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(54) **BROADHEAD**

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(*) Notice: This patent is subject to a terminal disclaimer.

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Related U.S. Patent Documents

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Appl. No.: **15/014,488**
Filed: **Feb. 3, 2016**

U.S. Applications:
(63) Continuation of application No. 14/726,918, filed on Jun. 1, 2015, now Pat. No. 9,267,773.

(51) **Int. Cl.**
F42B 6/08 (2006.01)

(52) **U.S. Cl.**
CPC ***F42B 6/08*** (2013.01)

(58) **Field of Classification Search**
USPC 473/583
See application file for complete search history.

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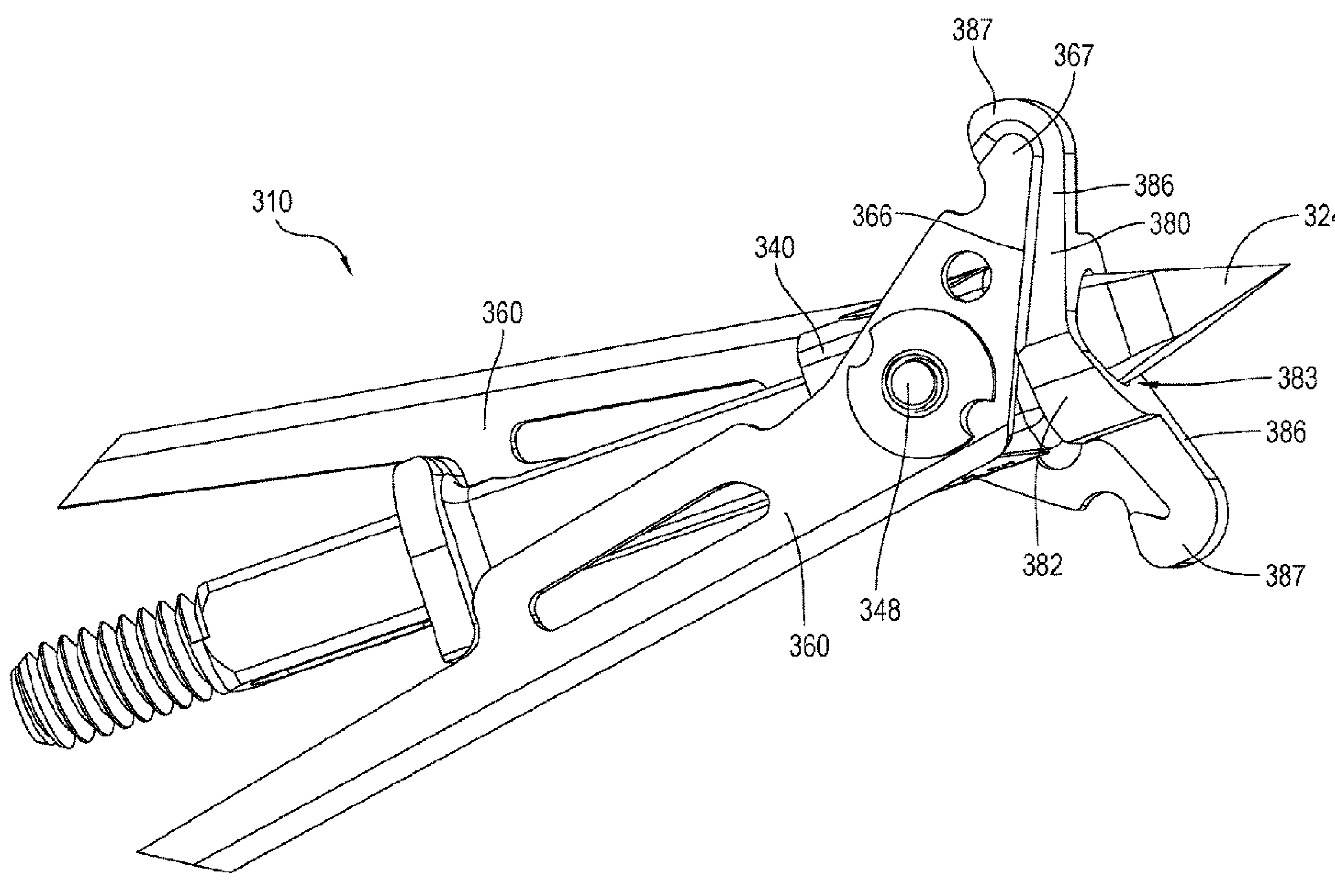
Primary Examiner — Jeffrey R Jastrzab

(74) *Attorney, Agent, or Firm* — Woodard, Emhardt, Henry, Reeves & Wagner, LLP

(57) **ABSTRACT**

Various embodiments of the present disclosure include a mechanical broadhead for use with an archery bow and arrow. In certain arrangements, a broadhead is provided that maintains the cutting blades in a retracted or closed position during flight of the arrow. Upon target contact, the blades expand outwardly from the closed position.

39 Claims, 25 Drawing Sheets



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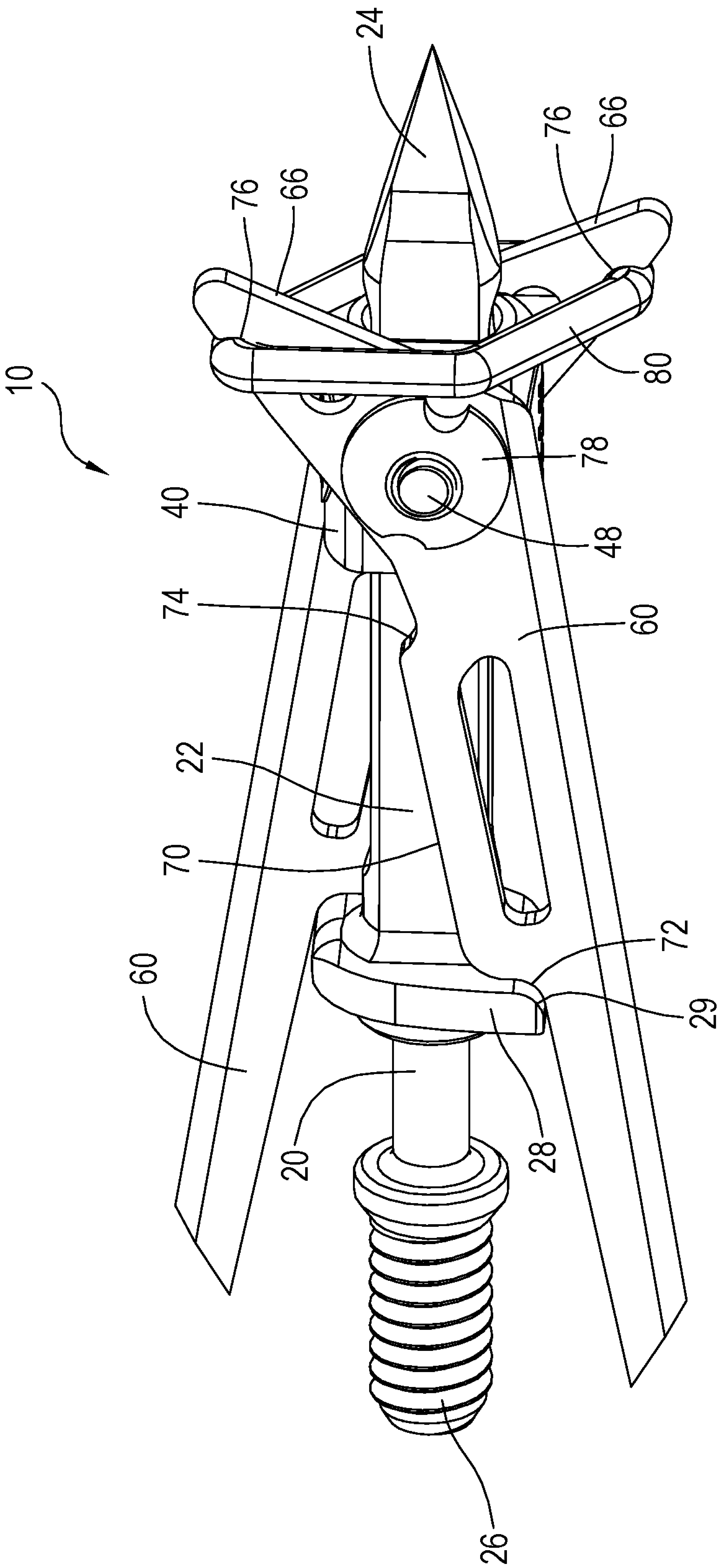

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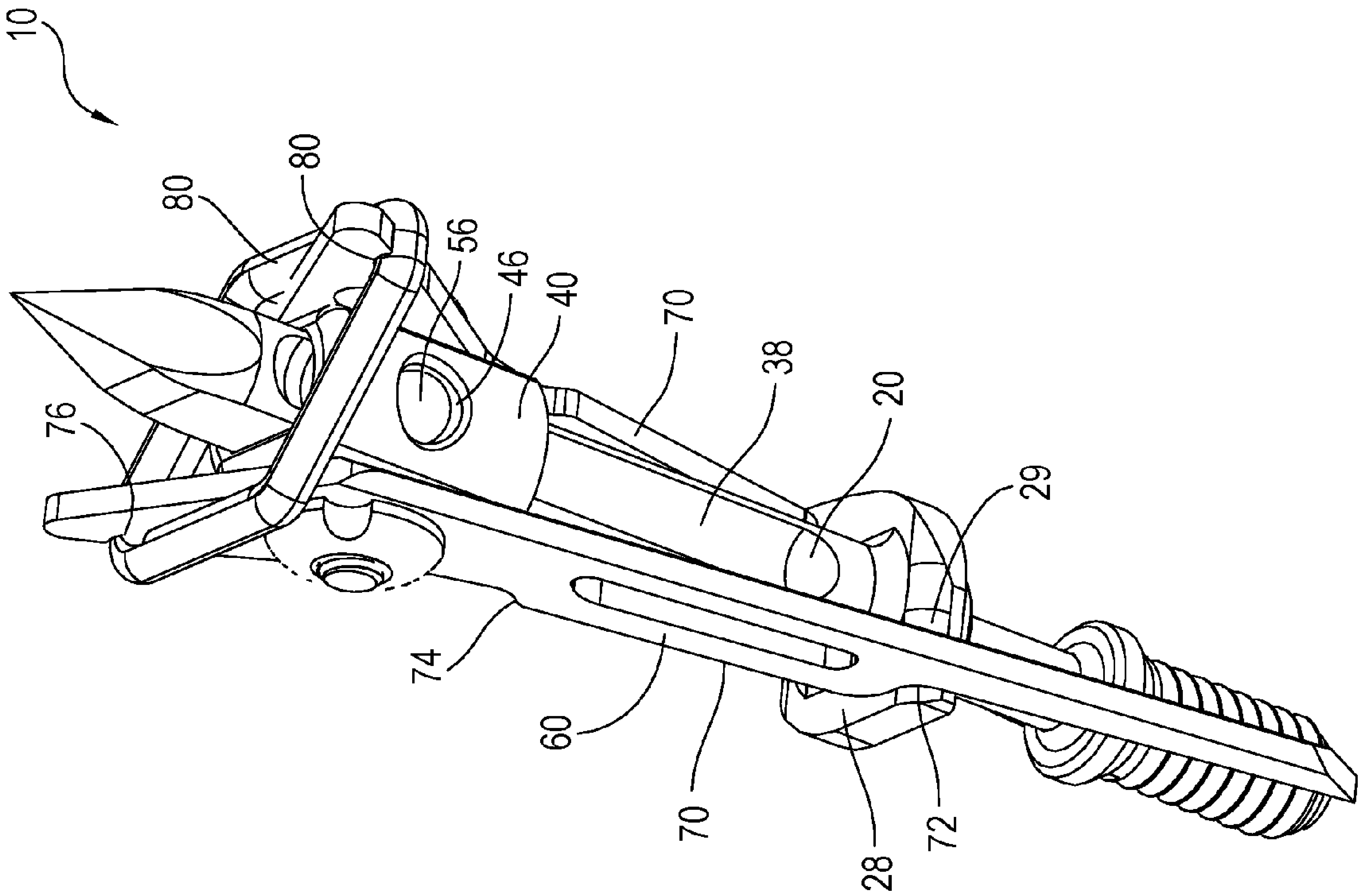

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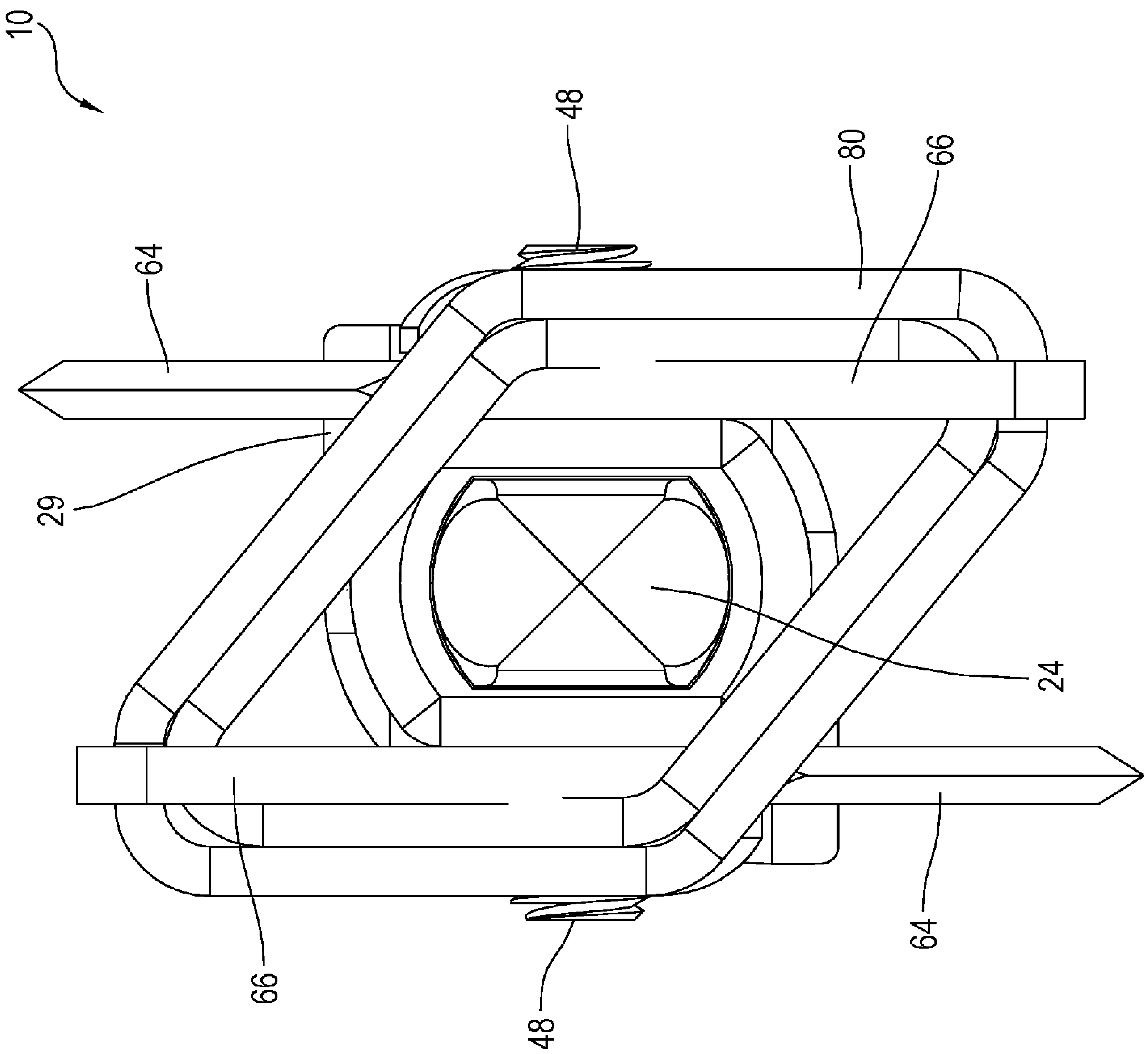

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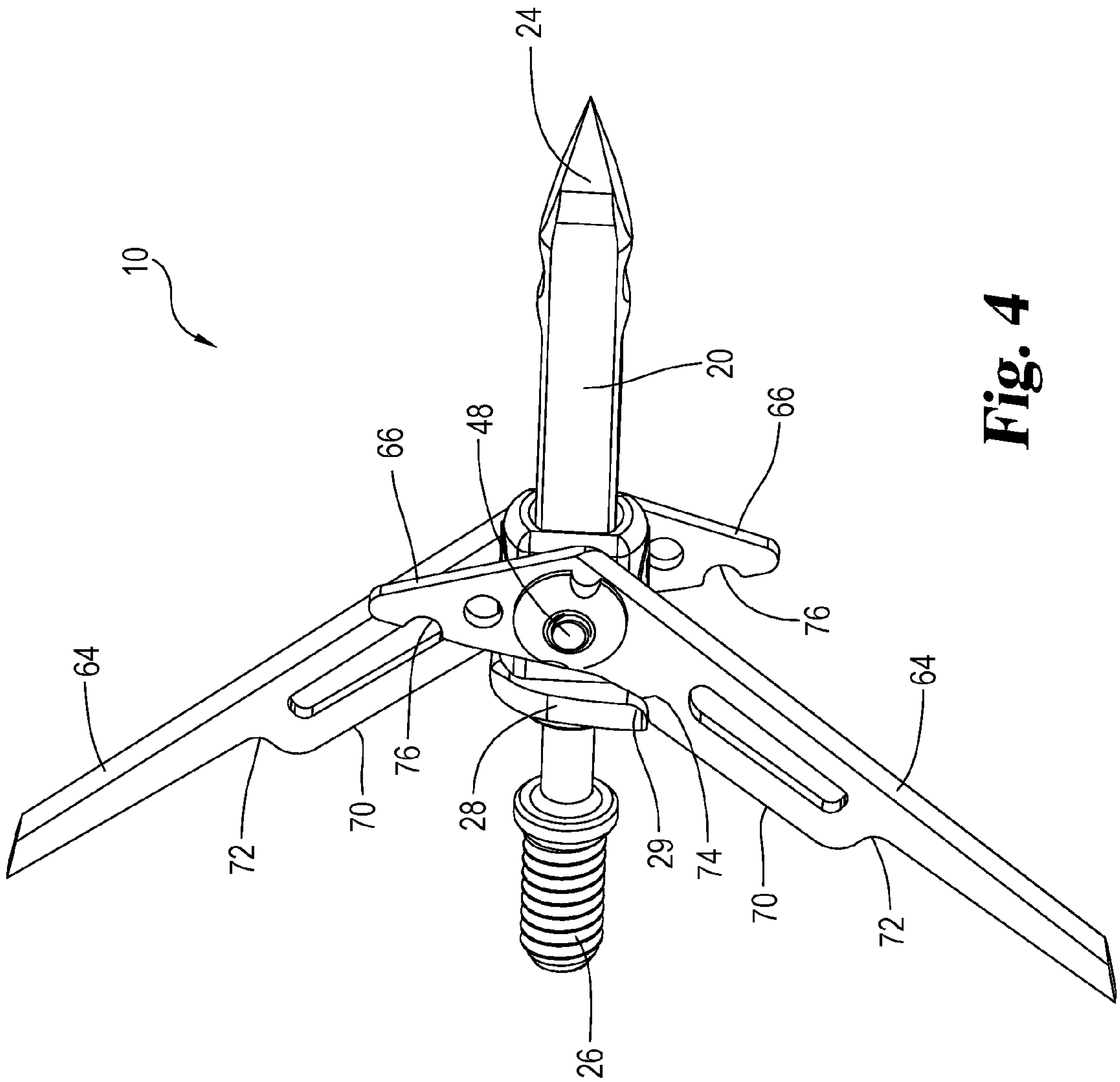

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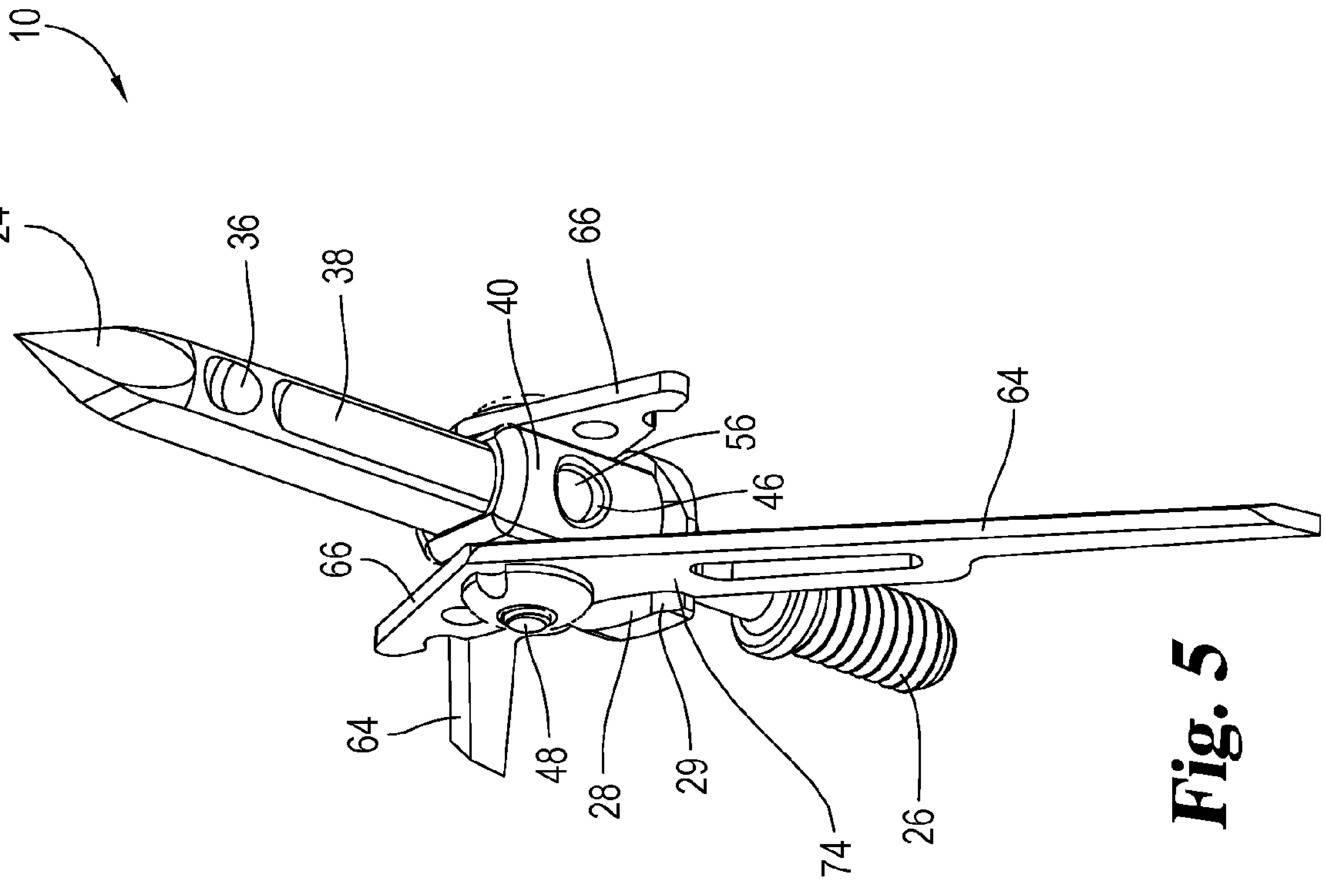

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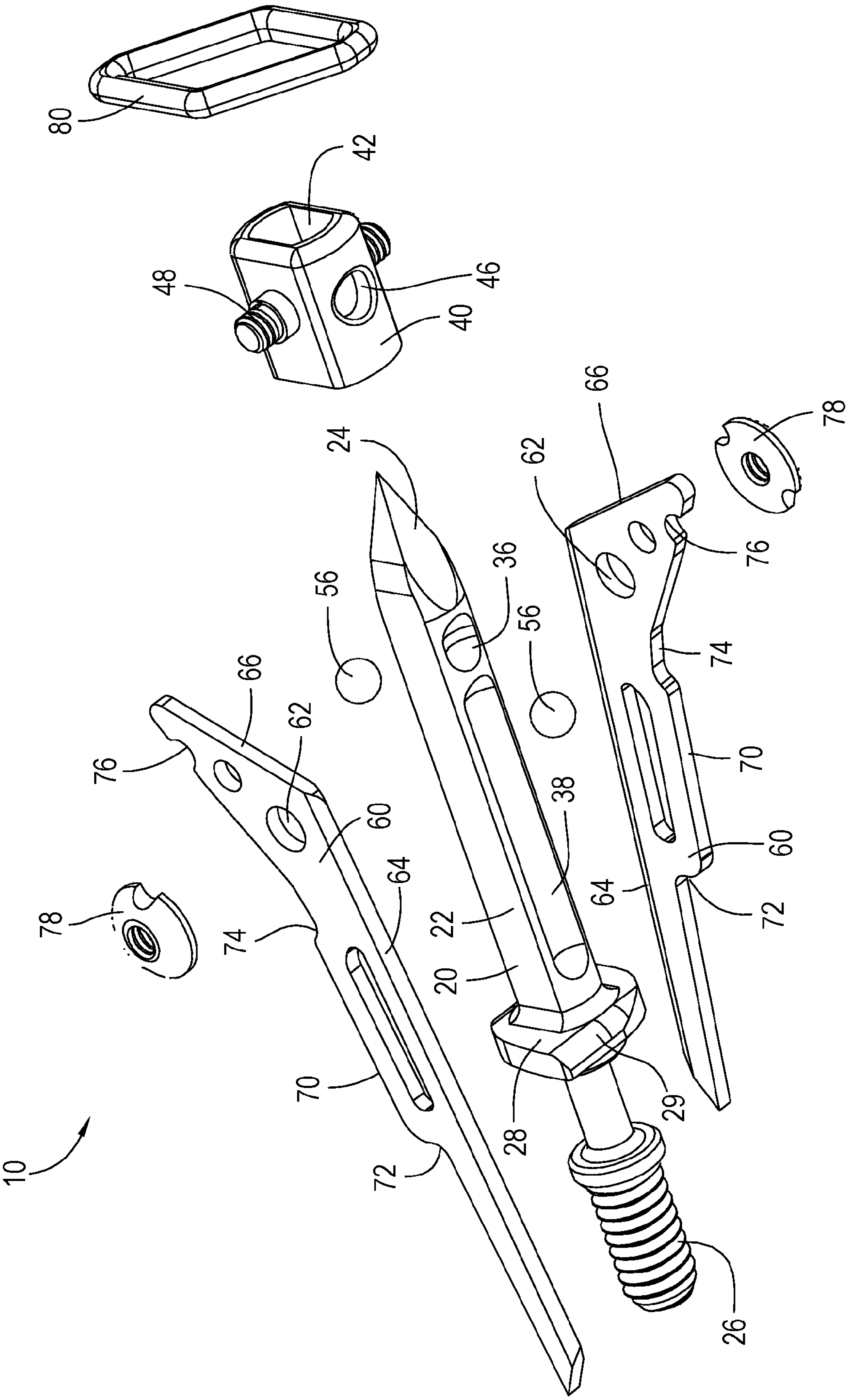

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Fig. 6

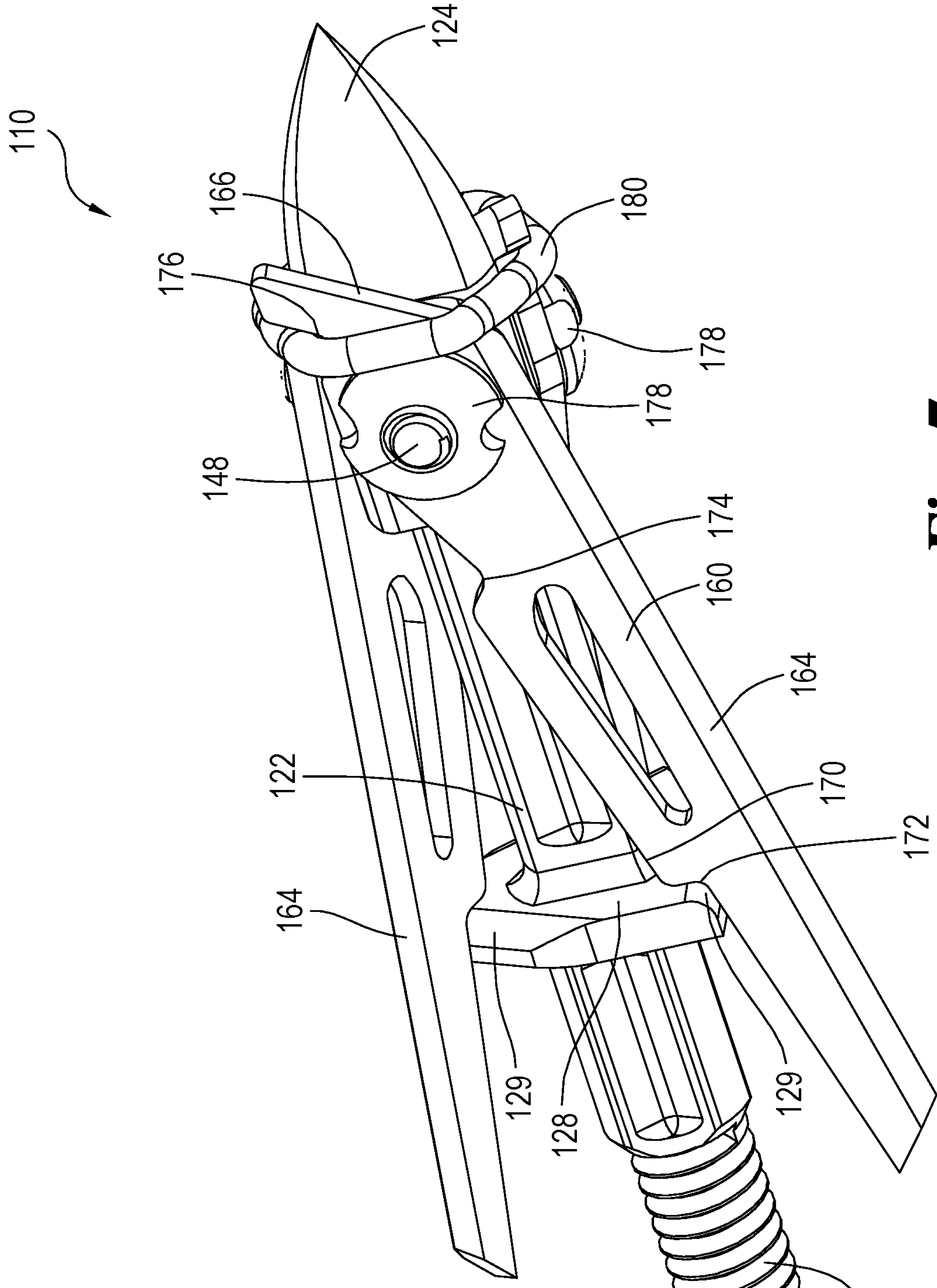

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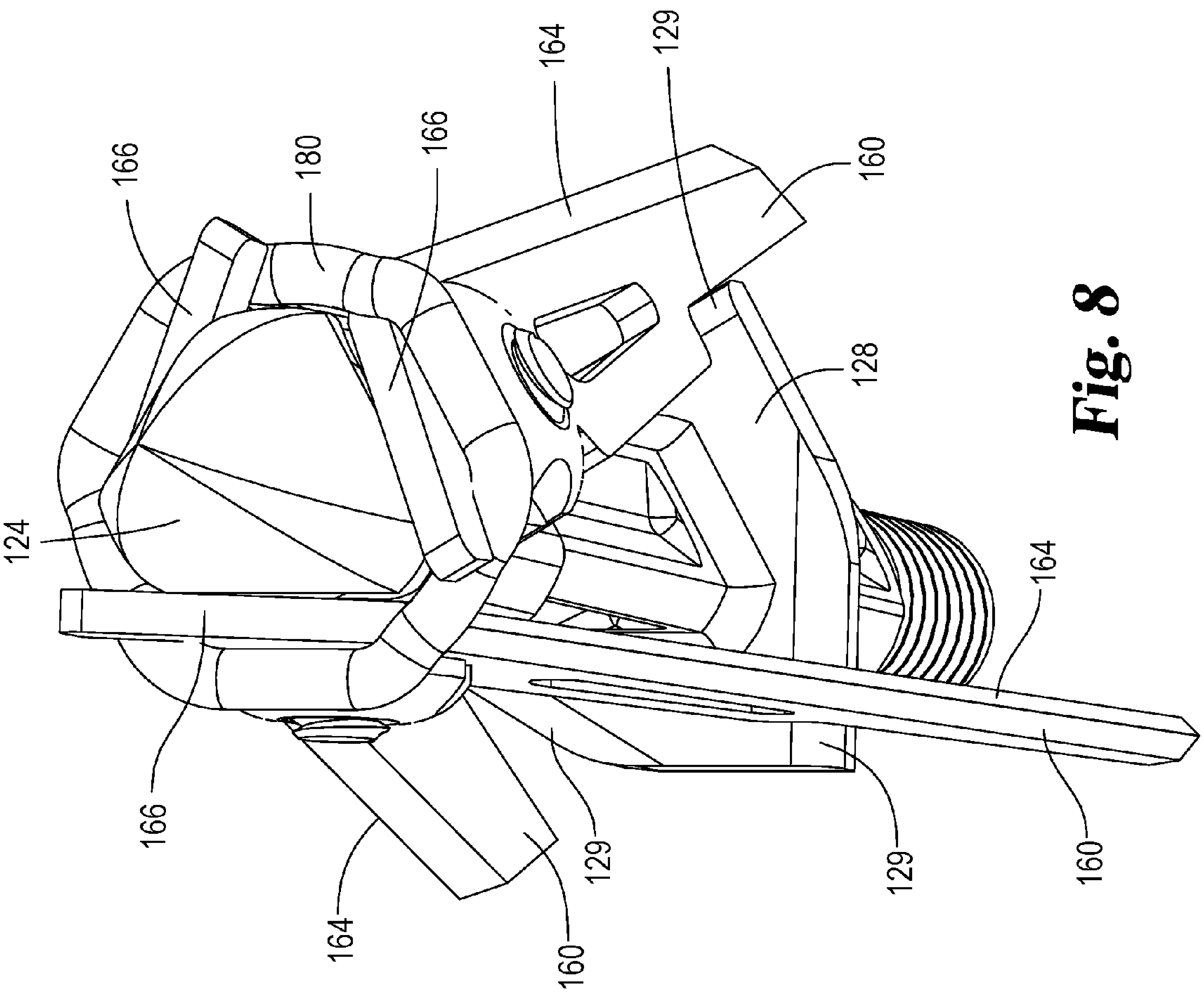
Fig. 7



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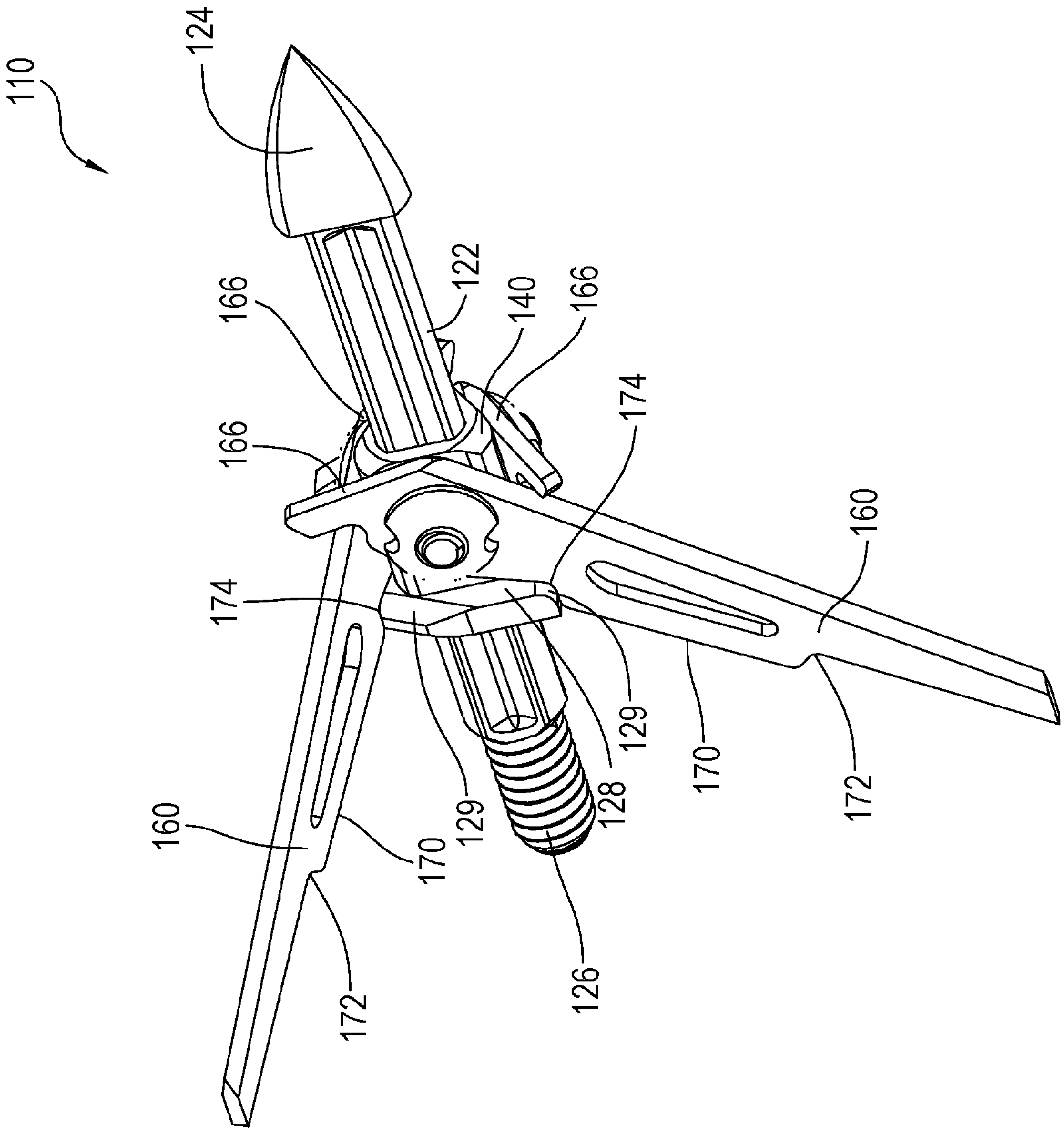
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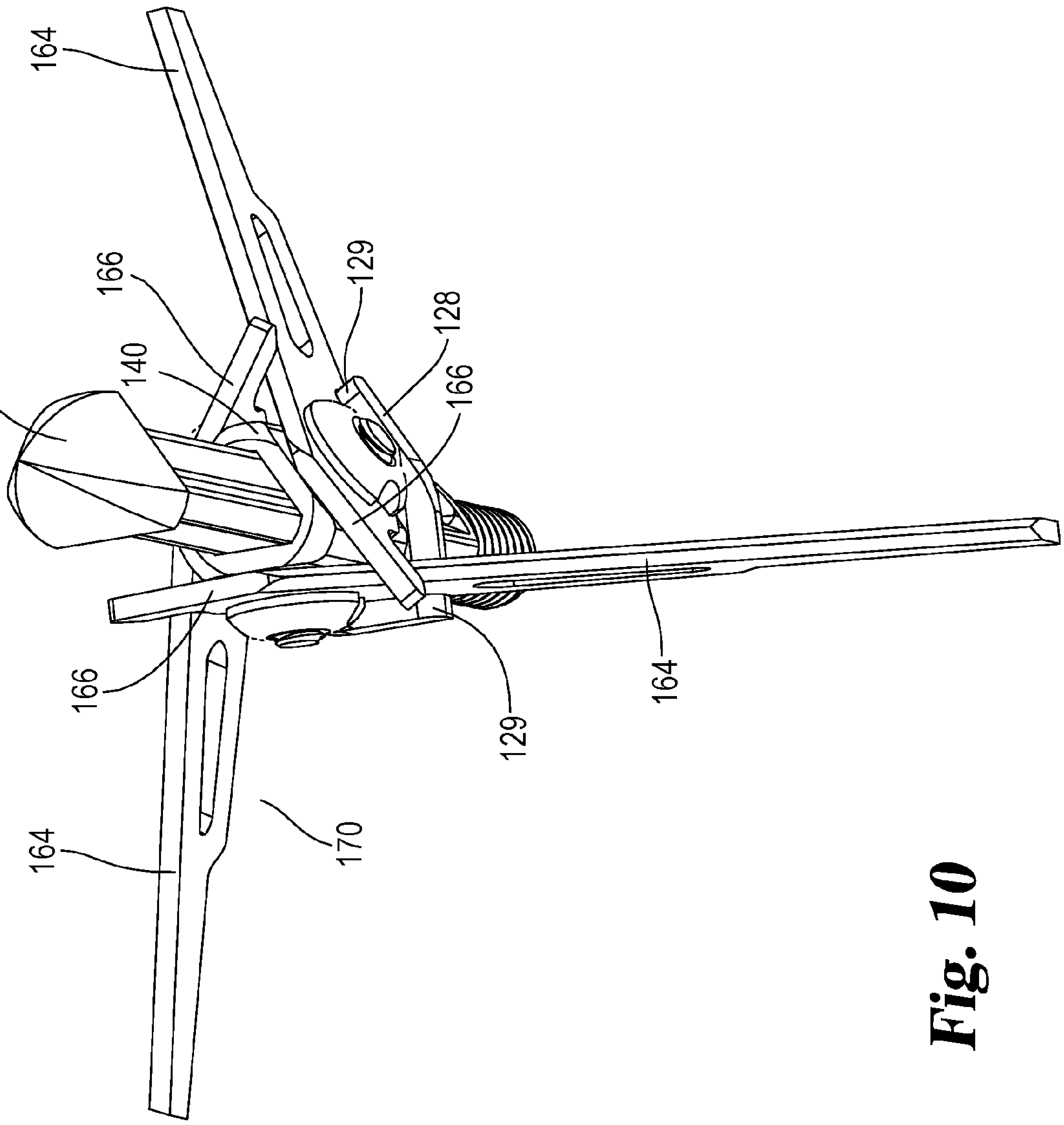
Fig. 9



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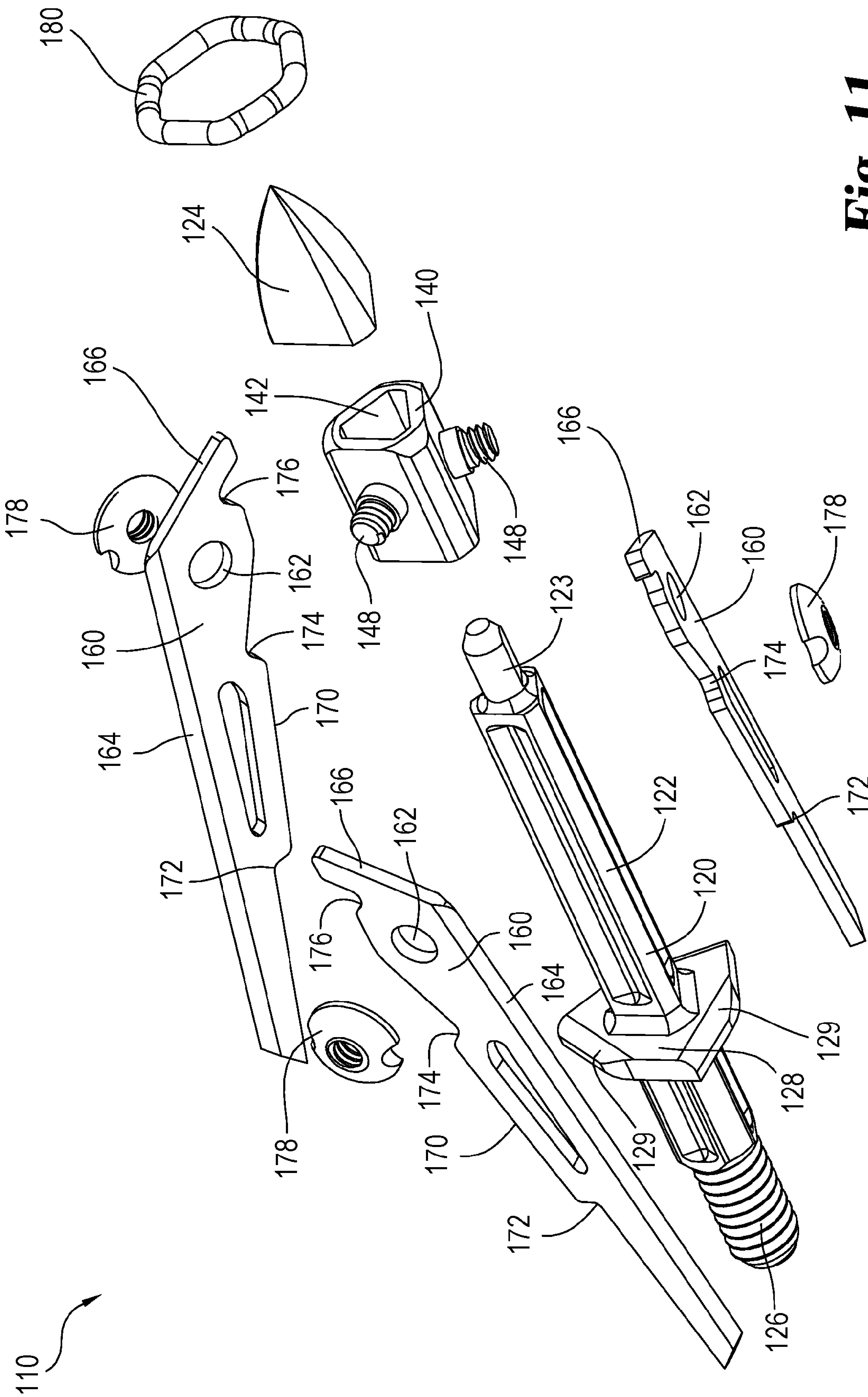
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Fig. 11

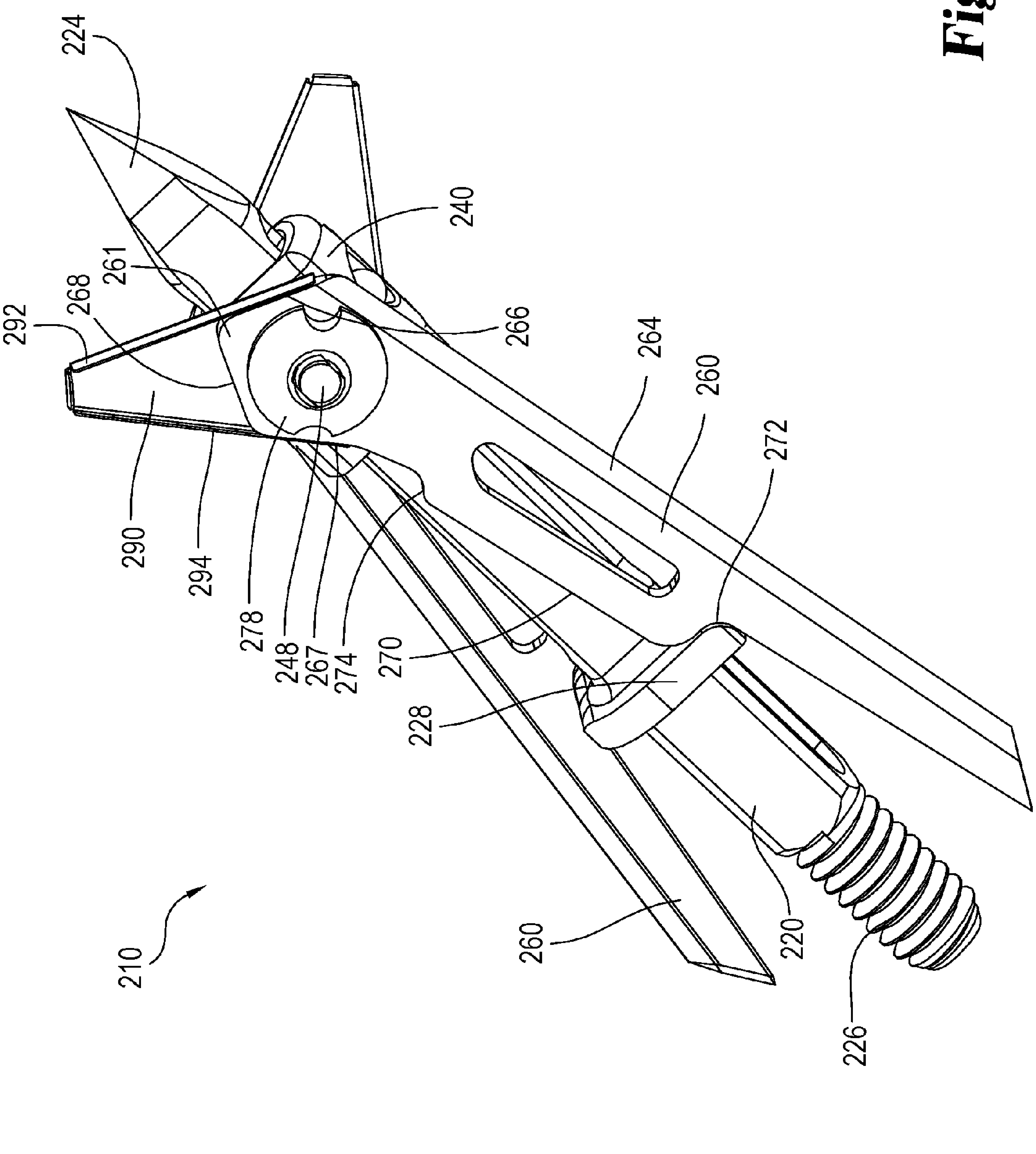
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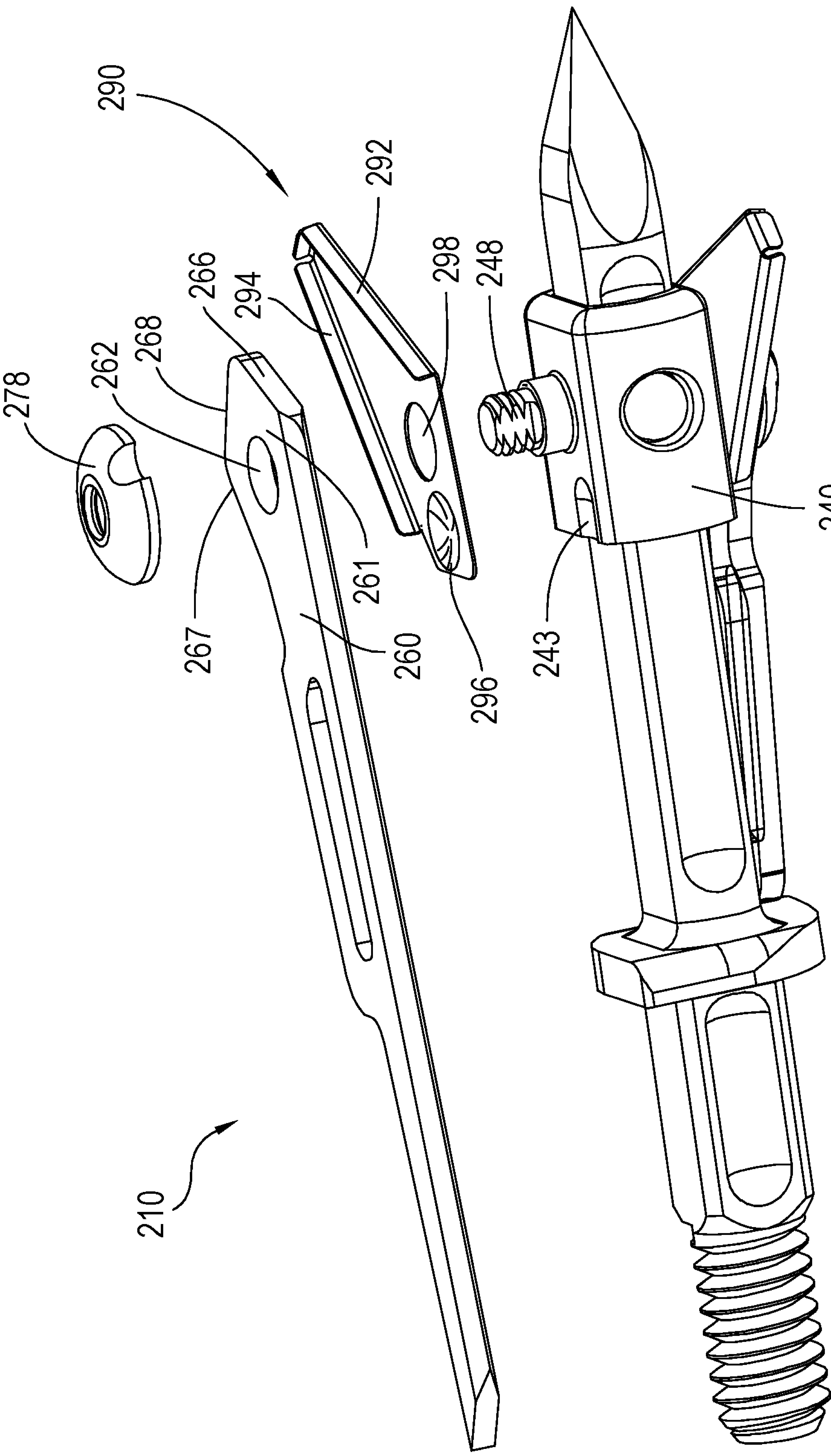
Fig. 12



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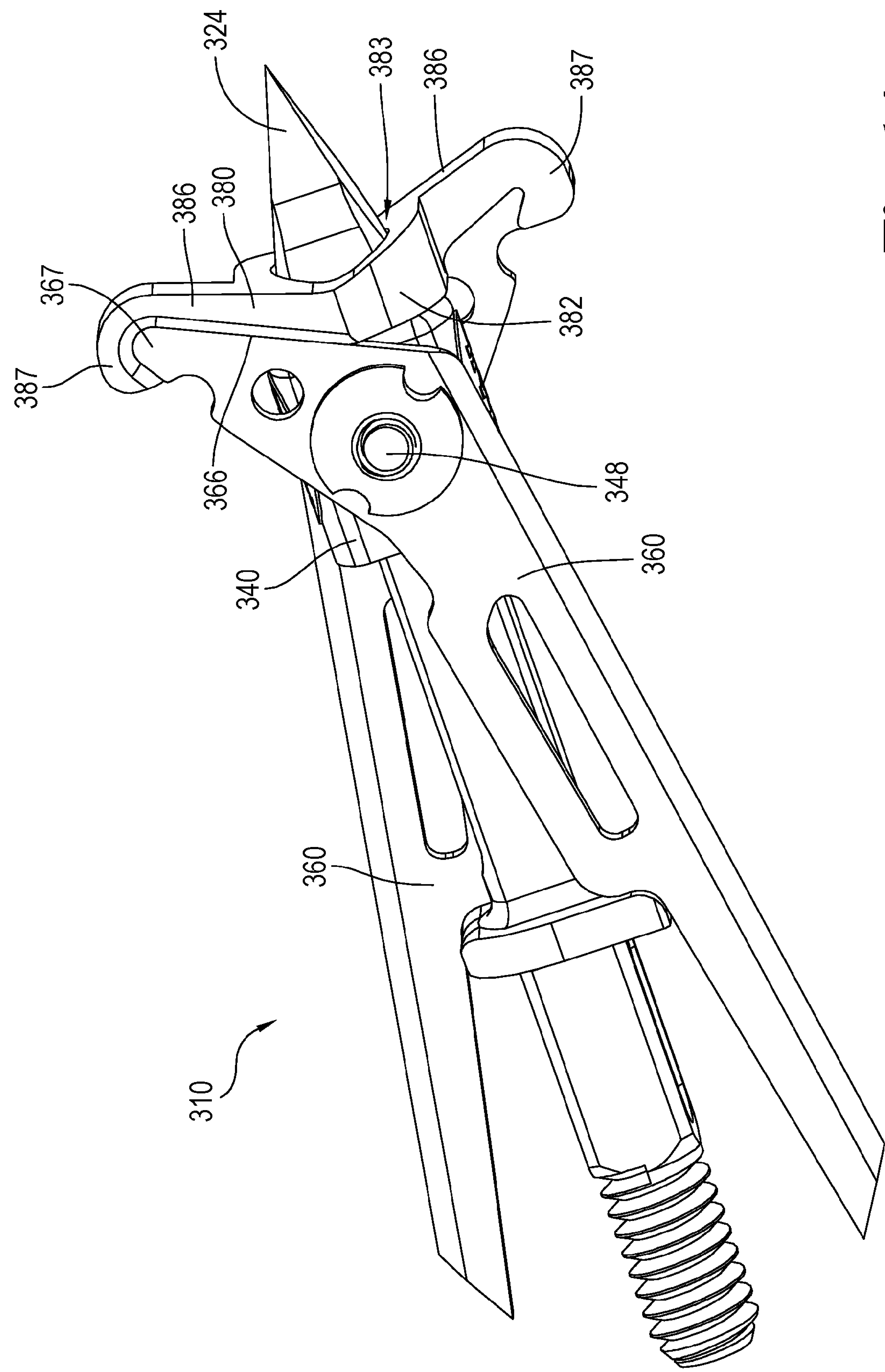

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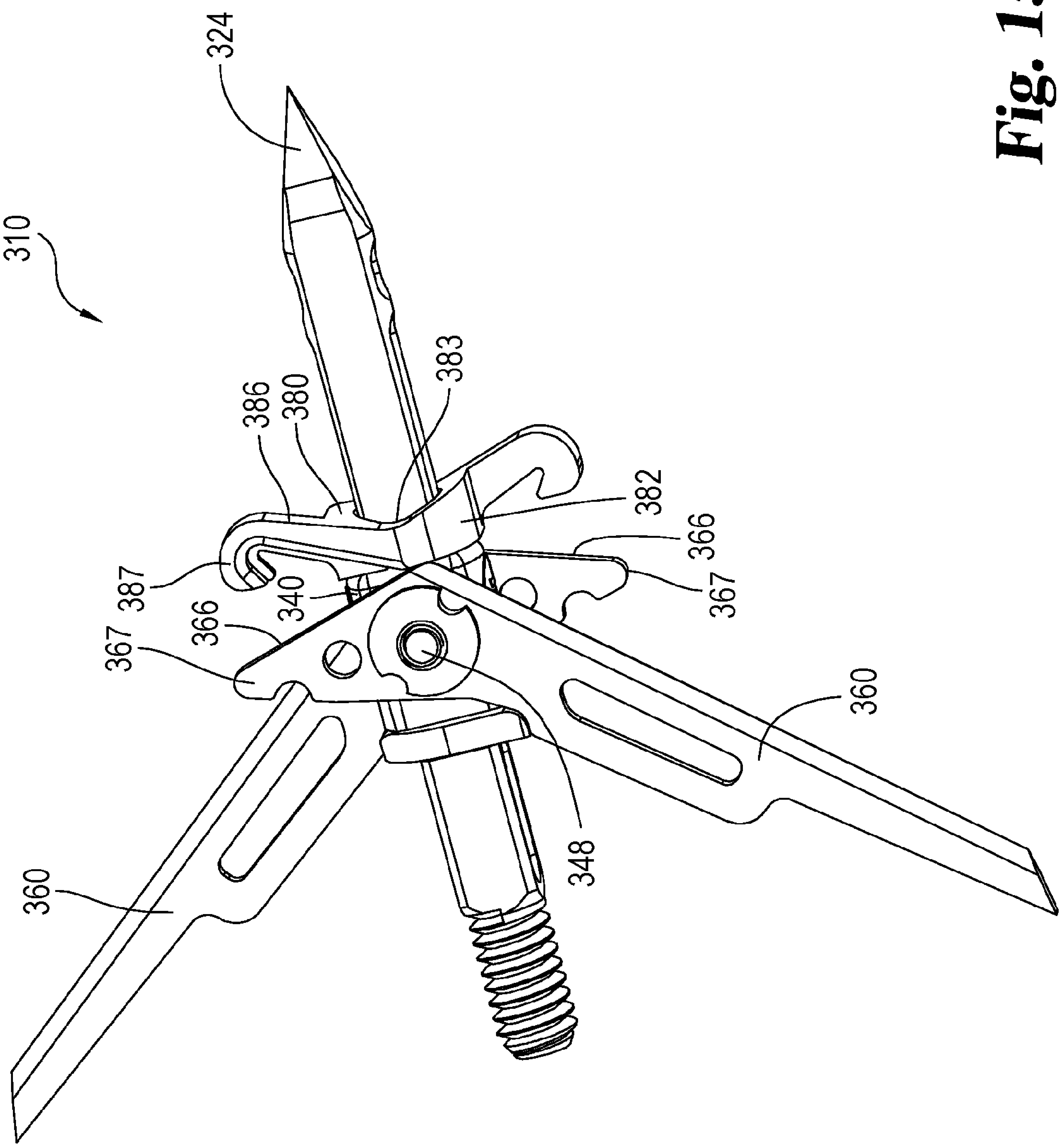

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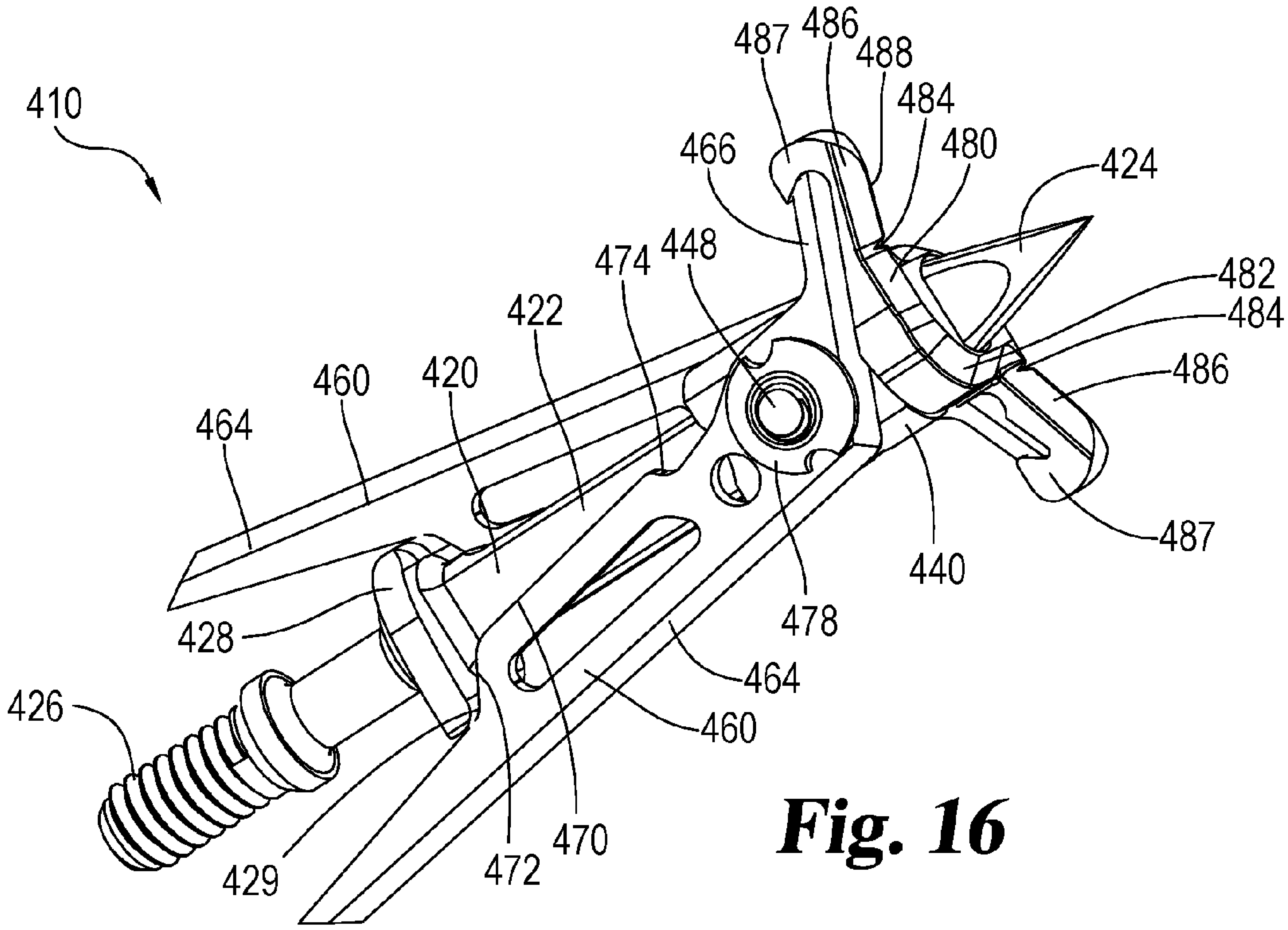
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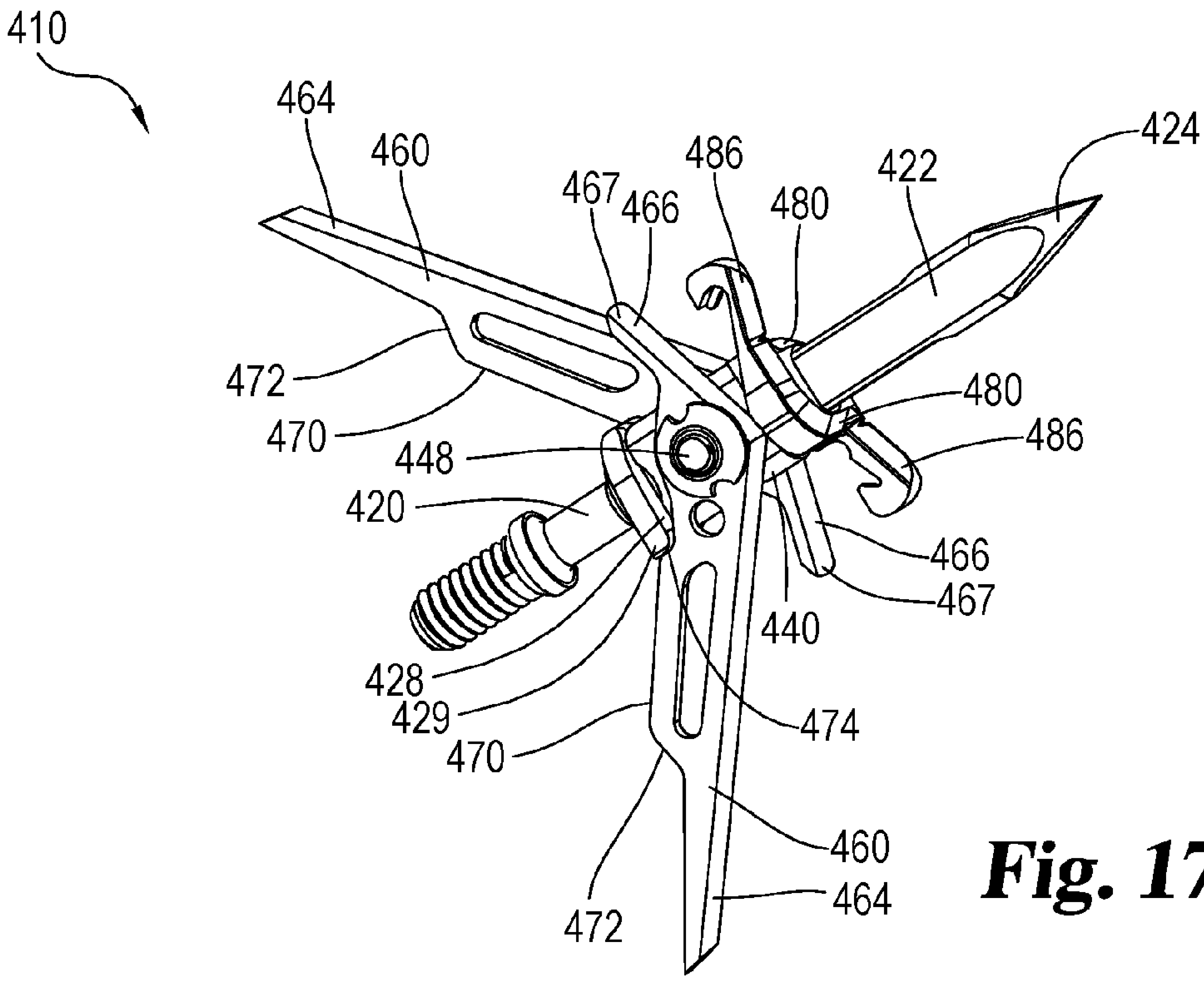
Fig. 16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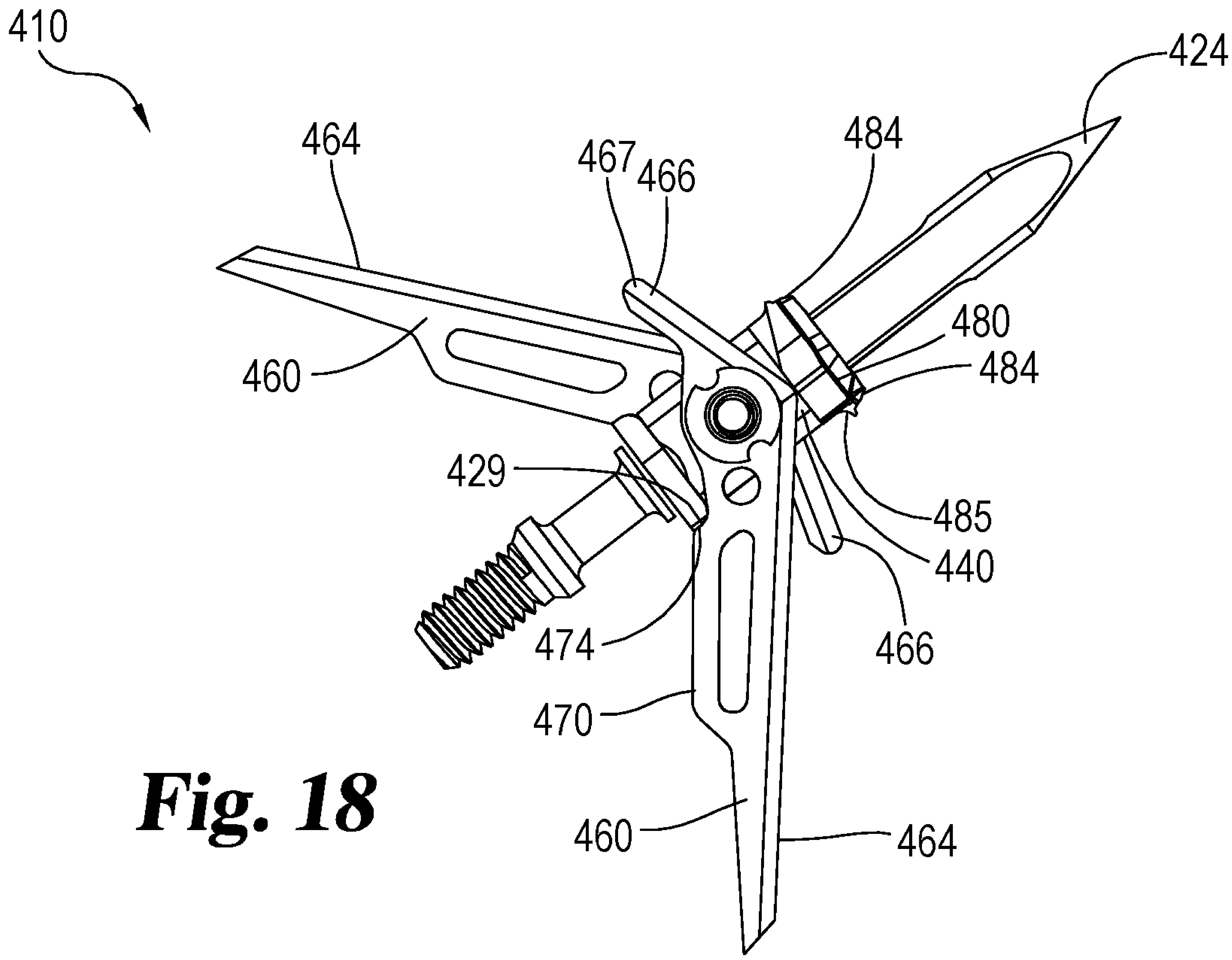
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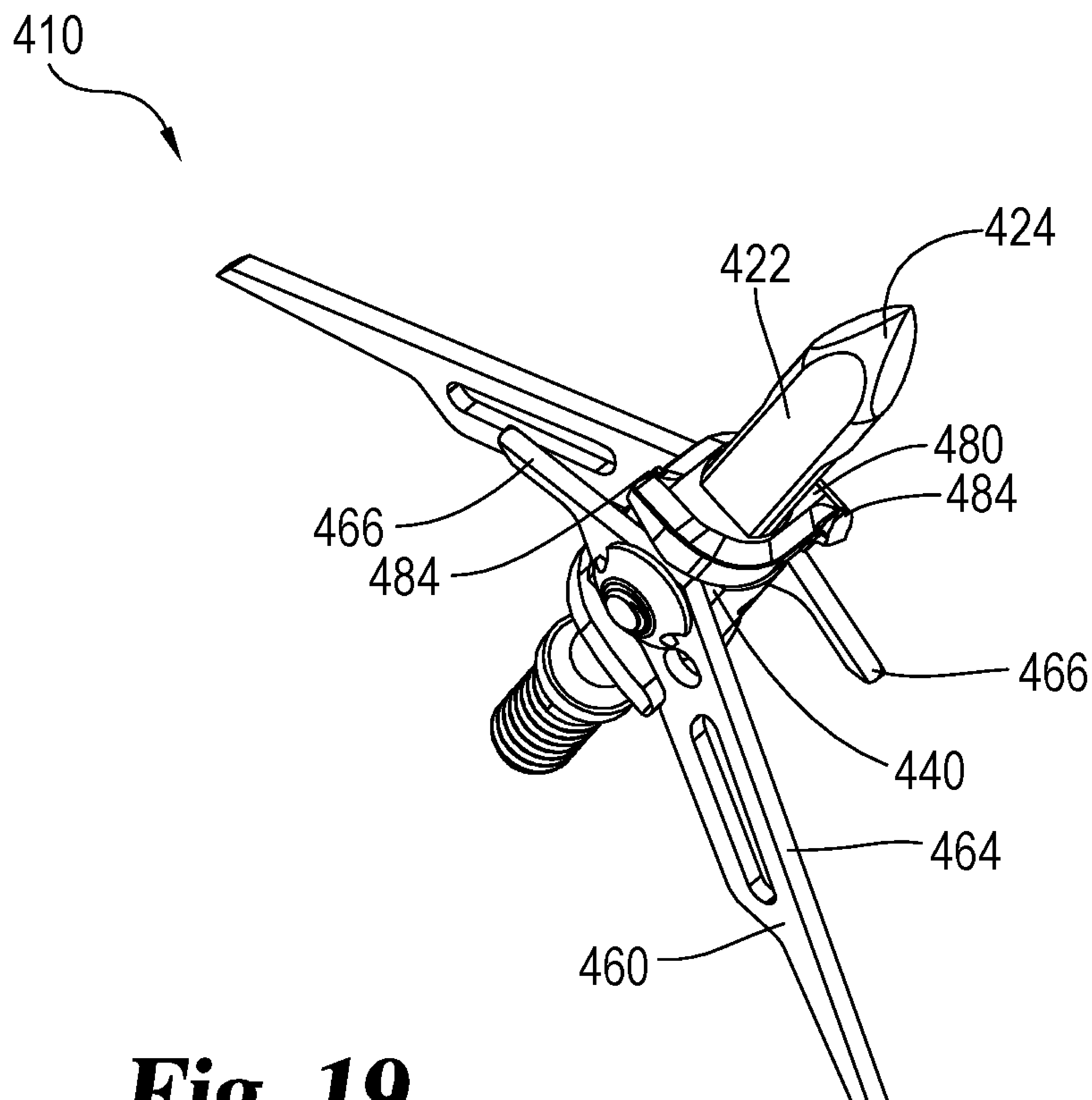
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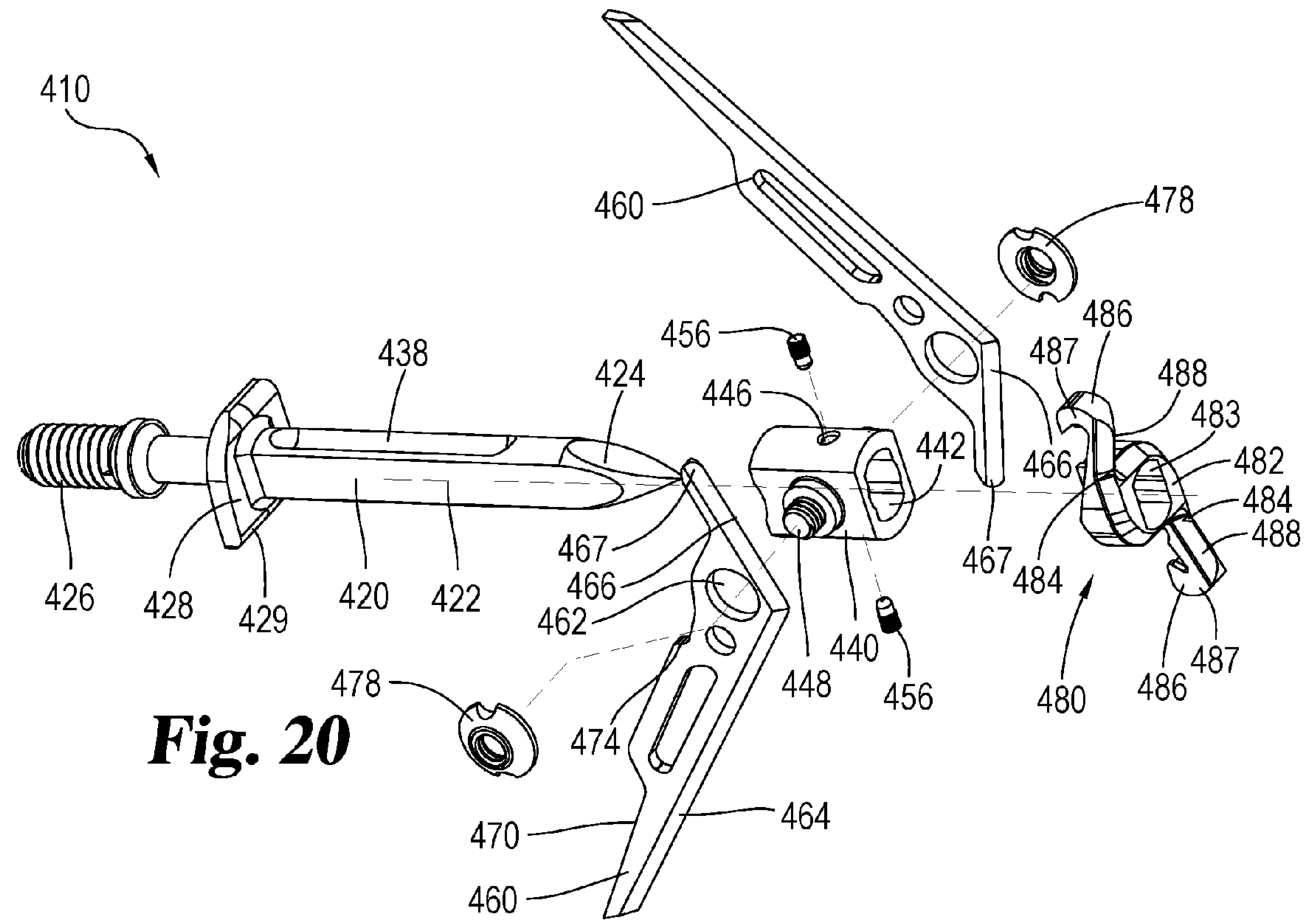

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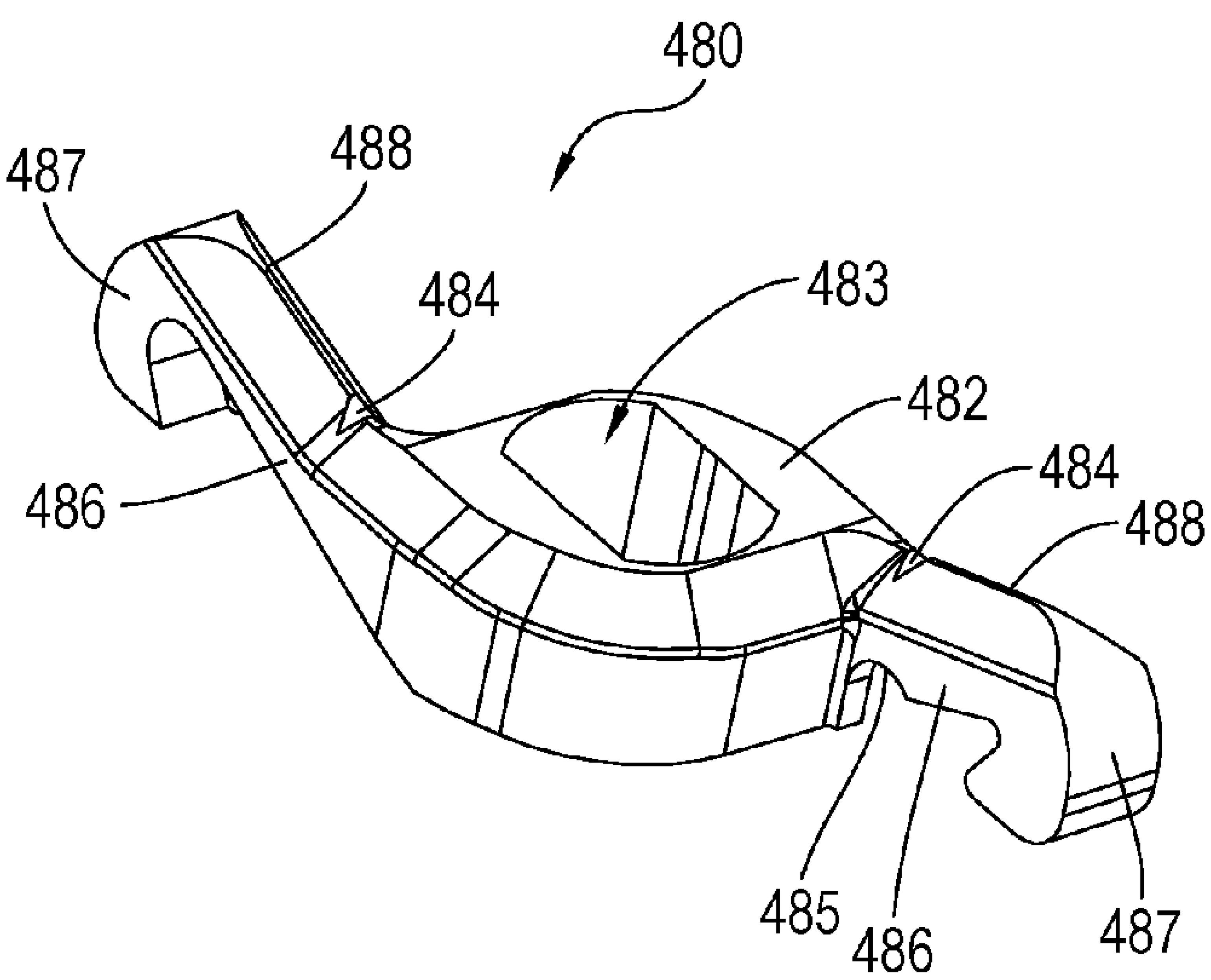

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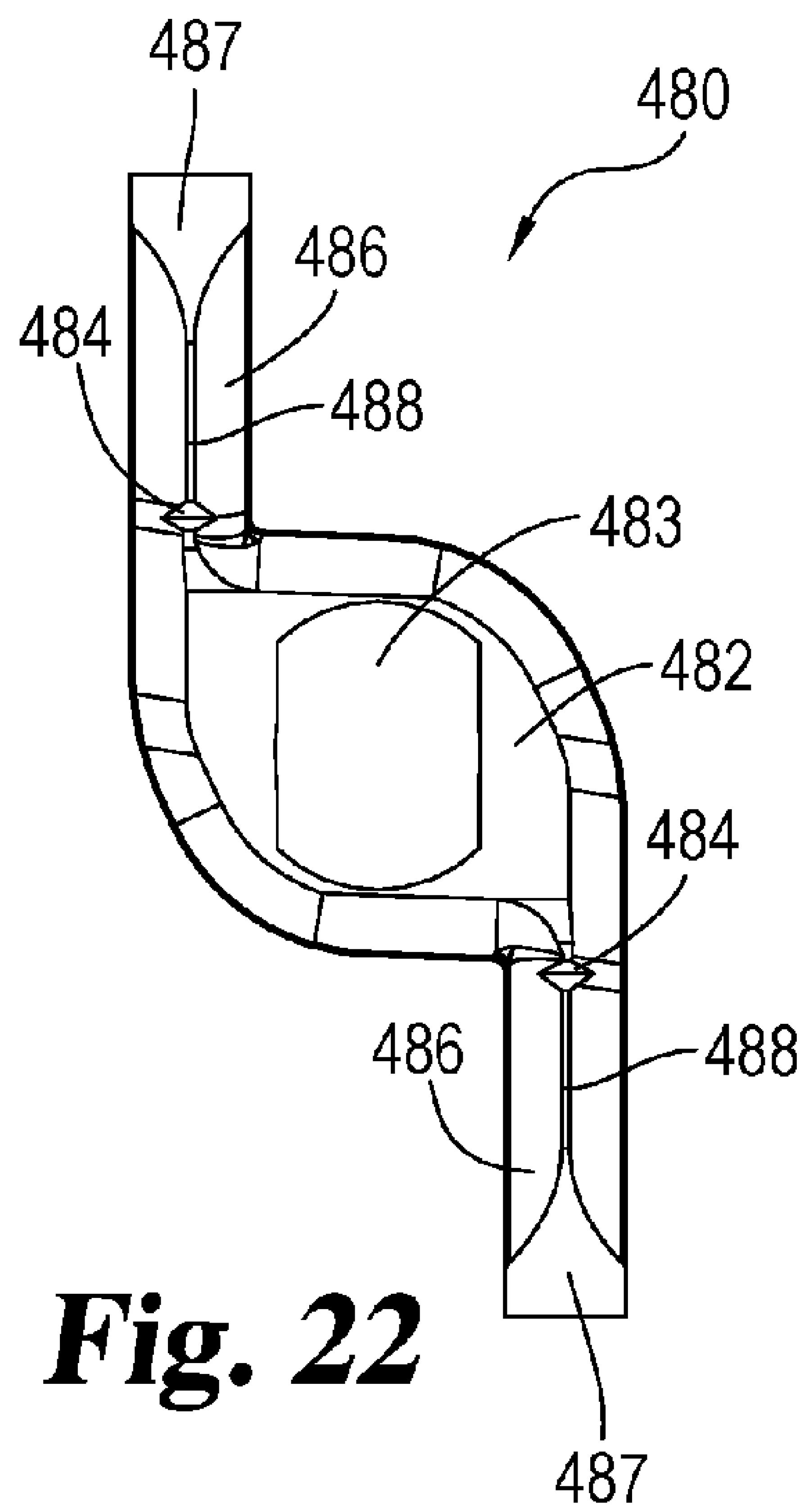

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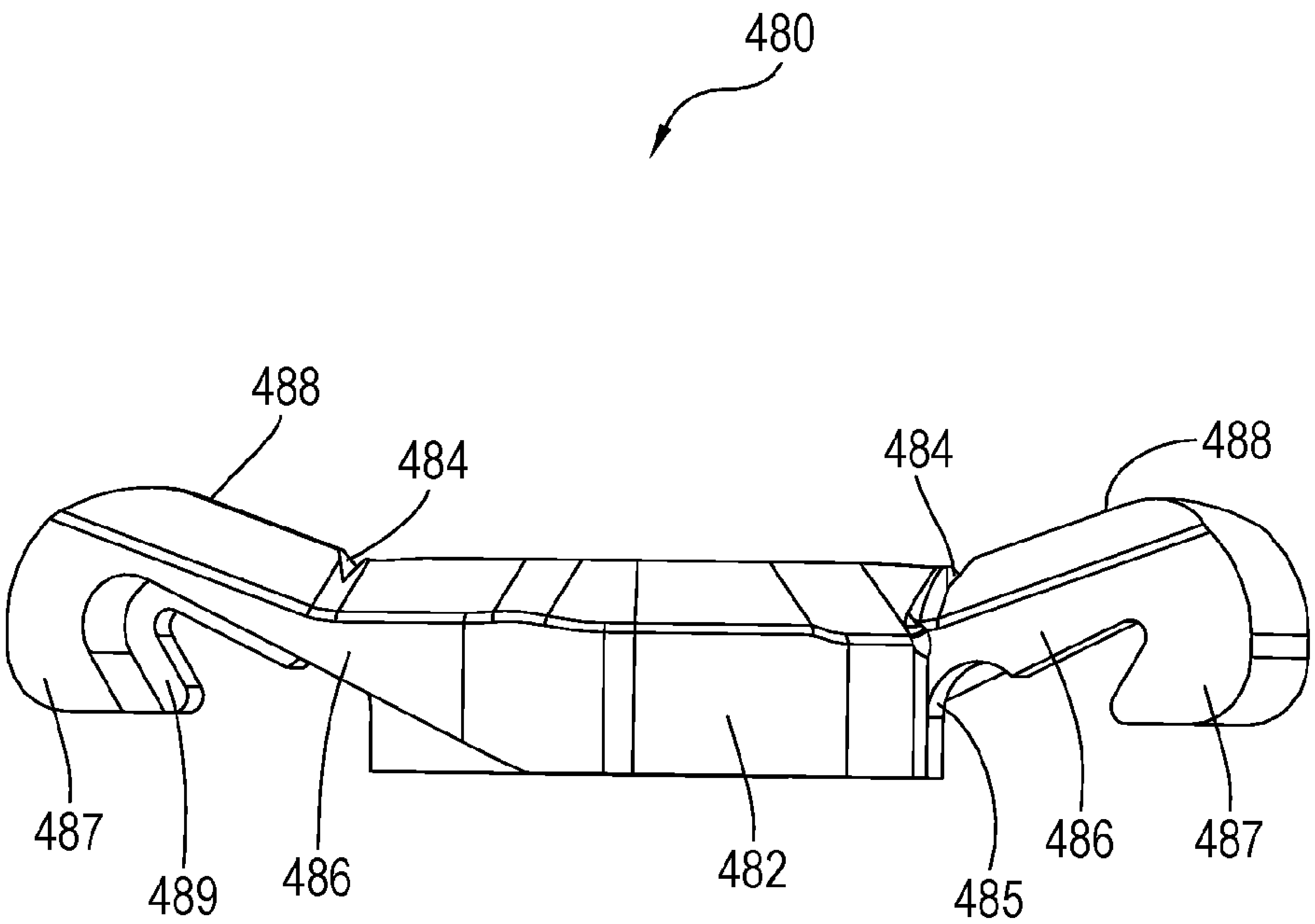
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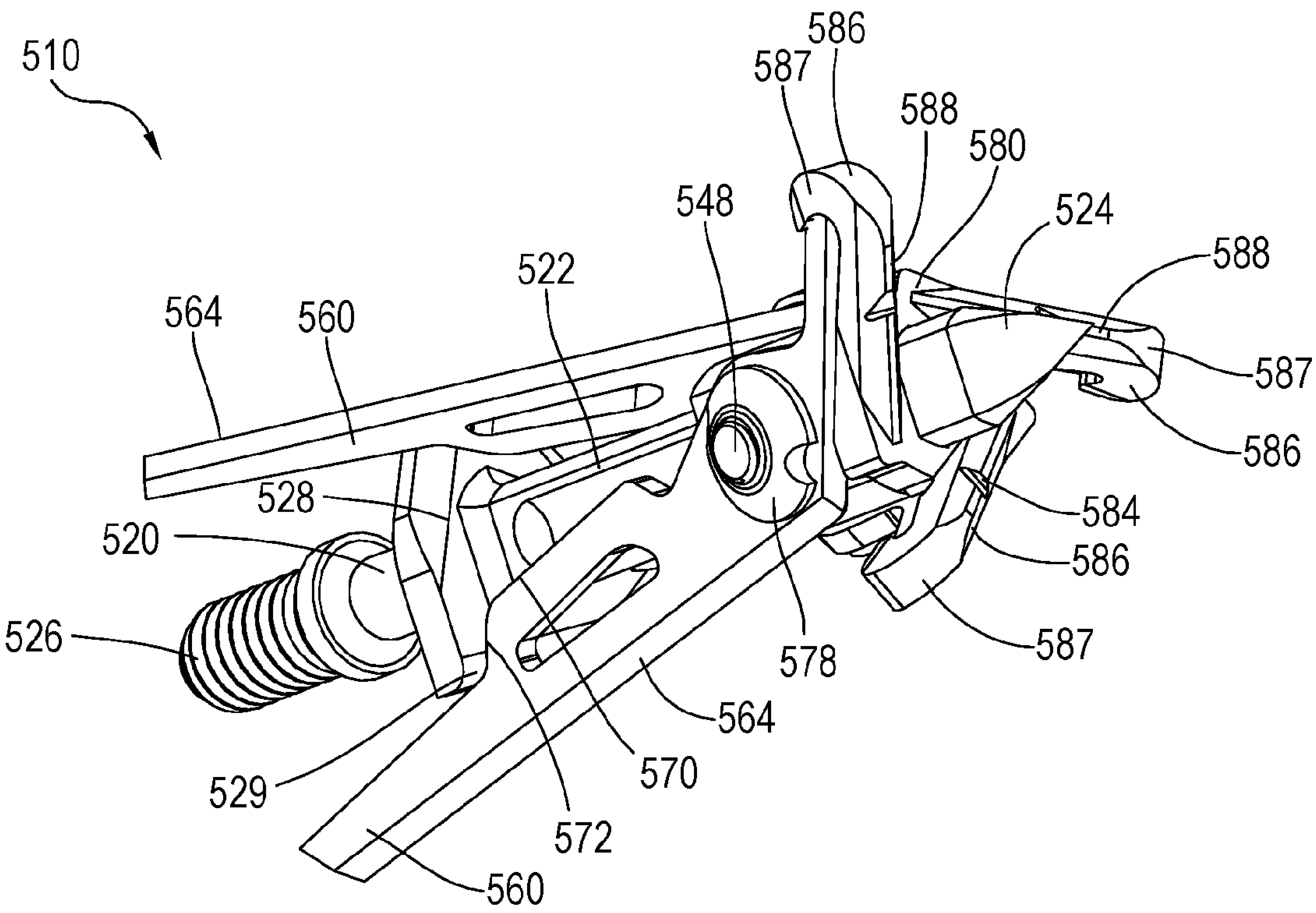
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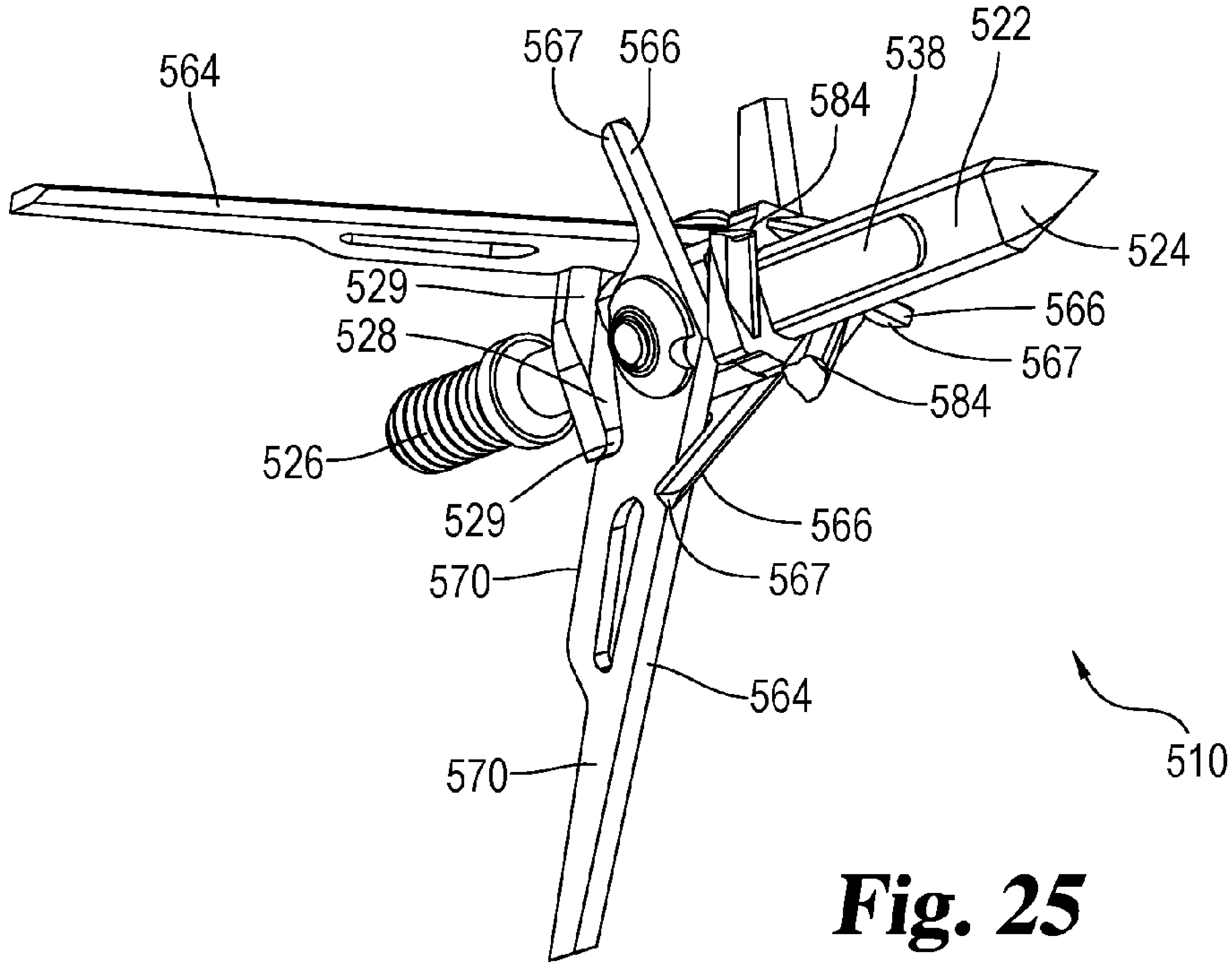
Fig. 24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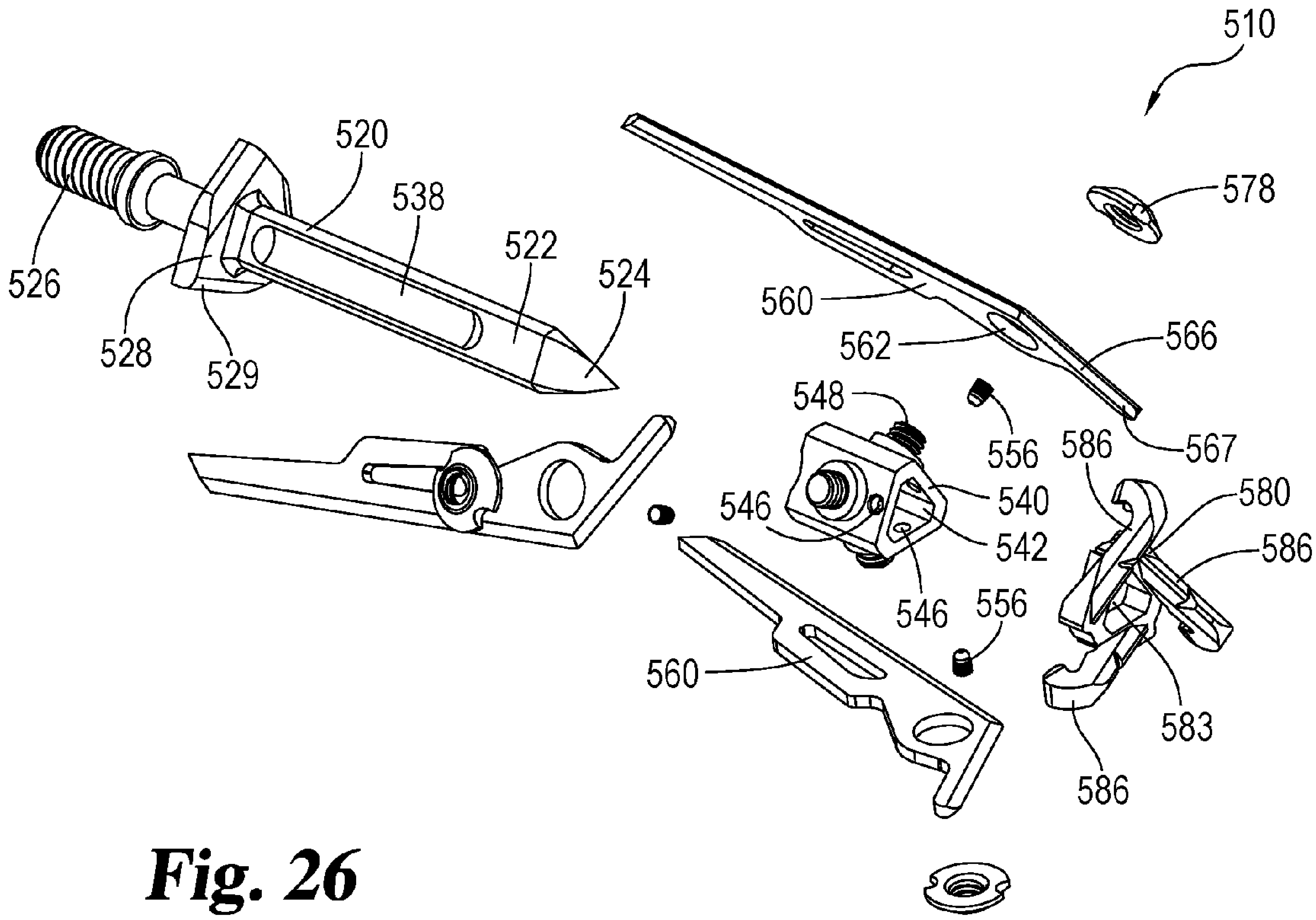
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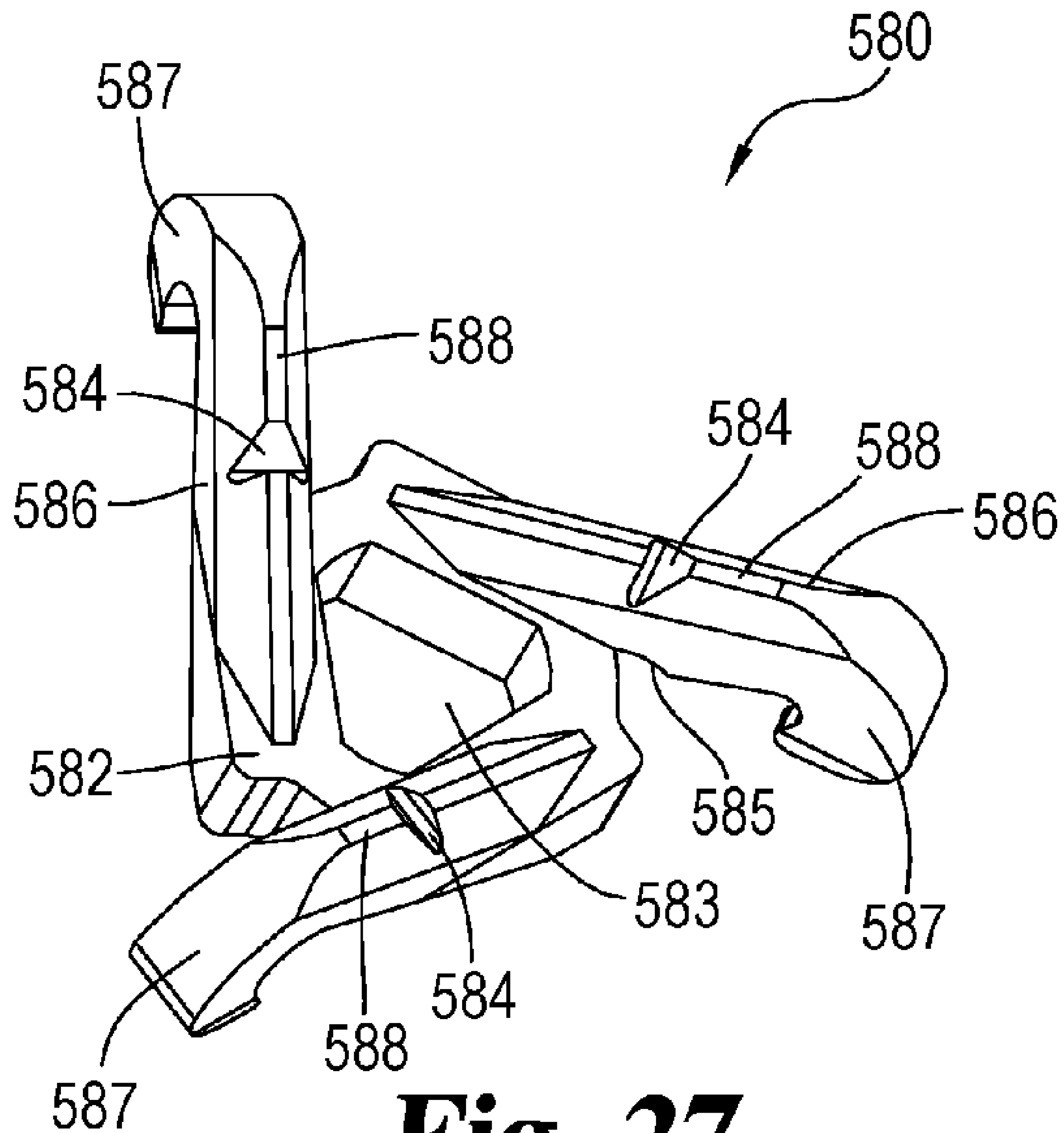
Fig. 26



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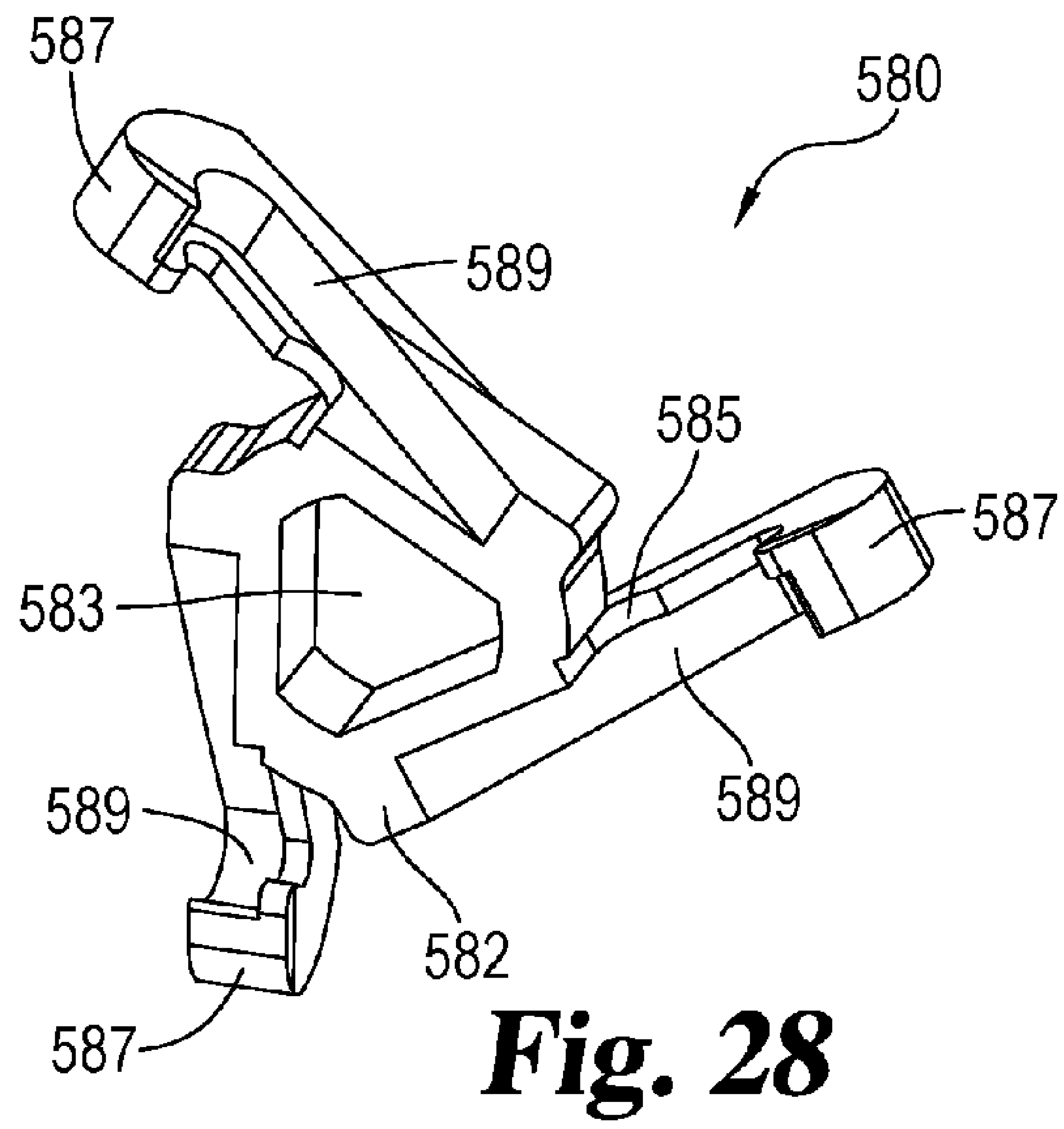

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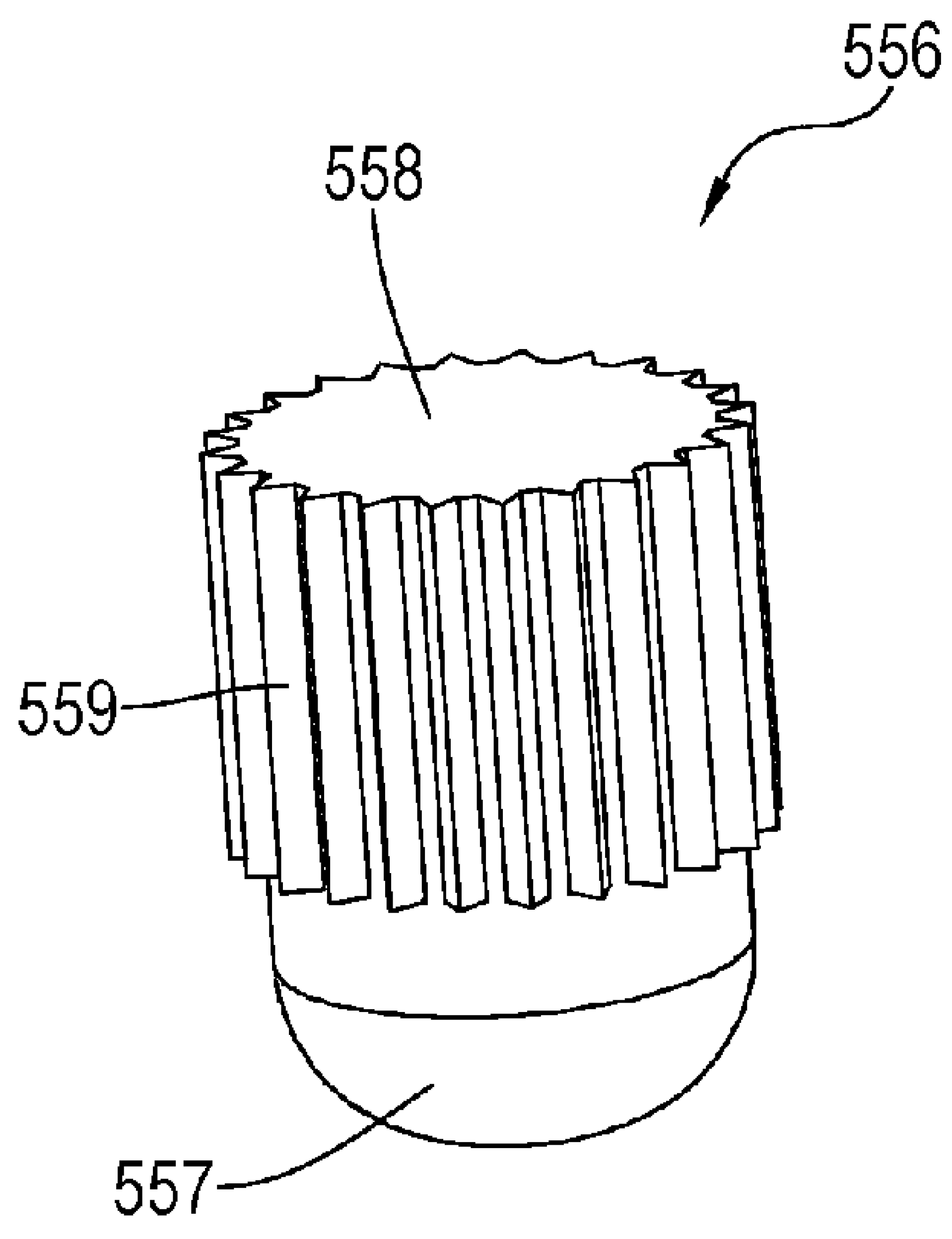

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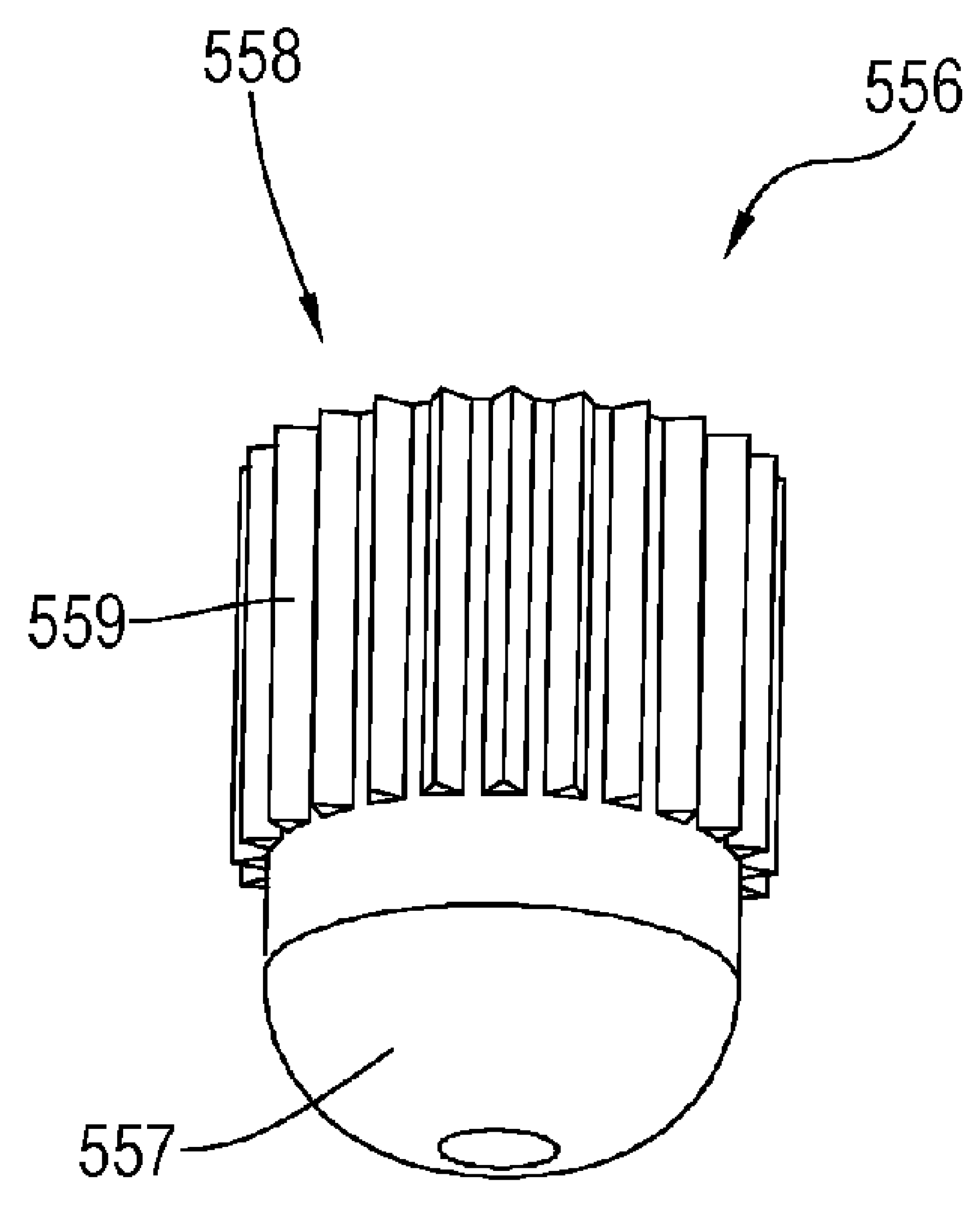

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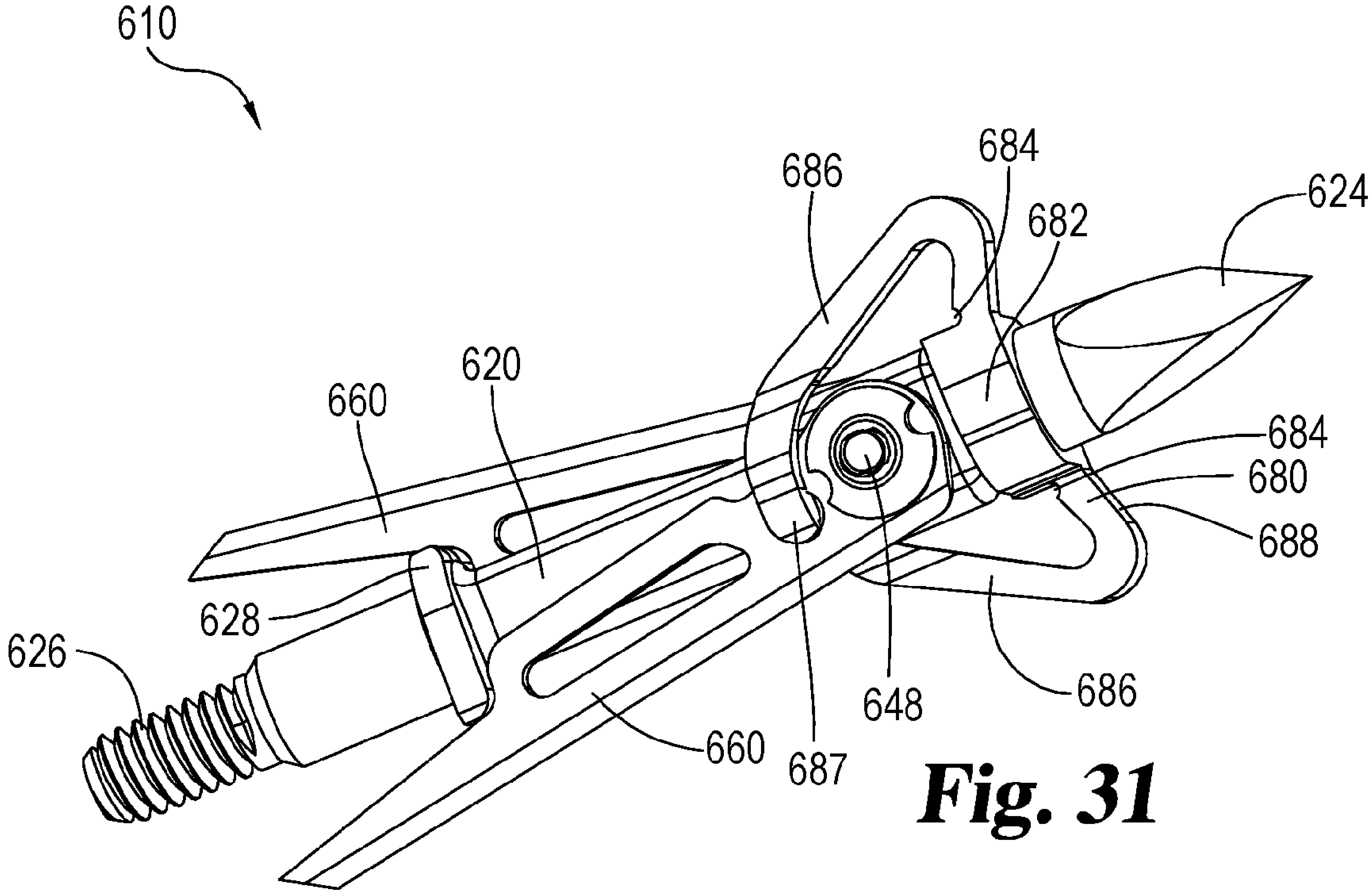
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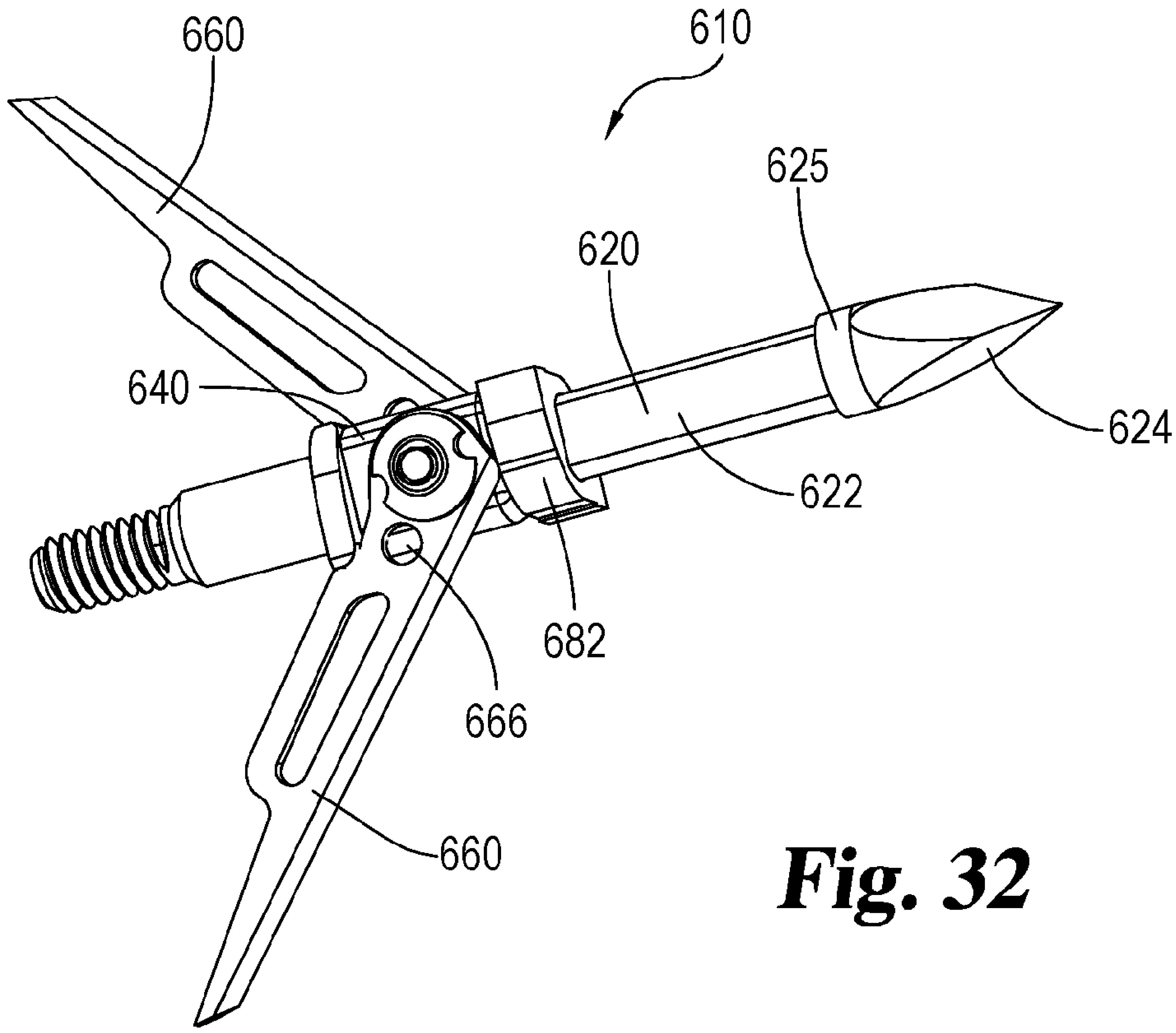
Fig. 31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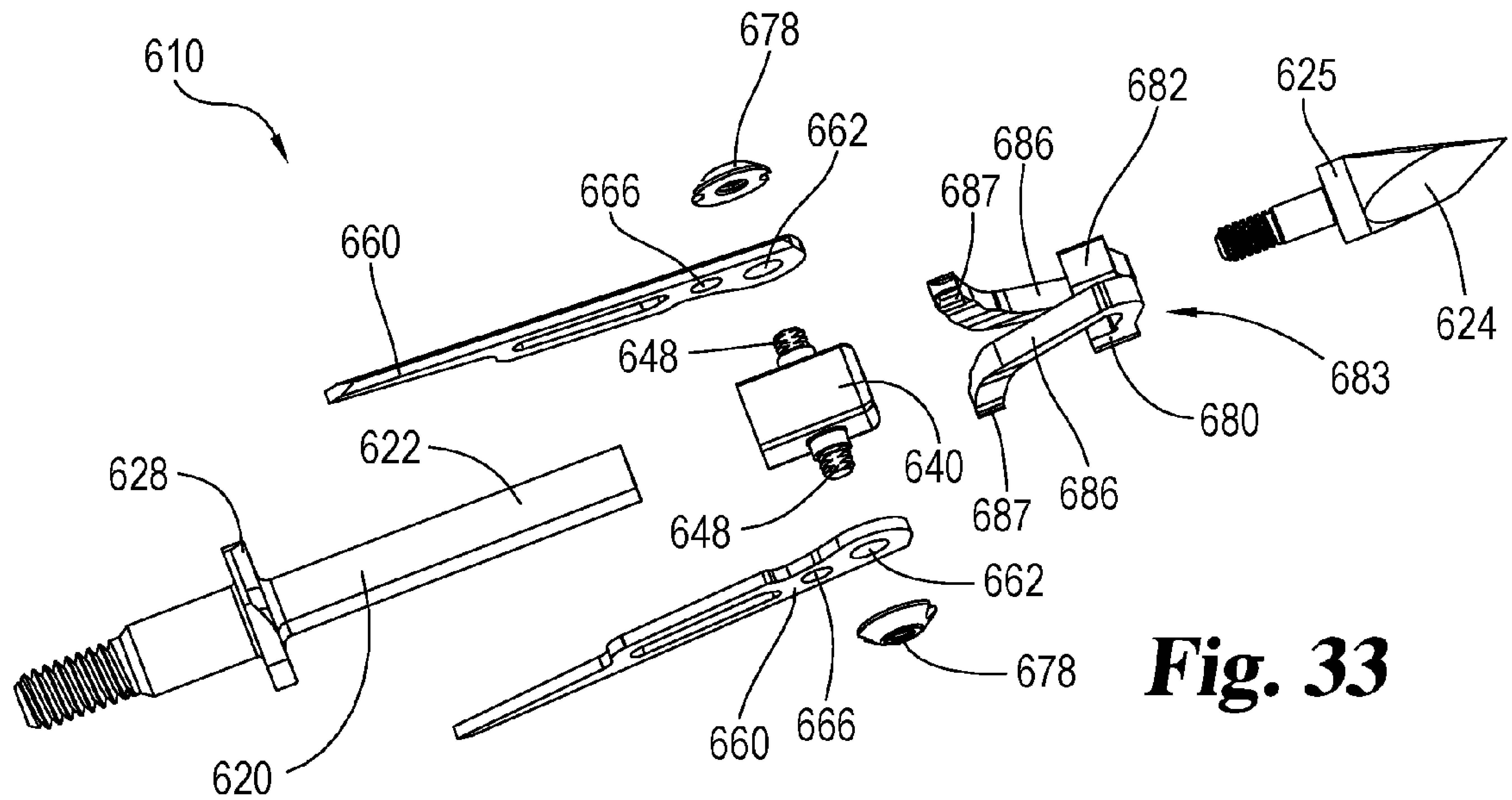
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Fig. 33

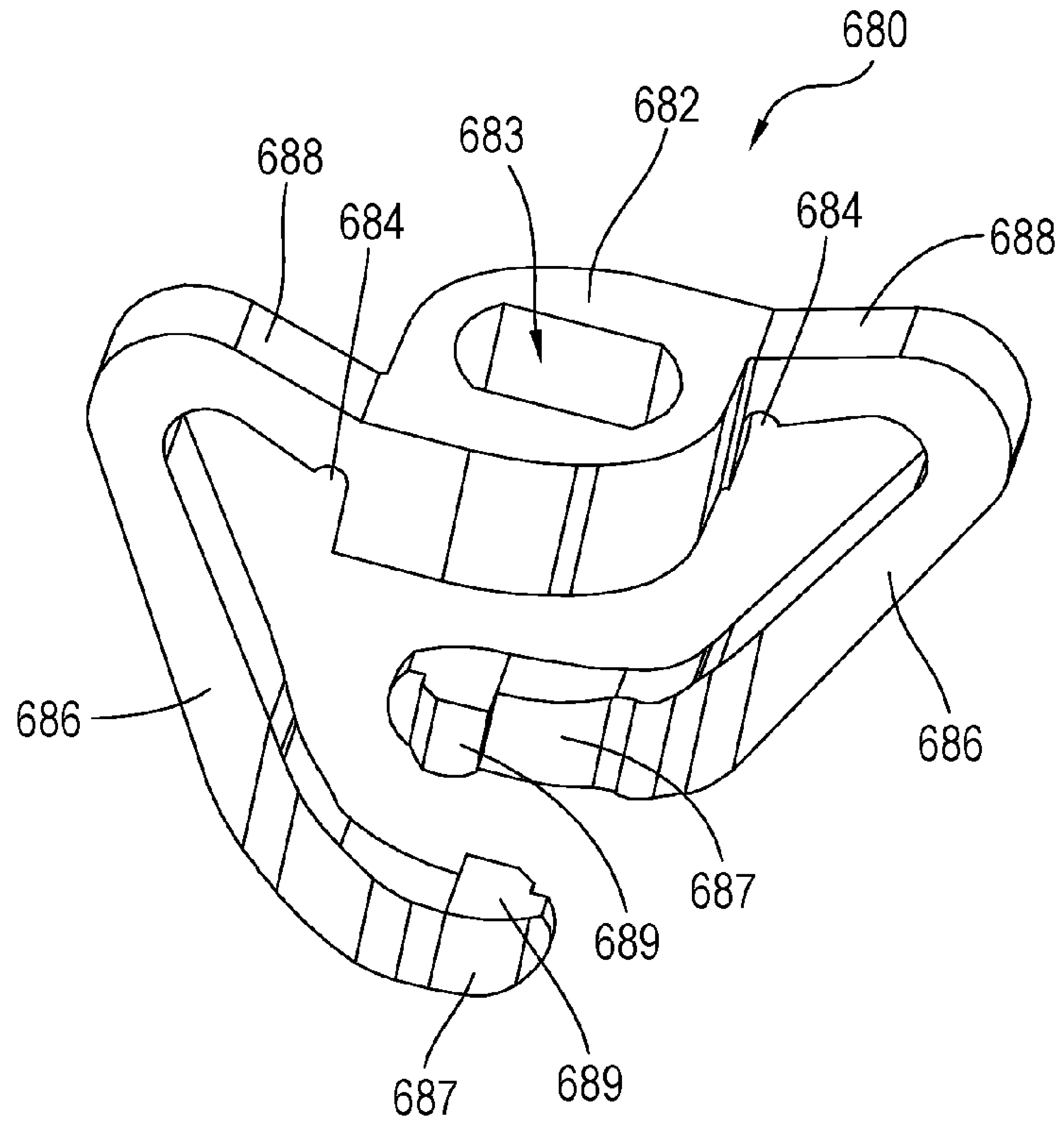
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Fig. 34

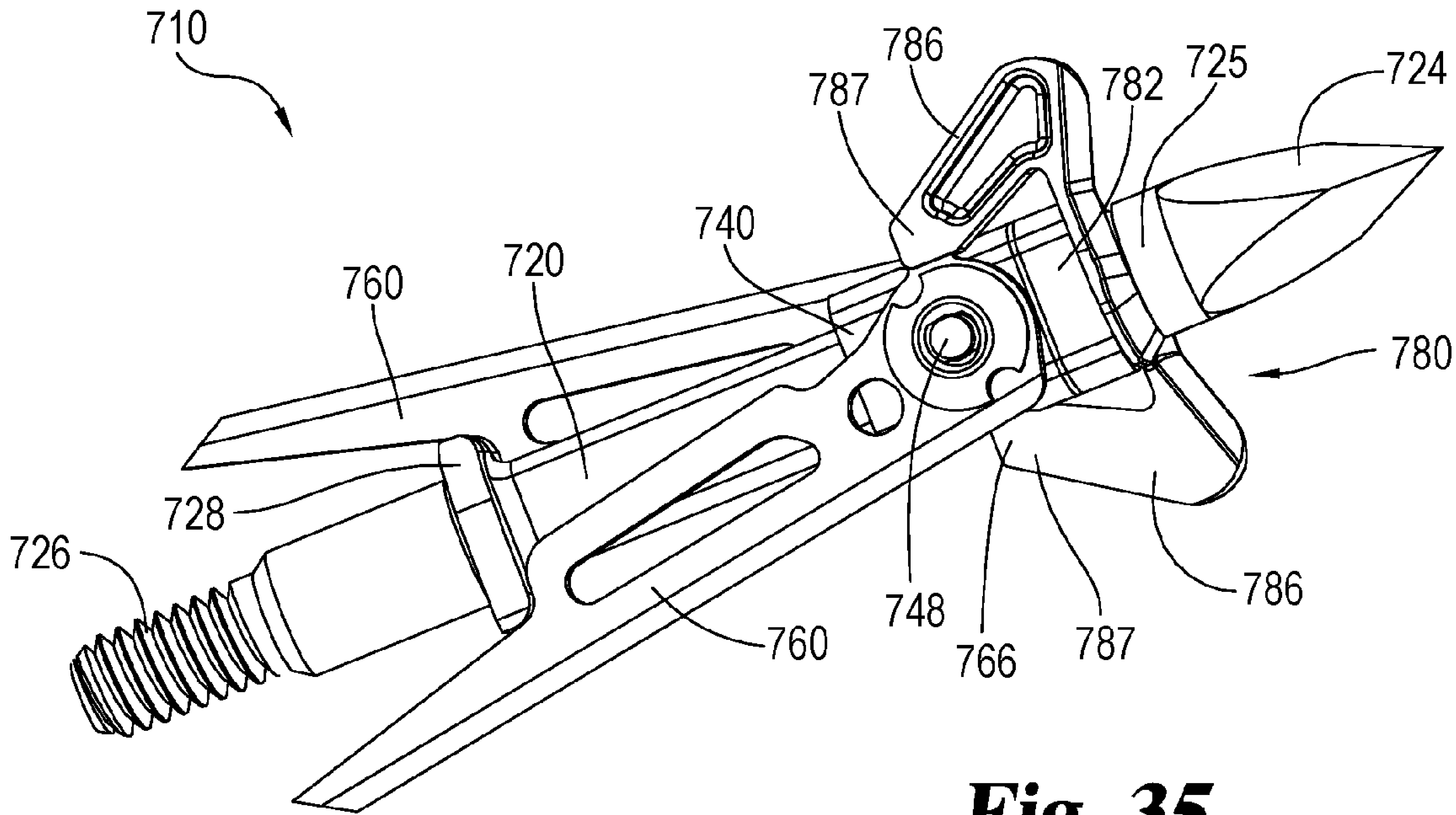
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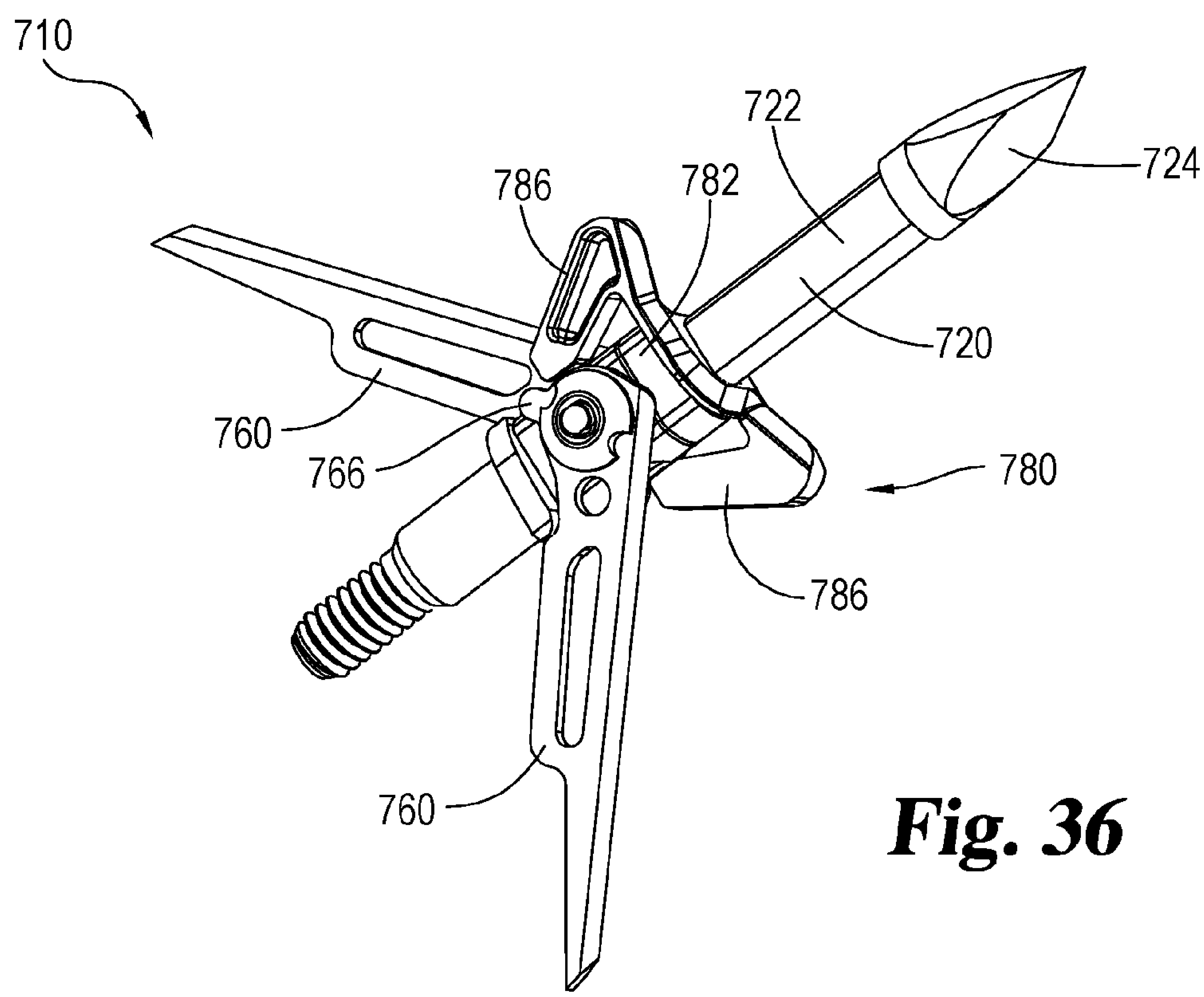
Fig. 35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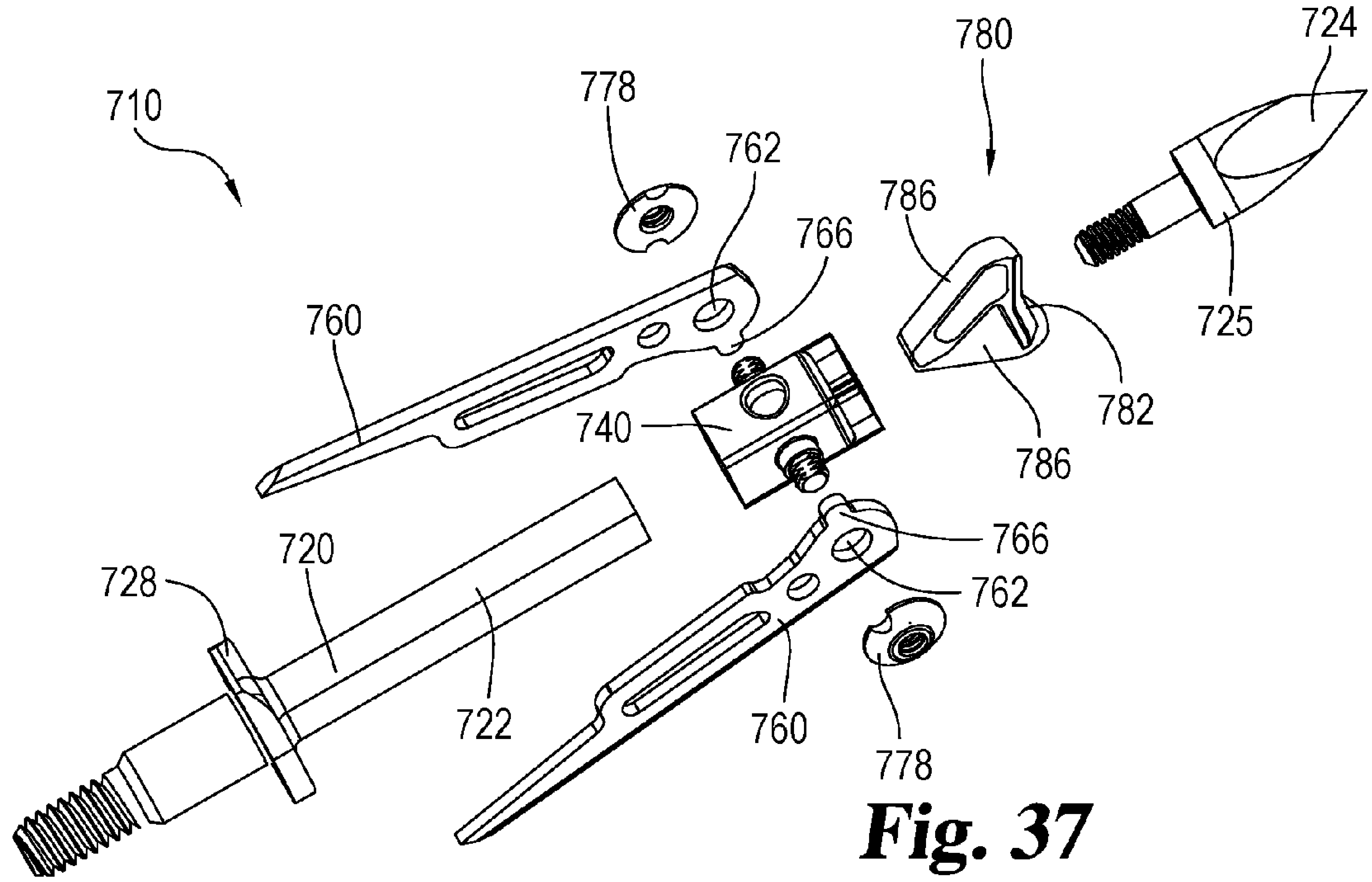
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Fig. 37

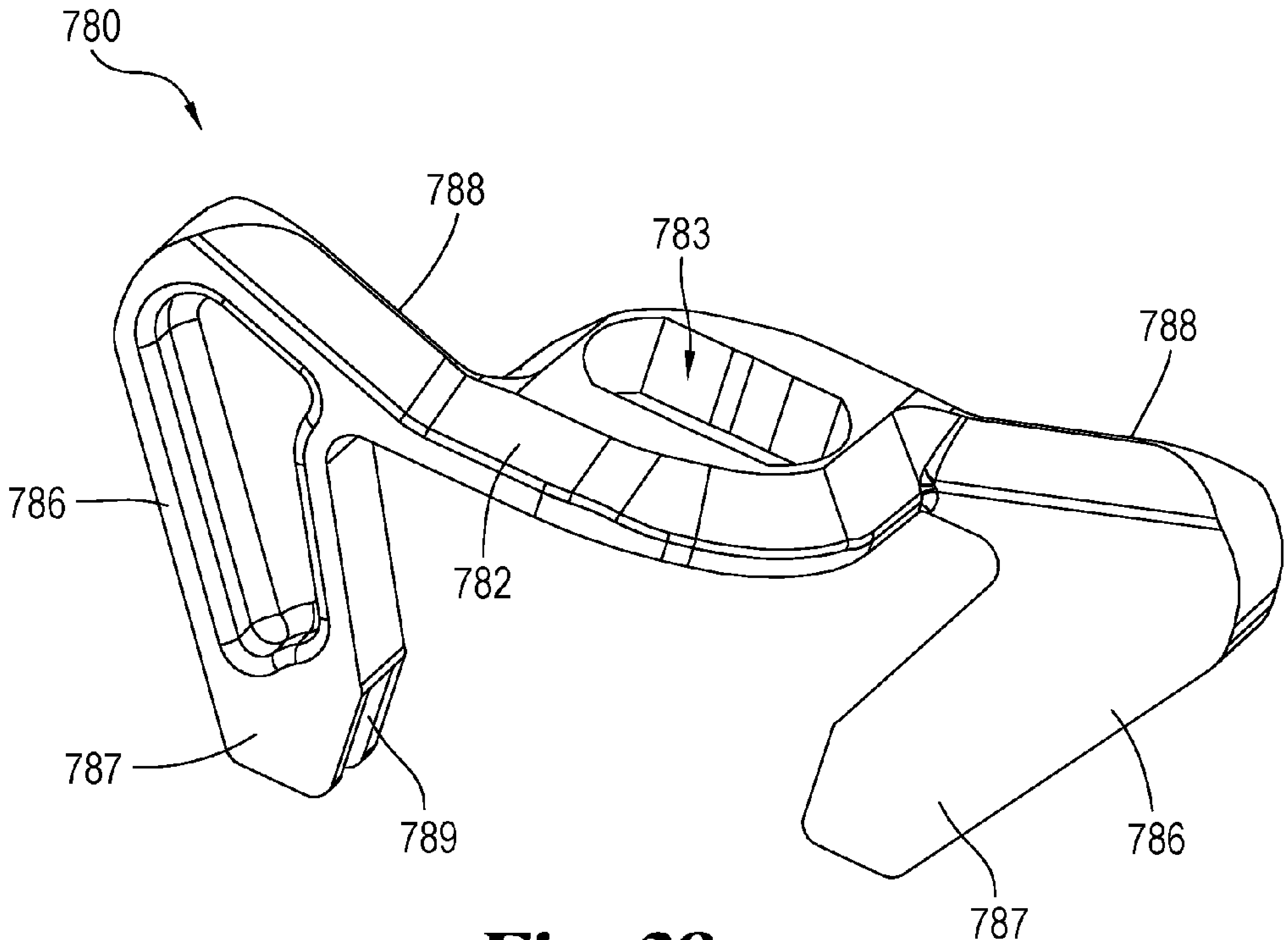
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Fig. 38

BROADHEAD

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

This application is a reissue of U.S. Pat. No. 9,664,484 issued on May 30, 2017.

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of application Ser. No. 14/726,918 filed on Jun. 1, 2015 and claims the benefit of U.S. Provisional Patent Application Ser. No. 62/007,620 filed on Jun. 4, 2014 and U.S. Provisional Patent Application Ser. No. 62/024,107 filed on Jul. 14, 2014, which are incorporated herein by reference in their entirety.

FIELD OF ENDEAVOR

This disclosure relates broadly to an expandable broadhead for arrows and more particularly to a broadhead having a mechanism to outwardly extend the blades upon impact with a target.

BACKGROUND

In archery, a fired arrow is equipped with a point or head that engages a target. In bowhunting, a broadhead type of arrowhead may be used to increase damage to or bleeding of the target and otherwise facilitate capture of the target. Some broadheads are fired in a closed, aerodynamic position, and, upon impact with a target, are mechanically activated to expand and provide a broader cutting diameter.

SUMMARY

Various embodiments of the present disclosure include a mechanical broadhead for use with an archery bow and arrow. In certain arrangements, a broadhead is provided that maintains the cutting blades in a retracted or closed position during flight of the arrow. Upon target contact, the blades expand outwardly from the closed position.

In certain embodiments, the broadhead includes a body defining a shaft portion. A hub is slidably mounted on the shaft portion. One or more cutting blades are pivotally attached to the hub. A retaining element biases the blades to a closed position. Optionally, the blades abut a rearward shelf on the body which assists to maintain the blades in a closed position prior to impact. Upon impact, the target surface impacts the leading edges of the blade and hub assembly. The initial impact causes an initial unlocking rotation of the blades, which disengages the blades from the rearward shelf and which may break or dislodge the retaining member. As the broadhead continues to travel forward, the hub and blade assembly moves rearward relative to the shaft portion. The blades are balanced and synchronized to slide along camming surfaces so that the blades rotate outward to a deployed position. As the blades and hub reach their rearwardmost position the blades are locked in the deployed, fully expanded position.

In certain alternate embodiments, arranged between each blade and hub is an activation arm. The activation arms are pivotally attached to the exterior of hub. A forward edge of each activation arm forms an impact surface. A central area of each activation arm surrounds and engages the upper end portion of a blade. The engagement between the activation arm and the blade upper end portion rotationally locks the blade and activation arm together. Optionally, each activation arm includes a retention feature which engages hub to inhibit rotation of the activation arm and blade when the broadhead is in the closed position.

In certain further embodiments, arranged forward of a hub and blades is a deployment slider. The rearward surface of deployment slider abuts the forward surface of the hub. The slider includes impact arms which extend laterally in front of each blade. Each impact arm defines a forward facing impact edge or surface. The rearward face of each impact arm defines a surface with a length and width which covers and abuts a blade forward edge when the broadhead is in the closed position. The impact arms have outer ends which receive and partially encircle a blade leading tip or corner. The slider engages the blades in the closed position to inhibit rotation of the blades prior to launch and during flight.

In certain further embodiments, a broadhead arrowhead includes a broadhead body adapted to attach to an arrow shaft, the broadhead body having a forward end and having a shaft portion between the forward end and a rearward shelf, the shaft portion defining a longitudinal axis. A hub and blade assembly includes a hub slidably mounted on the shaft portion between the forward end and the shelf. At least one blade is pivotally attached to the exterior of the hub and operable between a closed position and an open position. A deployment slider is arranged on the broadhead body forward of the hub and blade assembly, the deployment slider having a slider body and at least one laterally extending impact arm, with the impact arm configured to retain the at least one blade in a closed position. The at least one blade abuts the shelf in a closed position prior to impact and wherein an impact causes an unlocking rotation of the blade which disengages the blade from the rearward shelf and the impact arm. After the initial impact, the slider body and the hub and blade assembly move rearward relative to the shaft portion. During the rearward movement the blades slide upon a camming surface defined by the shelf, forcing the blades to rotate outward to a deployed position; so that when the hub and blade assembly reaches a rearwardmost position the blades are locked in a deployed, fully expanded position.

Certain alternate embodiments encompass a broadhead arrowhead having a broadhead body adapted to attach to an arrow shaft, the broadhead body having a forward end and having a shaft portion, the shaft portion defining a longitudinal axis. A hub and blade assembly including a hub is slidably mounted on the shaft portion and a plurality of blades are pivotally attached to the exterior of the hub, each blade operable between a closed position and an open position. A deployment slider is arranged on the broadhead body forward of the hub and blade assembly, the deployment slider having a slider body and a plurality of impact arms, with an impact arm extending laterally in front of each blade and configured to retain the respective blade in a closed position. Wherein upon an initial impact, each blade rotates and is no longer retained by the respective impact arm; and wherein after the initial impact, the slider body and the hub and blade assembly move rearward relative to the shaft portion and wherein during the rearward movement the blades rotate outward to a deployed position.

In still further alternate embodiments, a broadhead arrowhead includes a broadhead body adapted to attach to an arrow shaft, the broadhead body having a forward end and having a shaft portion, the shaft portion defining a longitudinal axis. A hub and blade assembly including a hub is slidably retained on the shaft portion, and a plurality of blades are pivotally attached to the exterior of the hub and operable between a closed position and an open position. Each blade has a sharpened outward cutting edge and a forward facing edge, and each blade defines a plane parallel to and offset from the longitudinal axis. A deployment slider is arranged on the broadhead body forward of the hub and blade assembly. The deployment slider has a slider body and a plurality of impact arms, with each impact arm extending laterally in front of and covering the forward facing edge of a respective blade. Wherein each impact arm is designed to break away from the slider body upon impact.

Other objects and attendant advantages will be readily appreciated as the same become better understood by references to the following detailed description when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of a mechanical broadhead in a closed position according to an embodiment of the disclosure.

FIG. **2** is a perspective view of the broadhead of FIG. **1**

FIG. **3** is a front view of the broadhead of FIG. **1**.

FIG. **4** is a side view of the broadhead of FIG. **1** in an open position.

FIG. **5** is a perspective view of the broadhead of FIG. **1** in an open position.

FIG. **6** is an exploded view of the broadhead of FIG. **1**.

FIG. **7** is a perspective view of an alternate embodiment of a mechanical broadhead in a closed position.

FIG. **8** is a front perspective view of the broadhead of FIG. **7**

FIG. **9** is a perspective view of the broadhead of FIG. **7** in an open position.

FIG. **10** is a front perspective view of the broadhead of FIG. **7** in an open position.

FIG. **11** is an exploded view of the broadhead of FIG. **1**.

FIG. **12** is a perspective view of an alternate embodiment of a mechanical broadhead in a closed position.

FIG. **13** is a partially exploded view of the broadhead of FIG. **12**.

FIG. **14** is a perspective view of an alternate embodiment of a mechanical broadhead in a closed position.

FIG. **15** is a side view of the broadhead of FIG. **14** in an open position.

FIG. **16** is a perspective view of an alternate embodiment of a mechanical broadhead in a closed position.

FIGS. **17-19** are views of the embodiment of FIG. **16** in an open position.

FIG. **20** is an exploded view of the broadhead of FIG. **16**.

FIGS. **21-23** are views of the slider of the embodiment of FIG. **16**

FIG. **24** is a perspective view of an alternate broadhead embodiment in a closed position.

FIG. **25** is a view of the embodiment of FIG. **24** in an open position.

FIG. **26** is an exploded view of the broadhead of FIG. **24**.

FIGS. **27-28** are views of the slider of the embodiment of FIG. **24**.

FIGS. **29-30** are views of a retaining pin used with the embodiments of FIGS. **16** and **24**.

FIG. **31** a perspective view of an alternate embodiment of a broadhead in a closed position.

FIG. **32** is a view of the embodiment of FIG. **31** in an open position.

FIG. **33** is an exploded view of the broadhead of FIG. **31**.

FIG. **34** is a view of the slider of the embodiment of FIG. **31**.

FIG. **35** a perspective view of an alternate embodiment of a broadhead in a closed position.

FIG. **36** is a view of the embodiment of FIG. **35** in an open position.

FIG. **37** is an exploded view of the broadhead of FIG. **35**.

FIG. **38** is a view of the slider of the embodiment of FIG. **35**.

DETAILED DESCRIPTION OF EMBODIMENTS

For the purposes of promoting an understanding of the principles of the disclosure, reference will now be made to the embodiments illustrated and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the disclosure is thereby intended, such alterations, modifications, and further applications of the principles being contemplated as would normally occur to one skilled in the art to which the invention relates

Various embodiments of the present disclosure include a mechanical broadhead for use with an archery bow and arrow that maintains the cutting blades in a retracted or closed position during a flight of the arrow. In some embodiments, a hub and blade assembly is slidably mounted on the shaft portion of a broadhead body. One or more blades are pivotally attached to the hub and are operable between a closed position and an open position. In certain embodiments, a deployment slider is arranged on the broadhead body forward of the hub and blade assembly. The deployment slider has a slider body and a plurality of impact arms, with each impact arm engagable to retain a blade in the closed position prior to launch and during flight of the arrow. Upon target impact, the blades expand from the closed position to an open position.

Directional references herein are for ease of explanation and are not intended to be limiting.

FIGS. **1-6** show views of an embodiment of a broadhead generally designated **10**. The broadhead **10** is adapted for mounting to an open end of a hollow arrow shaft. The broadhead **10** includes a body **20**. Body **20** has a forward end with a pointed tip **24**, and a rearward end **26** configured to be connected to an arrow shaft. For example, rearward end **26** may include threads configured for pairing with threads inside of the arrow shaft. In other forms, broadhead **10** may be mounted to an arrow shaft in other ways, such as with mechanical fasteners, adhesives, resins, mounting on a ferrule or arrow shaft insert, or using other attachment techniques.

The forward end of broadhead body **20** includes tip **24**. The tip **24** may be made integrally with or separate and attached to a forward portion of a central shaft **22**. Typically, the pointed tip **24** is tapered rearwardly and outwardly. The tip base may extend outward from or may merge with the profile of shaft **22**. Shaft **22** preferably is formed with a non-circular cross-section, for example in the illustrated embodiment shaft **22** has a substantially square cross-section.

In certain embodiments, a rearward portion of shaft **22** transitions into a shelf or ledge **28**, extending radially outward from at least portions of the sides of shaft **22**.

Certain edges of shelf or ledge **28** may form camming surfaces **29**. A portion of body **20** extends rearward from shelf **28** to rearward end **26**. Body **20** can be integrally made as a single piece. Alternately, body **20** may be assembled from one or more pieces secured together.

Hub **40** is slidably mounted on shaft **22**, typically between tip **24** and shelf **28**. Hub **40** is operable to translate forward or rearward relative to shaft **22**. Hub **40** defines an interior passage **42** with a cross-section sized and shaped to approximately match the cross-section of shaft **22** and which inhibits rotation of hub **40** with respect to shaft **22**. In the illustrated embodiment, a pair of retaining balls **56** are mounted between a pair of opposing internal sides of hub **40** and shaft **22** on opposing sides of shaft **22**. Portions of retaining balls **56** are partially received in openings **46** defined in opposing sides of hub **40**. In certain embodiments, openings **46** are smaller than the diameter of retaining balls **56** and prevent the retaining balls from escaping the hub. Alternately, openings **46** may be the same size or slightly larger than the diameter of retaining balls **56** to allow the balls to be introduced during assembly, and the retaining balls are then retained in hub **40**, for example with adhesive or with a cover applied over the openings. A cover may include marking indicia such as a product name.

When hub **40** is in its forward-most position, typically adjacent tip **24**, portions of retaining balls **56** are received in recesses **36** defined adjacent the forward end of shaft **22**. As hub **40** slides rearward during deployment, the retaining balls leave forward recesses **36** and transition partially into a pair of recessed grooves **38** defined on opposing sides of shaft **22**. The retaining balls may be made from a semi-resilient material or a non-compressible material. Example materials include nylon, plastics such as a DELRIN® self-lubricating plastic or a metal such as steel. Recesses **36**, openings **46** and retaining balls **56** are preferably sized with an interference fit to initially resist rearward movement of hub **40**. When a sufficiently rearward force is applied the balls are compressed and/or pushed into openings **46** a sufficient distance to allow the balls to leave recesses **36** allowing the hub to begin sliding rearward. As hub **40** continues to slide rearward, the retaining balls translate along grooves **38**.

Hub **40** includes a pair of mounting posts **48** extending outward perpendicular to the longitudinal axis of shaft **22**. Mounting posts **48** are arranged on opposing exterior sides of hub **40**, typically on alternate sides from openings **46**.

One or more cutting blades **60** are pivotally attached to the exterior of hub **40**. As illustrated, the flat sides of each blade define a plane which is parallel to yet offset or angled so the plane does not intersect the longitudinal axis of shaft **22**. In the illustrated embodiment, a pair of blades **60** are pivotally mounted to hub **40**. As illustrated, the planes of the two blades are parallel to each other on opposing sides of the longitudinal axis of shaft **122**. A pivot axle opening **62** defined in each blade is mounted over a mounting post **48** so that the mounting post acts as an axle for the blade. The blades are secured to the exterior of hub **40** via the mounting posts while remaining operable to pivot. In the illustrated embodiment, the mounting posts have a smooth cylindrical portion with a thickness approximately matching the thickness of the blades, with threaded portions extending beyond each blade. A locknut **78** can be secured to each mounting post to retain the blades on the mounting posts. Alternately, other connection methods or fasteners can be used to pivotally mount the blades to a hub.

Each blade **60** is roughly triangular in shape, and includes an outward cutting edge **64**. Typically the outward cutting edge is the primary cutting edge and is sharpened to cut a target such as an animal. Each blade further includes a forward or impact edge **66**. Each blade **60** further includes an inward edge. The inward edge includes a central camming portion **70**. Rearward of portion **70** is a retention notch **72**. Forward of portion **70** is a locking notch **74**. Each blade may also define a biasing notch **76** adjacent the forward end of the inward edge.

FIGS. **1-3** specifically illustrate broadhead **10** in a closed configuration. In the closed position, hub **40** is at its forwardmost position, adjacent to tip **24**. In the closed position, the length of blades **60** is close to parallel to shaft **22**. The retention notch **72** of each blade abuts a forward face of shelf **28**. A biasing element **80** is located in the biasing notches **76** of the respective blades. Non-limiting examples of suitable biasing elements include an elastic band, an isomeric band, an o-ring, a torsion spring, a flat spring, a compression spring, shrink tubing, and a frangible rigid polymer band.

The biasing element typically applies pressure to bias or urge the forward ends of the inward edges towards each other and tip **24**. The pivot axes of the blades cause the blades to operate in a bell-crank type lever arrangement, so that pressure urging the forward ends of the inward edges to rotate towards the tip, correspondingly urges the rearward portions, including camming portion **70**, to rotate in the opposite direction. For purposes of illustration, as applied to the blade illustrated in the foreground of FIG. **1**, biasing element **80** urges blade **60** to rotate clockwise. This urges the forward portion of blade **60** to rotate downward (in the illustrated perspective) around mounting post **48** towards tip **24**, while the retention notch **72** is urged to rotate upward towards shelf **28**. The urging assists the retention notch to secure the blade on shelf **28** and to prevent rearward movement or radial expansion of the blades prior to launch, during launch and during flight of the broadhead with an arrow. Concurrently, retaining balls **56** are engaged between recesses **36** and openings **46** and resist rearward movement of hub **40** and blades **60** prior to launch, during launch and during flight of the broadhead with an arrow.

When used with a bow and arrow, the broadhead may be fired at a target. During storage, prior to launch, and in flight prior to impact, the broadhead **10** preferably remains in the closed position as shown in FIGS. **1-2**, preferably having aerodynamic properties. For example, an arrow equipped with a broadhead in the closed position may approximate the flight characteristics of a field point. As illustrated with a front view in FIG. **3**, the tip **24** and impact edges **66** of the blades define impact surfaces when the broadhead strikes a target. The tip **24** initially impacts a target and begins to penetrate directly or less preferably with a glancing blow. As the tip enters the target, the target surface moves along and around the tip and then impacts the surfaces of the leading edges **66** of the respective blades. The contact of the target surface with the leading edges **66** creates resistance and applies rearward force to the leading edges. The target surface may also apply rearward force to forward portions of hub **40**, mounting posts **48** and locknuts **78**. This initial impact causes an initial rotation of the blades, for example the blade in the foreground of FIG. **1** rotates counterclockwise, which causes retention notch to disengage from shelf **28** by rotating slightly radially outward over camming surface **29**. This rotation may also break or dislodge retention member **80**.

As the broadhead continues to travel forward, the target surface continues to apply rearward force to the hub and blade assembly. This causes the blades to continue to rotate while also causing the blades **60** and hub **40** to begin traveling rearward as an assembly relative to the shaft portion, overcoming the resistance of retaining balls **56**. As hub **40** begins to translate rearward, the camming portion **70** of each blade is slidably pushed against the respective camming surface **29**, assisting, via a camming or wedging force, the cutting edges **64** to radially rotate and expand outward. Each camming surface **29** may have an upper profile which is rounded or slanted to assist in forcing the camming portion **70** outward as the blades slide rearward.

Due to the mounting points on common hub **40**, each blade is maintained at the same rearward/forward position with the other blades and accordingly the blades are balanced and synchronized in their rotation and movement. With the balanced assembly, the blades will rotate and open/deploy at the same rate even if the impact force is applied unevenly, for example due to a glancing impact between the broadhead and the target.

As the blades and hub **40** reach their rearwardmost position, the locking notches **74** of each blade engage a lower portion of the profile of the respective camming surfaces **29**. The lower profile portions include a step or locking edge with a face which is substantially parallel to the axis of body **20**, so that once locking notches **74** slide rearward past the upper portion of the camming surfaces, a locking edge engages each locking notch to prevent inward rotation, locking each blade in the deployed, fully expanded position. Expanded blades of the broadhead provide a larger cutting diameter and may increase hemorrhaging and bleeding when hunting. Increased bleed-out may provide a faster and more humane kill.

FIGS. **7-11** show views of an alternate embodiment of a broadhead generally designated **110**. The broadhead **110** is adapted for mounting to an open end of a hollow arrow shaft. The broadhead **110** includes a body **120**. Body **120** has a forward end with a pointed tip **124**, and a rearward end **126** configured to be connected to an arrow shaft. As illustrated, rearward end **26** includes threads configured for pairing with threads inside of the arrow shaft. In other forms, broadhead **110** may be mounted to an arrow shaft in other ways, such as with mechanical fasteners, adhesives, resins, mounting on a ferrule or arrow shaft insert, or using other attachment techniques.

Broadhead body **120** includes a forward end **123**. A tip **124** is attached to forward end **123**. During assembly tip **124** can be emplaced to be retained on forward end **123**, for example it can be secured with adhesive, a fastener, welding or brazing, a threaded engagement, a friction fit or a snap fit. Alternately tip **124**, can be made as an integral piece with body **120**. Typically, the tip **124** is tapered rearwardly and outwardly. The tip base may extend outward from or may merge with the profile of shaft **122**. Shaft **122** preferably is formed with a non-circular cross-section, for example in the illustrated embodiment shaft **122** has a roughly triangular cross section with truncated corners.

A rearward portion of shaft **122** transitions into a shelf or ledge **128**, extending outward from at least portions of the sides of shaft **122**. Certain edges of shelf or ledge **128** may form rounded or sloped camming surfaces **129**. A portion of body **120** extends rearward from shelf **128** to rearward end **126**. Body **120** may be integrally made as a single piece. Alternately, body **120** may be assembled from one or more pieces secured together.

Hub **140** is slidably mounted on shaft **122** between tip **124** and shelf **128**. Hub **140** may be operable to translate forward or rearward relative to shaft **122**. Hub **140** defines an interior passage **142** with a cross-section sized and shaped to approximately match the cross-section of shaft **122**. Hub **140** includes a plurality of external mounting posts **148**, illustrated with three in the present embodiment, extending perpendicular to the longitudinal axis of shaft **122**. Mounting posts **148** are arranged on separate sides of hub **140**.

One or more cutting blades **160** are pivotally attached to the hub **140**. The flat sides of each blade define a plane which is parallel to yet offset or angled so the plane does not intersect the longitudinal axis of shaft **122**. In the illustrated embodiment, three blades **160** are pivotally mounted to hub **140**. As illustrated, the planes of the three blades intersect in a triangular cross-section around the longitudinal axis of shaft **122**. In alternate embodiments, four or more mounting posts and blades may be used, subject to sufficient spacing based on the size of the broadhead.

A pivot axle opening **162** defined in each blade is mounted over a mounting post **148** so that the mounting post acts as an axle for the blade. The blades are pivotally secured to the exterior of hub **140** via the mounting posts. In the illustrated embodiment, the mounting posts have a smooth cylindrical portion with a thickness approximately matching the thickness of the blades, with threaded portions extending beyond each blade. A locknut **178** can be secured to each mounting post to retain the blades on the mounting posts. Alternately, other connection methods can be used to pivotally mount the blades to a hub.

Each blade **160** is roughly triangular in shape, and includes an outward cutting edge **164**. Typically the cutting edge is sharpened to cut a target such as an animal. Each blade further includes a leading forward or impact edge **166**. Each blade **160** further includes an inward edge. The inward edge includes a central camming portion **170**. Rearward of portion **170** is a retention notch **172**. Forward of portion **170** is a locking notch **174**. Each blade may also define a biasing notch **176** adjacent the forward end of the inward edge.

FIGS. **7-8** specifically illustrate broadhead **110** in a closed configuration. In the closed position, hub **140** is at its forwardmost position, adjacent to tip **124**. In the closed position, the length of blades **160** is close to parallel to shaft **122**. The retention notch **172** of each blade abuts a forward face of shelf **128**. A retaining element **180** is located in the biasing notches **176** of the respective blades. Non-limiting examples of suitable retaining elements include an elastic band, an isomeric band, an o-ring, a torsion spring, a flat spring, a compression spring, shrink tubing, and a frangible rigid polymer band.

The retaining element typically applies pressure to bias or urge the forward ends of the inward edges towards each other and tip **124**. The pivot axes of the blades cause the blades to operate in a bell-crank type lever arrangement, so that pressure urging the forward ends of the inward edges to rotate towards the tip, correspondingly urges the rearward portions, including camming portion **170**, to rotate in the opposite direction. For purposes of illustration, as applied to the blade illustrated in the foreground of FIG. **7**, retaining element **180** urges blade **160** to rotate clockwise. This urges the forward portion of blade **160** to rotate downward (in the illustrated perspective) around mounting post **148** towards tip **124**, while the retention notch **172** is urged to rotate upward towards shelf **128**. The urging assists the retention notch to secure the blade on shelf **128** and to prevent rearward movement or radial expansion of the blades prior to launch, during launch and during flight of the broadhead with an arrow.

When used with a bow and arrow, the broadhead may be fired at a target. In flight, the broadhead **110** preferably remains in the closed position as shown in FIGS. **7-8**, preferably having aerodynamic properties. For example, an arrow equipped with a broadhead in the closed position may approximate the flight characteristics of a field point. As illustrated with a front view in FIG. **8**, the tip **124** and impact edges **166** of the blades define impact surfaces when the broadhead strikes a target. The tip **124** initially impacts a target and begins to penetrate directly or less preferably with a glancing blow. As the tip enters the target, the target surface moves along and around the tip and then impacts the leading edges **166** of the respective blades. The contact of the target surface with the leading edges **166** creates resistance and applies rearward force to the leading edges. The target surface may also apply rearward force to forward portions of hub **140**, mounting posts **148** and locknuts **178**. This initial impact causes an initial rotation of the blades, for example the blade in the foreground of FIG. **7** rotates counterclockwise, which causes retention notch to disengage from shelf **128** by rotating slightly radially outward over camming surface **129**. This rotation may also break or dislodge retaining element **180**.

As the broadhead continues to travel forward, the target surface continues to apply rearward force to the hub and blade assembly. This causes the blades **160** and hub **140** to begin traveling rearward. As blades **160** and hub **140** begin to translate rearward, the central camming portion **170** of each blade is slidably pushed against a rounded or sloped profile of the respective camming surface **129**. The profiles of the camming surfaces **129** force the blades outward as they slide rearward, causing the cutting edges **164** to rotate and expand outward.

Due to the mounting points on common hub **140**, each blade is maintained at the same rearward/forward position with the other blades and accordingly the blades are balanced and synchronized in their rotation and movement. With the balanced assembly, the blades will rotate and open/deploy at the same rate even if the impact force is applied unevenly, for example due to a glancing impact between the broadhead and the target.

As the blades and hub **140** reach their rearwardmost position, the locking notches **174** of each blade slide past and engage locking edges of the respective camming surfaces **129**, preventing the blades from rotating inward and locking each blade in the deployed, fully expanded position. The locking edges are formed with face portions which are parallel to and abut portions of the locking notches when the blades are in the open position.

The bodies, tips, blades and hubs of the present embodiments can be made from metal materials for strength and durability, for example, iron, steel, stainless steel, aluminum or titanium. Alternately, other conventional materials having appropriate strength, durability and weight characteristics such as certain composite, plastic or glass materials may be used. Optionally, certain components may include openings or grooves to reduce the amount of metal used, correspondingly reducing the broadhead's mass and weight.

FIGS. **12-13** show views of an alternate embodiment of a broadhead generally designated **210**. Except as discussed herein, the structure and function of broadhead **210** is the same as or comparable to broadhead **10**. Broadhead **210** includes a body **220** with a pointed tip **224**, and a rearward end **226** configured to be connected to an arrow shaft. A rearward portion of body **220** includes a shelf or ledge **228** which may form camming surfaces.

Hub **240** is slidably mounted on body **220**. Hub **240** is operable to translate forward or rearward relative to the shaft portion of body **220**. Optionally in this embodiment, a pair of retaining balls are mounted between a pair of opposing internal sides of hub **240** and the shaft on opposing sides of the shaft. Portions of the retaining balls are partially received in openings defined in opposing sides of hub **240**. When hub **240** is in its forward-most position, rearward of tip **224**, portions of the retaining balls are received in recesses defined adjacent the forward end of the shaft. As hub **240** slides rearward during deployment, the retaining balls leave the forward recesses and transition partially into a pair of recessed grooves defined on opposing sides of the shaft. The recesses, openings and retaining balls are preferably sized with an interference fit to initially resist rearward movement of hub **240**, yet when a sufficient rearward force is applied the hub begins sliding rearward.

One or more cutting blades **260** are pivotally attached to the exterior of hub **240**. The flat sides of each blade define a plane which is parallel to yet offset or angled so the plane does not intersect the longitudinal axis of the shaft. In the illustrated embodiment, a pair of blades **260** are pivotally mounted to a pair of mounting posts **248** extending outward on opposing exterior sides of hub **240**.

As illustrated, the planes of the two blades are parallel to each other and offset on opposing sides of the longitudinal axis of body **220**. An upper end portion **261** of each blade defines a pivot opening **262** which is mounted over a mounting post **248** so that the mounting post acts as an axle for the blade. The blades are secured to the exterior of hub **240** via the mounting posts while remaining operable to pivot. In the illustrated embodiment, the mounting posts have a smooth cylindrical portion with a thickness approximately matching the thickness of the blades, with threaded portions extending beyond each blade. A locknut **278** can be secured to each mounting post to retain the blades on the mounting posts. Alternately, other connection methods or fasteners can be used to pivotally mount the blades to a hub.

Each blade **260** includes an outward cutting edge **264**. Each blade **260** further includes an inward edge. The inward edge includes a central camming portion **270**. Rearward of portion **270** is a retention notch **272**. Forward of portion **270** is a locking notch **274**.

The upper portion **261** of each blade **260** encircles hub **240** and defines a truncated upper area having three short side edges. This includes a forward edge **266**, a rearward edge section **267**, and a lateral edge **268**.

Arranged between each blade **260** and hub **240** and extending forward is an activation arm **290**. Each activation arm **290** is pivotally attached to the exterior of hub **240** around a mounting post **248**. A portion of activation arm forward and to the side of mounting post **248** is formed roughly in the shape of a truncated triangle, with mounting post hole **298** being on the base edge of the triangle. A forward edge **292** forms an impact surface along one side of the triangle. The third side of the triangle is defined by a rearward edge **294**. The shape of activation arm is not intended to be limiting and can be altered as desired. In the illustrated embodiment, forward edge **292** and rearward edge **294** are non-parallel.

A central area of activation arm **290** surrounds and engages the upper end portion **261** of blade **260**. The inside surface of a portion of forward edge **292** abuts and engages the surface of blade forward edge **266**. The inside surface of a portion of rearward edge **294** abuts and engages blade rearward edge section **267**. The engagement between activation arm **290** and the blade upper end portion **261** rotationally locks the blade and activation arm together. Correspondingly, rotation of activation arm **290** will cause blade **260** to rotate and rotation of blade **260** will cause activation arm **290** to rotate.

As shown in the exploded view in FIG. **13**, each activation arm **290** includes a retention feature which engages hub **240** to inhibit rotation of the activation arm and blade when the broadhead is in the closed position. The illustrated retention feature is a protrusion **296**, for example in a domed or hemi-spherical shape, extended from the activation arm towards the hub. Correspondingly, hub **240** defines an indentation or cavity **243** which protrusion **296** extends into, and into which protrusion **296** is received, when the broadhead is in the closed position. The extension of protrusion **296** into indentation **243** forms a friction fit which resists rotation of the activation arm. The friction assists the retention notch **272** to secure the blade on shelf **228** and to prevent rearward movement or radial expansion of the blades prior to launch.

FIGS. **12-13** specifically illustrate broadhead **210** in a closed configuration. In the closed position, hub **240** is at its forwardmost position, adjacent to tip **224**. The retention notch **272** of each blade abuts a forward face of shelf **228**.

When used with a bow and arrow, the broadhead may be fired at a target. During storage, prior to launch, and in flight prior to impact, the broadhead **210** preferably remains in the closed position, preferably having aerodynamic properties. The impact edges **292** of the activation arms define impact surfaces when the broadhead strikes a target. The tip **224** initially impacts a target and begins to penetrate directly or less preferably with a glancing blow. As the tip enters the target, the target surface moves along and around the tip and then impacts the surfaces of the leading edges **292** of the activation arms. The contact of the target surface with the leading activation arm edges creates resistance and applies rearward and rotational force to the activation arms. The target surface may also apply rearward force to forward portions of hub **240**, mounting posts **248** and locknuts **278**. This initial impact causes an initial rotation of the activation arms, which in turn causes the blades to rotate, for example the blade in the foreground of FIG. **12** rotates counterclockwise, which causes retention notch **272** to disengage from shelf **228** by rotating slightly radially outward.

As the broadhead continues to travel forward, the target surface continues to apply rearward force to the hub and activation arms. This causes the blades to continue to rotate while also causing the blades **260** and hub **240** to begin traveling rearward as an assembly, overcoming the resistance of protrusion **296** and, if used, any retaining balls. As hub **240** begins to translate rearward, the camming portion **270** of each blade is slidably pushed against the respective camming surfaces, assisting, via a camming or wedging force, the cutting edges **264** to radially rotate and expand outward.

Due to the mounting points on common hub **240**, each blade is maintained at the same rearward/forward position with the other blades and accordingly the blades are balanced and synchronized in their rotation and movement. With the balanced assembly, the blades will rotate and open/deploy at the same rate even if the impact force is applied unevenly, for example due to a glancing impact between the broadhead and the target.

FIGS. **14-15** show views of an alternate embodiment of a broadhead generally designated **310**. Except as discussed herein, the structure and function of broadhead **310** is the same as or comparable to broadhead **10** and will not be fully repeated for brevity.

One or more cutting blades **360** are pivotally attached to the exterior of hub **340**. The flat sides of each blade define a plane which is parallel to yet offset or angled so the plane does not intersect the longitudinal axis of the shaft. In the illustrated embodiment, a pair of blades **360** are pivotally mounted to a pair of mounting posts **348** extending outward on opposing exterior sides of hub **340**.

As in broadhead **10**, each blade **360** is roughly triangular in shape, and includes an outward cutting edge plus the inward edge which includes a central camming portion, a retention notch and a locking notch. Each blade further includes a leading forward edge **366** which extends to a leading tip or corner **367**.

In certain embodiments, arranged forward of hub **340** and blades **360** is a deployment slider **380**. In some alternate embodiments, slider **380** can be omitted. Deployment slider **380** includes a slider body or base portion **382** which defines an interior passage **383** with a cross-section sized and shaped to encircle and approximately match the cross-section of the tip and shaft of broadhead **310**. Optionally, the cross-section of passage **383** prevents rotation of slider **380** with respect to the shaft. The rearward surface of slider body **382** abuts the forward surface of hub **340**.

Slider **380** includes impact arms **386** which extend laterally from body **382** in front of each blade **360**. Each impact arm **386** defines a forward facing impact edge or surface. The rearward face of each impact arm **386** defines a surface with a length and width sloped at an angle which covers and abuts a blade forward edge **366** when the broadhead is in the closed position. The rearward face of the impact arm may optionally define a slot or groove which receives the blade forward edge **366** in a nesting arrangement.

Impact arms **386** extend to outer ends **387**. In the illustrated embodiment, outer ends **387** are each curved rearward. The rearward face of each outer end **387** receives and partially encircles a blade leading tip or corner **367**. The rearward face of the outer ends **387** may optionally define a slot or groove which receives the blade tip **367** in a nesting arrangement.

Slider **380** engages blades **360** in the closed position of broadhead **310** to inhibit rotation of the blades prior to launch and during flight. Optionally, the slider may snugly engage the blade edges and encircle the tips in a snap-on type of action. In the closed arrangement, slider **380** may apply a neutral retaining force or an inward biasing force to blade tips **367** to retain the blades **360** in the closed position.

When used with a bow and arrow, broadhead **310** may be fired at a target. During storage, prior to launch, and in flight prior to impact, the broadhead **310** preferably remains in the closed position, preferably having aerodynamic properties. The impact edges **386** of the slider **380** define impact surfaces when the broadhead strikes a target. The tip **324** initially impacts a target and begins to penetrate directly or less preferably with a glancing blow. As the tip enters the target, the target surface moves along and around the tip and then impacts the surfaces **386** of slider **380**. The contact of the target surface with the slider creates resistance and applies rearward force to the slider. The forwardly sloped impact arms **386** match the slope of the blade forward edges **366**. Preferably the broadhead impact axis matches the longitudinal axis of the broadhead body and is at an acute angle to the slope of impact arms **386**. The initial impact force pushes the impact arms rearward along the slopes of the blade leading edges, causing an initial rotational movement in blades **360**. This causes an initial rotation of the blades to disengage the blade tips **367** from the outer ends **387** of slider **380**.

As the broadhead continues to travel forward, the target surface continues to apply rearward force to the slider. This in turn applies rearward force to the hub **340** and hub assembly including blades **360**. As hub **340** begins to translate rearward, the camming portion of each blade is slidably pushed against the respective camming surfaces, assisting, via a camming or wedging force, the cutting edges to radially rotate and expand outward.

Due to the mounting points on common hub **340**, each blade is maintained at the same rearward/forward position with the other blades and accordingly the blades are balanced and synchronized in their rotation and movement. With the balanced assembly, the blades will rotate and open/deploy at the same rate even if the impact force is applied unevenly, for example due to a glancing impact between the broadhead and the target.

FIGS. **16-23** show views of an alternate embodiment of a broadhead generally designated **410**. The broadhead **410** is adapted for mounting to an open end of a hollow arrow shaft. The broadhead **410** includes a body or ferrule **420**. Body **420** has a forward end with a pointed tip **424**, and a rearward end **426** configured to be connected to an arrow shaft. Optionally, rearward end **426** includes threads configured for pairing with threads inside of the arrow shaft. In other forms, broadhead **410** may be mounted to an arrow shaft in other ways, such as with mechanical fasteners, adhesives, resins, mounting on a ferrule or arrow shaft insert, or using other attachment techniques.

The forward end of broadhead body **420** includes tip **424**. The tip **424** may be made integrally with or attached to a forward portion of a central shaft **422**. Typically, the pointed tip **424** is tapered rearwardly and outwardly. The tip base may extend outward from or may merge with the profile of shaft **422**. In certain embodiments, shaft **422** is formed with a non-circular cross-section, for example in the illustrated embodiment shaft **422** has a substantially square cross section.

In certain embodiments, a rearward portion of shaft **422** transitions into a shelf or ledge **428**, extending radially outward from at least portions of the sides of shaft **422**. Certain edges of shelf or ledge **428** may form camming surfaces **429**. A portion of body **420** extends rearward from shelf **428** to rearward end **426**. Body **420** made be made as a single piece. Alternately, body **420** may be assembled from one or more pieces secured together, such as a tip section which can be mounted to shaft **422**.

Hub **440** is slidably mounted on shaft **422**, for example between tip **424** and shelf **428**. Hub **440** is operable to translate forward or rearward relative to shaft **422**. Hub **440** defines an interior passage **442** with a cross-section sized and shaped to approximately match the cross-section of shaft **422** and which inhibits rotation of hub **440** with respect to shaft **422**.

In the illustrated embodiment, at least one and optionally a pair of set screws or retaining pins **456** are mounted through a pair of openings **446** in opposing sides of hub **440** on opposing sides of shaft **422**. Retaining pins **456** can be the same or similar to retaining pins **556** illustrated in FIGS. **29-30** and discussed hereafter. Retaining pins **456** may be press-fit or threadably engaged with openings **446**. Inward ends of retaining pins **456** are advanced inward during assembly and received in elongated axial grooves or slots **438** on opposing sides of shaft **422**. Retaining pins **456** may be selectively advanced into groove **438** a sufficient distance to prevent hub **440** from sliding off of shaft **422**, yet allow hub **440** to freely translate along shaft **422** within a range defined by the axial length of grooves **438**.

Hub **440** includes a pair of mounting posts **448** extending outward perpendicular to the longitudinal axis of shaft **422**. Mounting posts **448** are arranged on opposing exterior sides of hub **440**, typically on alternate sides from openings **446**.

One or more cutting blades **460** are pivotally attached to the exterior of hub **440**. There may be a plurality of cutting blades **460**, which is intended to mean two or more. As illustrated, the flat sides of each blade define a plane which is parallel to yet offset or angled so the plane does not intersect the longitudinal central axis of shaft **422**. In the illustrated embodiment, a pair of blades **460** are pivotally mounted to hub **440**. As illustrated, the planes of the two blades are parallel to each other on opposing sides of the longitudinal axis of shaft **422**. A pivot axle opening **462** defined in each blade is mounted over a mounting post **448** so that the mounting post acts as an axle for the blade. The blades are secured to the exterior of hub **440** via the mounting posts **448** while remaining operable to pivot. In the illustrated embodiment, the mounting posts have a smooth cylindrical portion with a thickness approximately matching the thickness of the blades, which may act as an axle for each blade. Threaded portions extend outward from the smooth portions and beyond each blade. A locknut **478** can be secured to each mounting post to retain the blades on the mounting posts. Alternately, other connection methods or fasteners can be used to pivotally mount the blades to a hub.

Each blade **460** is roughly triangular in shape, and includes an outward cutting edge **464**. Typically the outward cutting edge is the primary cutting edge and is sharpened to cut a target such as an animal. Each blade further includes a forward or impact edge **466**, optionally also having a sharpened edge. The impact edge **466** may extend to a blade leading tip or corner **467**, defining a pivot control point. The offset length of the corner **467** from the pivot axle opening **462** defines a lever arm which may be used to control rotation of the blade, for example by initiating blade rotation when force is applied to impact edge **466**. Each blade **460** further includes an inward edge. The inward edge includes a central camming portion **470**. Rearward of portion **470** is a retention notch **472**. Forward of portion **470** is a locking notch **474**.

FIG. **16** illustrates broadhead **410** in a closed configuration. In the closed position, hub **440** is at its forwardmost position, adjacent to tip **424**. In the closed position, the length of blades **460** is closer to parallel to shaft **422**, for example forming an acute angle less than 45 degrees, and in many arrangements substantially less than 45 degrees. The retention notch **472** of each blade abuts a forward face of shelf **428**. FIGS. **17-18** illustrate broadhead **410** in an open configuration. In the open position, hub **440** is at its rearwardmost position, adjacent to shelf **428**. In the open position, the length of blades **460** diverges substantially from shaft **422** and are closer to perpendicular to shaft **422**, forming an angle greater than 45 degrees.

In certain embodiments, arranged forward of the assembly with hub **440** and blades **460** is a deployment slider **480**. In some alternate embodiments, slider **480** can be omitted. Deployment slider **480** includes a body or base portion **482** which defines an interior passage **483** with a cross-section sized and shaped to encircle and approximately match the cross-section of the tip and shaft of broadhead **410**. Optionally, the cross-section of passage **483** inhibits rotation of slider **480** with respect to shaft **422**. The rearward surface of base portion **482** abuts the forward surface of hub **440**.

Slider **480** includes impact arms **486** which extend laterally in front of each blade **460**. As illustrated in FIG. **22**, a pair of impact arms **486** may be parallel and offset from each other. Each impact arm **486** defines a forward facing impact edge or surface **488**. Optionally, each forward facing impact edge **488** may be sharpened to provide an additional cutting edge. The rearward face of each impact arm **486** defines a surface with a length, width and slope which matches, covers and abuts the forward edge **466** of one of the blades **460** when the broadhead is in the closed position. The rearward face of the impact arm **486** may optionally define a slot, groove or shelf **489** which receives the blade forward edge **466** in a nesting arrangement. In FIG. **23** the illustrated embodiment includes a rearward shelf **489** which forms an "L" shape with a rearward face to abut the front of edge **466**, and a slight rearward extending flange or projection which extends parallel and partially adjacent a side of edge **466**.

Impact arms **486** extend to outer ends **487**. In the illustrated embodiment, outer ends **487** may be each curved rearward forming a hooked shape. The rearward face of each outer end **487** receives and partially encircles a blade leading tip or corner **467**. The rearward face of the outer ends **487** may optionally define a slot or groove which receives the blade tip **467** in a nesting arrangement.

Slider **480** is engagable to retain blades **460** in the closed position to inhibit rotation of the blades prior to launch and during flight. Optionally, the slider may snugly engage the blade edges and encircle the tips in a snap-on type of action. The impact arms **486** are predominately rigid but may be slightly bent forward during engagement to allow the ends **487** to flex and "snap" around the respective blade tips **467**. In the closed arrangement, slider **480** may apply a neutral retaining force or an inward biasing force to blade tips **467** to retain the blades **460** in the closed position.

Detailed views of slider **480** are shown in FIGS. **21-23**. Slider **480** may be made for multiple uses, or may be a disposable and replaceable component. In certain embodiments, arms **486** are intended to remain connected to body **482** during and after use. In certain other embodiments, arms **486** are designed to disconnect by breaking away from slider body **482** upon impact. FIGS. **18** and **19** illustrate slider **480** after the arms have broken away. In some embodiments, slider **480** defines breakaway notches between slider body **482** and each arm **486**. Breakaway notches are, for example, an indented area forming a smaller cross-sectional area and thus define weak points in the slider. Upon impact, force transmitted along the slider will cause the impact arms to break-away from the slider body **482** at the notch as a defined breakage point. In some embodiments, forward breakaway notches **484** are defined inward along the upper edge or face at the junction between an impact arm **486** and slider body **482**. Forward breakaway notches **484** may have a relatively narrow V-shaped profile in a channel across the impact arm. The forward facing notches may allow a slight forward flexing of the impact arms to allow the impact arms to engage and retain the blades, yet which facilitate break-away action of the impact arms when rearward impact force is applied. In some embodiments, rearward breakaway notches **485** are defined along the rearward edge or face at the junction between an impact arm **486** and slider body **482**.

Slider **480** and other slider embodiments herein may be made from various materials, for example from plastic, polycarbonate, a semi-crystalline polyamide, a thermoplastic elastomer, acrylic, a resin material, a glass-filled nylon material or metal. In certain embodiments, the slider materials are chosen for high stiffness and strength to retain the blades during flight, yet with properties which are is sufficiently brittle upon impact to facilitate the break-away action of the impact arms when desired. In certain embodiments, the slider may be made from a transparent material. Alternately the slider can be made in various colors as desired.

When used with a bow and arrow, broadhead **410** may be fired at a target. During storage, prior to launch, and in flight prior to impact, the broadhead **410** preferably remains in the closed position, preferably having aerodynamic properties. The impact edges **486** of the slider **480** define impact surfaces when the broadhead strikes a target. The tip **424** initially impacts a target and begins to penetrate directly or less preferably with a glancing blow. As the tip enters the target, the target surface moves along and around the tip and then impacts the forward surfaces of the impact arms and body. The contact of the target surface with the slider creates resistance and applies rearward force to the slider. The initial impact force pushes the impact arms rearward along with the blade leading edges, causing an initial rotational movement in blades **460**. This causes an initial rotation of the blades to unlock the blades, including disengaging the blade tips **467** from the outer ends **487** of slider **480**. As part of this initial rotation, impact arms **486** may breakaway and disconnect from slider body **480**.

As the broadhead continues to travel forward, the target surface continues to apply rearward force to the slider. This in turn applies rearward force to the hub assembly including hub **440** and blades **460**. As hub **440** begins to translate rearward, the camming portion **470** of each blade is slidably pushed against the respective camming surfaces **429**, assisting, via a camming or wedging force, the cutting edges to radially rotate and expand outward. Hub **440** translates rearward until it abuts shelf **428** while blades **460** expand outward. When hub **440** is in the rearward position, locking notches **474** of the blades engage shelf **428** to lock the blades in the expanded position. Due to the mounting points on common hub **440**, each blade is maintained at the same rearward/forward position with the other blades.

If arms **486** have disconnected from slider body **482** during impact, only the slider body will remain on shaft **422**, as shown in FIGS. **18** and **19**. To reset broadhead **410** to the closed position, the hub and blade assembly is pulled forward relative to shaft **422**. If slider **480** is reusable, the tips **467** of blades **460** are engaged with impact arms **486**. Alternately, a remnant slider body **482** may be removed and a new slider **480** may be placed over tip **424** and situated to engage blades **460**.

FIGS. **24-30** show views and components of an alternate embodiment of a broadhead generally designated **510**. Except as discussed herein, the structure and function of broadhead **510** is the same as or comparable to broadhead **410** and will not be fully repeated for brevity. The primary difference between broadhead **410** and broadhead **510** is that broadhead **510** is a three-bladed version, with corresponding adaptations to the structure and components. The broadhead **510** includes a body or ferrule **520**. Body **520** has a forward end with a pointed tip **524**, and a rearward end **526** configured to be connected to an arrow shaft. In certain embodiments, shaft **522** is formed with a non-circular cross-section, for example in the illustrated embodiment shaft **522** has a substantially triangular cross-section with truncated corners. A rearward portion of shaft **522** may transition into a substantially perpendicular shelf or ledge **528**, extending radially outward from at least portions of the sides of shaft **522**. Certain edges of shelf or ledge **528** may form camming surfaces **529**.

Hub **540** is slidably mounted on shaft **522**. Hub **540** is operable to translate forward or rearward relative to shaft **522**. Hub **540** defines an interior passage **542** with a cross-section sized and shaped to approximately match the cross-section of shaft **522** and which inhibits rotation of hub **540** with respect to shaft **522**.

In the illustrated embodiment, one or more set screws or retaining pins **556** are mounted through openings **546** in the sides of hub **540** on corresponding sides of shaft **522**. In optional embodiments, one pin may be used, two pins may be used, or a number of pins can be used. Retaining pins **556** may be pushed into position or alternately threadably engaged with the openings. An example retaining pin is illustrated in FIGS. **29-30**. Inward ends **557** of retaining pin **556** are advanced inward during assembly and received in elongated axial grooves or slots **538** defined on sides of shaft **522**. The outer ends **558** of the retaining pins may be used to push or tap each retaining pin into place. In the illustrated example, retaining pin **556** has splined cylindrical sides **559** which engage grooves in the hub opening.

Each retaining pin **556** may be selectively advanced to extend into a respective groove **538** a sufficient distance to prevent hub **540** from sliding off of shaft **522**, yet allowing hub **540** to freely translate along shaft **522** within the range defined by the axial length of groove **538**. While hub rotation is not generally desired, the width of groove **538** also defines a rotational tolerance of hub **540** and pin **556**. Optionally, the inward end **557** extends inward and is received within the volume of a respective groove **538**, but the inward end **557** does not need to contact the bottom or sides of the groove. In certain embodiments, inward end **557** is rounded, for example formed in a hemispherical shape. Optionally, the pin may be made with a slide facilitating material or a material to facilitate sliding motion may be placed between the pin inward end and the respective groove, for example a Delrin® or Teflon® material.

Hub **540** includes mounting posts **548** extending outward perpendicular to the longitudinal axis of shaft **522**. Mounting posts **548** are arranged on exterior sides of hub **540**.

One or more cutting blades **560** are pivotally attached to the exterior of hub **540**. As illustrated, the flat sides of each blade define a plane which is parallel to yet offset or angled so the plane does not intersect the longitudinal central axis of shaft **522**. In the illustrated embodiment, three blades **560** are pivotally mounted to hub **540**. In other embodiments, two or four blades could potentially be used with correspondingly structural modifications. A pivot axle opening **562** defined in each blade is mounted over a mounting post **548** so that the mounting post acts as an axle for the blade. The blades are secured to the exterior of hub **540** via the mounting posts **548** while remaining operable to pivot. In the illustrated embodiment, the mounting posts have a smooth cylindrical portion with a thickness approximately matching the thickness of the blades, which may act as an axle for each blade. Threaded portions extend outward from the smooth portions and beyond each blade. A locknut **578** can be secured to each mounting post to retain the blades on the mounting posts. Alternately, other connection methods or fasteners can be used to pivotally mount the blades to a hub.

Each blade **560** is roughly triangular in shape, and includes an outward cutting edge **564**. Typically the outward cutting edge is the primary sharpened edge to cut a target such as an animal. Each blade further includes a forward or impact edge **566**. The impact edge **566** may extend to a blade leading tip or corner **567**, defining a pivot control point. The offset length of the corner **567** from the pivot axle opening **562** defines a lever arm which may be used to control rotation of the blade, for example by force applied to impact edge **566**. Each blade **560** further includes an inward edge. Optionally forward edge **566** may also be sharpened. The inward edge includes a central camming portion **570**. Rearward of portion **570** is a retention notch **572**. Forward of portion **570** is a locking notch.

FIG. **24** illustrates broadhead **510** in a closed configuration. In the closed position, hub **540** is at its forwardmost position, adjacent to tip **524**. In the closed position, the length of blades **560** is closer to parallel to shaft **522**. The retention notch **572** of each blade abuts a forward face of shelf **528**. FIG. **25** illustrates broadhead **510** in an open configuration. In the open position, hub **540** is at its rearwardmost position, adjacent to shelf **528**. In the open position, the length of blades **560** diverges substantially and is closer to perpendicular to shaft **522**.

In certain embodiments, arranged forward of hub **540** and blades **560** is a deployment slider **580**, shown in detail in FIGS. **27-28**. In some alternate embodiments, slider **580** can be omitted. Deployment slider **580** includes a body or base portion **582** which defines an interior passage **583** with a cross-section sized and shaped to encircle and approximately match the cross-section of the tip and shaft of broadhead **510**. Optionally, the cross-section of passage **583** inhibits rotation of slider **580** with respect to shaft **522**. When assembled, the rearward surface of body portion **582** abuts the forward surface of hub **540**.

Slider **580** includes impact arms **586** which extend laterally in front of each blade **560**. The illustrated embodiment includes three impact arms **586**. Each impact arm **586** defines a forward facing impact edge or surface **588**. Optionally, each forward facing impact edge **588** may be sharpened to provide a forward facing cutting edge. The rearward face of each impact arm **586** defines a profile surface with a length, width and slope which matches, covers and abuts the forward edge **566** of one of the blades **560** when the broadhead is in the closed position. Optionally, the blade cutting edges **566** and impact arms **586** may be sloped slightly forward and outward. The rearward face of the impact arm **586** may optionally define a slot, groove or shelf **589** which receives the blade forward edge **566** in a nesting arrangement. FIG. **28** illustrates the rearward shelf **589** forming an "L" shape with a rearward face to abut the front of edge **566**, and a slight rearward extending flange or projection which extends parallel to blade **560** and partially adjacent a side of edge **566**.

Impact arms **586** extend to outer ends **587**. In the illustrated embodiment, outer ends **587** are each curved rearward in a hook shape. The rearward face of each outer end **587** may receive and partially encircle a blade leading tip or corner **567**. The rearward face of the outer ends **587** may optionally define a slot or groove which receives the blade tip **567** in a nesting arrangement.

Slider **580** engages and retains blades **560** in the closed position to inhibit rotation of the blades prior to launch and during flight. Optionally, the slider may snugly engage the blade edges and encircle the tips in a snap-on type of action. The impact arms **586** are predominately rigid but may be slightly bent forward during engagement to allow the ends **587** to flex and "snap" around the respective blade tips **567**. In the closed arrangement, slider **580** may apply a neutral retaining force or an inward biasing force to blade tips **567** to retain the blades **560** in the closed position.

Detailed views of slider **580** are shown in FIGS. **27-28**. Slider **580** may be made for multiple uses, or may be a disposable and replaceable component. In certain embodiments, arms **586** are intended to remain connected to body **582** during and after use. In certain other embodiments, arms **586** are designed to disconnect by breaking away from slider body **582** upon impact, as illustrated in FIG. **25**. In some embodiments, slider **580** defines breakaway notches between slider body **582** and a portion of each arm **586**. Breakaway notches are, for example, an indented area forming a smaller and cross-sectional area connection and thus define weak points in the slider. Upon impact, force transmitted along the slider will cause the impact arm to break-away from the slider body **582** at the notch as a defined breakage point. In some embodiments, forward breakaway notches **584** are defined inward along the upper edge or face at or adjacent the junction between an impact arm **586** and slider body **582**. In some embodiment, rearward breakaway notches **585** are defined along the rearward edge or face at the junction between an impact arm **586** and slider body **582**. Slider **580** may be made from various materials as discussed herein.

When used with a bow and arrow, broadhead **510** may be fired at a target. During storage, prior to launch, and in flight prior to impact, the broadhead **510** preferably remains in the closed position, preferably having aerodynamic properties. The impact edges **586** of the slider **580** define impact surfaces when the broadhead strikes a target. The tip **524** initially impacts a target and begins to penetrate directly or less preferably with a glancing blow. As the tip enters the target, the target surface moves along and around the tip and then impacts the forward surfaces of the impact arms and body. The contact of the target surface with the slider creates resistance and applies rearward force to the slider. If present, the sharpened forward edges **588** of the impact arms enhance engagement and cutting of the target. The initial impact force pushes the impact arms rearward along with the blade leading edges, causing an initial rotational movement in blades **560**. This causes an initial rotation of the blades to disengage the blade tips **567** from the outer ends **587** of slider **580**. As part of this initial rotation, impact arms **586** may breakaway and disconnect from slider body **580**. If present, forward sharpened edges **566** of the blades assist in applying force to cause the impact arms **586** to breakaway.

As the broadhead continues to travel forward, the target surface continues to apply rearward force to the slider. This in turn applies rearward force to the hub **540** and hub assembly including blades **560**. If present, the sharpened forward edges **566** of the blades enhance engagement and cutting of the target. As hub **540** begins to translate rearward, the camming portion **570** of each blade may be slidably pushed against a respective camming surface **529**, assisting, via a camming or wedging force, the blade primary cutting edges **564** to radially rotate and expand outward. Hub **540** translates rearward until it abuts shelf **528** while blades **560** expand outward. When hub **540** is in the rearward position, locking notches of the blades engage shelf **528** to lock the blades in the expanded position.

If arms **586** have disconnected from slider body **582** during impact, only the slider body will remain on shaft **522**, as illustrate in FIG. **25**. To reset broadhead **510** to the closed position, the hub and blade assembly is pulled forward relative to shaft **522**. If slider **580** is reusable, the tips **567** of blades **560** are engaged with impact arms **586**. Alternately, a remnant slider body **582** may be removed and a new slider **580** may be placed over tip **524** and situated to engage blades **560**.

FIGS. **31-34** show views of an alternate embodiment of a broadhead generally designated **610**. Except as discussed herein, the structure and function of broadhead **610** is the same as or comparable to broadheads **10** and **410** and will not be fully repeated for brevity.

The broadhead **610** is adapted for mounting to an open end of a hollow arrow shaft. The broadhead **610** includes a body or ferrule **620**. Body **620** has a forward end with a pointed tip **624**, and a rearward end **626** configured to be connected to an arrow shaft. In the illustrated embodiment, tip **624** is a separate piece which may be connected to a bore in the forward portion of body **620**, for example via a threaded engagement. In this embodiment, tip **624** has a rearward base **625** with a larger cross-section than the cross-section of the shaft portion so that base protrudes beyond the shaft. Hub **640** is slidably mounted and retained on body **620** between base **625** and shelf **628**. Hub **640** is operable to translate forward or rearward along the shaft portion of body **620** between hub base **625** and shelf **628**. Hub **640** includes mounting posts **648** which extending outward perpendicular to the longitudinal axis of the shaft. Mounting posts **648** are arranged on exterior sides of hub **640**.

One or more cutting blades **660** are pivotally attached to the exterior of hub **640**. In the illustrated embodiment, a pair of blades **660** are pivotally mounted to hub **640**. As illustrated, the planes of the two blades are parallel to each other on opposing sides of the longitudinal axis of shaft **622**. Alternately a three-bladed version can be used, with the blades equally spaced around hub **640**. Hub **640** may triangular in a three-blade arrangement. A pivot axle opening **662** defined in each blade is mounted over a mounting post **648** so that the mounting post acts as an axle for the blade. The blades are secured to the exterior of hub **640** via the mounting posts **648** while remaining operable to pivot. A locknut **678** can be used to retain the blades on the mounting posts.

Each blade **660** is elongated in shape, and includes an outward cutting edge. Typically the cutting edge is sharpened to cut a target such as an animal. Each blade further defines a pivot control point, such as pivot control opening **666** offset from the pivot axle opening **662**. The offset distance of pivot control opening **666** from pivot axle opening **666** defines a lever arm which can be used to control rotation of blade **660**. Each blade **660** may further include an inward edge, with certain embodiments having a central camming portion, a retention notch and a locking notch, as discussed in detail with respect to other embodiments.

FIG. **31** illustrates broadhead **610** in a closed configuration. FIG. **32** illustrates broadhead **610** in an open configuration. In the open position, hub **640** is at its rearwardmost position. In the open position, the length of blades **660** is closer to perpendicular to the longitudinal axis of body **620**.

Arranged forward of hub **640** and blades **660** is a deployment slider **680**, shown in detail in FIG. **34**. Deployment slider **680** includes a body or base portion **682** which defines an interior passage **683** with a cross-section sized and shaped to encircle and approximately match the cross-section of the shaft portion of broadhead body **620**. Slider **680** is slidably mounted on body **620** with hub **640**. The rearward surface of base portion **682** abuts the forward surface of hub **640**.

Slider **680** includes impact arms **686** which extend laterally. Each impact arm **686** defines a forward facing impact edge or surface **688**. Optionally, each forward facing impact edge **688** may be sharpened to provide an additional cutting edge. Each impact arm **686** extends laterally, rearwardly and then inwardly at a rearward position to a rearward end **687** adjacent to and engaging the pivot control opening **666** of one of the blades. Rearward end **687** is arranged in an offset and cantilevered position relative to body **682**. The forward lateral portion may be angled forward from base portion **682**, and the rearward portion may be tapered inward and rearward. Movement or flexing of arm **686** causes rearward end **687** to move relative to body **682**, for example laterally in a relative rotational movement. Rearward end **687** may define a projection or tab portion **689** which is received within and engages pivot control opening **666**.

Each impact arm **686** engages a pivot opening **666** to hold a blade **660** in the closed position of broadhead **610** to inhibit rotation of the blades prior to launch and during flight. In the closed arrangement, slider **680** may apply a neutral retaining force or an inward biasing force to retain the blades **660** in the closed position.

Slider **680** may be made for multiple uses, or may be a disposable and replaceable component. In certain embodiments, arms **686** are intended to remain connected to body **682** during and after use and may or may not remain engaged with pivot control openings **666** during deployment. In certain other embodiments, arms **686** are designed to disconnect from slider body **682** upon impact. In some embodiments, slider **680** defines breakaway notches **684** between slider body **682** and each arm **686**. Breakaway notches **684** define weak points in the slider. Upon impact, force transmitted along the slider will cause the impact arms to break-away from the slider body **682** at the notches as defined breakage points. In some embodiments, forward breakaway notches may be defined inward along the upper edge or face at the junction between an impact arm **686** and slider body **682**. In some embodiments, rearward breakaway notches are defined along the rearward edge or face at the junction between an impact arm **686** and slider body **682**. Slider **680** may be made from various materials as discussed herein.

When used with a bow and arrow, broadhead **610** may be fired at a target. During storage, prior to launch, and in flight prior to impact, the broadhead **610** preferably remains in the closed position, preferably having aerodynamic properties. The contact of the target surface with the tip and the slider creates resistance and applies rearward force to the slider. The initial impact force pushes the impact arms rearward. This applies a rearward impulse to the outer ends for the forward arm portions **688**, which by extension causes rearward ends **687** to move, for example laterally in a relative rotational movement. The movement of rearward ends **687** causes an initial rotational movement in blades **660**. This initial rotation disengages the rearward portion of the blades, allowing the retention notches to disengage from shelf **628**. As part of this initial rotation, impact arms **686** may breakaway and disconnect from slider body **680** or disengage from pivot control openings **666**.

As the broadhead continues to travel forward, the target surface continues to apply rearward force to the slider. This in turn applies rearward force to the hub assembly including hub **640** and blades **660**. As hub **640** translates rearward the blades radially rotate and expand outward.

If arms **686** have disconnected from slider body **682** during impact, only a cylindrical slider body **682** will remain on the shaft, as illustrated in FIG. **32**. To reset broadhead **610** to the closed position, the hub and blades are pulled forward relative to shaft **622**. If slider **680** is reusable, the arms **686** are re-engaged with pivot openings **666**. Alternately, a remnant slider body **682** may be removed, by removing tip **624**, and a new slider **680** may be placed on the shaft and situated to engage blades **660** before remounting tip **624**.

FIGS. **35-38** show views of an alternate embodiment of a broadhead generally designated **710**. Except as discussed herein, the structure and function of broadhead **710** is the same as or comparable to broadheads **10**, **410** and **610** and will not be fully repeated for brevity.

The broadhead **710** includes a body or ferrule **720**. Body **720** has a forward end with a pointed tip **724**, and a rearward end **726** configured to be connected to an arrow shaft. In the illustrated embodiment, tip **724** is a separate piece which may be connected to a bore in the forward portion of body **720**, for example via a threaded engagement. In this embodiment, tip **724** has a rearward base **725** with a larger cross-section than the cross-section of the shaft portion of body **720** so that base protrudes beyond the shaft. Hub **740** is slidably mounted and retained on body **720** between the base of tip **724** and shelf **728**. Hub **740** is operable to translate forward or rearward along the shaft portion of body **720**. Hub **740** includes a pair of mounting posts **748** extending outward perpendicular to the longitudinal axis of the shaft. Mounting posts **748** are arranged on opposing exterior sides of hub **740**.

One or more cutting blades **760** are pivotally attached to the exterior of hub **740**. In the illustrated embodiment, a pair of blades **760** are pivotally mounted to hub **740**. As illustrated, the planes of the two blades are parallel to each other on opposing sides of the longitudinal axis of shaft **722**. Alternately a three-bladed version can be used, with the blades equally spaced around hub **740**. The shaft portion and hub **740** may be triangular in a three-blade arrangement. A pivot axle opening **762** defined in each blade is mounted over a mounting post **748** so that the mounting post acts as an axle for the blade. The blades are secured to the exterior of hub **740** via the mounting posts **748** using a locknut **778**.

Each blade **760** is elongated in shape, and includes an outward cutting edge. Typically the cutting edge is sharpened to cut a target such as an animal. Each blade further defines a pivot control point, for example a pivot tab **766** offset from the pivot axle opening **762**. The offset distance of pivot tab **766** from pivot axle opening **762** defines a lever arm which can be used to control rotation of blade **760**. Each blade **760** further includes an inward edge, with certain embodiments having a central camming portion, a retention notch and a locking notch, as discussed in detail with respect to other figures.

FIG. **35** illustrates broadhead **710** in a closed configuration. FIG. **36** illustrates broadhead **710** in an open configuration. In the open position, hub **740** is at its rearwardmost position. In the open position, the length of blades **760** diverges substantially from body **720**.

Arranged forward of hub **740** and blades **760** is a deployment slider **780**, shown in detail in FIG. **38**. Deployment slider **780** includes a body or base portion **782** which defines an interior passage **783** with a cross-section sized and shaped to encircle and approximately match the cross-section of the shaft portion of broadhead body **720**. Slider **780** is slidably mounted and retained on body **720** with hub **740** between the base of tip **724** and shelf **728**. Optionally, the cross-section of passage **783** prevents rotation of slider **780** with respect to the shaft. The rearward surface of body portion **782** abuts the forward surface of hub **740**.

Slider **780** includes impact arms **786** which extend laterally. Each impact arm **786** defines a forward facing impact edge or surface **788**. Optionally, each forward facing impact edge **788** may be sharpened to provide an additional cutting edge. In this embodiment, each impact arm **786** extends laterally, rearwardly and then inwardly to a rearward end **787** adjacent the pivot tab **766** of one of the blades. Rearward end **787** is arranged in an offset and cantilevered position relative to body **782**. The forward lateral portion may be angled forward from base portion **782**, and the rearward portion may be tapered inward and rearward. Flexing of arm **786** causes rearward end **787** to move relative to body **782**, for example laterally in a relative rotational movement. Rearward end **787** may define a notch or cavity **787** which engages a pivot point on the blade for example pivot tab **766** in a tab-in-notch arrangement.

Impact arms **786** engage pivot tabs **766** to hold blades **760** in the closed position of broadhead **710** to inhibit rotation of the blades prior to launch and during flight. In the closed arrangement, slider **780** may apply a neutral retaining force or an inward rotational biasing force to retain the blades **760** in the closed position.

Slider **780** may be made for multiple uses, or may be a disposable and replaceable component. In certain embodiments, arms **786** are intended to remain connected to body **782** during and after use. In certain other embodiments, arms **786** are designed to disconnect from slider body **782** upon impact. In some embodiments, slider **780** defines breakaway notches between slider body **782** and each arm **786**. Breakaway notches define weak points in the slider. Upon impact, force transmitted along the slider will cause the impact arms to break away from the slider body **782** at the notches as defined breakage points. Slider **780** may be made from various materials as discussed herein.

When used with a bow and arrow, broadhead **710** may be fired at a target. During storage, prior to launch, and in flight prior to impact, the broadhead **710** preferably remains in the closed position, preferably having aerodynamic properties. The tip **724** initially impacts a target and begins to penetrate directly or less preferably with a glancing blow. As the tip enters the target, the target surface moves along and around the tip and then impacts the forward surfaces of the impact arms and body portion. The contact of the target surface with the slider creates resistance and applies rearward force to the slider. The initial impact force pushes the impact arms rearward. This applies a rearward impulse to the outer ends of the forward arm portions **788**, which causes rearward ends **787** to move, for example rearward in a relative rotational movement. The movement of rearward ends **787** causes an initial rotational movement in blades **760**. As part of this initial rotation, the impact arms may flex rearward or impact arms **786** may breakaway and disconnect from slider body **780**. Alternately, pivot tabs **766** may rotate out of engagement with notches **789**.

As the broadhead continues to travel forward, the target surface continues to apply rearward force to the slider. This in turn applies rearward force to the hub and blade assembly. As the assembly translates rearward, the blades radially rotate and expand outward.

If arms **786** have disconnected from slider body **782** during impact, only a remnant, approximately cylindrical slider body **782** will remain on the shaft. To reset broadhead **710** to the closed position, the hub and blade assembly is pulled forward relative to the shaft portion. If slider **780** is reusable, the arms **786** are re-engaged with pivot tabs **766**. Alternately, a remnant slider body **782** may be removed, by removing tip **724**, and a new slider **780** may be placed on the shaft and situated to engage blades **760** before remounting tip **724**.

While the embodiments have been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiments have been shown and described and that all changes and modifications that come with the spirit of the disclosure are desired to be protected.

What is claimed is:

1. A broadhead arrowhead, comprising:

a broadhead body adapted to attach to an arrow shaft, the broadhead body having a forward end and having a shaft portion, the shaft portion defining a longitudinal axis;

a blade assembly slidably mounted on the shaft portion, including at least one blade pivotally operable between a closed position and an open position;

a deployment slider arranged on the broadhead body forward of the blade assembly, the deployment slider having a slider body and at least one laterally extending impact arm, with the impact arm engagable with the at least one blade to retain the blade in a closed position;

wherein after the initial impact, the slider body and the blade assembly move rearward relative to the shaft portion whereupon during the rearward movement the at least one blade is forced to rotate outward to a deployed position.

2. The broadhead arrowhead of claim **1**, comprising:

a plurality of pivotally mounted blades in the blade assembly equally spaced around the shaft portion, each blade operable between a closed position and an open position, and the deployment slider having a plurality of laterally extending impact arms with each arm retaining a respective blade in a closed position.

3. The broadhead arrowhead of claim **2**, wherein each impact arm extends to engage a pivot control opening defined in one of the blades.

4. The broadhead arrowhead of claim **3**, wherein each impact arm extends laterally and then rearwardly and inwardly to a rearward end adjacent to and engaging a pivot control point defined in a respective one of the blades.

5. The broadhead arrowhead of claim **4**, wherein the forward lateral portion of each impact arm is angled forward from the slider body.

6. The broadhead arrowhead of claim **4**, wherein each rearward end is arranged in an offset and cantilevered position relative to the slider body.

7. The broadhead arrowhead of claim **2**, wherein in the closed arrangement, said slider applies a neutral retaining force or an inward biasing force to retain the blades in the closed position.

8. The broadhead arrowhead of claim **7**, wherein each impact arm defines a sharpened forward facing impact edge.

9. The broadhead arrowhead of claim **2**, wherein each impact arm is designed to break away from the slider body upon impact.

10. The broadhead arrowhead of claim **9**, comprising breakaway notches defined between the slider body and each arm to form defined breakage points.

11. The broadhead arrowhead of claim **10**, wherein rearward breakaway notches are defined along the rearward edge of the arm adjacent the junction between each impact arm and the slider body.

12. A broadhead arrowhead, comprising:

a broadhead body adapted to attach to an arrow shaft, the broadhead body having a forward end and having a shaft portion, the shaft portion defining a longitudinal axis;

a blade assembly slidably mounted on the shaft portion and including a plurality of pivotally mounted blades, each blade operable between a closed position and an open position;

wherein each blade defines a pivot control point offset from the pivotal mounting point;

a deployment slider arranged on the broadhead body forward of the blade assembly, the deployment slider having a slider body and a plurality of impact arms, with each impact arm engagable with the pivot control point of a respective blade; and,

wherein upon an initial impact, each arm operates on a respective pivot control point to cause the respective blade to rotate, wherein after the initial impact, the slider body and the blade assembly move rearward relative to the shaft portion and wherein during the rearward movement the blades rotate outward to a deployed position.

13. The broadhead arrowhead of claim **12**, wherein each impact arm extends laterally and rearwardly to a pivot control point.

14. The broadhead arrowhead of claim **13**, wherein the pivot control point of each blade is a pivot tab.

15. The broadhead arrowhead of claim **14**, wherein each impact arm defines a notch which engages a pivot tab.

16. The broadhead arrowhead of claim **13**, wherein the pivot control point of each blade is a pivot control opening.

17. The broadhead arrowhead of claim **12**, wherein each impact arm is designed to break away from the slider body upon impact.

18. The broadhead arrowhead of claim **17**, comprising breakaway notches defined adjacent the junction between the slider body and each impact arm to form defined breakage points.

19. A broadhead arrowhead, comprising: a broadhead body adapted to attach to an arrow shaft, the broadhead body having a forward end and having a shaft portion, the shaft portion defining a longitudinal axis;

a blade assembly slidably retained on the shaft portion including a plurality of pivotally mounted blades operable between a closed position and an open position, each blade including a sharpened outward cutting edge, and each blade defining a plane parallel to and offset from the longitudinal axis;

a deployment slider arranged on the broadhead body forward of the blade assembly, the deployment slider having a slider body and a plurality of impact arms, with each impact arm extending laterally in front of the forward facing edge of a respective blade.

20. A broadhead arrowhead, comprising:

a broadhead body adapted to attach to an arrow shaft, the broadhead body having a forward end and having a shaft portion, the shaft portion defining a longitudinal axis;

a blade assembly slidably mounted on the shaft portion, including at least one blade pivotally operable between a closed position and an open position;

a retaining element arranged on the broadhead body forward of the blade assembly, the retaining element having a body and at least one extending impact arm, with the impact arm engagable with the at least one blade to retain the blade in a closed position;

wherein after the initial impact the at least one blade is forced to rotate outward to a deployed position.

21. The broadhead arrowhead of claim 20, comprising: a plurality of pivotally mounted blades in the blade assembly equally spaced around the shaft portion, each blade operable between a closed position and an open position, and the retaining element having a plurality of laterally extending impact arms with each arm retaining a respective blade in a closed position.

22. The broadhead arrowhead of claim 21, wherein in the closed arrangement, said retaining element applies a neutral retaining force or an inward biasing force to retain the blades in the closed position.

23. The broadhead arrowhead of claim 21, wherein each impact arm is designed to break away from the retaining element body upon impact.

24. The broadhead arrowhead of claim 23, comprising breakaway notches defined between the retaining element body and each arm to form defined breakage points.

25. The broadhead arrowhead of claim 21, wherein each impact arm extends to engage a pivot control point defined on a respective one of the blades.

26. The broadhead arrowhead of claim 21, wherein each impact arm extends to an outer end which is curved rearward forming a hooked shape, wherein the hooked shape partially encircles a blade leading tip.

27. The broadhead arrowhead of claim 21, wherein each impact arm is bent slightly forward while engaging a blade tip and applies a biasing force to retain the blades in the closed position.

28. A broadhead arrowhead, comprising:

a broadhead body adapted to attach to an arrow shaft, the broadhead body having a forward end and having a shaft portion, the shaft portion defining a longitudinal axis;

a blade assembly including a hub slidably mounted around the shaft portion, and including at least one blade pivotally mounted on an axle and operable between a closed position and an open position;

a retaining element engagable with the at least one blade to retain the blade in a closed position;

wherein after the initial impact, the blade axle moves rearward relative to the shaft portion whereupon during the rearward movement the at least one blade is forced to rotate outward to a deployed position.

29. The broadhead arrowhead of claim 28, wherein in the closed arrangement, said retaining element applies an inward biasing force to retain the at least one blade in the closed position.

30. The broadhead arrowhead of claim 28, wherein in the closed arrangement, said retaining element applies a neutral retaining force to retain the at least one blade in the closed position.

31. The broadhead arrowhead of claim 28, wherein a rearward portion of the shaft portion transitions into a shelf extending radially outward from the shaft portion, wherein an edge of the shelf forms a camming surface for an inward edge of the at least one blade.

32. A broadhead arrowhead, comprising:

a broadhead body adapted to attach to an arrow shaft, the broadhead body having a shaft portion;

a blade assembly including a hub slidably mounted around the shaft portion and including a plurality of blades pivotally mounted to the hub, wherein each blade is rotatable between a closed position and an open position;

wherein a rearward portion of the shaft portion transitions into a shelf extending radially outward from the shaft portion, wherein edges of the shelf form camming surfaces for an inward edge of each blade;

wherein after the initial impact, the hub moves rearward relative to the shaft portion whereupon each blade is forced to rotate outward by a camming surface and wherein the rearward movement of the hub synchronizes the plurality of blades to rotate at the same rate.

33. A broadhead arrowhead, comprising:

a broadhead body adapted to attach to an arrow shaft, the broadhead body having a shaft portion;

at least one elongated axial groove defined on a side of the shaft portion;

a blade assembly including a hub slidably mounted on the shaft portion and including a plurality of blades pivotally mounted to the hub, wherein each blade is rotatable between a closed position and an open position; and,

at least one retaining pin mounted through an opening defined in sides of the hub with an inward end of the retaining pin received in the axial groove, wherein the retaining pin prevents the hub from sliding off of the shaft yet allows the hub to freely translate along the shaft within a range defined by the axial groove.

34. The broadhead arrowhead of claim 33, a plurality of elongated axial grooves defined on sides of the shaft portion and a plurality of retaining pins mounted through openings defined in sides of the hub with an inward end of each retaining pin received in an axial groove.

35. The broadhead arrowhead of claim 34, wherein the retaining pins are pushed into the openings defined in the hub.

36. The broadhead arrowhead of claim 34, wherein the retaining pins have splined cylindrical sides which engage grooves in the hub openings.

37. The broadhead arrowhead of claim 34, wherein the retaining pins are threaded into the openings defined in the hub.

38. The broadhead arrowhead of claim 34, wherein the inward ends of the retaining pins are rounded.

39. The broadhead arrowhead of claim 34, comprising a material to facilitate sliding motion placed between each pin inward end and the respective groove.

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