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(54) **MAGNET FASTENER**

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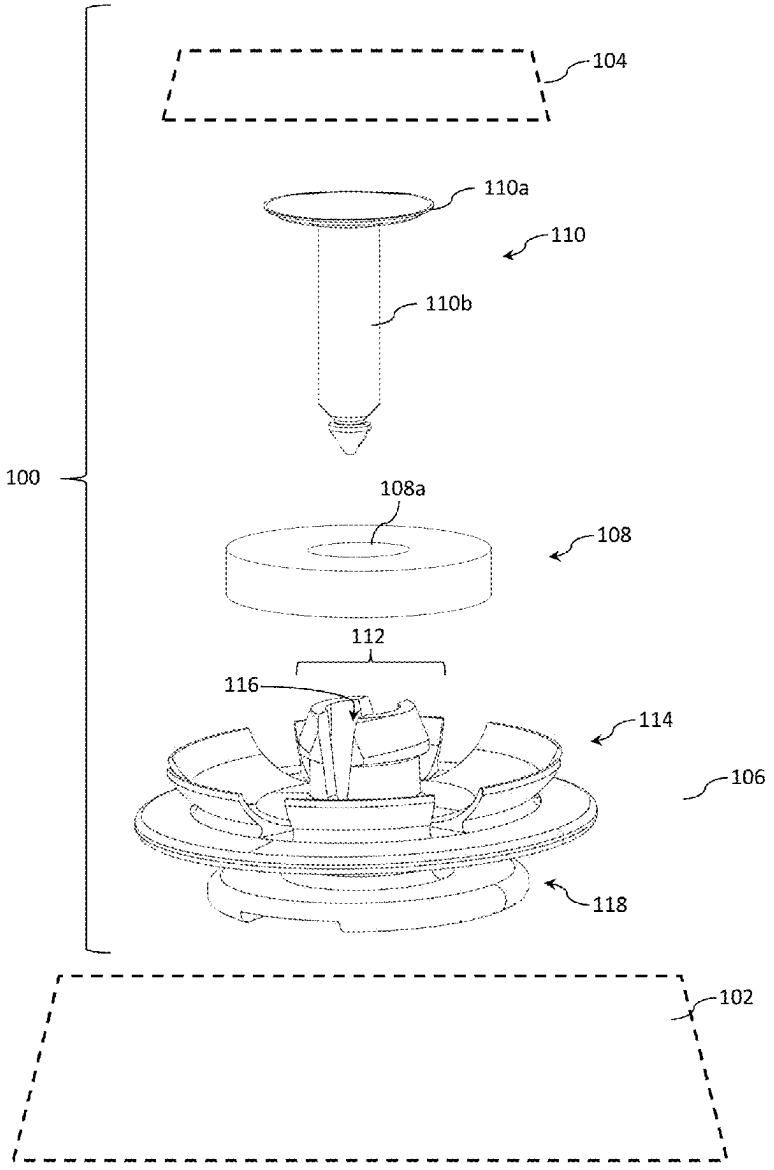
(57) **ABSTRACT**

Disclosed is a magnet fastener assembly for attaching a first component to a second component. The magnet fastener assembly includes a pin, a magnet, a magnet retainer, and a clip feature. The pin has a head and a shank. The magnet retainer includes a basket structure and a post. The basket structure is configured to flex and accommodate the magnet. The post is configured to receive a shank of a pin. The clip feature coupled to the magnet retainer via a base and configured to couple to the first component.



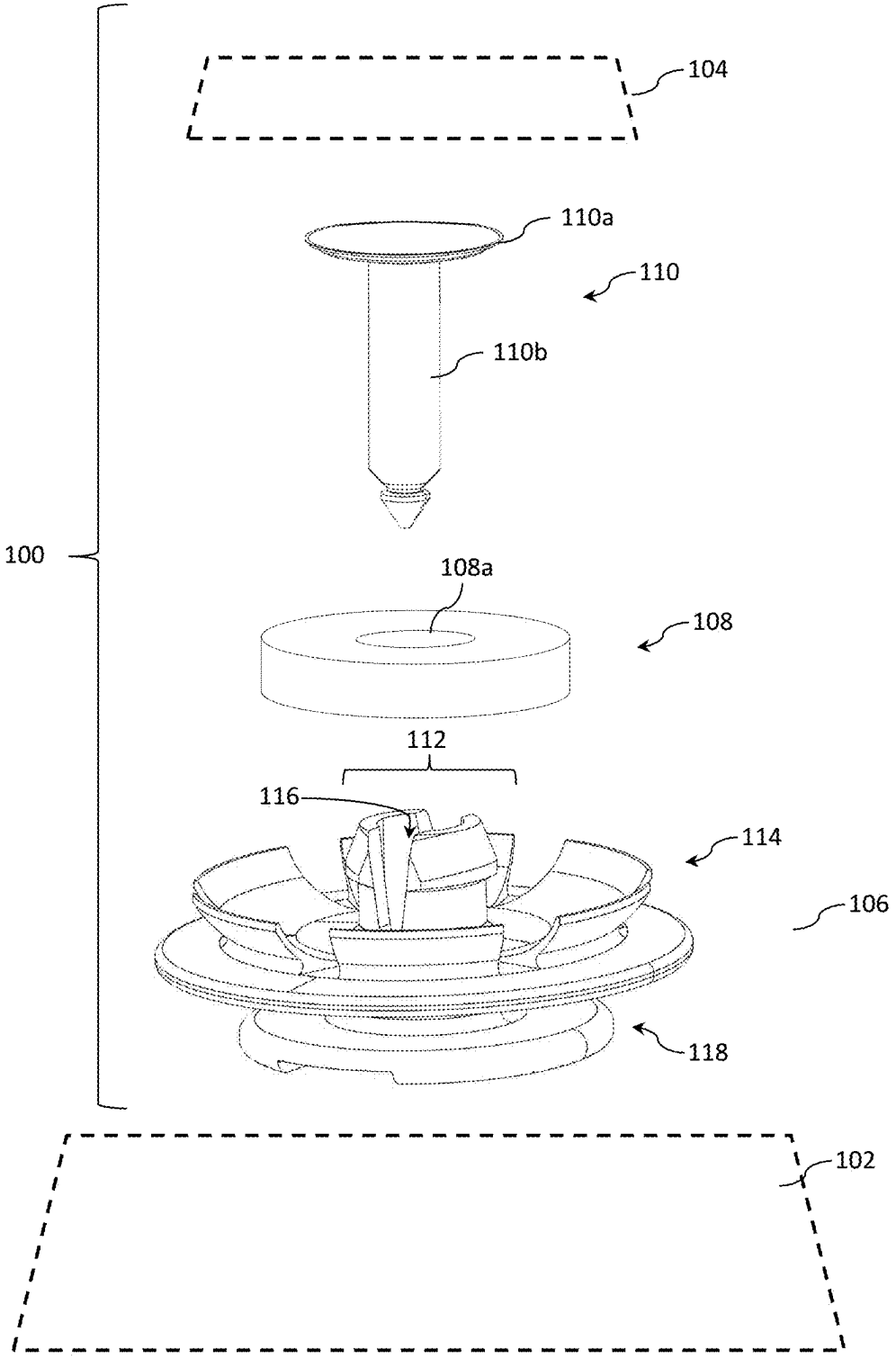


FIG. 1

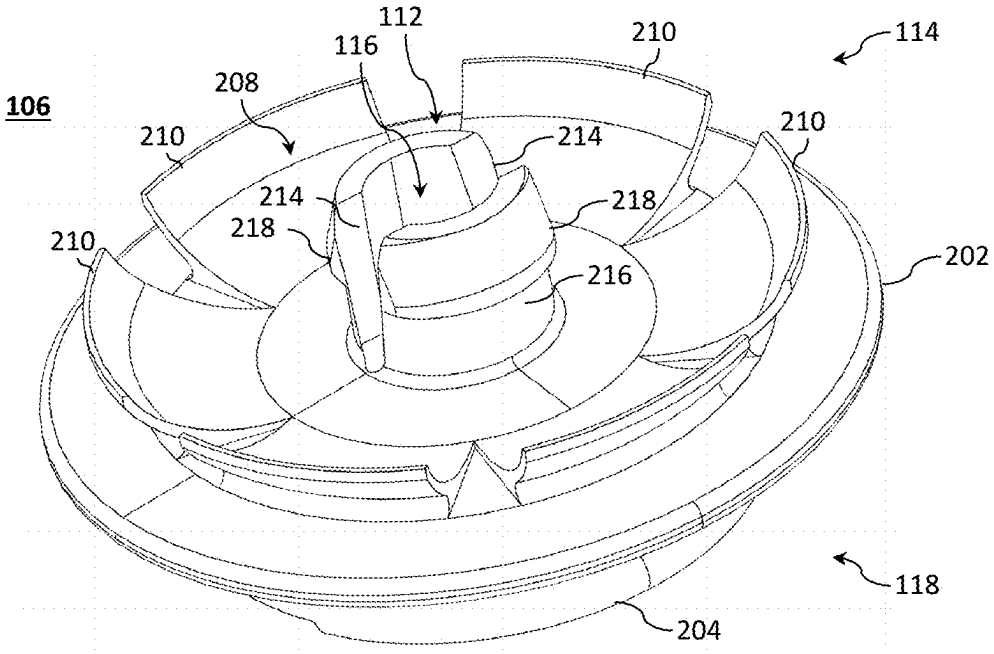

106
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FIG. 2a

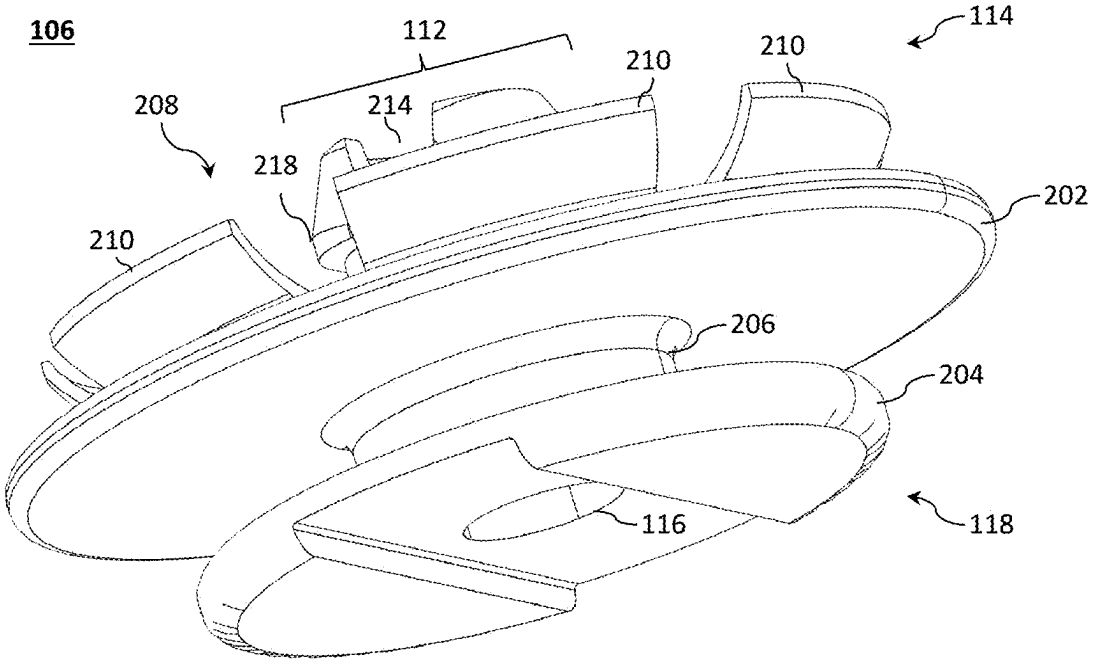
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FIG. 2b

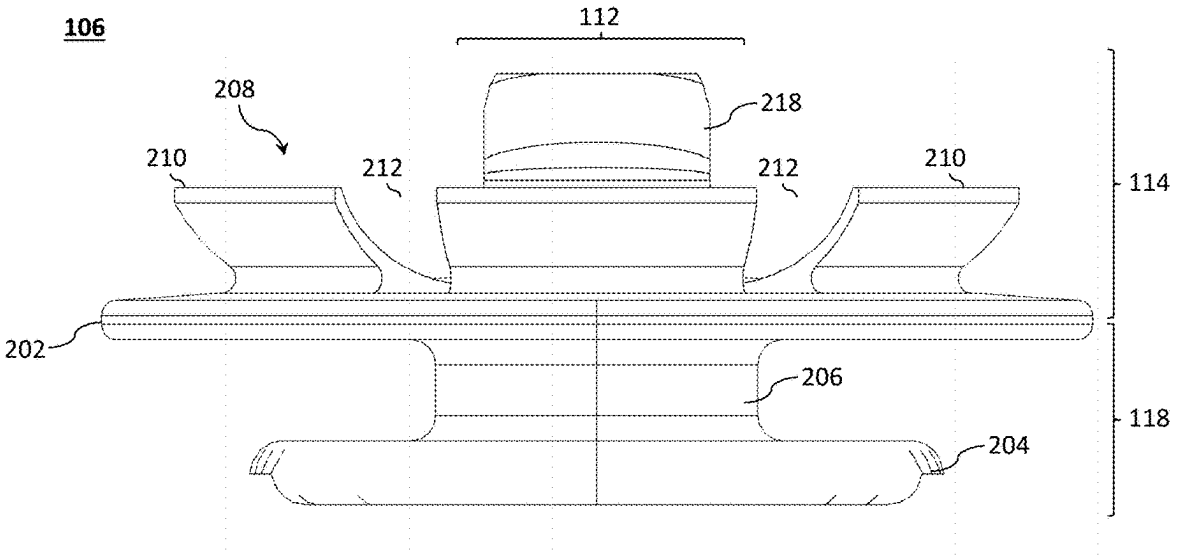
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FIG. 2c

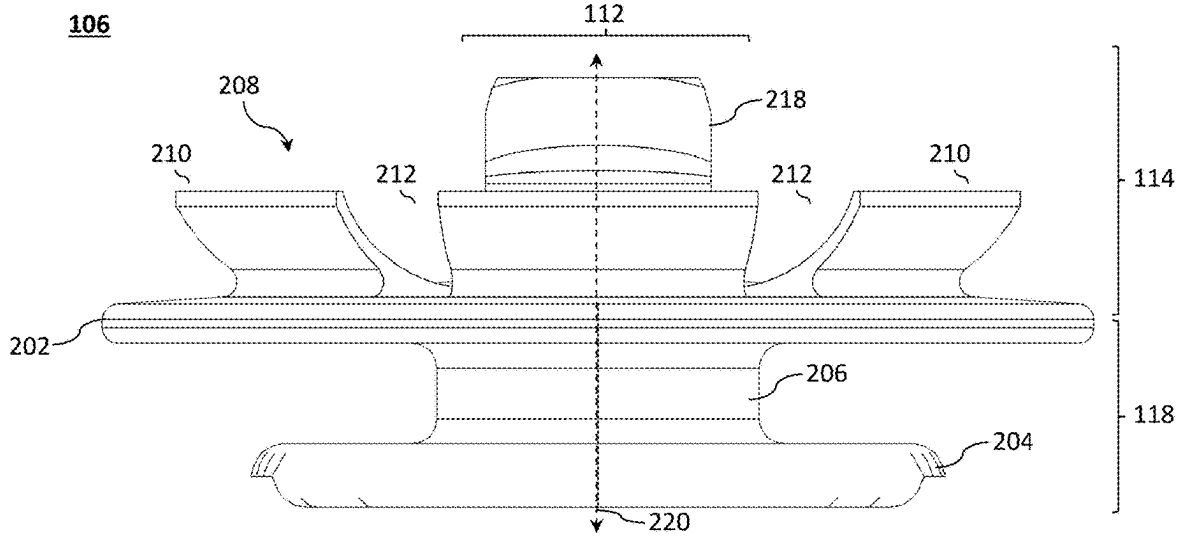
106
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FIG. 2d

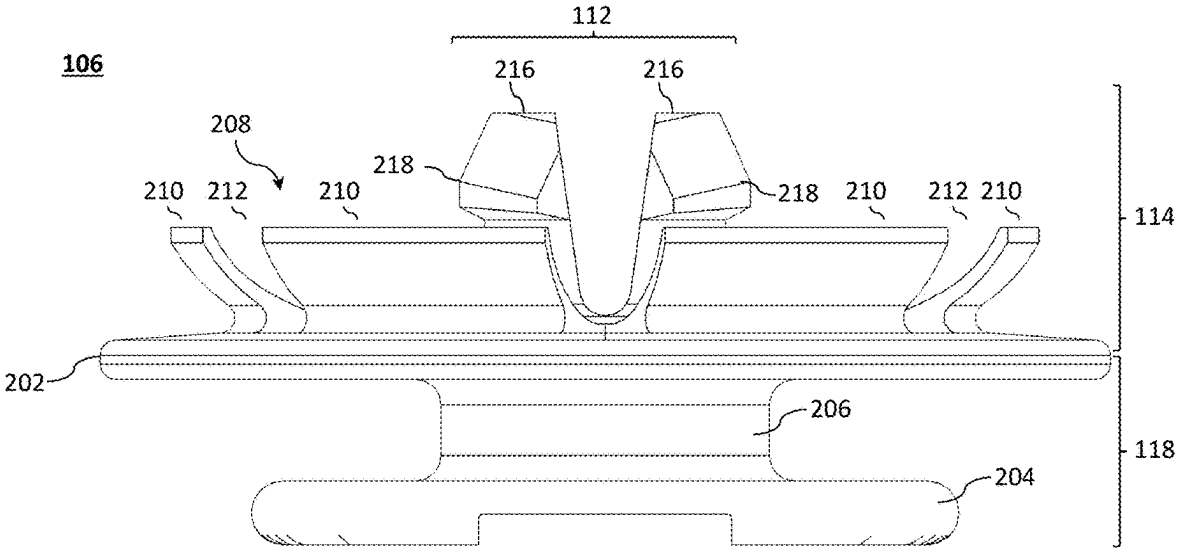
112
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FIG. 2e

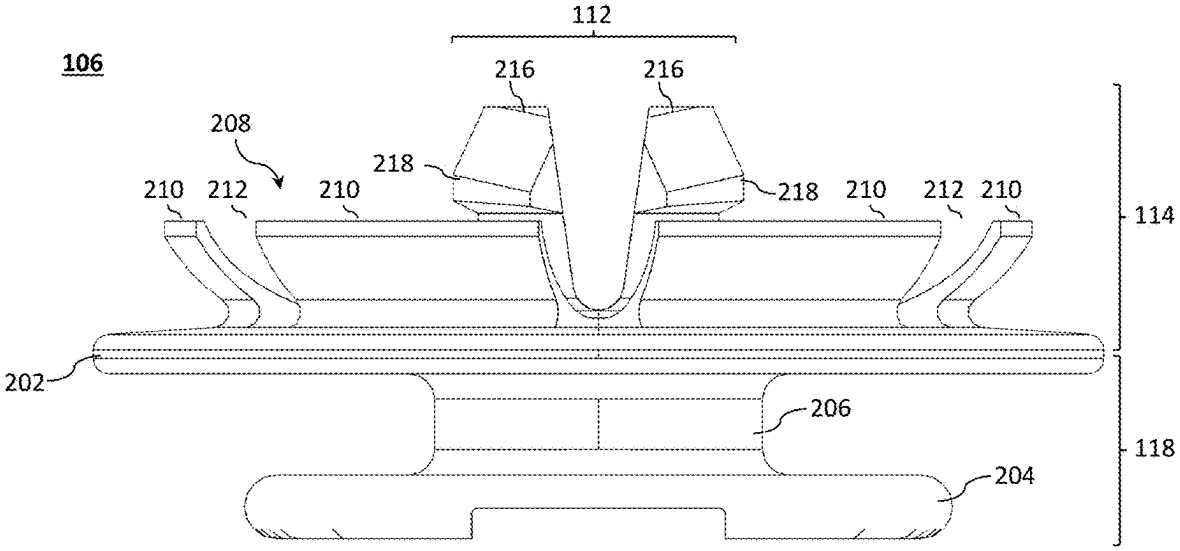
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FIG. 2f

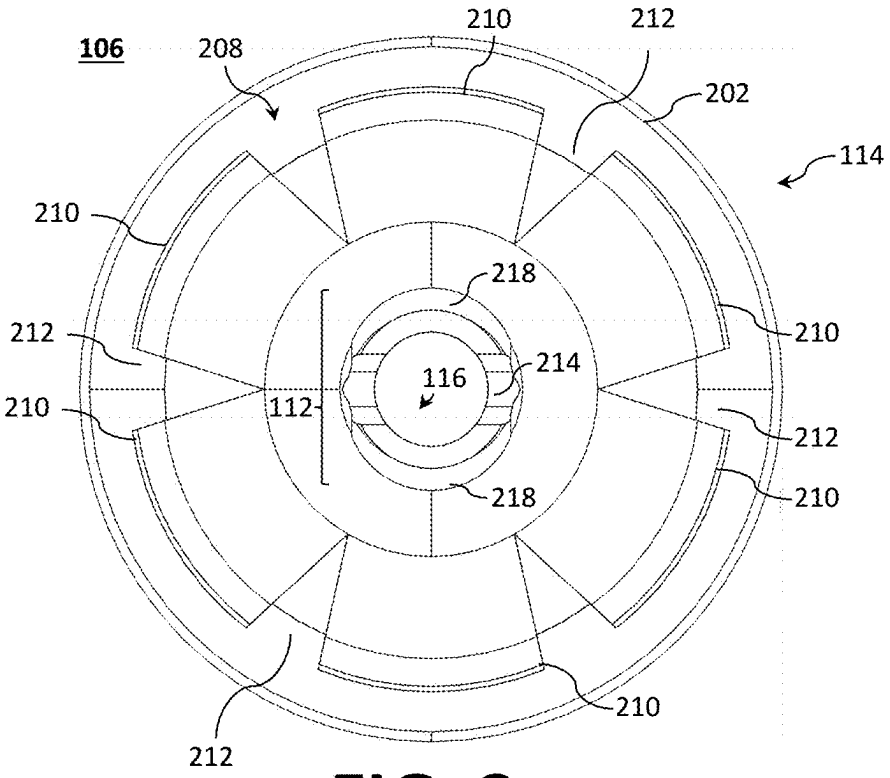
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FIG. 2g

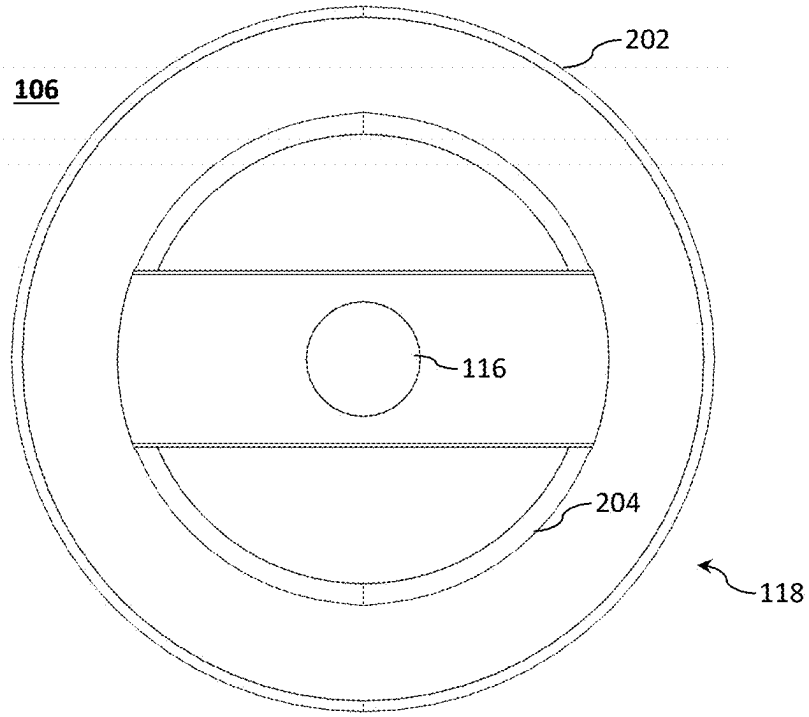
202
106
116
204
118

FIG. 2h

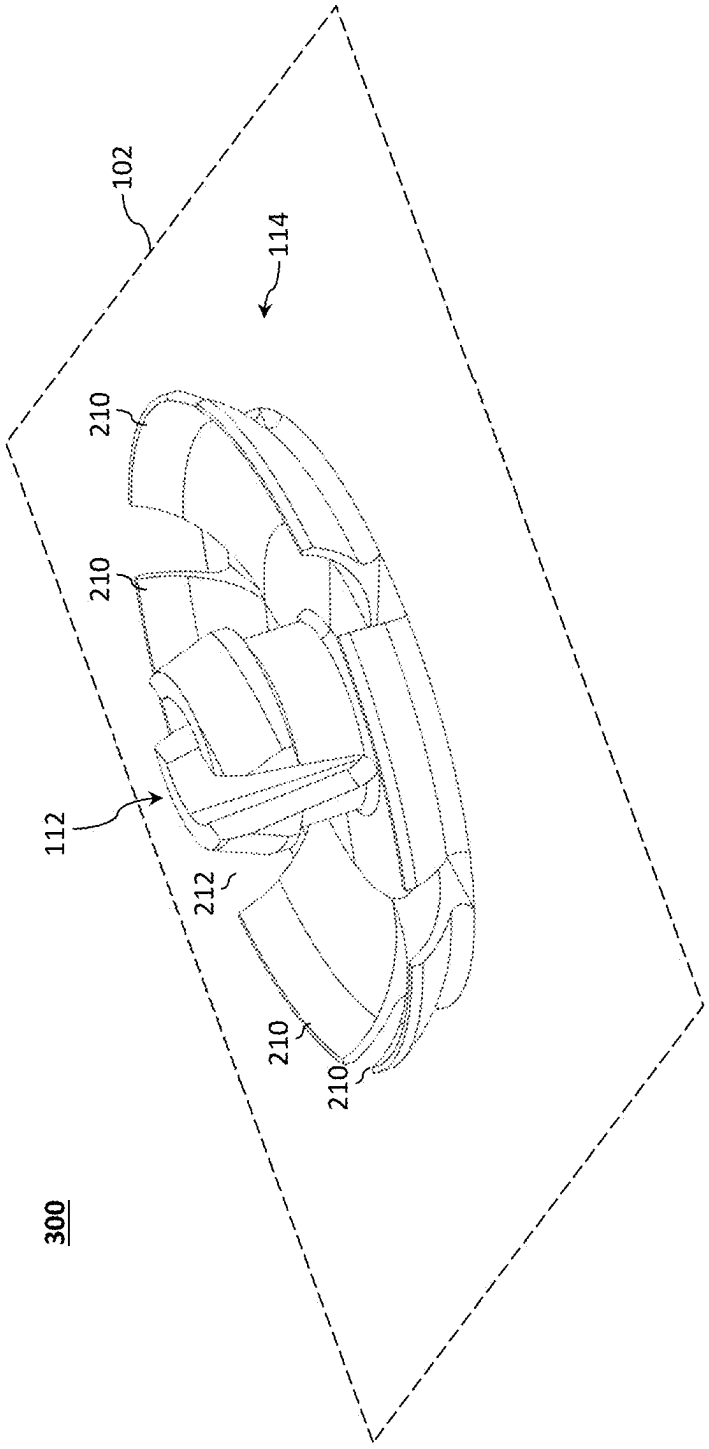

FIG. 3

MAGNET FASTENER

RELATED APPLICATION

[0001] The present application claims priority to U.S. Provisional Patent Application No. 63/556,068, filed Feb. 21, 2024, and entitled "Magnet Fastener," which is hereby incorporated by reference in its entirety.

BACKGROUND

[0002] Automotive components require fastening techniques that are simple to manufacture and assemble. Further, fastening techniques should above all be reliable and efficient. Fastening clips are particularly useful to secure automotive components; for example, to secure headliners, interior panels, and the like to roofs, door structures, and other automotive components.

[0003] An automobile headliner is typically made of cloth, foam or other suitable material and generally includes a substrate layer. Various interior automobile mechanisms can be used to retain the headliner in position against the automobile roof, such as fastener clips. The fastener clip can be secured to the component (e.g., the automobile headliner) by an adhesive (e.g., glue), clips, doghouses, etc., and can be attached to the underlying roof structure by one of several known arrangements. In some examples, a magnetic fastener clip is used to secure the headliner to the mating roof structure by way of the magnet. For example, commonly-owned U.S. Pat. No. 7,306,190 discloses a fastener for securing automobile headliners to automobile roofs via a magnet assembly.

[0004] While magnetic fasteners of the type generally described have facilitated installation of automobile headliners, there is a continuing need for improved structures and arrangements for such magnetic fasteners.

SUMMARY

[0005] The present disclosure relates generally to a magnet fastener and magnet fastener assembly, substantially as illustrated by and described in connection with at least one of the figures, as set forth more completely in the claims.

DRAWINGS

[0006] The foregoing and other objects, features, and advantages of the devices, systems, and methods described herein will be apparent from the following description of particular examples thereof, as illustrated in the accompanying figures; where like or similar reference numbers refer to like or similar structures. The figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the devices, systems, and methods described herein.

[0007] FIG. **1** illustrates a perspective assembly view of an example magnet fastener assembly in accordance with an aspect of this disclosure.

[0008] FIG. **2***a* illustrates a top perspective view of the magnet fastener used in the magnet fastener assembly of FIG. **1**.

[0009] FIG. **2***b* illustrates a bottom perspective view of the magnet fastener.

[0010] FIGS. **2***c* through **2***f* illustrate, respectively, first, second, third, and fourth side views of the magnet fastener.

[0011] FIGS. **2***g* and **2***h* illustrate, respectively, top and bottom plan views of the magnet fastener.

[0012] FIG. **3** illustrates a perspective view of an example magnet fastener assembly integrated with an automotive component in accordance with another aspect of this disclosure.

DESCRIPTION

[0013] References to items in the singular should be understood to include items in the plural, and vice versa, unless explicitly stated otherwise or clear from the text. Grammatical conjunctions are intended to express any and all disjunctive and conjunctive combinations of conjoined clauses, sentences, words, and the like, unless otherwise stated or clear from the context. Recitation of ranges of values herein are not intended to be limiting, referring instead individually to any and all values falling within and/or including the range, unless otherwise indicated herein, and each separate value within such a range is incorporated into the specification as if it were individually recited herein. In the following description, it is understood that terms such as "first," "second," "top," "bottom," "side," "front," "back," and the like are words of convenience and are not to be construed as limiting terms. For example, while in some examples a first side is located adjacent or near a second side, the terms "first side" and "second side" do not imply any specific order in which the sides are ordered.

[0014] The terms "about," "approximately," "substantially," or the like, when accompanying a numerical value, are to be construed as indicating a deviation as would be appreciated by one of ordinary skill in the art to operate satisfactorily for an intended purpose. Ranges of values and/or numeric values are provided herein as examples only, and do not constitute a limitation on the scope of the disclosure. The use of any and all examples, or exemplary language ("e.g.," "such as," or the like) provided herein, is intended merely to better illuminate the disclosed examples and does not pose a limitation on the scope of the disclosure. The terms "e.g.," and "for example" set off lists of one or more non-limiting examples, instances, or illustrations. No language in the specification should be construed as indicating any unclaimed element as essential to the practice of the disclosed examples.

[0015] The term "and/or" means any one or more of the items in the list joined by "and/or." As an example, "x and/or y" means any element of the three-element set {(x), (y), (x, y)}. In other words, "x and/or y" means "one or both of x and y". As another example, "x, y, and/or z" means any element of the seven-element set {(x), (y), (z), (x, y), (x, z), (y, z), (x, y, z)}. In other words, "x, y, and/or z" means "one or more of x, y, and z."

[0016] Disclosed is a magnet fastener assembly configured to join a first component to a second component. In one example, a magnet fastener for attaching a first component to a second component via a magnet comprises: a magnet retainer, wherein the magnet retainer includes a basket structure and a post, wherein the basket structure is configured to flex and accommodate the magnet, and wherein the post is configured to receive a shank of a pin; and a clip feature coupled to the magnet retainer via a base and configured to couple to the first component.

[0017] In another example, a magnet fastener assembly for attaching a first component to a second component comprises: a pin having a head and a shank; a magnet; a magnet retainer, wherein the magnet retainer includes a basket structure and a post, wherein the basket structure is config-

ured to flex and accommodate the magnet, and wherein the post is configured to receive a shank of a pin; and a clip feature coupled to the magnet retainer via a base and configured to couple to the first component.

[0018] In yet another example, a magnet fastener assembly for attaching to a second component comprises: a magnet retainer that is integrated with a first component, wherein the magnet retainer includes a basket structure and a post, wherein the basket structure is configured to flex and accommodate the magnet, and wherein the post is configured to receive a shank of a pin; and a clip feature coupled to the magnet retainer via a base and configured to couple to the first component.

[0019] In some examples, the post is configured to engage the magnet via a central opening thereof.

[0020] In some examples, the basket structure is substantially concave and faces away from the base.

[0021] In some examples, the magnet fastener comprises a central aperture passing there through.

[0022] In some examples, the post and the basket structure are each generally circular and concentric relative to one another and to the central aperture.

[0023] In some examples, the basket structure comprises a plurality of wall segments and a plurality of gaps.

[0024] In some examples, each of the plurality of wall segments is an elongated, protruding curved structure that is connected at one end to the base and extends radially outward from a central axis of the magnet fastener.

[0025] In some examples, the basket structure is configured to enable the magnet to articulate about the post.

[0026] FIG. **1** illustrates a perspective assembly view of an example magnet fastener assembly **100** in accordance with an aspect of this disclosure. The illustrated magnet fastener assembly **100** is configured to form a blind connection between the first component **102** and the second component **104**. While only a single magnet fastener assembly **100** illustrated in the example, it should be appreciated that multiple fastening assemblies **100** may be used to couple a first component **102** to a second component **104**, depending on the number of fastener points needed between the first and second components **102**, **104**. For example, larger components and panels typically require multiple fastening points.

[0027] The first component **102** and the second component **104** may be, for example, automotive components. Depending on the application, the first component **102** and the second component **104** may be fabricated from, for example, metal (or a metal alloy), synthetic or semi-synthetic polymers (e.g., plastics, such as acrylonitrile butadiene styrene (ABS) and polyvinyl chloride (PVC), etc.), composite materials (e.g., fiber glass), or a combination thereof. In the automotive industry, example first components **102** include, without limitation, headliners, door trim panels, moldings, trim pieces, and other substrates. The second component **104** may be, for example, a structural component of a vehicle, such as the roof, doors, pillars (e.g., an A-pillar, B-pillar, C-pillar, etc.), dashboard components (e.g., a cross member, bracket, frame, etc.), seat frames, center consoles, fenders, sheet metal framework, or the like. In an example, the first component **102** is non-magnetic (e.g. non-ferrous) and the second component **104** is magnetic (e.g., ferrous).

[0028] The magnet fastener assembly **100** shown in the exemplary embodiment of FIG. **1** is suitable for use as a blind fastener to attach an automobile headliner to the interior side of a roof of a vehicle, for example. While the illustrated magnet fastener assembly **100** is used to form a blind connection between a vehicle headliner and the roof of a vehicle, it should be understood that the principles of the present disclosure can be used in fasteners of other types and for purposes other than fastening automobile components.

[0029] The magnet fastener assembly **100** generally comprises a magnet fastener **106**, a magnet **108** (illustrated as an annular magnet), and a pin **110**. The pin **110** comprises a head portion **110***a* and a shank **110***b*. As illustrated, the magnet **108** is connected to the magnet fastener **106** using a combination of a post **112** and the pin **110**. To that end, the shank **110***b* is sized and shaped to pass through an opening **108***a* form in the magnet **108** to engage the magnet fastener **106** via a central aperture **116**. As will be discussed, the magnet fastener **106** can connect to the magnet **108** for connection to another component, while allowing the magnet **108** to tilt relative to the post **112** of the magnet fastener **106**.

[0030] The magnet fastener assembly **100** is attached to second component **104** magnetically via the magnet **108** coupled thereto at the magnet retainer **114** and attached to the first component **102** via the clip feature **118** using, for example and depending on the material type, adhesive (e.g., glue), a mechanical feature (e.g., clips, a doghouse interface, etc.), or even a second magnet. While the post **112** is configured to secure the magnet **108** to the magnet fastener **106**, the strength of the magnet **108** (when connected to the second component **104**) may exceed the retention force of the post **112** alone. To address this, the pin **110** increases the retention force of the magnet **108** relative to the magnet fastener **106** to secure the magnet **108** in the magnet retainer **114**.

[0031] FIGS. **2***a* and **2***b* illustrate, respectively, top and bottom perspective views of the magnet fastener **106** used in the magnet fastener assembly **100**. FIGS. **2***c* through **2***f* illustrate, respectively, first, second, third, and fourth side views of the magnet fastener **106**, while FIGS. **2***g* and **2***h* illustrate, respectively, top and bottom plan views of the magnet fastener **106**. The illustrated magnet fastener **106** generally comprises the magnet retainer **114** joined to a clip feature **118** via a base **202**. The magnet retainer **114**, the clip feature **118**, and the base **202** can be a unitary structure (e.g., a single monolithic body). The base **202** is substantially circular, although other shapes and configurations also can be used. The magnet fastener **106** defines the central aperture **116** that passes between the magnet retainer **114** and the clip feature **118** and is configured to receive a shank **110***b* of the pin **110**. The clip feature **118** generally comprises plate **204** spaced from the base **202** via a stem **206**. The plate **204** is attached to the first component **102**.

[0032] The magnet fastener **106** can be made from various materials, including synthetic or semi-synthetic polymers (e.g., plastics, such as acrylonitrile butadiene styrene (ABS) and polyvinyl chloride (PVC), etc.), composite materials (e.g., fiber glass), metal (or a metal alloy), or a combination thereof. In one example, the magnet fastener **106** can be fabricated via mold tooling and a plastic-injection molding process. In another example, the magnet fastener **106** can be a printed thermoplastic material component that can be printed with great accuracy and with numerous details, which is particularly advantageous, for example, in creating components requiring complex and/or precise features.

[0033] Additive manufacturing techniques obviate the need for mold tooling typically associated with plastic injection molding, thereby lowering up-front manufacturing costs, which is particularly advantageous in low-volume productions. In some examples, components of the fastener assembly **100** may be fabricated using material extrusion (e.g., fused deposition modeling (FDM), stereolithography (SLA), selective laser sintering (SLS), material jetting, binder jetting, powder bed fusion, directed energy deposition, VAT photopolymerisation, and/or any other suitable type of additive manufacturing/3D printing process.

[0034] The magnet retainer **114** generally comprises the post **112** and a basket structure **208**. The illustrated basket structure **208** is substantially concave and faces away from the base **202**. In the illustrated example, the post **112** and the basket structure **208** are each generally circular and concentric relative to one another and to the central aperture **116**.

[0035] The basket structure **208** comprises a plurality of a plurality of wall segments **210** and a plurality of gaps **212**. Each of the plurality of wall segments **210** can be an elongated, protruding curved structure connected at one end to the base **202** and extending radially outward from the central axis **220** of the magnet fastener **106**. In the illustrated example, adjacent wall segments **210** are separated by a gap **212**, creating a segmented, flexible basket structure **208** that allows for compression and deformation. While six wall segments **210** and six gaps **212** are shown, additional or fewer wall segments **210** and gaps **212** may be employed based on, for example, needs and requirements around assembly and performance. Thus, the number of gaps **212** and wall segments **210** can vary depending on application and/or the size of the basket structure **208**.

[0036] The gaps **212** provide flexibility and enable the basket structure **208** to cup and to adapt to varying shapes and sizes of the magnet **108**. The cupping afforded by the concave shape of the basket structure **208** also enables the magnet **108** to articulate about the post **112** within a cavity of the basket structure **208** during assembly with the second component **104**. For example, the second component **104** may not align perfectly with the magnet **108** during assembly; however, to address this, the magnet **108** can articulate (e.g., tilt, pivot, etc.) about the post **112** to effectively conform to the surface of the second component **104**. In addition, the flexible nature of the basket structure **208** mitigates vibrations and thus mitigates buzz, squeak and rattle (BSR). Accordingly, the described basket structure **208** obviates the need for a seal or other dampening component such that the magnet **108** can be coupled directly to the magnet fastener **106**. Omitting the seal and other dampening components reduces cost, complexity, and weight.

[0037] The post **112** is defined substantially centrally in basket structure **208** and projects outwardly from the basket structure **208** relative to base **202**. During assembly, the magnet **108** slides over the post **112** and into the cavity of the basket structure **208**. The gaps **212** enable the wall segments **210** to flex and accommodate the magnet **108**.

[0038] The post **112** is hollow (i.e., to provide the central aperture **116**) and includes one or more substantially axial slots **214** on diametrically opposite sides to thereby separate the post **112** into opposed legs **216**. As illustrated, a distal portion of each leg **216** defines an outward protuberance **218** that collectively forms the widest portion of post **112**. The protuberances **218** in the exemplary embodiment are comprised of single segments each spanning the outer surface of legs **216**, respectively. However, it should be understood that protuberances **218** can be narrower than the full width of legs **216** or can be comprised of two or more segments on each leg **216**. From protuberances **218** the distal portion of post **112** angles or tapers radially inwardly.

[0039] The pin **110** includes a substantially cylindrical shank **110***b*, as seen most clearly in FIG. **1**. In the manufactured condition of magnet fastener **106**, during the molding or other formation of magnet fastener **106**, pin **110** is aligned with and connected within the axial opening **116** through hollow post **112**. Pin **110** is connected within basket structure **208** by one or more engagement features. Accordingly, as manufactured, magnet fastener **106** is a single, integral unit.

[0040] The magnet fastener assembly **100** is secured to a headliner or the like by placing the plate **204** against the first component **102** (e.g., a substrate of the headliner) and attaching it with glue or the like. The glue or other adhesive can pass through openings or channels in plate **204** to adhere and physically lock the plate **204** against the first component **102**. In a known manner, foam can be applied over the headliner material or substrate and around the plate **204**.

[0041] The magnet **108** is illustrated as an annular or doughnut-like magnetic body of a size to fit within the basket structure **208**. The magnet **108** has a central opening **108***a*, which is retained relative to the post **112** and basket structure **208** via protuberances **218**. The magnet **108** is attached to magnet fastener **106** by inserting a distal end of post **112** into central opening **108***a* and pushing the magnet **108** along post **112** and over protuberances **218**.

[0042] The tapered configuration of post **112** between the protuberances **218** and the distal end assists in locating the magnet **108** on the post **112**, and in aligning the magnet **108** for proper insertion on the post **112**. The tapered configuration further assists in deflecting the legs **216** as necessary for passing the magnet **108** fully and completely onto post **112**. Since the post **112** is hollow, with slots **214** on opposite sides thereof, individual legs **216** are deflected inwardly so that the protuberances **218** will pass through the opening **108***a*. Upon the protuberances **218** passing fully through the opening **108***a*, legs **216** rebound outwardly such that protuberances **218** overlap adjacent the opening **108***a*.

[0043] To lock the magnet **108** in proper position on post **112**, the pin **110** is pushed into distal regions of the post **112**. In the as-manufactured condition, pin **110** is aligned with the axial opening **116** extending through hollow post **112**. The pin **110** can be pushed by hand or mechanically to position the pin **110** into the post **112** to a blocking position between and adjacent legs **216** whereby legs **216** are restricted from inward deflection. Mechanical pushing the pin **110** to advance the pin **110** into the post **112** can be accomplished with a pusher that is forced against the pin **110** and advanced through the aperture **116** before the plate **204** is connected to the first component **102**. With pin **110** inserted into post **112**, legs **216** cannot be deflected inwardly and are retained in the outward position with protuberances **218**. Accordingly, the magnet **108** is locked in position on post **112**.

[0044] The magnet **108** can be fitted on post **112** somewhat loosely. Accordingly, magnet **108** can tilt on post **112** in any direction, thereby allowing magnet **108** to align for substantially flush engagement against the second component **104** for a firm connection of magnet fastener assembly **100**. Further, during installation or use magnet **108** can tilt

slightly relative to each other to accommodate pushing force exerted there against without fracturing.

[0045] FIG. **3** illustrates a perspective view of an example integrated magnet fastener assembly **300** (e.g., integrated with the first component **102**) in accordance with another aspect of this disclosure. While the magnet fastener **106** has been described as a separate component that is attached to the first component **102**, the magnet fastener **106** (or a portion thereof) may instead be integrated with the first component **102**, for example, as part of an additive manufacturing or plastic-injection molding process. In this example, the need for the clip feature **118** and base **202** would be obviated. By way of illustration, with reference to FIG. **3**, the first component **102** can be fabricated with an integrated post **112** and integrated basket structure **208** to form an integrated magnet fastener assembly **300**.

[0046] The above-cited patents and patent publications are hereby incorporated by reference in their entirety. While the present method and/or system has been described with reference to certain implementations, it will be understood by those skilled in the art that various changes may be made, and equivalents may be substituted without departing from the scope of the present method and/or system. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the present disclosure without departing from its scope. For example, block and/or components of disclosed examples may be combined, divided, re-arranged, and/or otherwise modified. Therefore, the present method and/or system are not limited to the particular implementations disclosed. Instead, the present method and/or system will include all implementations falling within the scope of the appended claims, both literally and under the doctrine of equivalents.

What is claimed:

1. A magnet fastener for attaching a first component to a second component via a magnet, the magnet fastener comprising:

a magnet retainer, wherein the magnet retainer includes a basket structure and a post,

wherein the basket structure is configured to flex and accommodate the magnet, and

wherein the post is configured to receive a shank of a pin; and

a clip feature coupled to the magnet retainer via a base and configured to couple to the first component.

2. The magnet fastener of claim **1**, wherein the post is configured to engage the magnet via a central opening thereof.

3. The magnet fastener of claim **1**, wherein the basket structure is substantially concave and faces away from the base.

4. The magnet fastener of claim **1**, wherein the magnet fastener comprises a central aperture passing there through.

5. The magnet fastener of claim **4**, wherein the post and the basket structure are each generally circular and concentric relative to one another and to the central aperture.

6. The magnet fastener of claim **1**, wherein the basket structure comprises a plurality of wall segments and a plurality of gaps.

7. The magnet fastener of claim **6**, wherein each of the plurality of wall segments is an elongated, protruding curved structure that is connected at one end to the base and extends radially outward from a central axis of the magnet fastener.

8. The magnet fastener of claim **1**, wherein the basket structure is configured to enable the magnet to articulate about the post.

9. A magnet fastener assembly for attaching a first component to a second component, the magnet fastener assembly comprising:

a pin having a head and a shank;

a magnet;

a magnet retainer, wherein the magnet retainer includes a basket structure and a post,

wherein the basket structure is configured to flex and accommodate the magnet, and

wherein the post is configured to receive a shank of a pin; and

a clip feature coupled to the magnet retainer via a base and configured to couple to the first component.

10. The magnet fastener assembly of claim **9**, wherein the post is configured to engage the magnet via a central opening thereof.

11. The magnet fastener assembly of claim **9**, wherein the basket structure is substantially concave and faces away from the base.

12. The magnet fastener assembly of claim **9**, wherein the magnet fastener comprises a central aperture passing there through.

13. The magnet fastener assembly of claim **12**, wherein the post and the basket structure are each generally circular and concentric relative to one another and to the central aperture.

14. The magnet fastener assembly of claim **9**, wherein the basket structure comprises a plurality of wall segments and a plurality of gaps.

15. The magnet fastener assembly of claim **14**, wherein each of the plurality of wall segments is an elongated, protruding curved structure that is connected at one end to the base and extends radially outward from a central axis of the magnet fastener.

16. The magnet fastener assembly of claim **9**, wherein the basket structure is configured to enable the magnet to articulate about the post.

17. A magnet fastener assembly for attaching to a second component, the magnet fastener assembly comprising:

a magnet retainer that is integrated with a first component, wherein the magnet retainer includes a basket structure and a post,

wherein the basket structure is configured to flex and accommodate the magnet, and

wherein the post is configured to receive a shank of a pin; and

a clip feature coupled to the magnet retainer via a base and configured to couple to the first component.

18. The magnet fastener assembly of claim **17**, wherein the basket structure is substantially concave and faces away from the base.

19. The magnet fastener assembly of claim **17**, wherein the basket structure comprises a plurality of wall segments and a plurality of gaps.

20. The magnet fastener assembly of claim **19**, wherein each of the plurality of wall segments is an elongated, protruding curved structure that is connected at one end to the base and extends radially outward from a central axis of the magnet fastener.

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