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Hamilton

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(54) **PASSIVELY ILLUMINATED FIBER OPTIC REFLEX SIGHTS FOR FIREARMS**

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(73) Assignee: **Sturm, Ruger & Company, Inc.**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 17 days.

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(22) Filed: **Jun. 6, 2022**

(65) **Prior Publication Data**

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Related U.S. Application Data

(60) Provisional application No. 63/197,855, filed on Jun. 7, 2021.

(51) **Int. Cl.**
F41G 1/30 (2006.01)

(52) **U.S. Cl.**
CPC ***F41G 1/30*** (2013.01)

(58) **Field of Classification Search**
CPC F41G 1/30
USPC 42/113
See application file for complete search history.

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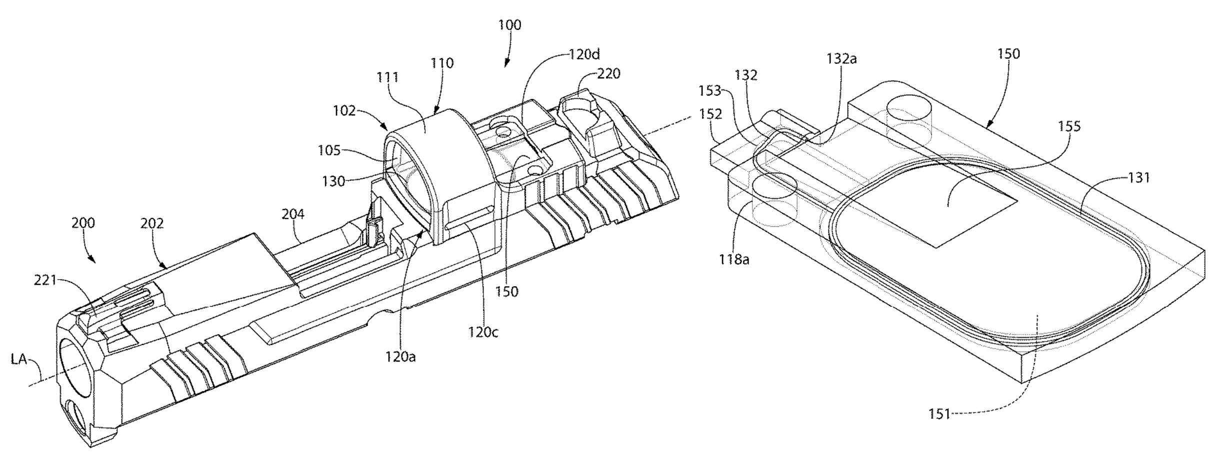
(74) *Attorney, Agent, or Firm* — The Belles Group, P.C.

(57) **ABSTRACT**

A passively and naturally illuminated optical reflex sighting system for a firearm in one embodiment includes a housing configured for detachable coupling to the firearm and comprising a plurality of light collection and transmission windows, an optical lens supported by the housing, a fiber optic element, and a light-transmissible cover enclosing the fiber optic element. The cover and fiber optic element are in visual communication with the housing windows which collect and transmit ambient light to the fiber optic element through the cover. The fiber optic element may be disposed inside and protected by the cover which may be clear. In operation, the fiber optic element absorbs ambient light and generates a reticle on the lens for aiming the firearm. A red or other colored dot reticle may be projected on the lens in some embodiments. No onboard artificial light is used to illuminate the fiber optic element.

30 Claims, 29 Drawing Sheets



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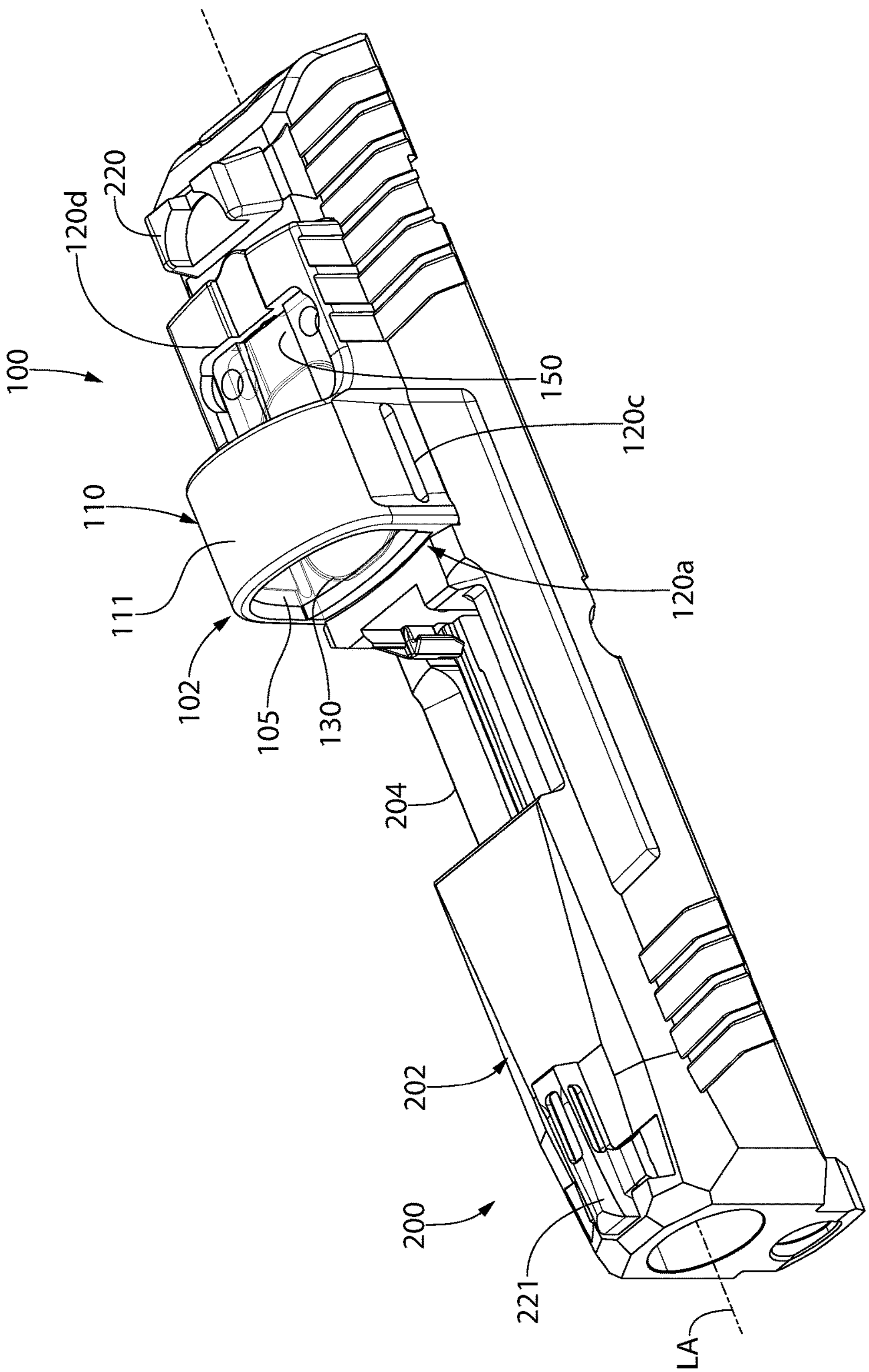

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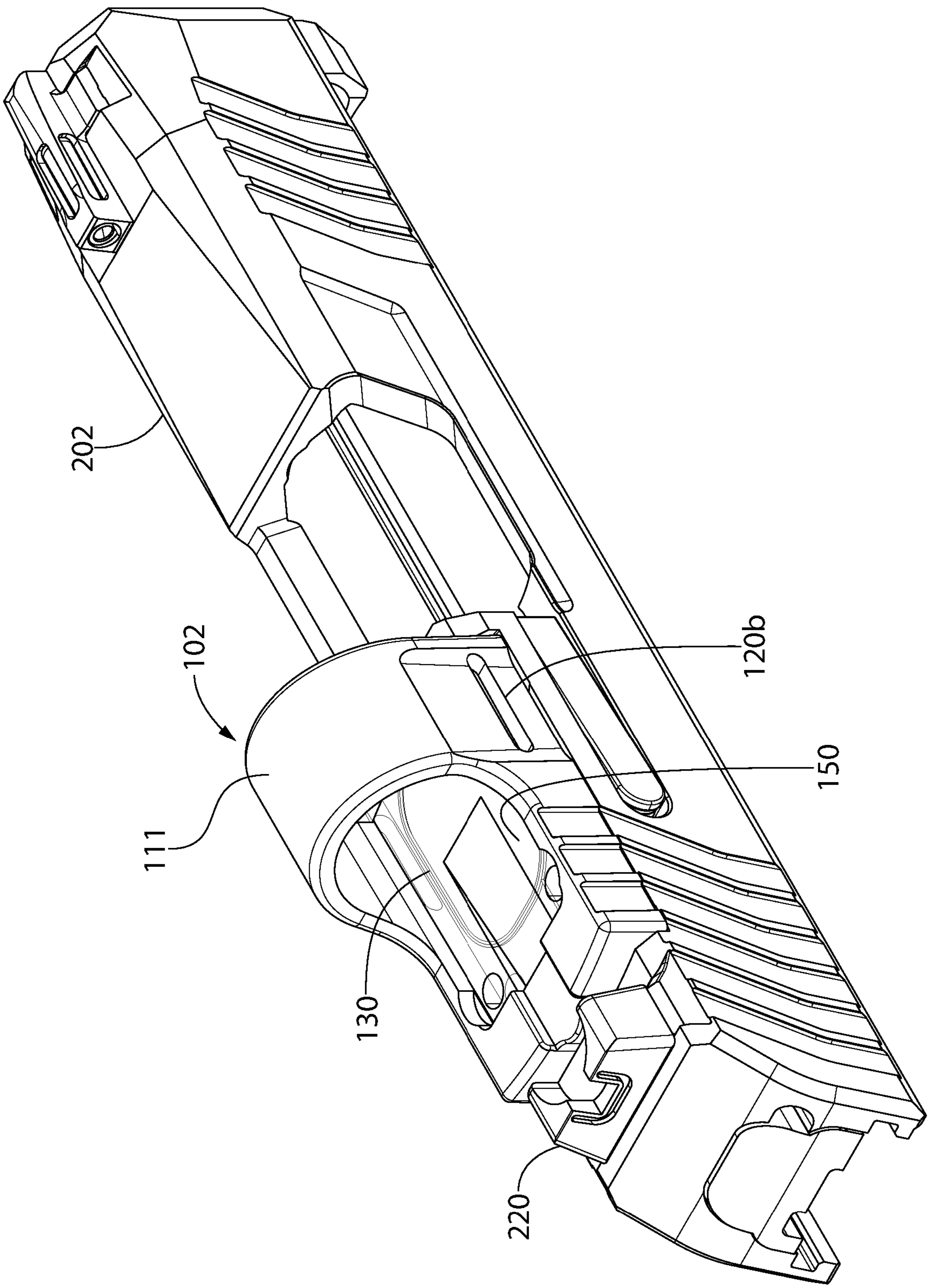
FIG. 1



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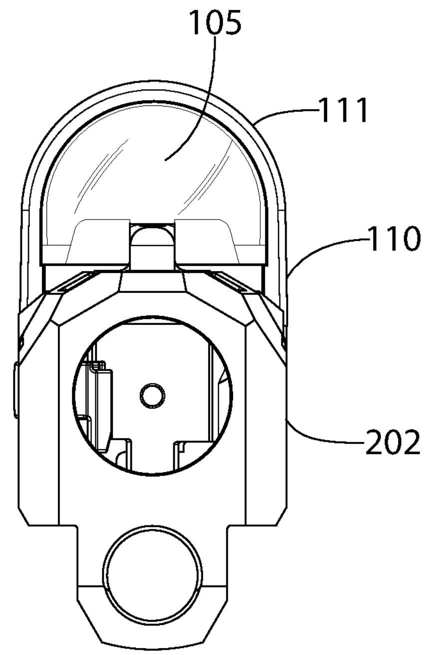

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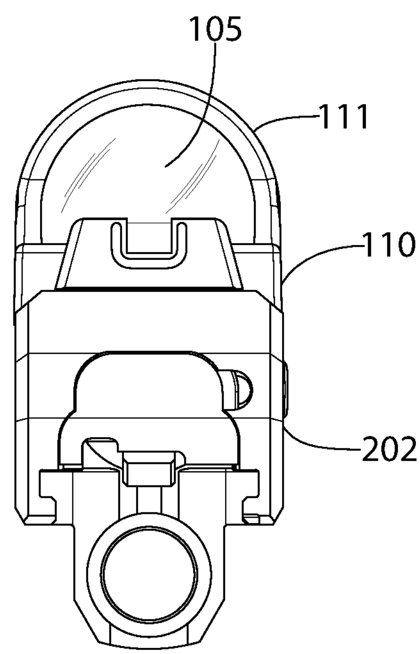

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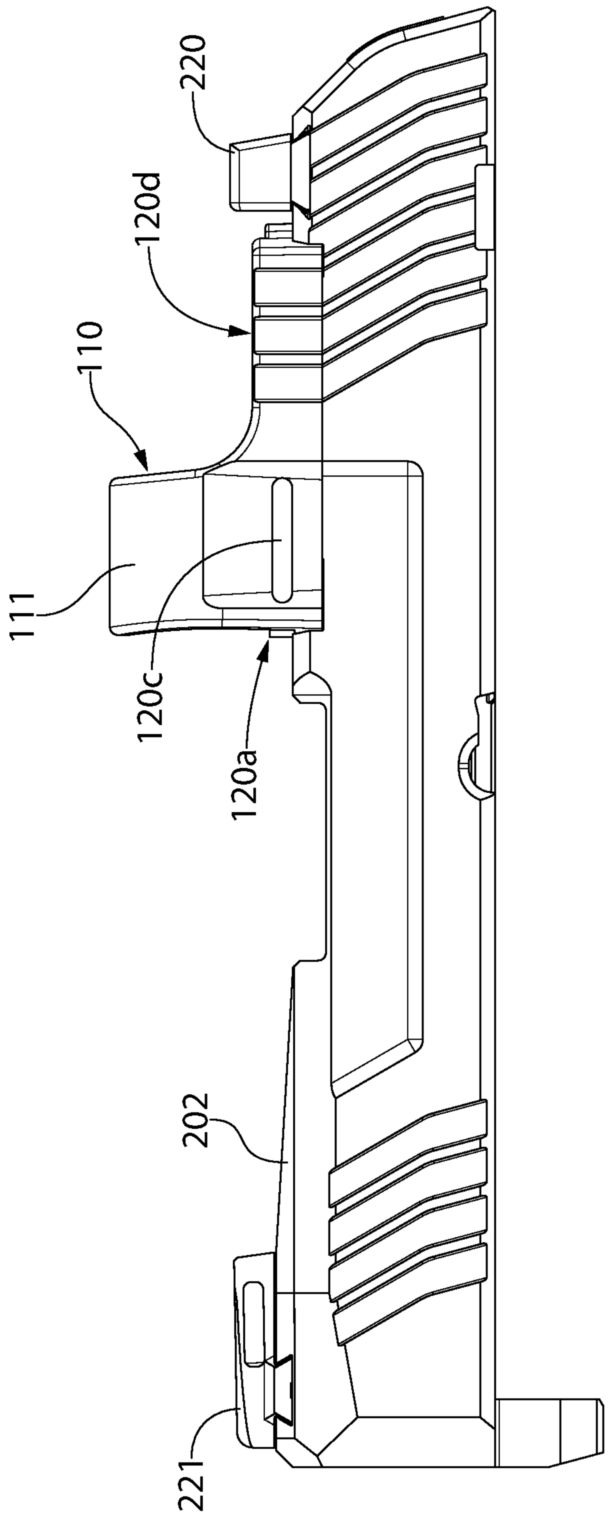

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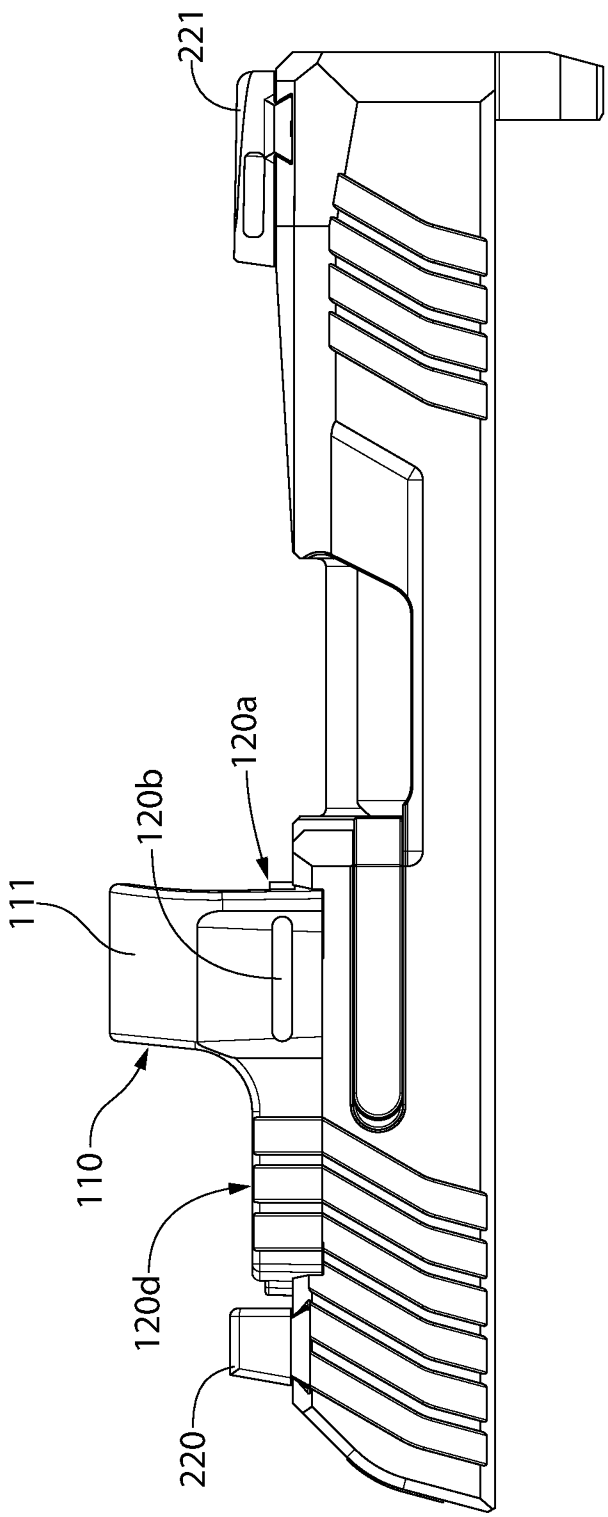

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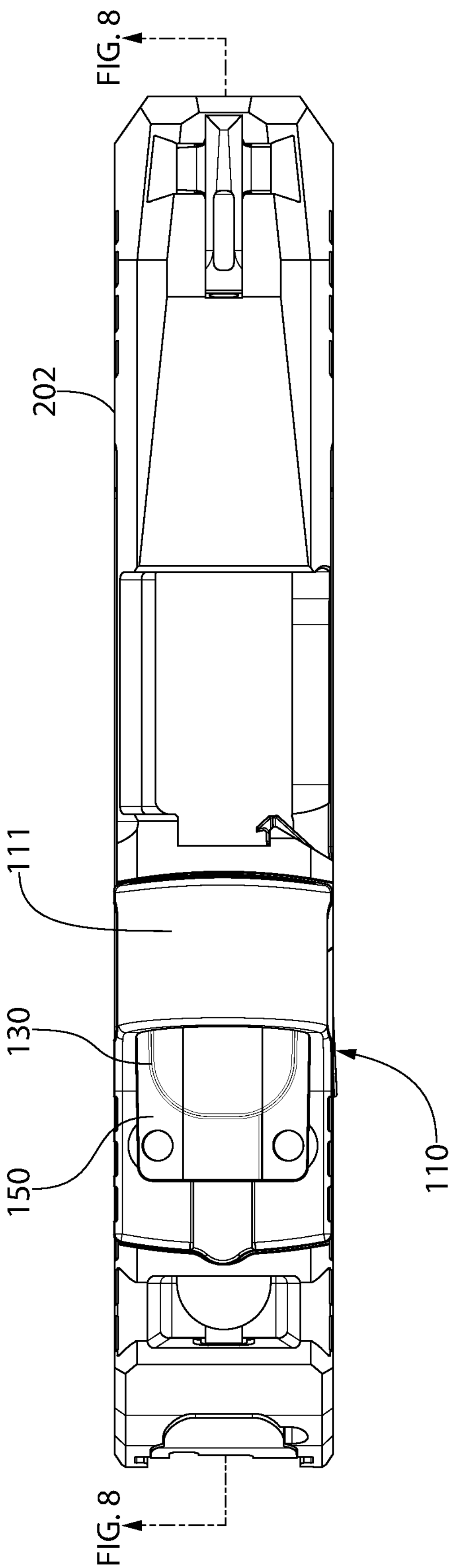

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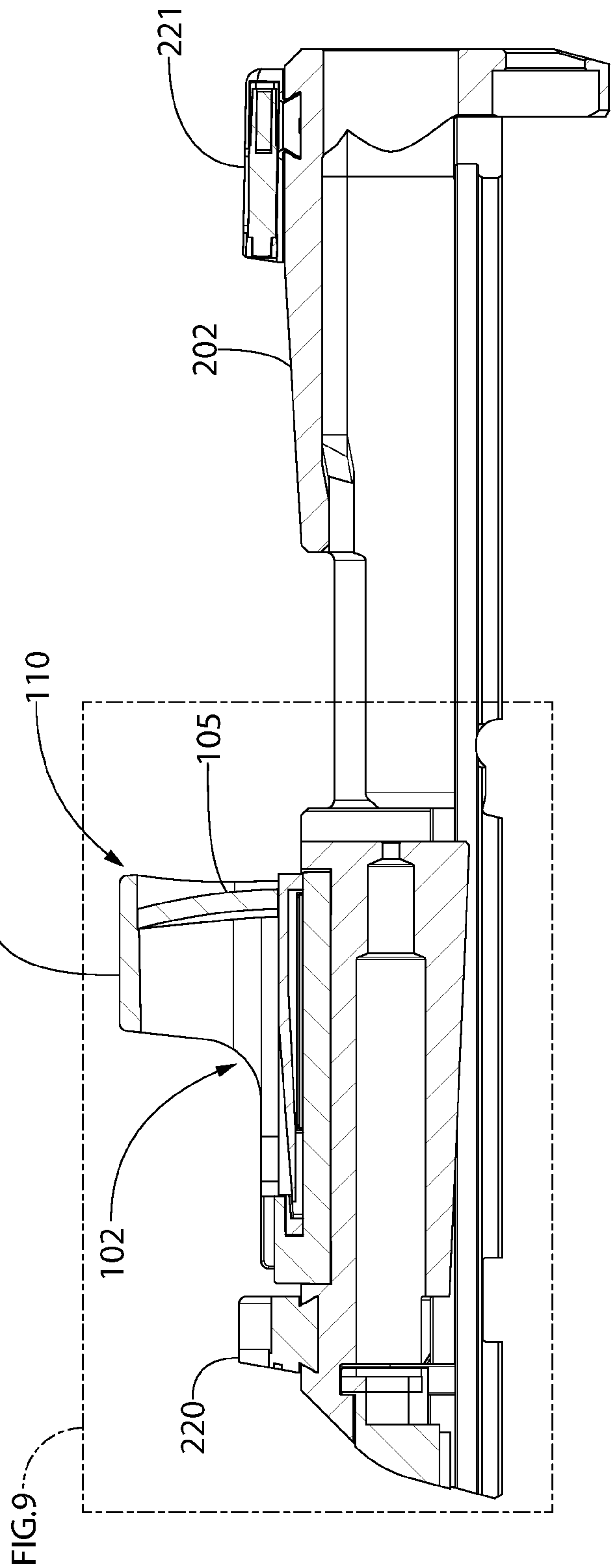

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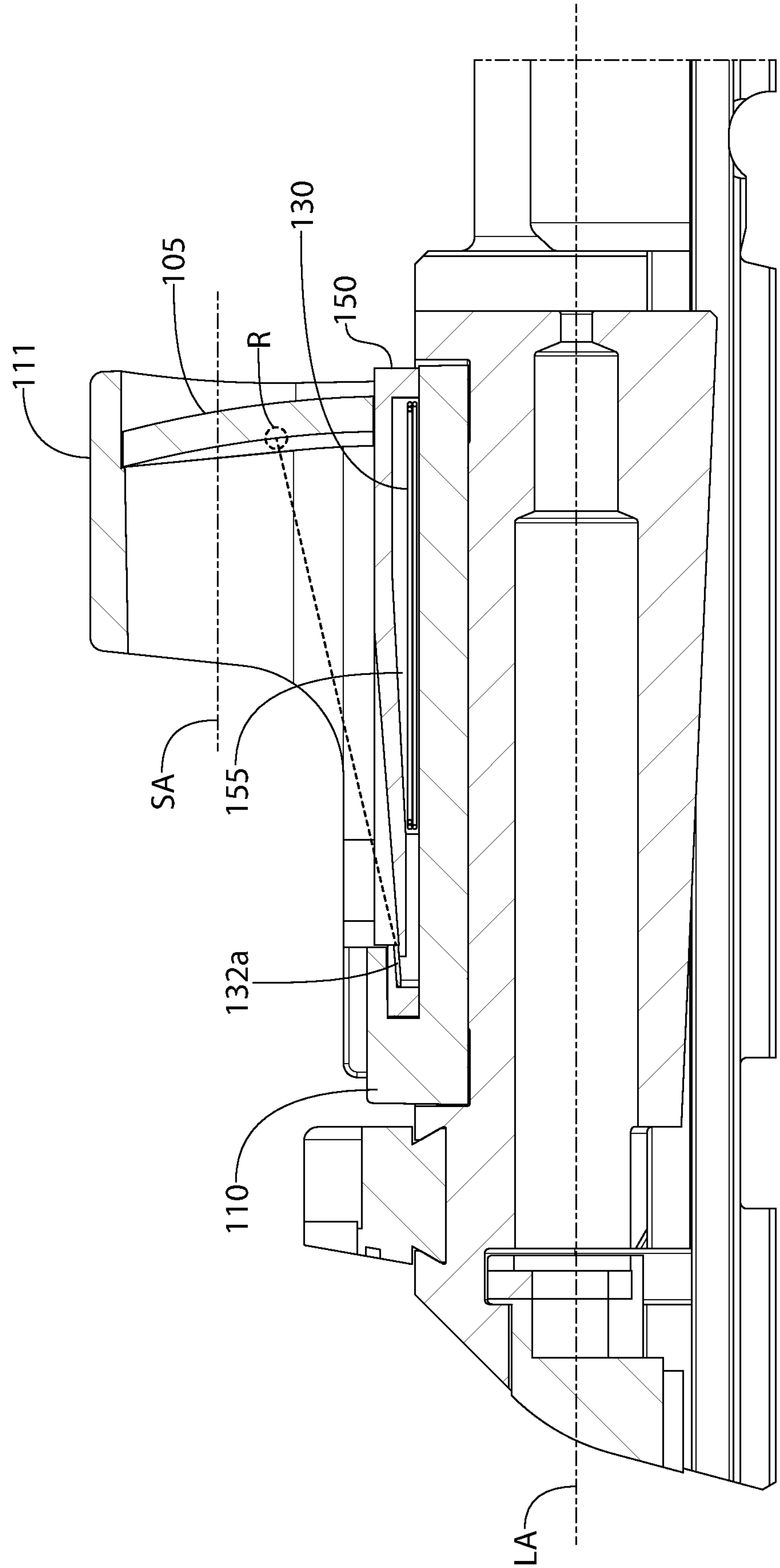

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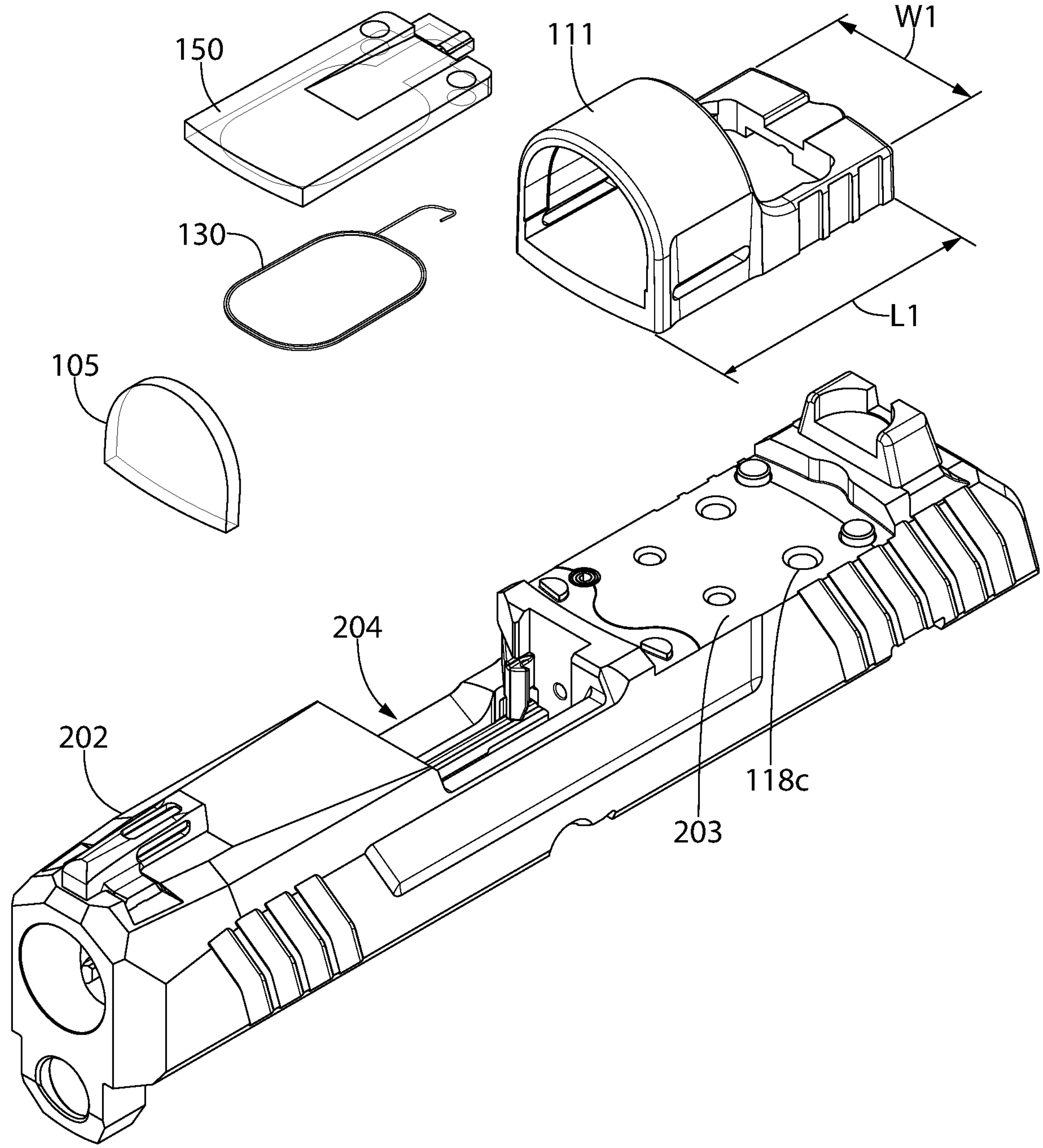

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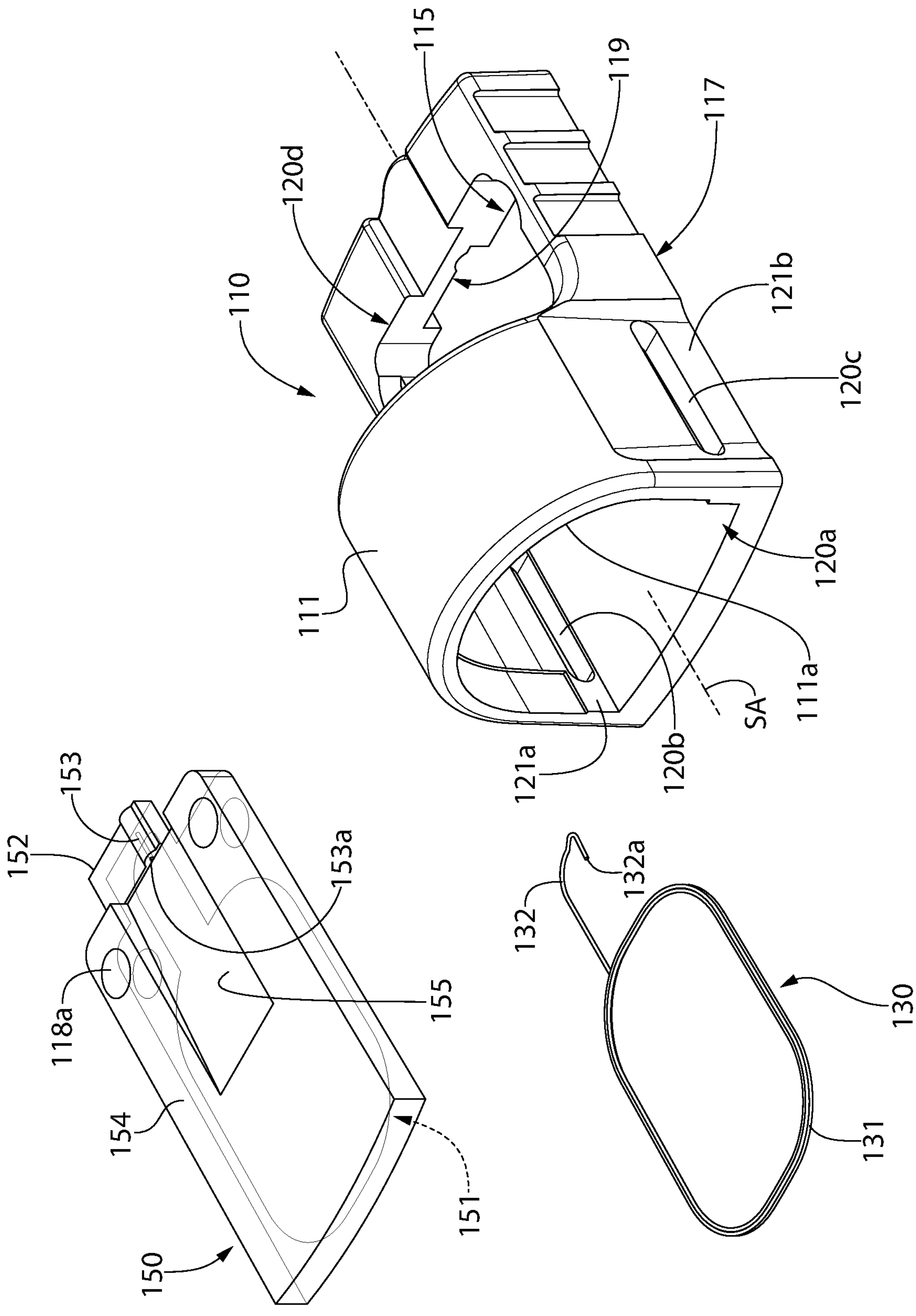
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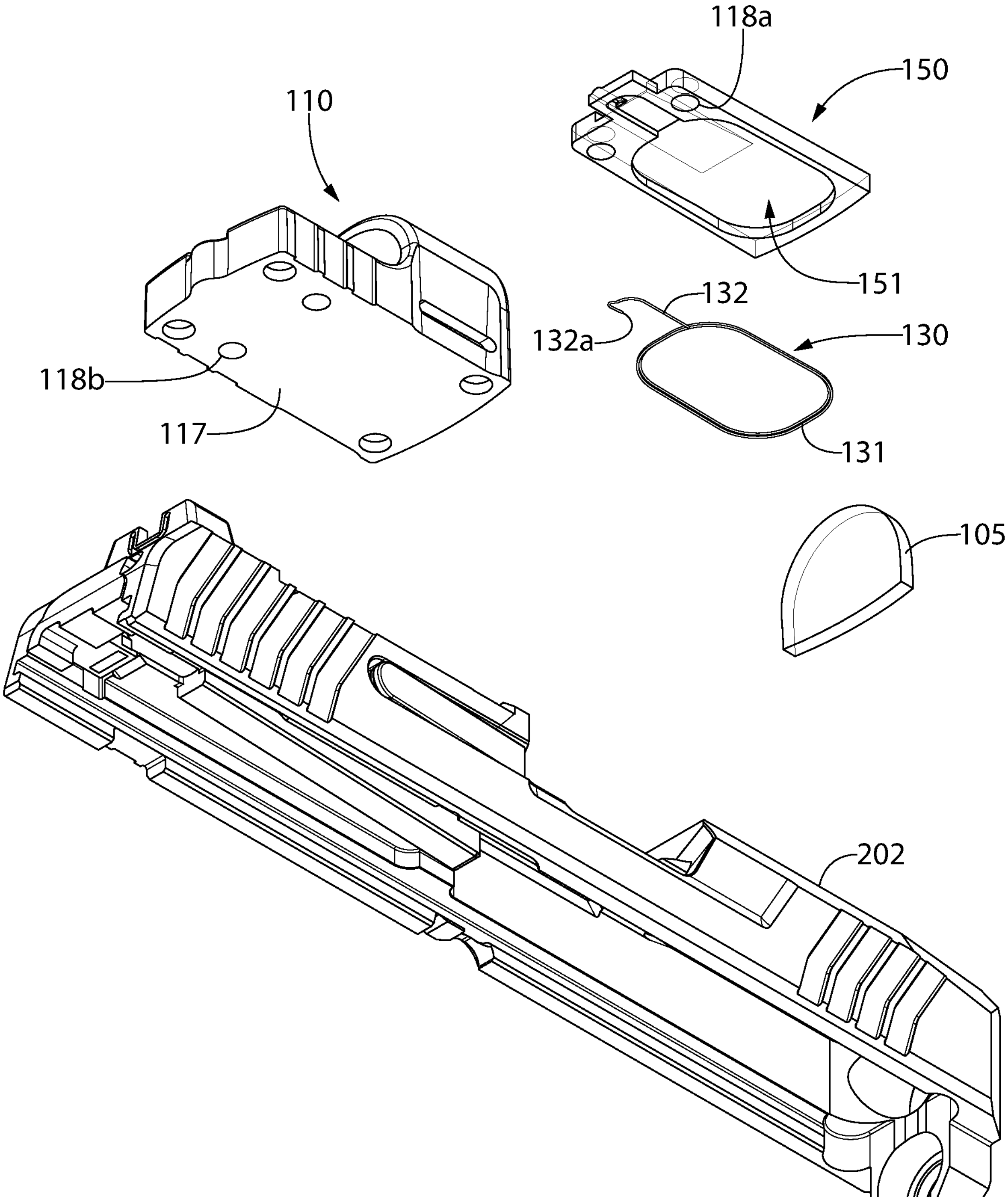

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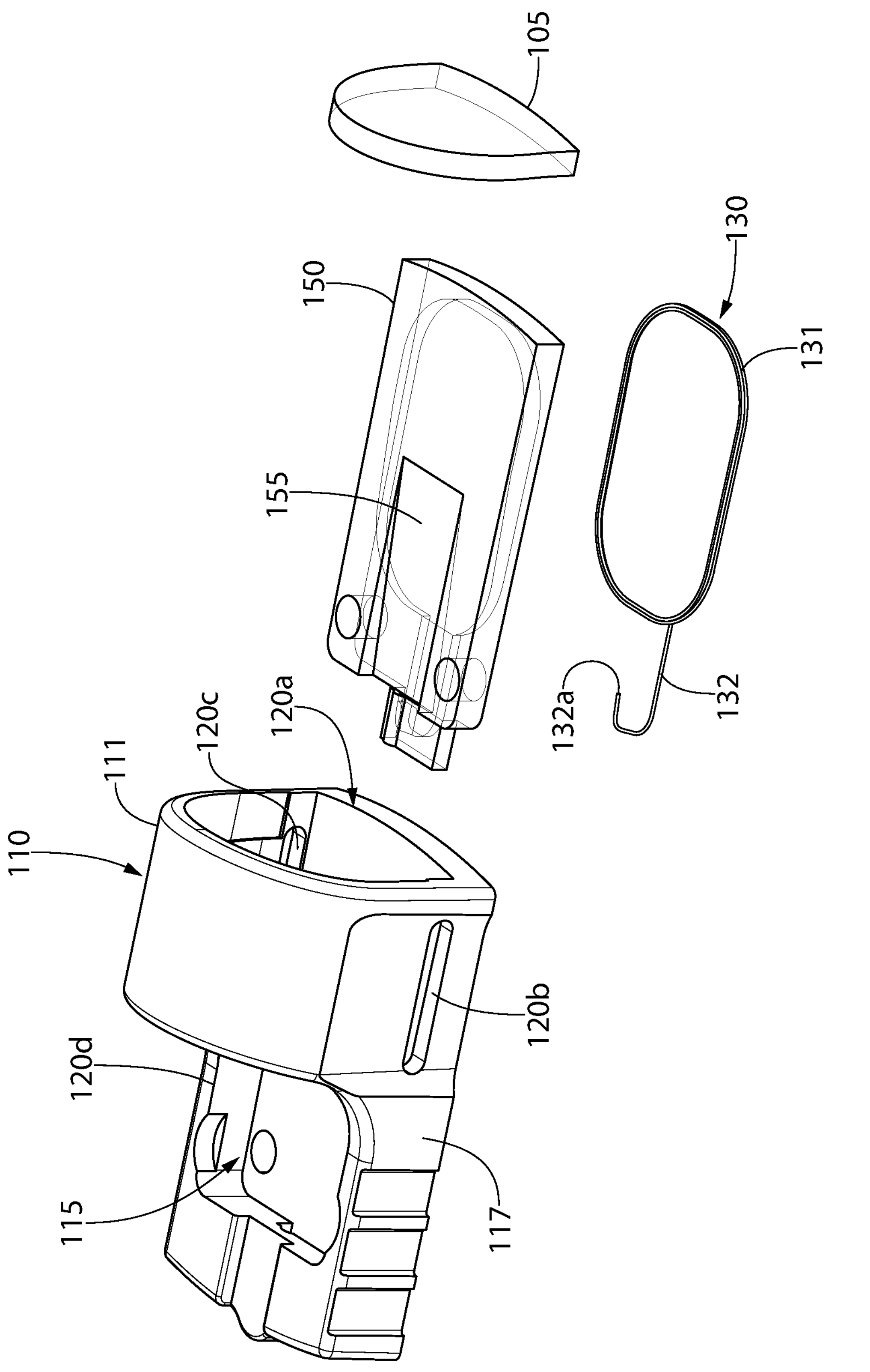

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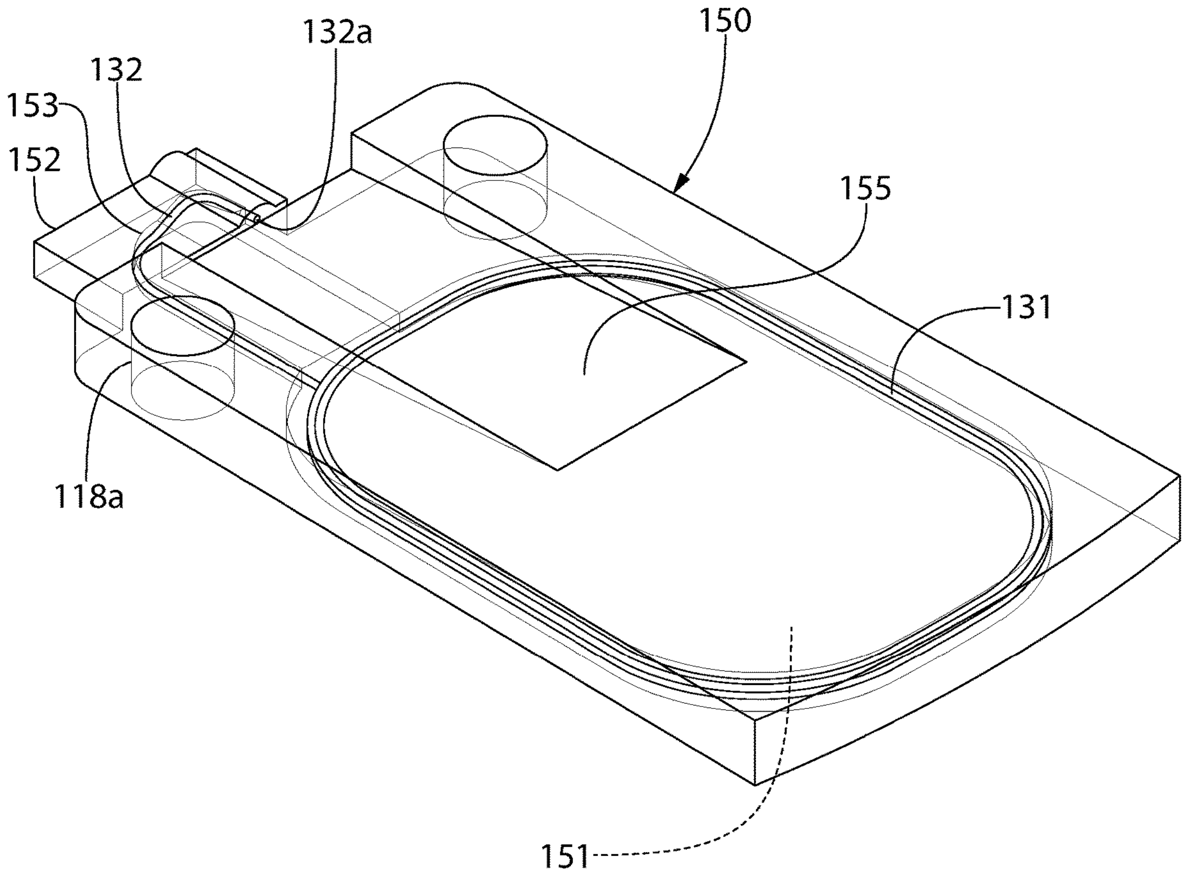

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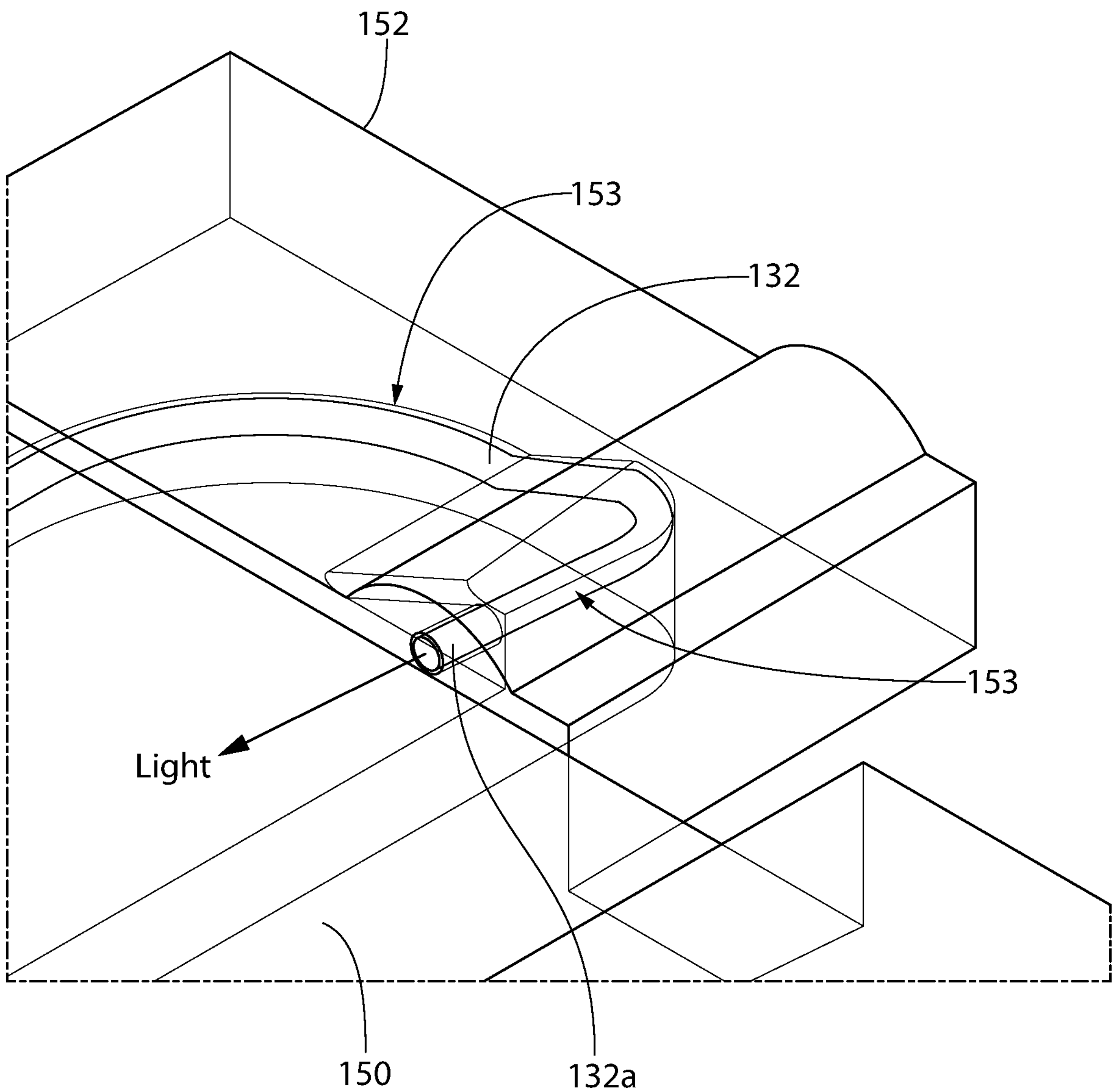

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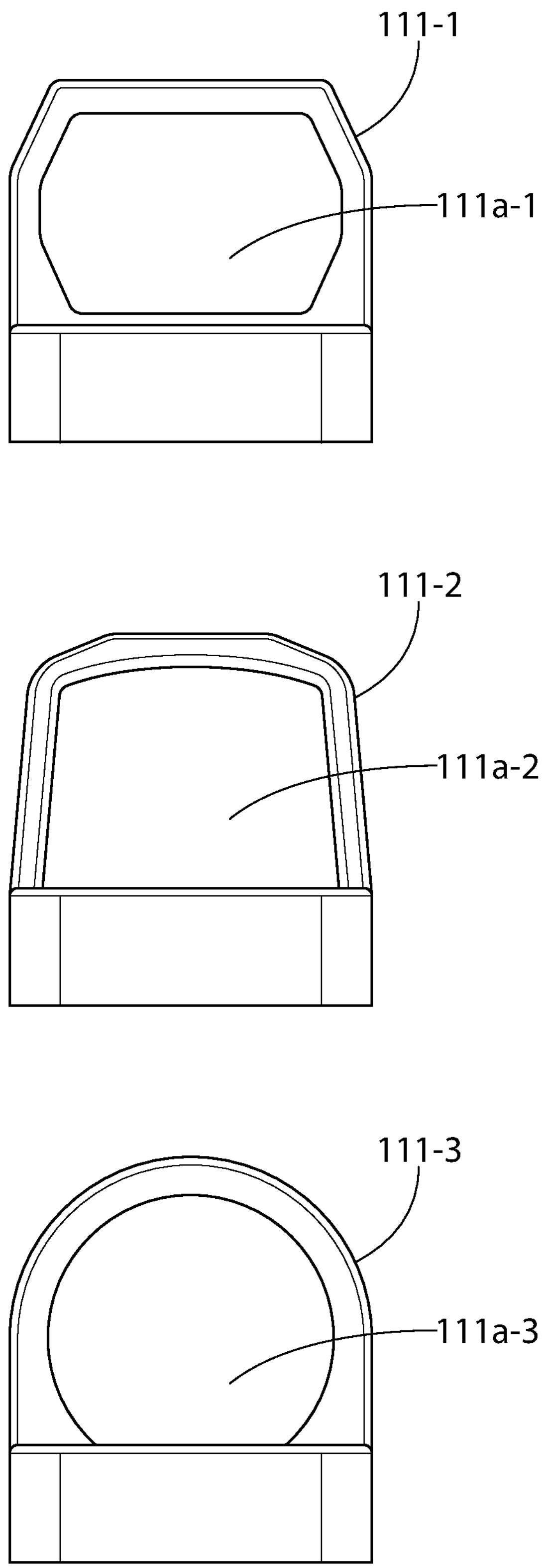

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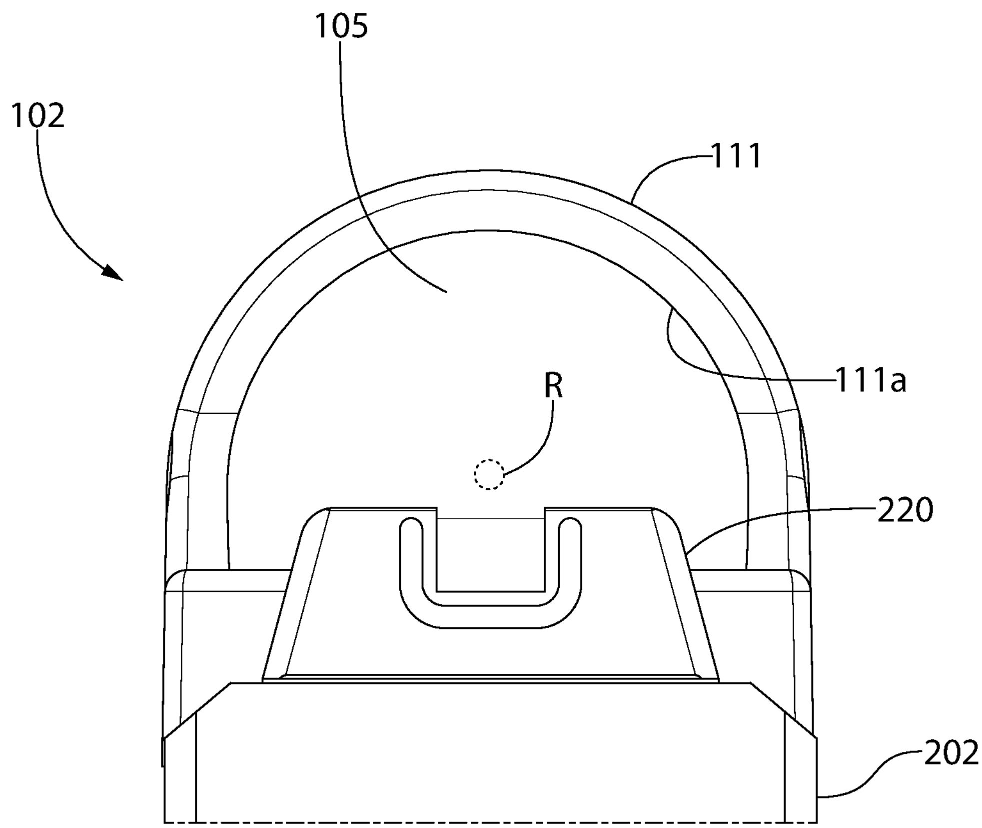

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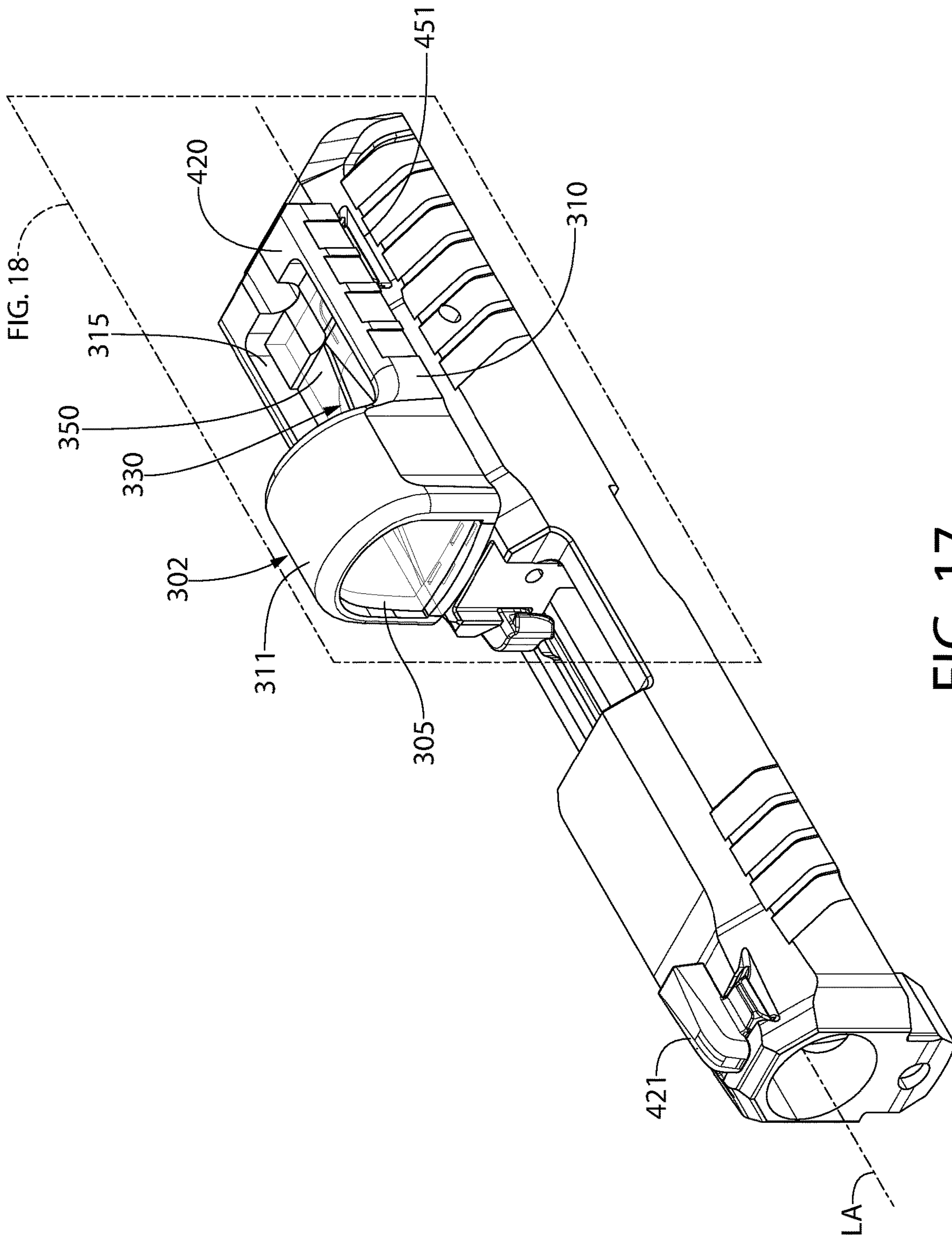

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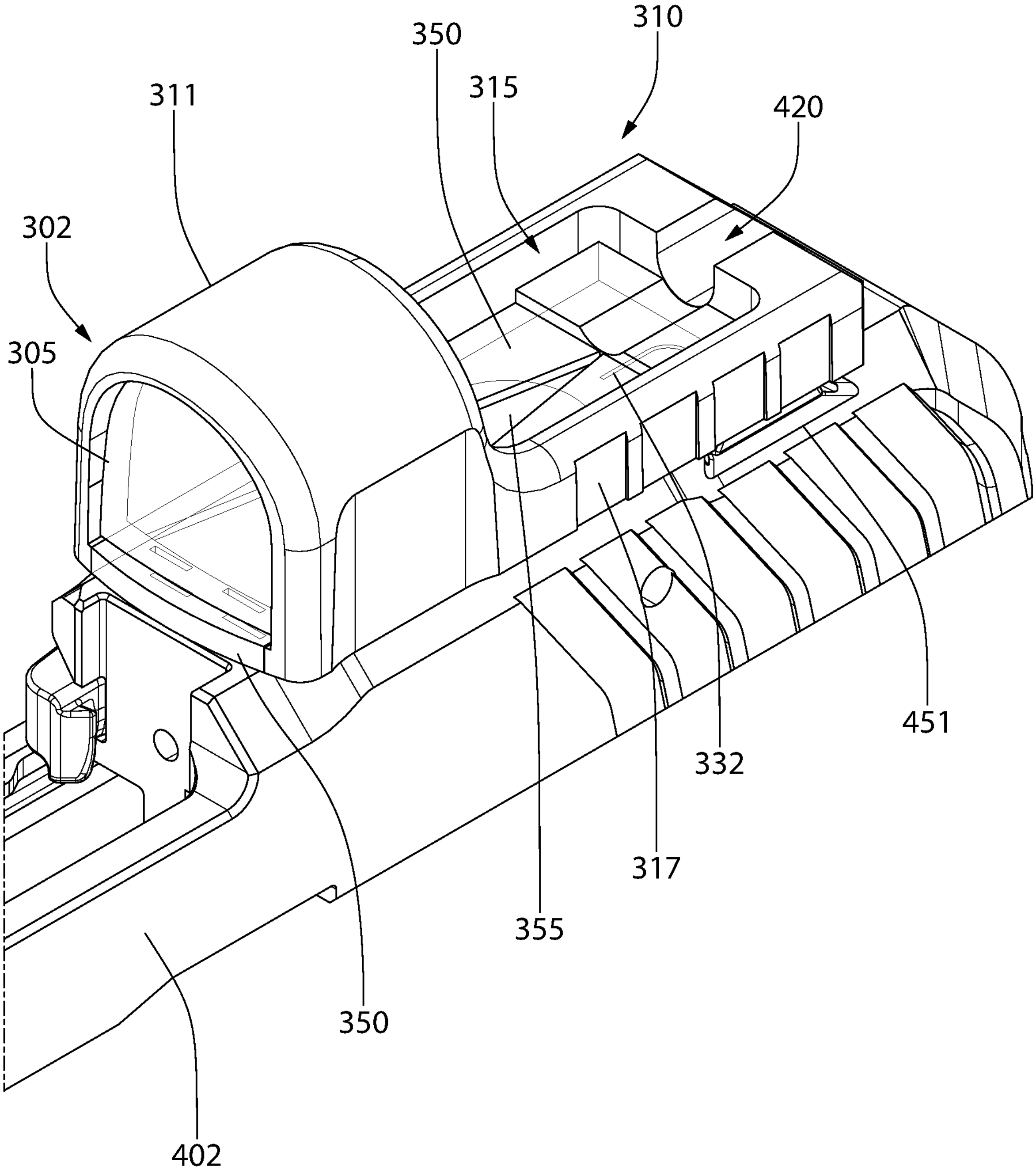

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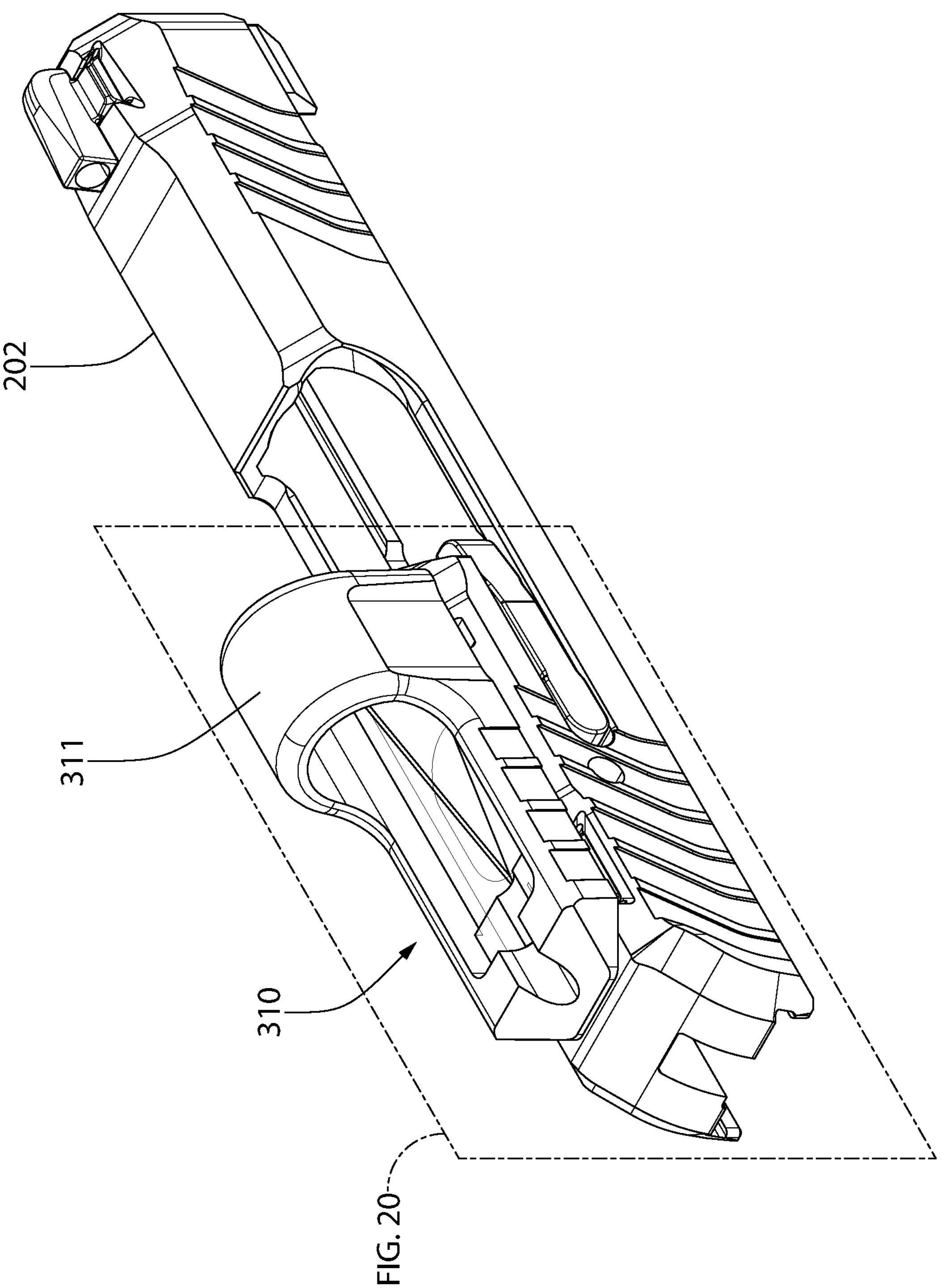

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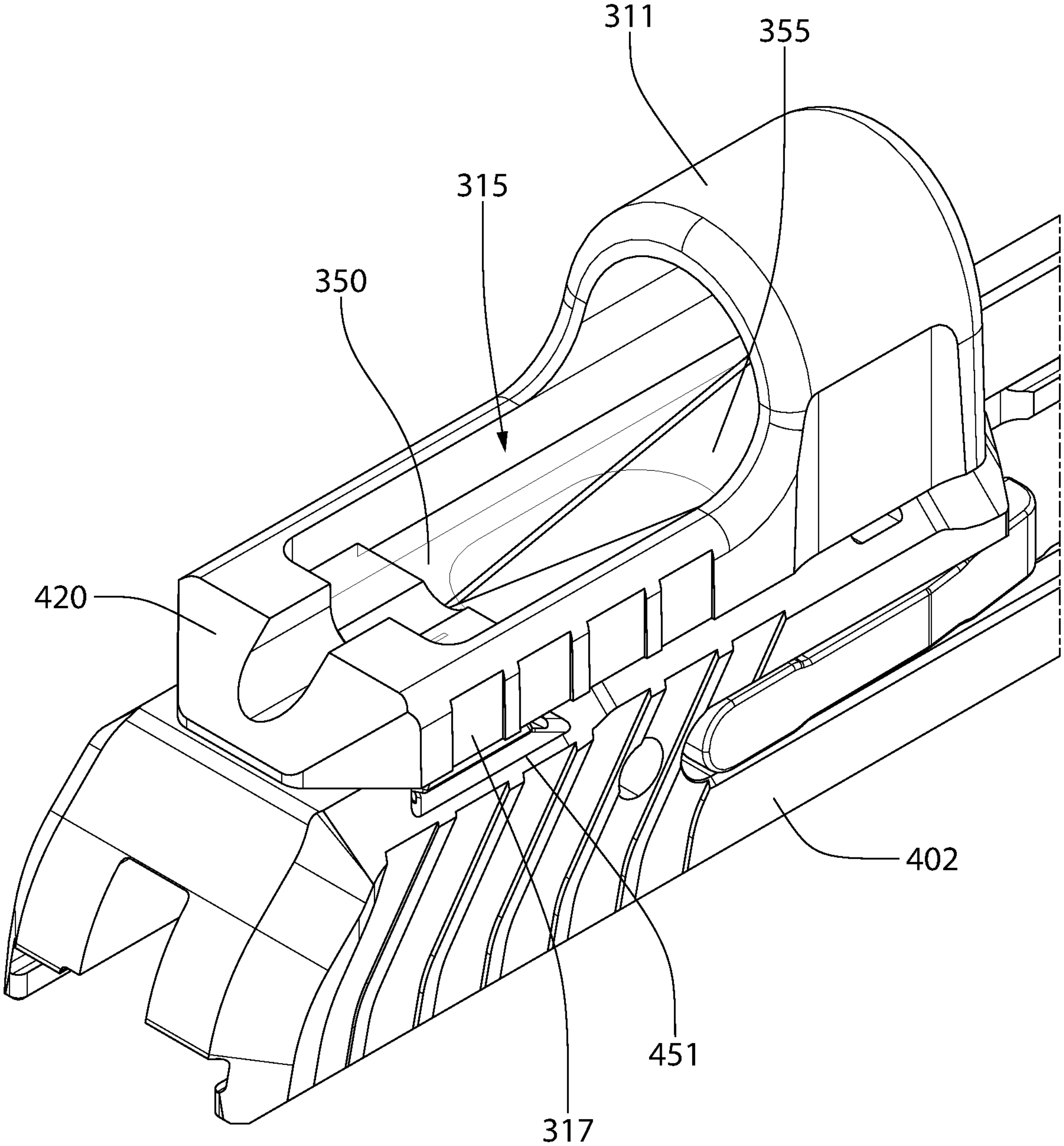

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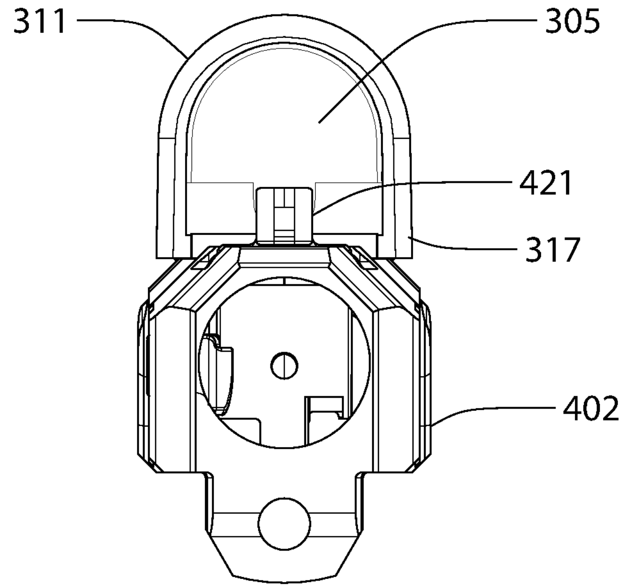

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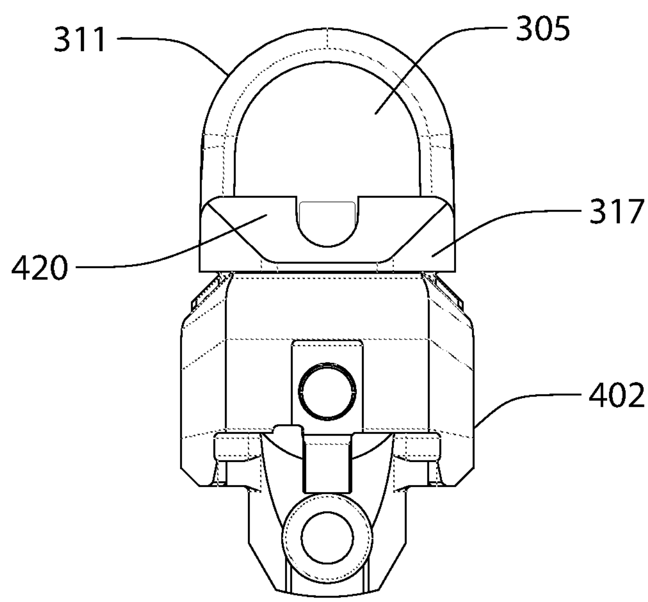

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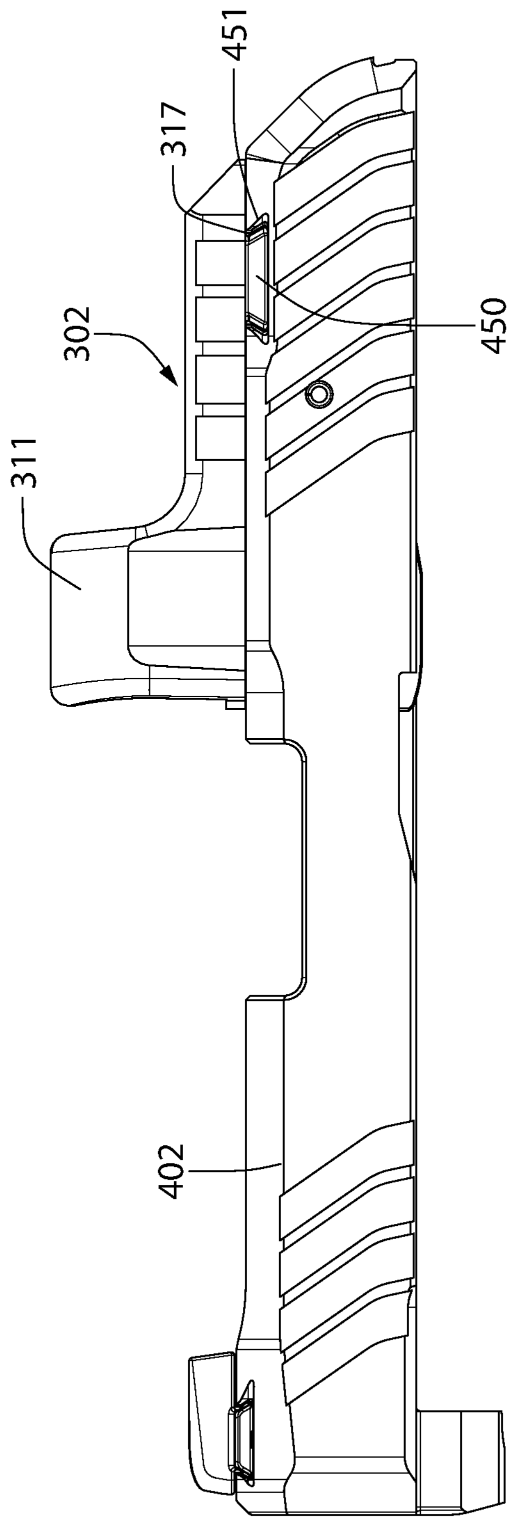

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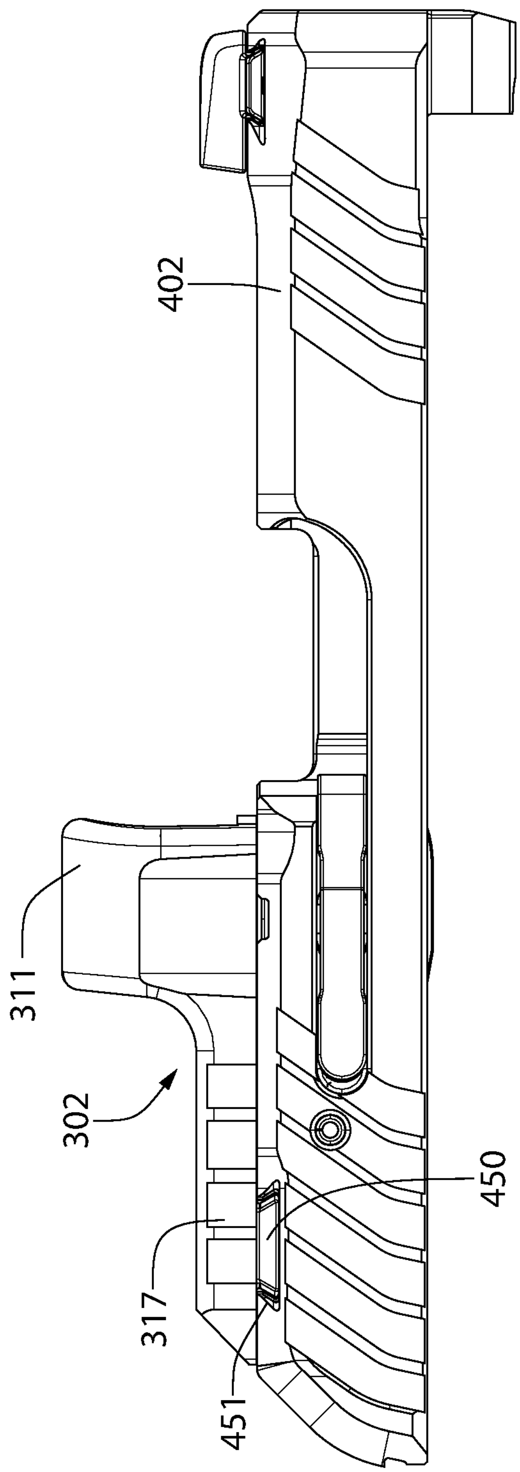

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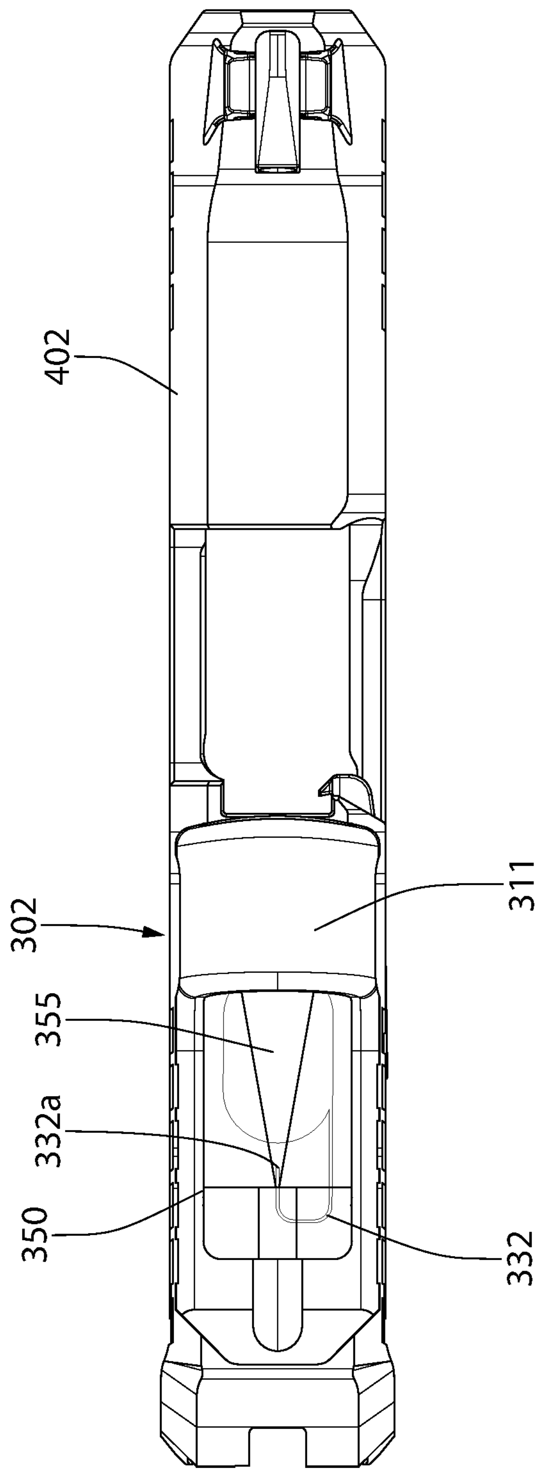

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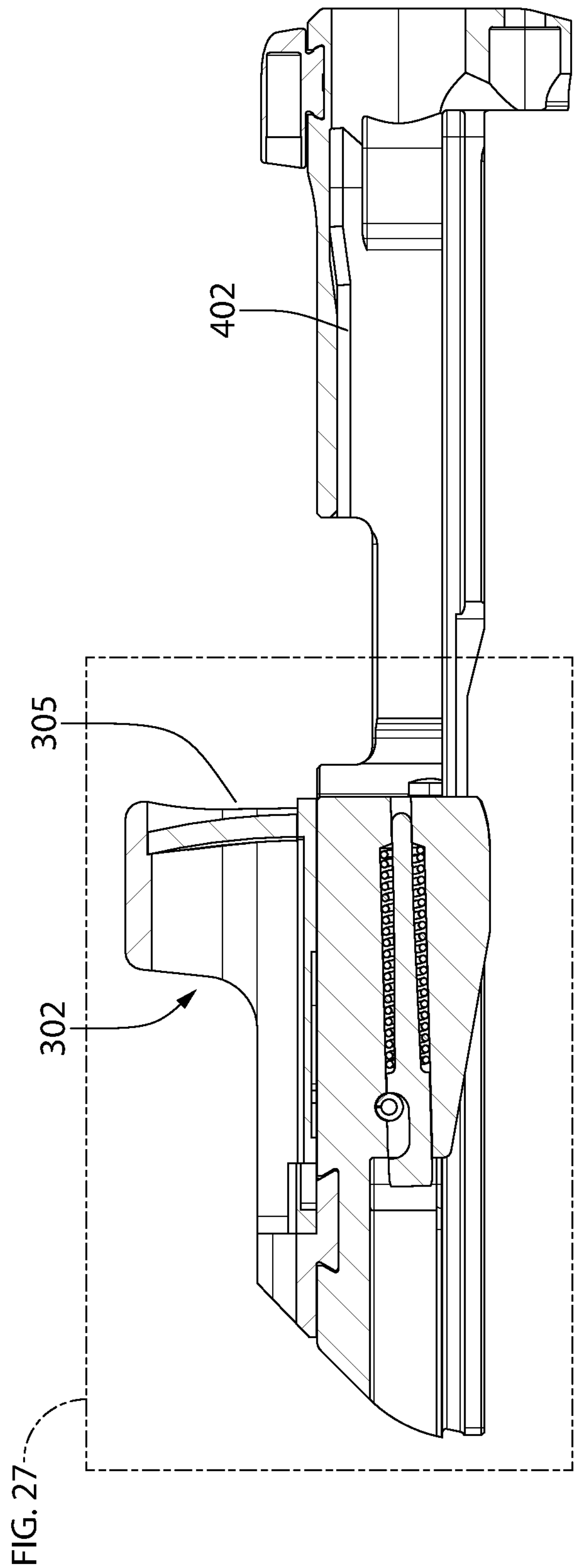

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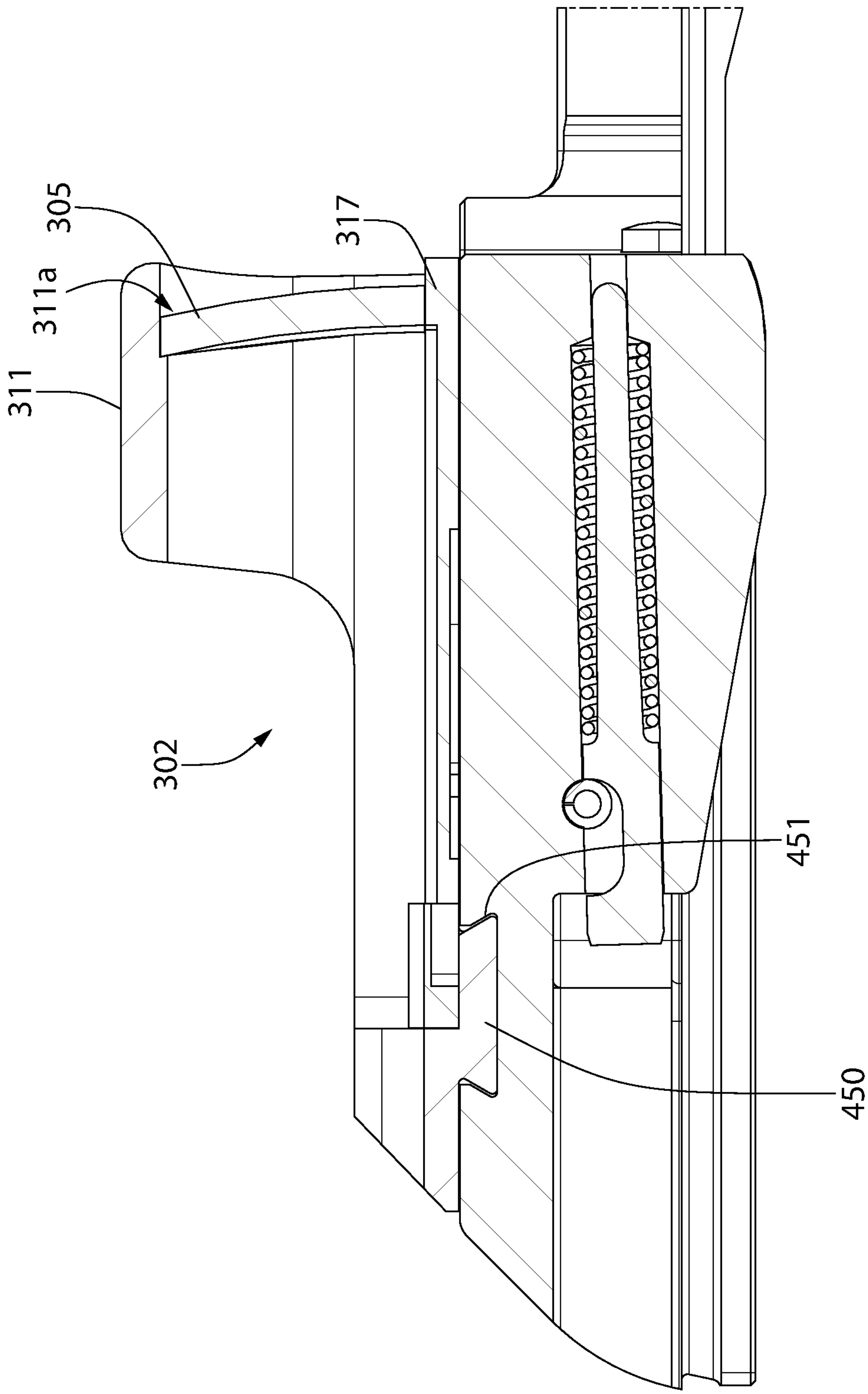

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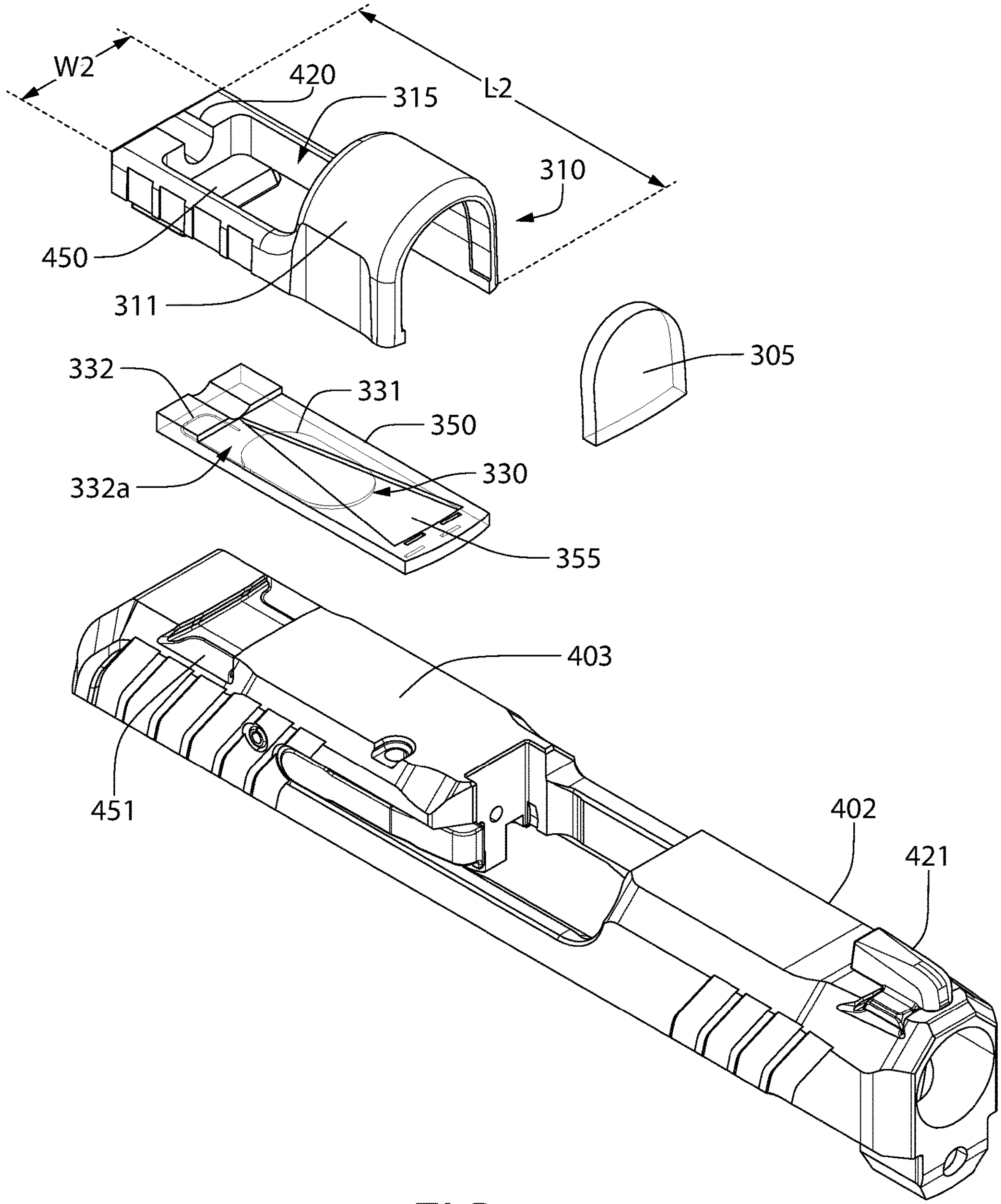
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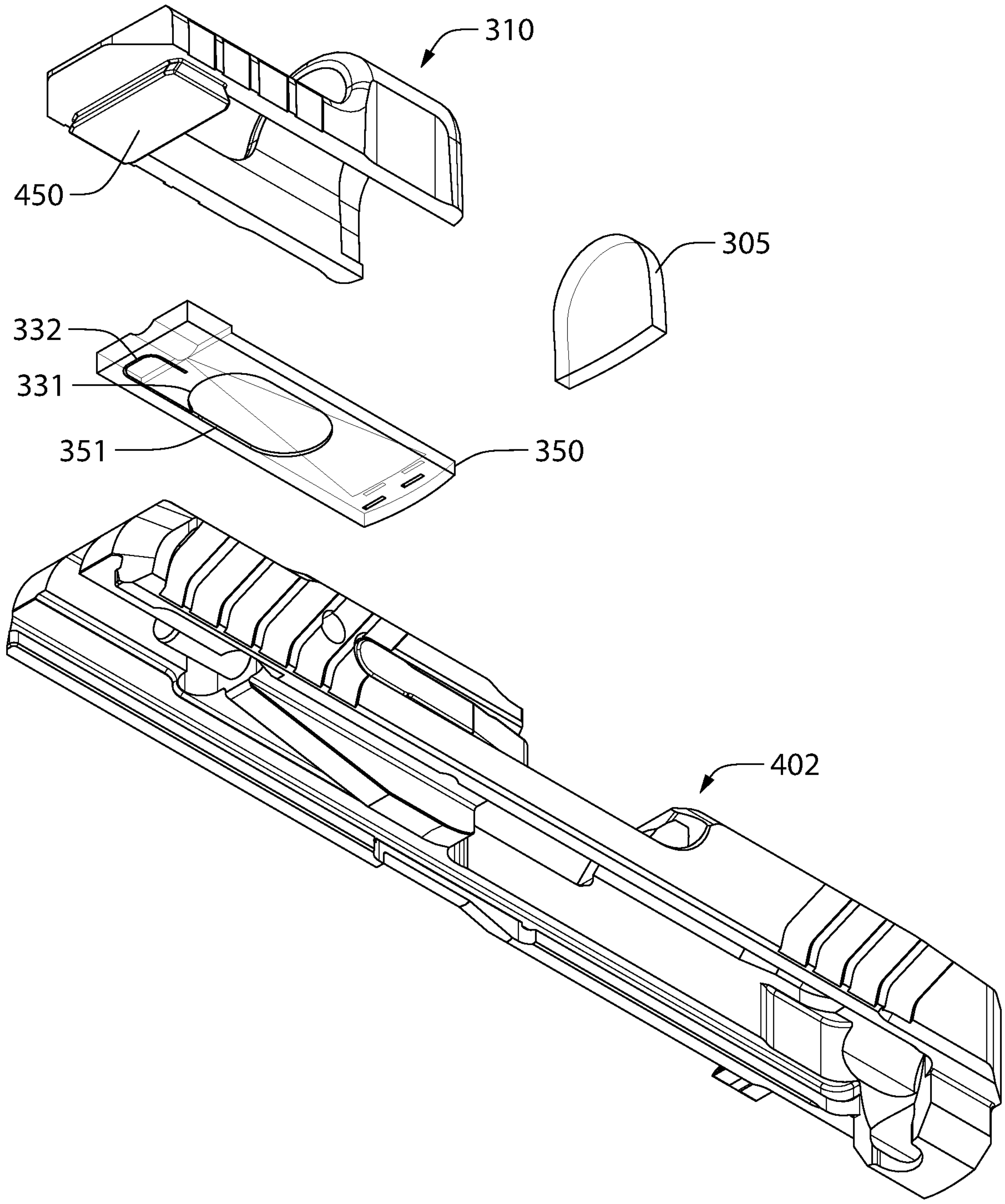
FIG. 28



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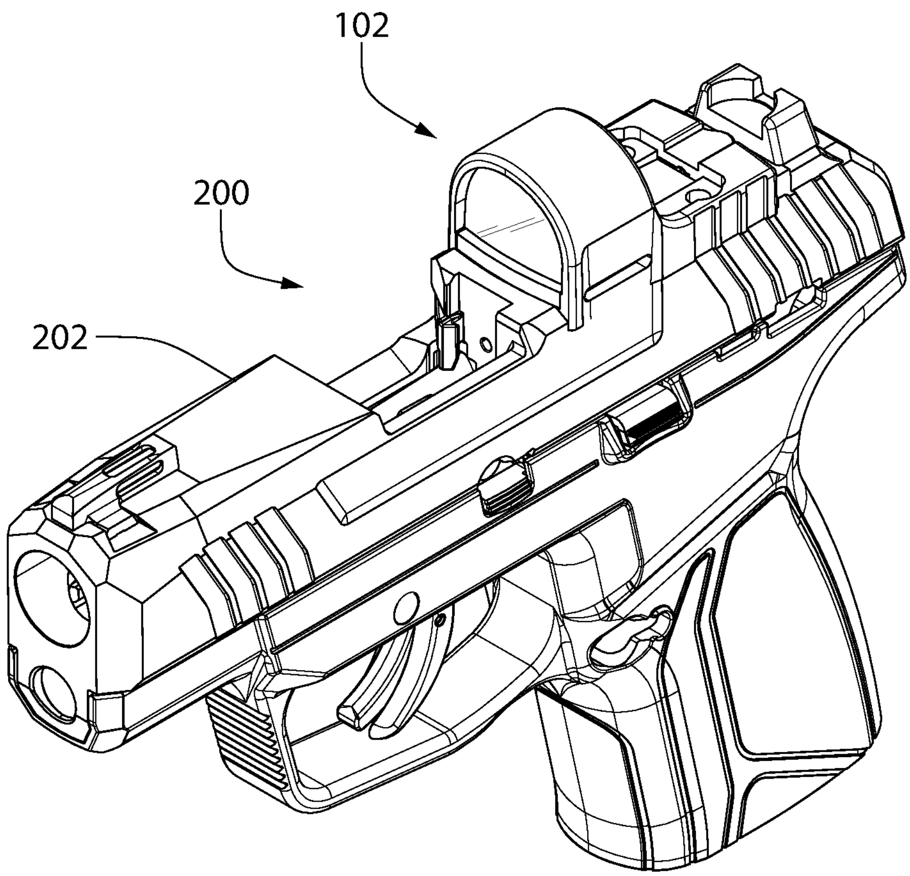

FIG. 30

PASSIVELY ILLUMINATED FIBER OPTIC REFLEX SIGHTS FOR FIREARMS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit of priority to U.S. Provisional Application No. 63/197,855 filed Jun. 7, 2021; which is incorporated herein by reference in its entirety.

BACKGROUND

The present invention generally relates to firearms, and more particularly to a passively and naturally illuminated reflex sighting system for firearms which uses available ambient light to generate a reticle for aiming.

A recent trend in the firearms industry is to attach an electrically-powered optical based illuminated sighting system to a wide variety of firearm platforms. These sights typically offer fast target acquisition, high contrast colored reticles (dots), and a parallax free sight picture. A red dot reflex optic is commonly used; however, other colors are available. Optical sights are distinguishable from the many forms of lighted sights that do not have an optical lens element onto which the dot reticle is projected by an electrically powered artificial illumination source (e.g., light). Some optical sight designs, however, are complex and relatively expensive resulting in a barrier to entry for some users seeking a more affordable sight option.

In addition, the bulky size of the housing required for an artificial illuminated reflex sight which must accommodate both the light source and its electric power source (e.g., battery) generally prohibits their use on smaller format concealed carry firearms such as compact semi-automatic pistols. Artificially illuminated reflex sights heretofore generally are restricted for use on larger size pistols and too impractical by nature for true concealed carry firearm usage. Although some users of such smaller pistols might prefer a dot reticle reflex sight, that option has not generally been available particularly at an affordable pricing point.

A need therefore exists for a reflex type sight which is affordable for all users, and which is adapted for use in some embodiments on smaller concealed carry type pistols.

SUMMARY

A passive natural ambient light illuminated reflex optical sighting system disclosed herein offers a simplified and affordable alternative to the foregoing more complex artificially illuminated reflex sighting systems without the complexities and expense of past designs. No onboard artificial illumination source (i.e. light) on either the sight or firearm is used to illuminate the fiber optic element in the present passively illuminated sight. In addition, the present ambient light illuminated reflex sighting system is also amenable for use with smaller concealed carry firearms such as pistols in some embodiments since the reflex sight housing can be made smaller than larger traditional power illuminated reflex sight housing because the illumination source (LED-light emitting diodes or other) and its electric power source (e.g., batteries) are omitted in some embodiments. This advantageously reduces the bulk and size of traditional battery-powered reflex sight housings with artificial lighting such as those used in the past making the present passive natural ambient-lighted reflex sight usable for both larger and smaller size firearms.

The present passively illuminated sighting system in one embodiment comprises a dot reticle reflex sight which utilizes a natural light gathering illumination element, which may be formed by a polymeric fiber optic element in one embodiment. In one preferred but non-limiting embodiment, the fiber optic element is therefore not illuminated by an electrically powered artificial light source onboard the sight or firearm. Instead, the element is configured and designed to collect and utilize only available ambient light from the environment (e.g., solar) surrounding the firearm alone to generate the dot reticle on the lens.

The intensity of the reticle produced on the lens by the present ambient-lighted reflex sight may be variable dependent upon the amount of ambient light available. The present fiber optic element is designed to provide a reticle of adequate intensity even when ambient light levels are low (e.g., dusk or dawn). The dot reticle of the present reflex sight may be red in one embodiment; however, other colors (e.g., green, etc.) may used by varying the color of the fiber optic element and/or the reflective coating on the lens element of the present optical reflex sight.

In one embodiment, the ambient light illuminated reflex optical sighting system generally comprises the housing detachably coupleable and mountable to a portion of the body of the firearm, a lens supported by the housing, a fiber optic element supported by the housing, and a light-transmissible cover at least partially enclosing the element for protection but constructed to transmit natural ambient light therethrough to the fiber optic element. The cover may be clear plastic in one non-limiting implementation.

The fiber optic element may be formed from extruded fiber optic rod and may have numerous configurations selected to optimize its light gathering and absorbing capabilities. In one embodiment, the fiber optic element may include a light-absorbing circuitous portion or section which may be formed by coiled section of the fiber optic rod having a multiple loop configuration comprised of two or more concentrically arranged and aligned loops of the optical rod. The light-absorbing coiled section advantageously increases the available surface area of the fiber optic element and concomitantly the amount of ambient light which can be absorbed in the available small footprint or space within the housing of the sighting system. The fiber optic element further comprises a light-emitting end section aimed at the lens for projecting the reticle beam and resultant reticle thereon, which may be dot shaped in some implementations. The end section may be formed contiguously with the coiled section as a unitary part of a single monofilament fiber optic rod such that the absorbed ambient light is transmitted internally through the entire fiber optic rod.

One goal of the present dot reticle sight design is to simplify the overall reflex sighting system and size of the reflex sight housing while maximizing the light gathering capability of the fiber optic element. The housing is specially configured to increase the amount of ambient light which can be collected and absorbed by the fiber optic element. Accordingly, in one embodiment, the housing may be configured such that ambient light can enter the fiber optic element from a plurality of sides (e.g., 2 or more sides) through the sight housing to enhance collection of light and corresponding light beam output of the fiber optic rod to form the reticle on the lens. In one implementation, light may enter the fiber optic element via a plurality of light collection and transmission windows. One non-limiting design may allow light to reach the fiber optic element from 4 or more sides such as via front, lateral, and top light collection windows of the housing.

The fiber optic element may be enclosed by a light-transmissible (e.g., transparent/clear) protective cover detachably mounted to the housing of the sighting system. The fiber optic element and cover may be received in an upwardly and forwardly open light-gathering cavity of the housing. The cover visually/optically communicates (i.e. transmits) ambient light received through the windows of the housing to the fiber optic element which absorbs the light to produce the dot reticle on the lens. The terms "visual or optical communication" (including various forms and tenses of those words) connotes that a light transmission path is created which is physically unobstructed. The ambient light illuminated reticle sight has sufficient light gathering abilities by design to be is usable in a variety of ambient lighting conditions at different time of the day and/or weather conditions (e.g., cloudy or overcast skies as well sunny conditions).

In one embodiment, the reflex sight system may be configured for mounting and use on a reciprocating slide of a semi-automatic pistol which may be the firearm. However, the sight may be configured for mounting to other types of handguns (e.g., revolvers) or long guns (e.g., rifles and shotguns).

According to one aspect, a natural or passively illuminated optical reflex sighting system for a firearm which utilizes only ambient light as the source of illumination comprises: a housing configured for detachable mounting to the firearm and comprising a plurality of light collection and transmission windows; a lens supported by the housing; a fiber optic element supported in the housing, the fiber optic element configured and operable to absorb ambient light; and a light-transmissible cover enclosing the fiber optic element, the cover and fiber optic element being in communication with the windows in the housing which collect and transmit the ambient light to the fiber optic element; wherein the fiber optic element is configured to absorb the ambient light and generate a reticle on the lens for aiming the firearm.

In another aspect, a firearm with passively illuminated optical reflex sighting system comprises: a firearm body defining a sight mounting section; an optical reflex sight comprising: a housing detachably coupled to the sight mounting section of the firearm body, the housing comprising a light-gathering cavity and a plurality of light collection and transmission windows in visual communication with the cavity; a lens supported by the housing; a fiber optic element supported in the cavity of the housing, the fiber optic element comprising a light-absorbing circuitous section and contiguous light-emitting end section aimed at the lens; and a light-transmissible cover enclosing the fiber optic element, the cover and light-absorbing circuitous section of the fiber optic element being in optical communication with the windows in the housing which collect and transmit the ambient light to the fiber optic element through the cover; wherein the fiber optic element is configured to absorb the ambient light from the windows and generate a reticle on the lens for aiming the firearm with no onboard artificial light which illuminates the fiber optic element.

In another aspect, a method for providing a firearm with a passively illuminated optical reflex sighting system comprises: providing a reticle reflex sight comprising a housing supporting a lens, and fiber optic element including a light-absorbing circuitous section and a light-emitting end portion aimed at the lens; mounting the sight on the firearm; absorbing natural ambient light via the light-absorbing circuitous section of the fiber optic element; and generating a reticle on the lens via the light-emitting end portion of the fiber optic element; wherein there is no onboard artificial light used to illuminate the fiber optic element.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein like elements are labeled similarly and in which:

FIG. **1** is a first top perspective view of a first embodiment of a body portion of a firearm including a first embodiment of a naturally illuminated optical reflex sight according to the present disclosure;

FIG. **2** is a second top perspective view thereof;

FIG. **3** is front view thereof;

FIG. **4** is a rear view thereof;

FIG. **5** is a left lateral side view thereof;

FIG. **6** is a right lateral side view thereof;

FIG. **7** is a top view thereof;

FIG. **8** is a right lateral side cross sectional view thereof;

FIG. **9** is an enlarged detail taken from FIG. **8** showing the reticle beam path (dashed lines) and resultant reticle produced on the lens;

FIG. **10** is an exploded top perspective view of the firearm and sight of FIG. **1**;

FIG. **10**A is an enlarged view of the sight components shown in FIG. **10**;

FIG. **11** is an exploded bottom perspective view of the firearm and sight of FIG. **1**;

FIG. **12** is an exploded perspective view of the sight components alone;

FIG. **13** is a top perspective view of the fiber optic element protective cover of the sight;

FIG. **14** is an enlarged perspective view of a rear extension of the protective cover;

FIG. **15** shows various optional configurations of the lens support frame of the sight housing;

FIG. **16** is a rear view looking forward from the perspective of a user showing the naturally illuminated optical reflex sight with a dot reticle generated on the lens by the fiber optic element;

FIG. **17** is a first top perspective view of a second embodiment of a body portion of a firearm including a second embodiment of a naturally illuminated compact optical reflex sight according to the present disclosure;

FIG. **18** is an enlarged detail taken from FIG. **17**;

FIG. **19** is second top perspective view of the firearm and sight of FIG. **17**;

FIG. **20** is an enlarged detail taken from FIG. **19**;

FIG. **21** is front view of the firearm and sight of FIG. **17**;

FIG. **22** is a rear view thereof;

FIG. **23** is a left lateral side view thereof;

FIG. **24** is a right lateral side view thereof;

FIG. **25** is a top view thereof;

FIG. **26** is a side cross sectional view thereof;

FIG. **27** is an enlarged detail taken from FIG. **26**;

FIG. **28** is a top exploded perspective view thereof;

FIG. **29** is a bottom exploded perspective view thereof; and

FIG. **30** is a perspective view of the entire firearm of FIG. **1** with the first embodiment of the sight mounted thereon.

All drawings are schematic and not necessarily to scale. Parts given a reference numerical designation in one figure may be considered to be the same parts where they appear in other figures without a numerical designation for brevity unless specifically labeled with a different part number and described herein. References herein to a whole figure number herein which may comprise multiple figures with the same whole number but including an alphabetical suffix shall be construed to be a general reference to all those figures sharing the same whole number, unless otherwise indicated.

DETAILED DESCRIPTION

The features and benefits of the invention are illustrated and described herein by reference to non-limiting exemplary ("example") embodiments. This description of exemplary embodiments is intended to be read in connection with the accompanying drawings or photos, which are to be considered part of the entire written description. Accordingly, the disclosure expressly should not be limited to such exemplary embodiments illustrating some possible non-limiting combination of features that may exist alone or in other combinations of features disclosed herein.

In the description of embodiments disclosed herein, any reference to direction or orientation is merely intended for convenience of description and is not intended in any way to limit the scope of the present invention. Relative terms such as "lower," "upper," "horizontal," "vertical,", "above," "below," "up," "down," "top" and "bottom" as well as derivative thereof (e.g., "horizontally," "downwardly," "upwardly," etc.) should be construed to refer to the orientation as then described or as shown in the drawing under discussion. These relative terms are for convenience of description only and do not require that the apparatus be constructed or operated in a particular orientation. Terms such as "attached," "affixed," "connected," "coupled," "interconnected," and similar refer to a relationship wherein structures are secured or attached to one another either directly or indirectly through intervening structures, as well as both movable or rigid attachments or relationships, unless expressly described otherwise.

As used throughout, any ranges disclosed herein are used as shorthand for describing each and every value that is within the range. Any value within the range can be selected as the terminus of the range.

FIGS. **1-16** show a first embodiment of an optical reflex sighting system naturally and passively illuminated by ambient light according to the present disclosure. The sighting system may be a dot reticle type illuminated sight which does not include an electrically-powered illumination source such as a light (e.g., LED or other) onboard the sight or firearm to illuminate the fiber optic element and generate the reticle. The present optical reflex sight functions on the natural ambient light absorption and transmission features of the sight further described herein to produce and project the reticle on the aiming lens of the sight. This distinguishes the present passively illuminated fiber-optic based reticle reflex sight from such conventional electrically powered and artificially illuminated reticle reflex sights of the past.

The present non-limiting embodiment of the reflex sight system **100** design according to the present disclosure includes a dot reticle optical reflex sight **102** which may be generally comprised of four main components: a lens **105**; a housing **110** configured for mounting to the firearm; the fiber optic element **130** configured and arranged for ambient light gathering and absorption; and a preferably clear/transparent light-transmissible cover **150** for the light gathering element which offers protection from the environment, dust/debris, and damage during handling of the firearm.

The dot reticle optical reflex sight **102** may be mounted to any portion and type of firearm **200** including a handgun such as semi-automatic pistol **200** shown herein (see, e.g., FIG. **30**), or a long gun (e.g., carbine, rifle, or shotgun). Pistol **200** includes a grip frame **206**, reciprocating slide **202** which moves rearward and forward to cycle the action after firing in a well known manner for unloading the spent cartridge case and chambering a fresh cartridge from the magazine. The spent cartridge case is extracted from the chamber and ejected through the ejection port **204**.

The sight housing **110** in the present naturally-illuminated optical reflex sight design serves several functions. The first is to provide a mounting feature to attach the sight unit to a firearm. The second is to provide a locating and mounting surface for the lens. The third is to locate and support the fiber optic element **130** and cover **150** assembly.

Housing **110** may have a horizontally/longitudinally elongated body defining a sight axis SA oriented parallel to longitudinal axis LA of the firearm when mounted thereon. Longitudinal axis LA is defined by the internal axial bore of the barrel of the firearm through which the projectile (e.g., bullet, etc.) travels when the firearm is discharged. The housing comprises an open front end **112**, rear end **113**, right lateral side **114***a*, and left lateral side **114***b*, and closed bottom **116**. The right and left lateral sides are defined by right and left parallel sidewalls **121***a*, **121***b*.

The body of housing **110** comprises a horizontal longitudinally/axially elongated base portion **117** configured for detachable mounting to the firearm, and an upright vertical lens frame portion **111** projecting upwardly therefrom and configured for mounting the lens thereto.

Any suitable means may be used for detachably coupling and mounting the base portion **117** of the sight housing to the firearm. In one non-limiting embodiment, threaded fasteners **118** may be used for coupling the base portion to a suitable structure or portion of the firearm which may be a stationary member (e.g., frame or chassis) or a movable member (e.g., reciprocating slide of the firearm action). In one embodiment, the base portion **117** may be configured for detachable coupling and mounting to a complementary configured substantially flat sight mounting section **203** of the body of the firearm **200** which defines an interface for attaching the sight **102** thereto. In one embodiment, the sight mounting section **203** of the firearm body may be formed on the top surface of the reciprocating slide **202** of semi-automatic pistol **200** as shown in the non-limiting illustrated embodiment. The bottom **116** of base portion **117** may be flat to define a flat-to-flat interface between the slide and sight housing **110** in one implementation. The fiber optic reflex sight **102** may be mounted rearward of the cartridge ejection port **204** formed in the slide.

Lens frame portion **111** may be generally arch-shaped and surrounds and protects the lens **105**. The lens frame portion **111** defines a central opening **111***a* which receives the lens and accordingly may be complementary configured in shape to match the perimetric shape of the lens. The lens frame portion **111** may be an integral unitary part of the monolithic body of the housing in some embodiments; however, other embodiments may utilize a separately formed frame portion which is permanently or detachably coupled to the base portion. FIG. **15** show some additional non-limiting examples of the shape that the arched lens frame portion **111** may take including arcuately curved configurations and angled or faceted configurations. Lens frame portion **111-1** has an angular configuration including a flat top and angled lateral facets on each side forming a substantially octagon-shaped central opening **111***a***-1**. Lens frame portion **111-2** is somewhat similar thereto but has a shorter flat top and more smoothly contoured angled lateral facet forming a substantially (albeit not perfectly) rectangular shaped central opening **111***a***-2**. Lens frame portion **111-3** is similar to lens frame portion **111** previously described herein (see, e.g., FIG. **16**) but has a central opening **111***a***-3** which forms more of a complete circle by comparison. Numerous other shaped lens support portions of housing **110** may be used of course. Accordingly, the shape of the lens frame portion **111** of the housing does not limit the invention in any respect.

Notably, the housing **110** is specially configured to optimize the amount of natural ambient light which can reach and illuminate the fiber optic element **130** from multiple directions (e.g., at least four different directions in one embodiment—more or less in others). Accordingly, in one embodiment the housing **110** includes a plurality of open light collection and transmission windows **120** arranged and operable to collect and transmit ambient light through the preferably clear/transparent cover **150** to the fiber optic element **130** where the light is absorbed and transmitted to generate the reticle on the lens. In one non-limiting example, the housing may comprise a forward-facing front window **120***a*, a pair of opposing lateral side windows **120***b* (right side) and **120***c* (left side), and a large upwardly open top window **120***d*. All of the windows are in visual/optical communication with light-gathering cavity **115** of housing **110** to illuminate the fiber optic element **130**.

The top window **120***d* is located between the front arched lens frame portion **111** of housing **110** and its rear end **113**, and formed by the upwardly open light-gathering cavity **115** of the housing. Front window **120***a* is formed by central opening **111***a* of the housing upright lens frame portion **111**.

Each lateral window **120***b*, **120***c* is formed by an opening extending completely through and penetrating the pair of right and left sidewalls **121***a*, **121***b* of housing **110**. In one embodiment, the lateral windows may have an elongated slot shape to maximize the amount of ambient light collected through the windows.

The foregoing windows **120***a*-**120***d* each visually communicate directly with and transmit available ambient light to the light gathering fiber optic element **130** enclosed by the cover **150**. Accordingly, the fiber optic element **130** is exposed to ambient light through the windows via the clear cover **150**.

The base portion **117** of housing **110** defines the upwardly open cavity **115** configured to receive and mount the cover **150** therein and at least the coiled section of fiber optic element **130**. The cover **150** may be detachably and fixedly mounted to the housing within cavity **115** by any suitable means, such as without limitation threaded fasteners, snap fit interlocked features, or other techniques used in the art to detachably coupled two components together. In one non-limiting embodiment, threaded fasteners **118** may be used which pass through corresponding fastener holes **118***a* and **118***b* in the cover **150** and base portion **117** of housing **110** to threadably engage threaded coupling holes **118***c* formed on the sight mounting section **203** of the firearm. The same fasteners **118** therefore efficiently mount the cover and sight housing to the firearm.

The lens **105** may be similar to many other existing reflex sight lenses, which are typically constructed of an optical grade polymer or glass. It can be constructed by stacking multiple lenses together to form a single optical element and may be rearwardly concave slightly in some embodiments (see, e.g., FIG. **9**). The lens **105** may include reflective and anti-reflective coatings applied to filter certain wavelengths of light and maximize brightness of the reflection of the illuminated dot reticle generated by the fiber optic element on the surface of the lens. The shape of the lens **105** is designed such that the reflection of the illuminated reticle forms a virtual image which appears to be several meters or more in front of the firearm to the user.

In one non-limiting embodiment, the illumination element of the present naturally illuminated sighting system is formed by fiber optic element **130** which may be constructed from a highly flexible extruded fiber optic rod of polymeric light-transmission material. Light (ambient and/or from external lighting not onboard the firearm or sight housing including artificial overhead lighting fixtures, etc.) enters the fiber optic element and bounces off internal reflective surfaces within the element. The exposed ends of the rod allow the reflected light to escape. The net effect is that the ends emit light at a higher intensity due to the gathering of internal reflections within the fiber optic element. This light has a high enough intensity to produce a reflection upon a lens surface that can create a reticle for the shooter. By utilizing a small diameter rod (e.g., about 0.010 inch in one non-limiting embodiment), the reticle is formed directly by the fiber optic element without an aperture component.

In the non-limiting illustrated embodiment, the fiber optic element **130** includes a single strand and curved light-emitting end portion or section **132** at rear, and a contiguously formed light-absorbing circuitous section which in one embodiment may be formed by coiled section **131** at front. Coiled section **131** may have a multiple loop construction and configuration comprised of two or more concentrically arranged and aligned loops of the optical rod. It bears noting that sections **131** and **132** may be formed by different portions of a single flexible fiber optic rod manipulated to produce the shape shown and described herein. The light-emitting end section **132** defines the free terminal end **132***a* which emits and projects the captured ambient light that produces the dot reticle on the lens **105**.

As previously noted, the coiled section **131** advantageously increases the available surface area of the fiber optic element and concomitantly the amount of ambient light which can be absorbed in the available small footprint or space within the housing of the sighting system. The coiled section **131** may be located forward of the light-emitting end section **132** of the fiber optic element as shown in the illustrated embodiment. The end section **132** may have a recurvant shape in one embodiment as shown in the figures which bends around itself 90 degrees forming a hook-like shape. The light-emitting terminal end **132***a* of fiber optic element **130** is spaced rearwardly from lens **105** by a specific distance to project a focused reticle R on the lens. Terminal end **132***a* and the adjacent end section **132** of the fiber optic element are also angled upwards obliquely to sight axis SA of the ambient light illuminated reflex sight **102** towards a central portion of lens **105** to project the illuminated reticle thereon.

It bears noting that in other embodiments, the coiled section **131** of fiber optic element **130** may be at the rear and light-emitting end section **132** may be in front and not recurvant in shape.

The current illustrated embodiment of the fiber optic element **130** may use a single monofilament fiber optic rod to form the light-emitting end section **132** and adjoining light-absorbing coiled section **131** which may include an oval or circular coil comprised of multiple loops formed from the fiber optic rod. The loops or coils of the coiled section may be concentrically arranged and adjacent in relation to each other in a closely packed loop to maximize the amount of natural ambient light absorbed. The fiber optic element **130** may therefore have a greater thickness in the light-absorbing coiled section **131** than the single strand light-emitting end section **132**.

An oval loop design may be used in one embodiment for the light-absorbing coiled section **131**. In other embodiments, a circular loop design may be used. In yet other embodiments contemplated, other arrangements and configurations of the fiber optic rod may be used which result in a high density pattern (e.g., zig-zag rows of the fiber optic rod side-to-side or front-to-rear, parallel rows side-to-side or front-to-rear, etc.). One design goal is to use a fiber optic rod having a total unwound length sufficient to absorb an amount of ambient light sufficient to produce a clearly visible reticle on the lens at all times under varying ambient lighting conditions dawn to dusk. The reticle R is formed by light transmitted onto the lens from the light-emitting terminal end **132***a* of the fiber optic element **130**.

In other possible implementations, the fiber optic element could alternatively be a custom molded polymer component with a design including internal optical surfaces designed to reflect gathered light and maximize the light output and intensity from the exposed end of the fiber optic element aimed at the lens **105**.

The cover **150** of the optical reflex sight **102** may be preferably made of a light-transmissible material such as transparent/clear polymer as one non-limiting example. The cover may be a generally rectangular cuboid shaped block of solid material in one embodiment configured to fully cover and encase the fiber optic element **130** for protection while concomitantly allowing light to pass through and enter the element. A downwardly open recess **151** on the bottom of cover **150** configured to receive and enclose at least the coiled portion or section **131** (e.g., concentric loops) of the fiber optic element may be provided as shown in one embodiment. The fiber optic element **130** may be mounted directly to and fully supported by the cover independently of the sight housing. Accordingly, the coiled section **131** in some embodiments may be secured directly to the cover inside the recess **151** by a suitable method including without limitation adhesives or "potting" with a suitable hardenable electronic component potting material.

In one embodiment, the clear fiber optic element cover **150** may further comprise a rear fiber support extension **152** which defines a guide channel **153** which receives, guides, and supports the single strand and recurvant light-emitting end section **132** of fiber optic element **130**. Fiber support extension **152** projects rearwardly from the rectangular front main portion **154** of the cover which holds the coiled section **131** of the fiber optic element **130**. Fiber support extension **152** may have any suitable shape for its purpose. In certain embodiments, fiber support extension **152** may have a lateral width less than the front main portion **154** as shown.

Guide channel **153** communicates with bottom recess **151** of the cover for threading the single strand light-emitting end section therethrough. On the top rear of cover **150**, the channel terminates with a forward illumination opening **153***a* which receives and exposes the light-emitting terminal end **132***a* of the fiber optic element **130** for projecting the reticle on the lens **105**. The optical element terminal end **132***a* of recurvant single strand end section **132** of optical fiber element **130** may be completely nested within forward illumination opening **153***a* of cover **150** for protection from damage when handling the sight or firearm.

In certain embodiment, the top surface of cover **150** may include a downwardly and rearwardly sloping illumination ramp **155** extending rearwards from a central part of the front main portion **154** of cover **150** to the illumination opening **153***a* at the rear of the cover. This prevents physical and visual obstruction of the reticle light beam projected forward through the air onto the lens **105** by fiber optic element **130** (see, e.g., FIG. **9** dashed reticle light beam lines and resultant reticle R produced on the lens). In other designs, the ramp may be omitted depending on the configuration of the cover **150** provided if no illumination path obstruction occurs. The reticle light beam follows a light path that is obliquely angled to sight axis SA and longitudinal axis LA of the firearm.

To further protect the exposed terminal end **132** of fiber optic element **130**, the sight housing **110** in some embodiments may include a downwardly and forwardly open receptacle **119** at the rear end **113** into which the fiber support extension **152** of cover **150** may be slideably received and inserted. The receptacle **119** may be formed in base portion **117** of housing **110** and be complementary configured to the fiber support extension **152** such that the extension is nested therein (see, e.g., FIG. **10**A). When the fiber support extension **152** is inserted in receptacle **119**, only the front main portion **154** of the cover remains visible to collect and transmit ambient light to fiber optic element **130**

To assemble and mount the light-transmissible cover **150** in the housing **110**, the cover may be slideably inserted rearwards into cavity **115** of the housing through the open front end **112** of the housing formed by the central opening **111***a* of arched lens frame portion **111**. The fiber support extension **152** is slideably inserted rearwardly into the receptacle **119** at the rear of cavity **115** in the housing **110**. Once the cover is in place, the threaded fasteners **118** may be inserted through the cover and base portion **117** of the housing to secure the cover. To remove the cover, the foregoing assembly process is reversed. In one embodiment, the cover **110** cannot be removed upwardly from the housing cavity **115**.

As shown, the front end of the cover **150** is located adjacent to central opening **111***a* of the arched lens frame portion **111** of housing **115**. As previously described herein, central opening **111***a* defines the front window **120***a* in the housing for collecting and transmitting ambient light to the coiled section **131** of fiber optic element **130**. When the cover is fully mounted in housing **110**, the front end of the cover is disposed adjacent to the bottom end of the lens **105**.

The firearm **200** may also include a front iron sight **221** and rear iron sight **220** fixedly mounted to slide **202**. Rear iron sight **220** may be mounted to the firearm just to the rear of and proximate to the dot reticle optical reflex sight **102**. In preferred but non-limiting embodiments, the rear iron sight and front iron sight are provided in conjunction with the ambient-lighted optical reflex sight **102** for aiming when available natural light may be insufficient to produce a reticle R of adequate intensity. The optical reflex sight **102** may be configured such that the front iron sight is visible through lens **105** during such times with the rear iron sight for aiming.

When assembled into the housing **110**, the light-transmissible cover **150** is designed so that light may enter from the top, left, right and front of the housing assembly via the light collection and transmission windows **120***a*, **120***b*, **120***c*, and **120***d* of the housing as previously described herein. This offers an advantage over other fiber illuminated reflex sights, which do not maximize light collection angles from multiple sides and include a battery-operated artificial source of light mounted in the housing. It bears noting that the present naturally illuminated dot reticle optical reflex sight **102** continuously produces a reticle on lens **105** so long as there is a sufficient level of ambient light available. There is no "on" or "off" switch.

The optical reflex sight **102** advantageously may provide maximum light output for the reticle with few or no moving parts or features necessary or desired for making any adjustments. Other possible embodiments depending in part on the firearm however may include provisions which include a sight adjustment mechanism, a battery-powered LED to illuminate and increase light output from the fiber optic element such as when lower ambient light levels are encountered, and/or a versatile firearm mounting interface configured for mounting the sight on various different weapons platforms and types. Accordingly, numerous supplemental features and variants of the naturally and passively illuminated sight may be provided.

In some embodiments, the present fiber optic reflex sight may be configured to provide a micro pistol sized natural ambient light illuminated reticle fiber optic sight such as for a small format concealed carry semi-automatic pistol **400**. FIGS. **17-29** show such a compact firearm and a corresponding second embodiment of a compact dot reticle optical reflex sight **302**. Sight **302** contains essentially all of the features and is the same as dot reticle optical reflex sight **102** previously described herein including operation of the sight via natural ambient light collection and transmission to illuminate fiber optic element **330**. Those similar features of the sight will not be repeated here for sake of brevity and are assigned "300" series feature designation numbers instead. The smaller compact pistol and its components including the slide on which compact sight **302** is mounted have been assigned "400" series feature designation numbers. Some of the differences necessary for adaptation of the reflex sight to smaller concealed carry pistols and some common features will be described below.

Referring to FIGS. **17-29**, optical reflex sight **302** includes a compact housing **310** comprising base portion **317** defining upwardly open cavity **315** which receives light-transmissible cover **350** that houses fiber optic element **330** therein, and arched lens frame portion **311** supporting lens **305**. Frame portion **311** may be integrally formed as a monolithic unitary structural part of housing **310** with the base portion. The compact sight **302** further includes lens **305** and light-transmissible cover **350** which supports fiber optic element **330** in its downwardly open recess **351**. Cover **350** may include downwardly and rearwardly sloping illumination ramp **355** similarly to cover **150** and for the same purpose to prevent obstruction of the light beam emitted from light-emitting terminal end **332*a*** of the fiber optic element end section **332** which emits and projects the captured ambient light that produces the dot reticle on the lens **305**. Fiber optic element **330** includes light-absorbing circuitous section such as coiled section **331** similarly to fiber optic element **130** previously described herein.

The compact sight **302** may be mounted to the smaller size and profile slide **402** of a pistol in one embodiment via any suitable method such as the same manner previously described herein that sight **102** is mounted to the larger size and profile slide **202** at the sight mounting interface (e.g., fasteners). In the non-limiting illustrated embodiment, however, housing **310** of sight **302** may instead be detachably coupled and mounted to the rear portion of the firearm slide **402** via a mating dovetail and complementary configured slot arrangement (see, e.g., FIGS. **17-18** and **28-29**). Housing **310** comprises a downwardly projecting male dovetail protrusion **450** which is slideably received in a mating female dovetail slot **451** formed in the top surface of the rear end portion of the slide. The dovetail protrusion may be integrally formed with the body of housing **310** as a unitary structural part thereof in some implementations. Dovetail protrusion **450** is laterally inserted in a direction (i.e. transverse to longitudinal axis LA and sight axis SA) into the dovetail slot **451** to secure the fiber optic reflex sight **302** in place on the firearm slide **402**. In some embodiments, a small set screw (not shown but known in the art) may be used to lock the sight **302** in place within the dovetail slot.

The compact concealed carry pistol slide **402** includes a front sight **421**. Because the slide **402** is smaller, the compact housing **310** of sight **302** includes an integral rear iron sight **420** formed as a unitary structural part of the housing. By contrast, rear iron sight **220** of the larger size slide **202** may be mounted directly to the rear end of the slide due to the greater amount of available space on the larger slide.

For the smaller concealed carry firearm, the present compact sight **302** has a housing **310** having a width W2 in one embodiment which may not be greater than 0.75 inches to fit the available width of the sight mounting section **403** of the smaller slide. By contrast, the width W1 of housing **110** provided for the larger size slide **202** and firearm previously described herein may be about 0.94 inches. The length L2 of the compact sight housing **310** may be about 5.05 inches, whereas the length L1 of the larger size sight housing **110** may be about 5.8 inches for comparison in some embodiments. The smaller size of the compact sight **302** is thus advantageously easily adaptable to the smaller concealed carry size firearm (e.g., pistol) and its slide due to the omission of an electrically-powered artificial source of illumination such as a light (e.g., LED or other light source).

Due to the smaller size of the sight compact housing **310**, the pair lateral side light collection and transmission windows included for larger size sight **102** (see, e.g., windows **120*b*** and **120*c***) may be omitted in some embodiments as shown; however, other embodiments of the compact sight may include them. The open top window **120*d*** and front window **120*a*** may provide sufficient ability alone to collect and illuminate fiber optic element **330** with natural ambient light.

It bears noting that because the compact reflex sight **302** does not include an artificial source of light and associated power source similarly to reflex sight **102** previously described herein, this makes the resultant smaller sight housing **310** highly amenable for use with the smaller size concealed carry pistols **400**. This is advantageous for users who desire a dot reticle optical reflex sight for such firearms.

Any suitable metallic and/or non-metallic materials may be used for any of the integrated optical sighting system components described herein based on the purpose of those components.

While the foregoing description and drawings represent preferred or exemplary embodiments of the present invention, it will be understood that various additions, modifications and substitutions may be made therein without departing from the spirit and scope and range of equivalents of the accompanying claims. In particular, it will be clear to those skilled in the art that the present invention may be embodied in other forms, structures, arrangements, proportions, sizes, and with other elements, materials, and components, without departing from the spirit or essential characteristics thereof. In addition, numerous variations in the methods/processes as applicable described herein may be made without departing from the spirit of the invention. One skilled in the art will further appreciate that the invention may be used with many modifications of structure, arrangement, proportions, sizes, materials, and components and otherwise, used in the practice of the invention, which are particularly adapted to specific environments and operative requirements without departing from the principles of the present invention. The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being defined by the appended claims and equivalents thereof, and not limited to the foregoing description or embodiments. Rather, the appended claims should be construed broadly, to include other variants and embodiments of the invention, which may be made by those skilled in the art without departing from the scope and range of equivalents of the invention.

What is claimed is:

1. A naturally illuminated optical reflex sighting system for a firearm, comprising:

a housing configured for detachable mounting to the firearm and comprising a plurality of light collection and transmission windows;

a lens supported by the housing;

a fiber optic element supported in the housing, the fiber optic element configured and operable to absorb ambient light; and

a light-transmissible cover enclosing the fiber optic element, the cover and fiber optic element being in communication with the windows in the housing which collect and transmit the ambient light to the fiber optic element;

wherein the fiber optic element is configured to absorb the ambient light and generate a reticle on the lens for aiming the firearm;

wherein the housing defines an upwardly open light-gathering cavity which receives a circuitous portion of the fiber optic element and cover;

wherein the circuitous portion comprises a coiled section formed by a plurality of concentrically arranged loops of the optical fiber element.

2. The sighting system according to claim **1**, wherein the housing defines an upwardly open light-gathering cavity which receives the fiber optic element and cover.

3. The sighting according to claim **2**, wherein the windows are in visual communication with the cavity.

4. The sighting system according to claim **3**, wherein the windows comprise a front window, a pair of lateral side windows, and an upwardly open top window which exposes the cavity and fiber optic element to ambient light.

5. The sighting system according to claim **4**, wherein each lateral side window is formed by an elongated slot formed through a respective sidewall of the housing.

6. The sighting system according to claim **2**, wherein the reticle is dot-shaped.

7. The sighting system according to **3**, wherein the reticle is formed by light transmitted and projected onto the lens from a light-emitting terminal end of the fiber optic element.

8. The sighting system according to claim **2**, wherein the cover is formed of transparent polymer or glass.

9. The sighting system according to claim **8**, wherein the fiber optic element further comprises a light-emitting end section aimed at the lens which is contiguously formed with the light-absorbing circuitous portion.

10. The sighting system according to claim **9**, wherein the circuitous portion comprises a coiled section formed by a plurality of concentrically arranged loops of the optical fiber element.

11. The sighting system according to claim **10**, wherein the cover comprises a downwardly open recess configured to receive the coiled section.

12. The sighting system according to claim **11**, wherein the fiber optic element is mounted directly to and supported by the cover.

13. The sighting system according to claim **12**, wherein the coiled section of the fiber optic element is secured in the recess of the cover by an adhesive or an electronic potting material.

14. The sighting system according to claim **11**, wherein the cover includes a guide channel which receives the light-emitting end section of the fiber optic element, the guide channel being in communication with the recess for threading the light-emitting end section therethrough.

15. The sighting system according to claim **14**, wherein the channel is formed in a rear fiber support extension which projects rearwardly from a front main portion of the cover which holds the coiled section of the fiber optic element.

16. The sighting system according to claim **14**, wherein the light-emitting end section of the fiber optic element has a recurvant shape terminating in a free terminal end which emits and projects the captured ambient light that produces the reticle on the lens.

17. The sighting system according to claim **16**, wherein the housing includes a downwardly open receptacle at the rear end thereof into which the fiber support extension of cover is slideably received and inserted.

18. The sighting system according to claim **2**, wherein the housing comprises:

a longitudinally elongated base portion which defines the cavity and is configured for mounting to a sight mounting section of the firearm; and

a lens frame portion at a front end of the housing in which the lens is mounted.

19. The sighting system according to claim **18**, wherein the base portion is detachably mountable to the firearm by a pair of threaded fasteners which extend through cover and the base portion to threadably engage the sight mounting section of the firearm.

20. The sighting system according to claim **18**, wherein a front end of the cover is disposed below the lens in the lens frame portion of the housing and abuttingly engaged with a bottom end of the lens.

21. The sighting system according to claim **1**, wherein an intensity of the reticle produced on the lens is variable dependent upon an amount of ambient light available.

22. The sighting system according to claim **1**, wherein the housing has a maximum width of 0.75 inches.

23. The sighting system according to claim **1**, wherein the sighting system does not include an artificial source of light to generated the reticle.

24. The sighting system according to claim **1**, wherein the housing includes a downwardly projecting male dovetail protrusion which is slideably received in a mating female dovetail slot formed in the top surface of a rear end portion of the firearm.

25. A firearm with passively illuminated optical reflex sighting system comprising:

a firearm body defining a sight mounting section;

an optical reflex sight comprising:

a housing detachably coupled to the sight mounting section of the firearm body, the housing comprising a light-gathering cavity and a plurality of light collection and transmission windows in visual communication with the cavity;

a lens supported by the housing;

a fiber optic element supported in the cavity of the housing, the fiber optic element comprising a light-absorbing circuitous section and contiguous light-emitting end section aimed at the lens; and

a light-transmissible cover enclosing the fiber optic element, the cover and light-absorbing circuitous section of the fiber optic element being in optical communication with the windows in the housing which collect and transmit the ambient light to the fiber optic element through the cover;

wherein the fiber optic element is configured to absorb the ambient light from the windows and generate a reticle on the lens for aiming the firearm with no onboard artificial light which illuminates the fiber optic element;

wherein the cover comprises a downwardly open recess and the light-absorbing circuitous section of the fiber optic element is mounted within the recess, the cover supporting the fiber optic element independently of the housing of the sight.

26. The firearm according to claim **25**, wherein the light-absorbing circuitous section comprises a coiled section formed by a plurality of concentrically arranged loops of the optical fiber element.

27. The firearm according to claim **25**, wherein the housing includes a downwardly projecting male dovetail protrusion which is slideably received in a mating female dovetail slot formed in the top surface of a rear end portion of the firearm.

28. The firearm according to claim **25**, wherein the windows comprise a front window, a pair of lateral side windows, and an upwardly open top window which exposes the cavity and fiber optic element to ambient light.

29. A method for providing a firearm with a naturally illuminated optical reflex sighting system comprising:

providing a reticle reflex sight comprising a housing supporting a lens, and a fiber optic element including a light-absorbing circuitous section and a light-emitting end portion aimed at the lens;

mounting the sight on the firearm;

absorbing natural ambient light via the light-absorbing circuitous section of the fiber optic element through a horizontally oriented light transmissible cover; and

generating a reticle on the lens via the light-emitting end portion of the fiber optic element;

wherein there is no onboard artificial light used to illuminate the fiber optic element.

30. A naturally illuminated optical reflex sighting system for a firearm, comprising:

a housing configured for detachable mounting to the firearm and comprising a plurality of light collection and transmission windows;

a lens supported by the housing;

a fiber optic element supported in the housing, the fiber optic element configured and operable to absorb ambient light; and

a light-transmissible cover enclosing the fiber optic element, the cover and fiber optic element being in communication with the windows in the housing which collect and transmit the ambient light to the fiber optic element;

wherein the housing defines an upwardly open light-gathering cavity which receives the fiber optic element and cover;

wherein the cover is formed of transparent polymer or glass;

wherein the fiber optic element comprises a light-absorbing circuitous portion and a contiguously formed light-emitting end section aimed at the lens;

wherein the circuitous portion comprises a coiled section formed by a plurality of concentrically arranged loops of the optical fiber element;

wherein the cover comprises a downwardly open recess configured to receive the coiled section;

wherein the cover includes a guide channel which receives the light-emitting end section of the fiber optic element, the guide channel being in communication with the recess for threading the light-emitting end section therethrough;

wherein the fiber optic element is configured to absorb the ambient light and generate a reticle on the lens for aiming the firearm.

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