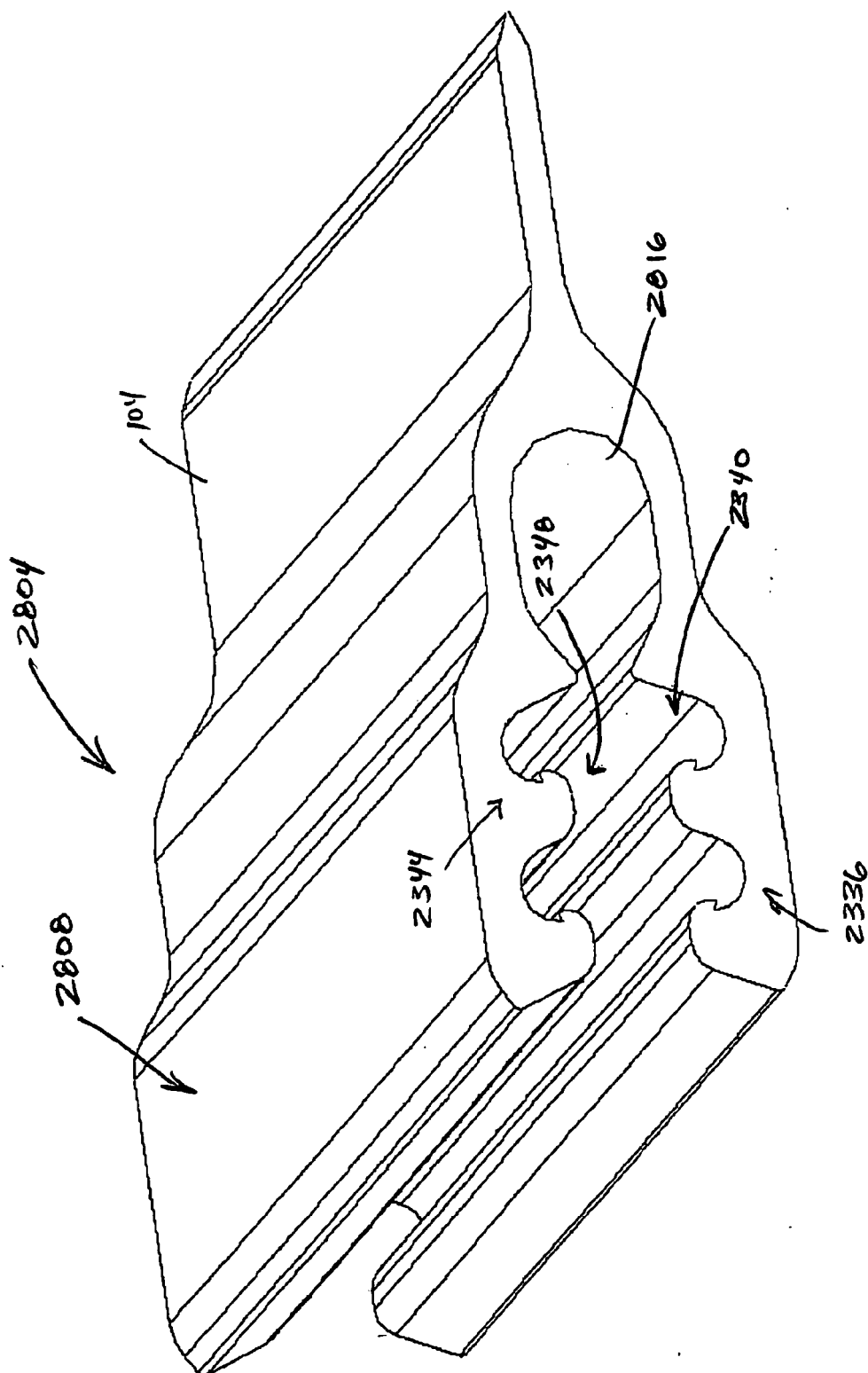
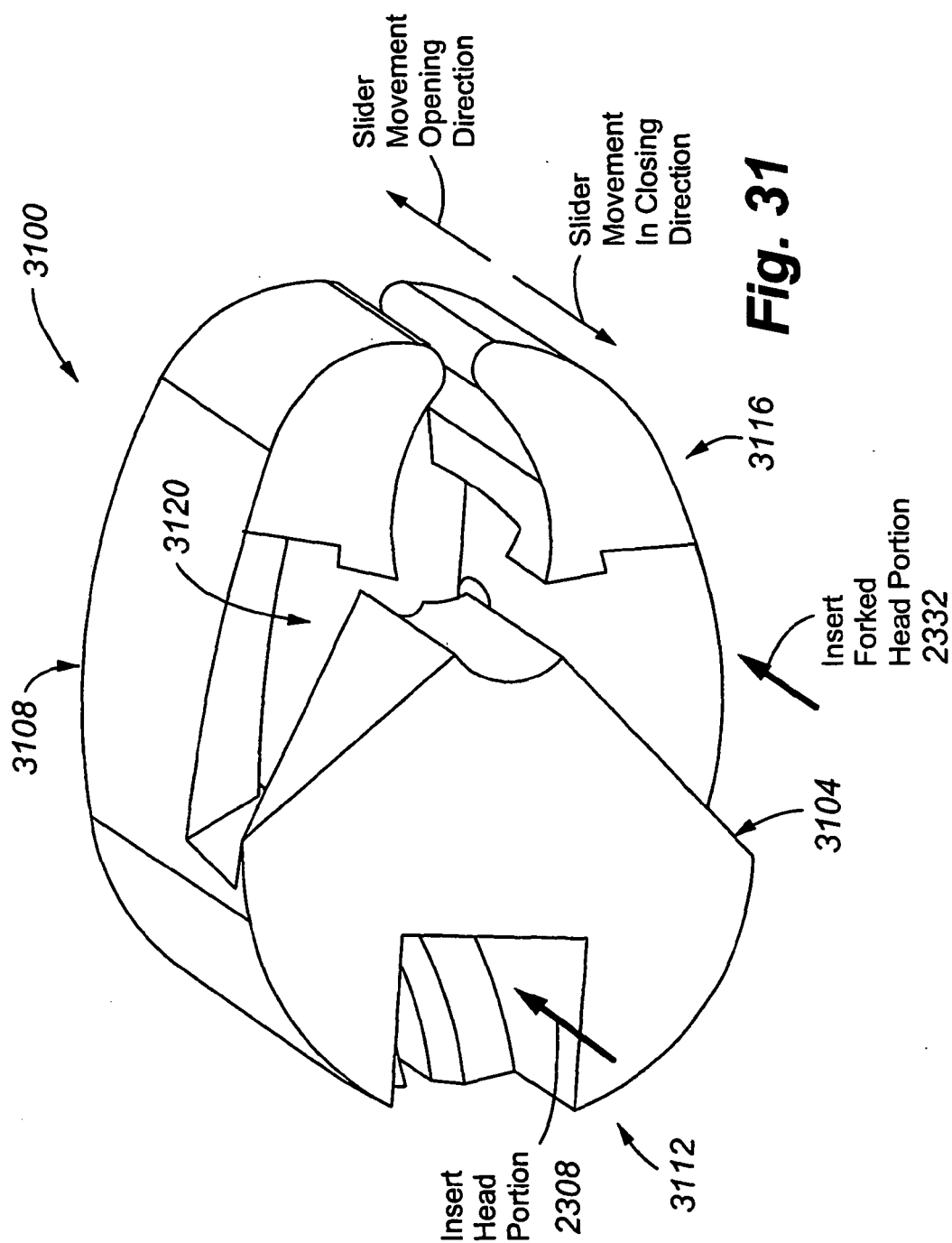


FIG. 30



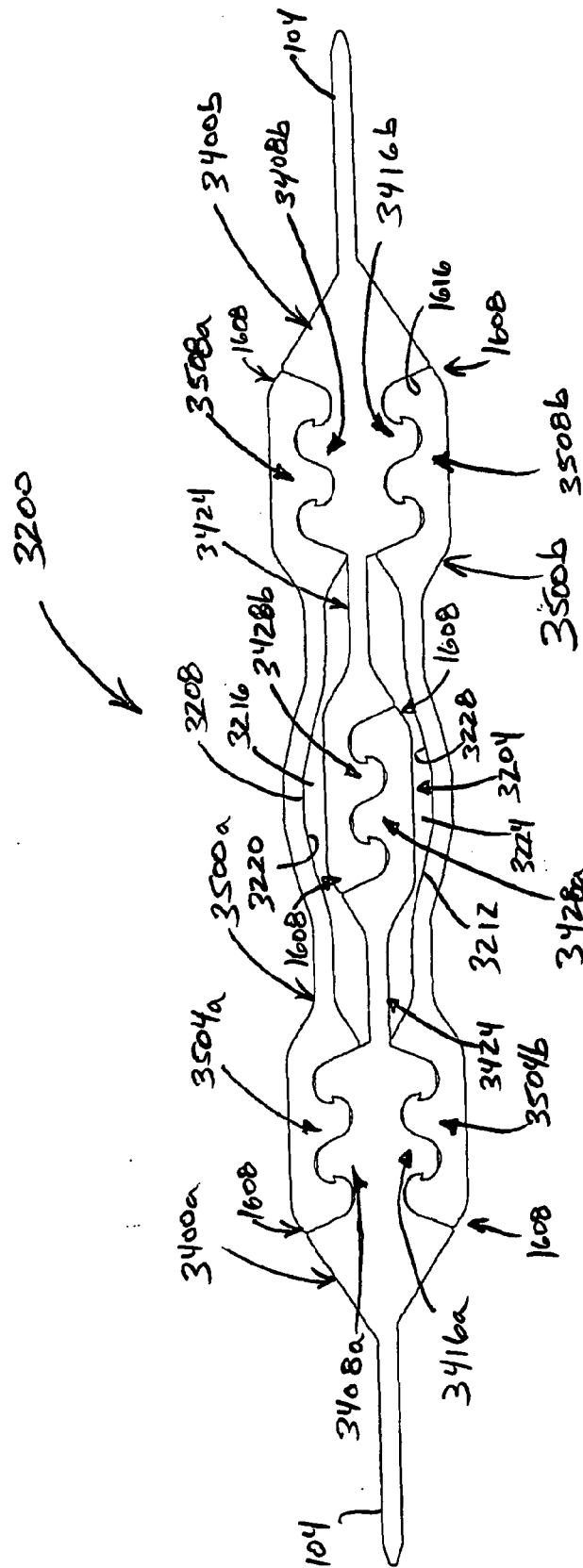


FIG. 32

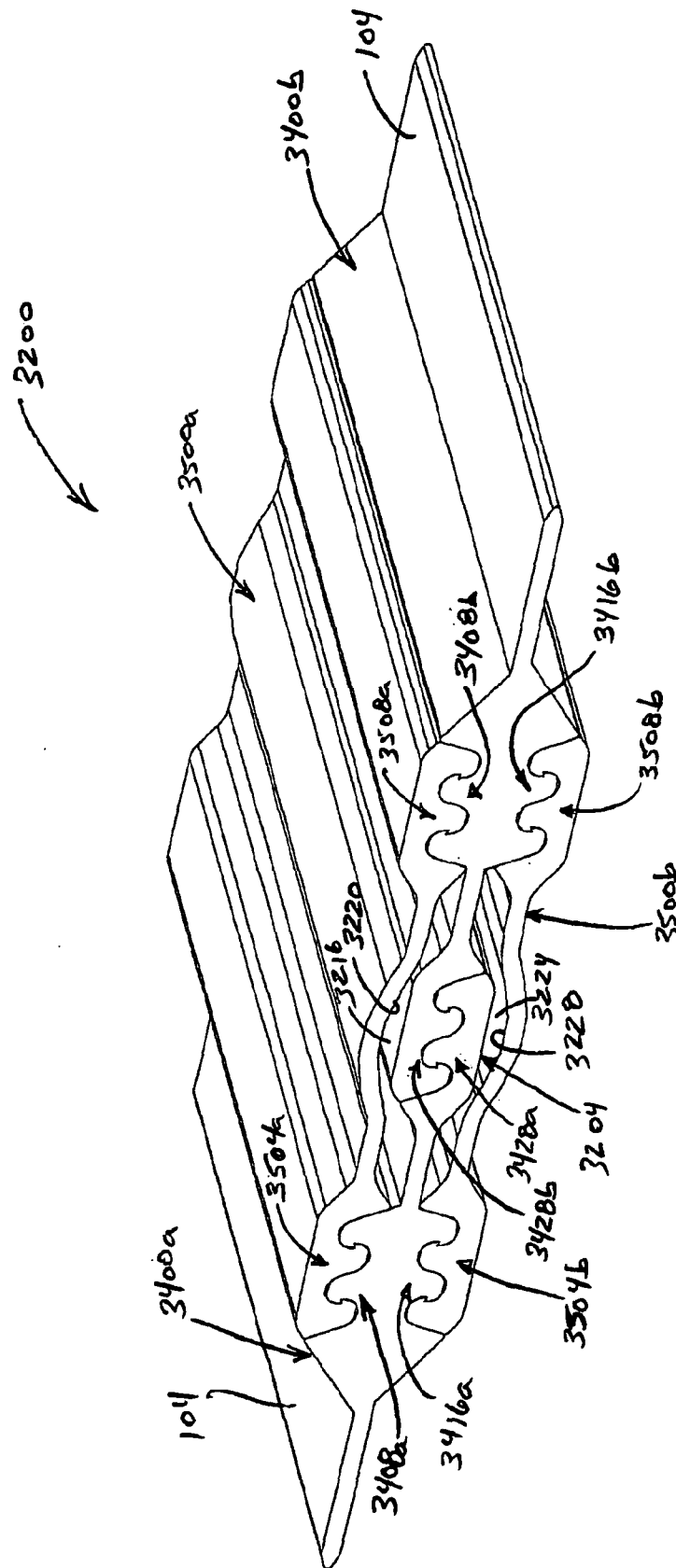


FIG. 33

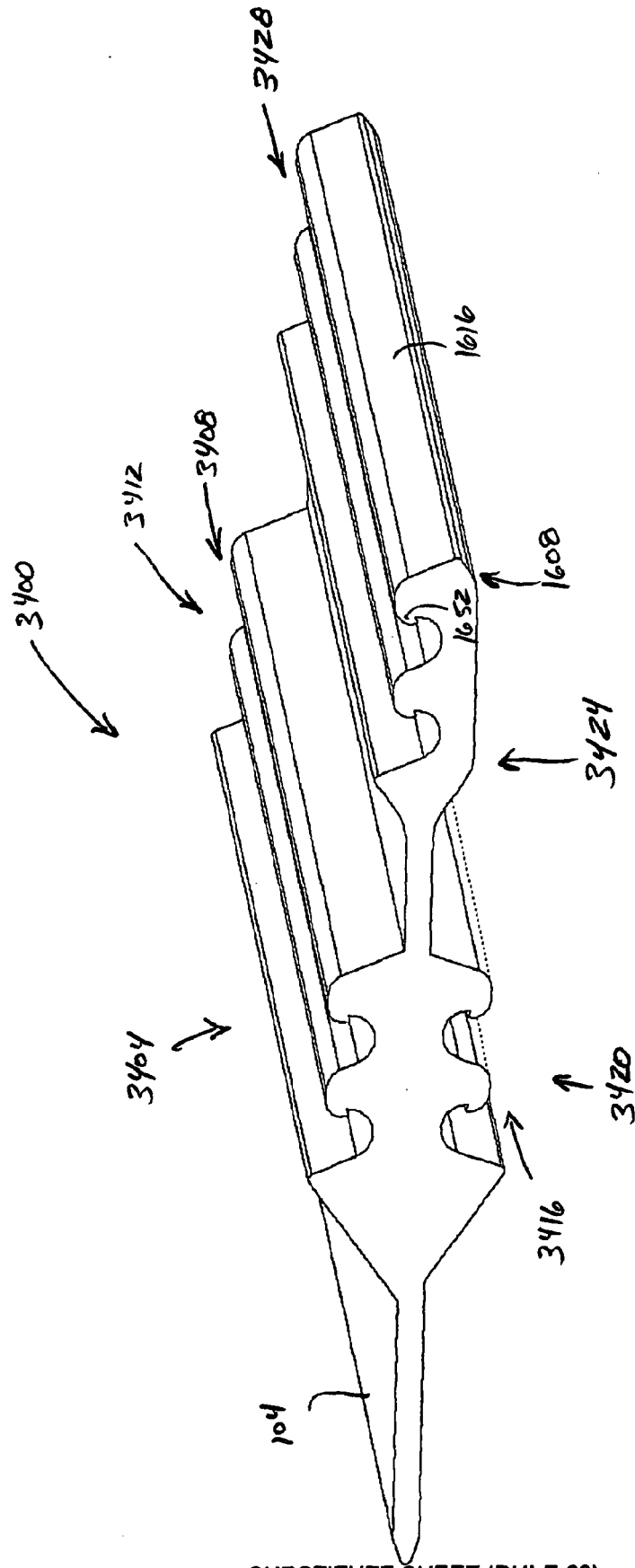


FIG. 34

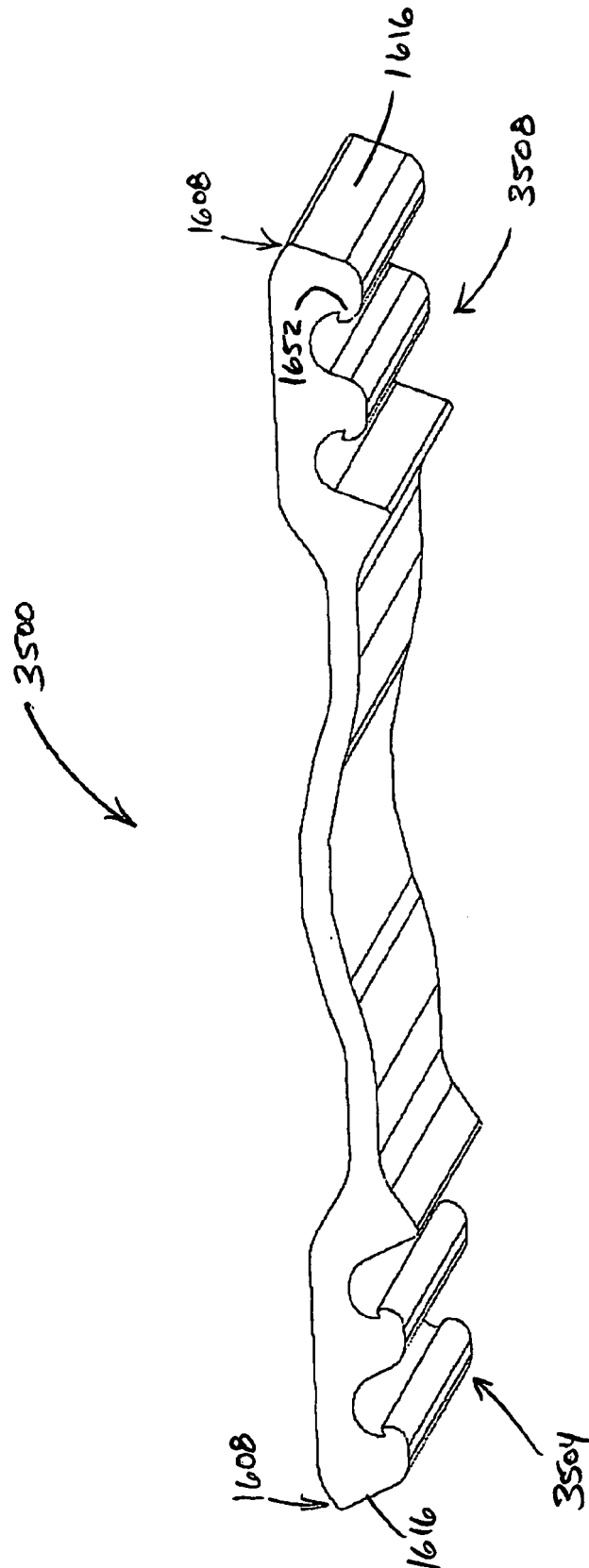


FIG. 35

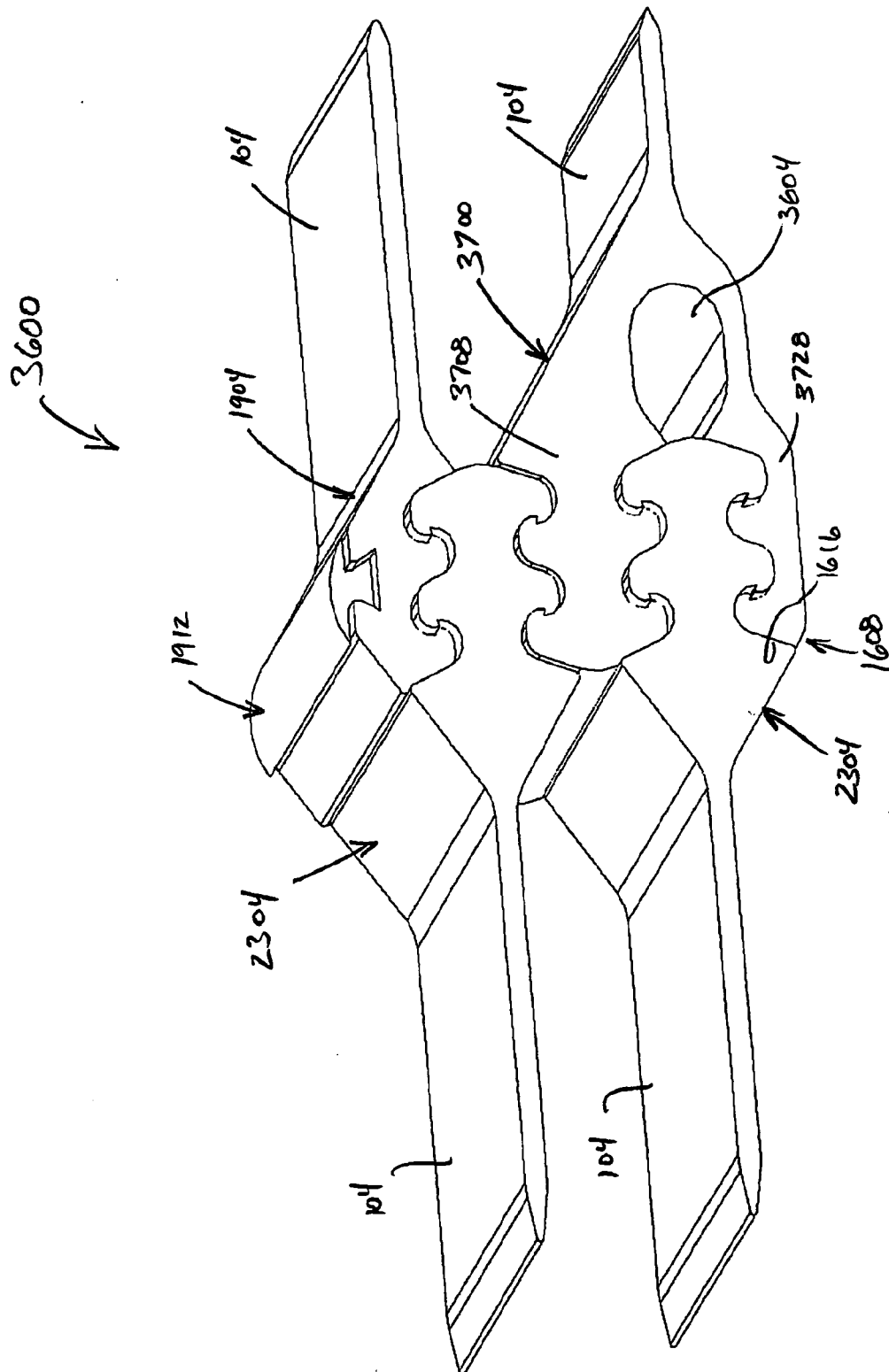


Fig. 36

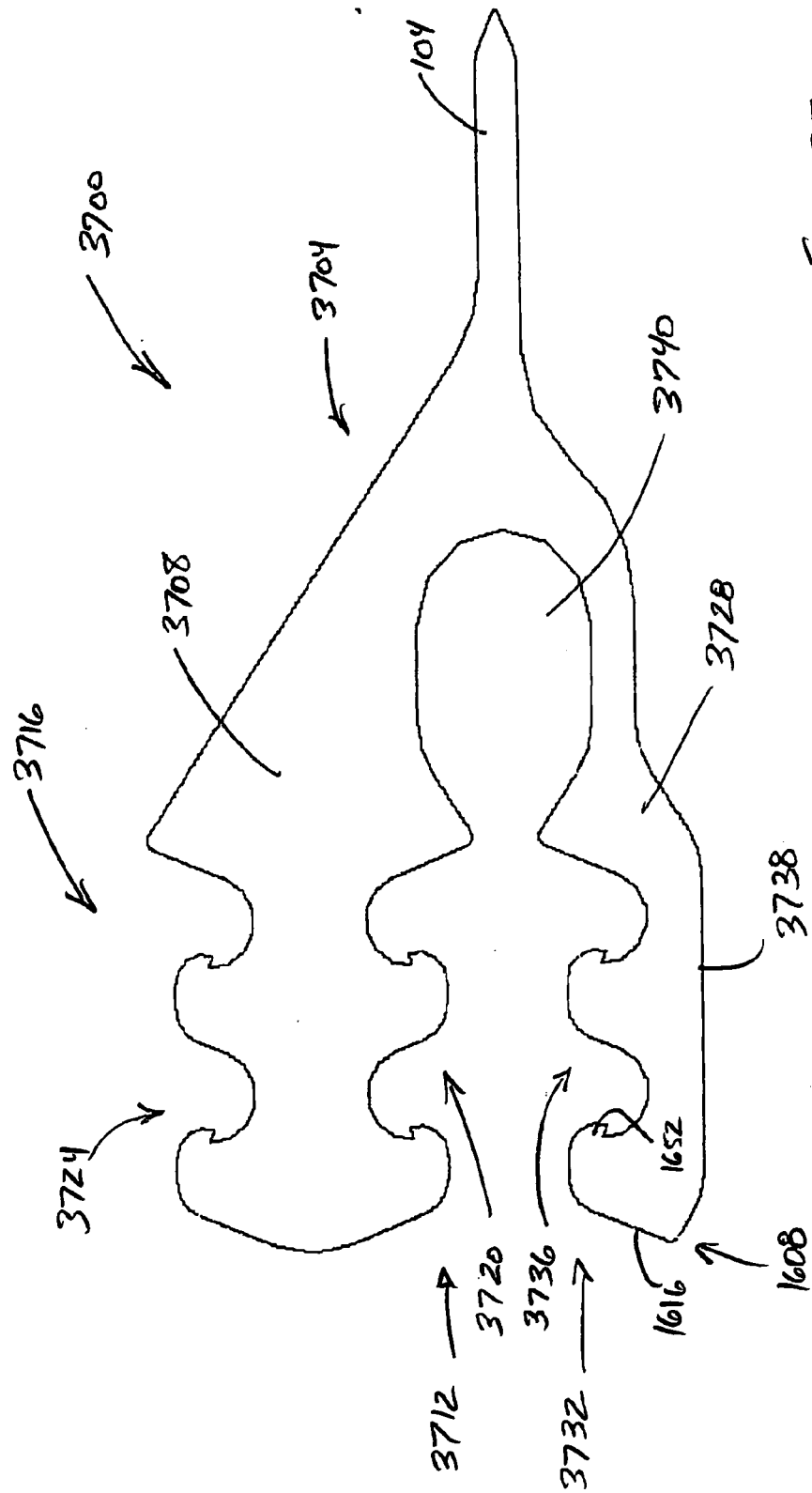
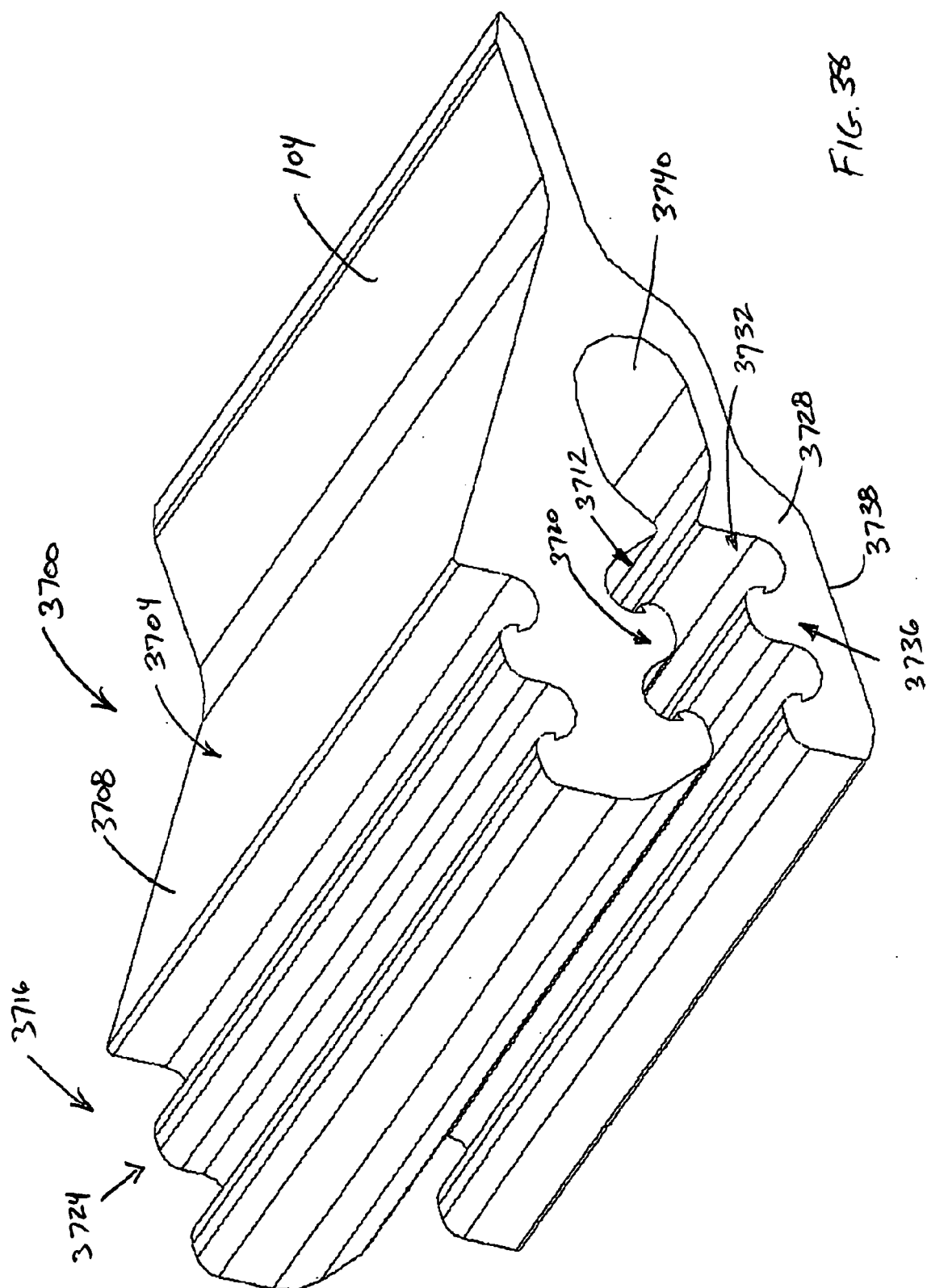


FIG. 37



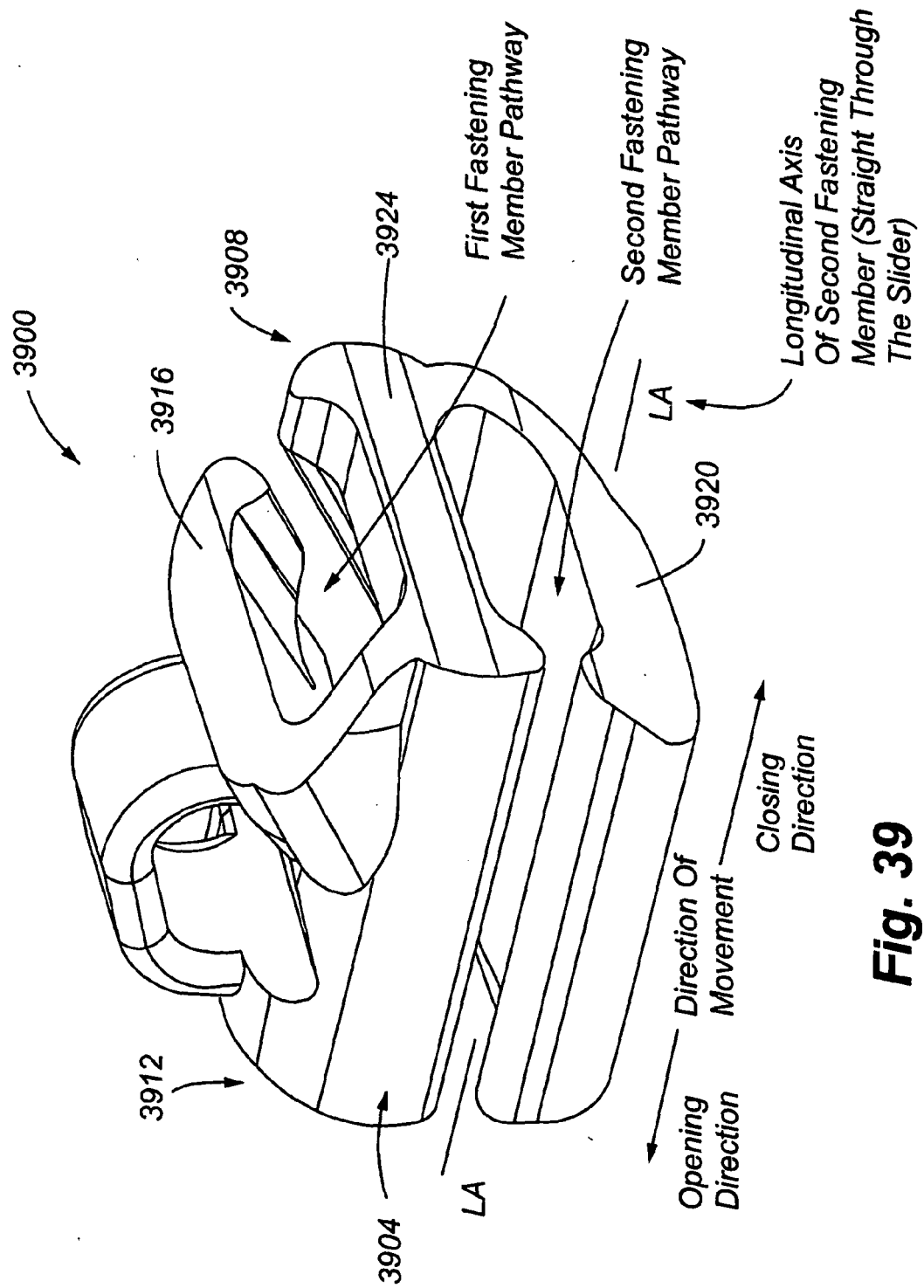
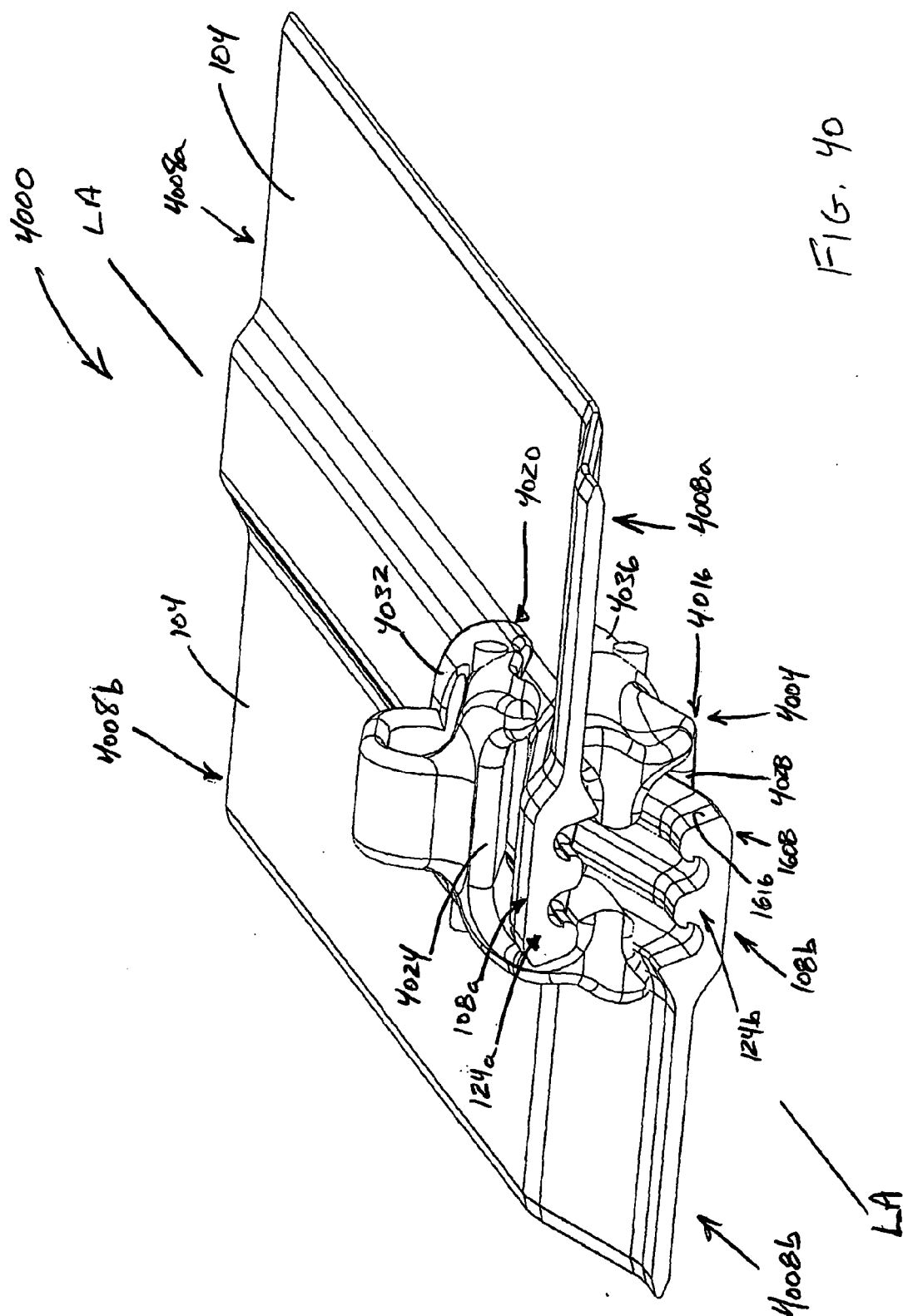
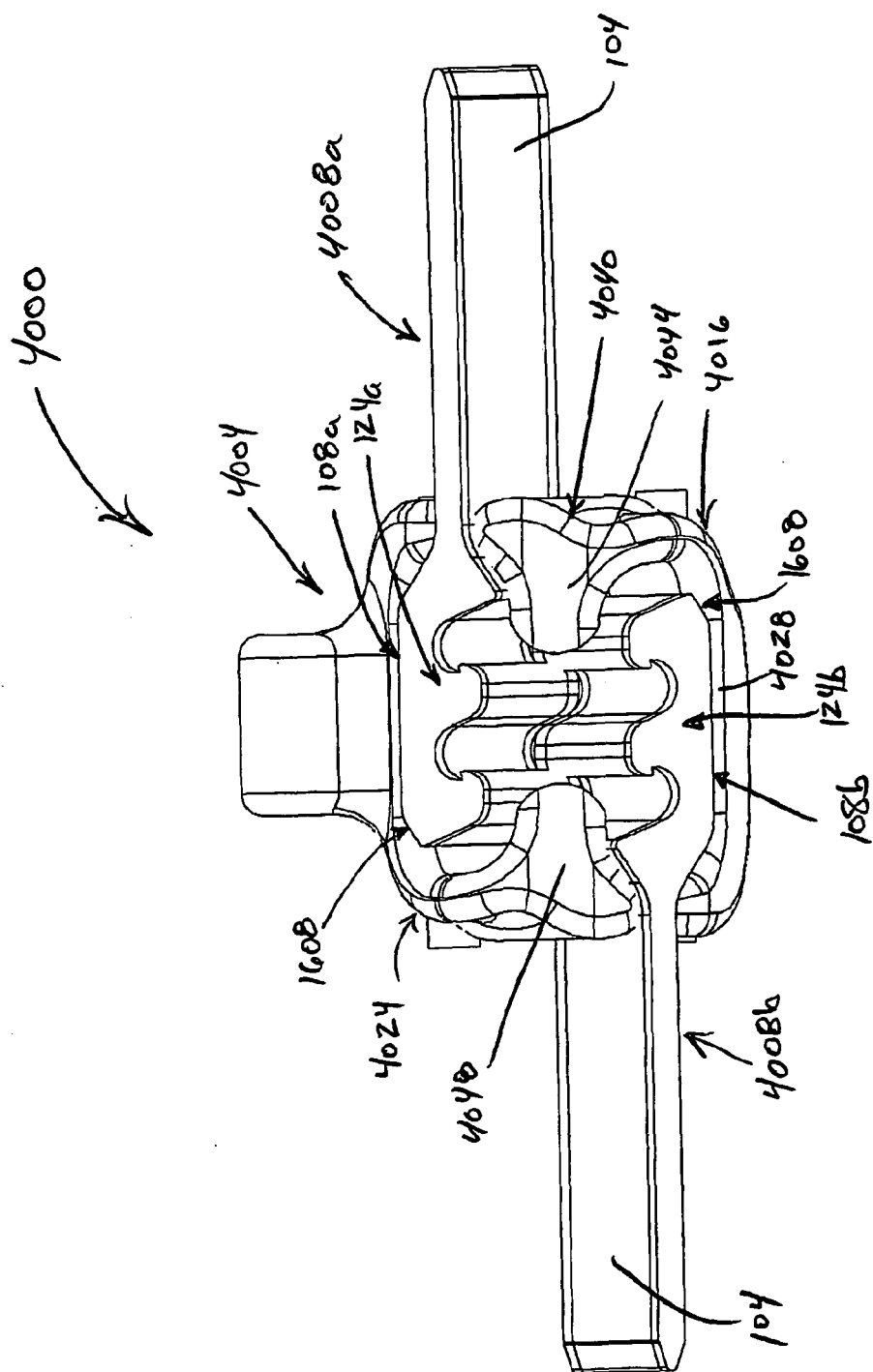
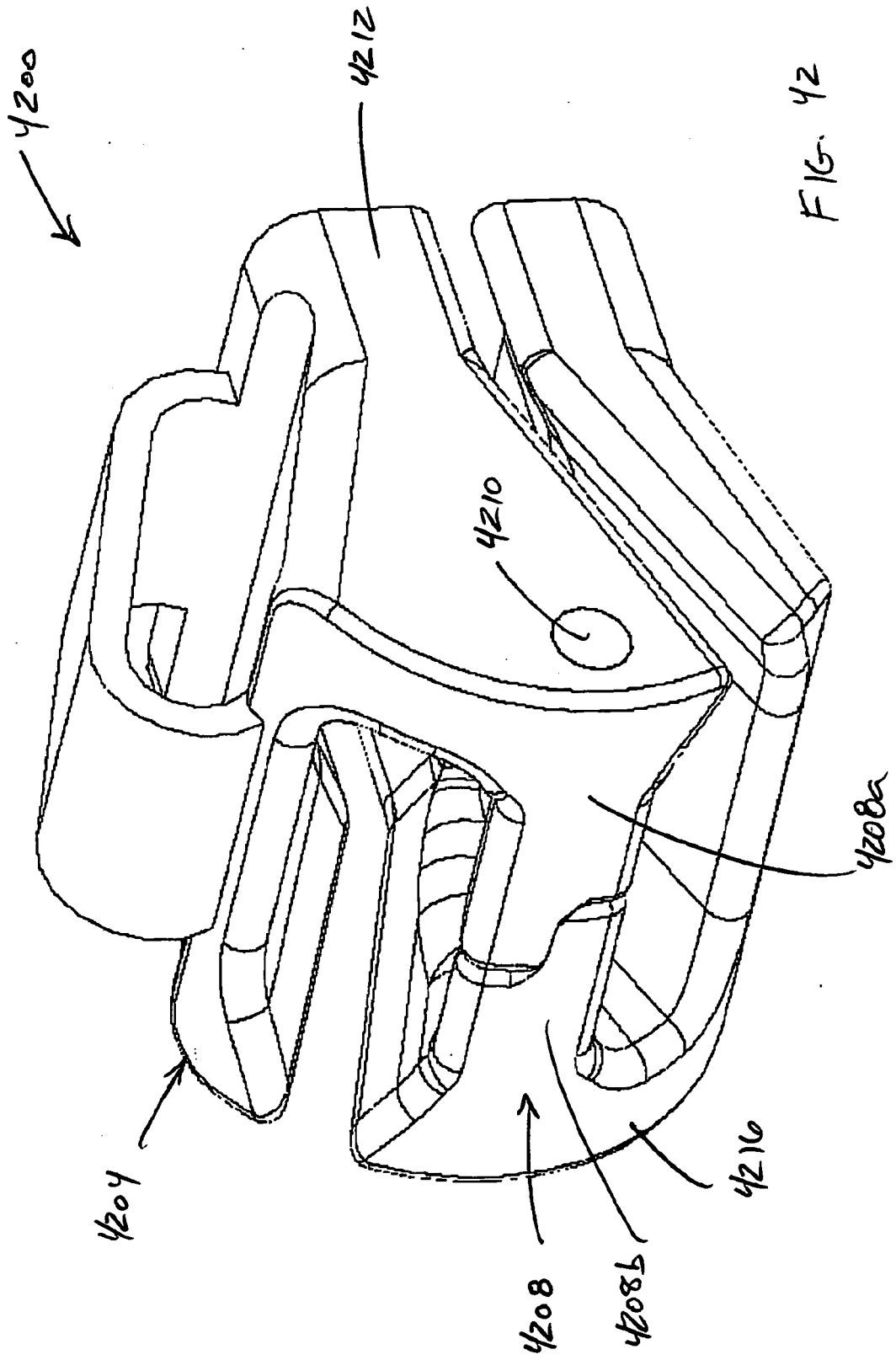
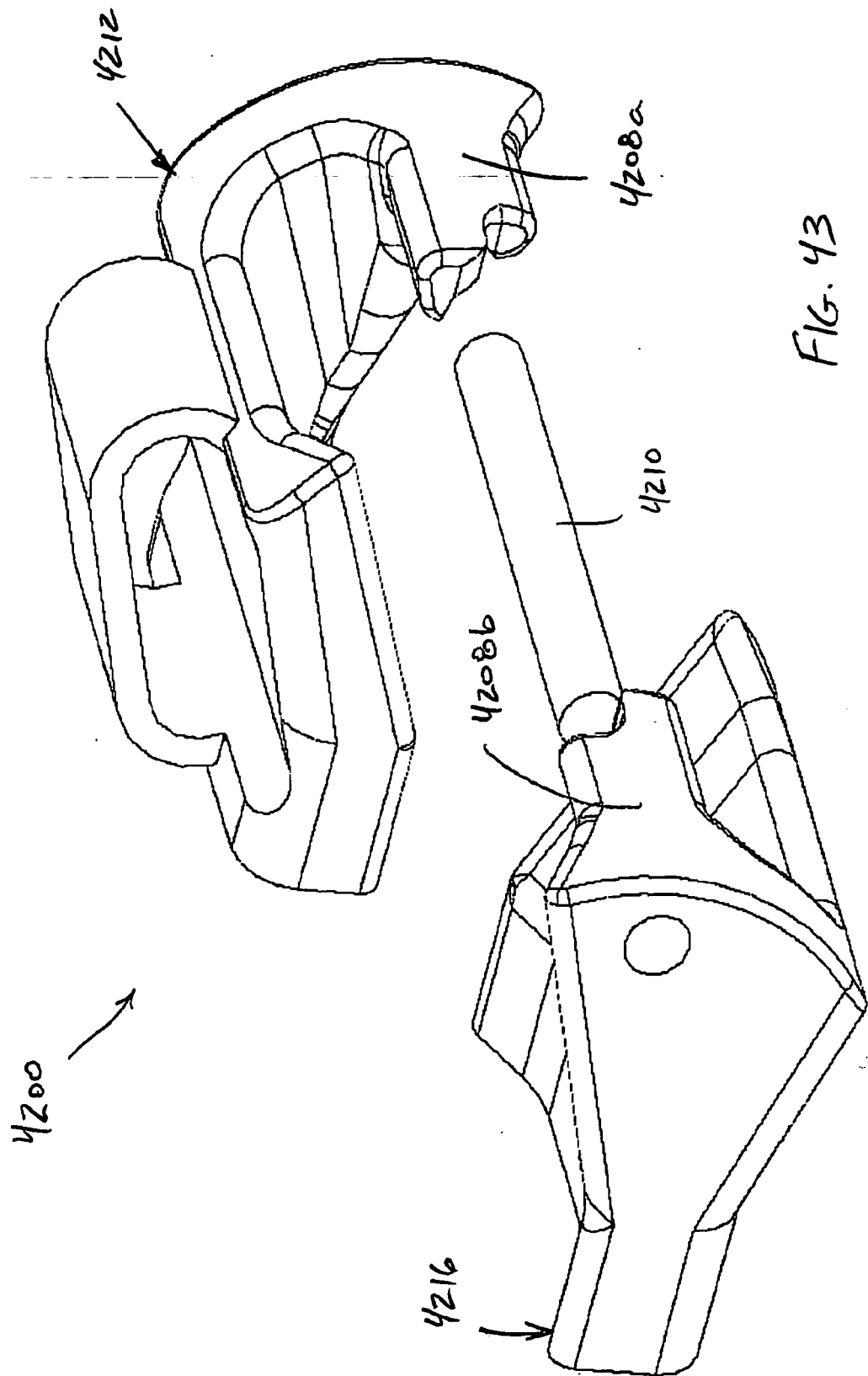


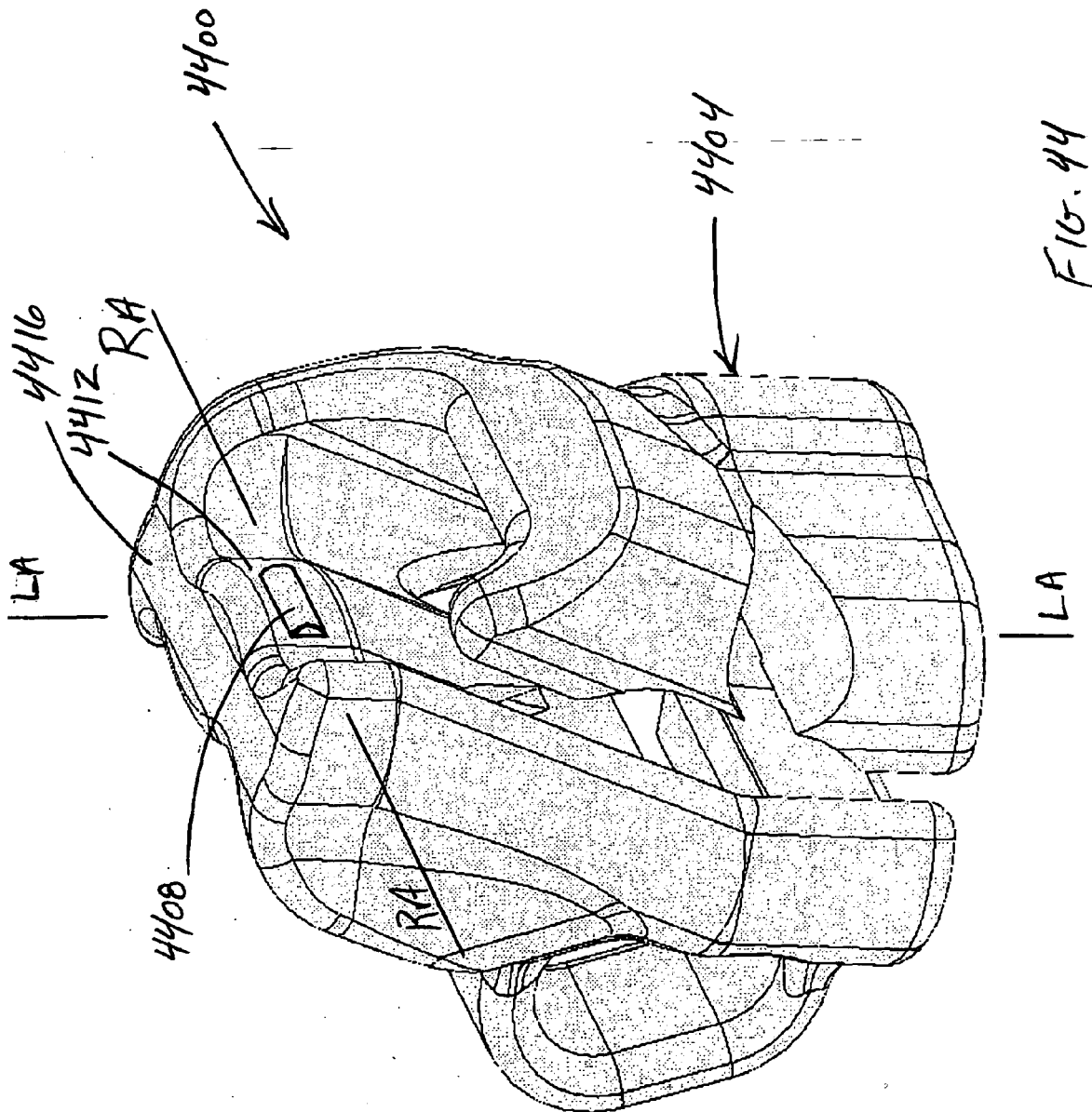
Fig. 39











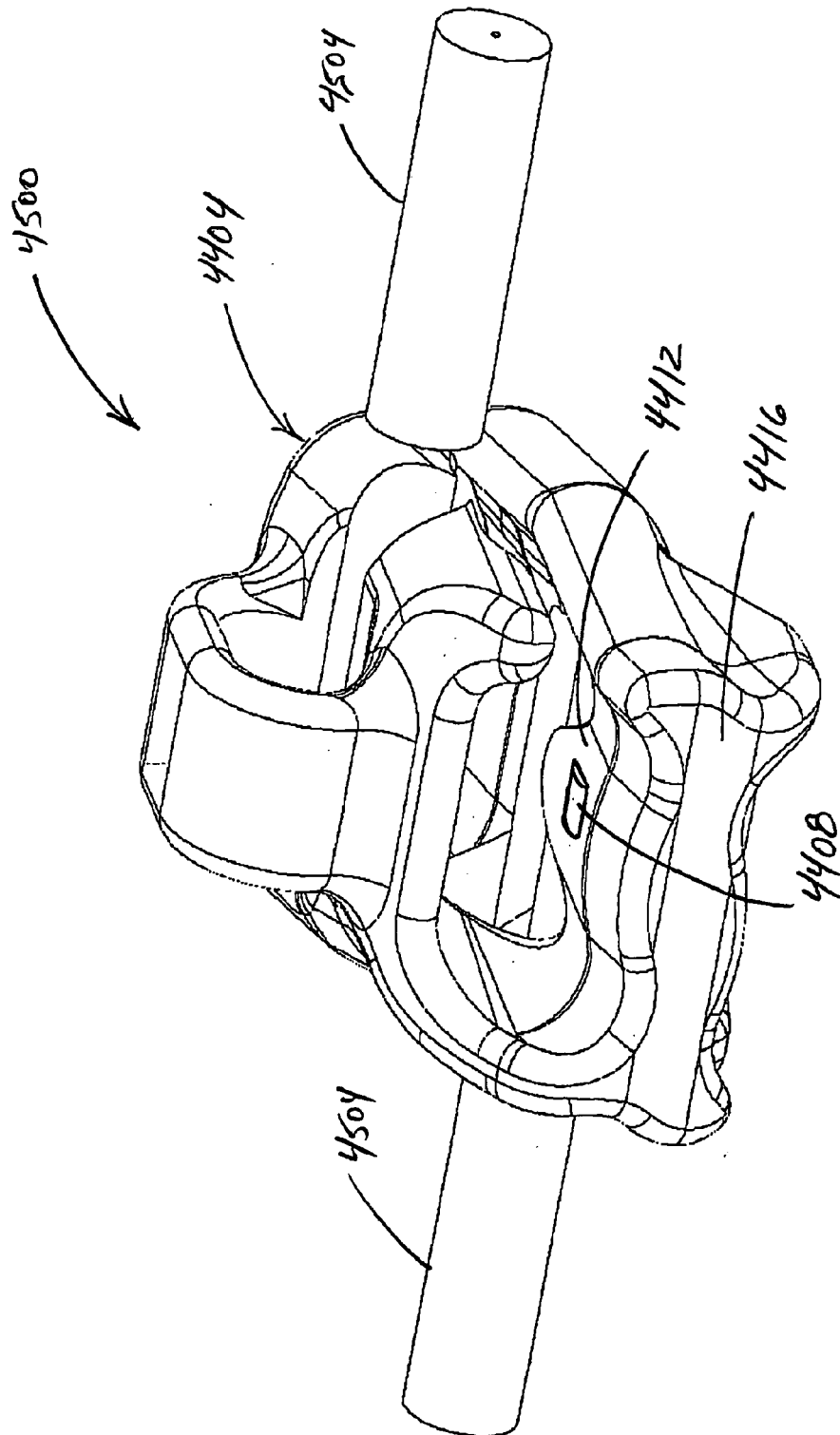
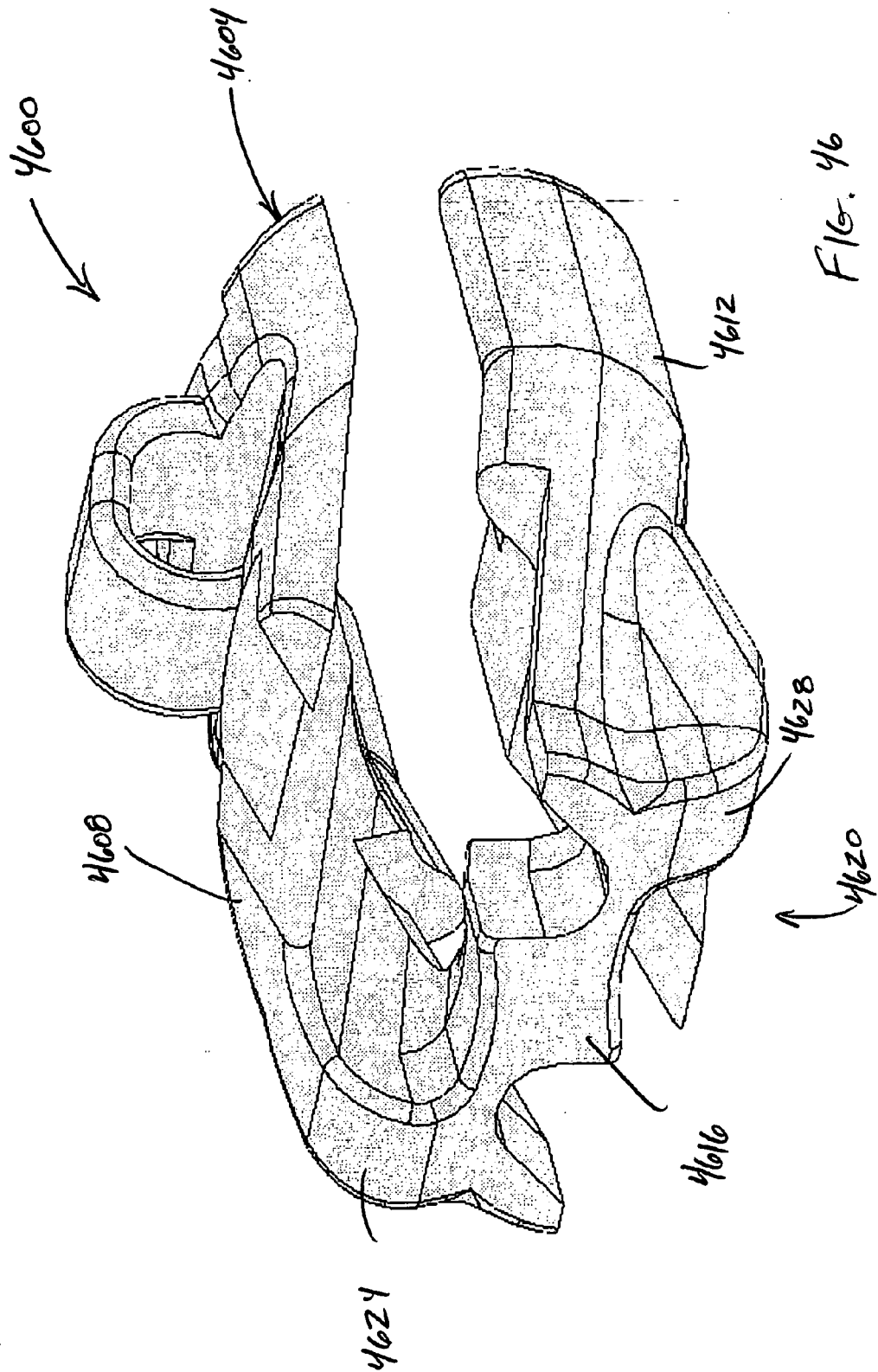


FIG. 45



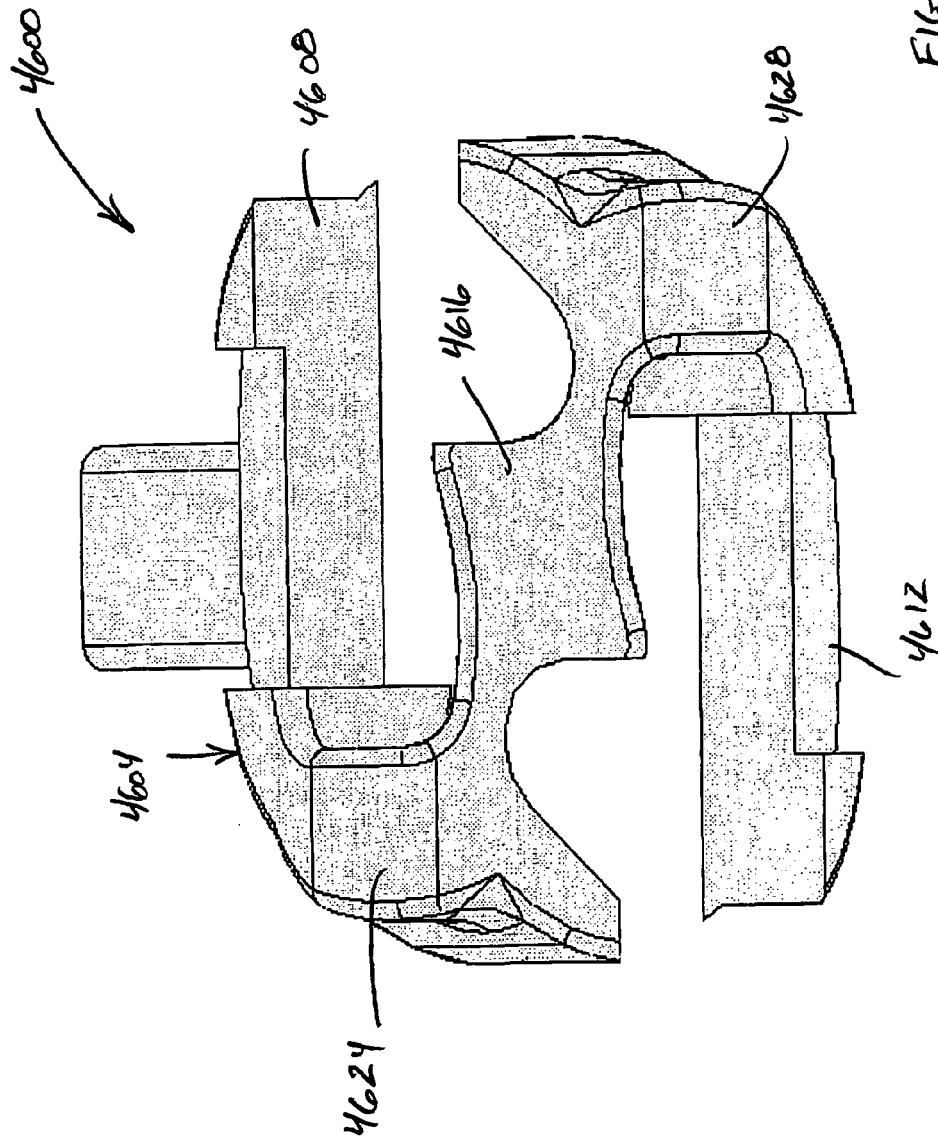


FIG. 47

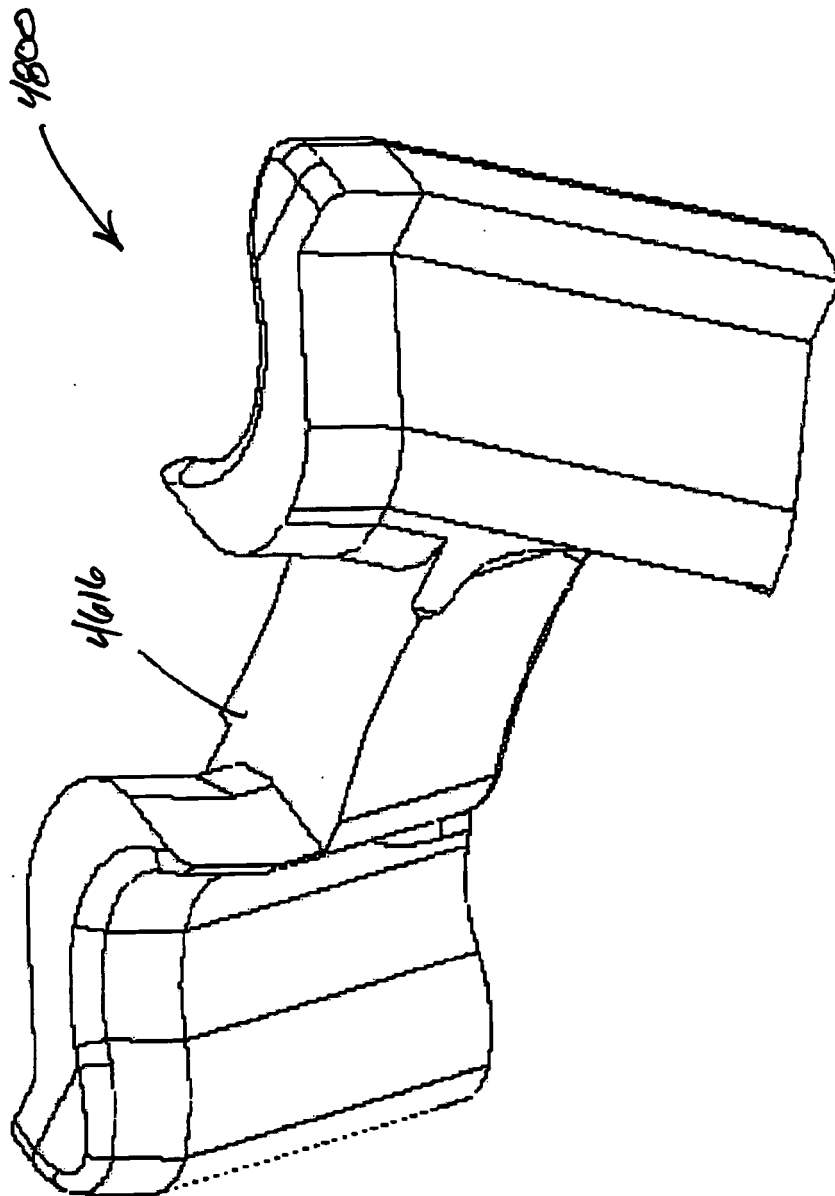


FIG. 48

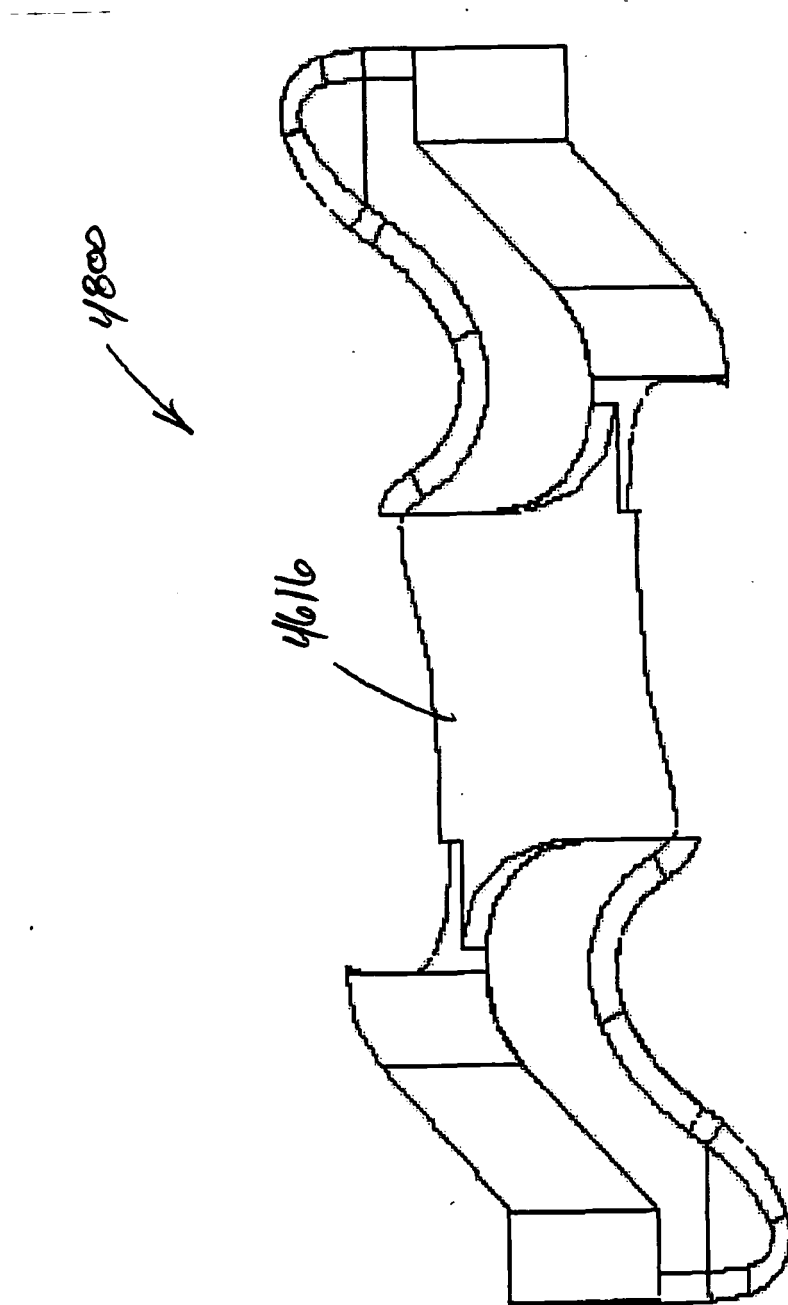


FIG. 49

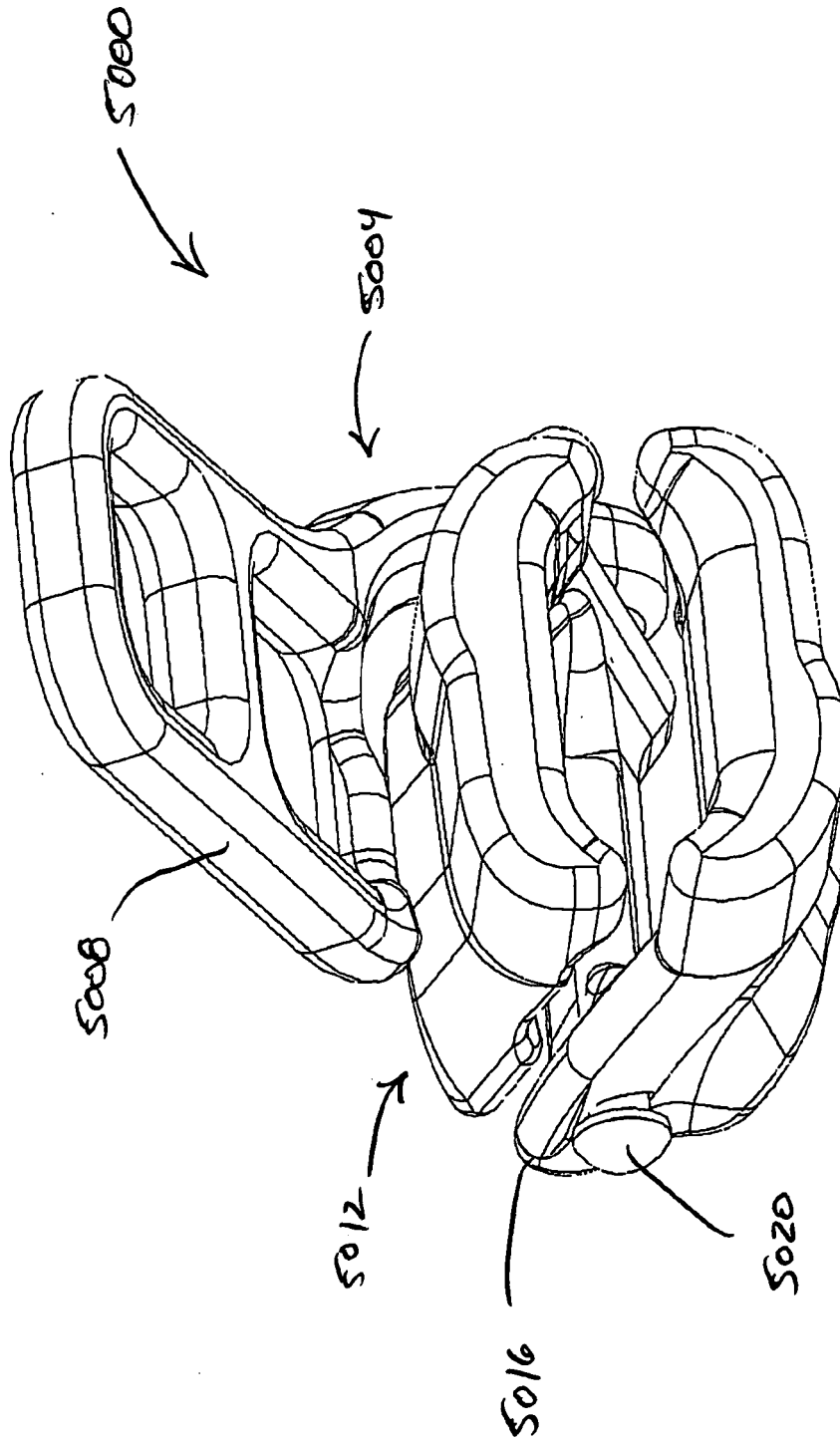
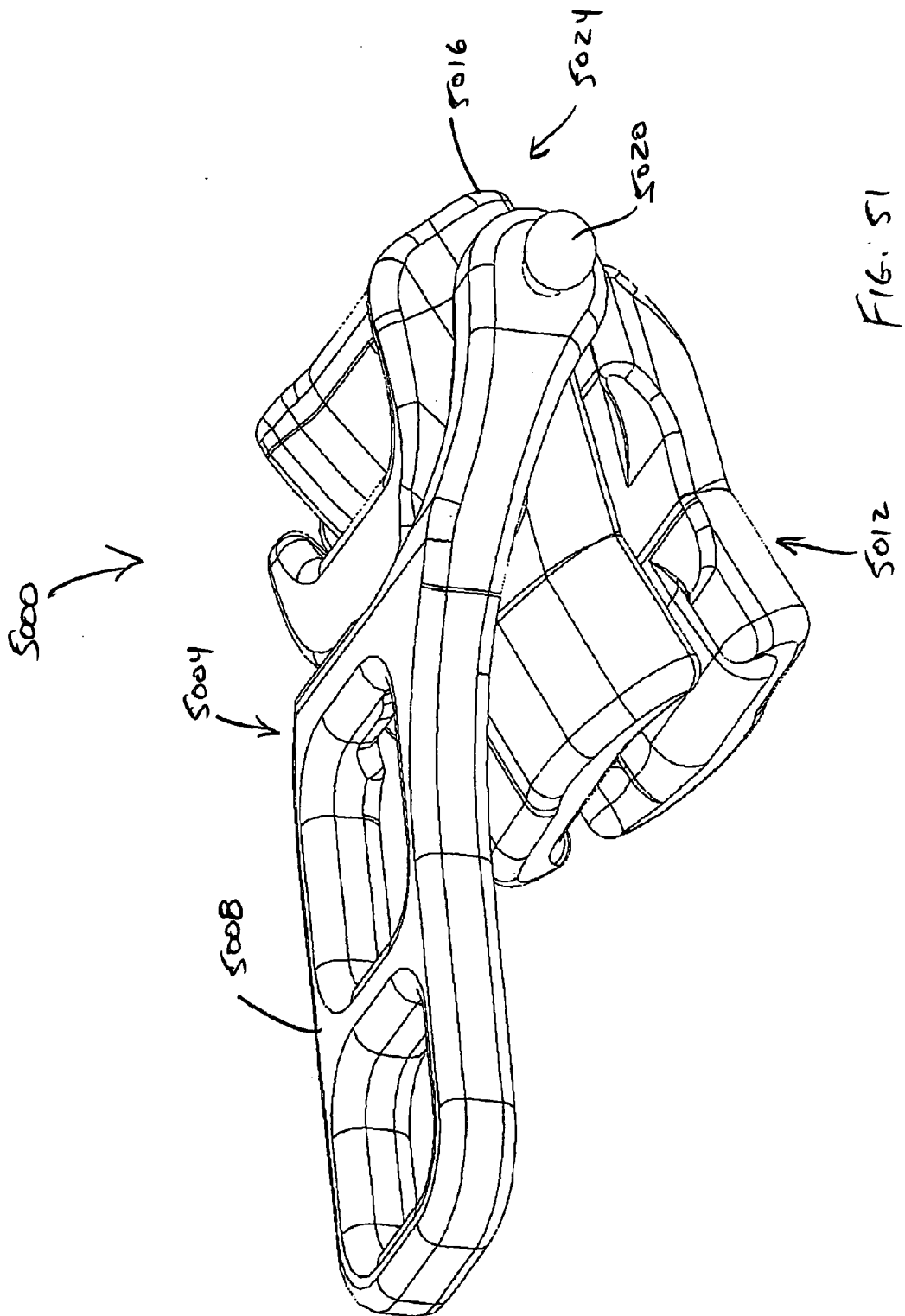


Fig. 50



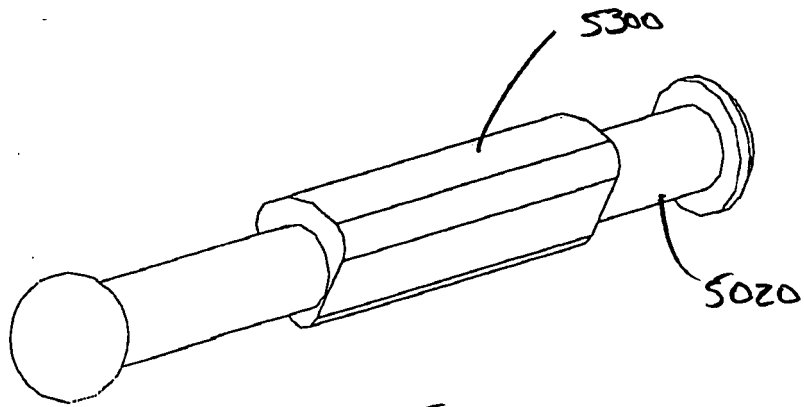


FIG. 53

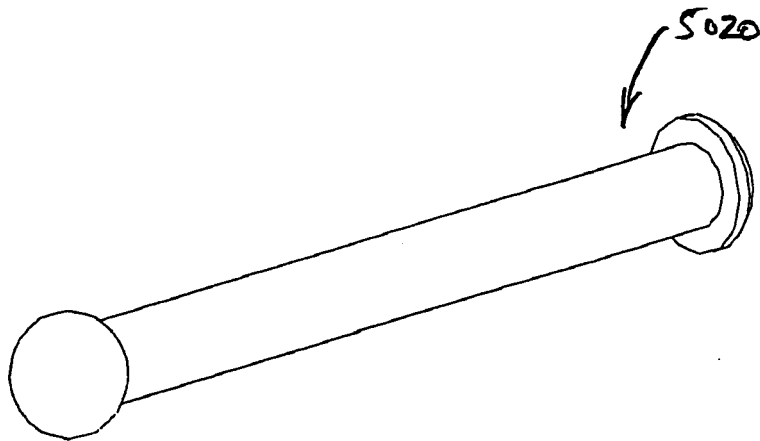
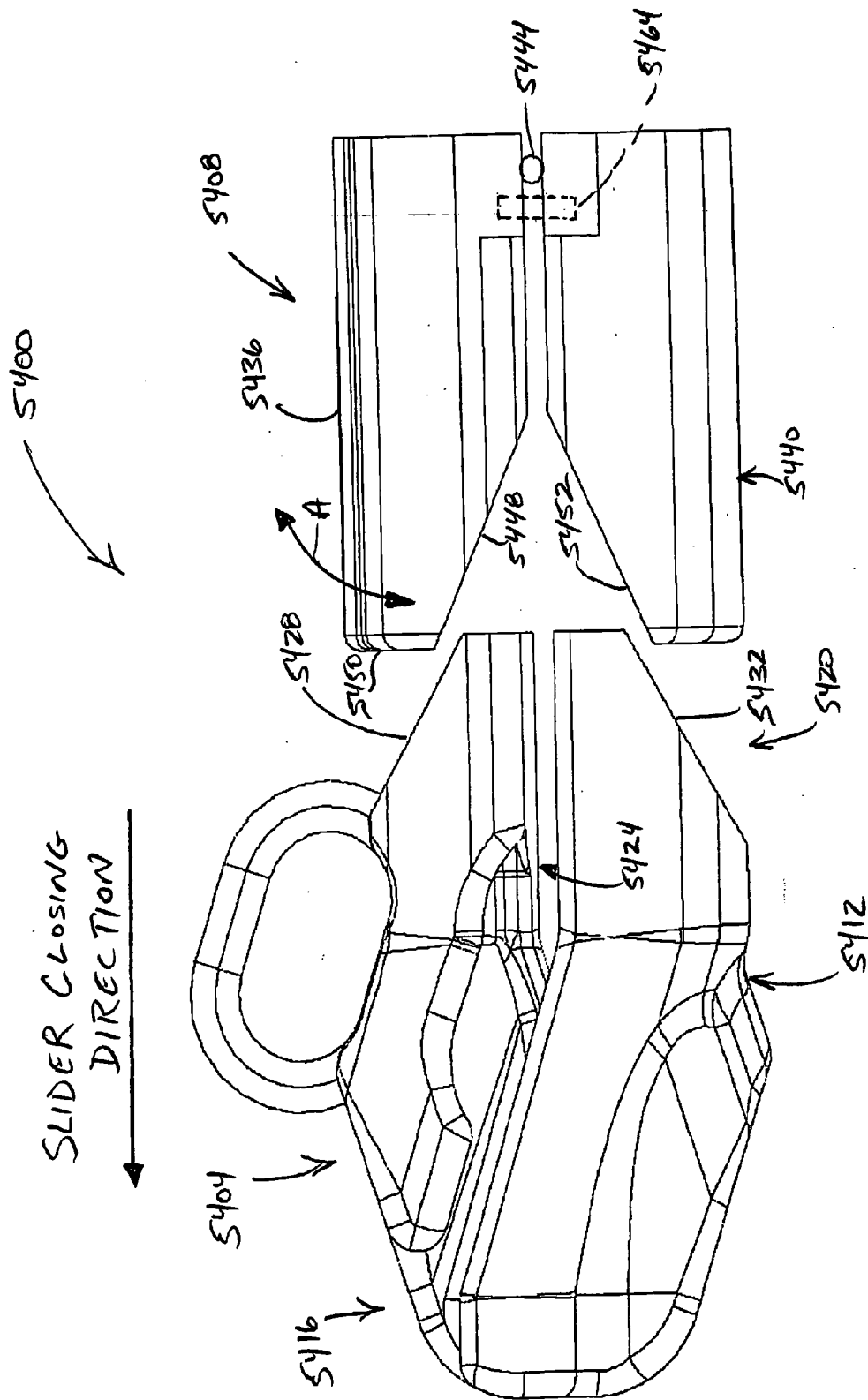


FIG. 52



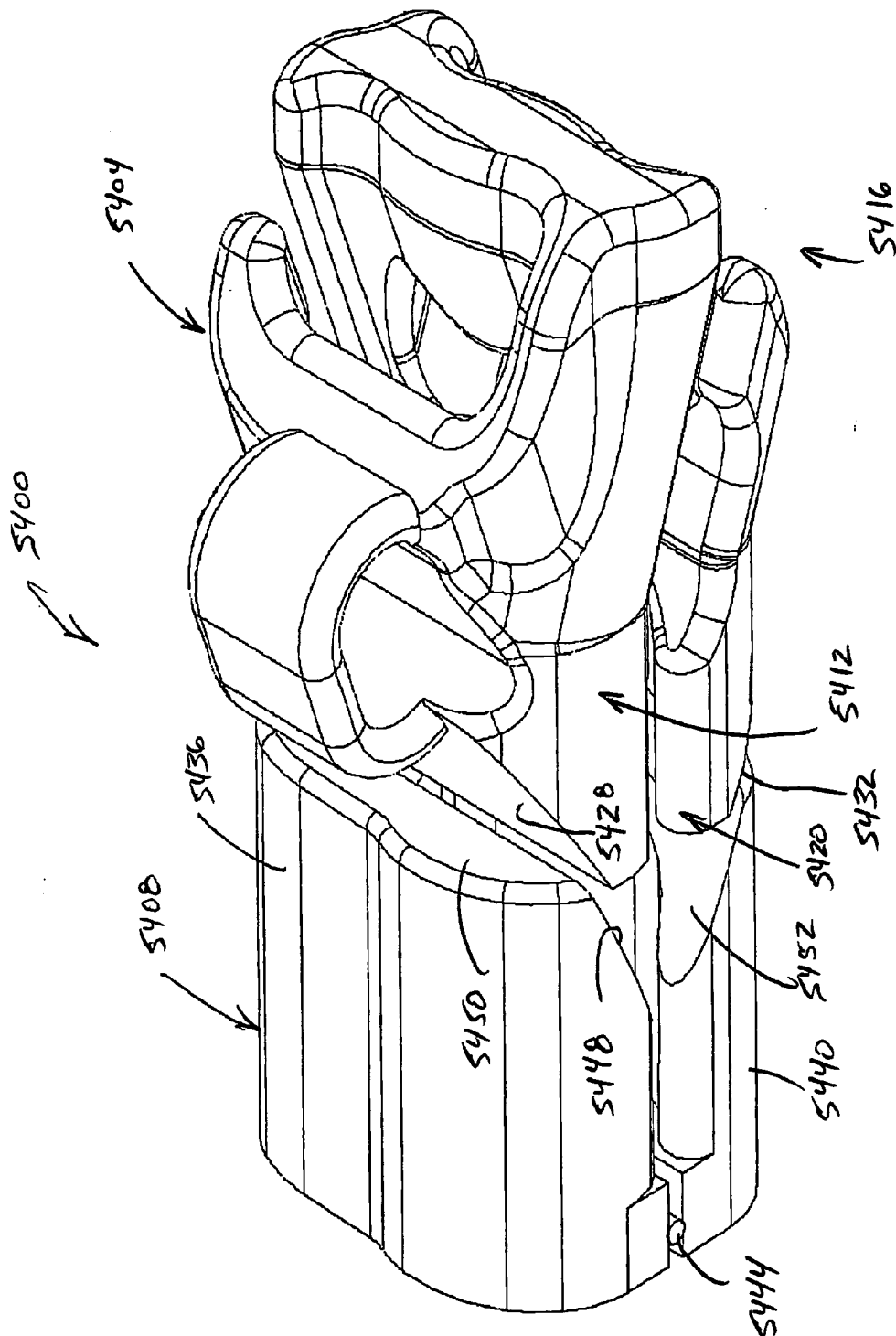
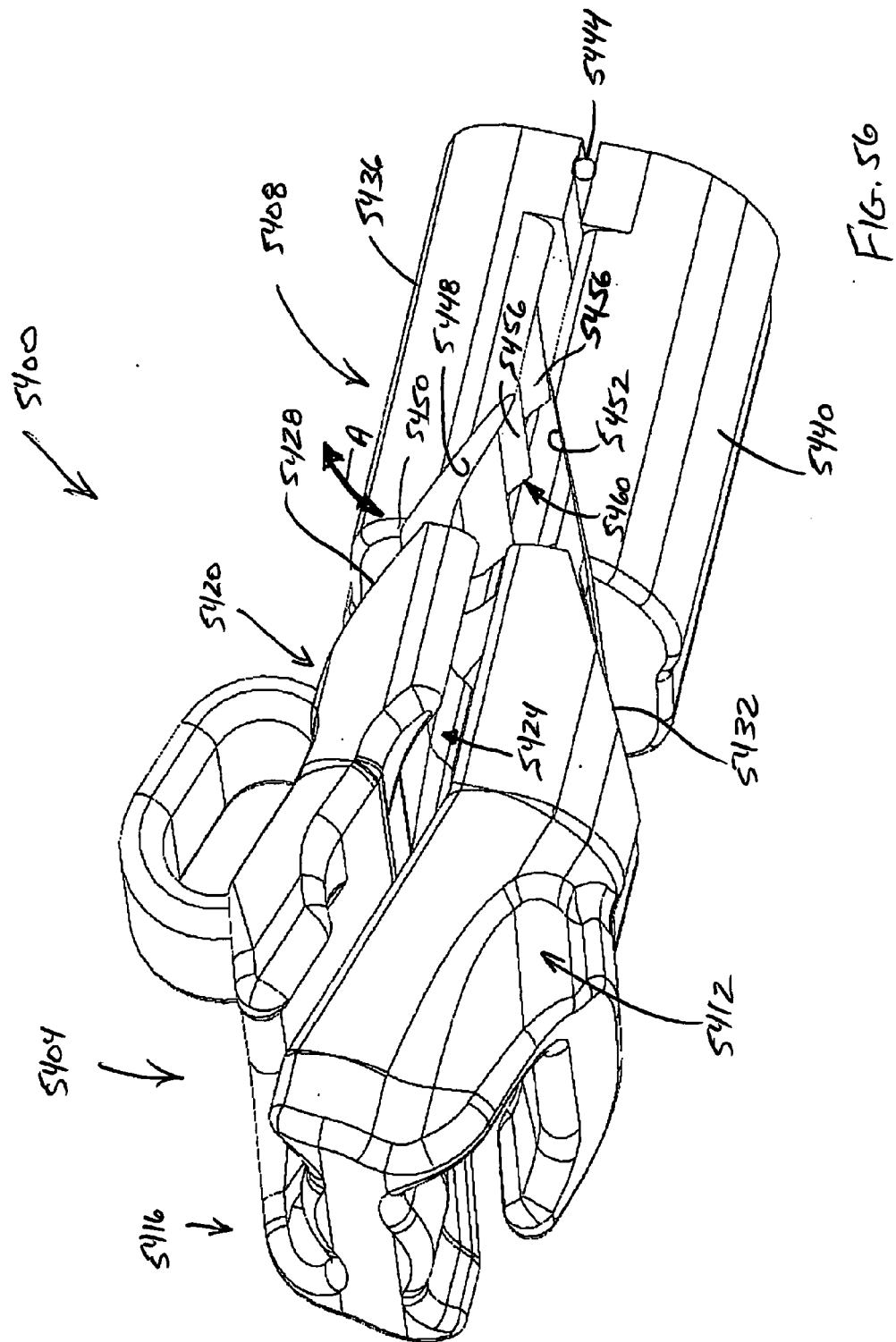


FIG. 55



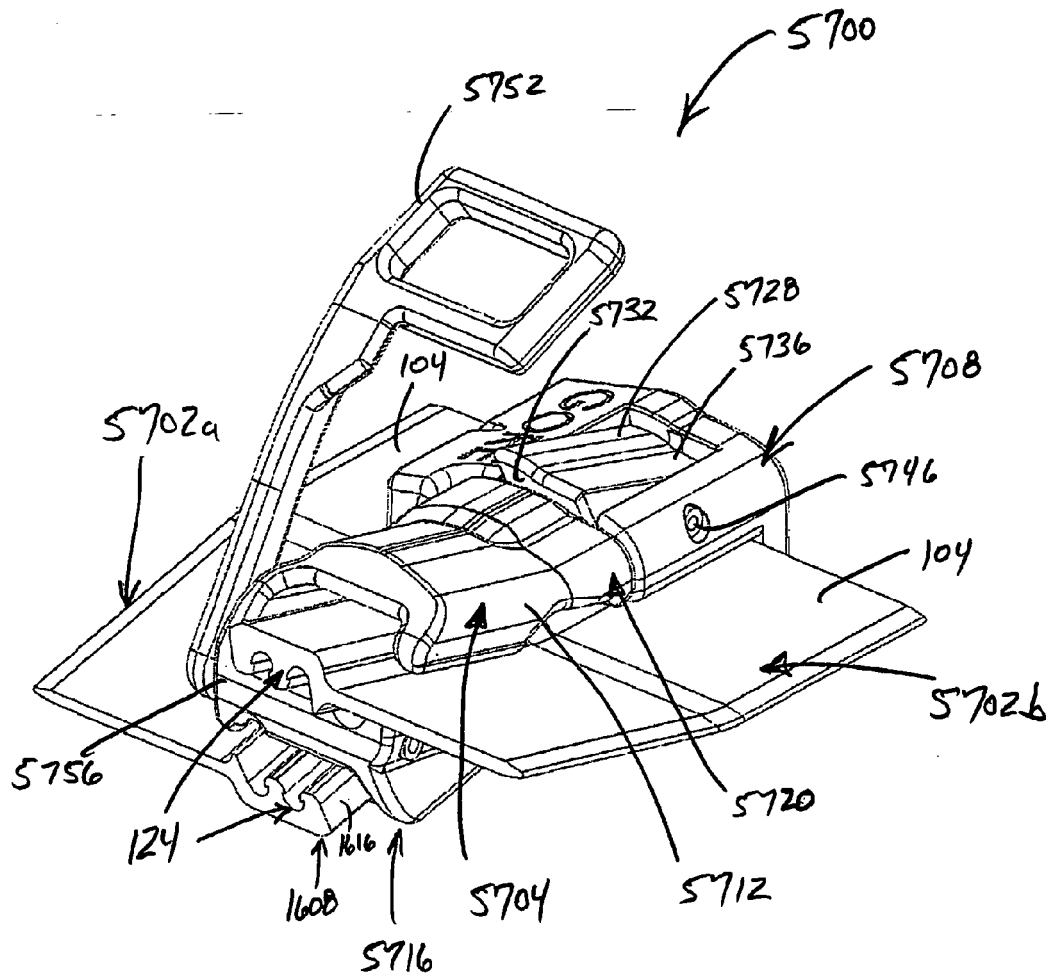
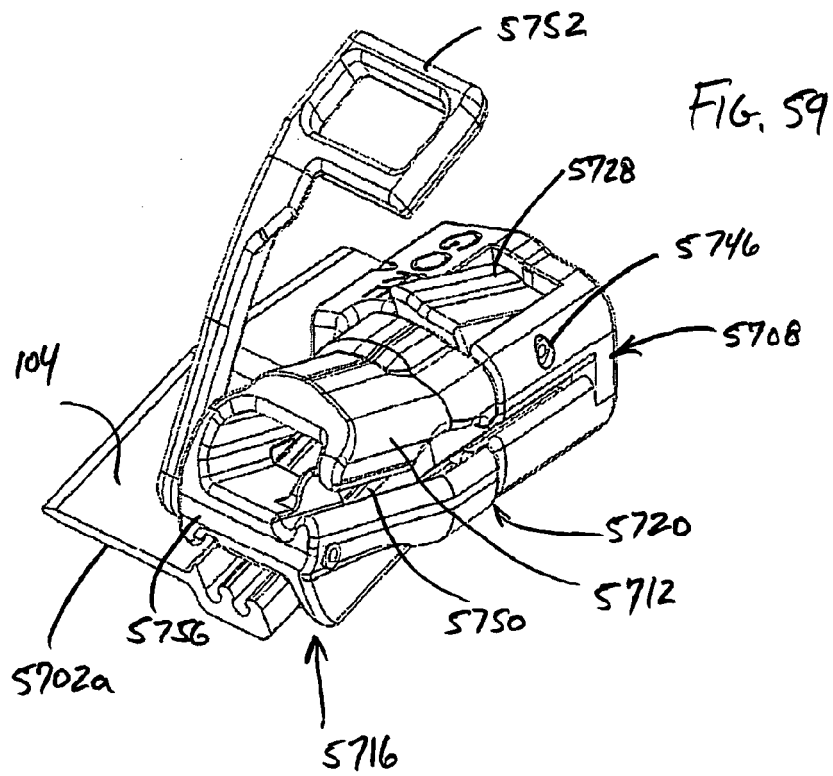
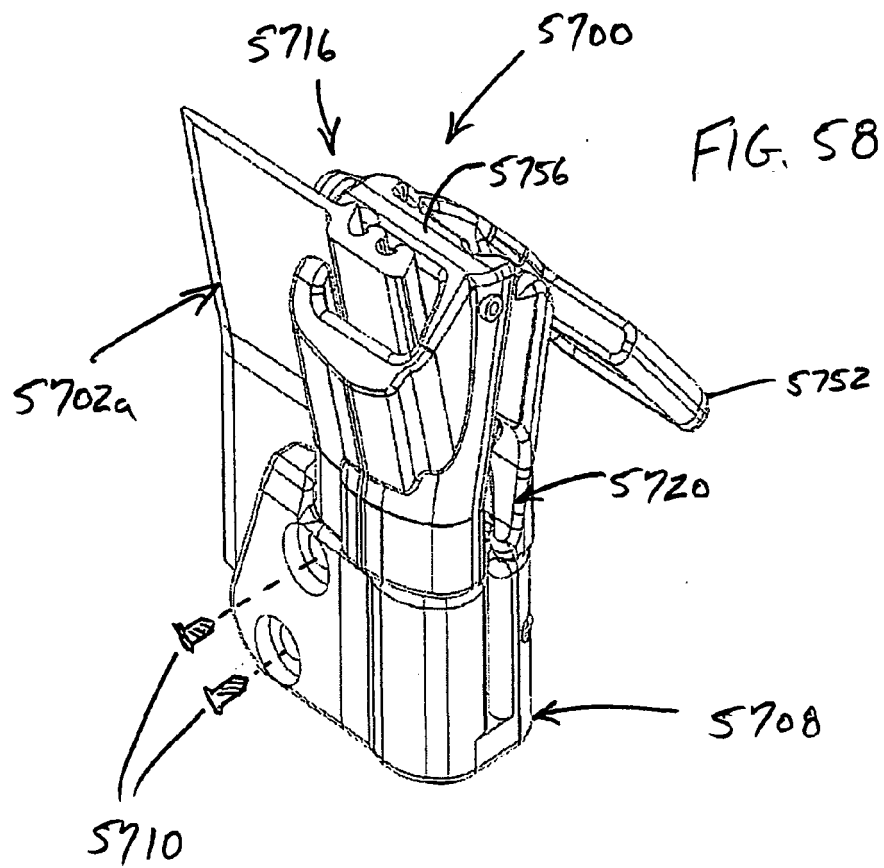
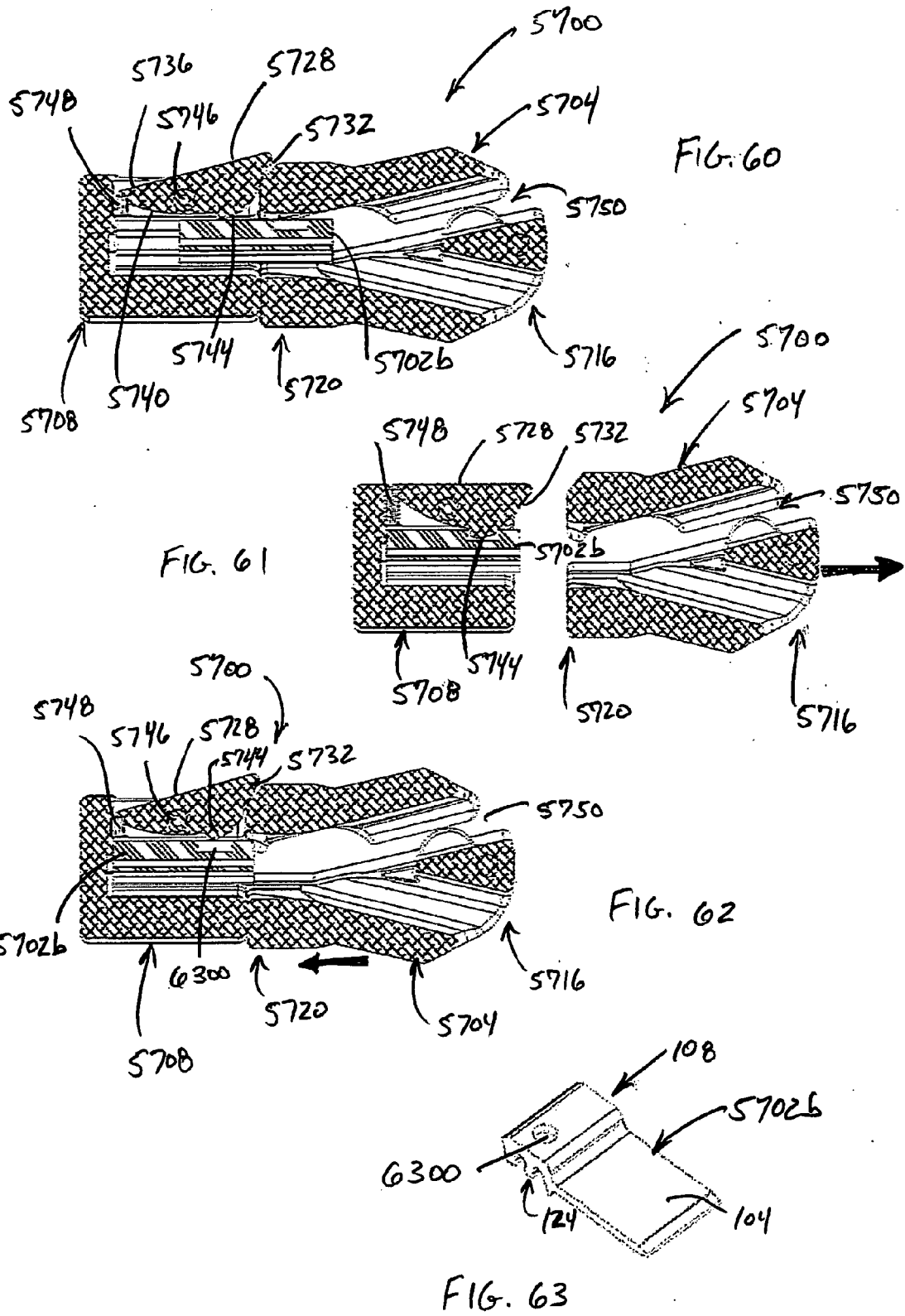
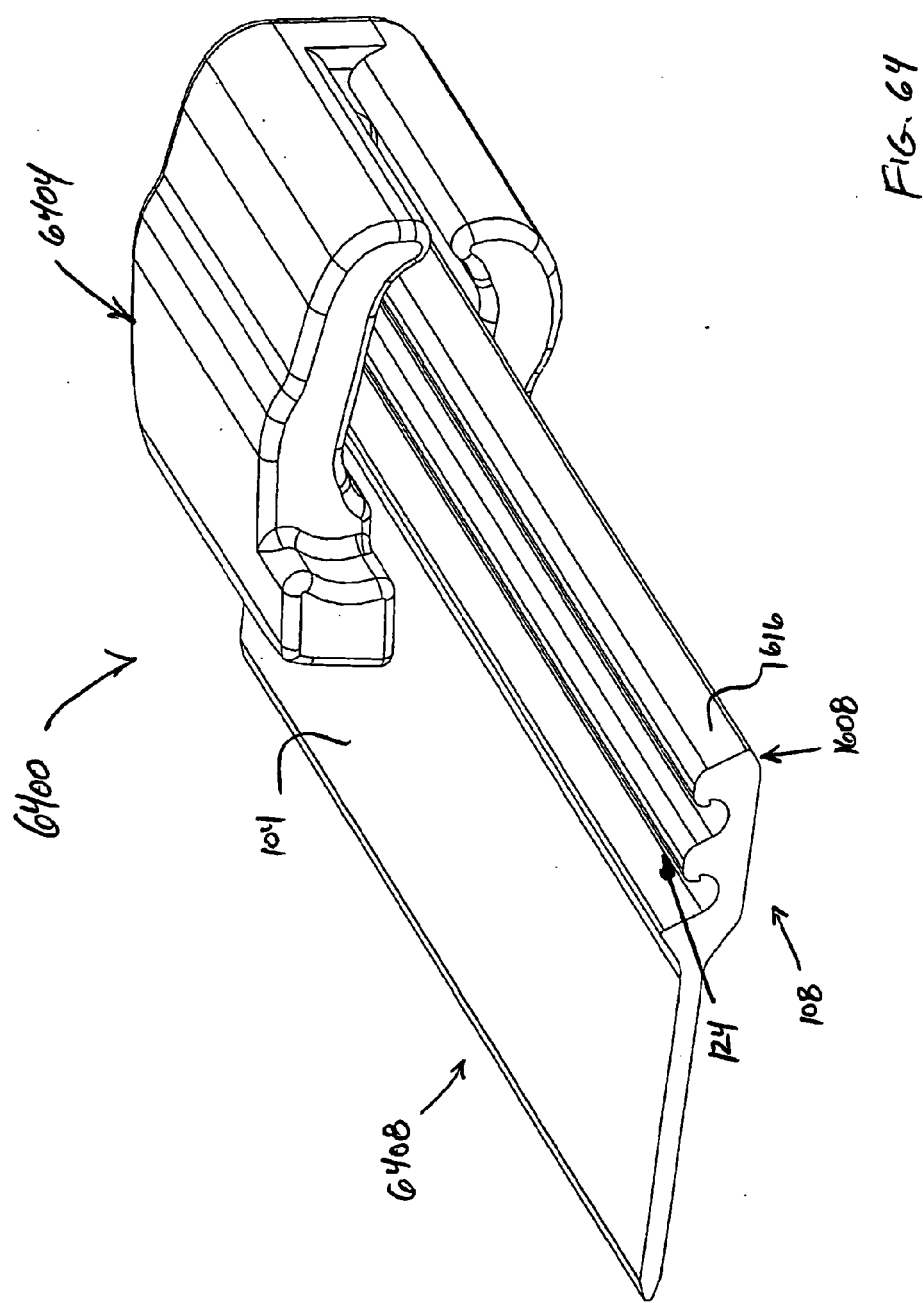
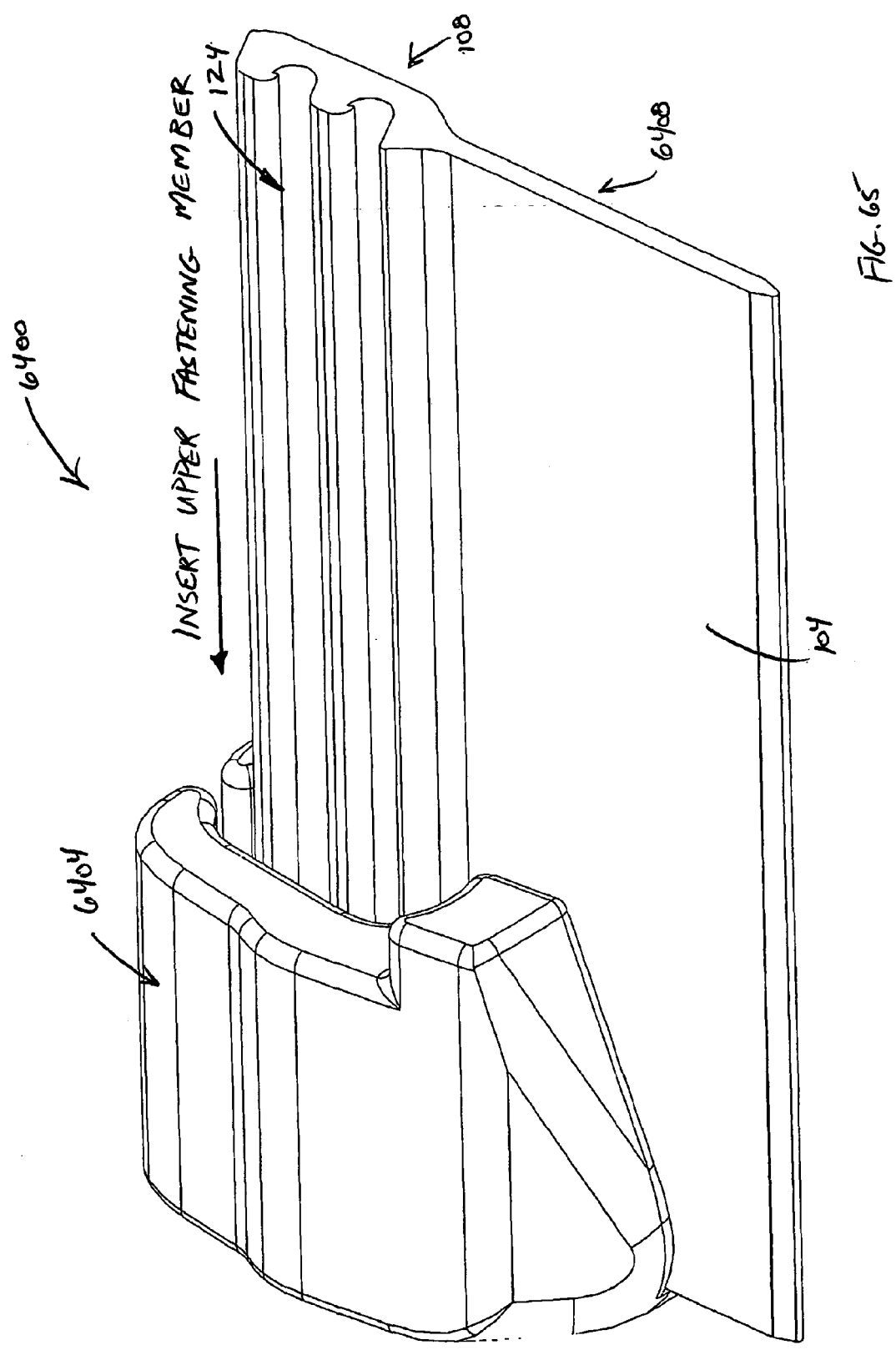


FIG. 57









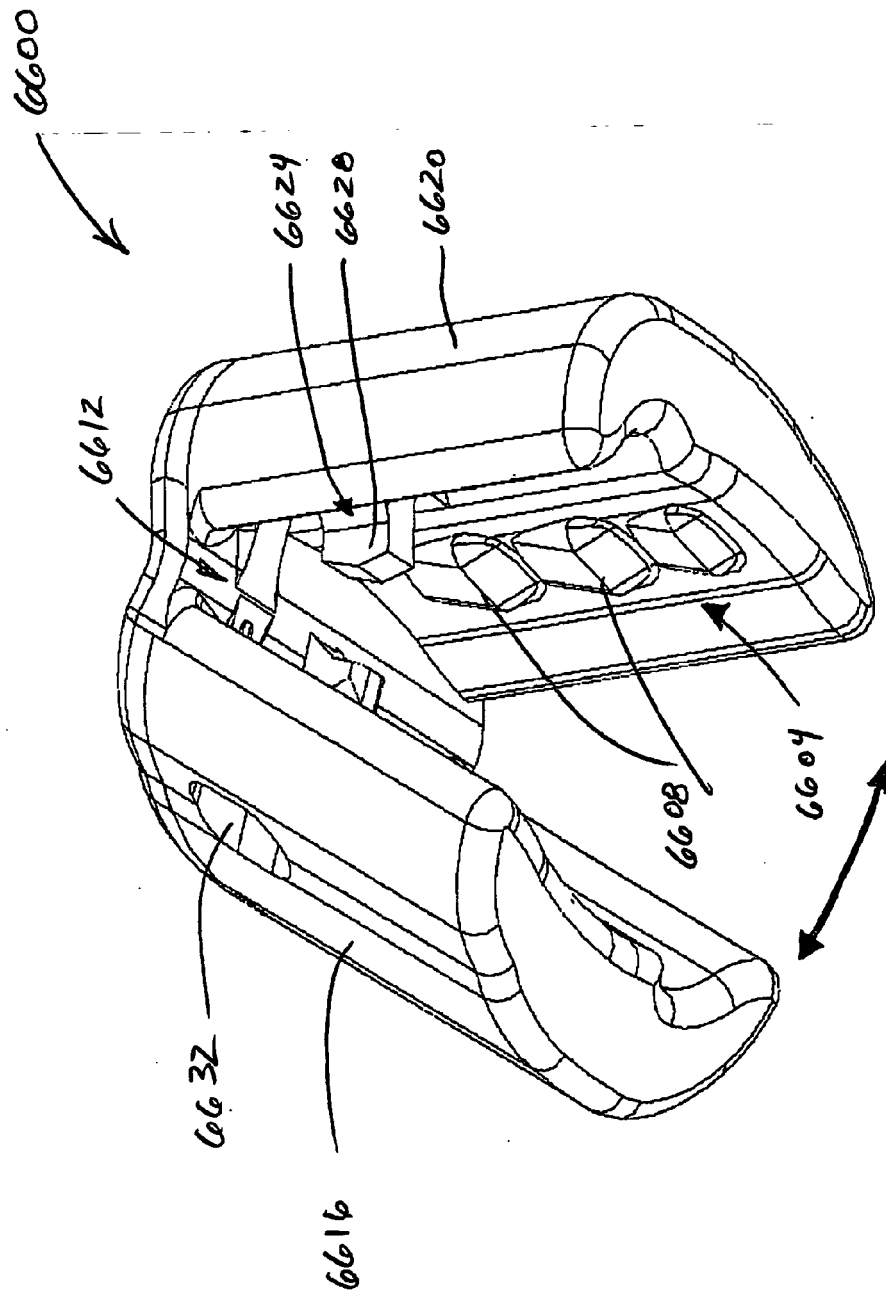


FIG. 66

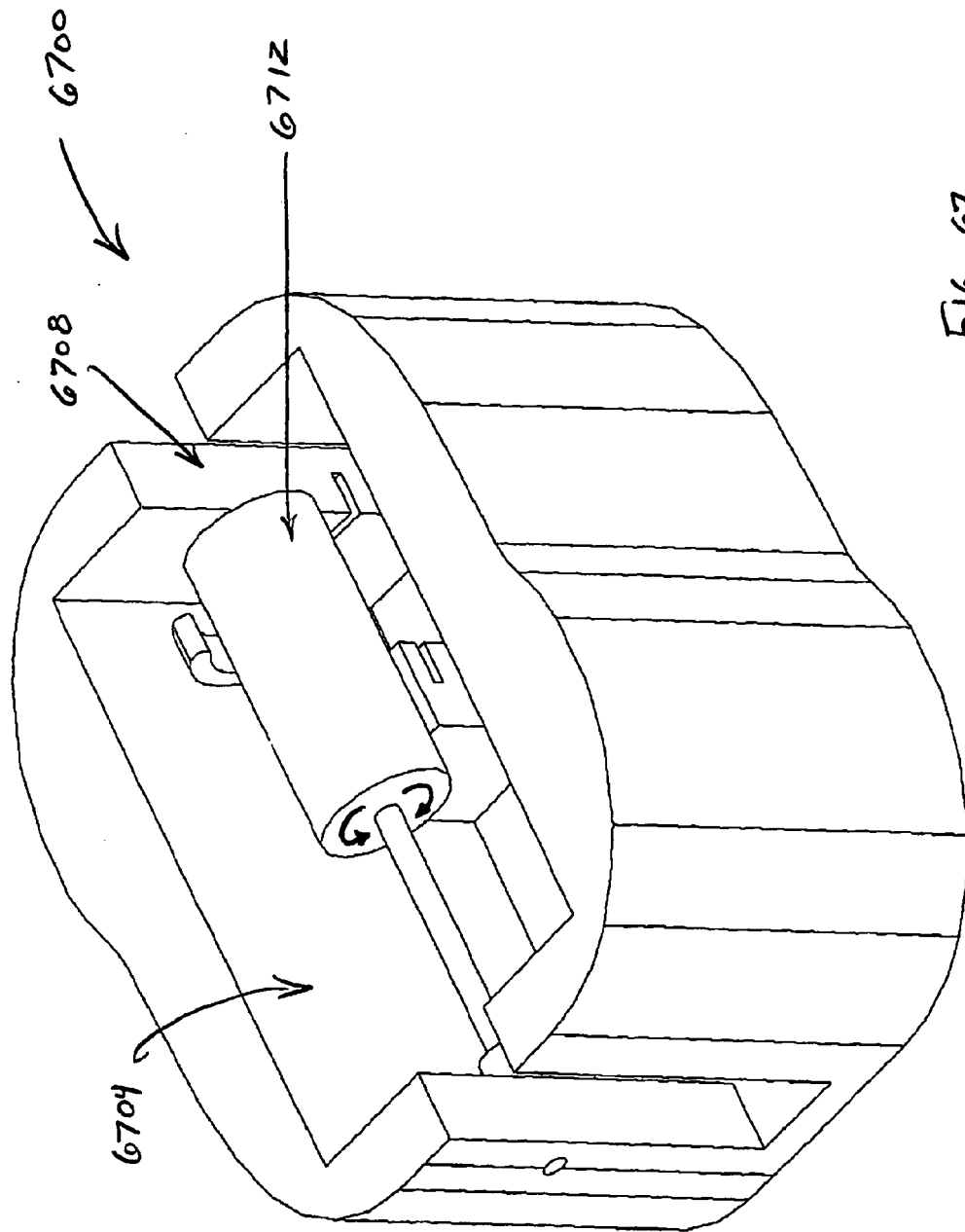


Fig. 67

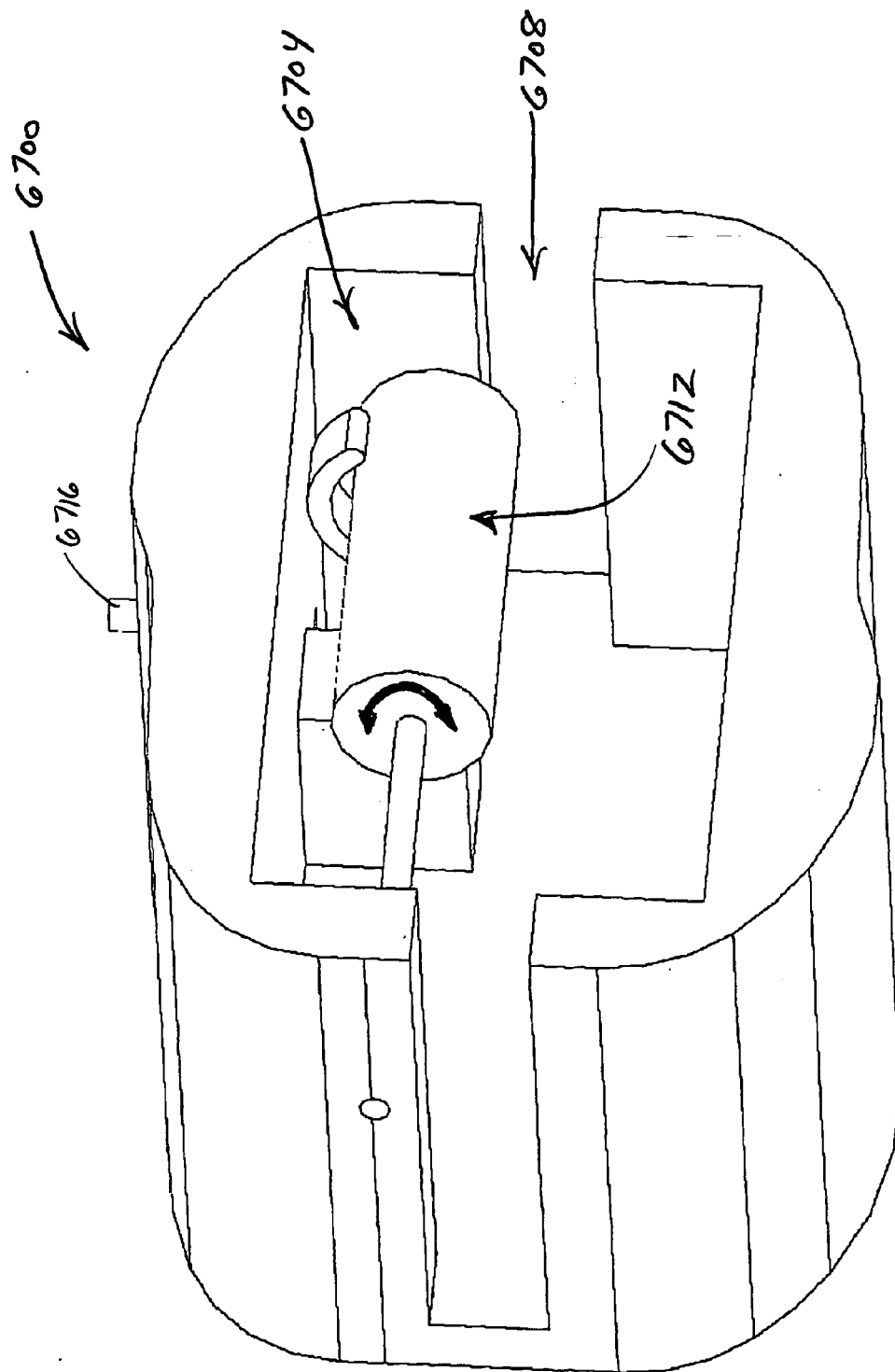


FIG. 68

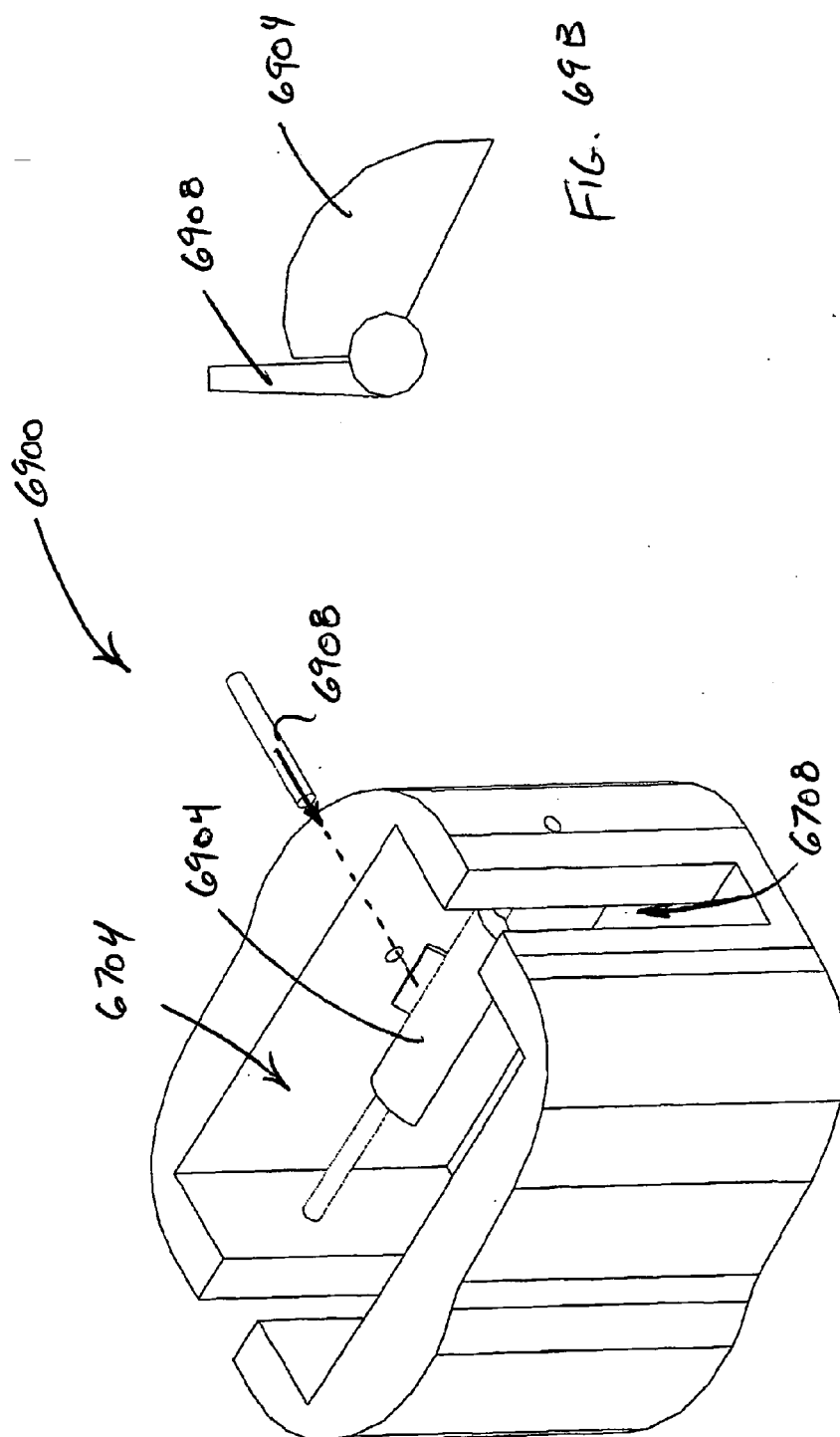
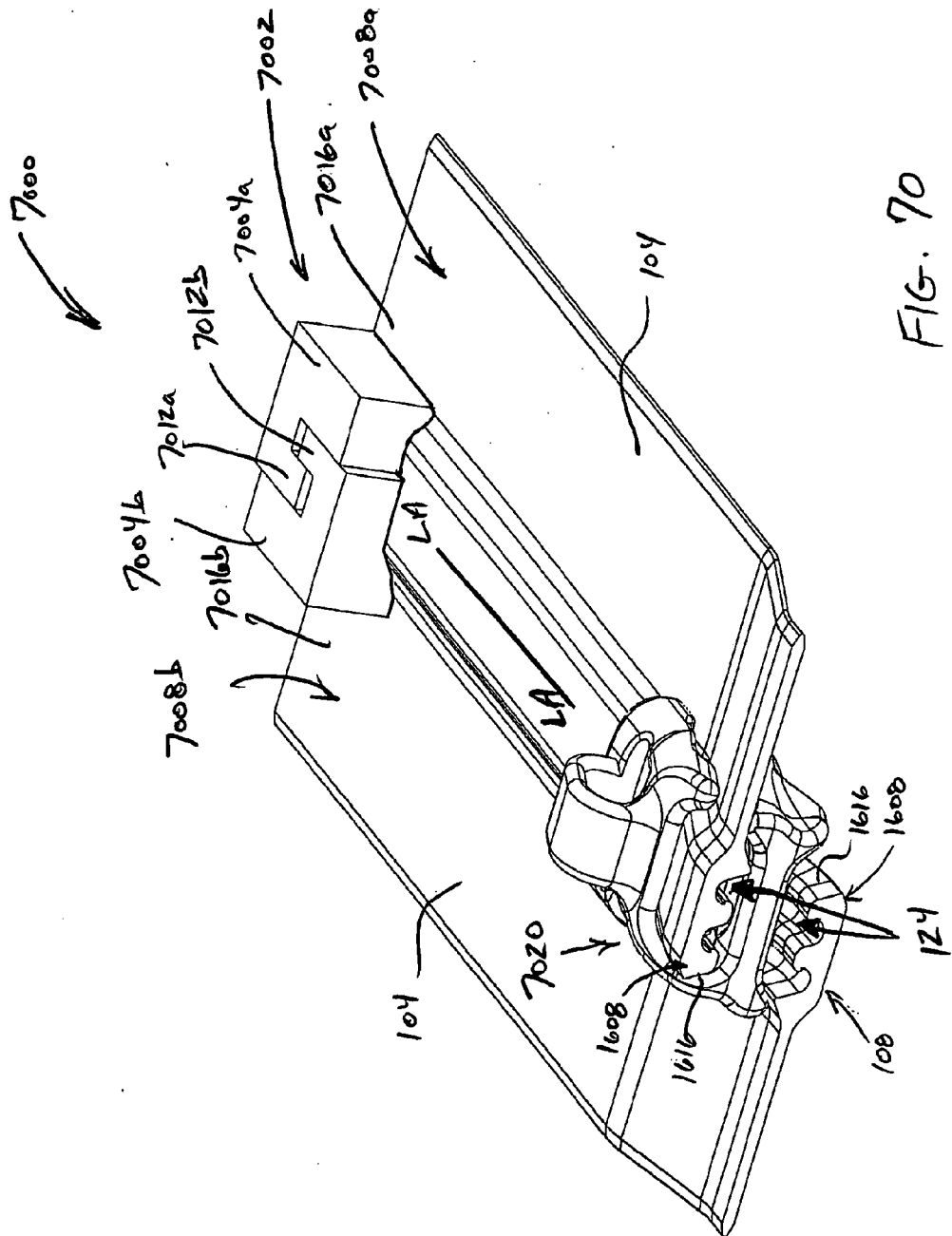
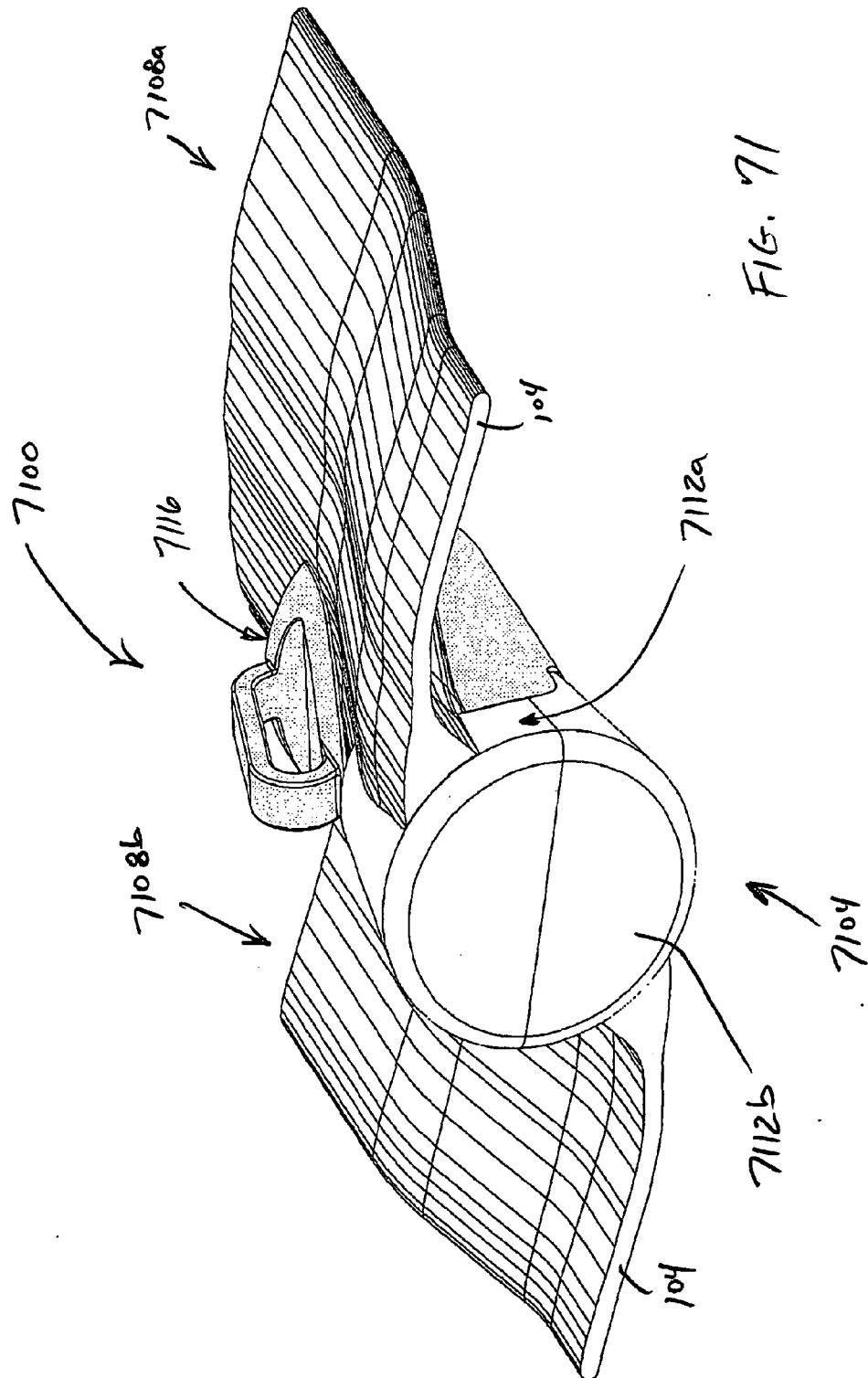


FIG. 69A

FIG. 69B





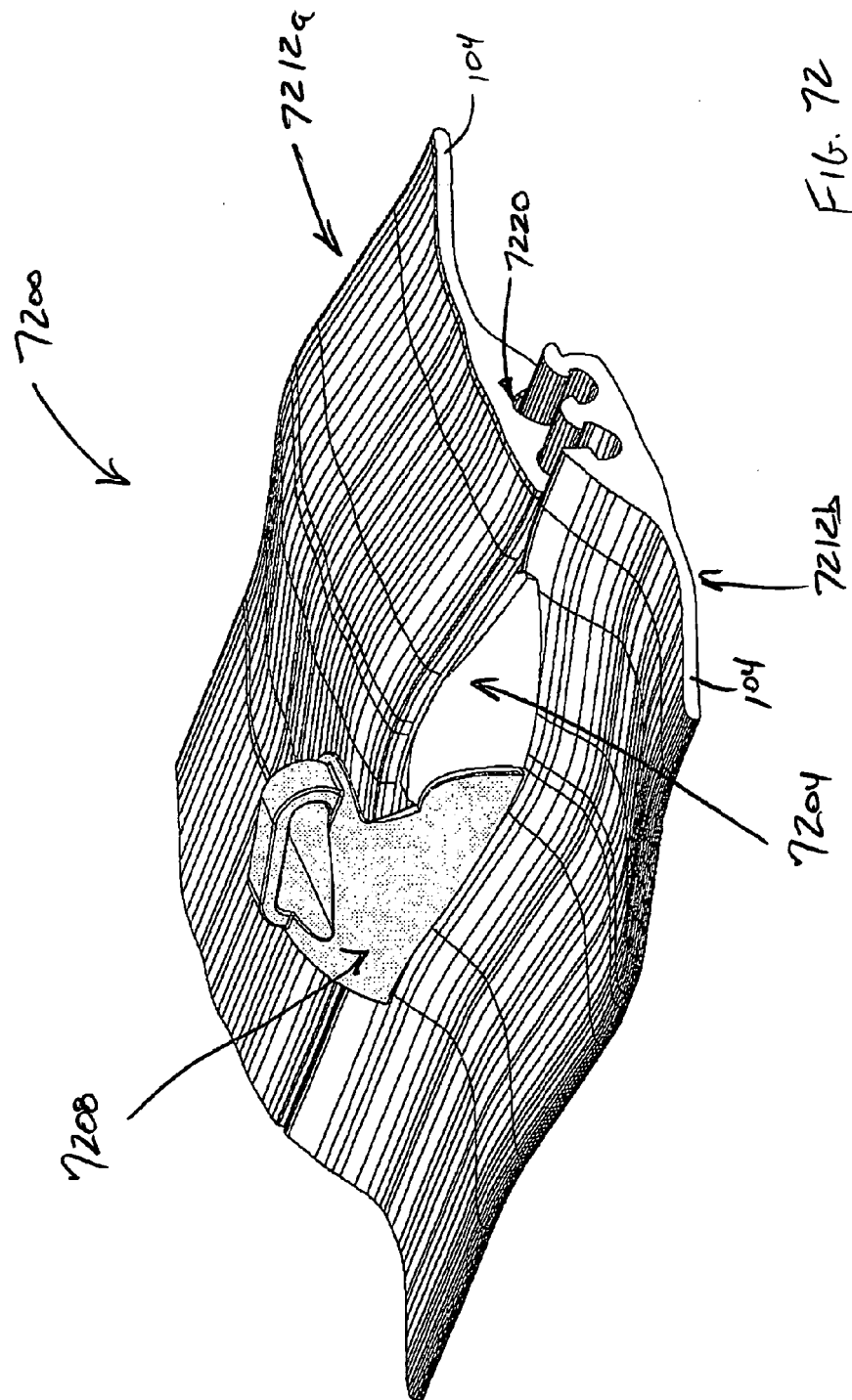


FIG. 72

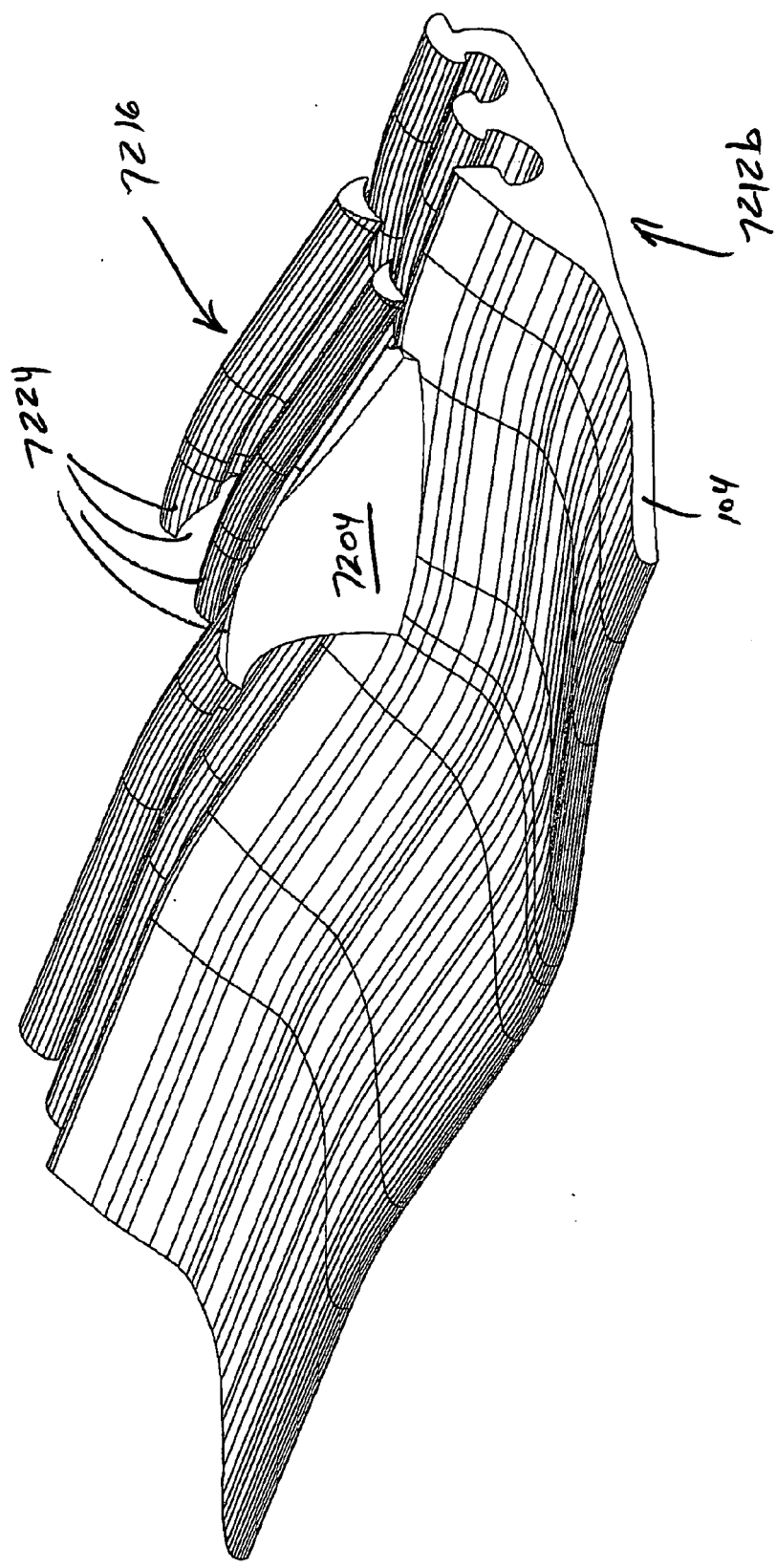


FIG. 73

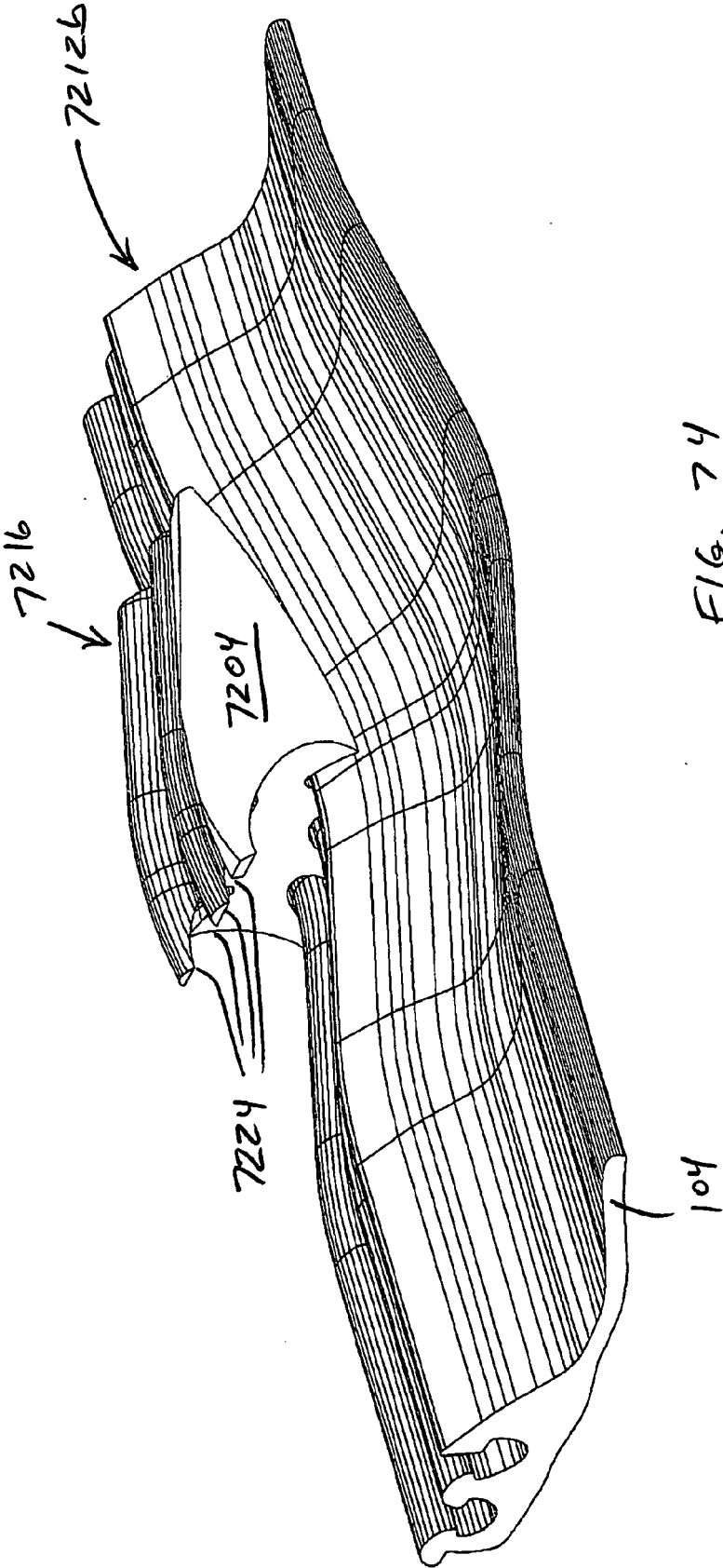


FIG. 74

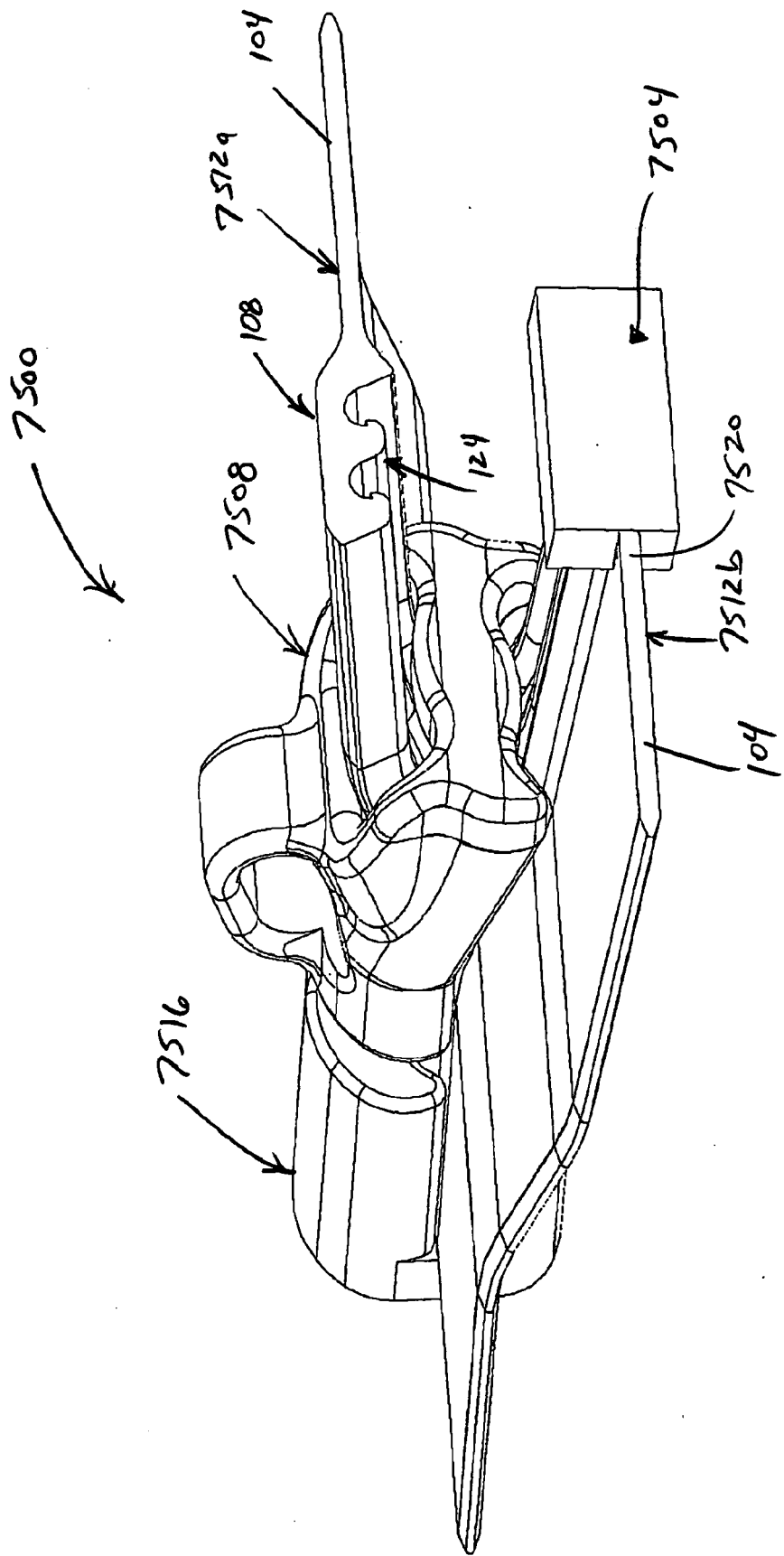
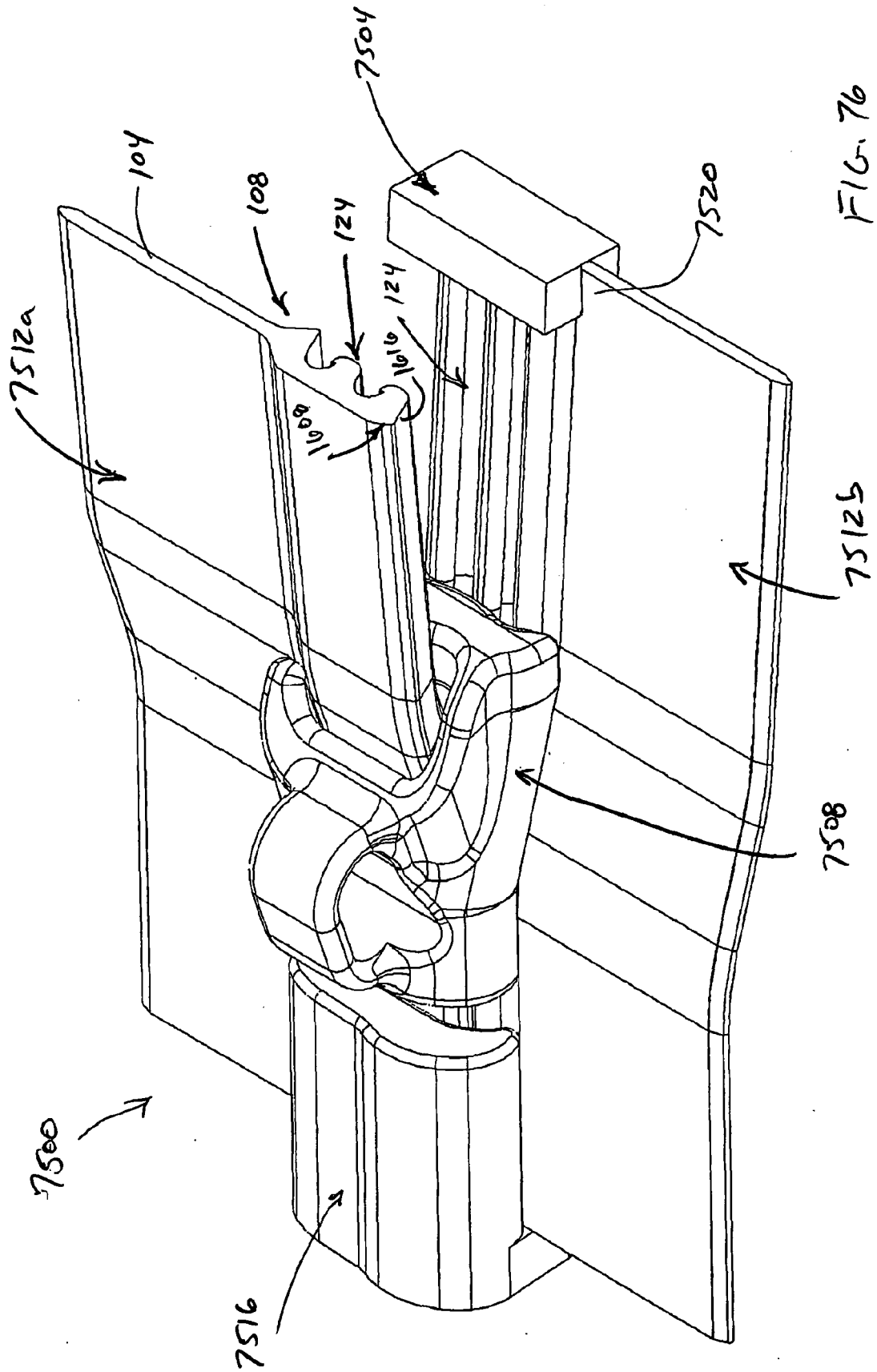


FIG. 75



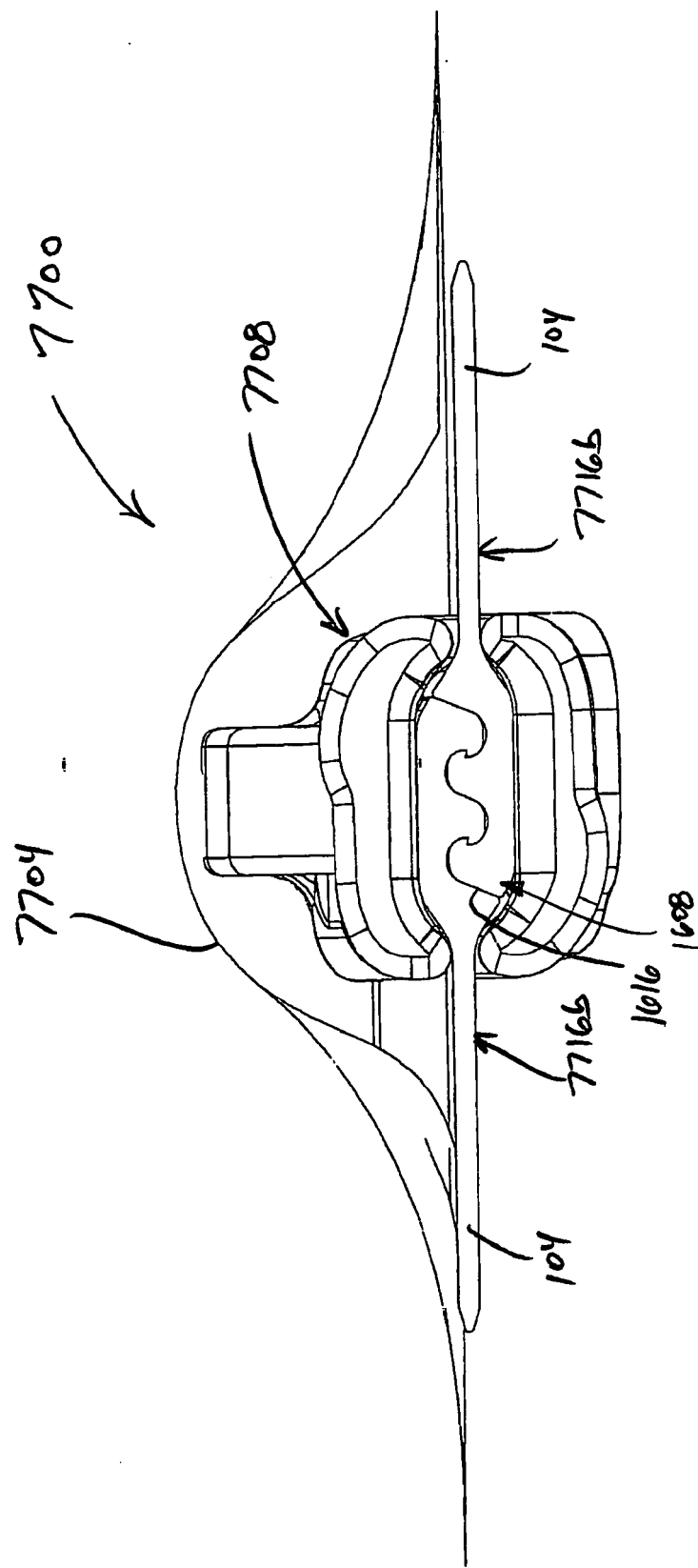
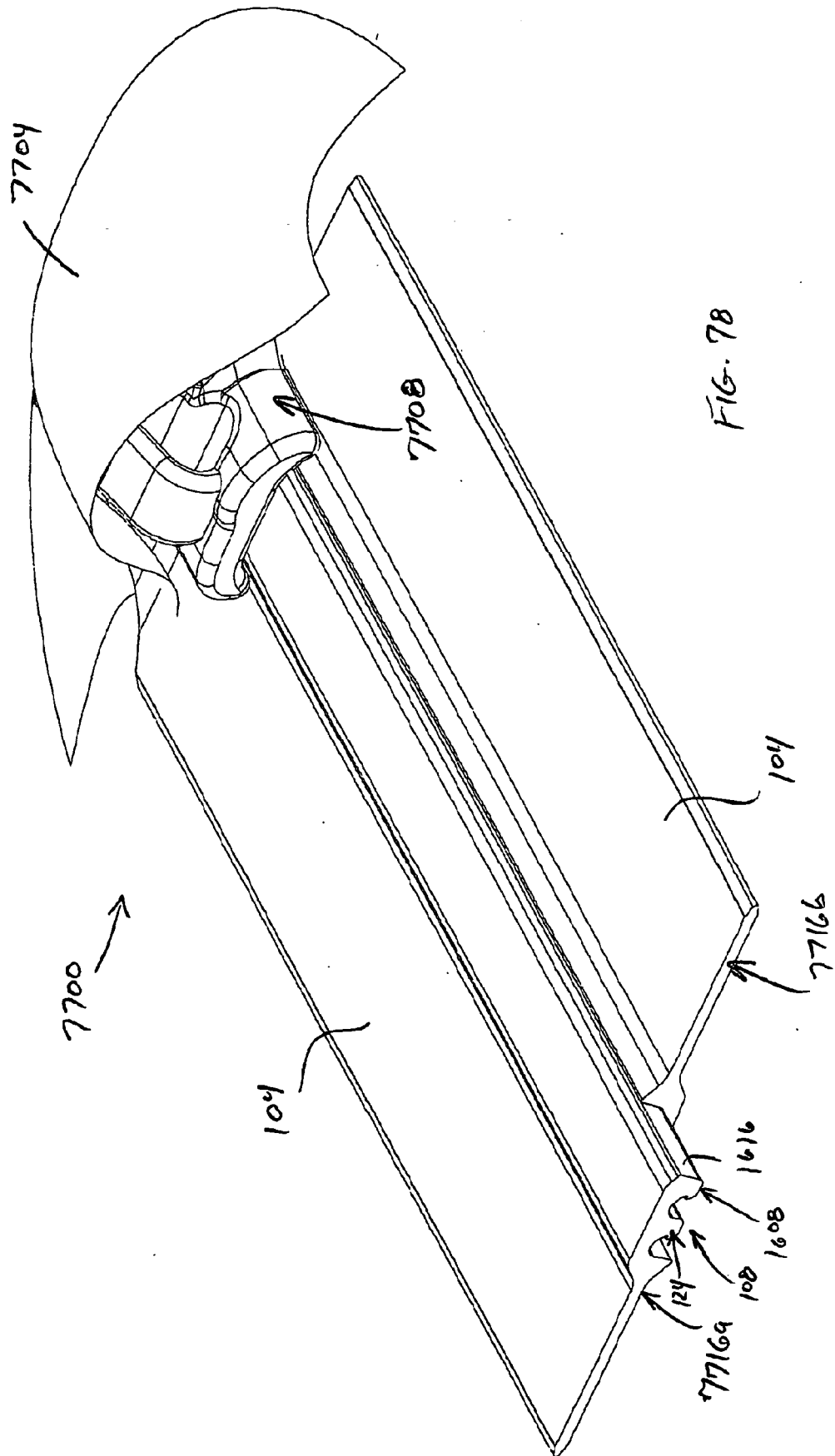


FIG. 77



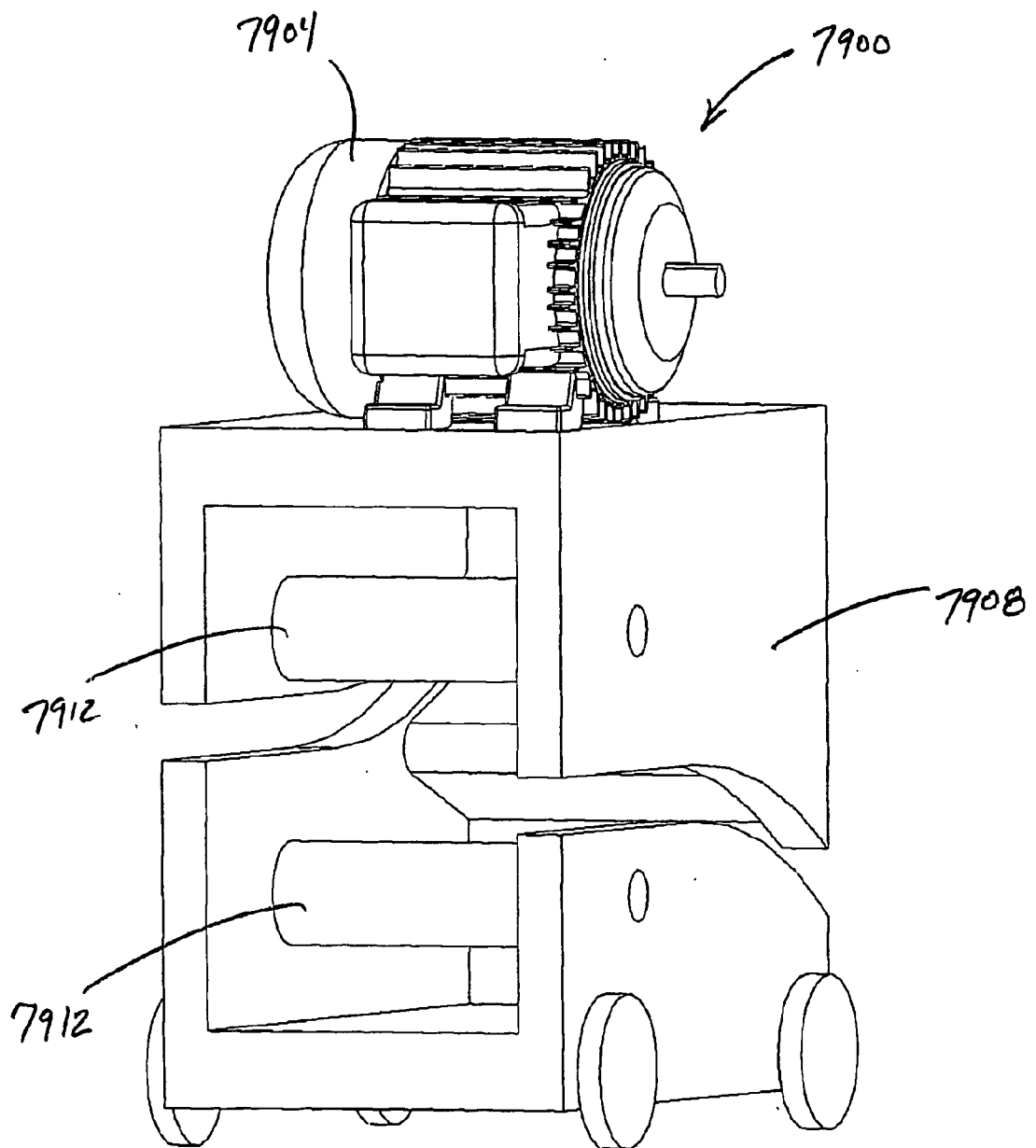


FIG. 79

REFERENCES CITED IN THE DESCRIPTION

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