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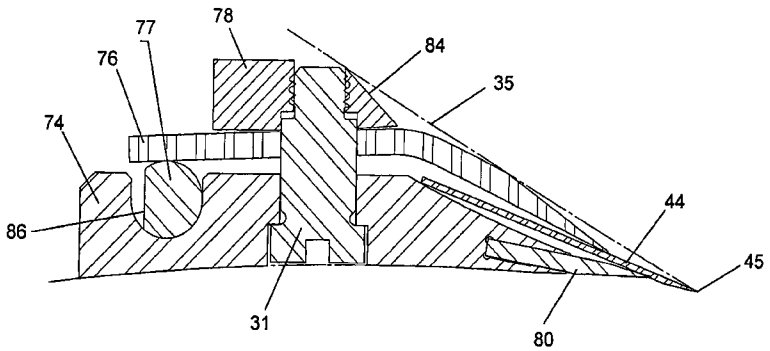
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(54) Title: APPARATUS FOR CUTTING PATATOES OR SIMILAR VEGETABLES



(57) Abstract: A cutting apparatus having an annular-shaped cutting head (42) and an impeller assembly (40) coaxially mounted for rotation within the cutting head (42) to deliver food products (72) radially outward toward the cutting head (42). The cutting head (42) has at least one knife (44) extending radially inward toward the impeller assembly (40). The knife (44) has a cutting edge (45) at a radially innermost extremity and a radially outer face (82) that defines a trajectory plane (35) for slices removed from the products (72) by the cutting edge (45). The knife (44) is clamped to the cutting head (42) with a clamping feature that provides clearance for slices when traveling the trajectory plane (35) of the knife (44).

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APPARATUS FOR CUTTING FOOD PRODUCT

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 60/745,028, filed April 18, 2006, the contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention generally relates to cutting methods and equipment. More particularly, this invention relates to an apparatus equipped with an impeller assembly that positions and orients elongate food products prior to encountering a cutting device that produces size-reduced products of generally consistent thickness.

[0003] Various types of equipment are known for slicing, shredding and granulating food products such as vegetables, fruits, and meat products. A particular example is slicing equipment adapted for cutting root vegetables such as potatoes into thin slices suitable for making potato chips (also known as potato crisps). A widely used machine for this purpose is commercially available from Urschel Laboratories, Inc., under the name Urschel Model CC®. The Model CC® is a centrifugal-type slicer capable of producing uniform slices, strip cuts, shreds and granulations of a wide variety of food products at high production capacities. When used to produce potato slices for potato chips, the Model CC® can make use of substantially round potatoes to produce the desired circular chip shape with a minimum amount of scrap. Descriptions pertaining to the construction and operation of the Model CC®, including improved

embodiments thereof, are contained in U.S. Patent Nos. 5,694,824 and 6,968,765, the entire contents of which are incorporated herein by reference.

[0004] Figures 1 and 3 are perspective views of an impeller 10 and cutting head 12, respectively, of types that can be used in the Model CC® machine. In operation, the impeller 10 is coaxially mounted within the cutting head 12, which is generally annular-shaped with cutting knives 14 mounted on its perimeter. The impeller 10 rotates within the cutting head 12, which remains stationary. Each knife 14 projects radially inward toward the impeller 10 and in a direction generally opposite the direction of rotation of the impeller 10, and defines a cutting edge at its radially innermost extremity. The impeller 10 has generally radially-oriented paddles 16 with faces 34 that engage and direct food products (e.g., potatoes) 36 radially outward against the knives 14 of the cutting head 12 as the impeller 10 rotates. The paddles 16 are shown as oriented to have what is termed herein a negative pitch, which as viewed in Figure 2 denotes that the face 34 of each paddle 16 has a radially innermost extent angled away from the direction of rotation of the impeller 10 relative to a radial 38 of the impeller 10 terminating at the radially outermost extent of the face 34. Such an orientation has been found to be preferred with the impeller 10 and cutting head 12 of Figures 1 through 3. The impeller 10 is typically formed as a casting, such as from a manganese aluminum bronze (MAB) alloy, and therefore has a unitary construction.

[0005] The cutting head 12 shown in Figure 3 comprises a lower support ring 18, an upper mounting ring 20, and circumferentially-spaced support segments 22. The knives 14 of the cutting head 12 are individually secured with clamping assemblies 26 to the support segments 22, which are pivotally attached to the support and mounting rings 18 and 20, such as with one or more coaxial pins (not shown) that engage holes in the support and/or mounting rings 18 and 20. By pivoting on the pins, the orientation of a support segment 22 can be adjusted to alter the radial location of the cutting edge

of its knife 14 with respect to the axis of the cutting head 12, thereby controlling the thickness of the sliced food product. As an example, adjustment can be achieved with an adjusting screw and/or pin 24 located circumferentially behind the pivot pins. Figure 3 further shows gate insert strips 23 mounted to each support segment 22 immediately downstream of each knife 14. The gate insert strips 23 do not cover the entire axial extent of the cutting head 12, but instead define an opening 25 at each of their lower ends through which rocks and other debris that settle by gravity toward the bottom of the impeller 10 can feed through the cutting head 12 without damaging the knives 14.

[0006] The knives 14 can be attached to their respective support segments with bolts, clamping assemblies, etc. Figures 9 and 10 are cross-sectional views through a portion of the cutting head 12 looking toward the lower support ring 18. Figure 9 shows a knife 14 held in place with a clamping assembly 26 comprising inner and outer holders 27 and 28 secured with bolts 29 to a support segment 22, generally as described in U.S. Patent No. 6,968,765 and particularly in reference to Figure 7 of this prior patent. Figure 10 shows a knife 14 encased in a plastic cartridge 30, which helps to protect the knife 14 from damage by rocks and other debris that may be embedded in or otherwise present with the food products being fed through the impeller 10. The knife 14 and its plastic cartridge 30 are held in place between a pair of holders 27 and 28, with the radially outer holder 28 being forcibly held in place on the support segment 22 with a clamping rod 32. The clamping rod 32 is shown oriented perpendicular to the support and mounting rings 18 and 20, and secured to the radially inner holder 27 with a fastener 31. Rotating a lever 33 creates a camming action that forces the outer holder 28 outward against the rod 32, and forcing the outer holder 28 against the knife 14. In each case, the knives 14 are disposable and must be replaced to maintain the cutting efficiency of the cutting head 12 and the quality of the sliced food product. The cutting edge 15 of each knife 14 is shown in Figures 9 and 10 as being formed to have a double bevel. As evident from Figure 9, the trajectory 35 of slices produced at the

knife edge 15 is free of any obstacles downstream and radially outward from a plane defined by the outer surface of the outer holder 28. In Figure 10, the plastic cartridge 30 deflects slices away from the clamping rod 32.

[0007] While the Model CC® has performed extremely well for its intended purpose, further improvements are continuously desired and sought for slicing machines of the type represented by the Model CC®. For example, knives with double bevels as shown in Figures 9 and 10 tend to compress food product during slicing. In the case of slices cut from potatoes and cooked in oil to produce potato chips, compression during slicing can be sufficient to cause starch loss, which undesirably promotes oil absorption during cooking. While single-bevel knives reduce compression, they reduce the trajectory angle to the extent that the slices tend to impact the clamping rod 32 downstream. Though the plastic cartridge 30 avoids this by deflecting slices away from the clamping rod 32, the compressibility of the plastic material reduces the precision with which the cutting edges 15 of the knives 14 can be located, making production of slices with consistent thicknesses difficult. Other variables that can affect the operation of the Model CC® slicing machine and/or reduce the consistency of slices include the presence of contaminants such as stones embedded or mixed in with the products, which can damage the cutting edges of the knives, and the use of small products that tend to roll within the impeller 10.

BRIEF SUMMARY OF THE INVENTION

[0008] The present invention provides a cutting apparatus having an annular-shaped cutting head and an impeller assembly coaxially mounted for rotation within the cutting head. The impeller assembly rotates about an axis of the cutting head in a rotational direction relative to the cutting head to deliver round food products radially outward toward the cutting head. The cutting head has at least one knife extending

radially inward toward the impeller assembly in a direction opposite the rotational direction of the impeller assembly. The knife has a cutting edge at a radially innermost extremity thereof and a radially outer face that defines a trajectory plane for slices removed from the food products by the cutting edge.

[0009] According to one aspect of the invention, the knife is clamped to the cutting head with a clamping feature that includes a clamping bar with which the clamping feature generates a clamping force to secures the knife to the cutting head. The clamping bar is located adjacent a radially outermost extremity of the knife, oriented substantially parallel to the knife, and has a thickness in a radial direction of the cutting head that decreases in a direction toward the knife to provide clearance for the slices when traveling the trajectory plane of the knife. A significant advantage of this aspect of the invention is that slices of food product can be ejected from the cutting head without striking any structure downstream, and without resorting to the use of a double-beveled knife or sheathing the knife in a plastic cartridge. As such, the knife can have a single-bevel cutting edge to minimize compression of the product, and the cutting edge of the knife can be located with greater precision to produce slices with more consistent thicknesses.

[0010] The impeller assembly is preferably equipped with paddles to deliver the food products radially outward toward the cutting head. According to another aspect of the invention, each paddle has a radially outer extremity adjacent a periphery of the impeller assembly, an oppositely-disposed radially inner extremity, and a face between the radially inner and outer extremities and facing the rotational direction of the impeller assembly. Each paddle has grooves parallel to the radially outer extremity thereof. According to yet another aspect of the invention, each paddle has a plurality of removable posts mounted to its radially outer extremity and extending in a radially outward direction of the impeller assembly. A significant advantage achieved with the

grooved paddles is to discourage smaller food products from rolling within the impeller. A significant advantage achieved with the removable posts is to avoid stones and other contaminants mixed with the product from being forced into and damaging the knife cutting edge.

[0011] Other objects and advantages of this invention will be better appreciated from the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] Figures 1 and 2 are perspective and cross-sectional views, respectively, of an existing impeller for the Model CC® slicer.

[0013] Figure 3 is a perspective view of an existing cutting head for the Model CC® slicer.

[0014] Figures 4A, 4B, and 4C are perspective, side, and cross-sectional views, respectively, of an impeller assembly suitable for use with the Model CC® slicer in accordance with a preferred embodiment of the invention.

[0015] Figure 4D shows plan, perspective, and cross-sectional views of a deflector for use with the impeller assembly of Figures 4A and 4B in accordance with an optional aspect of the invention.

[0016] Figures 4E, 4F, and 4G are perspective, side, and cross-sectional views, respectively, of an impeller assembly suitable for use with the Model CC® slicer in accordance with an alternative embodiment of the invention.

[0017] Figure 5 is a cross-sectional view of the impeller assembly of Figures 4A, 4B, and 4C assembled with the deflector of Figure 4D and mounted within the cutting head of Figure 3.

[0018] Figures 6A and 6B are isolated top and side views, respectively, of an impeller paddle of the impeller assembly of Figures 4A, 4B, and 4C.

[0019] Figure 7 is an isolated side view of an impeller paddle of the impeller assembly of Figures 4E, 4F, and 4G.

[0020] Figure 8 is a cross-sectional view of an edge portion of the impeller assembly of Figures 4A, 4B, and 4C, schematically showing a single impeller paddle engaged with food products of various sizes.

[0021] Figures 9 and 10 are cross-sectional views showing portions of existing cutting heads used with the Model CC® slicer.

[0022] Figures 11, 12, and 13 are cross-sectional views showing portions of modified cutting heads suitable for use with the Model CC® slicer, and particularly the impeller assembly of Figures 4A, 4B, and 4C, in accordance with different embodiments of the invention.

[0023] Figures 14 and 15 are side and cross-sectional views, respectively, of a clamping assembly shown in Figure 13.

DETAILED DESCRIPTION OF THE INVENTION

[0024] Figures 4A, 4B, and 4C show a modified impeller assembly 40 in

accordance with the present invention. As depicted in Figure 5, the impeller assembly 40 is configured for rotation within cutting heads similar to the cutting head 12 of Figure 3, as well as cutting heads 42 configured in accordance with Figures 11 through 13.

[0025] Similar to the impeller 10 of Figures 1 and 2, the impeller assembly 40 has generally radially-oriented paddles 46 with faces 60 that engage and direct food products (e.g., potatoes) radially outward against knives of the cutting head as the impeller assembly 40 rotates. However, as evident from Figures 4A, 4B, and 4C, the paddles 46 are significantly different in construction and configuration from the prior art paddles 16 of Figures 1 and 2. Because of the configuration of the paddles 46, the impeller assembly 40 is preferably constructed of individually formed paddles 46 mounted and secured between a pair of annular-shaped plates 48 and 50. As a result of its modular construction, the impeller 40 and its components can be formed by processes other than casting, and formed of various materials in addition to commonly-used MAB alloys.

[0026] Each of the paddles 46 is shown in Figure 4A as being individually mounted with bolts 51 and pins 52 to a corresponding set of mounting holes 53 machined in the plates 48 and 50. The placement of the mounting holes 53 determines the orientation or pitch of each paddle face 60 relative to a radial 64 of the impeller assembly 40 terminating at the radially outermost extent of the paddle face 60. The pitch of the paddle faces 60 can be negative (such as the orientation seen in Figure 2), neutral (meaning that the face 60 of each paddle 46 lies in the radial 64 of the impeller assembly 40), or positive (such as the orientation seen in Figures 4C, in which the radially innermost extent 66 of each paddle face 60 is angled toward the direction of rotation of the impeller assembly 40 relative to the radial 64). A single set of holes 53 is provided for each paddle 46 so that the paddles 46 for a given impeller assembly 40 are limited to having a negative, neutral, or positive pitch, as may be desired. In an

alternative embodiment shown in Figures 4E, 4F, and 4G, multiple sets of mounting holes 53 are provided in the plates 48 and 50 to enable reorientation of the pitch of each paddle 46 on the impeller assembly 40.

[0027] Figures 6A and 6B show an individual paddle 46, which can be seen as symmetric in the axial direction of the impeller assembly 40 (from top to bottom in Figure 4A and 4B). The radially innermost extent 66 of each paddle 46 is generally straight and axially-oriented. Suitable dimensions for the paddle 46 will depend in part on the size of the food products being processed, and therefore can vary considerably. For accommodating food products with diameters up to about four inches (about ten centimeters), a suitable radial width for each paddle 46 is up to about two inches, as measured from the radially outermost extent of the paddle face 60 to a line at the intersection of the paddle face 60 and a radius defining the radially innermost extent 66 of the paddle 46. Figure 7 shows an individual paddle 46 of the alternative embodiment of Figures 4E, 4F, and 4G. The alternative paddle 46 of Figure 7 is asymmetric in the axial direction of the impeller assembly 40 (from top to bottom in Figure 4E and 4F), in contrast to the paddles 16 of Figures 4A through 4C, 6A, and 6B. The radially innermost extent 66 of each alternative paddle 46 is generally straight and axially-oriented adjacent the lower plate 48, but with a boundary 68 adjacent the upper plate 50 that curves radially outward as it approaches the upper plate 50. Though not required, this shape and contour for the innermost extent of each paddle 46 has the desirable effect of reducing damage to food products being processed.

[0028] The Figures depict the paddles 46 as being equipped with multiple posts 54 located and spaced along their radially outermost extent, forming multiple gaps 56 through which rocks and other debris can pass and exit the impeller assembly 40 and subsequently the cutting head without damaging the paddles 46 of the impeller assembly 40 or the knives of the cutting head. The posts 54 are preferably

replaceable, such as by threading into a face 58 machined into the radially outermost extent of each paddle 46. The posts 54 have generally conical shapes, and are preferably angled so that a profile of its conical shape is coplanar with the face 60 of its paddle 46, as seen in Figure 6. As most readily evident from Figures 4, 5, and 7, the face 60 of each paddle 46 has axially-oriented grooves 62 to inhibit food product from rotating while engaged by the paddle 46. The distances between adjacent grooves 62 is shown as decreasing in the direction toward the outside diameter of the impeller assembly 40, since smaller food products (such as potatoes two inches (about five centimeters) and smaller) are usually rounder in shape and have less mass, and are therefore more likely to roll while they are engaged by a paddle 46. It is believed that, in combination, the grooves 62 on impeller paddles 46 having a positive pitch provide an optimal anti-rolling effect when small potatoes are being fed through the impeller assembly 40.

[0029] Figure 4D represents a deflector 90 for use with either of the impeller assemblies 40 of this invention. The deflector 90 is tapered to generally have an inverted cone-shape to direct food products radially outward toward the impeller paddles 46. The deflector 90 is further formed to have a central semispherical depression or recess 92. The function of the recess 92 is to cause water (or another lubricating fluid commonly used in food processing) originally directed downward toward the recess 92 to be redirected radially outward toward the upper ends of the paddles 46, and thereafter cascade down the vertical surfaces of the paddles 46 to provide a lubricating and cleaning effect. The deflector 90 has a central bore 94 for centrally locating the deflector 90 on the lower plate 48 of the impeller assembly 40 as shown in Figure 5, and a countersunk bore 96 for receiving a bolt (not shown) to secure the deflector 90 to the lower plate 48.

[0030] Figure 5 schematically represents the impeller assembly 40 of Figures 4A

through 4C equipped with the deflector 90 of Figure 4D and coaxially and concentrically mounted for rotation within the cutting head 12 of Figure 3. The cutting head 12 is supported on a stationary frame 13, while the impeller assembly 40 is coupled to a drive shaft 41. The righthand side of Figure 5 is a cross-section of gate insert strip 23 mounted to a support segment 22 immediately adjacent a knife (not shown), and shows the gate insert strip 23 as not covering the entire axial extent of the paddles 46. Instead, the gate insert strip 23 defines an opening 25 at its lower end through which rocks and other debris that settle by gravity toward the bottom of the impeller assembly 40 can feed through the cutting head 12 without damaging the knife.

[0031] Figure 8 schematically represents a plan view of the impeller assembly 40 of Figures 4E through 4G, with the upper plate 50 removed and round potatoes 72 of different diameters engaged with one of its paddles 46. From Figure 8, it can be seen that a four-inch diameter potato is tangent to the face 60 of the paddle 46 at a point on the intersection of the face 60 with a radius of the straight inner boundary 66 of the paddle 46, evidencing that the paddle 46 is sized to accommodate food products with diameters up to four inches (about 10 cm). The paddle 46 is shown in Figure 8 as having a positive pitch of about five degrees. If the paddle 46 were mounted to the next set of mounting holes 53 above the paddle 46 (as viewed in Figure 8), the paddle 46 would be angled an additional five degrees, providing a positive ten-degree pitch. If the paddle 46 were mounted to the next set of mounting holes 53 below the paddle 46 (as viewed in Figure 8), the paddle 46 would have a neutral pitch.

[0032] Figures 11, 12, and 13 are cross-sectional views showing portions of cutting heads 42 configured with different knife clamping hardware according to various embodiments of the invention. In each case, knives 44 are secured with a pair of holders 74 and 76, with the radially outer holder 76 being forcibly held in place on its support segment 70 with a clamping rod 78, essentially as described for Figure 10.

However, none of the knives 44 represented in Figures 11 through 13 are sheathed in a plastic cartridge as done in Figure 10. The intent of omitting the plastic cartridge 30 of Figure 10 is to more accurately locate the cutting edge 45 of each knife 44 relative to the axis of the cutting head 42 to achieve improved slice thickness accuracy and consistency. Specifically, the pliability of plastic materials renders the plastic cartridge 30 compressible, which reduces to some extent that accuracy with which the knife cutting edges 45 can be radially located with respect to the axis of the cutting head 42. Therefore, eliminating the cartridge 30 and forming the knife 44 and its holders 74 and 76 of substantially incompressible materials, such as metal, eliminates the dimensional changes that occur from compression under the clamping load of the rod 78, and ensures more accurate positioning of the knife cutting edges 45.

[0033] In Figure 11, a conventional double-beveled knife 44 is shown essentially similar to the knife 14 of Figure 9. In practice, the trajectories 35 of slices traveling downstream from the knife 44 (as determined by the radially outer face 82 of the knife 44 and the radially outer holder 76) is such that slices are likely to hit the clamping rod 78. As a first solution, Figure 12 shows the clamping rod 78 as having a half-round cross-section, which allows the clamping rod 78 to have a sufficiently lower profile that is radially inward from the trajectories 35 of slices exiting the knife 44. The knife 44 of Figure 12 is also supported by an insert 80, such that the knife 44 is between the insert 80 and the inner holder 74. The insert 80 serves to protect the edge of the inner holder 74 from stones or other debris that are often unintentionally fed through the impeller assembly 40 along with food products.

[0034] In contrast to the knives 44 described thus far, the knife 44 shown in Figure 13 is beveled only on its radially outer surface 82. According to the present invention, a single-beveled knife edge 45 is believed to produce a cleaner slice and reduce the compression of food products during the slicing operation observed with the

double-beveled knives 14 and 44 of Figures 9 through 12. However, as a result of lacking a bevel on its outer surface 82, the single-beveled knife 44 of Figure 13 does not deflect slices to the extent that the double-beveled knives 14 and 44 of Figures 9 through 12 are capable. To avoid slices impacting the clamping rod 78, Figure 13 shows the clamping rod 78 as generally having the form of a rectilinear bar with a tapered leading edge 84, resulting in the rod 78 having a sufficiently lower profile proximate to the knife 44 that is radially inward from the trajectories 35 of slices exiting the knife 44.

[0035] Figures 14 and 15 illustrate the clamping action performed by the clamping rod 78 in more detail. The embodiment shown in Figures 14 and 15 combine the insert 80 of Figure 12 with the tapered clamping rod 78 of Figure 13. As evident from Figures 14 and 15, the lever 77 has forced one end of the outer holder 76 against the clamping rod 78, which in turn forces the opposite end of the outer holder 76 into engagement with the knife 44, forcing the knife 44 against the inner holder 74. The knife 44 can be release by rotating the lever 77 clockwise (as viewed in Figure 15), such that a flat 86 on the lever 77 faces the outer holder 76, releasing the outer holder 76 from its engagement with the clamping rod 78.

[0036] While the invention has been described in terms of specific embodiments, it is apparent that other forms could be adopted by one skilled in the art. For example, the physical configurations of the impeller assembly 40, cutting head 42, and their components could differ from that shown, and materials and processes other than those noted could be use. Therefore, the scope of the invention is to be limited only by the following claims.

CLAIMS:

1. A cutting apparatus comprising an annular-shaped cutting head (42) and an impeller assembly (40) coaxially mounted within the cutting head (42) for rotation about an axis of the cutting head (42) in a rotational direction relative to the cutting head (42), the impeller assembly (40) having means (46) for delivering food products (72) radially outward toward the cutting head (42), the cutting head (42) comprising:

at least one knife (44) extending radially inward toward the impeller assembly (40) in a direction opposite the rotational direction of the impeller assembly (40), the knife (44) having a cutting edge (45) at a radially innermost extremity thereof and a radially outer face (82) that defines a trajectory plane (35) for slices removed from the food products (72) by the cutting edge (45); and

means (31,74,76,77,78,80) for clamping the knife (44) to the cutting head (42), the clamping means (31,74,76,77,78,80) comprising a clamping member (78) with which the clamping means (31,74,76,77,78,80) generates a clamping force that secures the knife (44) to the cutting head (42), the clamping member (78) being located adjacent a radially outermost extremity of the knife (44) and oriented substantially parallel to the knife (44), the clamping member (78) having a thickness in a radial direction of the cutting head (42) that decreases in a direction toward the knife (44) to provide clearance for the slices when traveling the trajectory plane (35) of the knife (44).

2. The cutting apparatus according to claim 1, wherein the knife (44) has a radially inner face opposite the radially outer face (82) of the knife (44), the radially inner face is beveled at the cutting edge (45), and the radially outer face (82) is not beveled at the cutting edge (45).

3. The cutting apparatus according to claim 2, wherein if not for the

radially outer face (82) of the knife (44) being unbeveled, the trajectory plane (35) of the knife (44) would result in the slices hitting the clamping member (78).

4. The cutting apparatus according to claim 1, wherein the clamping means (31,74,76,77,78,80) further comprises an outer holding member (76) contacting the radially outer face (82) of the knife (44), an inner holding member (74) contacting a radially inner face of the knife (44) opposite the radially outer face (82), means (31) for securing the clamping member (78) to the inner holding member (74), and means (77) for forcing the outer holding member (76) into engagement with the radially outer face (82) of the knife (44) to clamp the knife (44) between the inner and outer holding members (74,76).

5. The cutting apparatus according to claim 4, wherein the forcing means (77) is operable to force a first end of the outer holding member (76) against the clamping member (78) and thereby force an oppositely-disposed second end of the outer holding member (76) into engagement with the radially outer face (82) of the knife (44) and force the knife (44) against the inner holding member (74).

6. The cutting apparatus according to claim 4, wherein the clamping means (31,74,76,77,78,80) further comprises a removable insert (80) that defines a radially innermost extremity of the inner holding member (74), and the removable insert (80) contacts the radially inner face of the knife (44) adjacent the cutting edge (45) thereof.

7. The cutting apparatus according to claim 1, wherein the clamping means (31,74,76,77,78,80) does not compress a polymeric material when generating the clamping force with the clamping member (78).

8. The cutting apparatus according to claim 1, wherein the clamping means (31,74,76,77,78,80) comprises only metallic materials.

9. A cutting apparatus comprising an annular-shaped cutting head (42) and an impeller assembly (40) coaxially mounted within the cutting head (42) for rotation about an axis of the cutting head (42) in a rotational direction relative to the cutting head (42), the impeller assembly (40) having means (46) for delivering food products (72) radially outward toward the cutting head (42), the cutting head (42) comprising:

at least one knife (44) extending radially inward toward the impeller assembly (40) in a direction opposite the rotational direction of the impeller assembly (40), the knife (44) having a cutting edge (45) at a radially innermost extremity thereof, a radially outer face (82) that defines a trajectory plane (35) for slices removed from the food products (72) by the cutting edge (45), and a radially inner face opposite the radially outer face (82) of the knife (44), wherein the radially inner face is beveled at the cutting edge (45) and the radially outer face (82) is not beveled at the cutting edge (45); and

means (31,74,76,77,78,80) for clamping the knife (44) to the cutting head (42), the clamping means (31,74,76,77,78,80) comprising a clamping member (78) with which the clamping means (31,74,76,77,78,80) generates a clamping force that secures the knife (44) to the cutting head (42), the clamping member (78) being located adjacent a radially outermost extremity of the knife (44) and oriented substantially parallel to the knife (44), the clamping member (78) having a thickness in a radial direction of the cutting head (42) that decreases in a direction toward the knife (44) to provide clearance for the slices when traveling the trajectory plane (35) of the knife (44);

wherein if not for the radially outer face (82) of the knife (44) being unbeveled, the trajectory plane (35) of the knife (44) would result in the slices hitting the clamping member (78).

10. The cutting apparatus according to claim 9, wherein the clamping means (31,74,76,77,78,80) further comprises an outer holding member (76) contacting the radially outer face (82) of the knife (44), an inner holding member (74) contacting a radially inner face of the knife (44) opposite the radially outer face (82), means (31) for securing the clamping member (78) to the inner holding member (74), and means (77) for forcing the outer holding member (76) into engagement with the radially outer face (82) of the knife (44) to clamp the knife (44) between the inner and outer holding members (74,76).

11. The cutting apparatus according to claim 10, wherein the forcing means (77) is operable to force a first end of the outer holding member (76) against the clamping member (78) and thereby force an oppositely-disposed second end of the outer holding member (76) into engagement with the radially outer face (82) of the knife (44) and force the knife (44) against the inner holding member (74).

12. The cutting apparatus according to claim 10, wherein the clamping means (31,74,76,77,78,80) further comprises a removable insert (80) that defines a radially innermost extremity of the inner holding member (74), and the removable insert (80) contacts the radially inner face of the knife (44) adjacent the cutting edge (45) thereof.

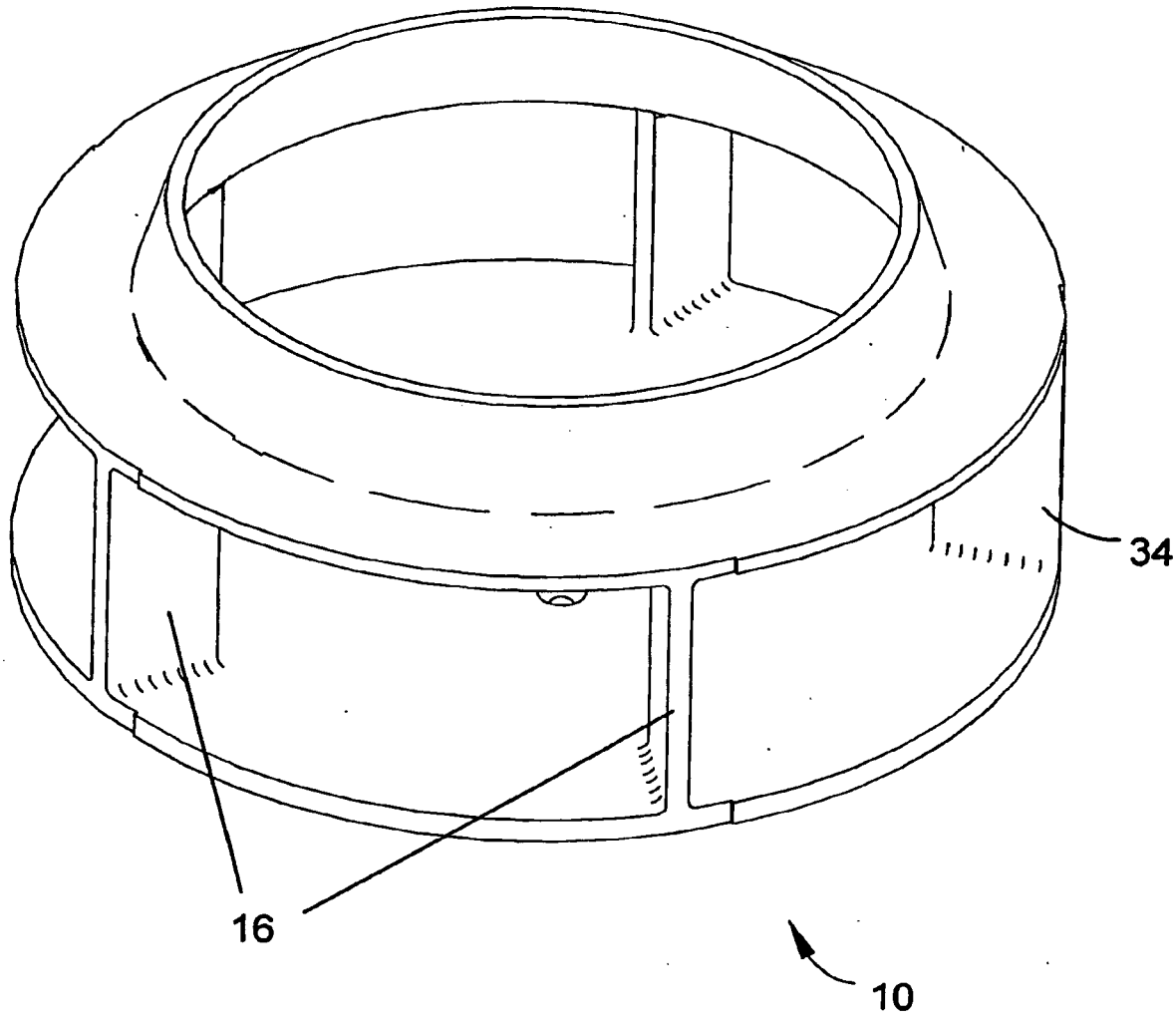


FIGURE 1
PRIOR ART

FIGURE 2
PRIOR ART

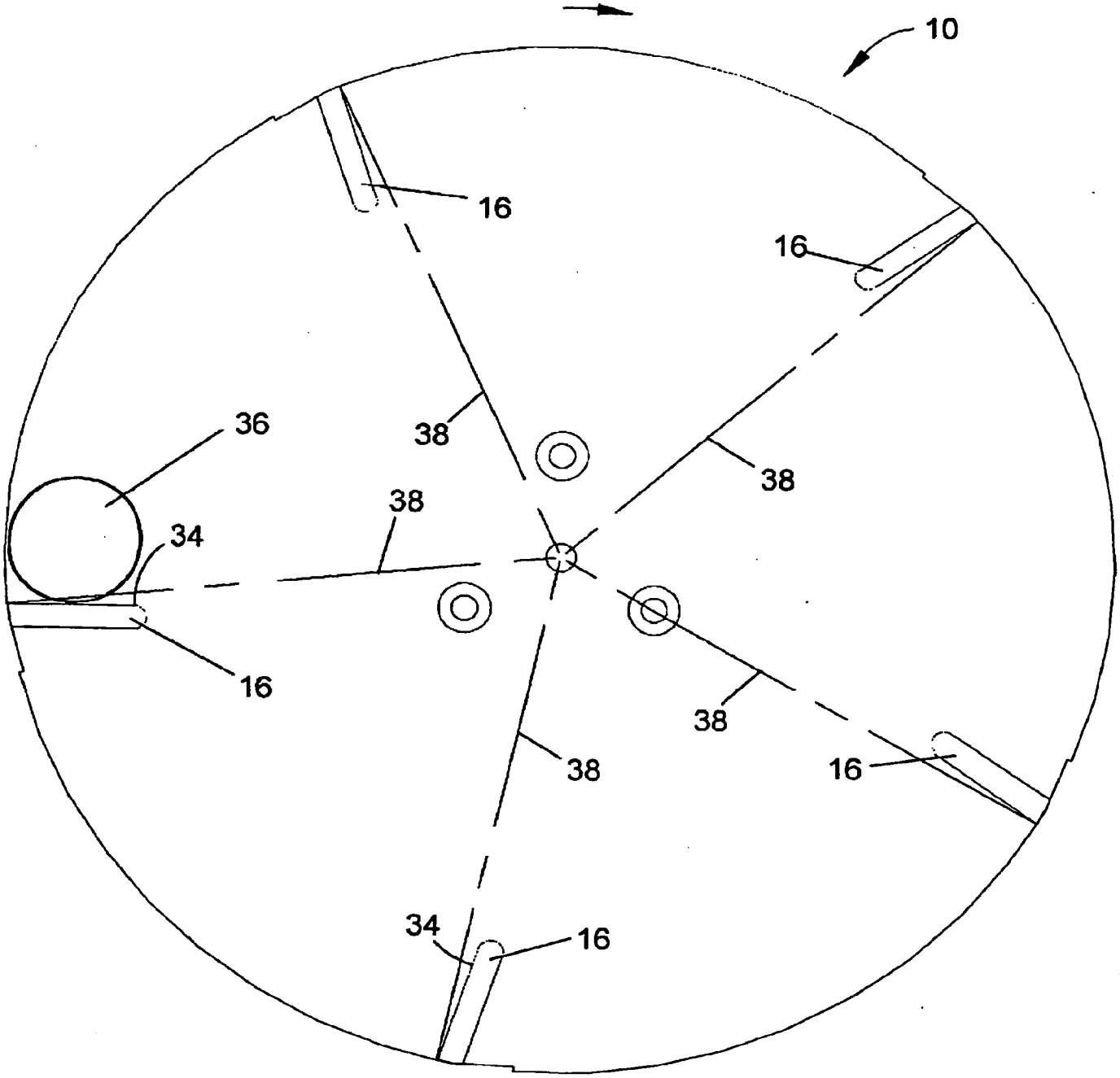
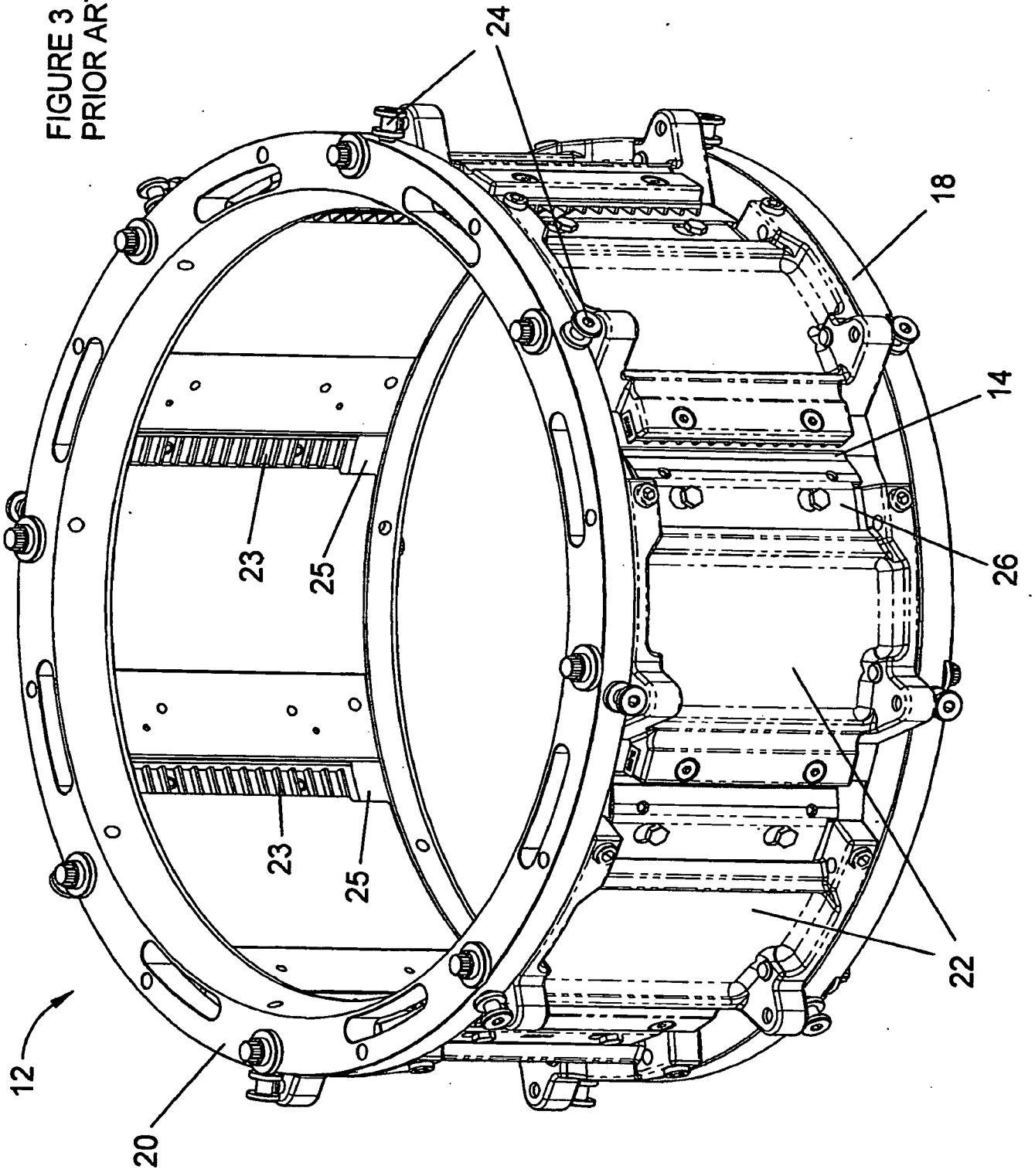


FIGURE 3
PRIOR ART



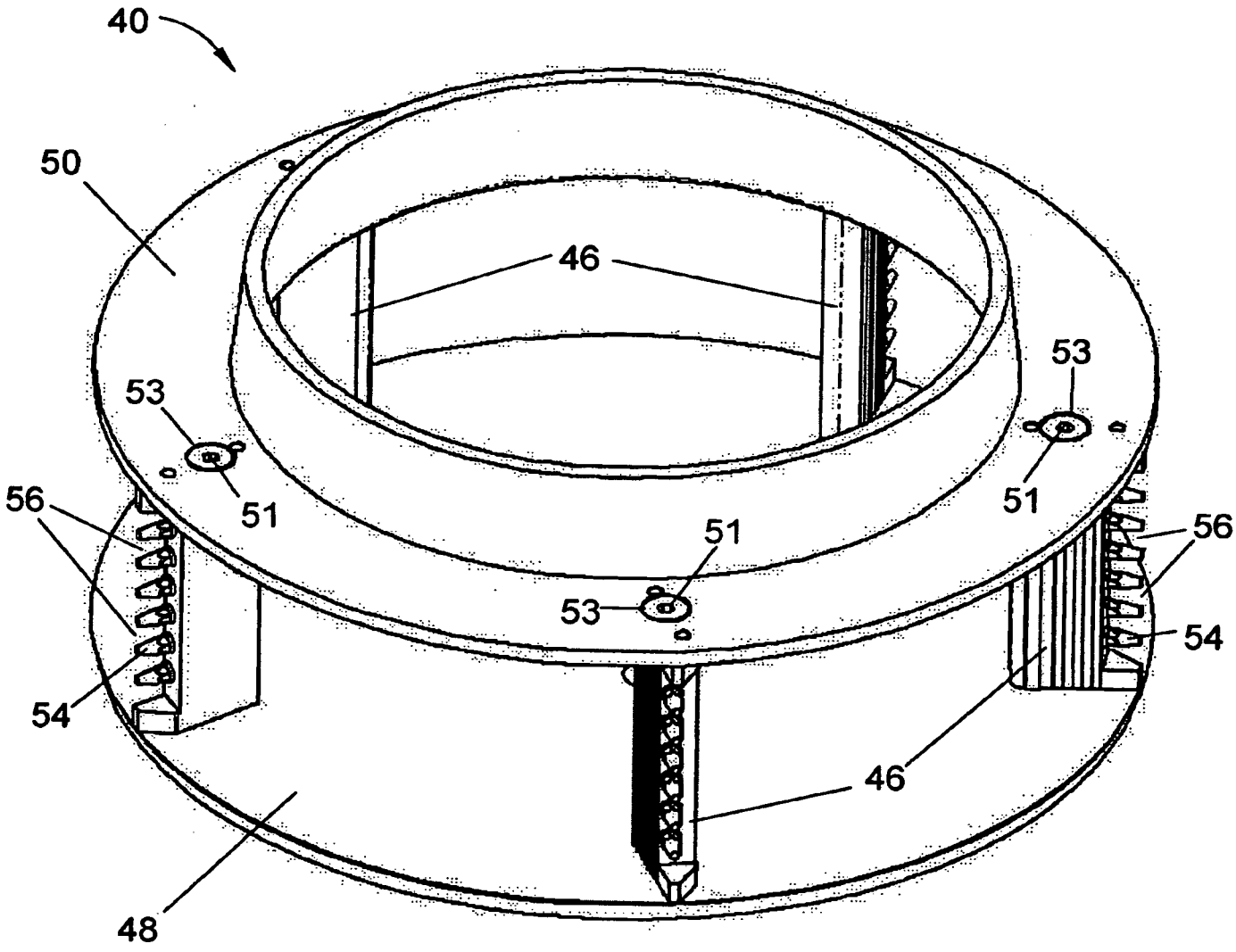


FIGURE 4A

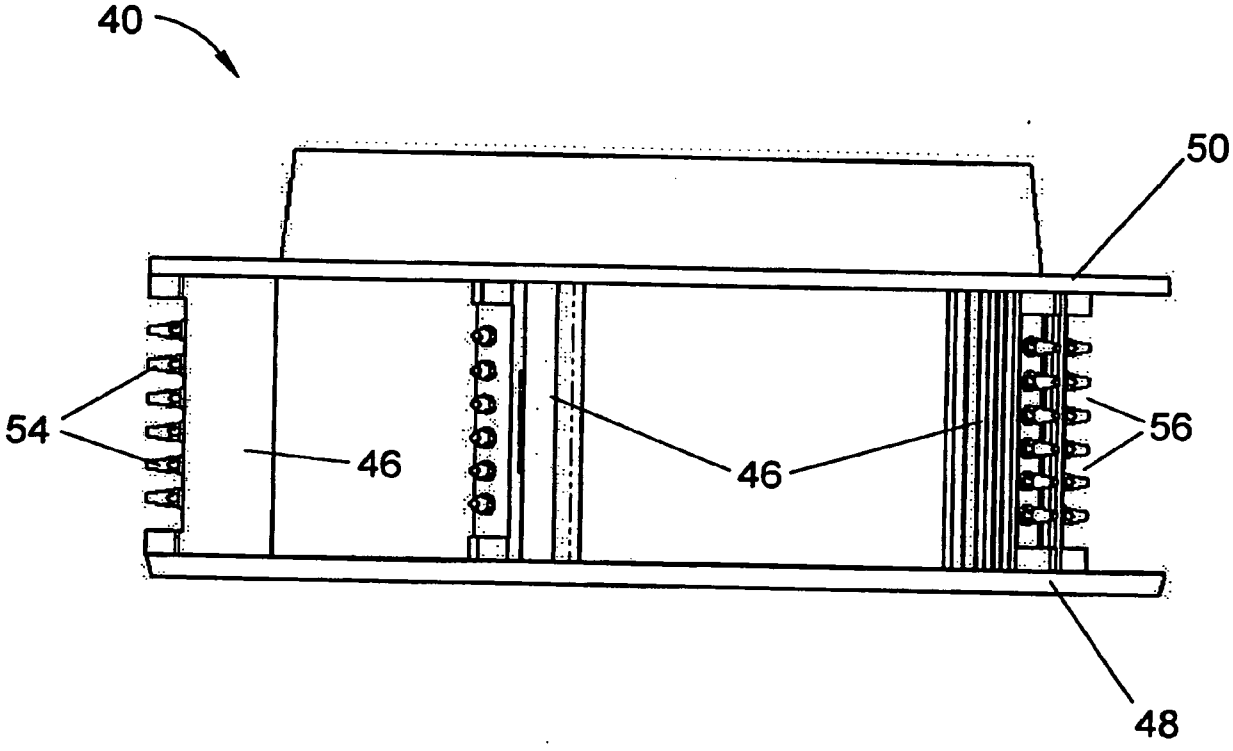
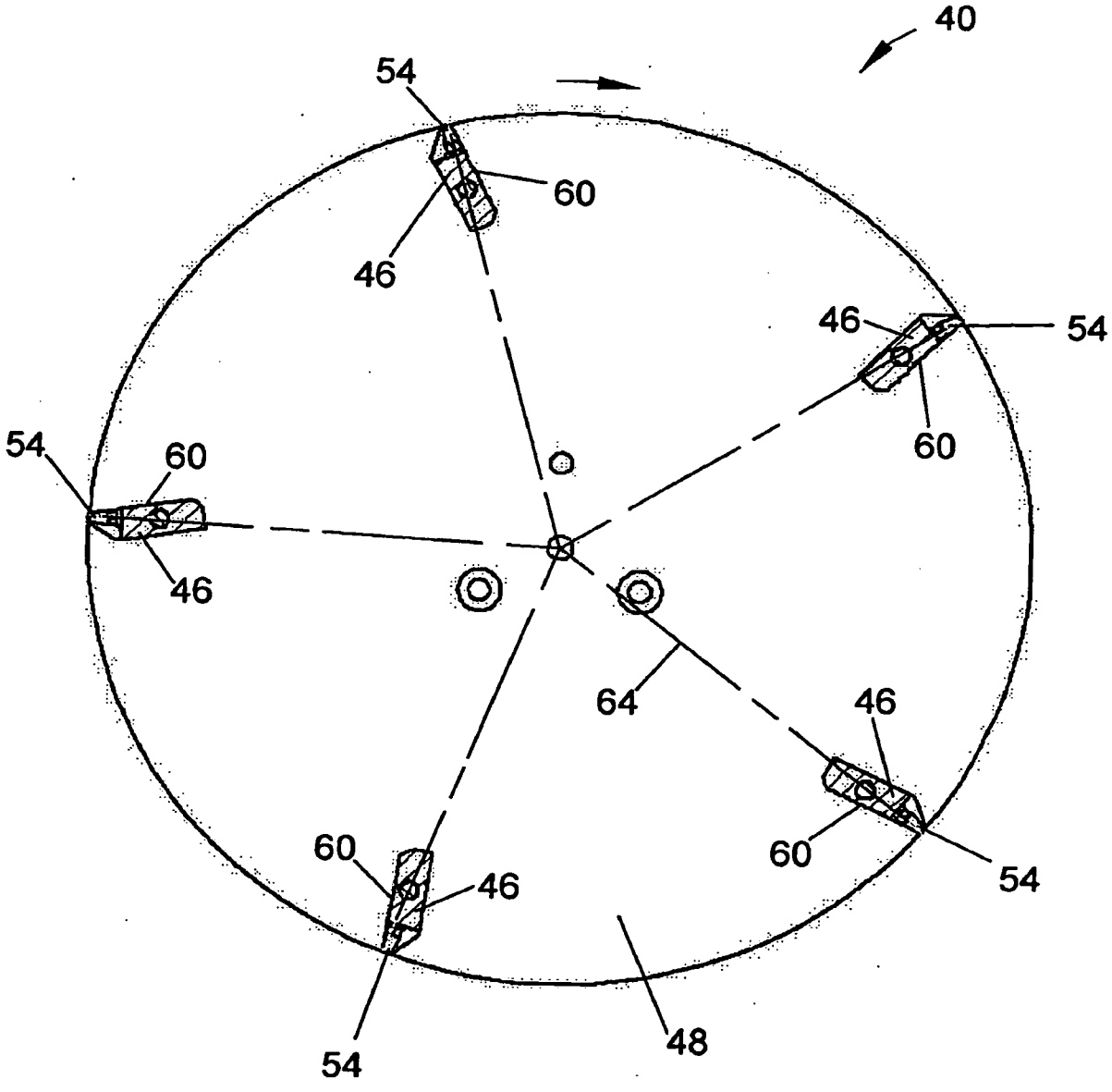


FIGURE 4B

FIGURE 4C



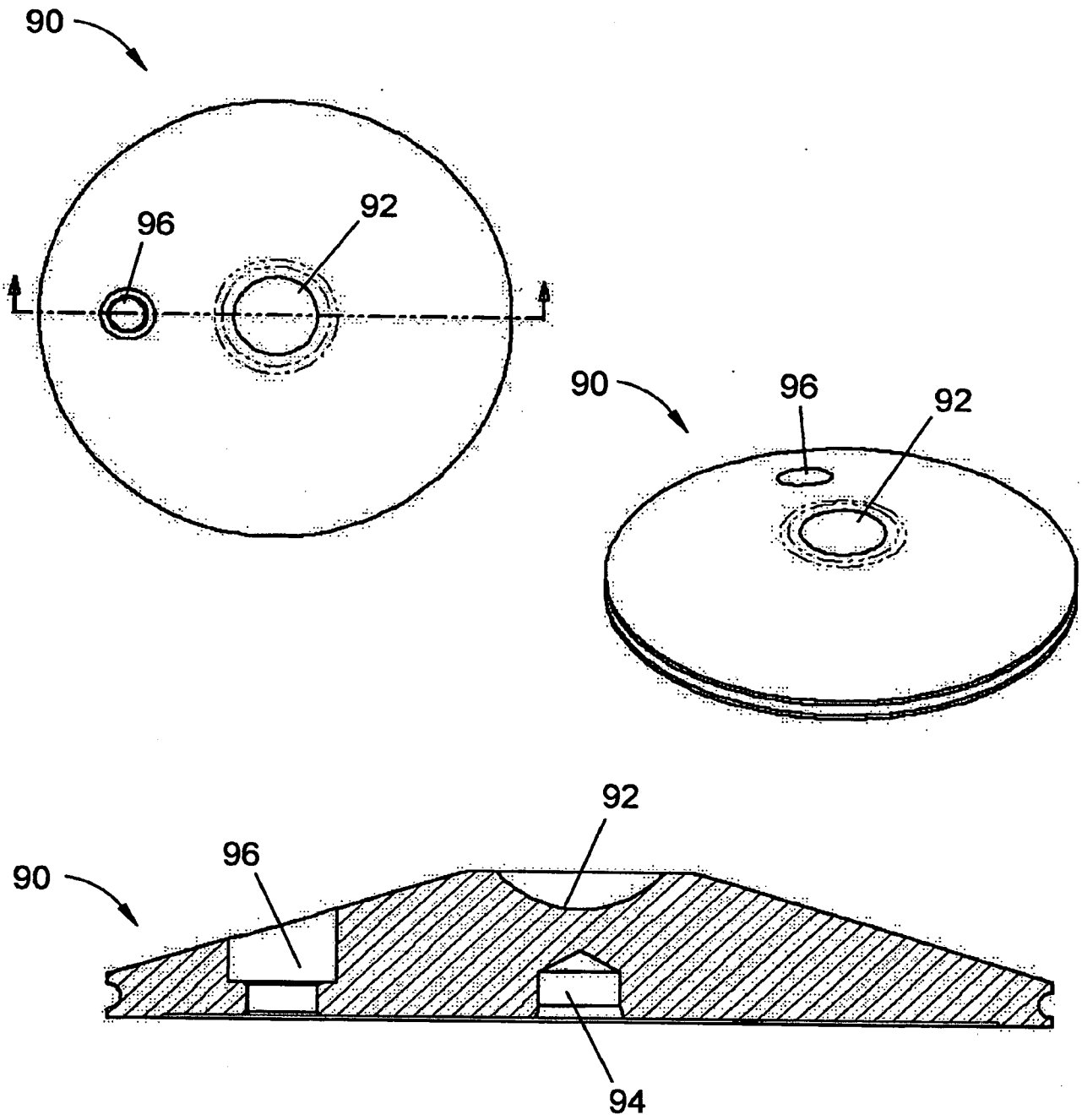


FIGURE 4D

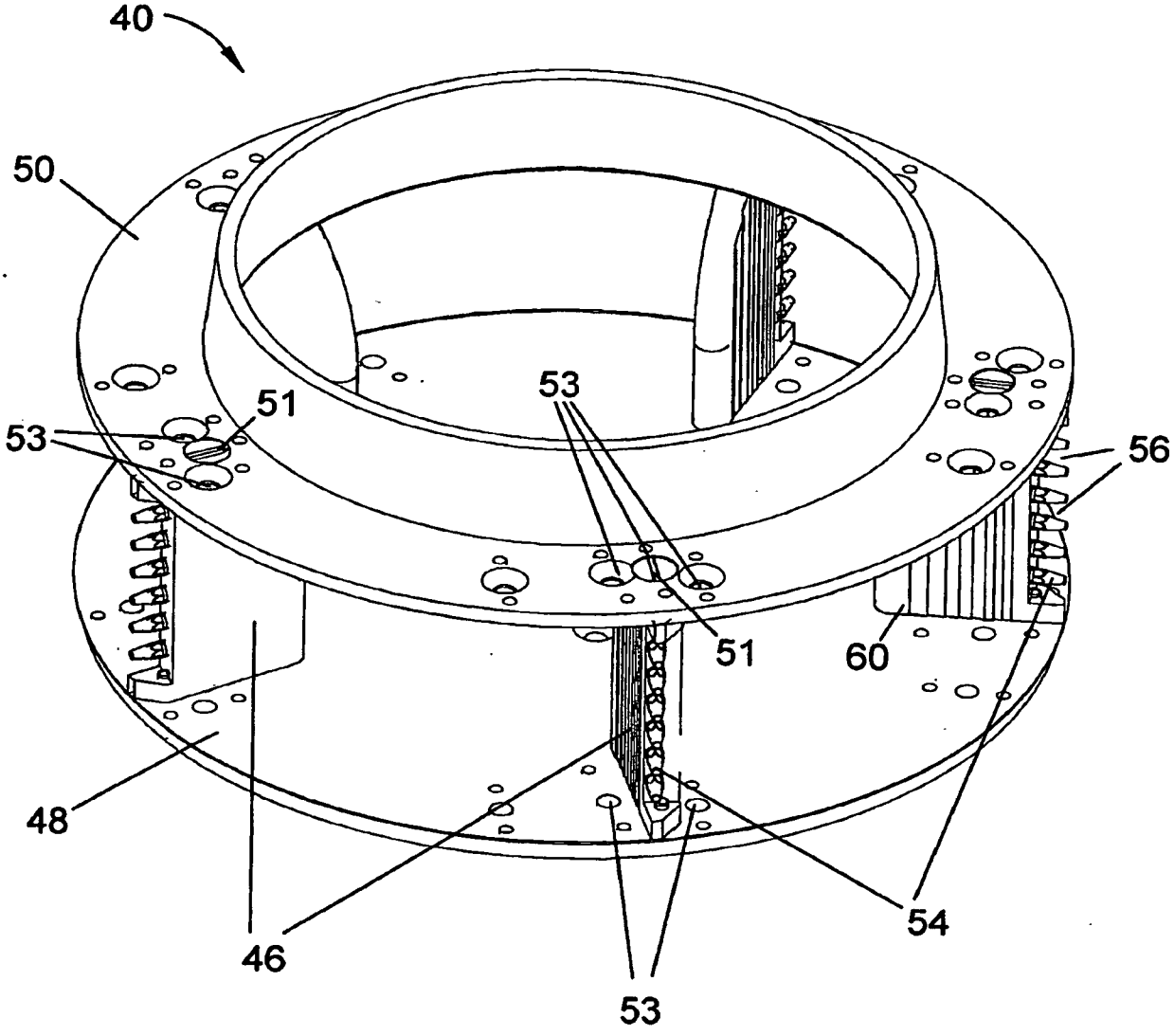


FIGURE 4E

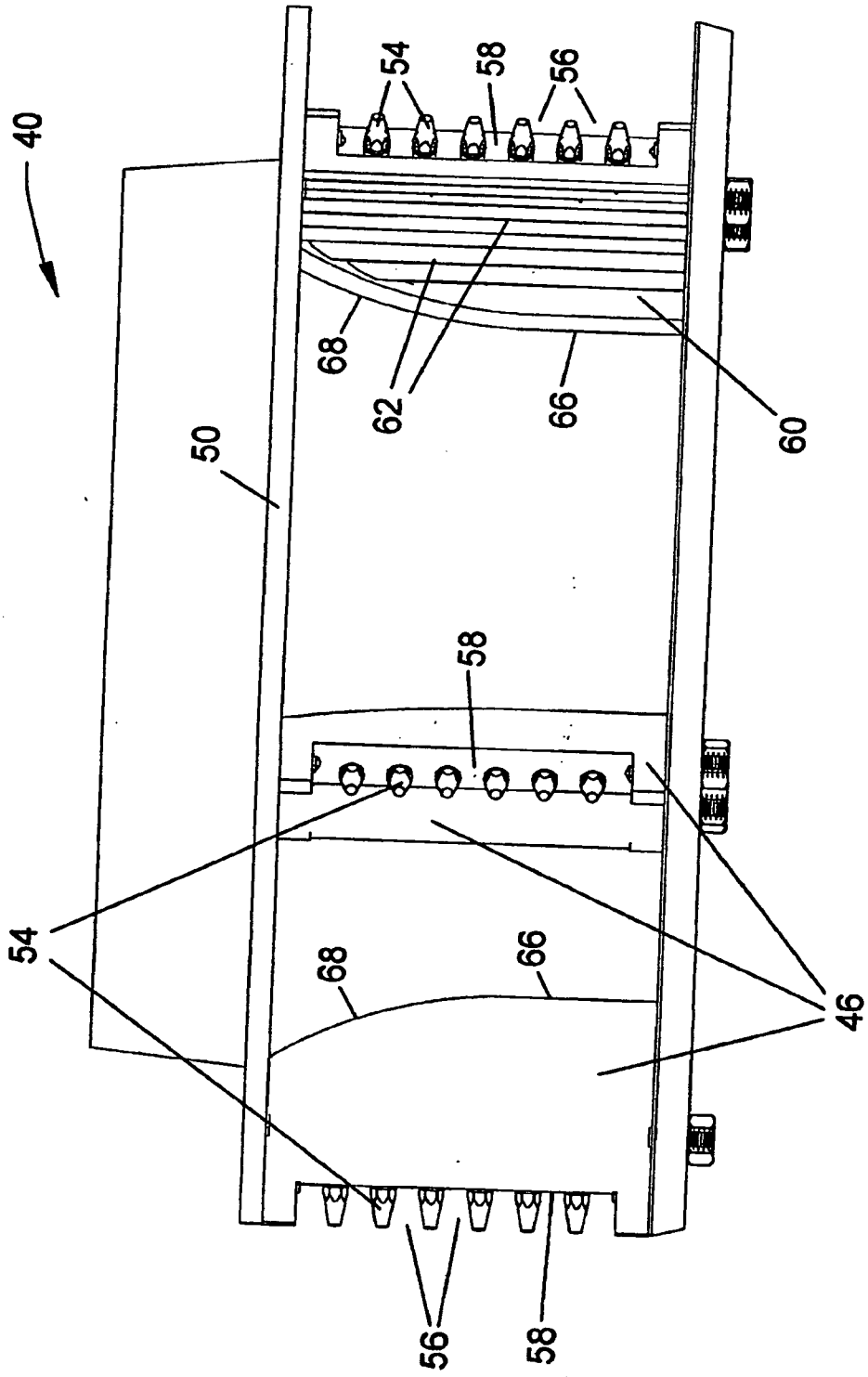
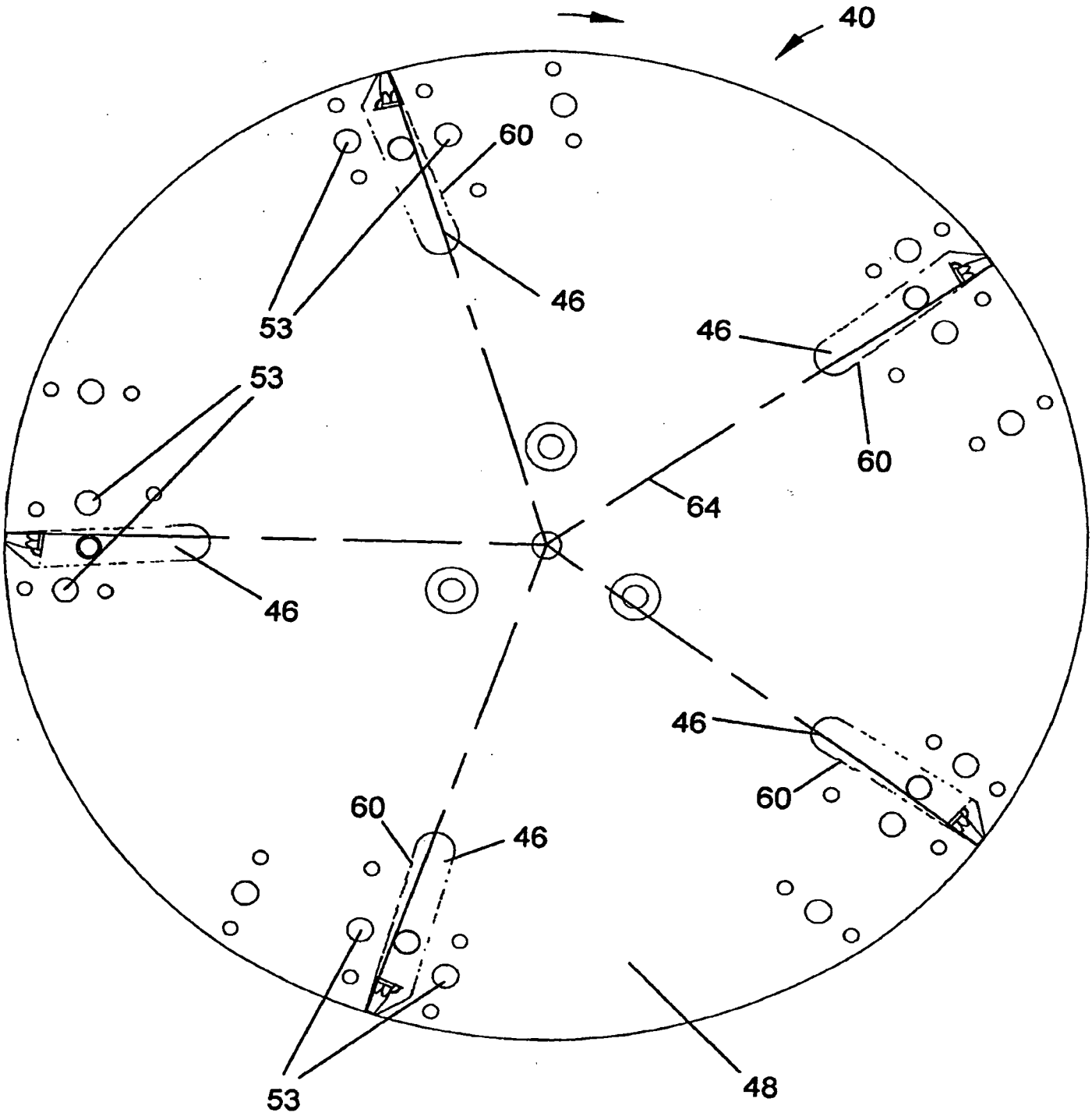


FIGURE 4F

FIGURE 4G



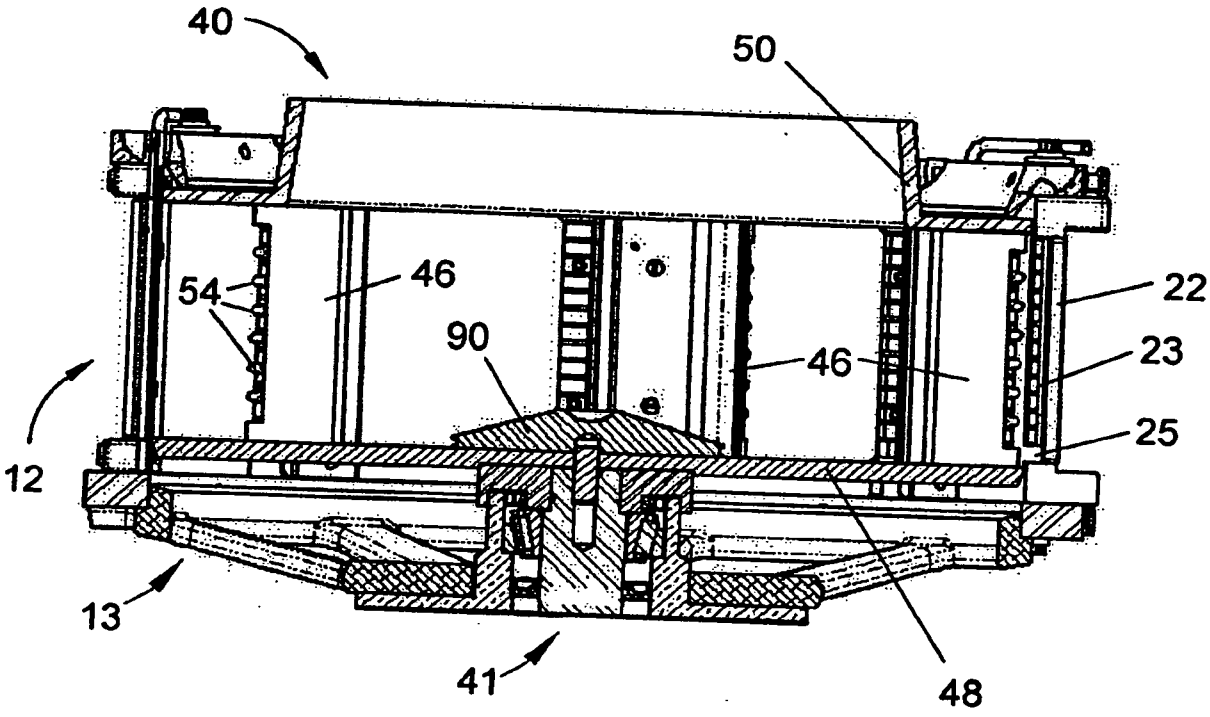


FIGURE 5

FIGURE 6A

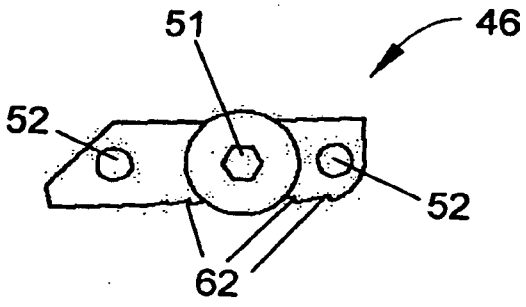
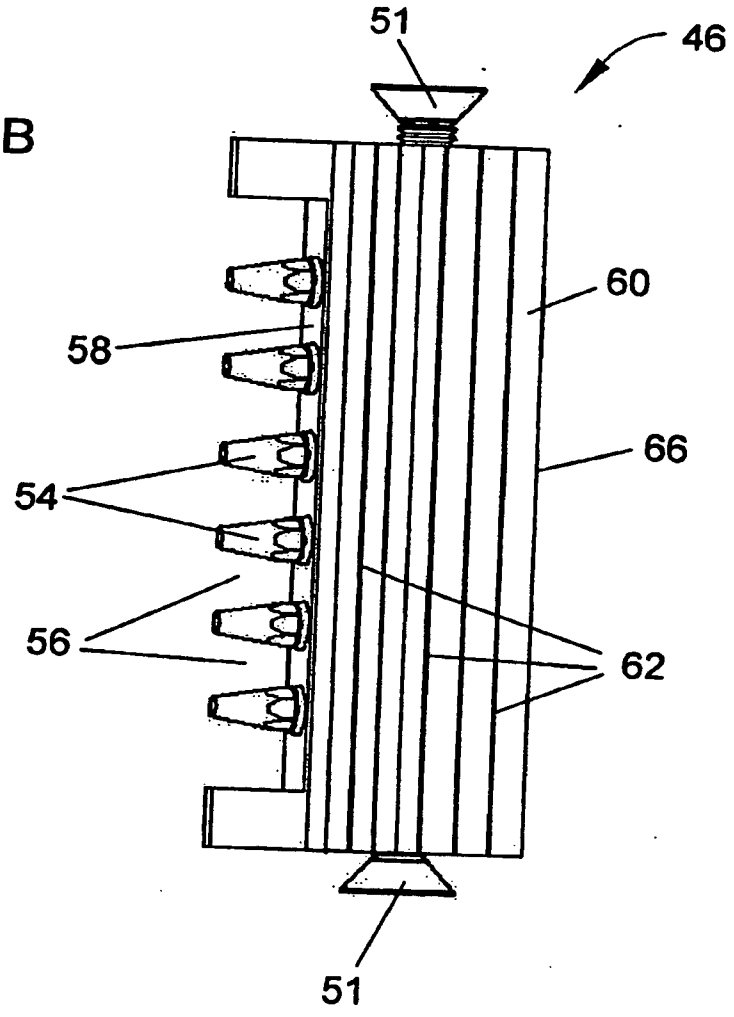


FIGURE 6B



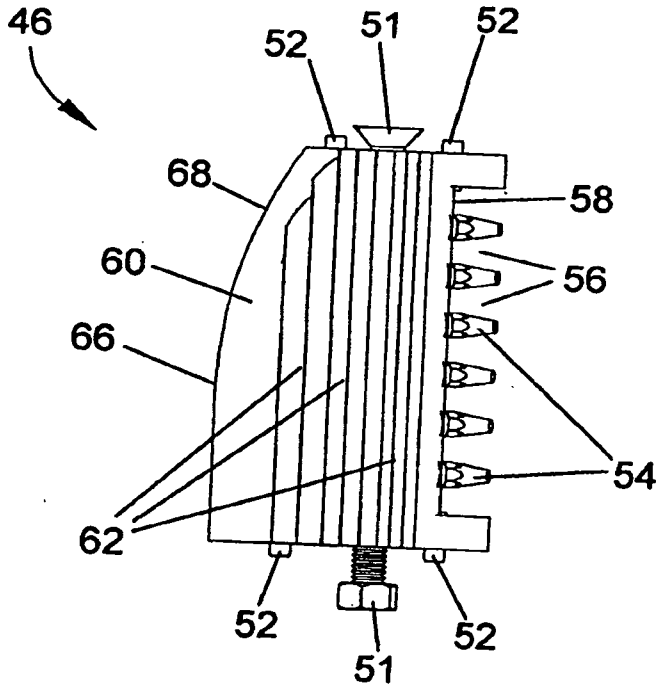


FIGURE 7

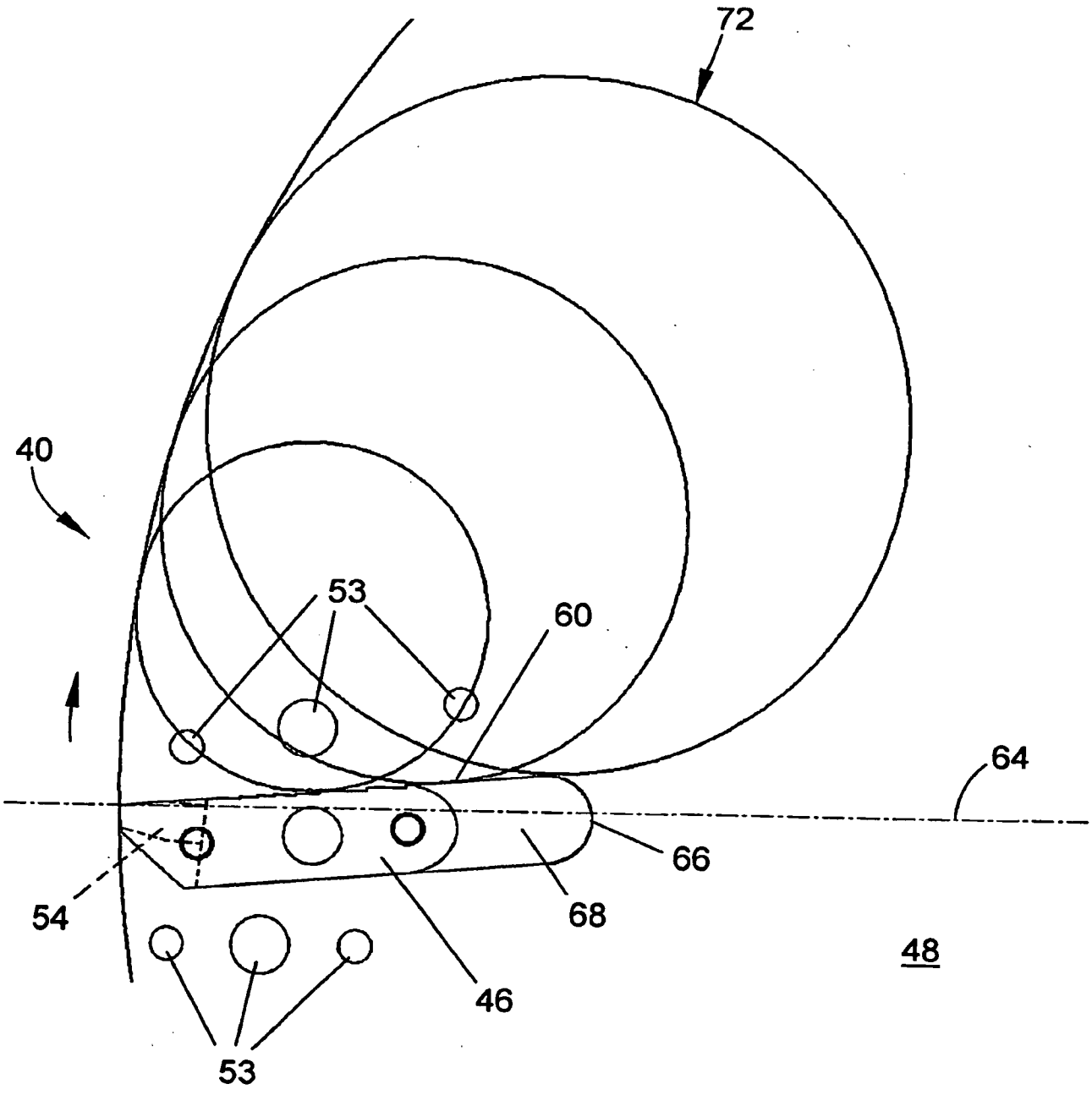


FIGURE 8

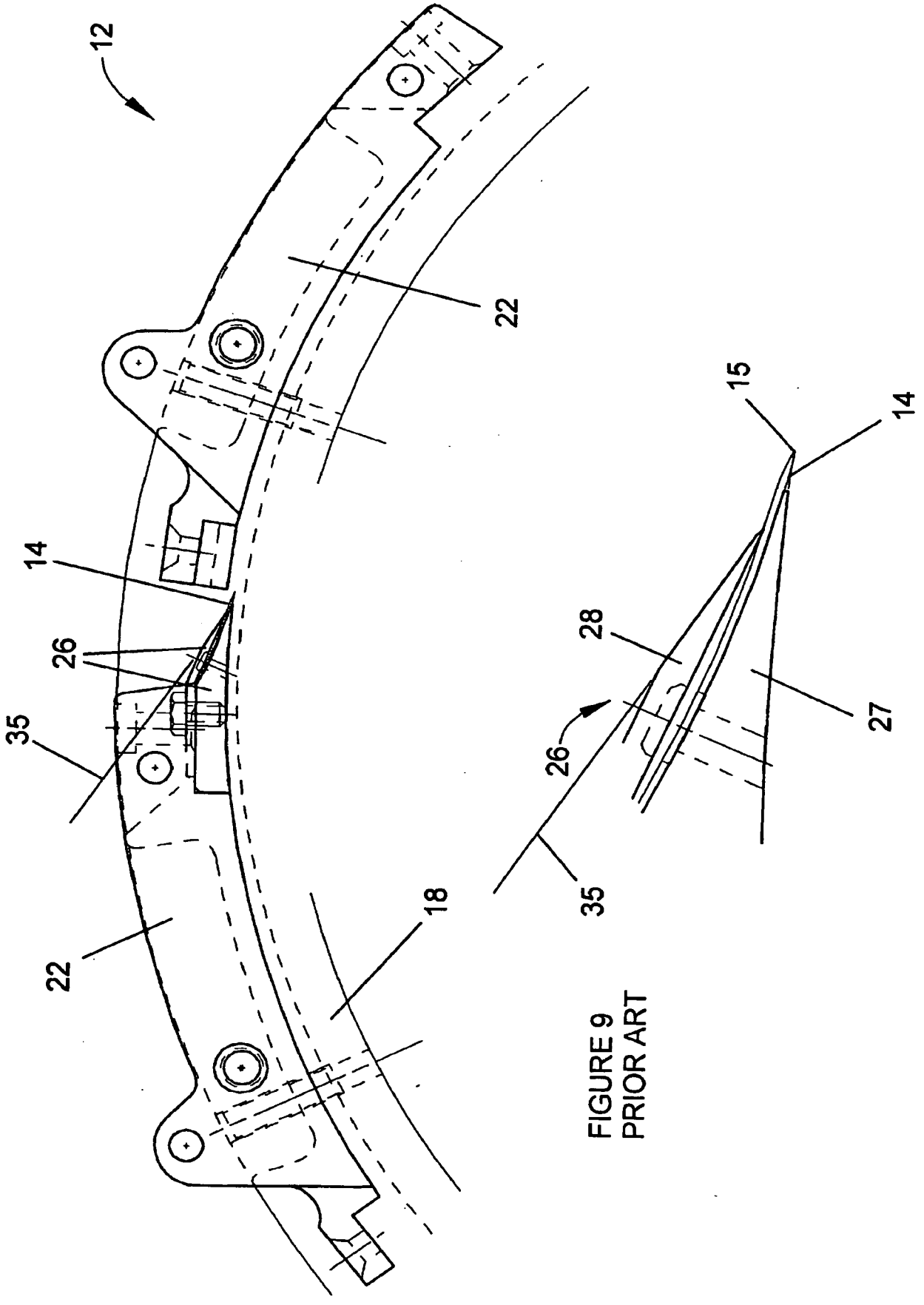


FIGURE 9
PRIOR ART

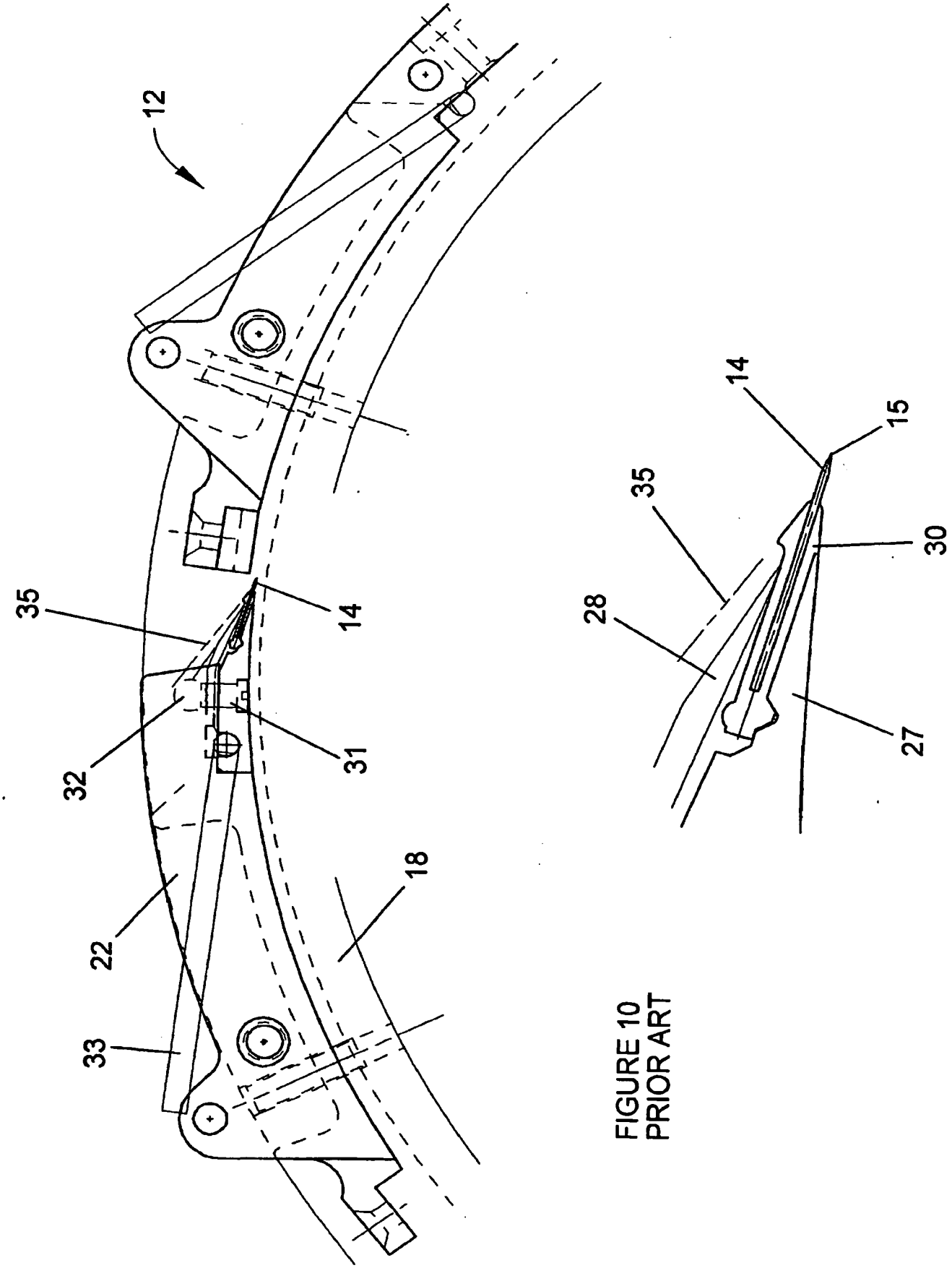


FIGURE 10
PRIOR ART

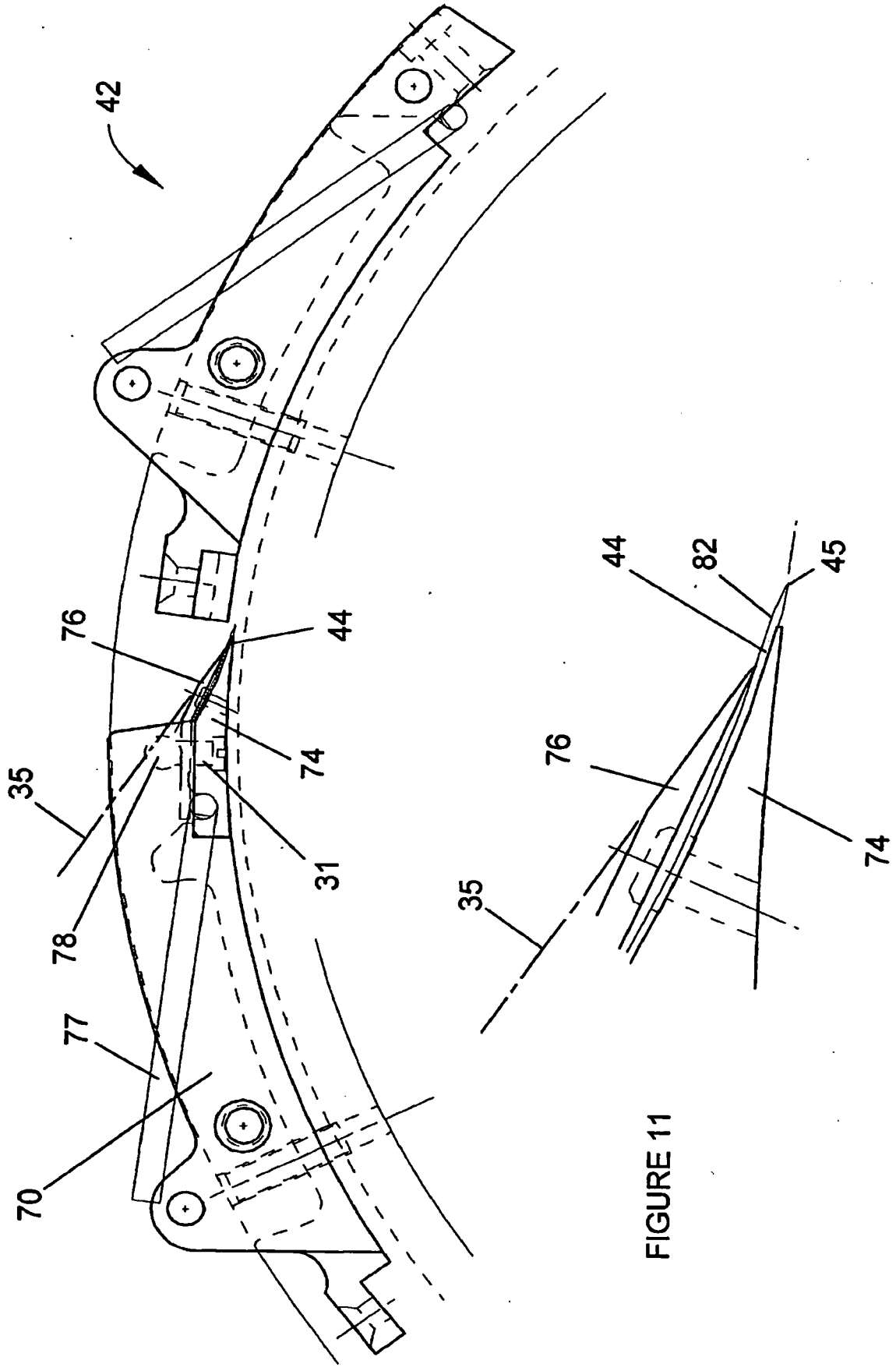


FIGURE 11

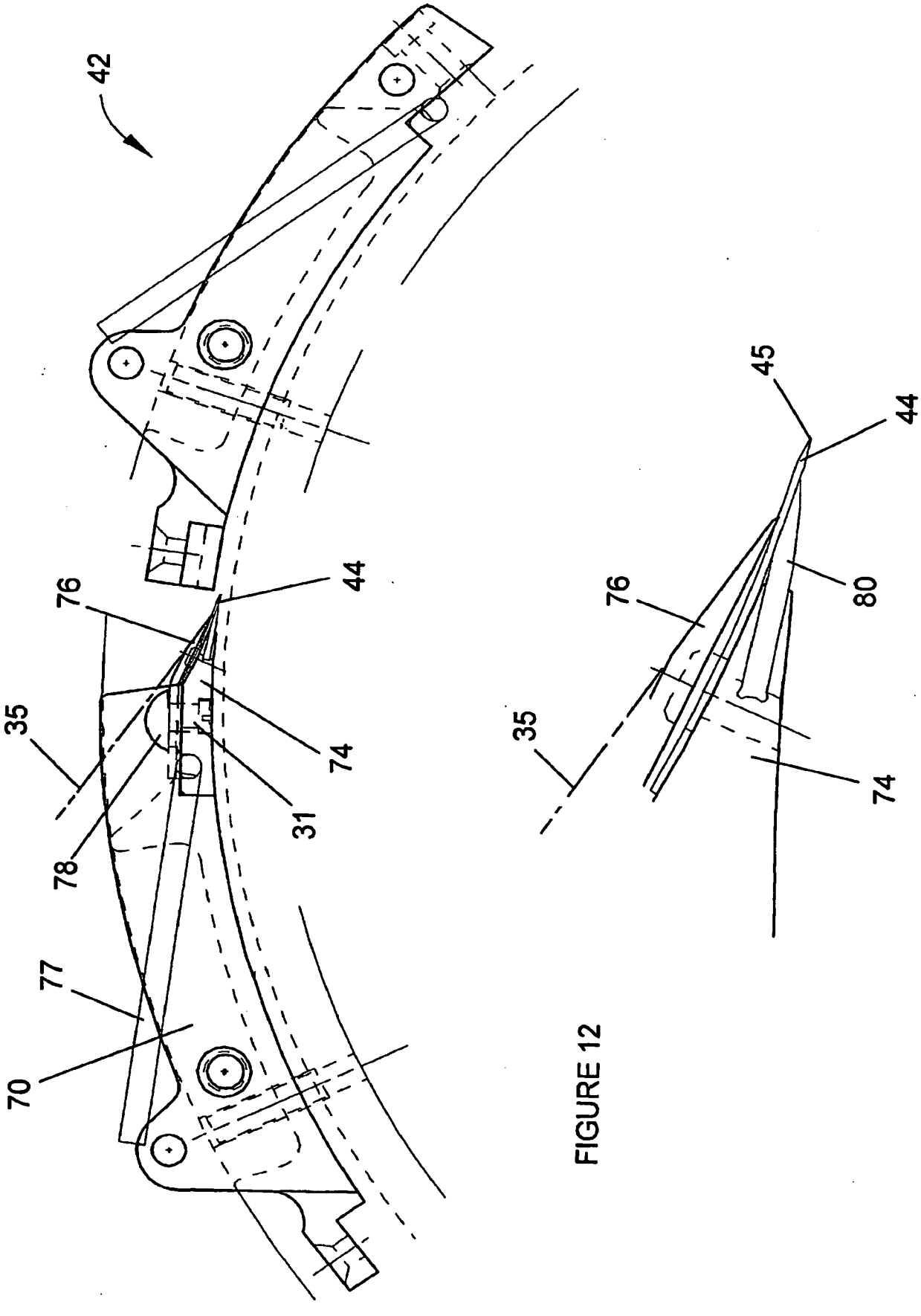


FIGURE 12

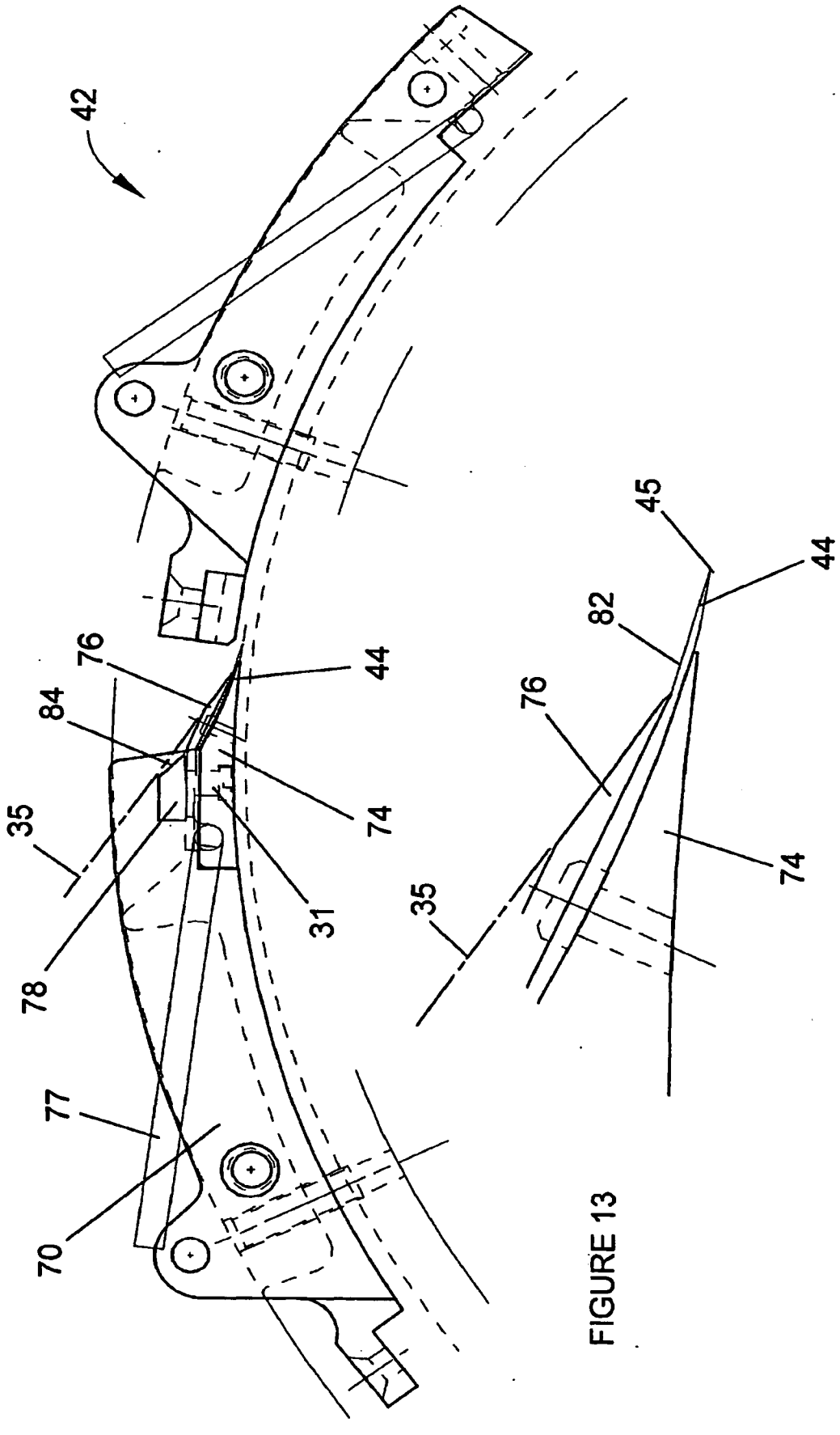


FIGURE 13

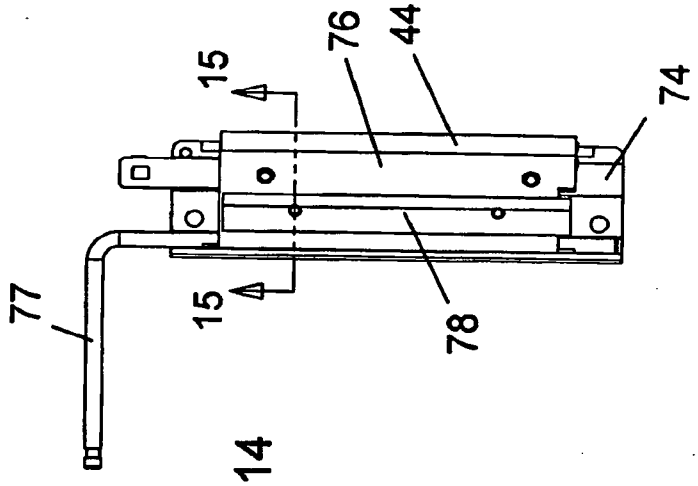


FIGURE 14

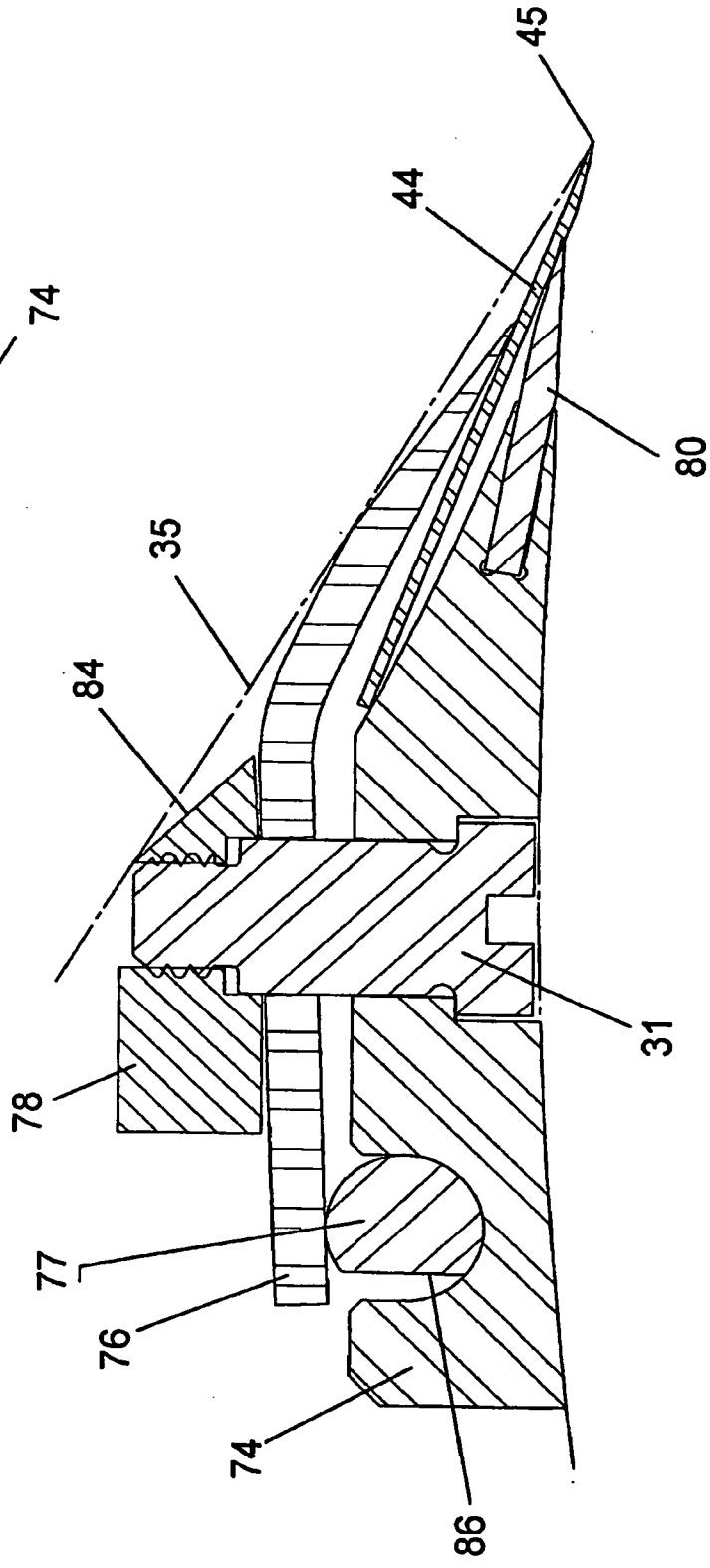


FIGURE 15

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/009550

A. CLASSIFICATION OF SUBJECT MATTER
INV. B26D1/36 B26D3/26 B26D7/26 B26D1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B26D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/000344 A1 (BUCKS BRENT L [US]) 6 January 2005 (2005-01-06) paragraph [0085] - paragraph [0091]; figures 21a,27,28	1,2,7,8
X	US 3 139 128 A (URSCHEL JOE R ET AL) 30 June 1964 (1964-06-30) figures 9,10	1,7,8
X	DE 195 18 609 C1 (MAIER ZERKLEINERUNGSTECH GMBH [DE]) 1 February 1996 (1996-02-01) the whole document	1,2,7,8
X	US 4 972 888 A (DEAN DONALD A [US]) 27 November 1990 (1990-11-27) abstract; figures	1,2,7,8

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search	Date of mailing of the international search report
14 August 2007	02/10/2007

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Canelas, Rui

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2007/009550

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 968 765 B2 (KING DANIEL W [US]) 29 November 2005 (2005-11-29) cited in the application the whole document -----	1-12

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2007/009550

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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US 3139128 A	30-06-1964	NONE	
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