

APPLICATION
OF
ALLEN DOMINEK
FOR
LETTERS PATENT OF THE UNITED STATES
MUZZLE BRAKE

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MUZZLE BRAKE

FIELD

[0001] The present disclosure relates to firearm muzzle devices and, more particularly, to muzzle brakes for directing gas discharged from firearm barrels.

BACKGROUND

[0002] Firearm discharge generates high-pressure gas that propels a projectile through a firearm barrel and produces a reactive force on the firearm. Gas released from a muzzle after projectile exit may affect recoil and muzzle movement. Muzzle brakes are used at muzzle ends of firearm barrels to redirect released gas and reduce recoil. The effectiveness of a muzzle brake is affected by the distribution of discharged gas as the projectile travels through the muzzle brake.

[0003] What is needed is a muzzle brake arrangement that addresses recoil and effectively redistributes gases while accommodating practical constraints on muzzle-brake size, weight, and gas discharge.

SUMMARY

[0004] According to one embodiment of the disclosure, a muzzle brake includes a body defining a bore extending along a projectile direction, the body configured to attach the muzzle brake to a muzzle end of a firearm barrel, and a first port positioned adjacent the body. The first port includes a forward surface, opposing side surfaces, and a rearward surface, the forward surface having a first length extending generally orthogonally to the projectile direction, the rearward surface having a second length extending generally orthogonally to the projectile direction, the first length being greater than the second length, and the forward surface having a surface area greater than a surface area of the rearward surface. The forward surface is configured to receive discharged gas from the firearm barrel to generate a forward force on the muzzle brake, and the body and rearward surface are configured such that a portion of the discharged gas exits the muzzle brake around the rearward surface.

[0005] According to certain embodiments, the body comprises a threaded coupling in the bore configured to threadably attach the muzzle brake to the muzzle end of the firearm barrel.

[0006] According to certain embodiments, the body has a generally rectangular cross-section transverse to the projectile direction.

[0007] According to certain embodiments, the forward surface is oriented at an angle of about 20 degrees relative to a plane orthogonal to the projectile direction.

[0008] According to certain embodiments, the first port has a width of about 0.75 inches along the projectile direction between the forward surface and the rearward surface.

[0009] According to certain embodiments, the rearward surface is formed by a rear surface of the body disposed around the bore.

[0010] According to certain embodiments, the muzzle brake further includes a second port positioned forward of the first port along the projectile direction, the second port being rotated about 90 degrees about the projectile direction relative to the first port. In some embodiments, the second port includes a forward surface, a rearward surface, a top surface, and a bottom surface, and is open at opposing side portions and a rear end around the rearward surface.

[0011] According to certain embodiments, the muzzle brake further includes a third port positioned forward of the second port along the projectile direction, the third port being rotationally aligned with the first port. In some embodiments, the third port includes opposing side surfaces, a forward surface, and a rearward surface, and is open at a top end, a bottom end, and a rear end around the rearward surface.

[0012] According to certain embodiments, the muzzle brake further includes a fourth port positioned forward of the third port along the projectile direction, the fourth port being rotated about 90 degrees about the projectile direction relative to the third port and rotationally aligned with the second port. In some embodiments, the fourth port includes a forward surface, a rearward surface, a top surface, and a bottom surface, and is open at opposing side portions and a rear end around the rearward surface.

[0013] According to certain embodiments, the first port is open at a top end, a bottom end, and a rear end around the rearward surface of the first port.

[0014] According to another embodiment of the disclosure, a muzzle brake includes a body defining a bore extending along a projectile direction, a first port, and a second port. The body is configured to attach the muzzle brake to a muzzle end of a firearm barrel. The first port is positioned adjacent the body and includes a forward surface, opposing side surfaces, and a rearward surface. The forward surface includes a length extending generally orthogonally to the projectile direction that is greater than a corresponding length of the rearward surface, and the forward surface includes a surface area greater than a surface area of the rearward surface. The first port is open at a top end, a bottom end, and a rear end around the rearward surface of the first port. The second port is positioned forward of the first port along the projectile direction and includes a second port having a forward surface, a rearward surface, a top surface, and a bottom surface. The second port is open at opposing side portions and a rear end around the rearward surface of the second port.

[0015] According to certain embodiments, the forward surface of the first port is oriented at an angle of about 20 degrees relative to a plane orthogonal to the projectile direction.

[0016] According to certain embodiments, the second port is rotated about 90 degrees about the projectile direction relative to the first port with the muzzle brake including an aperture extending between the first port and the second port that is configured to permit passage of a projectile and residual gas from the first port to the second port.

[0017] According to certain embodiments, the first port and the second port each have a width of about 0.75 inches along the projectile direction between respective forward and rearward surfaces.

[0018] According to certain embodiments, the first port has a length of about 1.2 inches and the second port has a length of about 0.5 inches, each length measured radially outwardly from the bore.

[0019] According to certain embodiments, the first port has a length of about 1.9 inches and the second port has a length of about 1.25 inches, each length measured radially outwardly from the bore.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Other embodiments of the disclosure will become apparent by reference to the detailed description in conjunction with the figures, wherein elements are not necessarily to scale so as to more clearly show the details, wherein like reference numbers indicate like elements throughout the several views, and wherein:

[0021] FIG. 1 depicts a perspective view of a two-port muzzle brake according to one embodiment of the disclosure.

[0022] FIG. 2 depicts a cross-sectional view of the two-port muzzle brake of FIG. 1.

[0023] FIG. 3 depicts a perspective view of a three-port muzzle brake according to one embodiment of the disclosure.

[0024] FIG. 4 depicts a cross-sectional view of the three-port muzzle brake of FIG. 3.

[0025] FIG. 5 depicts a perspective view of a four-port muzzle brake according to one embodiment of the disclosure.

[0026] FIG. 6 depicts a cross-sectional view of the four-port muzzle brake of FIG. 5.

DETAILED DESCRIPTION

[0027] The present disclosure is directed to a muzzle brake having one or more ports for redistributing gases as a projectile traverses the muzzle brake. Generally, the muzzle brake includes a body having a mounting portion defining a bore extending along a projectile direction. The mounting portion is configured to attach the body to a muzzle end of a firearm barrel. A first port is positioned adjacent the mounting portion and is defined by a forward surface (i.e., front baffle), two opposing side surfaces, and a rearward surface (i.e., rear baffle) opposite the forward surface. The forward surface has a first length that is greater than a second length of the rearward surface such that the forward surface has a surface area greater than a surface area of the rearward surface. Gas discharged from the firearm barrel is received by the forward surface to generate a forward force on the body, while the rearward surface is minimized to allow for discharged gases from the firearm to exit the muzzle brake as the projectile traverses the first port of the muzzle brake.

[0028] In preferred embodiments, the rearward surface is defined by the rear surface of the mounting portion disposed around the bore with the remainder of the rearward surface of the first port open to an exterior environment. Where one or more ports are positioned forward of the first port, a rear baffle of a forward port may likewise be reduced or opened to the exterior environment as depicted herein.

[0029] Referring to FIGS. 1-2, a two-port muzzle brake 10 according to an exemplary embodiment of the present disclosure includes a body 20 having a mounting portion defining a bore 22 through the body 20 along a projectile direction. In preferred embodiments, and as shown herein, bore 22 is in the form of a threaded opening configured to receive corresponding threads to attach the body 20 to a muzzle end of a firearm barrel (not shown). However, other attachment mechanisms and configurations may be used to attach the body 20 to the muzzle end of the firearm barrel, provided that the bore 22 is aligned with the firearm barrel for passage of the projectile and discharged gas.

[0030] A first port 12 is positioned adjacent the mounting portion and includes opposing side surfaces 24, a forward surface 26, and a rearward surface 30. The first port 12 of this embodiment is open at a top end, a bottom end, and the rear end of the first port with the exception of the rearward surface 30. As shown, the forward surface 26 extends farther vertically with respect to

the horizontal projectile direction than the rearward surface 30, thereby providing the forward surface 26 (i.e., front baffle) with a greater surface area than the rearward surface 30 (i.e., rear baffle). In preferred embodiments, the rearward surface 30 of the first port 12 is defined by the rear surface of the body 20 used to secure the muzzle brake to the firearm. Thus, to minimize the rearward surface 30, the size of body 20 disposed around bore 22 is minimized.

[0031] In certain embodiments, the forward surface 26 of the first port 12 is oriented at an angle of about 20 degrees relative to a plane orthogonal to the projectile direction with an angle of about 20 degrees to about 35 degrees considered to be “generally orthogonal” for purposes of the present disclosure. The forward surface 26 may be tilted in a direction that presents the forward surface 26 to gas discharged from the firearm barrel. The 20-degree orientation is a preferred example, and the angle of the forward surface 26 may be selected according to a desired recoil-reduction force.

[0032] With continued reference to FIGS. 1-2, a second port 50 may be positioned forward of the first port 12 along the projectile direction. The second port 50 includes a forward surface 52, a rearward surface 58, a top surface 54, and a bottom surface 56. The second port 50 is preferably open at opposing side portions as shown. An aperture 60 extends between the first port 12 and the second port 50 such that the projectile, along with gases that do not exit through the openings in the first port 12, may pass through the aperture 60 into the second port 50. Gas received in the second port 50 may then be discharged through the open rear and opposing open side portions of the second port 50, while the projectile and residual gas may pass through a forward opening 70 formed in the forward surface 52 of the second port 50.

[0033] In the embodiment depicted in FIGS. 1- 2, the second port 50 is generally similar in shape to the first port 12. However, in this embodiment, the second port 50 is rotated about 90 degrees about the projectile direction with respect to the first port 12, such that the generally similar structures of the first port 12 and the second port 50 have different orientations (the side surfaces 24 of the first port 12 correspond to the top surface 54 and bottom surface 56 of the second port 50). In an alternative two-port embodiment, the second port 50 has the same orientation as the first port 12 (i.e., the two ports are aligned in back-to-back fashion) though the second port 50 may

have a smaller length of the forward surface and side surfaces as compared to the corresponding surfaces of the first port 12.

[0034] Referring to FIGS. 3-4, a three-port muzzle brake 100 according to one exemplary embodiment of the disclosure includes the first port 12 and the second port 50 described above. In this embodiment, the muzzle brake 100 further includes a third port 80 positioned forward of the second port 50 along the projectile direction. According to this embodiment, the third port 80 is generally similar in configuration and orientation to the first port 12 and includes opposing side surfaces 84, forward surface 86, and rearward surface 82. The third port 80 of this embodiment is also open at a top end, a bottom end, and around the rearward surface 82.

[0035] With reference to FIG. 4, the projectile and gas that remains after passing through the second port 50 may pass into the third port 80 through an aperture 70 formed in the rearward surface 82 of the third port 80. According to this embodiment, the third port 80 includes a similar configuration and orientation as the first port 12 with opposing side surfaces 84, a front surface 86, and a rearward surface 82. However, in this embodiment, the length of the side surfaces 84 and front surface 86 may be reduced as compared to the first port 12 as there is a smaller amount of discharged gas that enters the third port 80 after the projectile passes through the first port 12 and second port 50. Gas received in the third port 80 may be discharged through the open top and bottom ends and the rear of the third port 80 around the aperture 70, while the projectile and residual gas may continue through the muzzle brake in the projectile direction and exit the muzzle brake 100 through aperture 85. In alternative three-port embodiments, the third port 80 may be rotationally aligned with the second port 50.

[0036] Referring to FIGS. 5-6, a four-port muzzle brake 200 includes the first port 12, the second port 50, and the third port 80 described above, and further includes a fourth port 90 positioned forward of the third port 80 along the projectile direction. The fourth port 90 is generally similarly configured to the second port 50 and is rotated about 90 degrees about the projectile direction with respect to the third port 80. Thus, the fourth port 90 of this embodiment includes a forward surface 92, a rearward surface 98 disposed around aperture 85, a top surface 94, and a bottom surface 96. As such, a portion of gas received in the fourth port 90 may be discharged through the opposing open sides and around the rearward surface 98 while the projectile exits the muzzle brake 200

through aperture 95. In an alternate embodiment, the fourth port 90 is rotationally aligned with the third port 80.

[0037] In preferred embodiments, the first port 12 has a width of about 0.75 inches along the projectile direction between the forward surface 26 and the rearward surface 30. The second port 50, third port 80, and fourth port 90 may likewise each have a width of about 0.75 inches along the projectile direction between respective forward and rear surfaces. Although a width of about 0.75 inches is suitable across the disclosed caliber examples and ports, the port width may be selected according to the gas generation associated with a selected firearm load, the caliber, and the desired net forward force generated by gas received against the forward surfaces. In particular, a larger port width may be used for a higher-powered firearm configuration when computational fluid dynamic calculations indicate that the larger port width provides the desired net forward force. Accordingly, the port widths of the first port 12, second port 50, third port 80, and fourth port 90 may be the same as one another or may differ among the ports.

[0038] The port lengths are measured radially outwardly from the center of the bore. In certain embodiments configured for a 0.284-inch caliber bore, the first port 12 has a length of about 1.2 inches and the second port 50 has a length of about 0.5 inches. In certain embodiments configured for a 0.375-inch caliber bore, the first port 12 has a length of about 1.6 inches, the second port 50 has a length of about 0.8 inches, and the third port 80 has a length of about 0.5 inches.

[0039] In certain embodiments configured for a 0.5-inch caliber bore, the first port 12 has a length of about 1.9 inches, the second port 50 has a length of about 1.25 inches, the third port 80 has a length of about 0.75 inches, and the fourth port 90 has a length of about 0.5 inches.

[0040] As normalized guidance across the disclosed caliber examples, the radial lengths of the first port 12, second port 50, third port 80, and fourth port 90 may be approximately in a ratio of 4.1:2.1:1.4:1, respectively, for embodiments including each such port. Because the port-length relationship may vary among particular muzzle brake configurations, these normalized values are illustrative averaged values rather than fixed requirements.

[0041] For the 0.284-inch caliber bore example, the ports may have a depth of about 0.4 inches measured radially outwardly from the center of the bore perpendicular to the respective port

lengths. The body 20 may have a width of about 1 inch. Other surfaces (i.e., walls) described herein preferably having a thickness of about 0.1 inches. In other embodiments, the port depth may be selected in dependence upon the body width and wall thickness, such that the port depth provides the desired internal port volume and maintains the selected wall thickness. Accordingly, the stated port-depth, body-width, and wall-thickness values are illustrative and are not required for every muzzle brake configuration.

[0042] In certain embodiments, the body is monolithic such as formed by 3D printing in a continuous printing process to form the mounting body 20, first port 12, and any second port 50, third port 80, and fourth port 90. A generally rectangular cross-section transverse to the projectile direction as shown in the exemplary embodiments herein is preferred to provide the selected port lengths while reducing body weight relative to a cylindrical body muzzle brake providing an equivalent axial port length. In other embodiments, each of the ports may be formed separately (e.g., laser cut steel) and joined together such as by brazing or welding to form the desired muzzle brake.

[0043] As should be understood, the muzzle brake disclosed herein may include the first port 12 alone or in combination with the second port 50, the third port 80, and the fourth port 90. The number of ports may be selected according to the amount of expected gas remaining for receipt against the forward surface of a port positioned forward along the projectile direction. Thus, the second port 50 may be the final port when gas passing through the first port 12 produces only a minor additional forward force in a further port, whereas the third port 80 and the fourth port 90 may be included when the residual gas supports additional forward force.

[0044] The foregoing description of preferred embodiments for this disclosure have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the disclosure to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiments are chosen and described in an effort to provide the best illustrations of the principles of the disclosure and its practical application, and to thereby enable one of ordinary skill in the art to utilize the disclosure in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and

variations are within the scope of the disclosure as determined by any claims when interpreted in accordance with the breadth to which they are fairly, legally, and equitably entitled.

CLAIMS

What is claimed is:

1. A muzzle brake comprising:
a body defining a bore extending along a projectile direction, the body configured to attach the muzzle brake to a muzzle end of a firearm barrel; and
a first port positioned adjacent the body, the first port including a forward surface, opposing side surfaces, and a rearward surface, the forward surface having a first length extending generally orthogonally to the projectile direction, the rearward surface having a second length extending generally orthogonally to the projectile direction, the first length being greater than the second length, and the forward surface having a surface area greater than a surface area of the rearward surface,
wherein the forward surface is configured to receive discharged gas from the firearm barrel to generate a forward force on the muzzle brake, and the body and rearward surface are configured such that a portion of the discharged gas exits the muzzle brake around the rearward surface.
2. The muzzle brake of claim 1, wherein the body comprises a threaded coupling in the bore configured to threadably attach the muzzle brake to the muzzle end of the firearm barrel.
3. The muzzle brake of claim 1, wherein the body has a generally rectangular cross-section transverse to the projectile direction.
4. The muzzle brake of claim 1, wherein the forward surface is oriented at an angle of about 20 degrees relative to a plane orthogonal to the projectile direction.
5. The muzzle brake of claim 1, wherein the first port has a width of about 0.75 inches along the projectile direction between the forward surface and the rearward surface.
6. The muzzle brake of claim 1, wherein the rearward surface is formed by a rear surface of the body disposed around the bore.
7. The muzzle brake of claim 1, further comprising a second port positioned forward of the first port along the projectile direction, the second port being rotated about 90 degrees about the projectile direction relative to the first port.

8. The muzzle brake of claim 7, wherein the second port includes a forward surface, a rearward surface, a top surface, and a bottom surface, and is open at opposing side portions and a rear end around the rearward surface.

9. The muzzle brake of claim 7, further comprising a third port positioned forward of the second port along the projectile direction, the third port being rotationally aligned with the first port.

10. The muzzle brake of claim 9, wherein the third port includes opposing side surfaces, a forward surface, and a rearward surface, and is open at a top end, a bottom end, and a rear end around the rearward surface.

11. The muzzle brake of claim 9, further comprising a fourth port positioned forward of the third port along the projectile direction, the fourth port being rotated about 90 degrees about the projectile direction relative to the third port and rotationally aligned with the second port.

12. The muzzle brake of claim 11, wherein the fourth port includes a forward surface, a rearward surface, a top surface, and a bottom surface, and is open at opposing side portions and a rear end around the rearward surface.

13. The muzzle brake of claim 1, wherein the first port is open at a top end, a bottom end, and a rear end around the rearward surface of the first port.

14. A muzzle brake comprising:
a body defining a bore extending along a projectile direction, the body configured to attach the muzzle brake to a muzzle end of a firearm barrel;

a first port positioned adjacent the body, the first port including a forward surface, opposing side surfaces, and a rearward surface, the forward surface having a length extending generally orthogonally to the projectile direction that is greater than a corresponding length of the rearward surface, and the forward surface having a surface area greater than a surface area of the rearward surface, the first port being open at a top end, a bottom end, and a rear end around the rearward surface of the first port; and

a second port positioned forward of the first port along the projectile direction, the second port including a forward surface, a rearward surface, a top surface, and a bottom surface, the second

port being open at opposing side portions and a rear end around the rearward surface of the second port.

15. The muzzle brake of claim 14, wherein the forward surface of the first port is oriented at an angle of about 20 degrees relative to a plane orthogonal to the projectile direction.

16. The muzzle brake of claim 14, wherein the second port is rotated about 90 degrees about the projectile direction relative to the first port.

17. The muzzle brake of claim 16, further comprising an aperture extending between the first port and the second port and configured to permit passage of a projectile and residual gas from the first port to the second port.

18. The muzzle brake of claim 14, wherein the first port and the second port each have a width of about 0.75 inches along the projectile direction between respective forward and rearward surfaces.

19. The muzzle brake of claim 14, wherein the first port has a length of about 1.2 inches and the second port has a length of about 0.5 inches, each length measured radially outwardly from the bore.

20. The muzzle brake of claim 14, wherein the first port has a length of about 1.9 inches and the second port has a length of about 1.25 inches, each length measured radially outwardly from the bore.

ABSTRACT

A muzzle brake includes a body defining a bore extending along a projectile direction and configured to attach the body to a muzzle end of a firearm barrel. A first port is positioned adjacent the body and is defined by a forward surface and a rearward surface. The forward surface has a first length and a surface area greater than a second length and a surface area of the rearward surface. Gas discharged from the firearm barrel is received by the forward surface to generate a forward force on the body, and the body and rearward surface are configured such that a portion of the discharged gas exits the muzzle brake around the rearward surface.

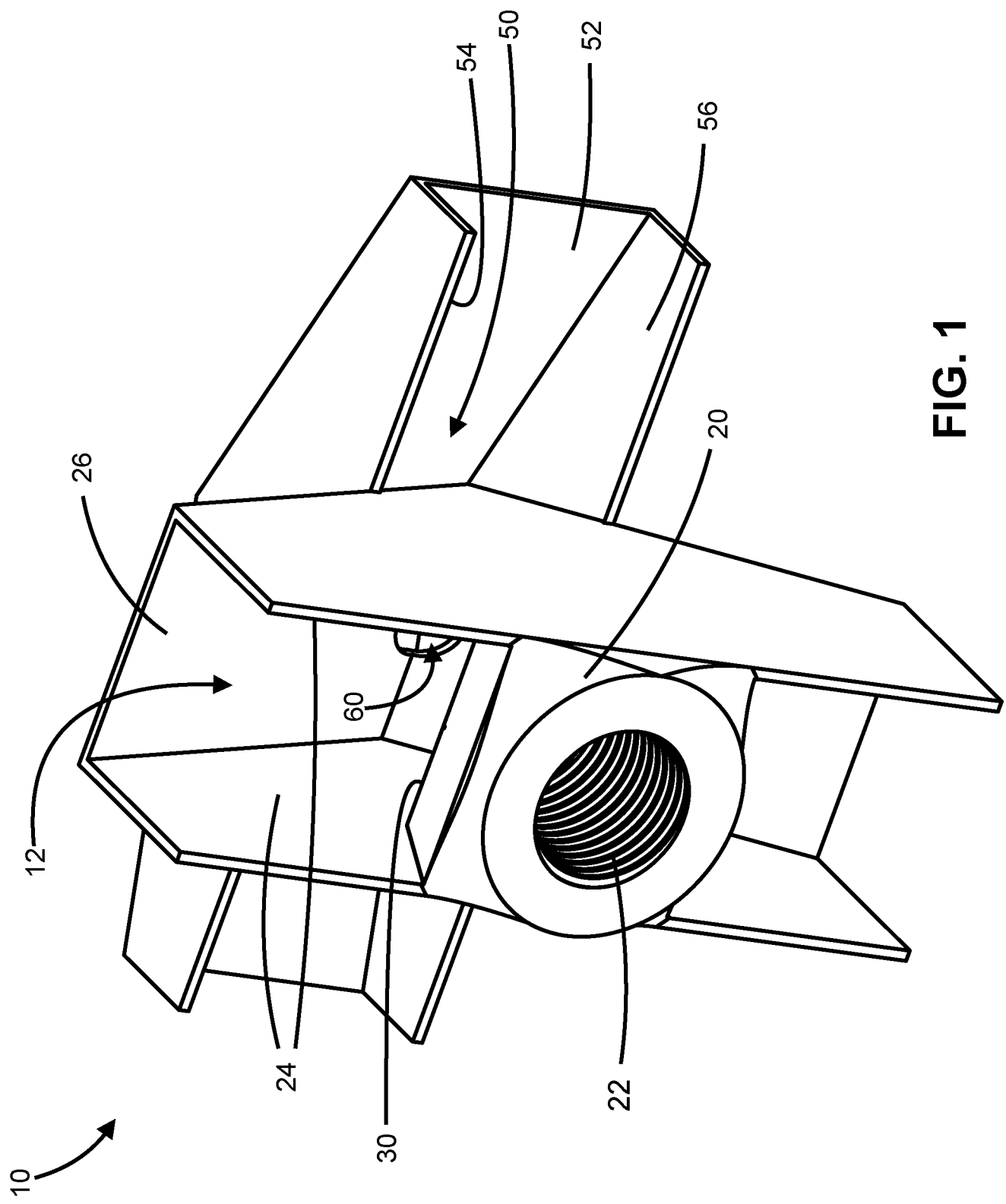


FIG. 1

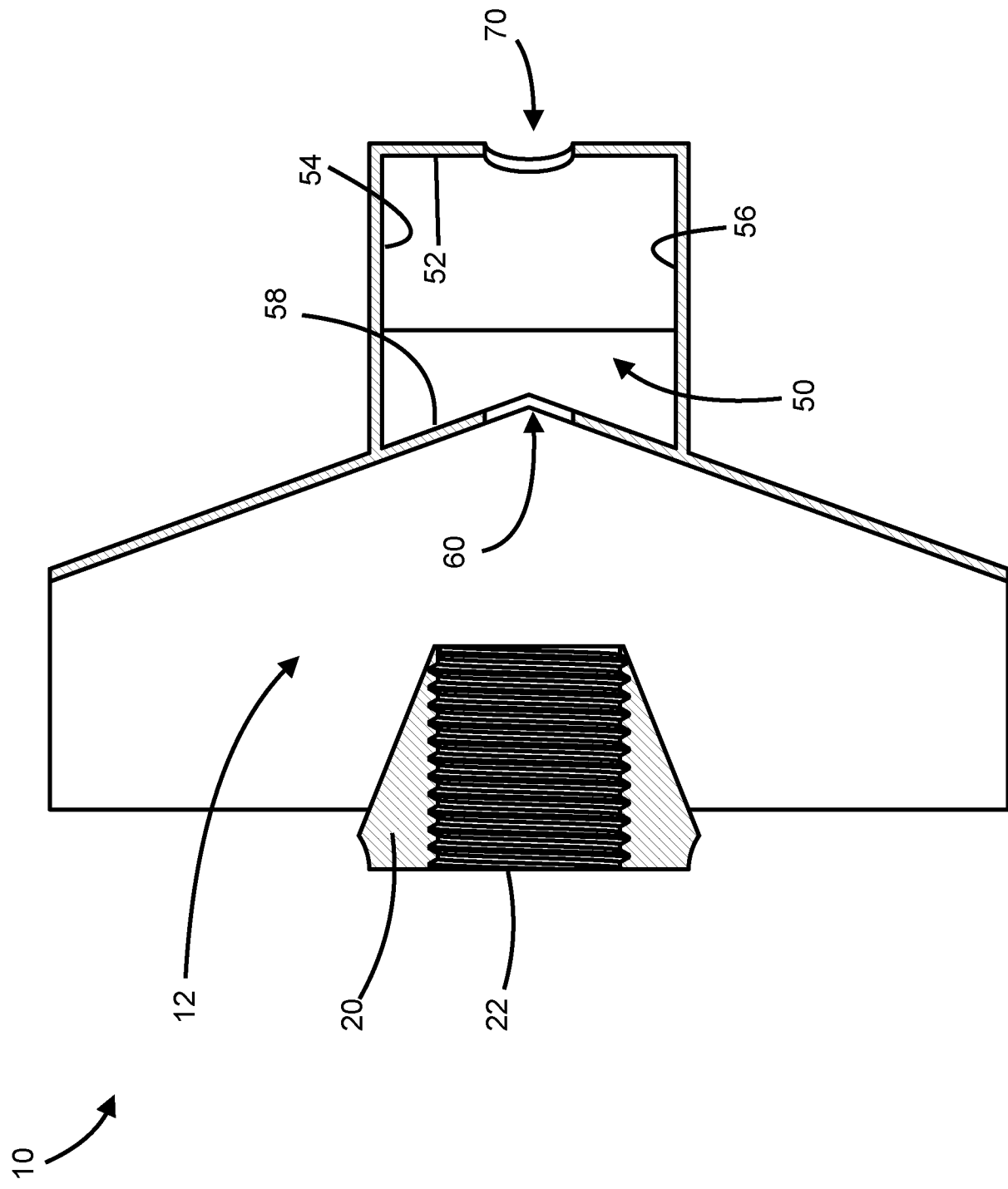


FIG. 2

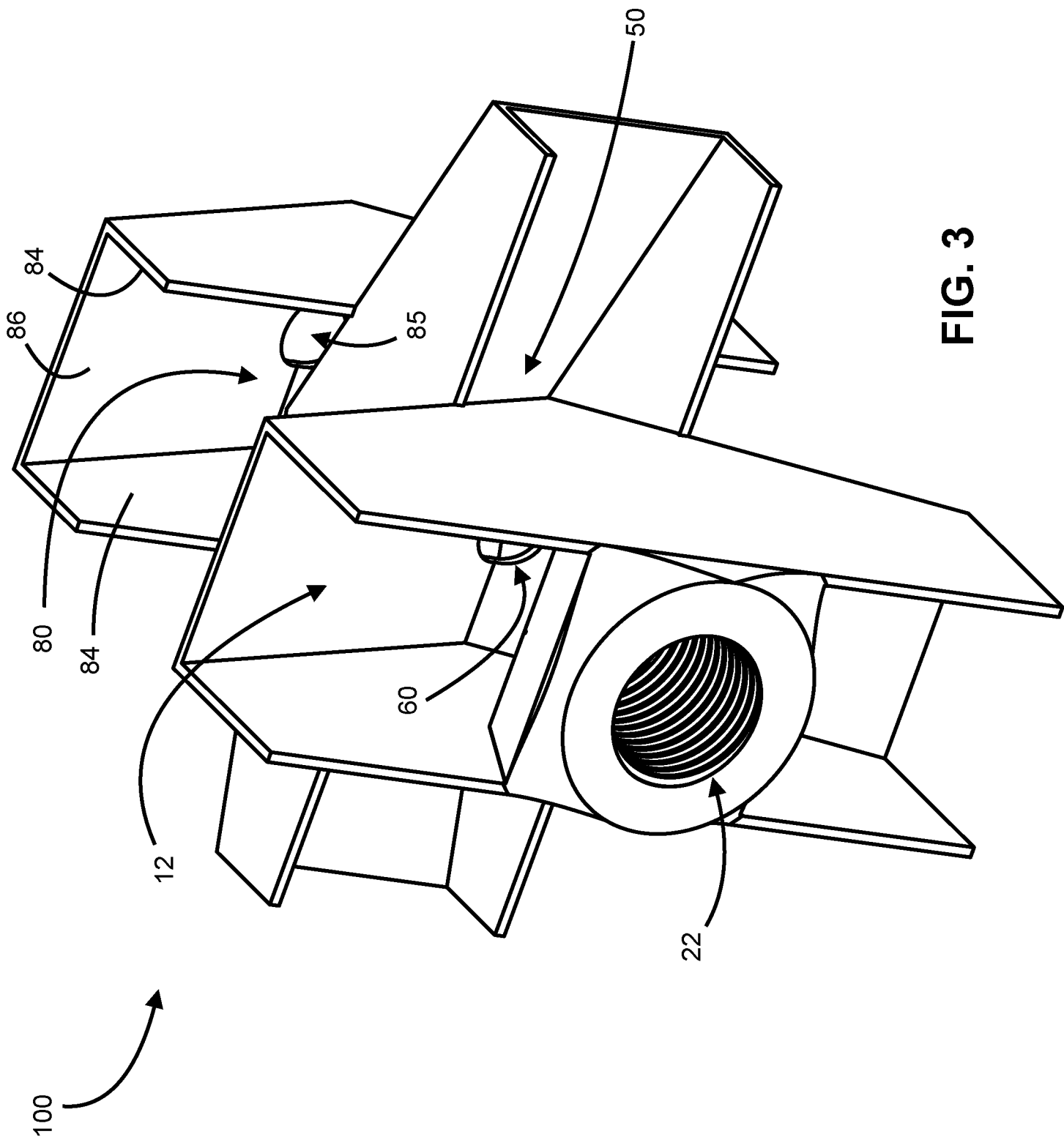


FIG. 3

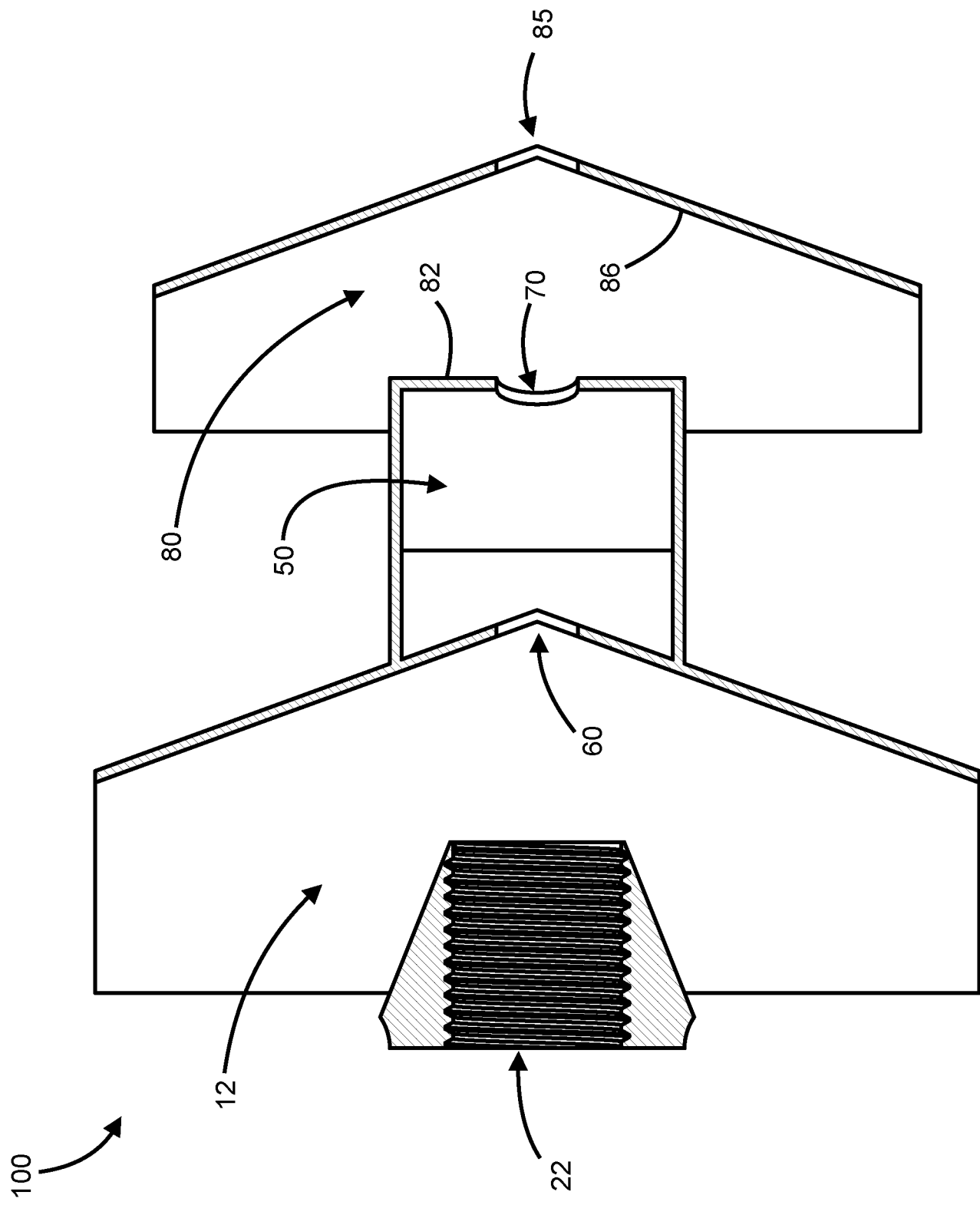


FIG. 4

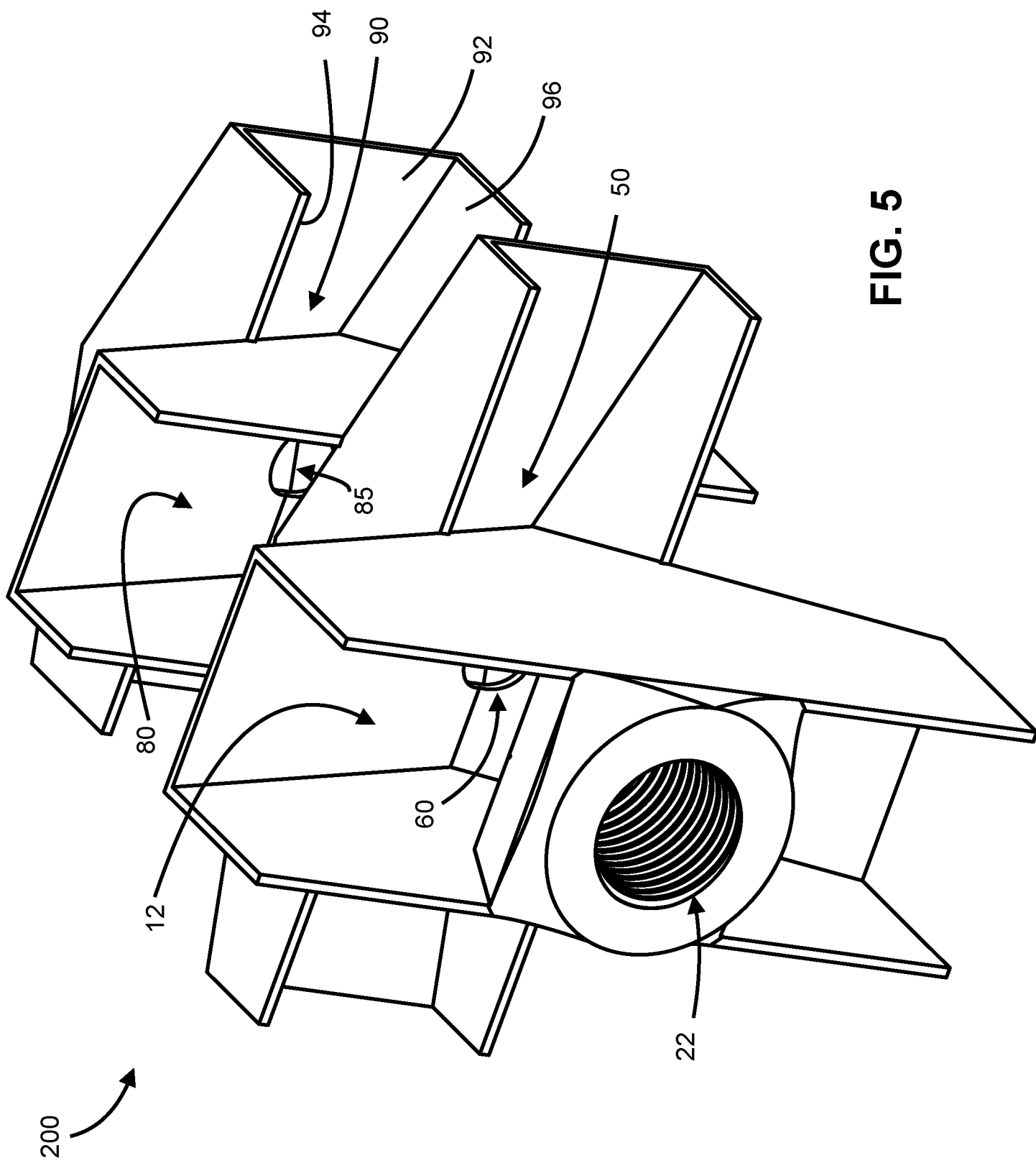


FIG. 5

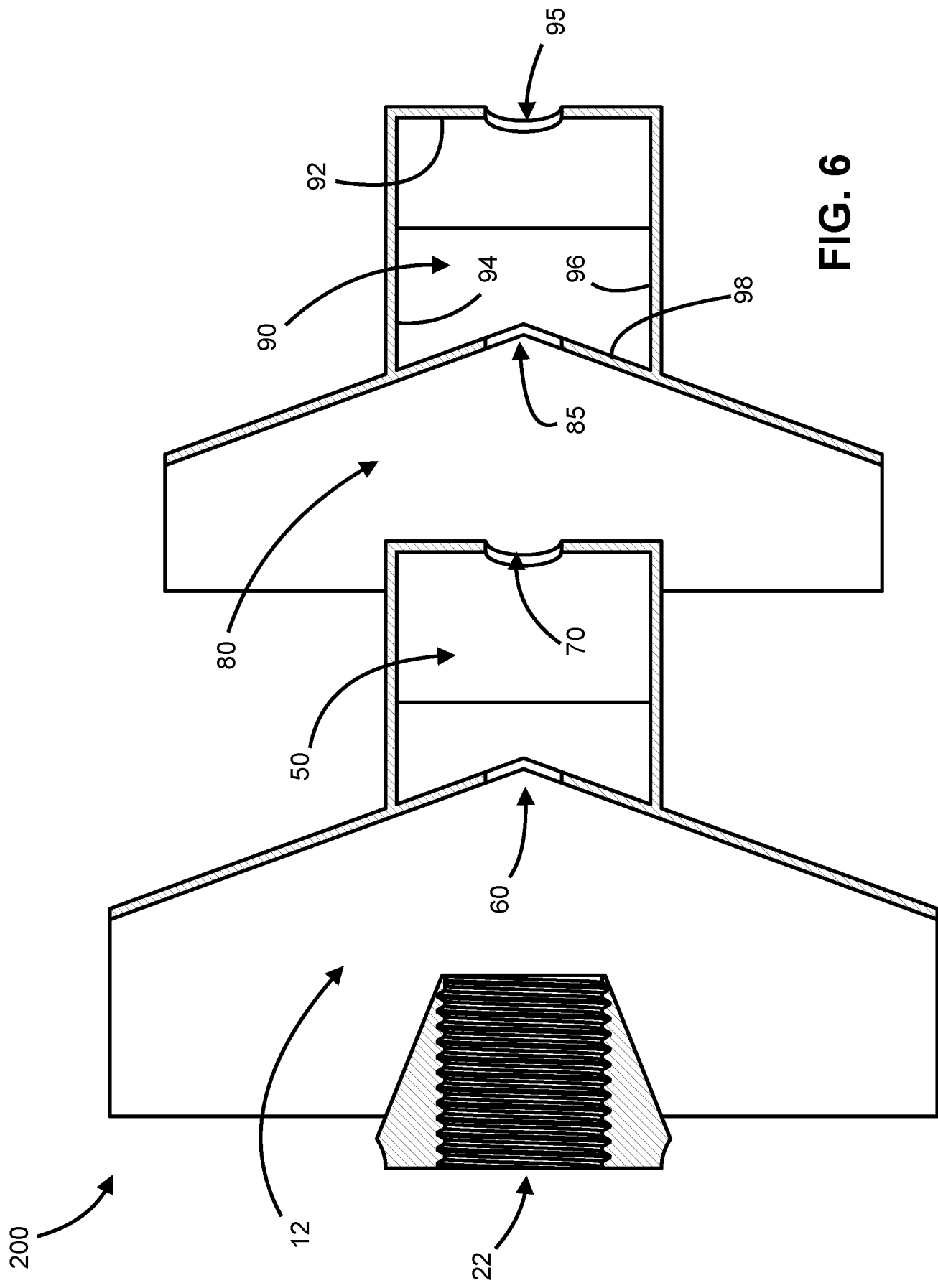


FIG. 6