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Mizek

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(54) **BROADHEAD**

(56)

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Filed: **Feb. 3, 2016**

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F42B 6/08 (2006.01)

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CPC **F42B 6/08** (2013.01)

(58) **Field of Classification Search**
CPC F42B 6/08
USPC 473/283
See application file for complete search history.

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Primary Examiner — Jeffrey R Jastrzab

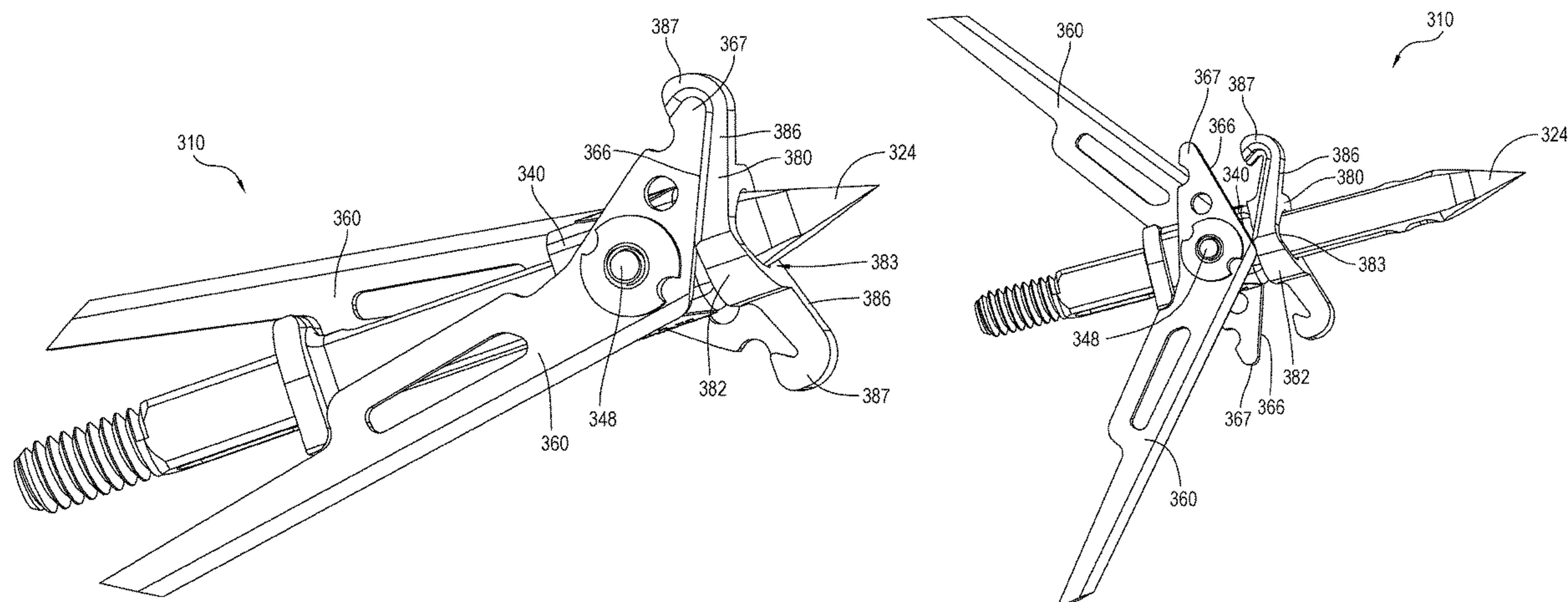
(74) *Attorney, Agent, or Firm* — Woodard, Emhardt, Henry, Reeves & Wagner, LLP

(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.

18 Claims, 25 Drawing Sheets



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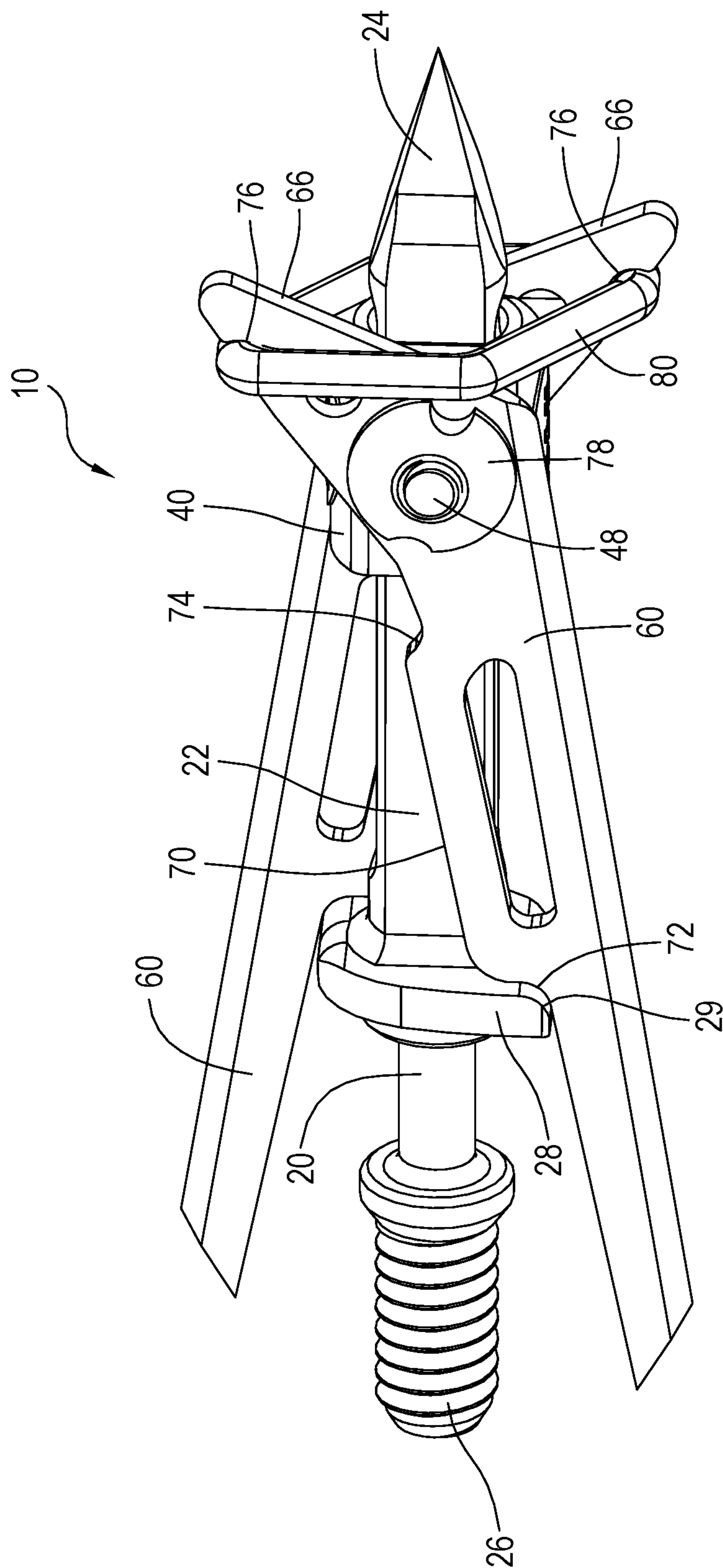


Fig. 1

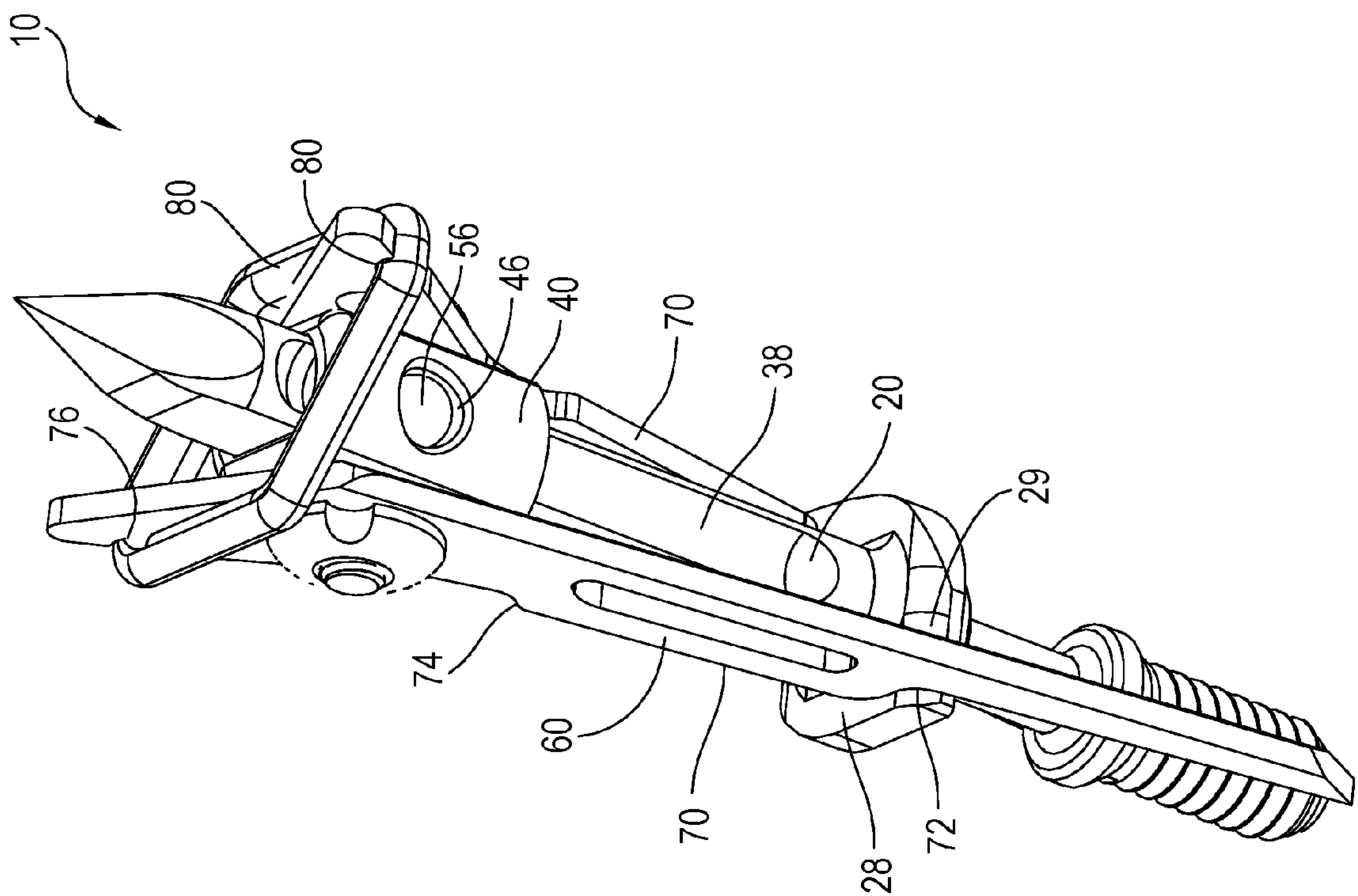


Fig. 2

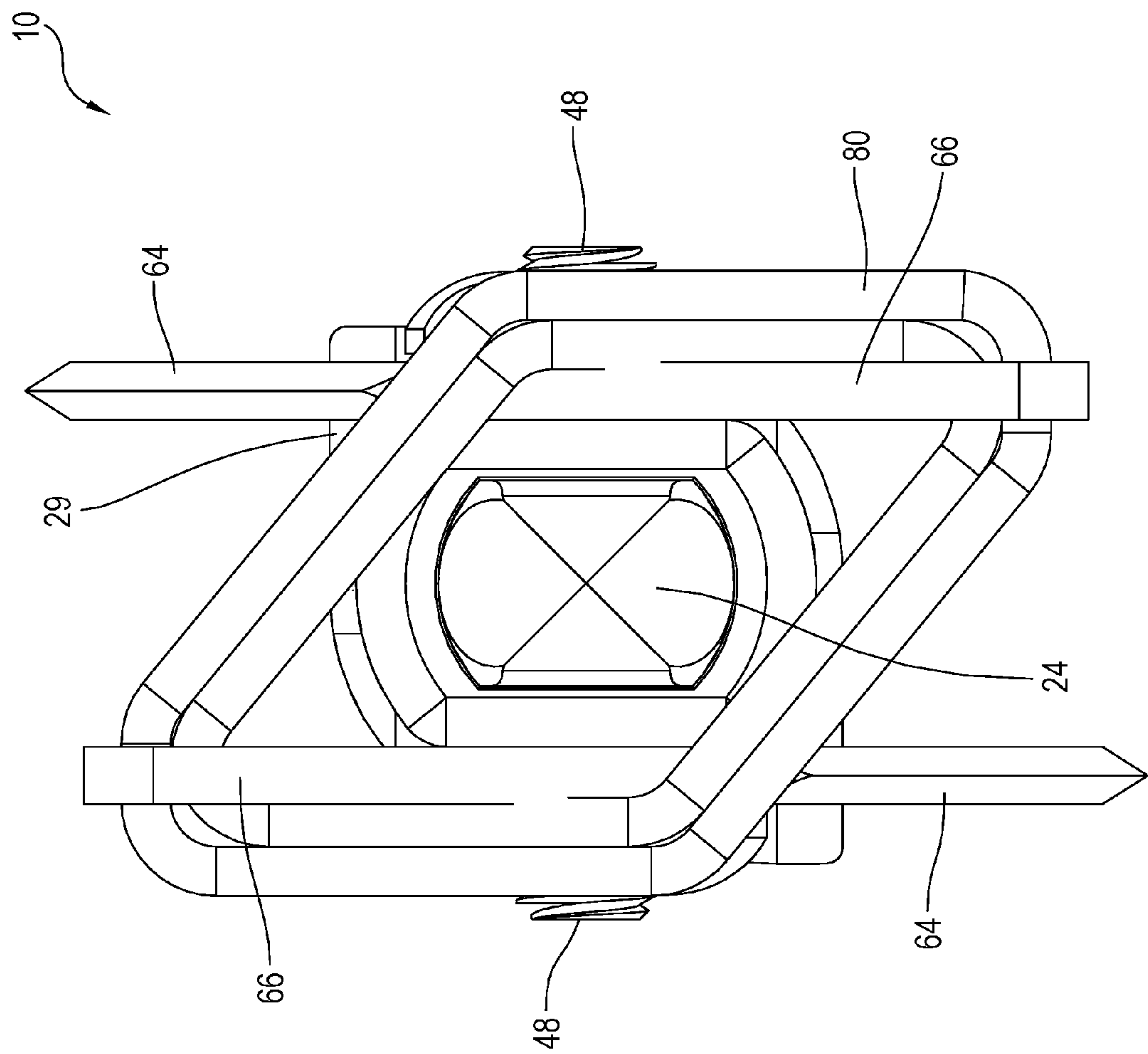


Fig. 3

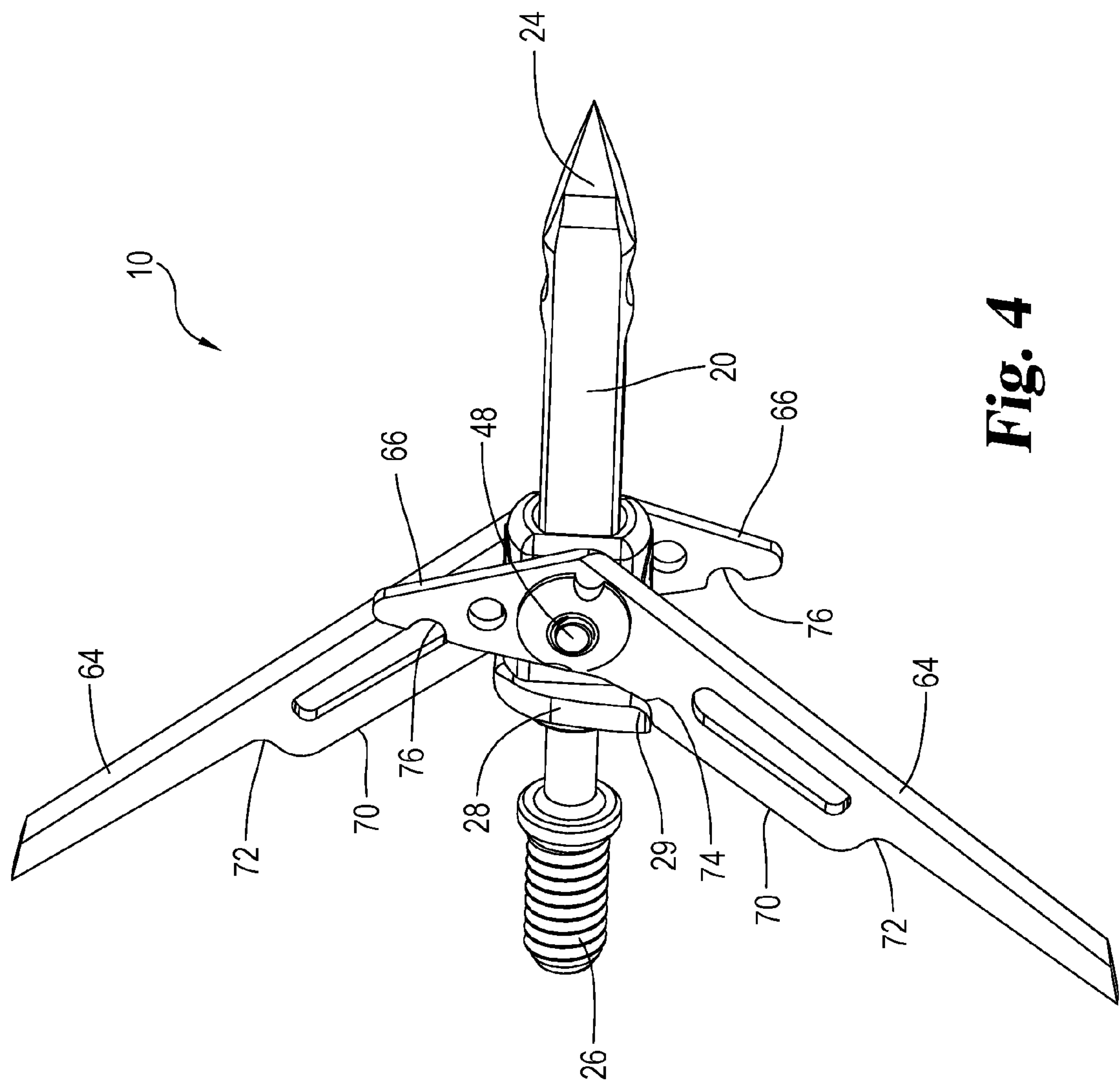


Fig. 4

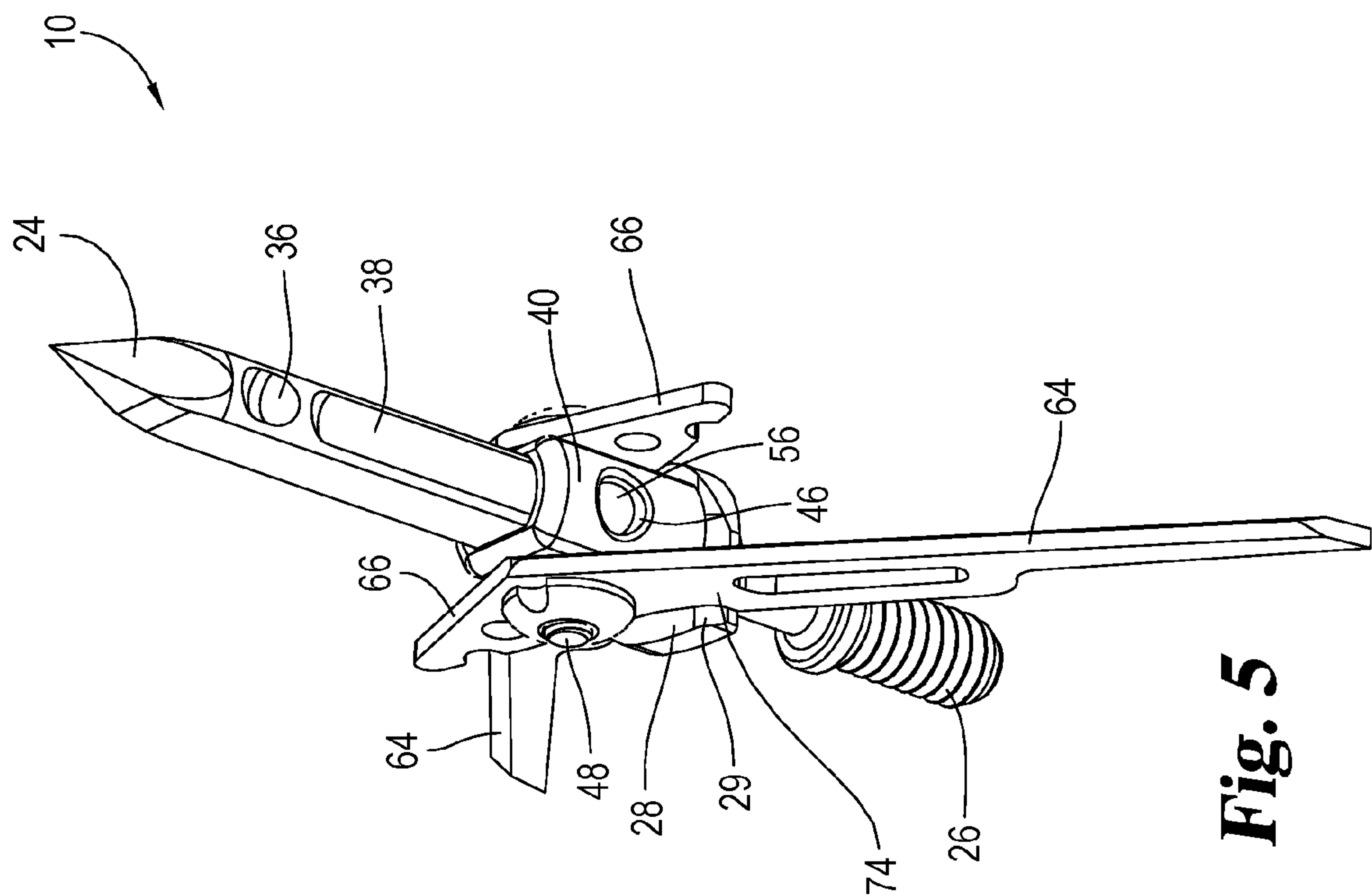


Fig. 5

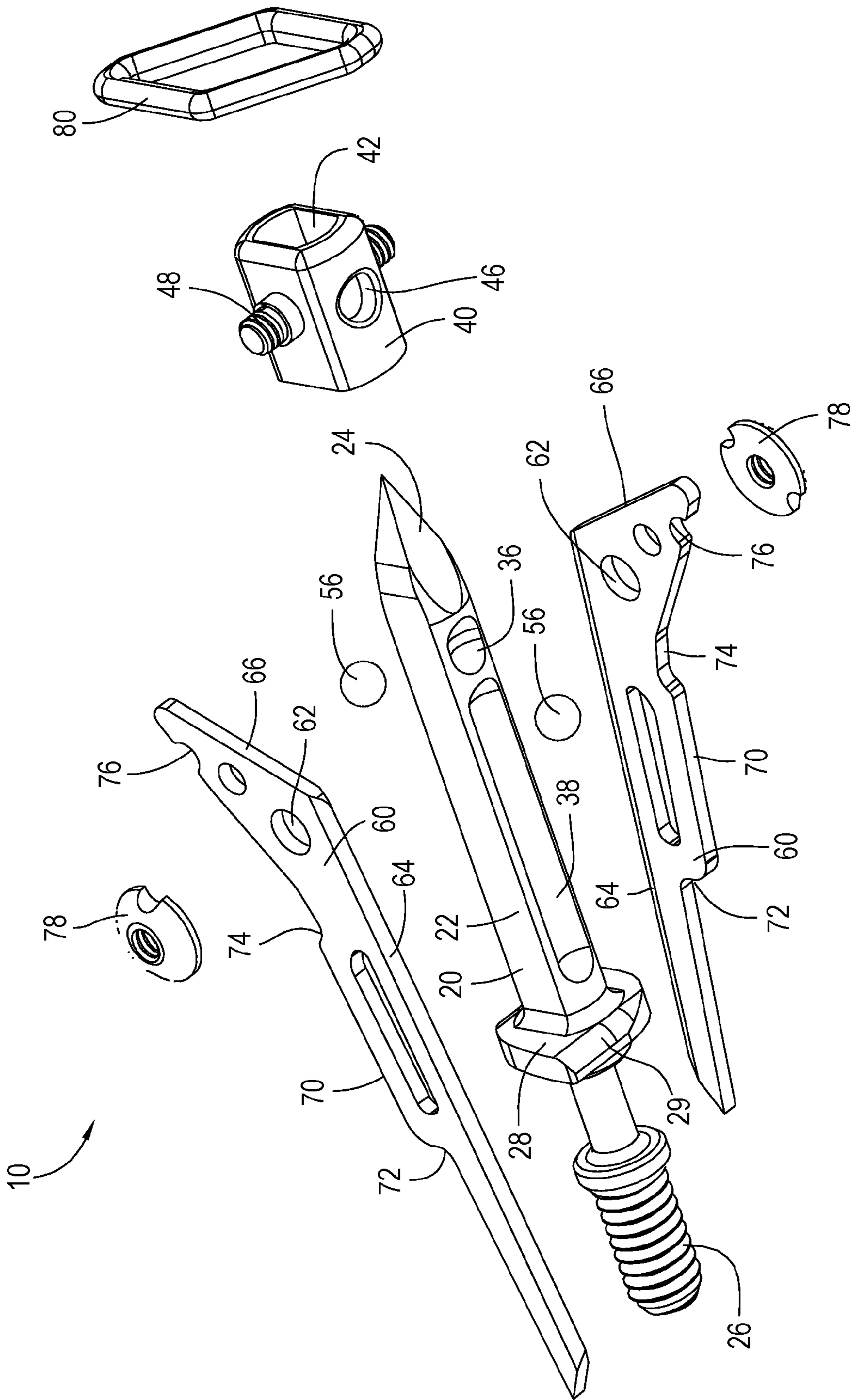


Fig. 6

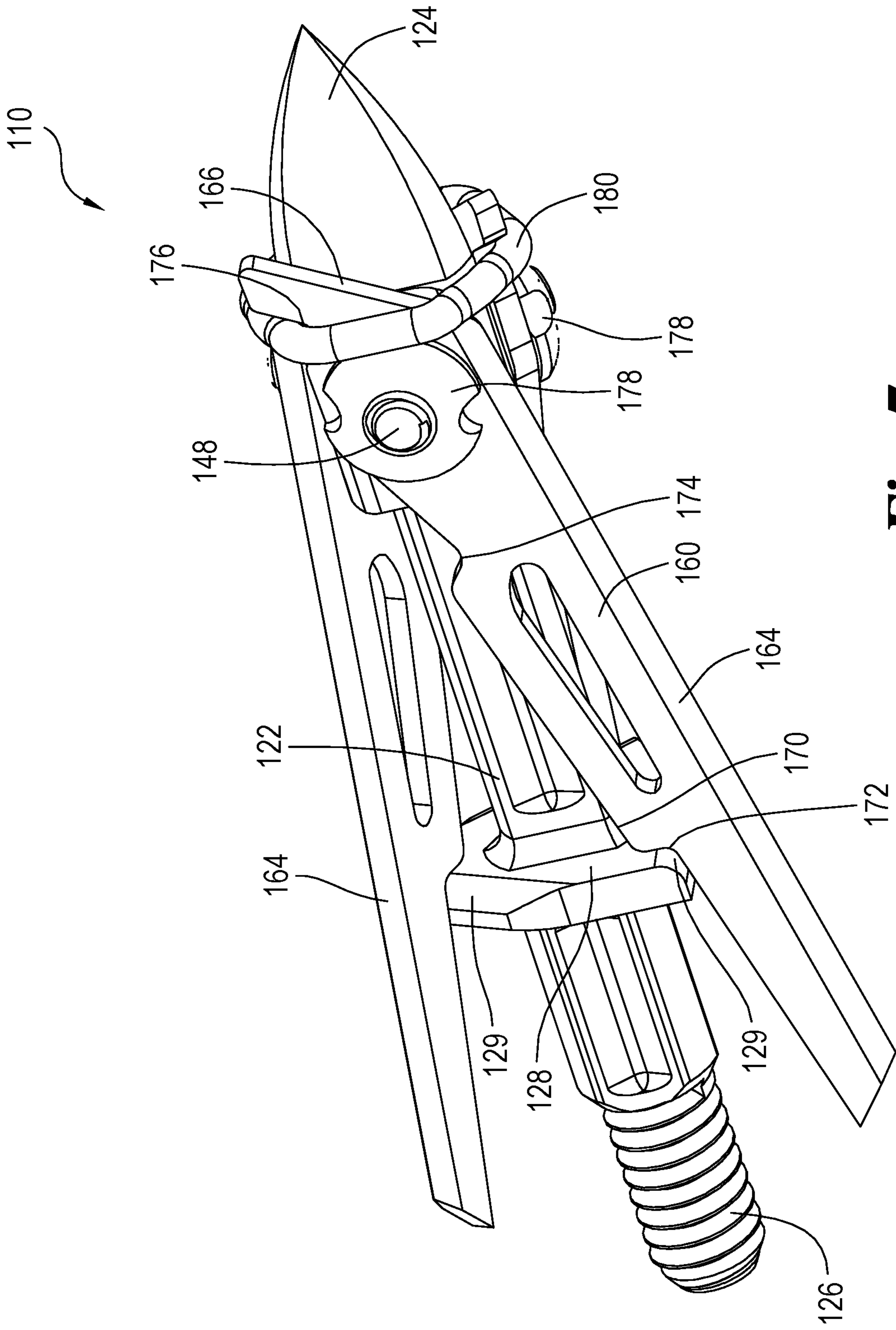


Fig. 7

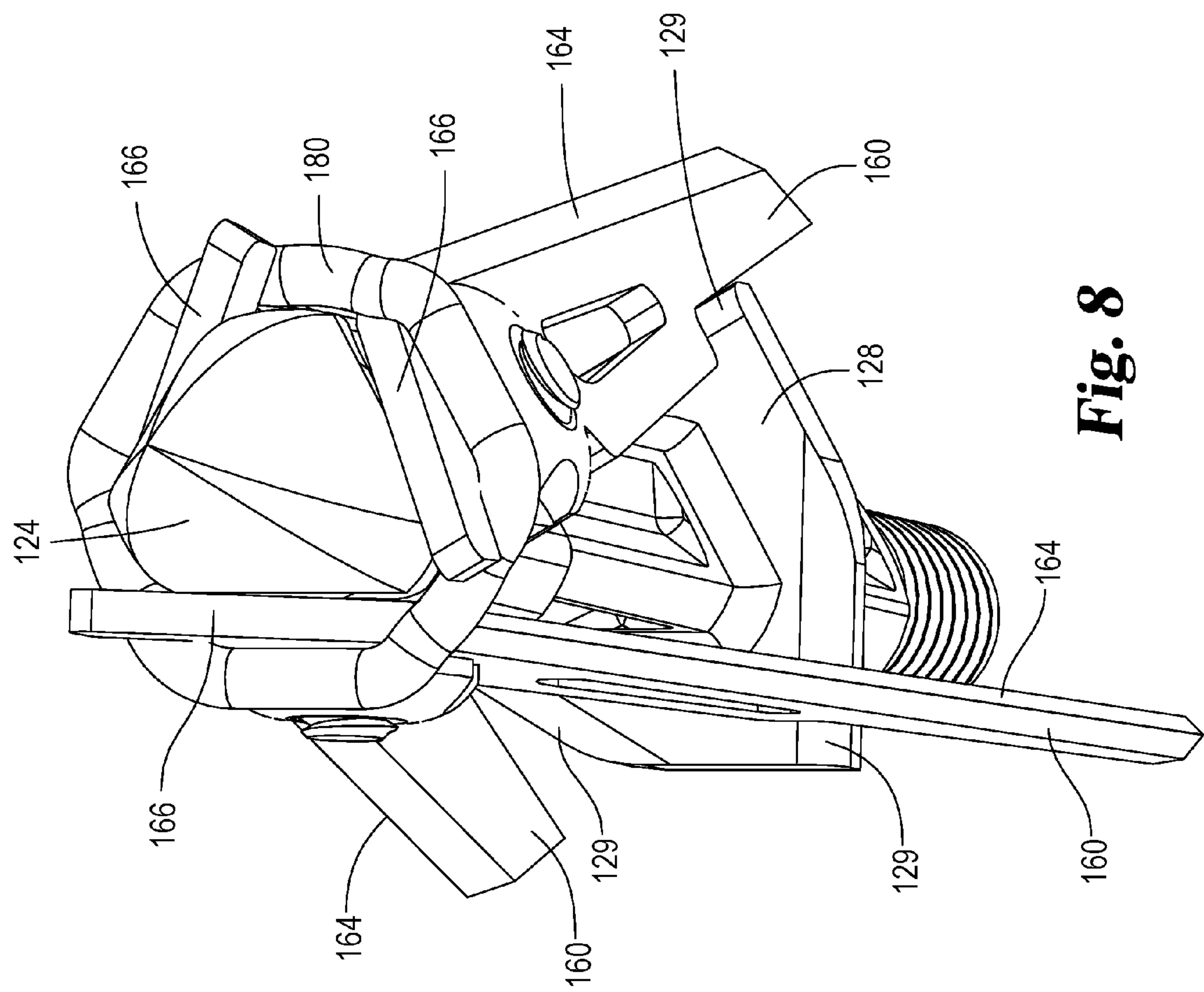


Fig. 8

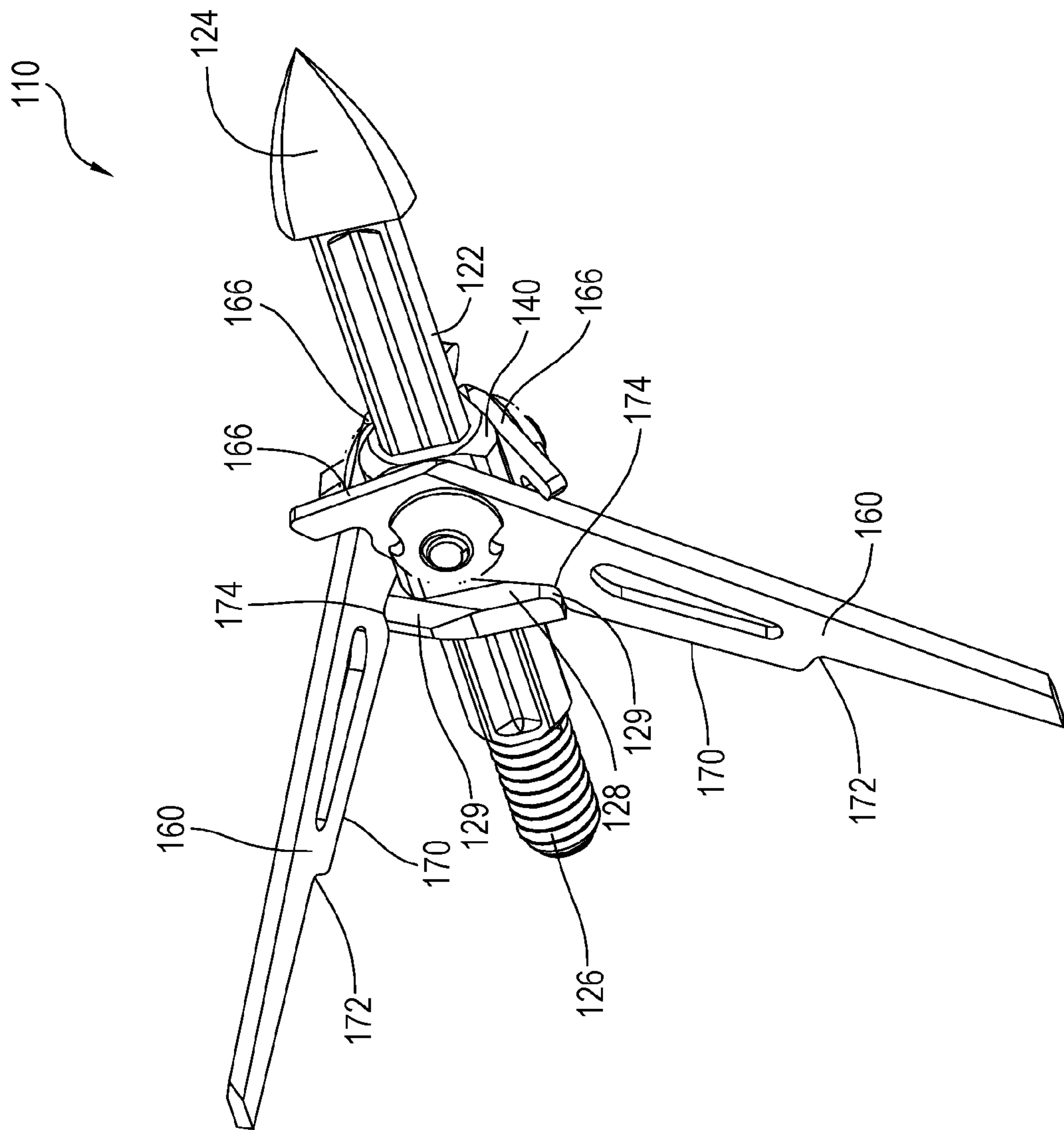


Fig. 9

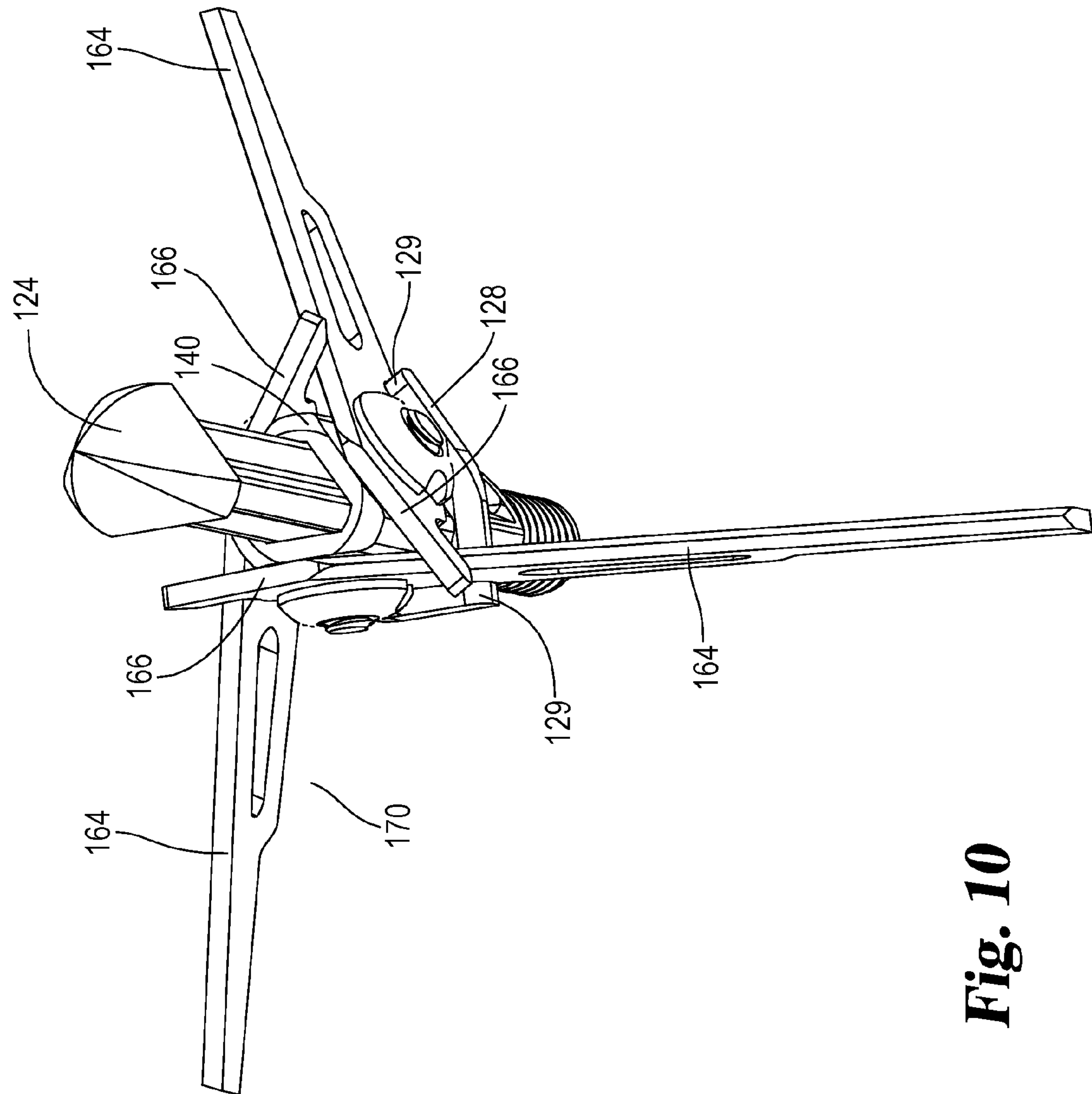


Fig. 10

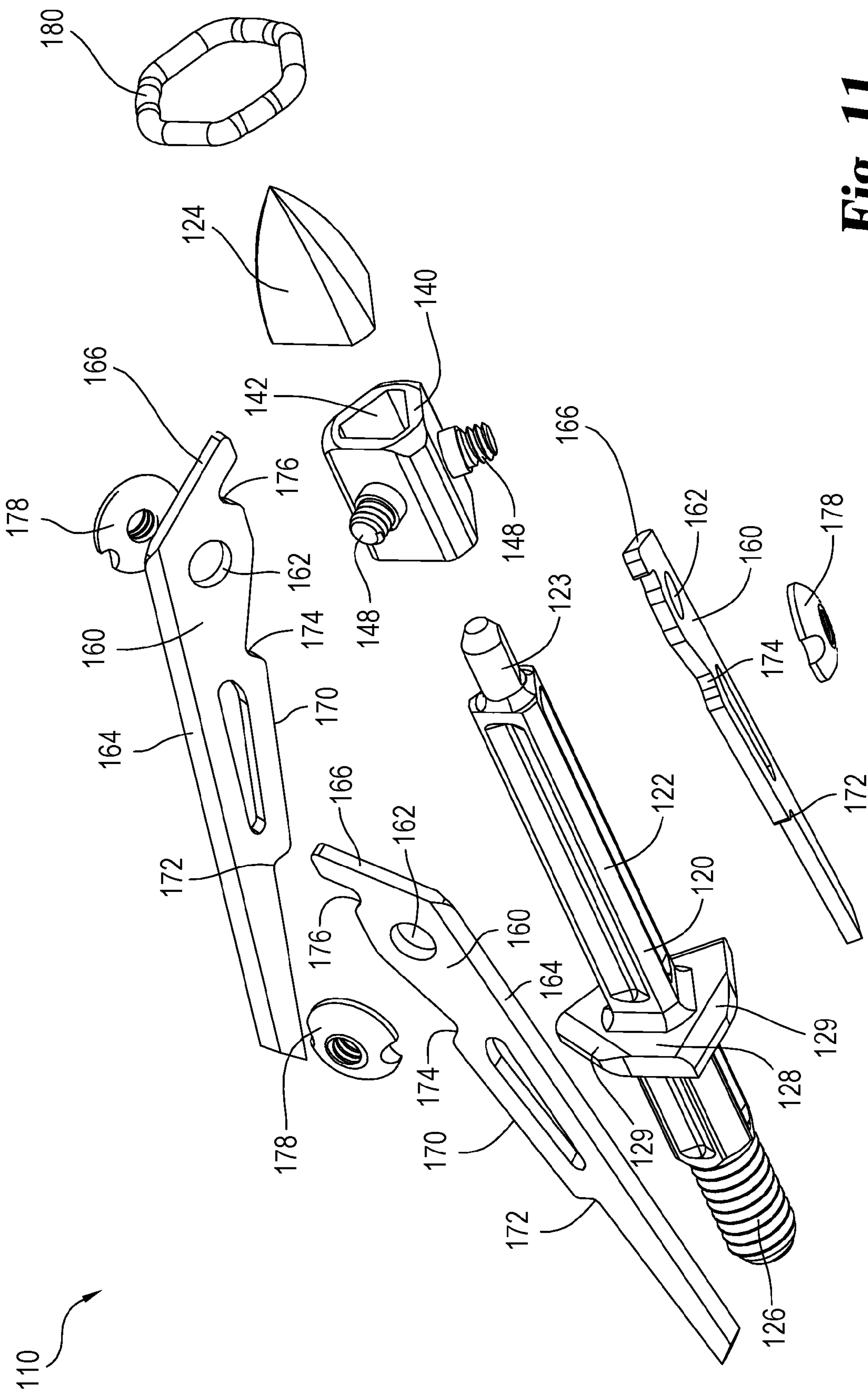


Fig. 11

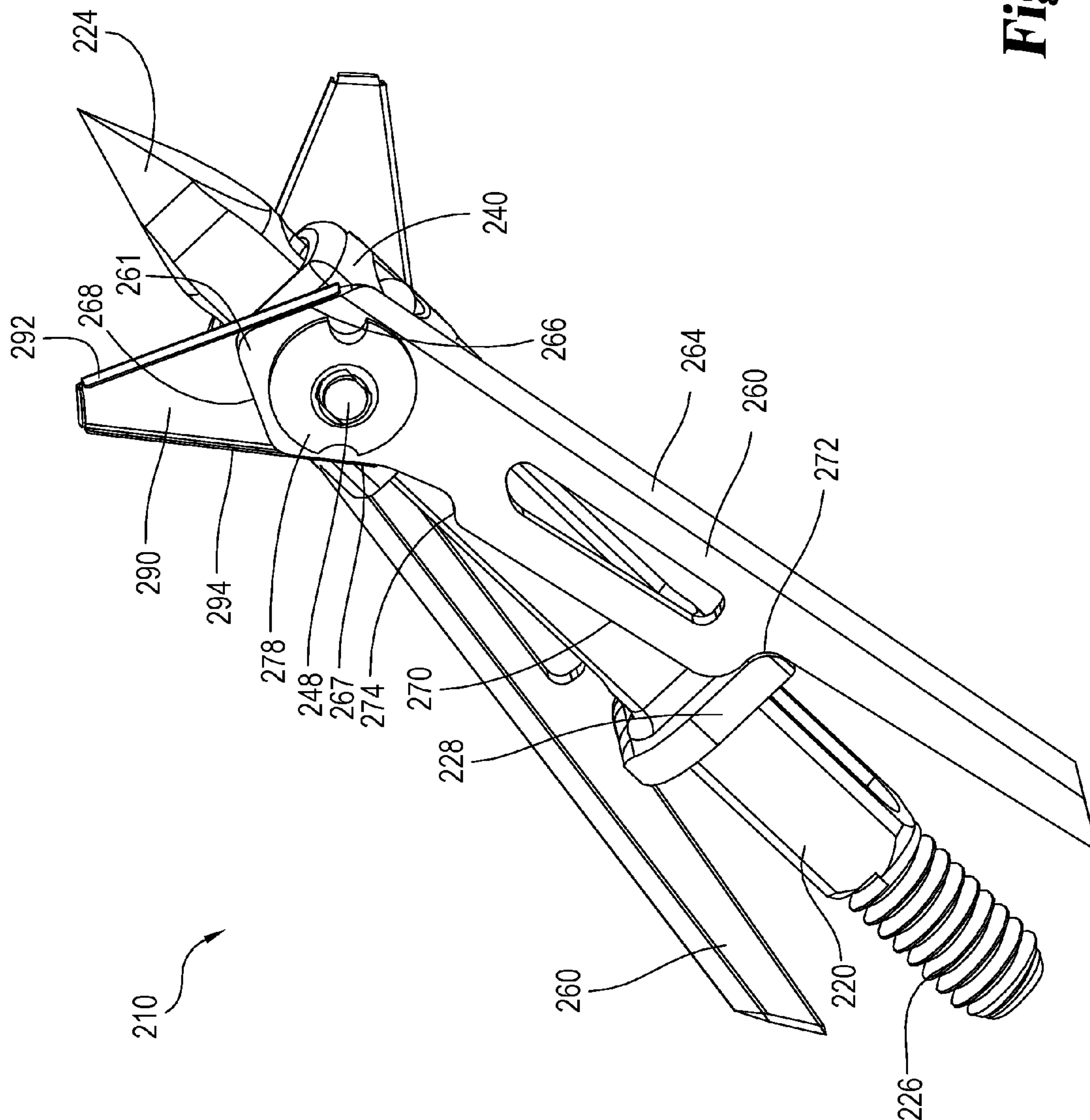


Fig. 12

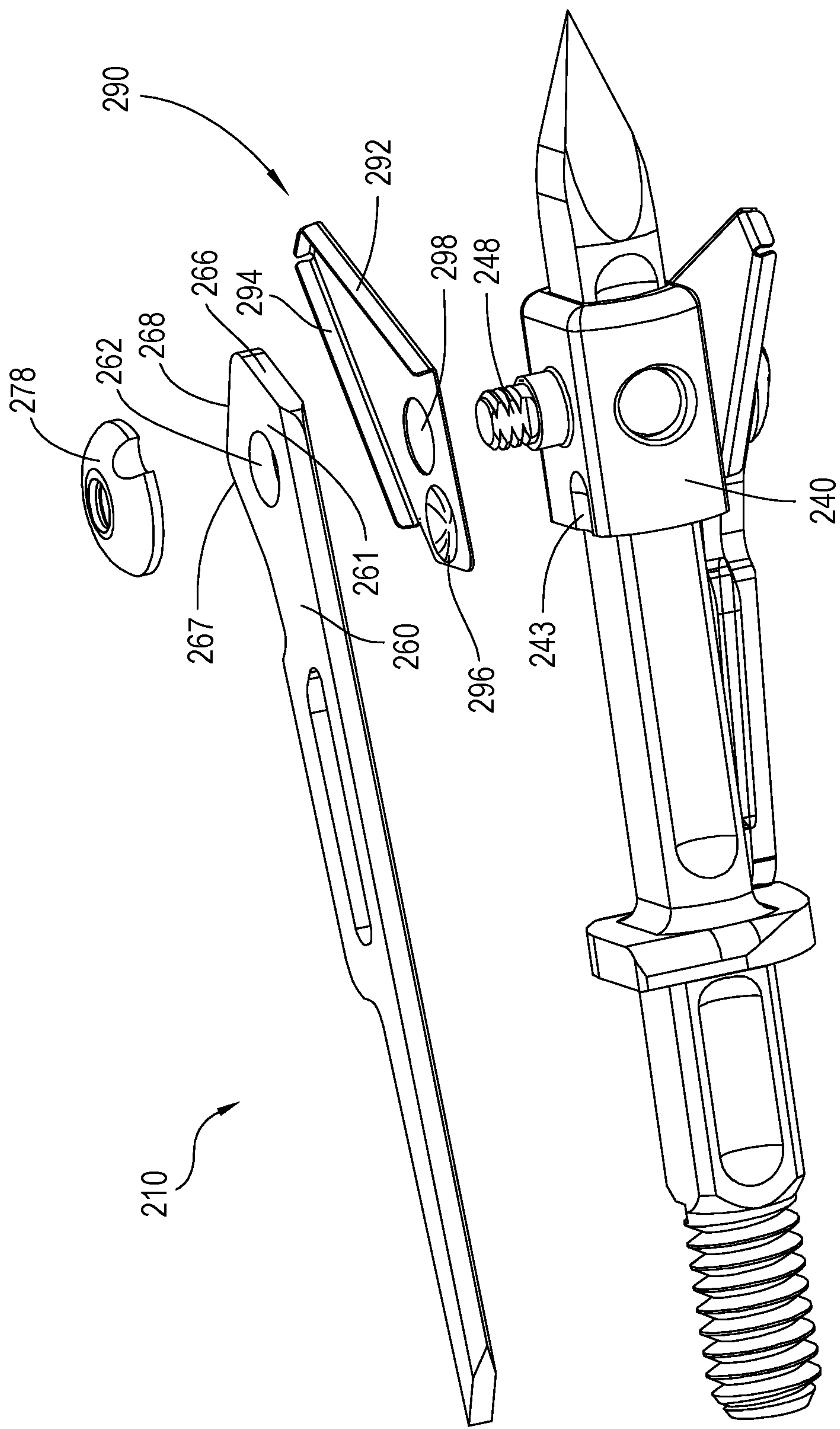


Fig. 13

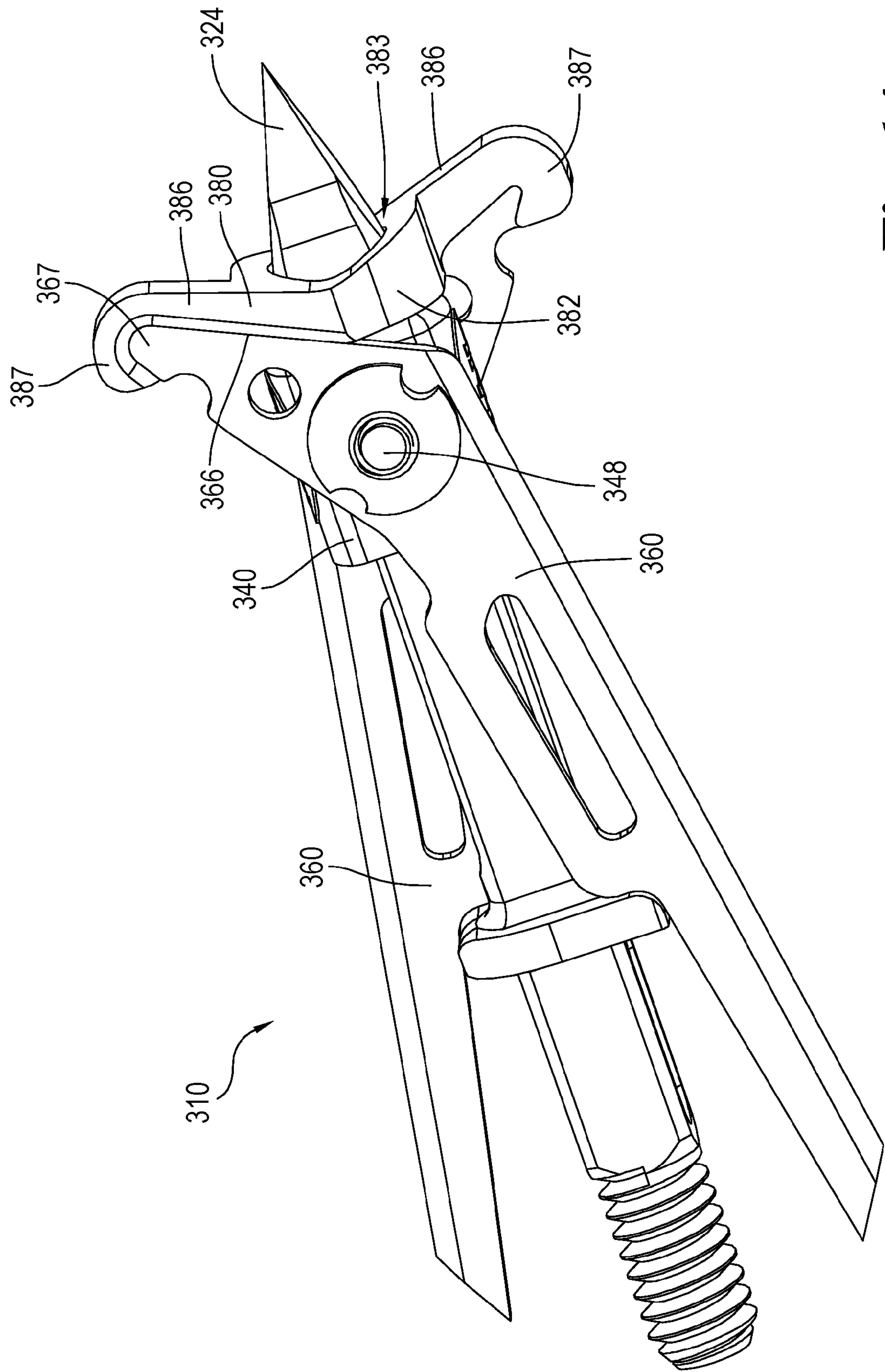


Fig. 14

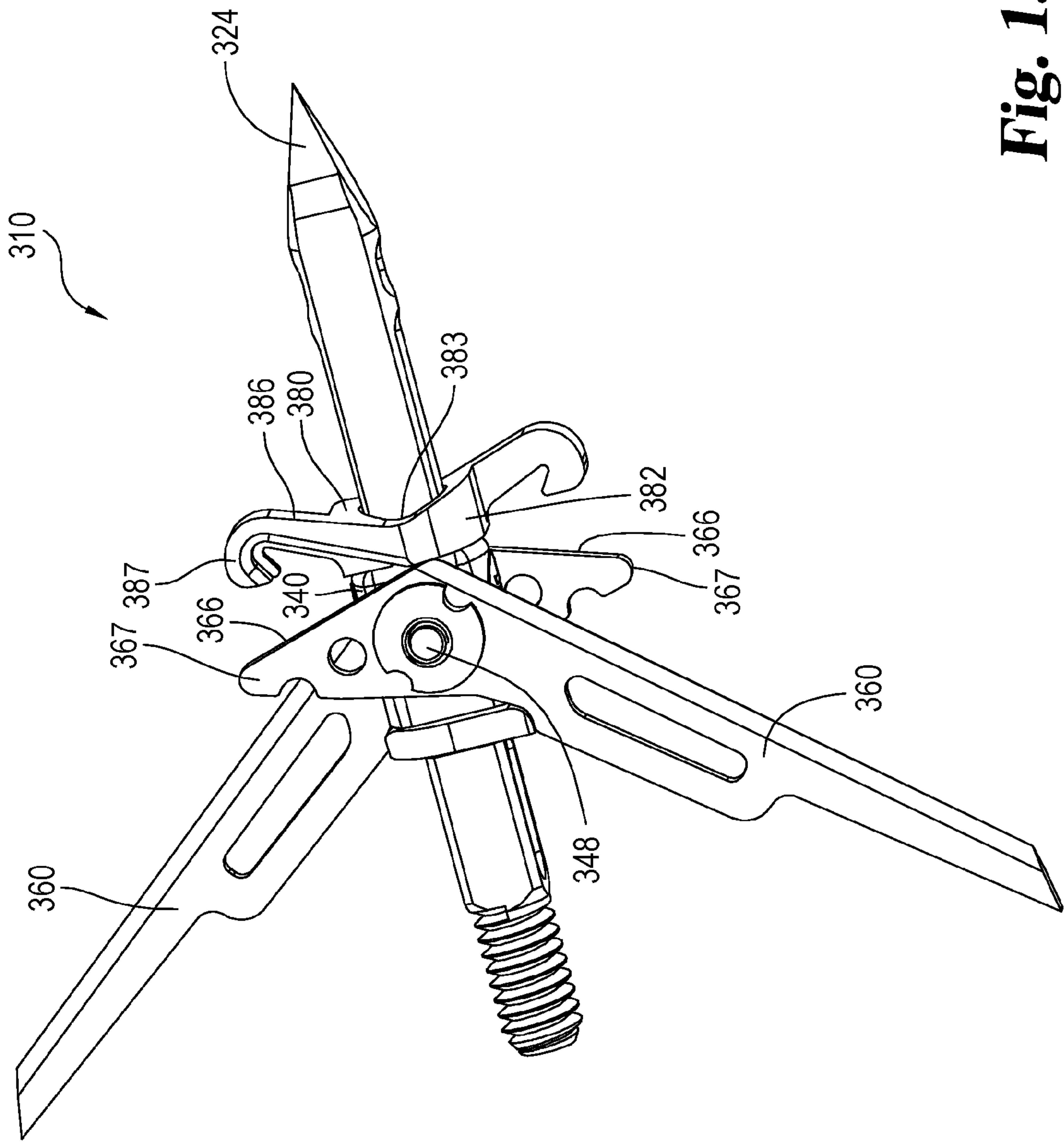


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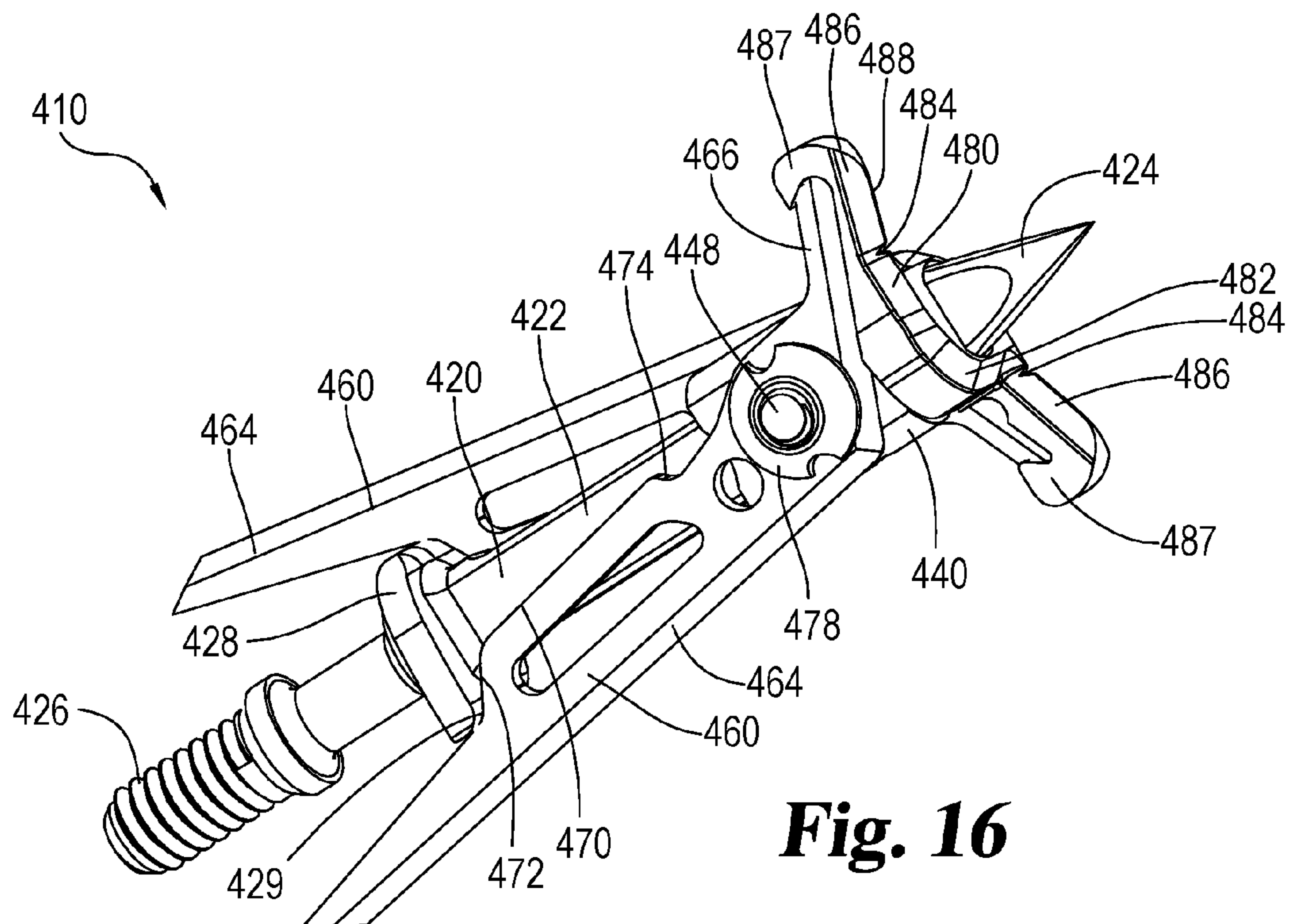


Fig. 16

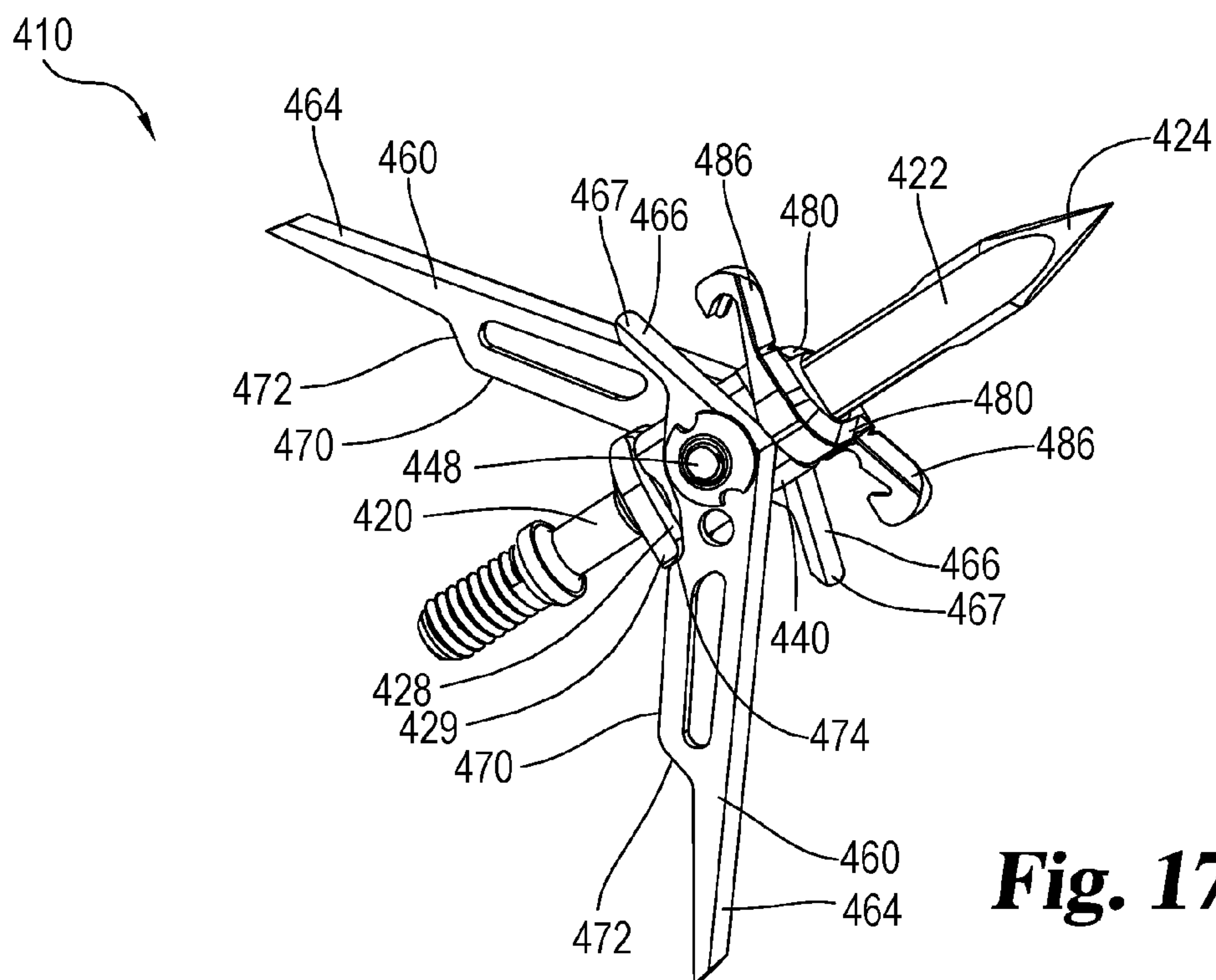


Fig. 17

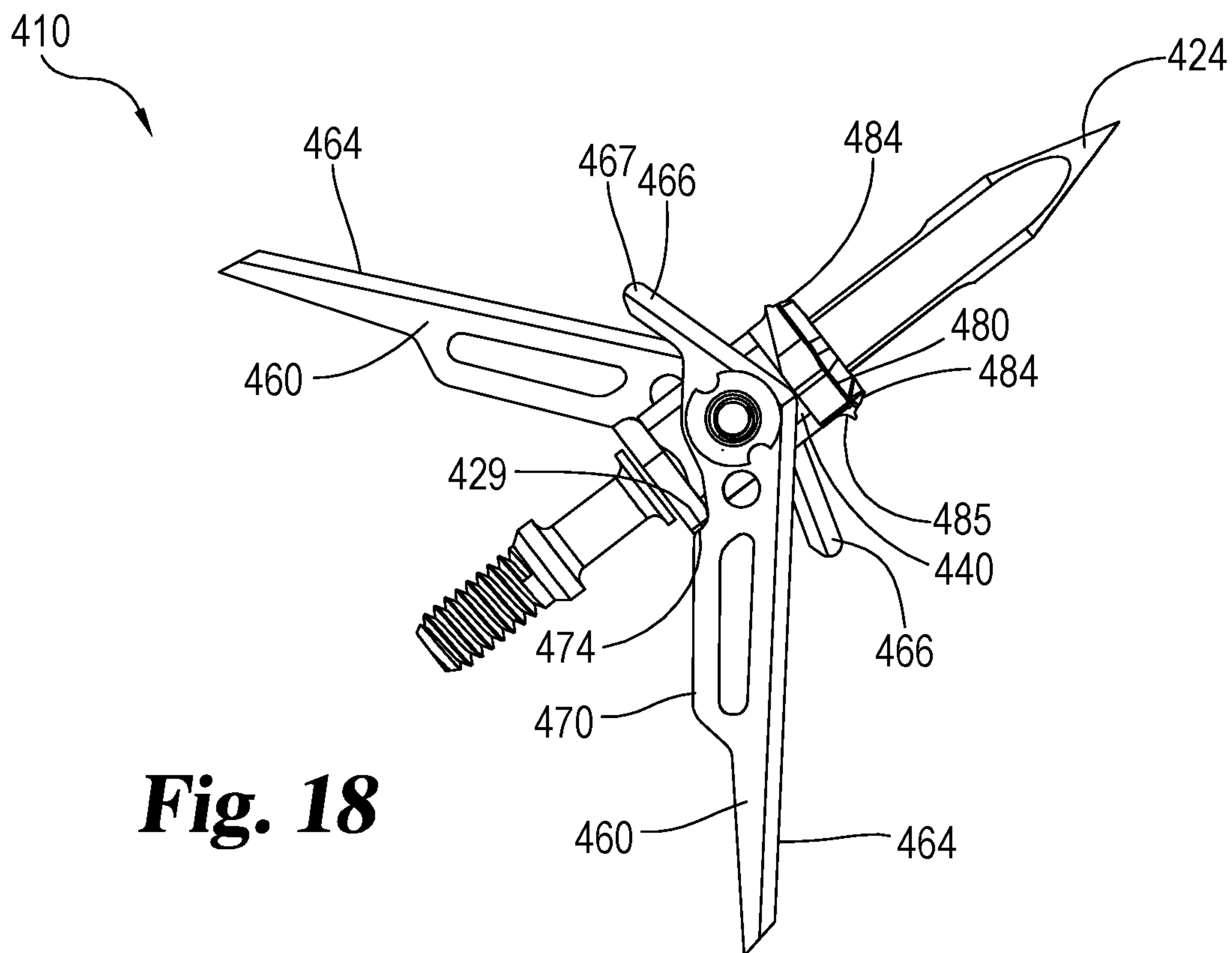


Fig. 18

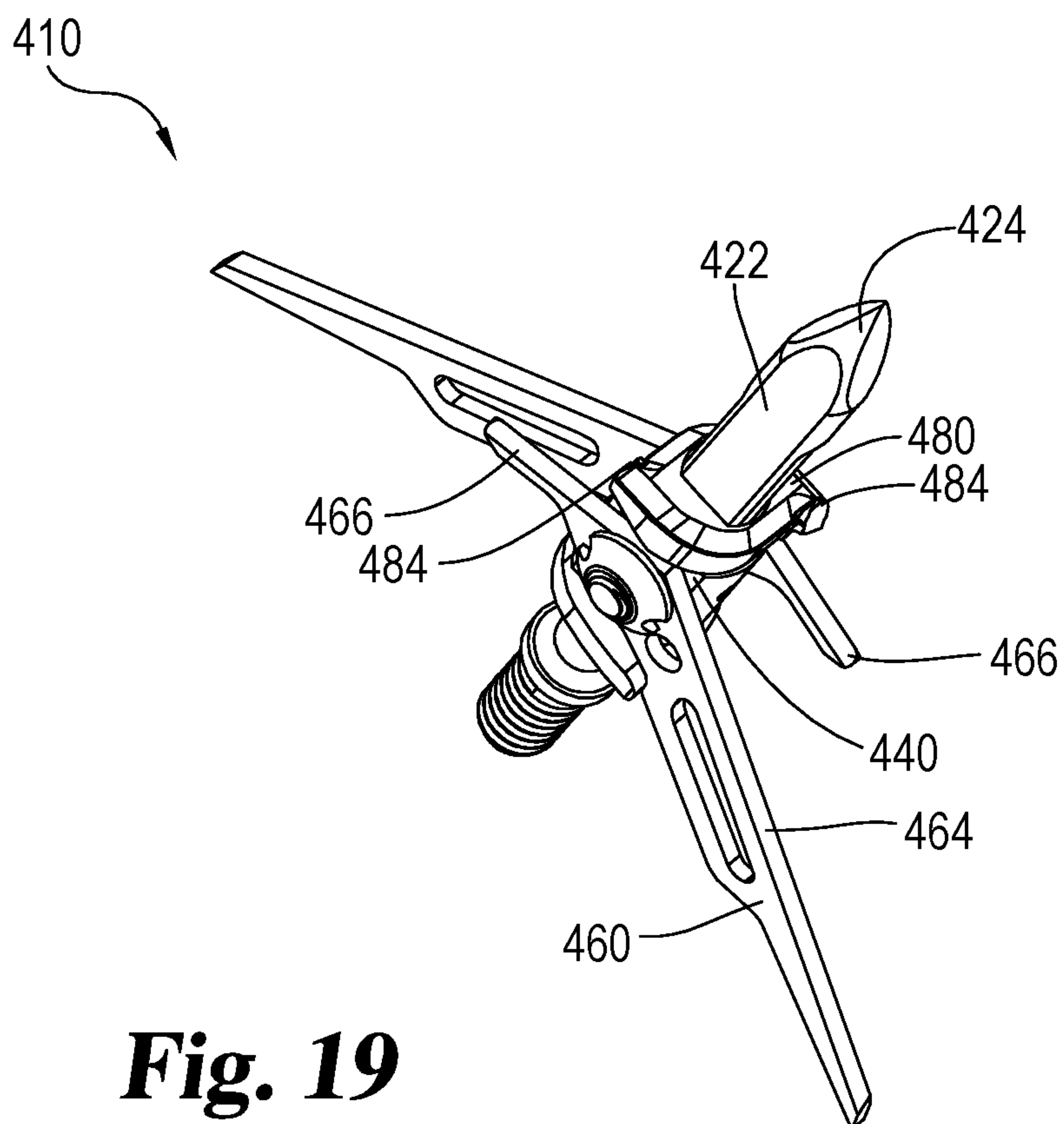


Fig. 19

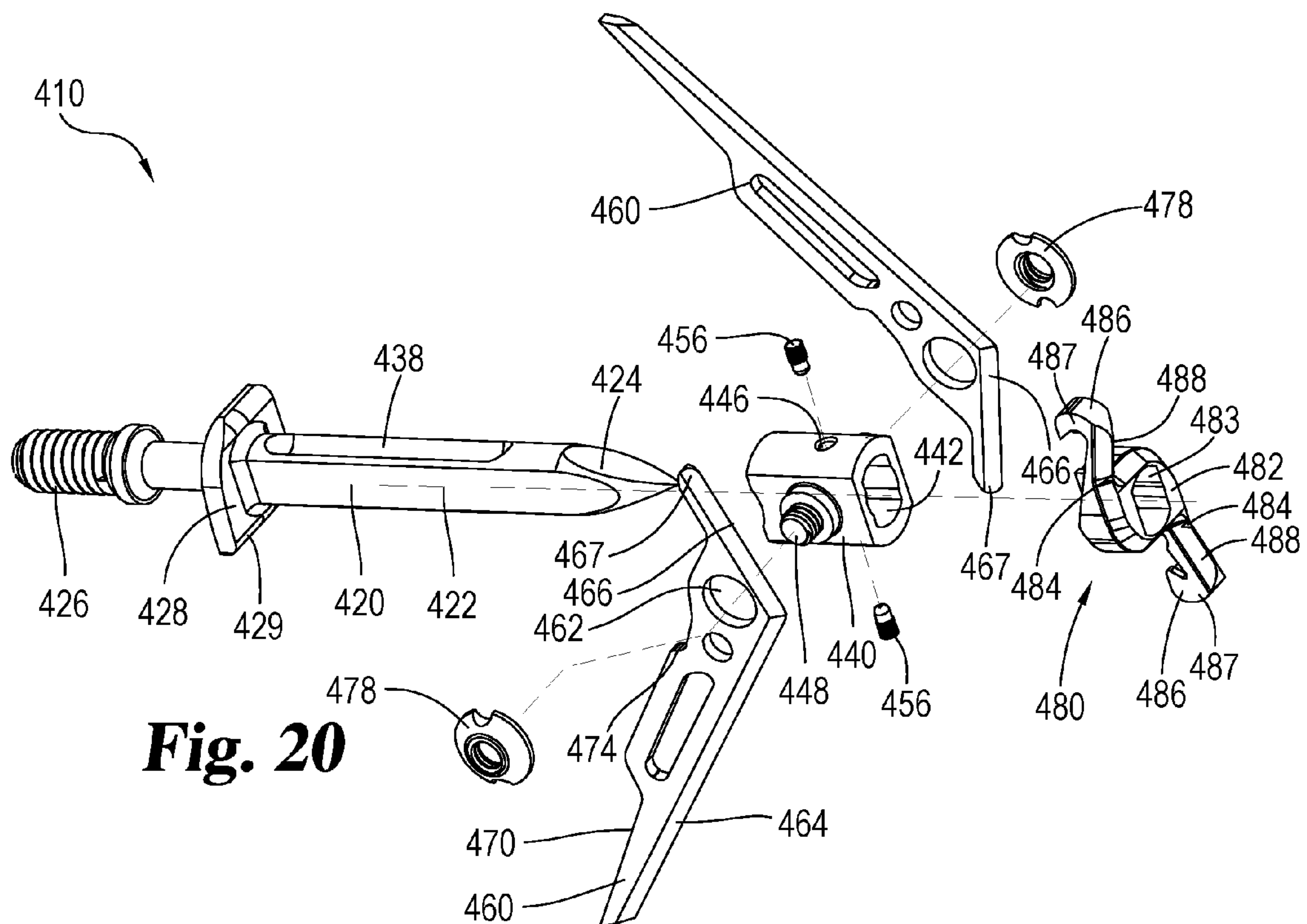


Fig. 20

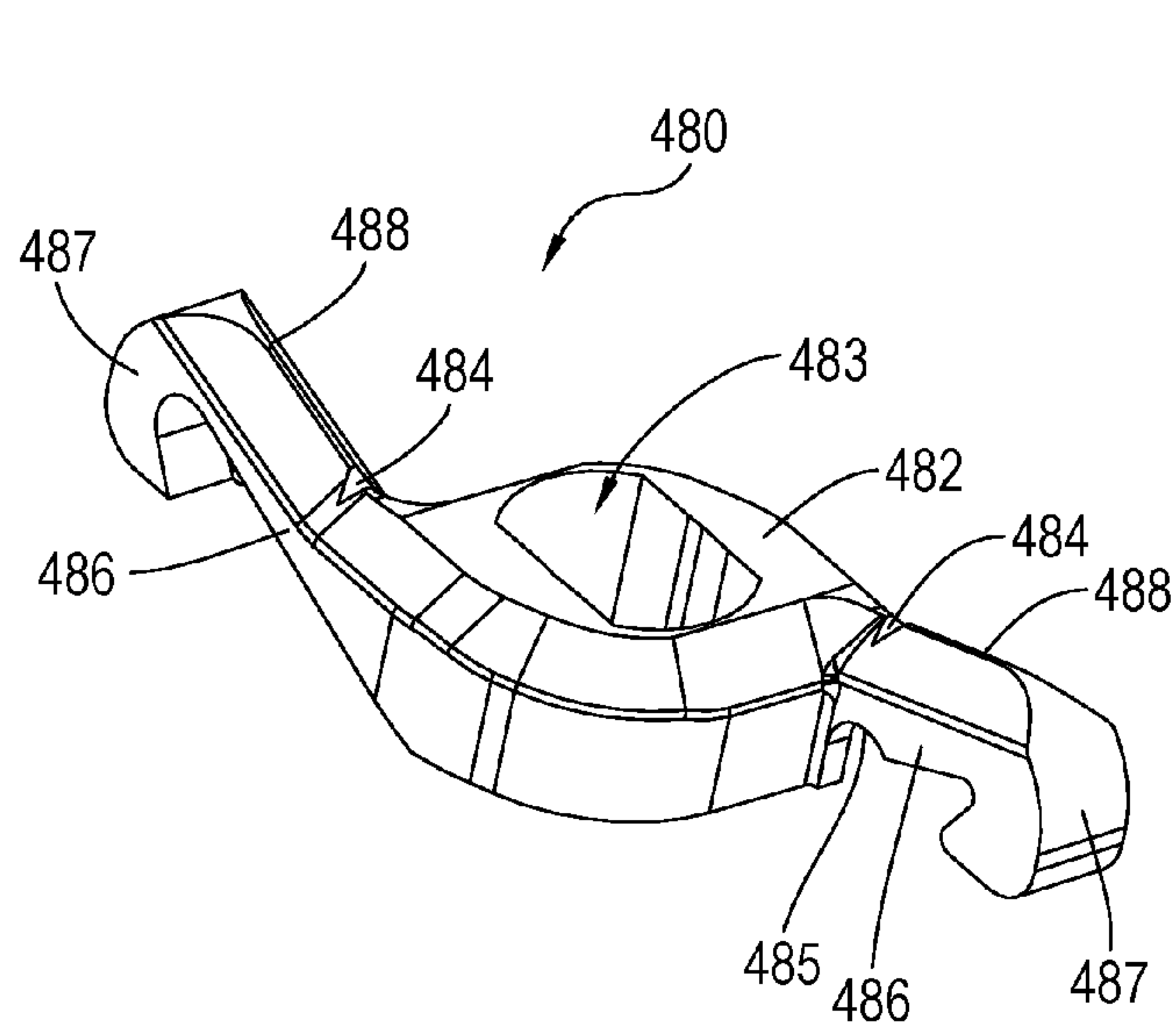


Fig. 21

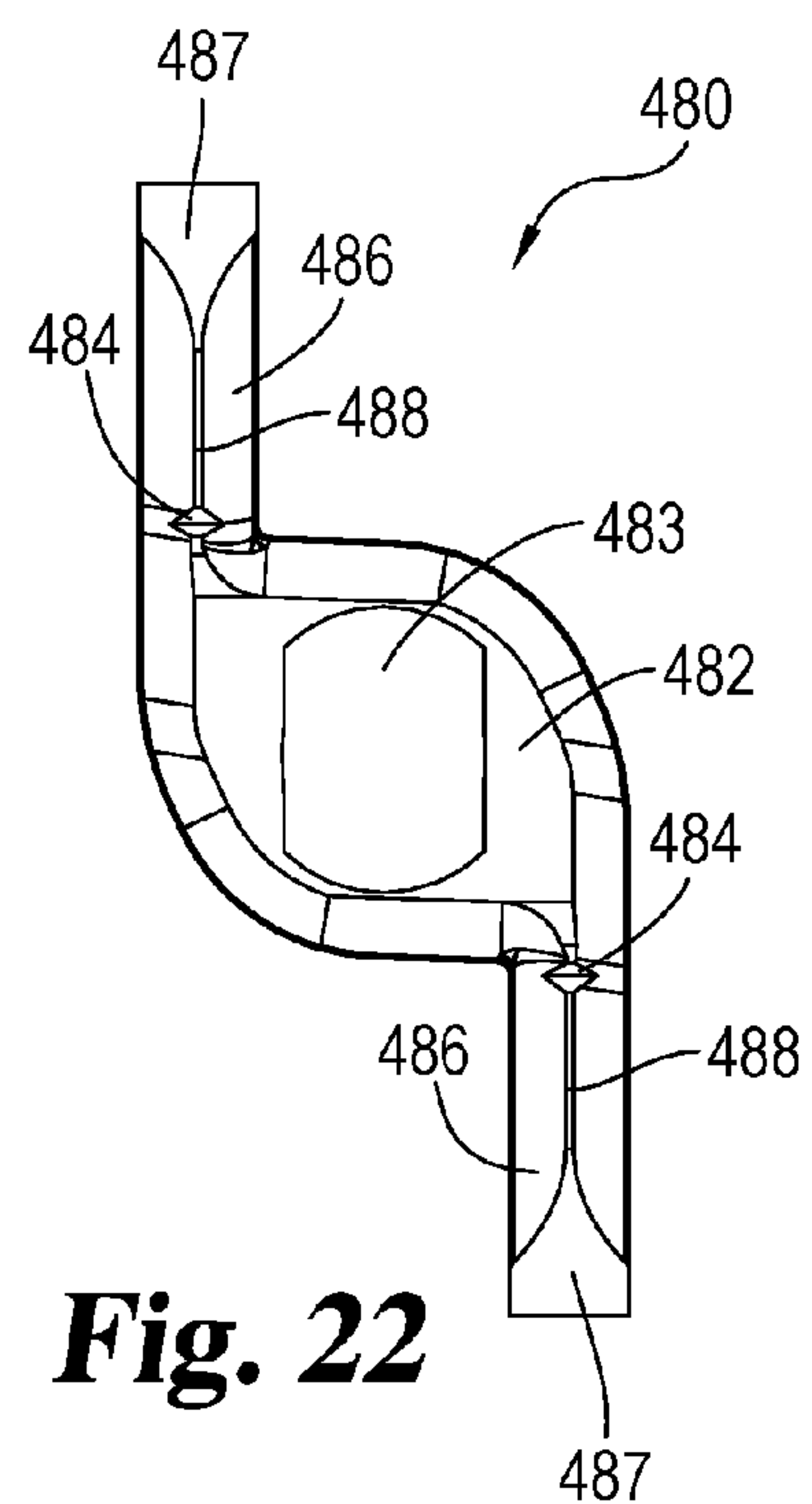


Fig. 22

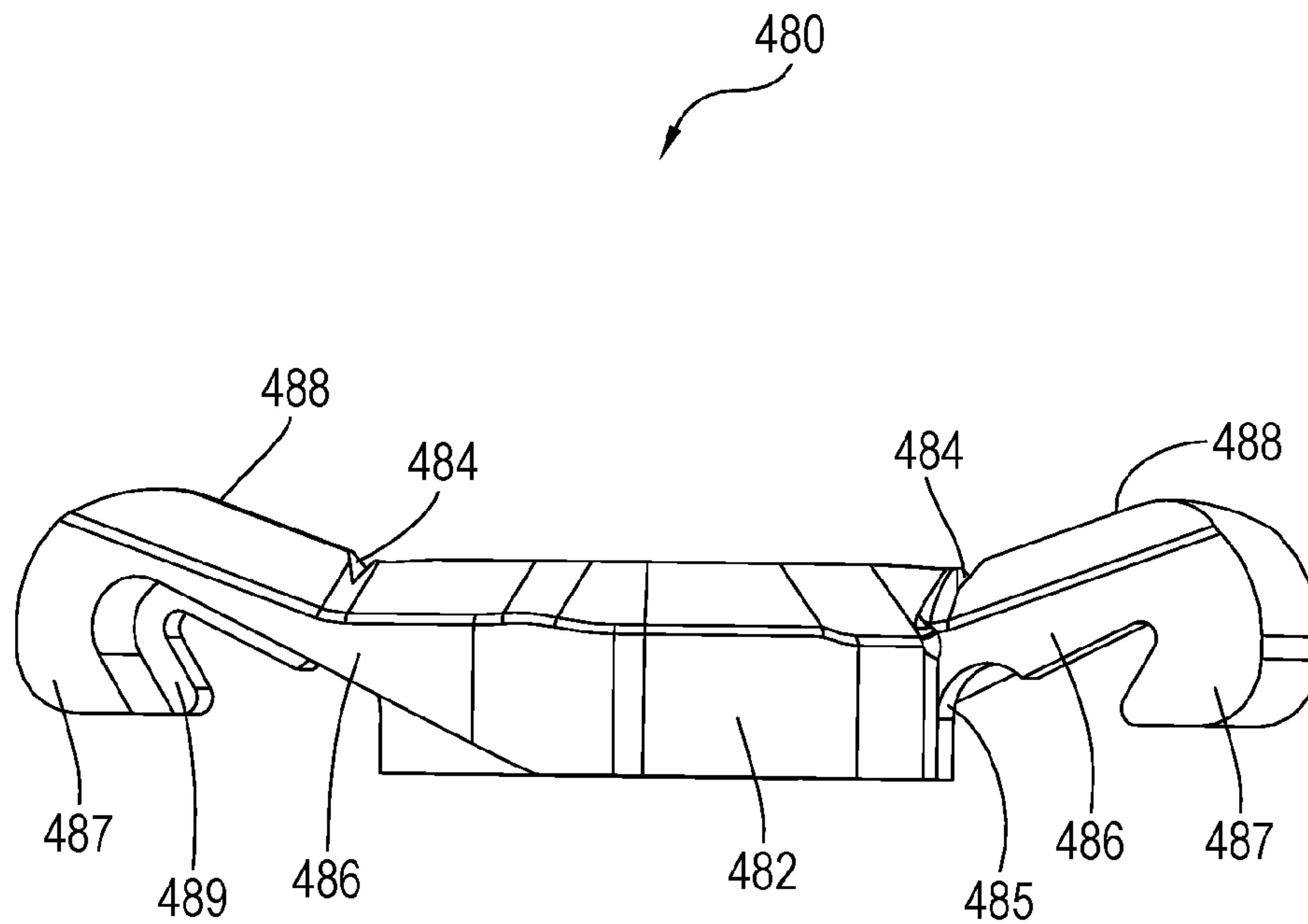


Fig. 23

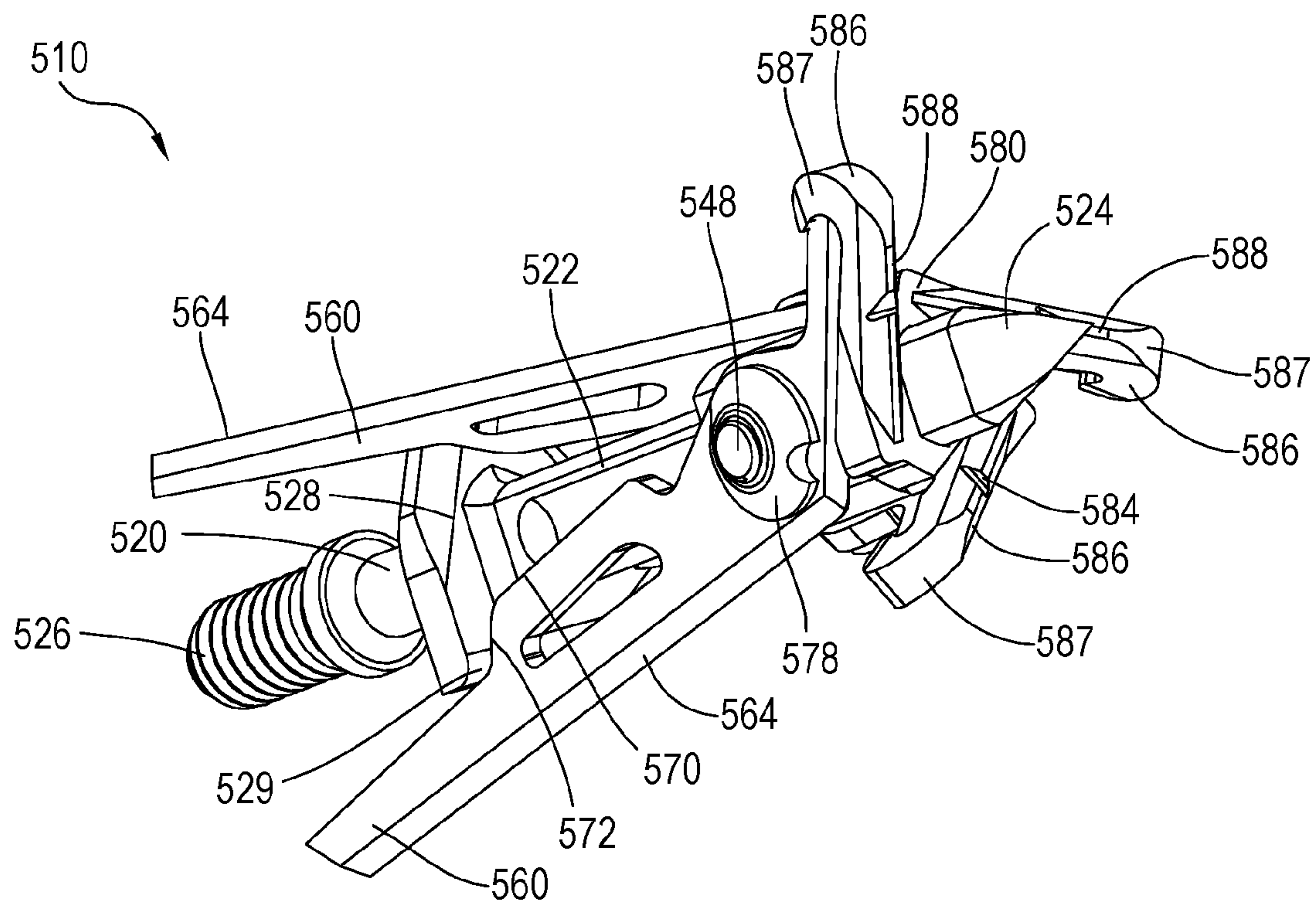
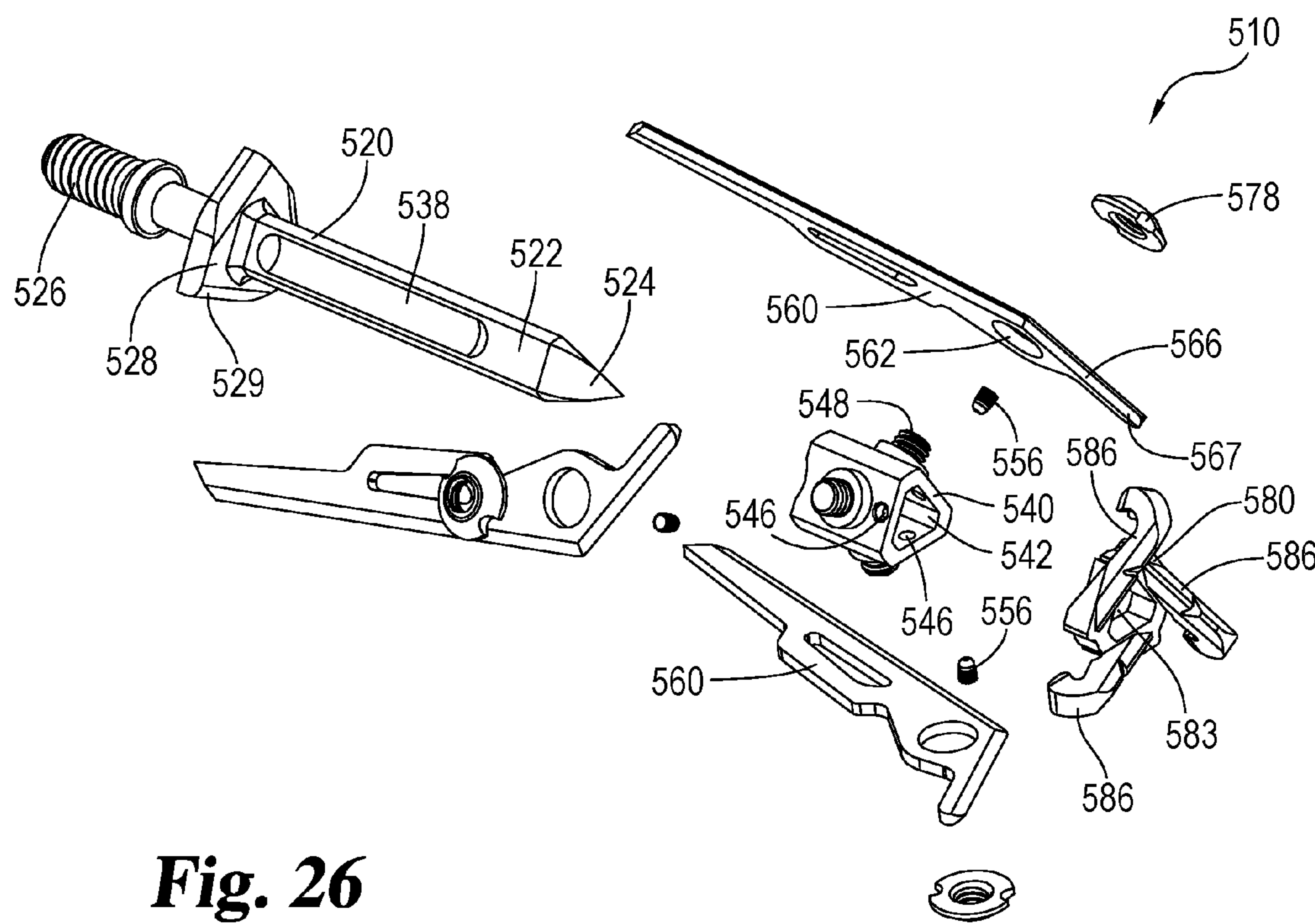
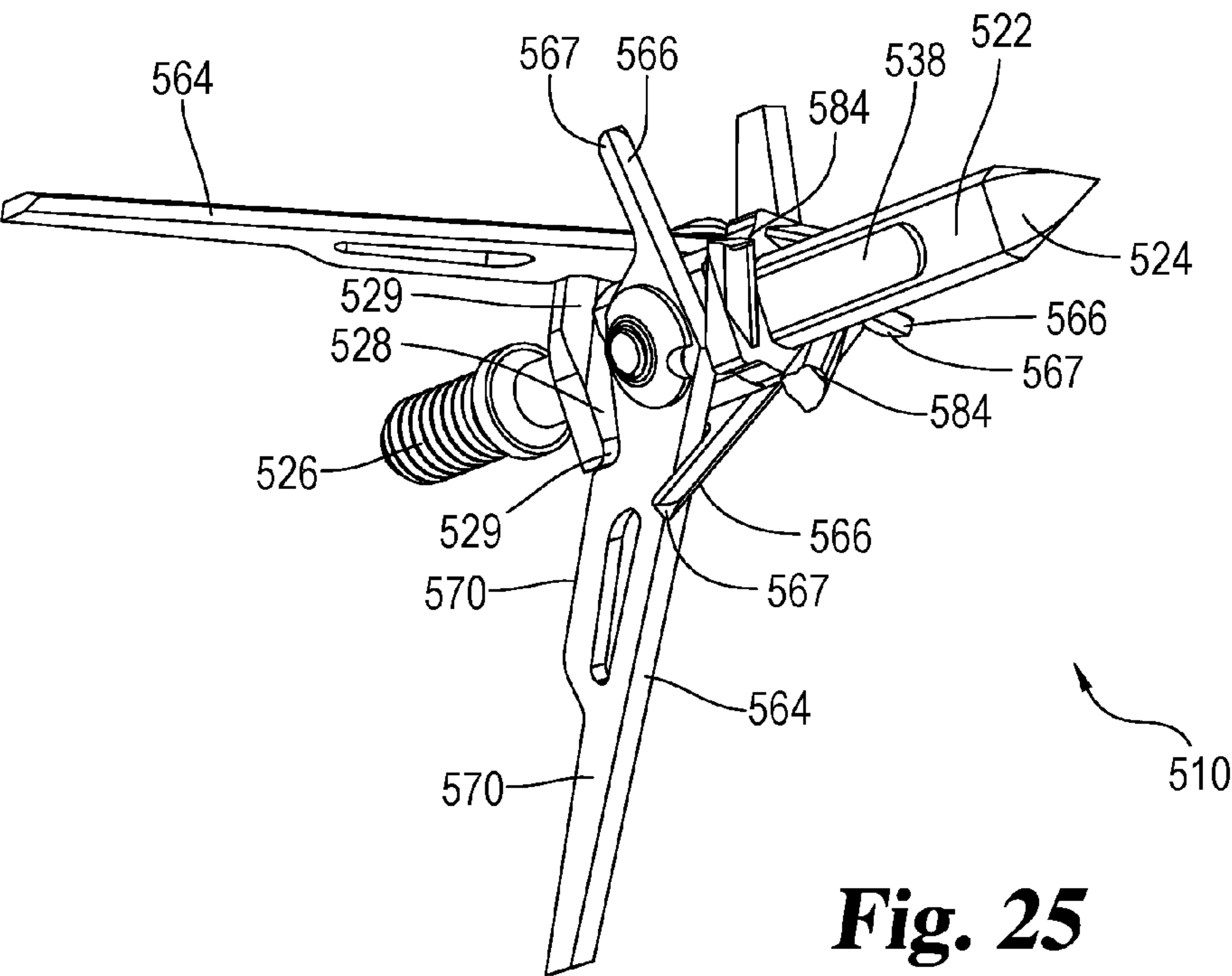
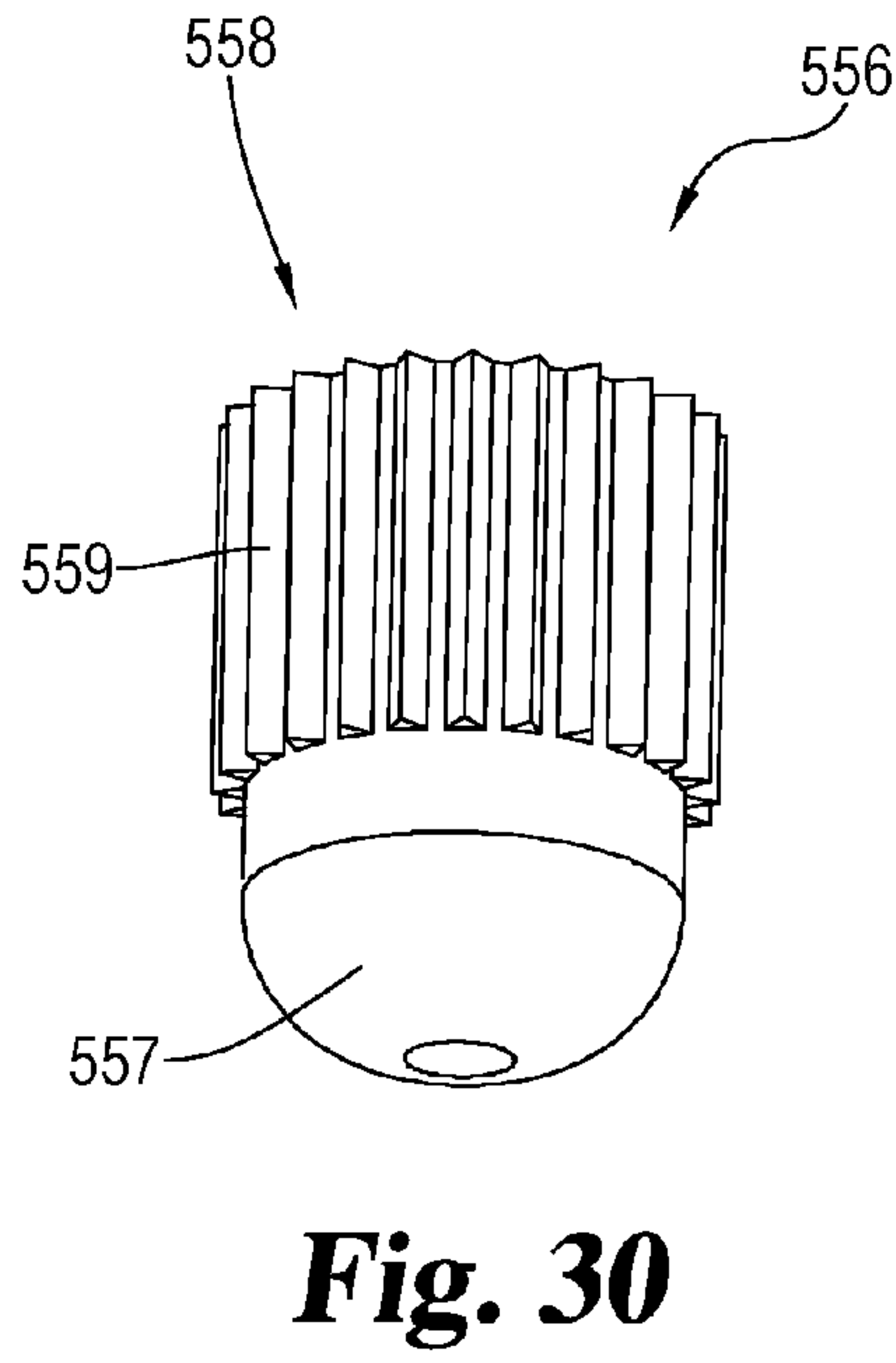
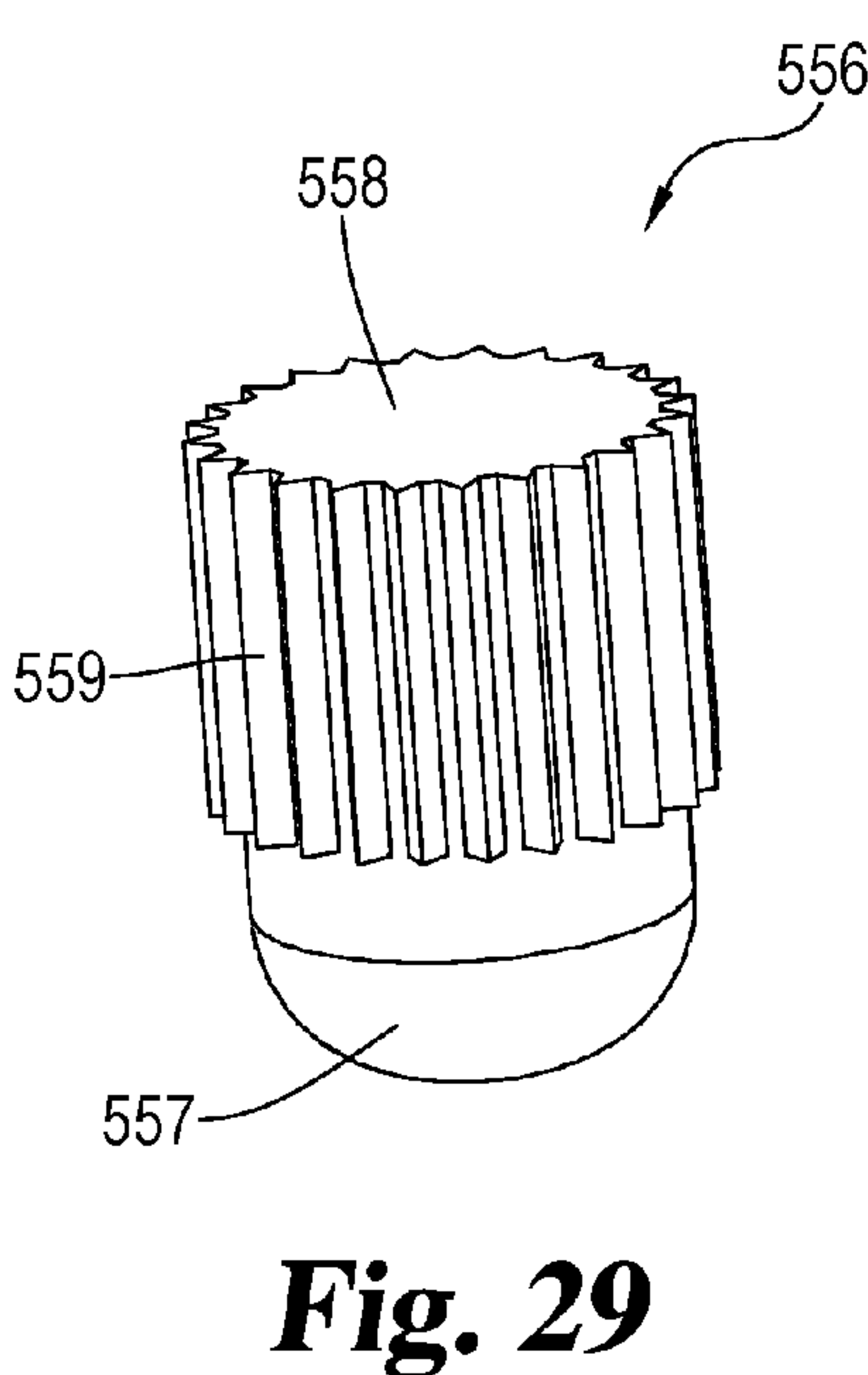
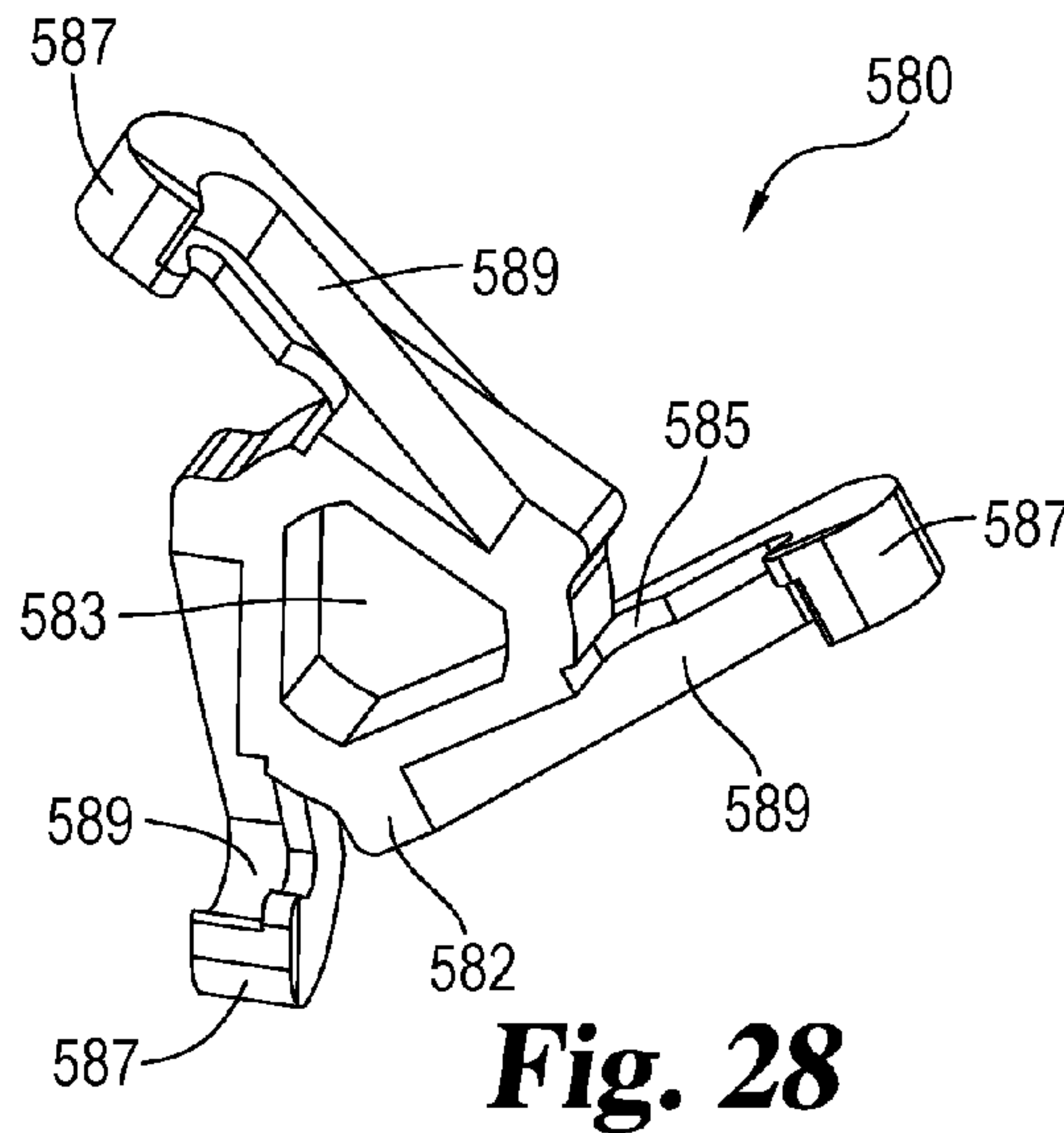
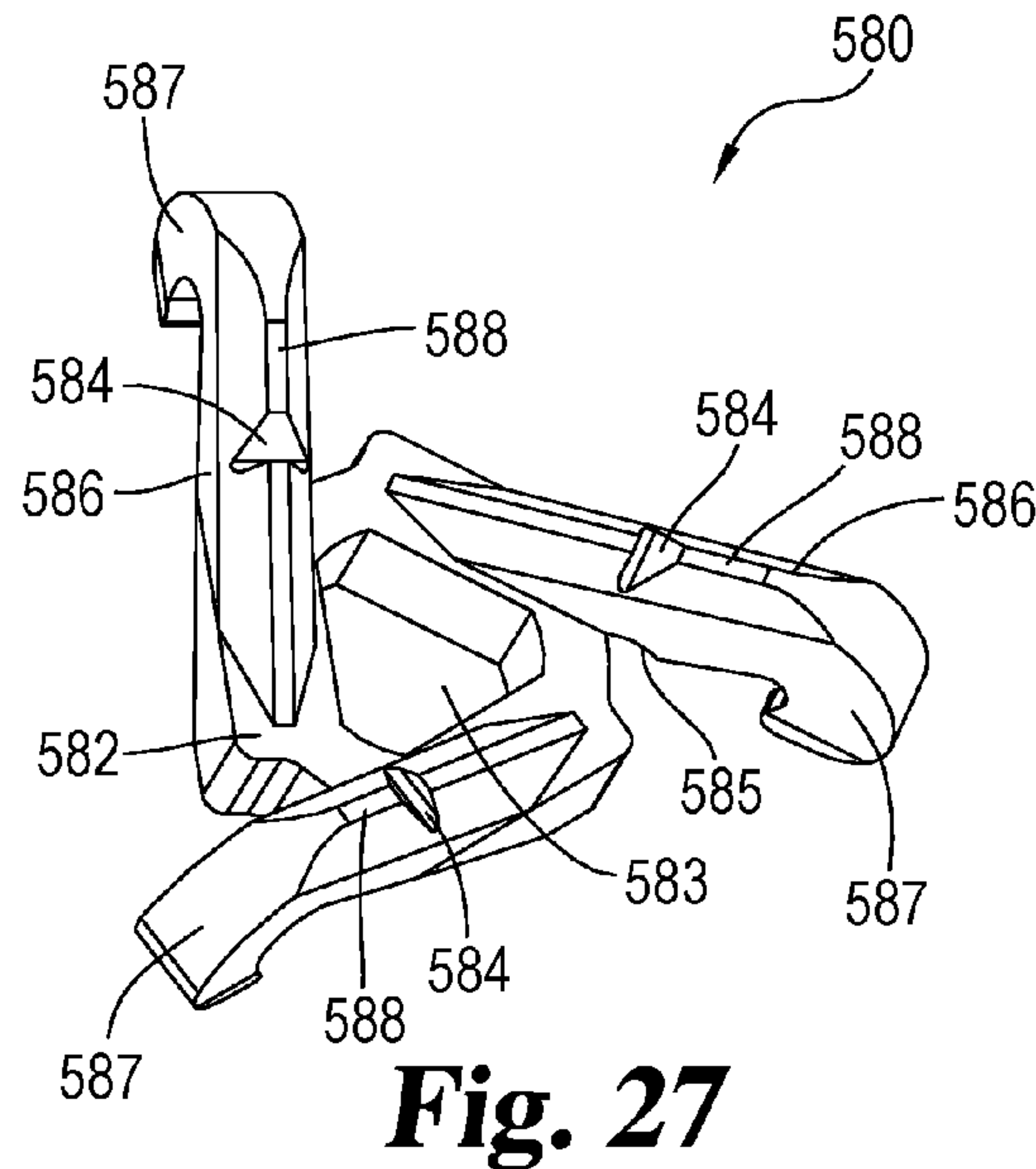
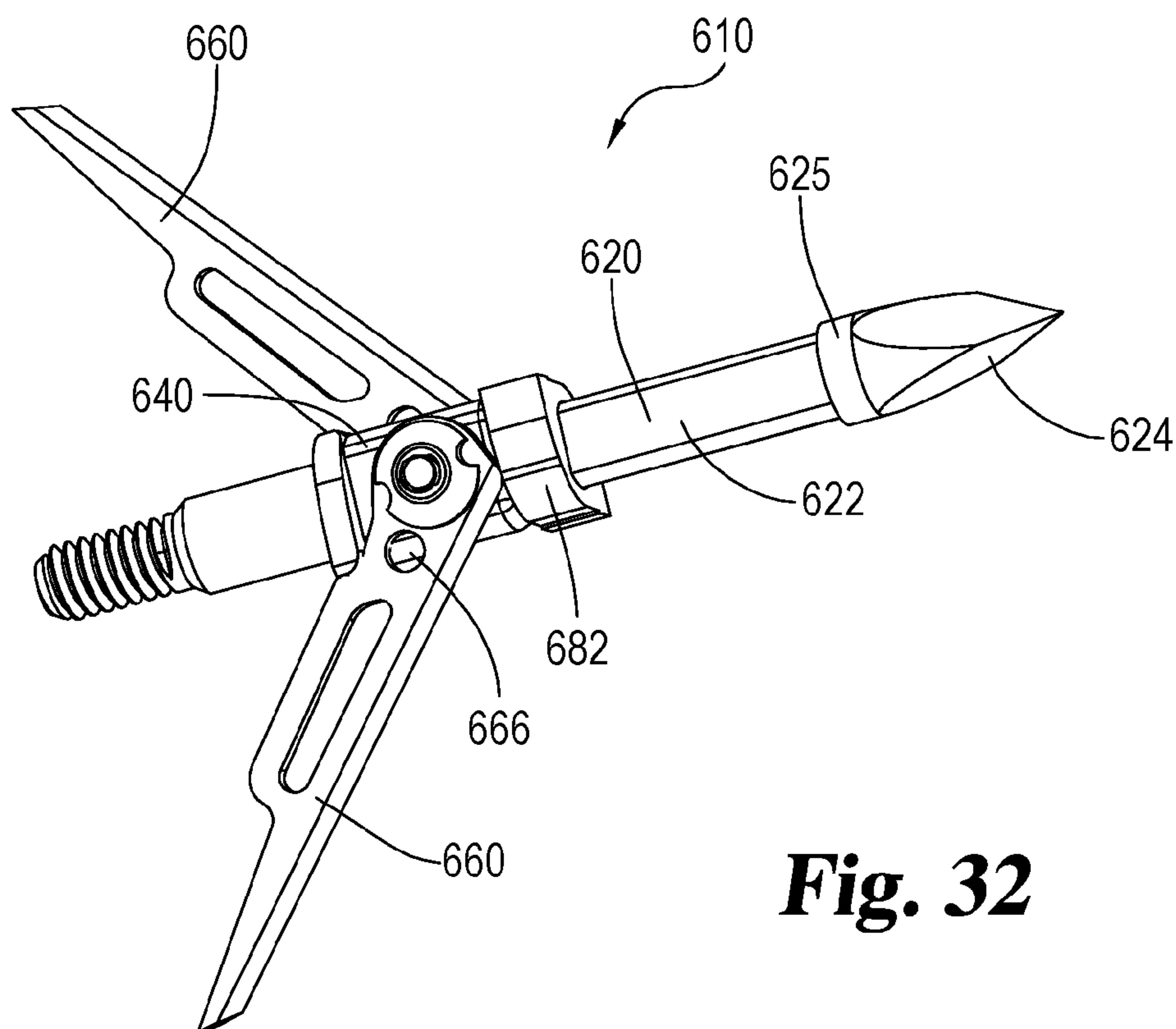
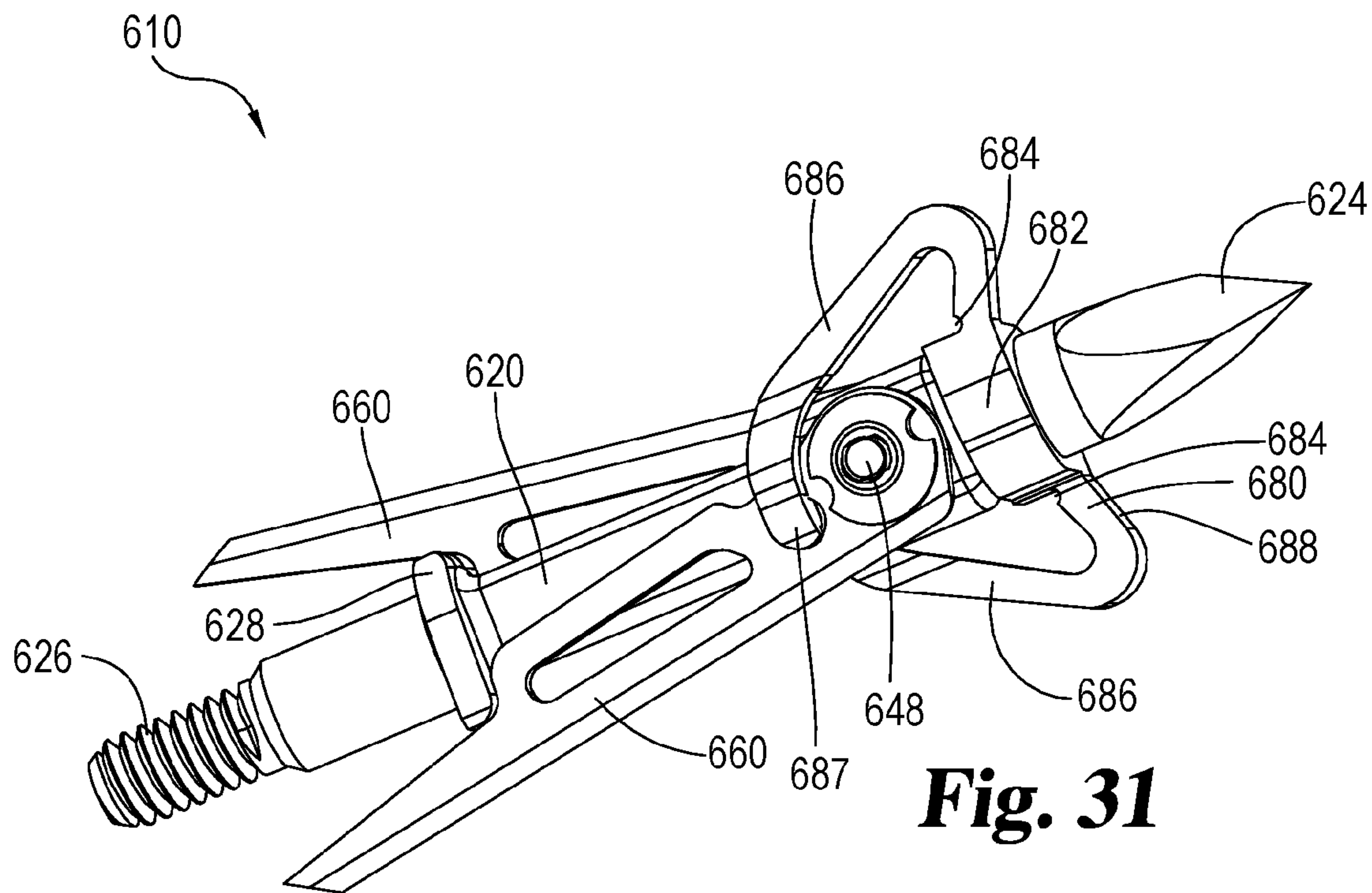


Fig. 24







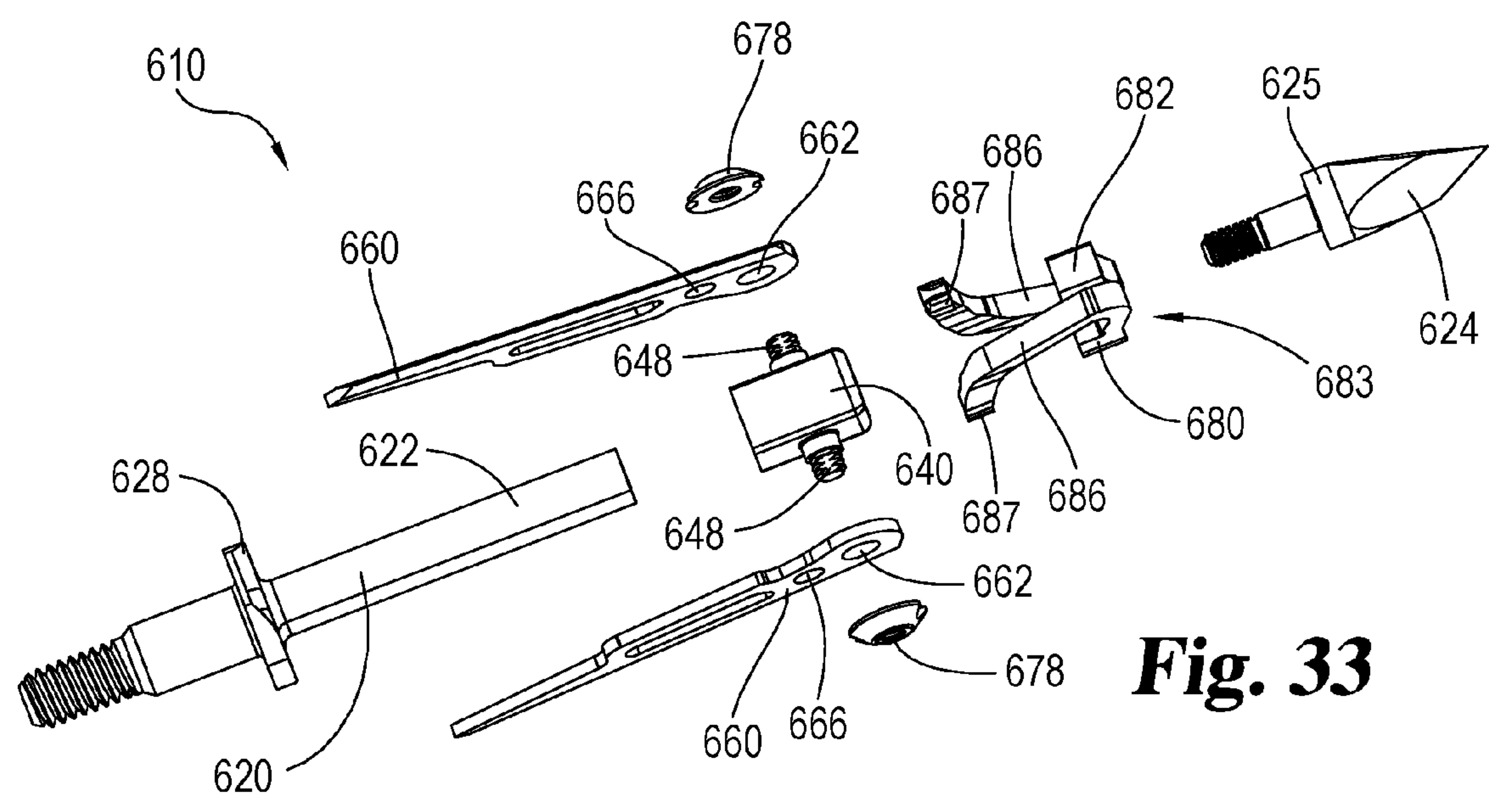


Fig. 33

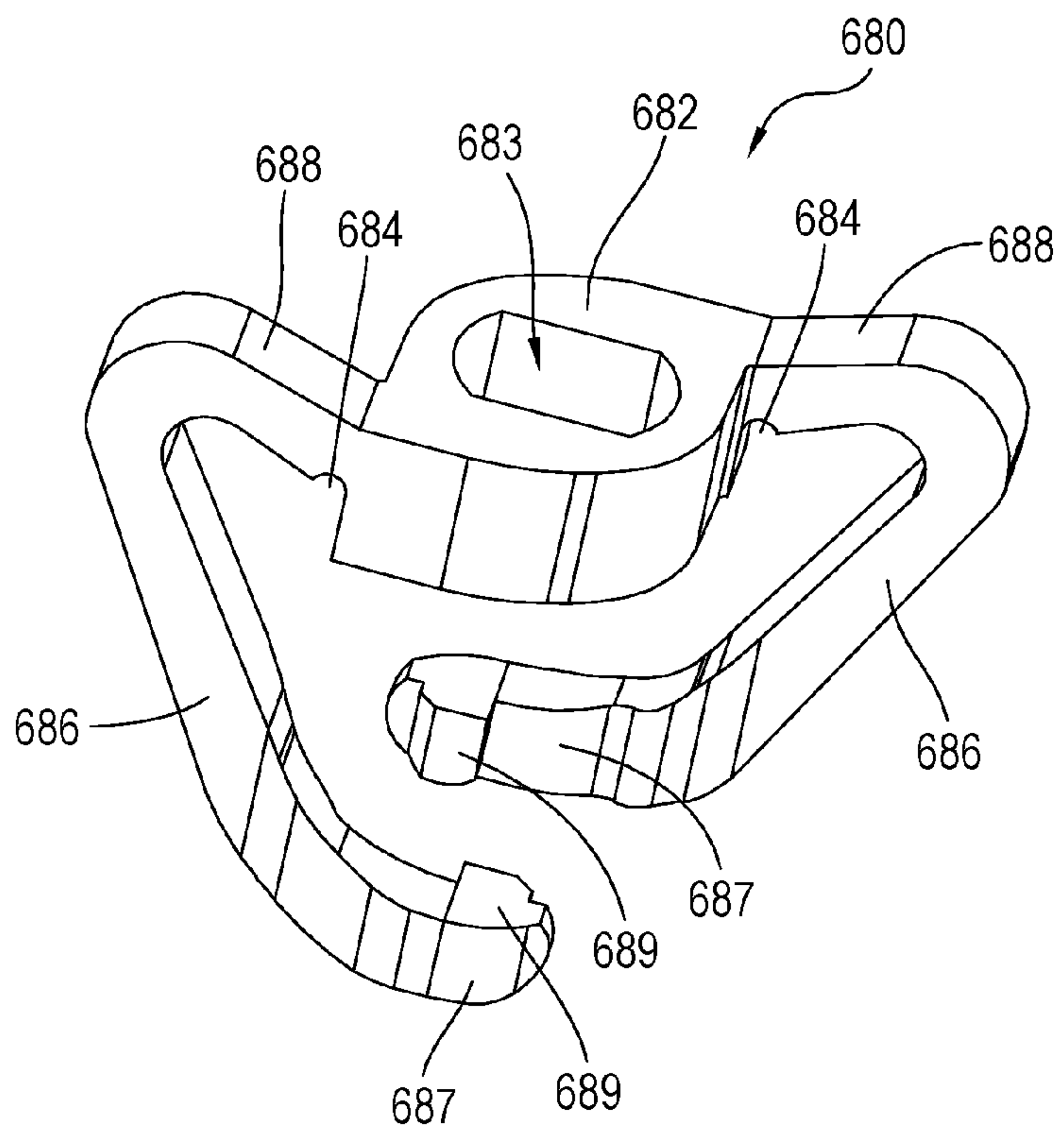


Fig. 34

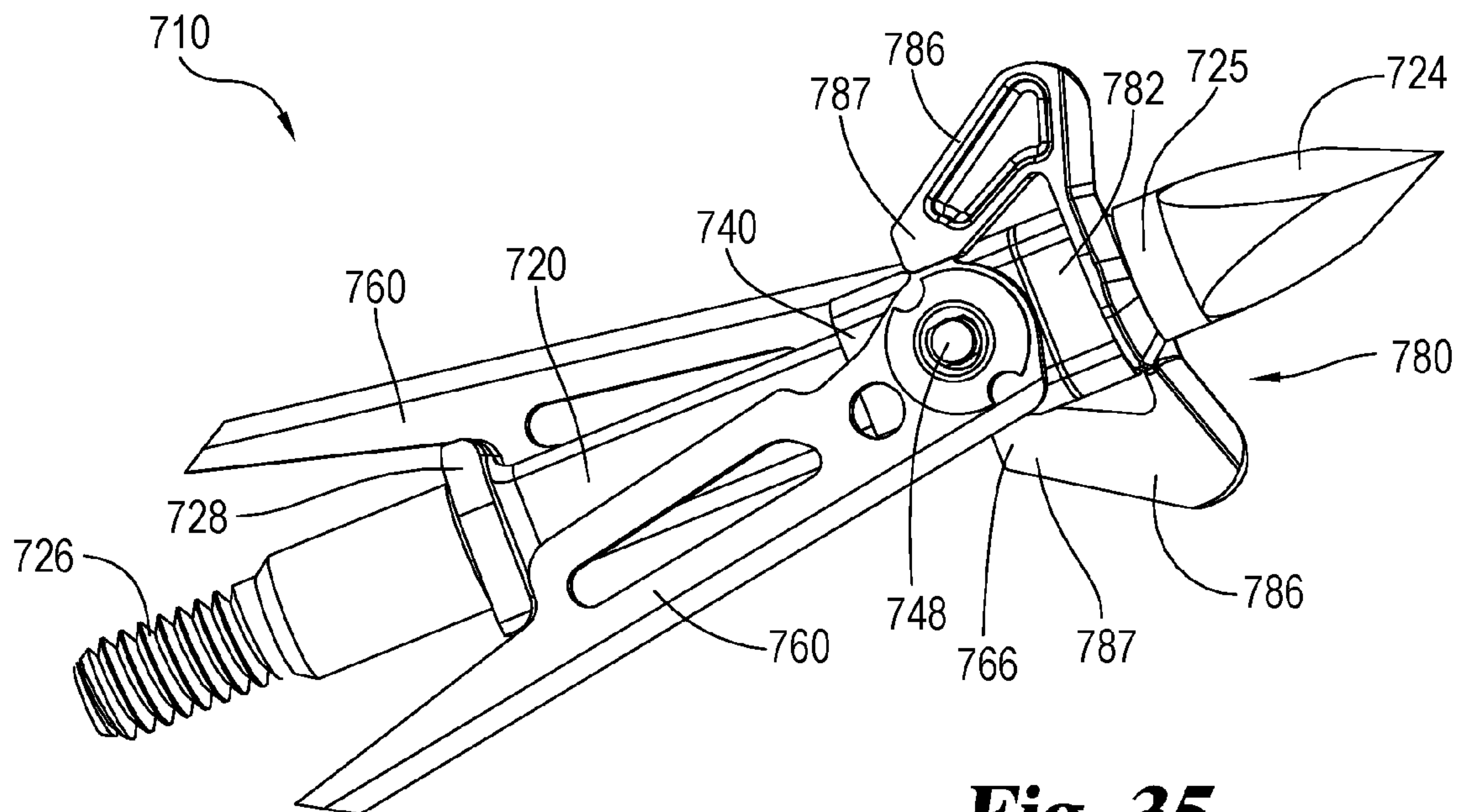


Fig. 35

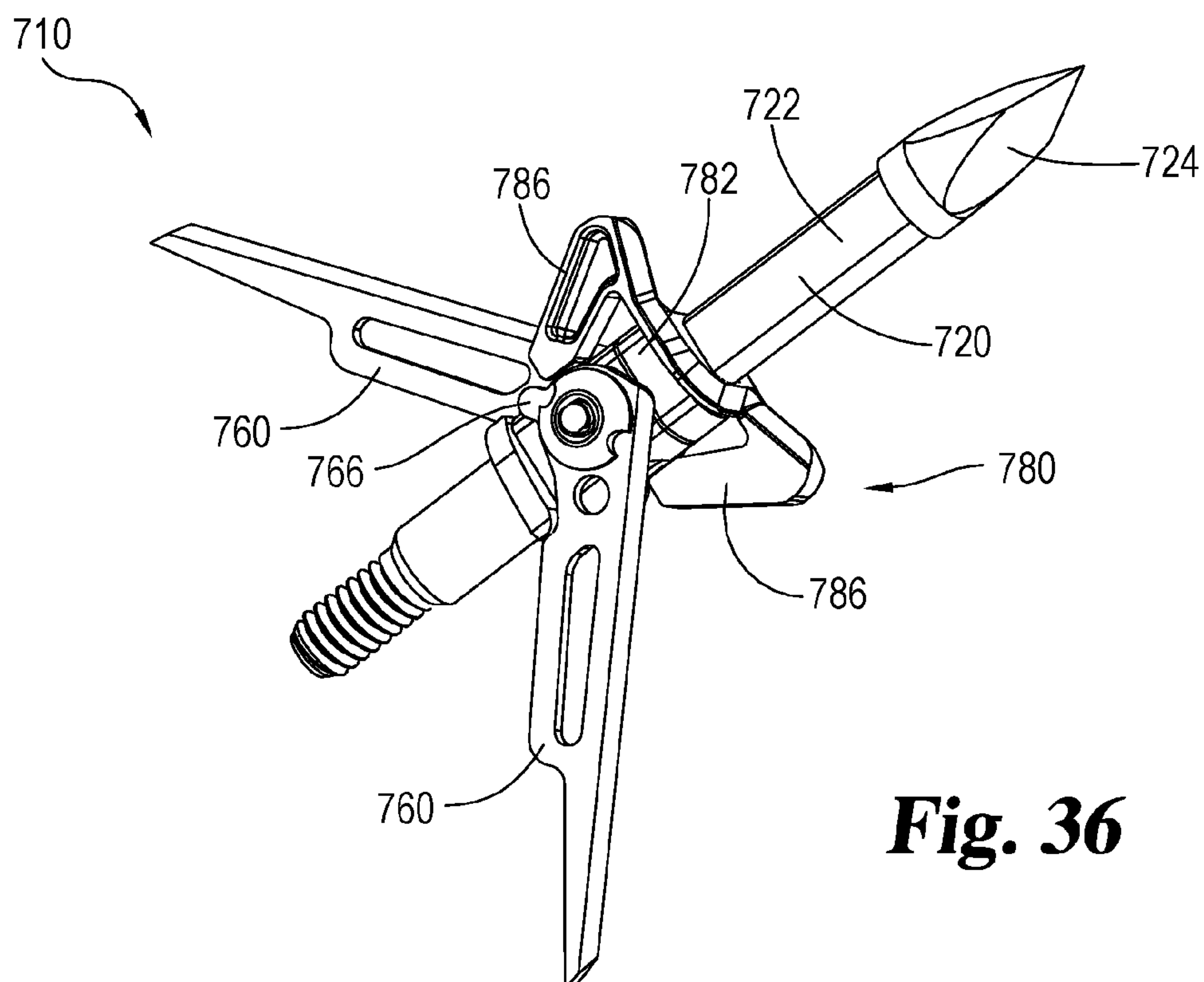
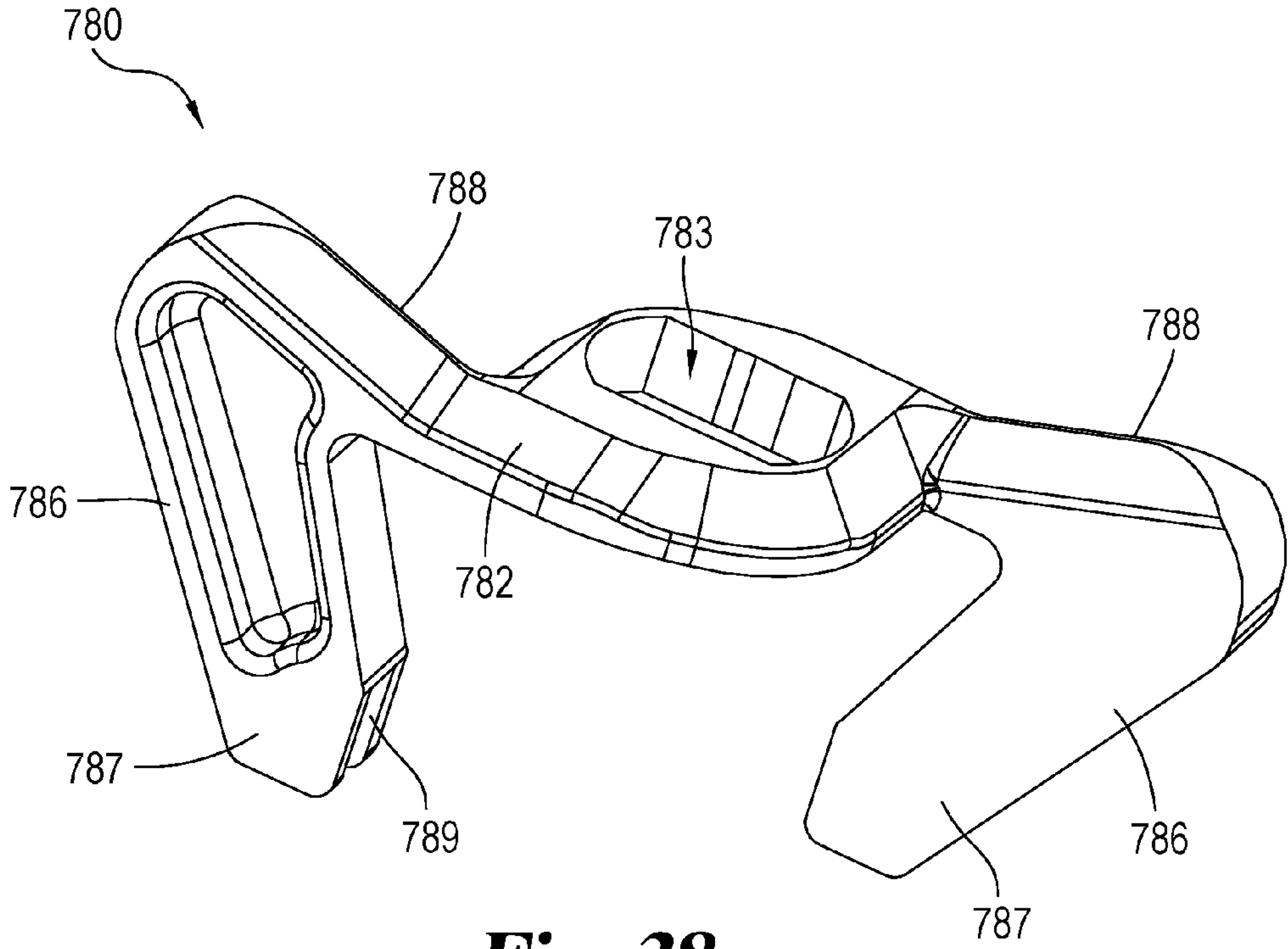
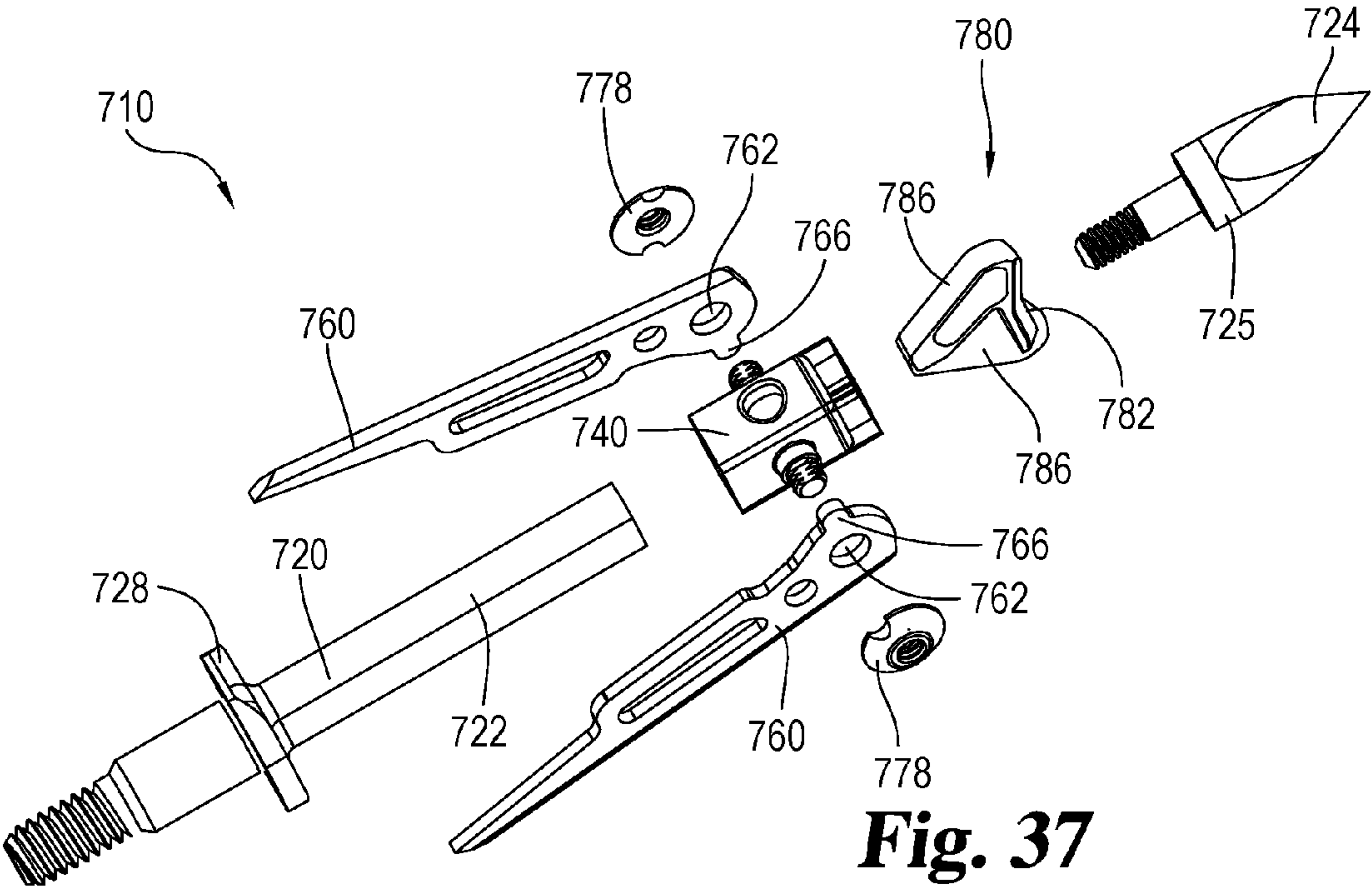


Fig. 36



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 continuation reissue of U.S. application Ser. No. 16/394,379 filed on Apr. 25, 2019, which is an application for 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

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portion and wherein during the rearward movement the blades rotate outward to a deployed position.

In still further alternate embodiments, a broadhead arrow-head 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.

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

FIG. 31 is 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 is 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.

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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,

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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 so 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

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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

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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 move-

ment 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 may 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

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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 mate-

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rials are chosen for high stiffness and strength to retain the blades during flight, yet with properties which are 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 break-away 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

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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

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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;

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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, wherein each of said at least one blades includes an outward cutting edge and a leading forward edge that extends to a leading tip;

a retaining element, wherein said retaining element includes a laterally extending impact arm, wherein said retaining element is in contact with the leading tip of each of said at least one blades, and wherein said retaining element is configured to retain each of said at least one blades in said closed position;

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wherein after an initial impact, the blade assembly 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.

21. The broadhead arrowhead of claim 20, wherein said impact arm includes an outer end and wherein said outer end receives and encircles a blade leading tip of said at least one blade.

22. 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 the closed position and an open position.

23. The broadhead arrowhead of claim 20, wherein said blade assembly includes a hub, wherein said hub is in contact with said shaft portion, and wherein said at least one blade is attached to an exterior surface of said hub.

24. The broadhead arrowhead of claim 23, wherein said hub is slidably mounted around said shaft portion.

25. The broadhead arrowhead of claim 20, wherein said retaining element is also in contact with the leading forward edge of each of said at least one blades.

26. The broadhead arrowhead of claim 20, wherein a rearward portion of the shaft portion transitions into a shelf extending radially outward from the shaft portion, and wherein an edge of the shelf forms a camming surface for the inward edge of each of said at least one blades.

27. The broadhead arrowhead of claim 26, wherein each of said at least one blades includes a retention notch, and wherein said retention notch is configured to abut said shelf when said blade assembly is in said closed position.

28. The broadhead arrowhead of claim 26, wherein said inward edge of each at least one blades includes a locking notch, wherein said locking notch is configured to abut said shelf when said blade assembly is in said open position.

29. The broadhead arrowhead of claim 20, wherein said shaft portion remains stationary as the blade assembly moves to said open position from said closed position.

30. 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 a plurality of blades pivotally operable between a closed position and an open position, wherein each of said blades is pivotally attached to a hub by a mounting post, and wherein said hub is slidably mounted around said shaft portion;

a retaining element engagable with each of said blades to retain the blades in said closed position, wherein said retaining element is positioned forward of said mounting post when said blades are in said closed position; wherein after an initial impact the blades are forced to rotate outward to the open position.

31. The broadhead arrowhead of claim 30, where said retaining element is designed to break away from the blades upon the initial impact.

32. The broadhead arrowhead of claim 31, wherein said retaining element is frangible.

33. The broadhead arrowhead of claim 30, wherein said retaining element is in contact with a leading tip of each of the blades.

34. The broadhead arrowhead of claim 30, wherein an inward edge of each blade includes a retention notch, and wherein said retention notch is configured to abut a shelf

extending radially outward from said shaft portion when said blade assembly is in said closed position.

35. The broadhead arrowhead of claim 34, wherein said inward edge of each blade includes a locking notch, and wherein said locking notch is configured to abut said shelf 5 when said blade assembly is in said open position.

36. The broadhead arrowhead of claim 30, wherein said hub is in contact with said shaft portion and wherein said plurality of blades are attached to an exterior surface of said hub.

37. The broadhead arrowhead of claim 30, wherein said shaft portion remains stationary as the blade assembly moves to said open position from said closed position.

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