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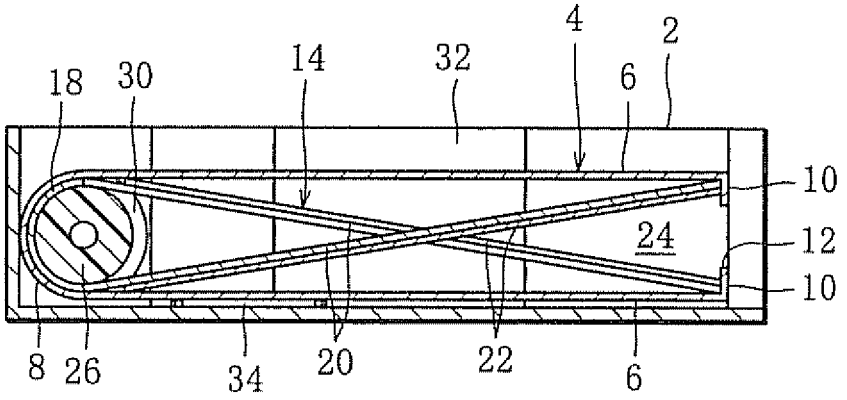
## (54) Knife sharpener

(57) A knife sharpener has at least two sharpening strips (20). The strips (20) are arranged to adjoin each other in the width direction and intersect with each other. The strips (20) are elastically deformable and include spread portions, respectively. The spread portions stretch from the intersecting point to one ends of the strips (20) and are splayed to form a V-shaped groove (24) having a vertex angle. Abrasive surfaces (22) are formed on one surfaces of the spread portions. The abrasive surfaces (22) form both side faces of the groove (24). The sharpener further has a fixing member (18) fixing the other ends of the strips (20) and stoppers (6) brought into contact with the strips (20) to limit maximum opening width of the groove (24). The abrasive surfaces (22) are bent by the fixing member (18) and stoppers (6) to increase the vertex angle when a knife is sharpened.

FIG. 3A




EP 1 642 677 A1

## Description

### BACKGROUND OF THE INVENTION

Field of the Invention

**[0001]** The present invention relates to a knife sharpener.

Description of the Related Art

**[0002]** As a knife sharpener of this type, Unexamined Japanese Patent Publication No. 2004-90169, for example, discloses a device having a V-shaped sharpening groove for the blade edge of a knife to be pressed and slid against it. More specifically, the knife sharpener disclosed in the document has a plurality of sharpening strips arranged to intersect with each other in the shape of the letter V. These sharpening strips compose the V-shaped sharpening groove between abrasive surfaces formed in one of the sides of each strip. According to the knife sharpener described in the document, since the sharpening strips each have elasticity, the burr of the blade edge is pressed by the abrasive surfaces and the blade edge is straightened when the knife is being sharpened. Therefore the knife can be sharpened in a short time.

**[0003]** In the process of sharpening the blade edge of a knife, there is formed in the tip end portion of the knife a portion called a final bevel having the shape of an isosceles triangle in section. It is preferable that the final bevel be so finished that each side face is shaped into a rounded convex surface. This is because if both side faces of the final bevel are sharpened into flat surfaces, the separability of an object to be cut is degraded at the time of the cutting, and this makes difficult the handling of the knife. Furthermore, since the final bevel is thin, a nick is easily made in the knife, and the sharpness of the knife is deteriorated in a short period. Consequently, the knife requires frequent sharpening.

### SUMMARY OF THE INVENTION

**[0004]** It is an object of the present invention to provide a knife sharpener with a simple structure, which sharpens a knife so that the knife has excellent handling and lasts in sharpness for a long period.

**[0005]** In order to achieve the above object, the knife sharpener of the present invention has at least two sharpening strips arranged to adjoin each other in a width direction thereof and intersect with each other at an intersection point, the sharpening strips each being elastically deformable and including spread portions, the spread portions stretching from the intersecting point to one ends of the sharpening strips and being splayed to form a V-shaped groove having a vertex angle; abrasive surfaces formed on one surfaces of the spread portions, respectively, the abrasive surfaces forming side faces of said groove; and bending means for bending the abrasive surfaces to increase the vertex angle when a blade edge of a knife is sharpened in said groove.

**[0006]** According to the knife sharpener of the present invention, when the blade edge of the knife is pressed against the groove, the sharpening strips are elastically deformed and each of the abrasive surfaces is bent into a concave shape so that the vertex angle increases. When the knife is relatively moved in the groove with the increased vertex angle, a final bevel produced in a tip end of the blade edge is so formed that both side faces thereof each have a convex shape matching the concave shape of the abrasive surfaces, which increases an angle of the final bevel.

**[0007]** The knife sharpened with the knife sharpener of the present invention in this manner enhances separability of an object to be cut and enables excellent handling thereof because both side faces of the final bevel formed in the tip end of the blade edge are each sharpened into the convex shape. Such a knife allows the final bevel to be thick, so that a nick is hard to be made in the knife, and the sharpness of the knife lasts for a long time.

**[0008]** In a preferred aspect, the bending means includes fixing member fixing the other ends of the sharpening strips, and stoppers brought into contact with the sharpening strips to limit the maximum opening width of the groove.

**[0009]** In a preferred aspect, the knife sharpener further has a case accommodating the sharpening strips and having a slot stretching in the width direction of the sharpening strips. The slot receives the blade edge of the knife movably in a direction of blade length of the knife when the blade edge is sharpened.

**[0010]** In a preferred aspect, the case is formed into a box-like shape and has a wall with the slot in shape of a straight line formed therein and inner wall surfaces serving as the stoppers.

**[0011]** In a preferred aspect, four or more the sharpening strips are alternately arranged along the width direction thereof.

**[0012]** In a preferred aspect, the knife sharpener further has an outer case that accommodates the case as an inner case such that the inner case is protrudable therefrom and serves as a holding portion during the sharpening of the knife.

**[0013]** In a preferred aspect, a plurality of said grooves are radially arranged around a rotary shaft to be rotatable integrally with the rotary shaft, and the spread portions of the sharpening strips are splayed in a radial outward direction of the rotary shaft, and the knife sharpener further has a motor for rotating the rotary shaft.

**[0014]** In a preferred aspect, the case is disposed to be rotatable integrally with the rotary shaft and formed into a cylinder-like shape. The case has a circumferential wall with the slot in a ring shape formed therein and inner wall surfaces serving as the stoppers.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0015]** The present invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings which are given by way of illustration only, and thus, are not limitative of the present invention, and wherein:

FIG. 1 is a perspective view showing a knife sharpener of a first embodiment with an outer case and an inner case thereof being partially cut away;
FIG. 2 is a plan view showing the knife sharpener of FIG. 1 with the inner case being partially cut away;
FIGS. 3A and 3B are sectional views taken along line III-III in FIG. 2, showing a state where an inner case is accommodated in the outer case and a state where the inner case protrudes from the outer case, respectively;
FIG. 4 is a developed view showing a sharpening member applied to the knife sharpener of FIG. 1;
FIGS. 5A and 5B are diagrams for explaining a function of stoppers in the knife sharpener of FIG. 1, and showing a sharpening groove with and without the stoppers, respectively;
FIG. 6 is a view showing a knife sharpened with the knife sharpener of FIG. 1, and an enlarged sectional view showing a blade edge and its vicinity in a circle;
FIG. 7 is a side view showing a knife sharpener of a modification example, partially illustrated in section;
FIG. 8 is an exploded view showing the knife sharpener of FIG. 7; and
FIG. 9 is an elevation view showing a sharpening member applied to the knife sharpener of FIG. 7 with one disc thereof.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0016]** FIG. 1 through FIGS. 3A and 3B show a knife sharpener of a first embodiment. The knife sharpener has an outer case 2. The outer case 2 is formed into a box-like shape of a rectangular parallelepiped, and yet an entire one end face and an entire one side face of the outer case 2 are open.

**[0017]** An inner case 4 is accommodated in the outer case 2 in an embedded state and is protrudable from the open side face of the outer case 2. The inner case 4 is formed by bending a band plate into the shape of the letter U and has two side wall portions 6 and one curved portion 8. The side wall portions 6 stretch parallel to each other along a longitudinal direction of the outer case 2. When the inner case 4 is accommodated in the outer case 2, one of the side wall portions 6 is so positioned as to close the open side face of the outer case 2. Base ends of the side wall portions 6 are joined together with the semicircular curved portion 8. The curved portion 8 is disposed on the other end face side of the outer case 2.

**[0018]** When the inner case 4 is accommodated in the outer case 2, tip ends of the side wall portions 6 are positioned on the open end face side of the outer case 2. At the tip ends of the side wall portions 6, there are formed projections 10 and 10 projecting toward each other. A gap formed between the projections 10 and 10 defines a slot 12. When the inner case 4 protrudes from the outer case 2, the slot 12 receives a knife to be sharpened such that the knife is movable in a direction of blade length. The blade length direction matches a width direction of the side wall portions 6, or a longitudinal direction of the slot 12.

**[0019]** Disposed in the inner case 4 is a sharpening member 14, which is formed by bending a plate material 16 shown in FIG. 4. The plate material 16 has a rectangular base portion 18 in the middle thereof, and two strip portions 20 extend from each end of the base portion 18. A gap between the strip portions 20 on each end of the base portion 18 is virtually equal to the width of the strip portion 20. The four strip portions 20 have axes parallel to each other. The strip portions 20 are formed alternately in both the ends of the base portion 18 with respect to the width direction thereof.

**[0020]** Each of the strip portions 20 has elasticity. There is formed an abrasive surface 22 in one face of each of the strip portions 20. Abrasive grains having a proper grain diameter dispersedly adhere onto the abrasive surface 22 such that surface roughness thereof conforms to for example a 300 grit whetstone, that is, a coarse grit whetstone. Although a material of the abrasive grains is not particularly limited, it is preferably diamond or titanium nitride in consideration of its high strength.

**[0021]** Referring to FIG. 1 and FIGS. 3A and 3B again, in order to make the sharpening member 14 out of the plate material 16, the plate material 16 is bent at its longitudinally middle portion.

**[0022]** To be more specific, the base portion 18 of the plate material 16 is so bent that the abrasive surfaces 22 faces outside, and is molded into a semicircle that is inscribable to the curved portion 8 of the inner case 4. Roots of the strip portions 20, which continue to the base portion 18, are bent in the same direction as a bending direction of the base portion 18 such that the strip portions 20 extending from both the ends of the base portion 18 intersect with each other as if engaged with each other.

**[0023]** The sharpening member 14 made out of the plate material 16 is accommodated in the inner case 4 in a state where the base portion 18 is inscribed to the curved portion 8 of the inner case 4. The strip portions 20 crossly extend between the side wall portions 6 of the inner case 4, and tip ends of the strip portions 20 come into contact with inner wall surfaces of the side wall portions 6 near roots of the projections 10. Since the four strip portions 20 intersect with each other as if engaged with each other, they are arranged alternately in the width direction of the side wall portions 6, or in the longitudinal direction of the slot 12, and positioned adjacently to each other.

**[0024]** In the sharpening member 14, portions (here-

inafter referred to as spread portions) included in the strip portions 20, which stretch from an intersecting point to the tip ends of the strip portions 20, form a V-shaped sharpening groove 24. The spread portions are splayed toward the slot 12, and an opening of the sharpening groove 24 is positioned near the slot 12. The sharpening groove 24 stretches along the slot 12, and the abrasive surfaces 22 form both side faces of the sharpening groove 24.

**[0025]** Since the tip ends of the strip portions 20 are in contact with inner wall surfaces of the inner case 4, the maximum width of the opening of the sharpening groove 24 is determined by distance between the inner wall surfaces and is greater than the width of the slot 12. When the sharpener is out of operation, an intersection angle (hereinafter also referred to as a preset intersection angle) between the strip portions 20 is determined by the distance between the inner wall surfaces of the inner case 4.

**[0026]** In the outer case 2, a block 26 made of resin is disposed on the other end face side thereof. The block 26 supports the inner case 4 and the sharpening member 14 such that they are turnable.

**[0027]** To be concrete, the block 26 has a columnar shape, and the bent base portion 18 of the sharpening member 14 and the bent roots of the strip portions 20 are in sliding contact with an outer circumferential surface of the block 26. As illustrated in FIG. 2, the block 26 is fastened to one side wall of the outer case 2 with a screw 28 and has a flange portion 30 in one end on the screw 28 side. The flange portion 30 is positioned between the inner case 4 and the one side wall of the outer case 2, thereby securing a space therebetween. Disposed in this space is a leaf spring 32, which presses the inner case 4 against a side wall of the outer case 2, opposite to the one side wall.

**[0028]** In FIG. 3, reference numeral 34 represents a collapsible stopper rod. The stopper rod 34 is disposed between the outer case 2 and the inner case 4. Both ends of the stopper rod 34 are hinge-jointed to the outer case 2 and the inner case 4.

**[0029]** A knife-sharpening method using the above-mentioned knife sharpener will be described below.

**[0030]** To use the knife sharpener, the inner case 4 is first rotated to protrude from the outer case 2. As illustrated in FIG. 3B, the inner case 4 is brought into an upright position such that the slot 12 is positioned on an upper side. At this point, the inner case 4 is supported by the stopper rod 34, which prevents undesired falling of the inner case 4. Subsequently, the user holds down the outer case 2 with one hand, and grasps the knife with the other. Subsequently, while pressing a blade edge of the knife against the sharpening groove 24 through the slot 12, the user moves the knife back and forth several times in the blade length direction, to thereby sharpen the blade edge.

**[0031]** When the strip portions 20 are pressed by the blade edge of the knife during the sharpening, as diagrammatically shown in FIG. 5A, the strip portions 20 are elastically deformed and bent outward into a concave shape in relation to the blade edge of the knife. In other words, due to the pressure of the knife, an intersection angle $\theta$ between the strip portions 20, which corresponds to a vertex angle of the sharpening groove, is increased beyond the preset intersection angle determined by the inner wall surfaces of the inner case 4. This is because the roots of the strip portions 20 are fixed in the inner case 4, and moreover the tip ends of the strip portions 20 are in contact with the inner wall surfaces of the inner case 4.

**[0032]** If the blade edge is moved in the sharpening groove 24 in the state where the intersection angle $\theta$ is beyond the preset intersection angle as described, a final bevel having convex side faces is formed in the blade edge correspondingly to the bending of the strip portions 20, and the convex faces have a virtually involute shape. FIG. 5B diagrammatically shows the deformation of the strip portions 20 when the knife is pressed against the sharpening groove 24 on the assumption that the tip ends of the strip portions 20 are not restrained by the inner wall surfaces of the case 4. It is apparent from FIG. 5B that if the ends of the strip portions 20 are not restrained, it is impossible to gain the final bevel having convex side faces.

**[0033]** FIG. 6 shows a knife 40 sharpened with the above-mentioned knife sharpener. As shown in a circle of the figure, a final bevel 44 is formed within an area stretching about 0.02 to 0.2 mm from a tip end of a blade edge 42 of the knife 40. In the sharpener, according to a preferred aspect, the preset intersection angle, elasticity characteristic, and the like of the strip portions 20 are so selected that an angle $\alpha$ of the blade edge 42 of the knife 40 sharpened falls in a range between about 18 and 22 degrees, and that an angle $\beta$ of the final bevel 44 between about 28 and 32 degrees.

**[0034]** In case that the knife 40 is used, since both faces of the final bevel 44 created in the blade edge 42 is formed into the convex shape, the knife is easily separated from an object to be cut and moreover cuts well at the time of the cutting, compared to a knife in which both the faces of the final bevel 44 are shaped into flat surfaces.

**[0035]** Furthermore, since the sharpening groove 24 splays beyond the preset intersection angle during the sharpening, the angle $\beta$ of the final bevel 44 is greater than the angle $\alpha$ of the blade edge 42. As a result, a nick attributable to omission of carbide grains or the like is hard to be made, and the sharpness of the knife is retained for a long period. Consequently, it is not necessary to sharpen the knife frequently.

**[0036]** The present invention is not limited to the first embodiment, and various modifications can be made. For example, the outer case 2 may be molded from resin to have such a shape that is easily held down. It is also possible to integrally form a holding portion in the inner

case 4 without providing the outer case 2.

**[0037]** In the first embodiment, the inner wall surfaces of the inner case 4 function as the stoppers that determine the maximum opening width of the sharpening groove 24 and the preset intersection angle between the strip portions 20. As stoppers, however, it is possible to provide for example pins that can contact somewhere in the spread portions of the strip portions 20 from the outside.

**[0038]** In addition, the tip ends of the strip portions 20 are in contact with the inner wall surfaces of the inner case 4 even in the unused state, and the intersection angle $\theta$ in the unused state equals the preset intersection angle. However, the preset intersection angle may be set greater than the intersection angle $\theta$ in the unused state by providing an allowance between the tip ends of the strip portions 20 and the inner wall surfaces of the inner case 4.

**[0039]** Although in the first embodiment, the sharpening member 14 has the four strip portions 20 intersecting with each other, the number of the strip portions 20 is sufficient if there are at least two or more so that the strip portions 20 may intersect with each other. It is preferable, however, that the number of the strip portions 20 be four or more in order to retain the proper elasticity characteristic in the strip portions 20 and prevent the knife from wobbling during the sharpening at the same time.

**[0040]** Additionally, although the sharpening member 14 is made of metal, a sharpening member made of resin or a vegetable fiber may be utilized. In this case, the strip portions and the abrasive surfaces may be integrally formed by molding a mixture of a resin fiber or a vegetable fiber and abrasive grains to have thickness by using a method of manufacturing paper, self welding or an adhesive agent.

**[0041]** Furthermore, it is possible to form the strip portions in which the abrasive surfaces are integrally formed by rolling a plurality of, for example, 400-mesh or 600-mesh metal nets in which abrasive grains are studded on the surfaces of wires, in a piled state to be integrated. In this case, the thickness of the gained strip portions may be adjusted by inserting released paper between the metal nets.

**[0042]** FIGS. 7 and 8 show the knife sharpener of a second embodiment. The knife sharpener has a motor 54 to which a case 50 and a sharpening member 52 are integrally and rotatably attached.

**[0043]** More specifically, the case 50 of the knife sharpener has two discs 56. The discs 56 are fixed to a rotary shaft 58 of the motor 54 and are separated away from each other. Formed in the rims of the discs 56, rim-shaped projections 60 protruding toward each other, and a gap between the projections 60 defines the width of a slot 62. The slot 62 extends in a circumferential direction of the discs 56, or the case 50, to have a ring-like shape.

**[0044]** The sharpening member 52 of the knife sharpener has a first member 64 and a second member 66 combined together as if engaged with each other, and a columnar spacer 68 interposed between centers of the first and second members 64 and 66. The first and second members 64 and 66 have equilateral octagonal base portions 64a and 66a, respectively, for sandwiching the spacer 68. Strip portions 64b and 66b radially extend from each side of the base portions 64a and 66a as shown in FIG. 9. Abrasive surfaces 64c and 66c are formed in one face of each of the strip portions 64b and 66b, respectively.

**[0045]** The width of each of the strip portions 64b and 66b corresponds to half the length of each side of the base portions 64a and 66a. Roots of the strip portions 64b and 66b are arranged on one side of each side of the base portions 64a and 66a so as to allow the strip portions 64b and 66b to intersect with each other as if engaged with each other. The roots of the strip portions 64b and 66b are so bent that the strip portions 64b and 66b intersect with each other. Tip ends of the strip portions 64b and 66b are in contact with inner wall surfaces of the discs 56 near roots of the projections 60.

**[0046]** Again in this case, spread portions of the strip portions 64b and 66b, which stretch from the intersecting points to the tip ends of the strip portions 64b and 66b, form V-shaped sharpening grooves 70. The spread portions are splayed toward the slot 62, and openings of the sharpening grooves 70 are positioned near the projections 60. The sharpening grooves 70 are disposed at regular intervals in a circumferential direction of the slot 62. The abrasive surfaces 64c and 66c of the strip portions 64b and 66b form both side faces of the sharpening grooves 70.

**[0047]** Again, since the tip ends of the strip portions 64b and 66b are in contact with inner wall surfaces of the discs 56, or inner end faces of the case 50, the maximum width of the opening of each of the sharpening grooves 70 is determined by distance between the inner wall surfaces, and is greater than the width of the slot 62. When the sharpener is not in use, the preset intersection angle between the strip portions 64b and 66b is determined by the distance between the inner wall surfaces of the case 50.

**[0048]** The discs 56, the first and second members 64 and 66, and the spacer 68 each have a fixing hole in which the rotary shaft 58 of the motor 54 is inserted such that they cannot relatively rotated.

**[0049]** Reference numeral 72 denotes a protective cover, which encloses the rotating case 50. Formed in the protective cover 72 is an opening 74 that matches an upper half peripheral portion of the slot 62.

**[0050]** In case that the knife sharpener of the above modification example is used, the blade edge of the knife is first pressed against the sharpening grooves 70 splaying upward through the opening 74 of the protective cover 72 and the slot 62. If the motor 54 is operated with the knife grasped in this state, the first and second members 64 and 66 are integrally rotation-activated together with the case 50. The rotation causes the rotation of the sharpening grooves 70, that is, relative movement between

the sharpening grooves 70 and the knife in the blade length direction, which sharpens the blade edge. Accordingly, the knife sharpener enables not only the formation of the final bevel 44 in the blade edge but also the rapid sharpening. The rotation speed of the motor 54 can be properly changed using a controller which is not shown.

**[0051]** The invention thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the spirit and scope of the invention, and all such modifications as would be obvious to one skilled in the art are intended to be included within the scope of the following claims.

## Claims

**1.** A knife sharpener comprising:

at least two sharpening strips (20) arranged to adjoin each other in a width direction thereof and intersect with each other at an intersecting point, said sharpening strips (20) each being elastically deformable and including spread portions, the spread portions stretching from the intersecting point to one ends of said sharpening strips and being splayed to form a V-shaped groove (24) having a vertex angle; and
an abrasive surface (22) formed on one surfaces of the spread portions, respectively, said abrasive surfaces (22) forming side faces of said groove (24), **characterized in that**:

said sharpener further comprises bending means for bending said abrasive surfaces (22) to increase the vertex angle when a blade edge of a knife is sharpened in the groove (24).

**2.** The knife sharpener according to claim 1, **characterized in that**:

said bending means includes:

a fixing member (18) fixing the other end of said sharpening strips (20); and
stoppers brought into contact with said sharpening strips (20) to limit maximum opening width of said groove (24).

**3.** The knife sharpener according to claim 1, **characterized in that**:

said sharpener further comprises a case (4) accommodating said sharpening strips (20) and having a slot (12) stretching in the width direction of said sharpening strips (20), the slot (12) receiving the blade edge of the knife movably in a direction of blade length of the knife when the blade edge is sharpened.

**4.** The knife sharpener according to claim 3, **characterized in that**:

said case (4) is formed into a box-like shape and has a wall with the slot (12) in shape of a straight line formed therein and inner wall surfaces (6) serving as the stoppers.

**5.** The knife sharpener according to claim 1, **characterized in that**:

four or more said sharpening strips (20) are alternately arranged along the width direction thereof.

**6.** The knife sharpener according to claim 1, **characterized in that**:

said sharpener further comprises an outer case (2) accommodating said case (4) such that said case (4) is protrudable therefrom and serving as a holding portion when the blade edge of the knife is sharpened.

**7.** The knife sharpener according to claim 3, **characterized in that**:

a plurality of said grooves (70) are radially arranged around a rotary shaft (58) to be rotatable integrally with the rotary shaft (58), and the spread portions of said sharpening strips (64b, 66b) are splayed in a radial outward direction of the rotary shaft (58); and
said sharpener further comprises a motor (54) for rotating the rotary shaft (58).

**8.** The knife sharpener according to claim 7, **characterized in that**:

said case (50) is disposed to be rotatable integrally with the rotary shaft (58) and is formed into a cylinder-like shape, said case having a circumferential wall with the slot (62) in a ring shape formed therein and inner wall surfaces (56) serving as the stoppers.

FIG. 1

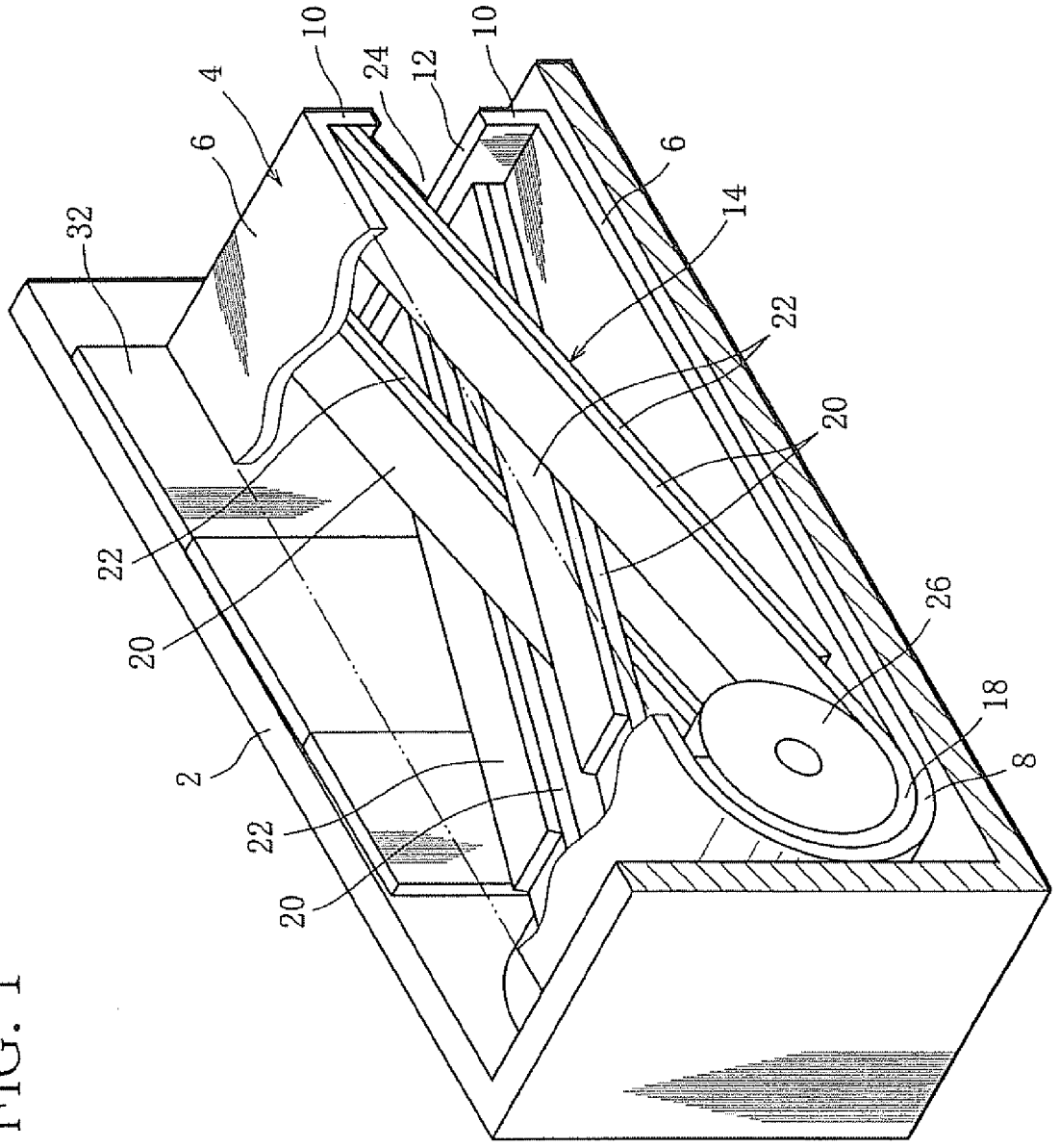


FIG. 2

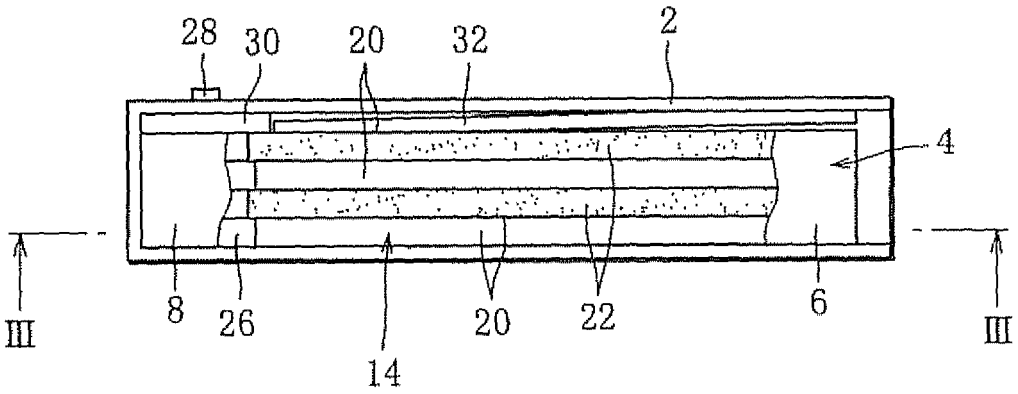


FIG. 3A

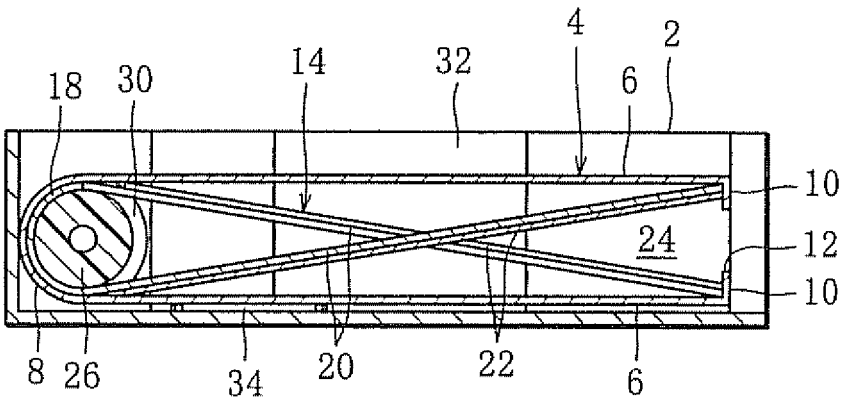

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FIG. 3B

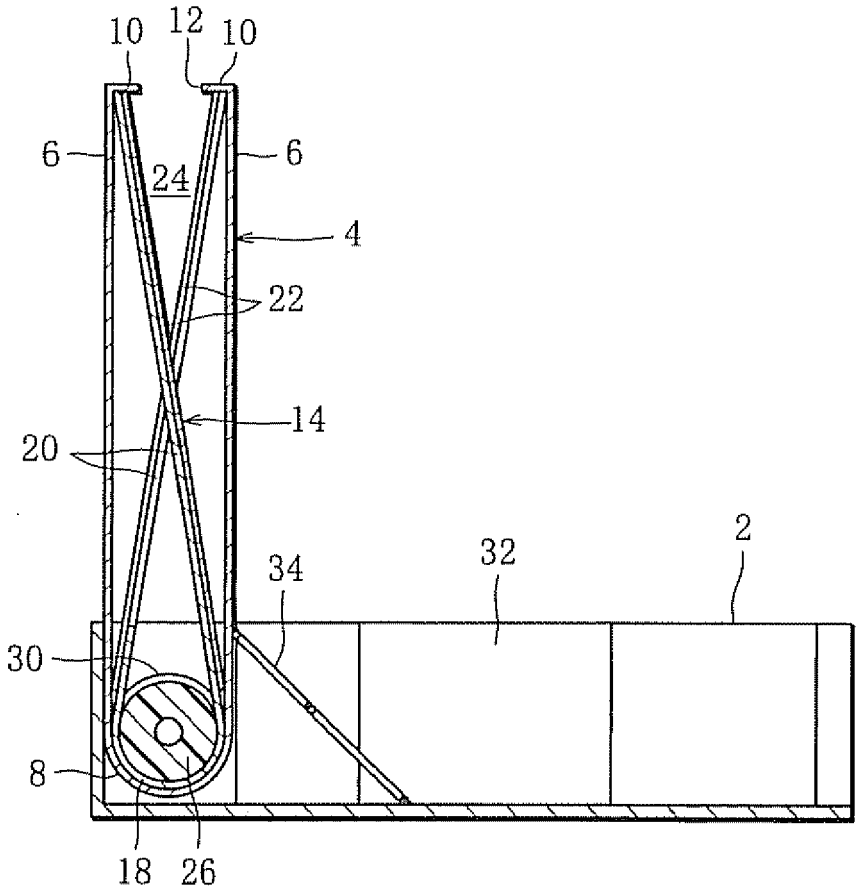
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FIG. 4

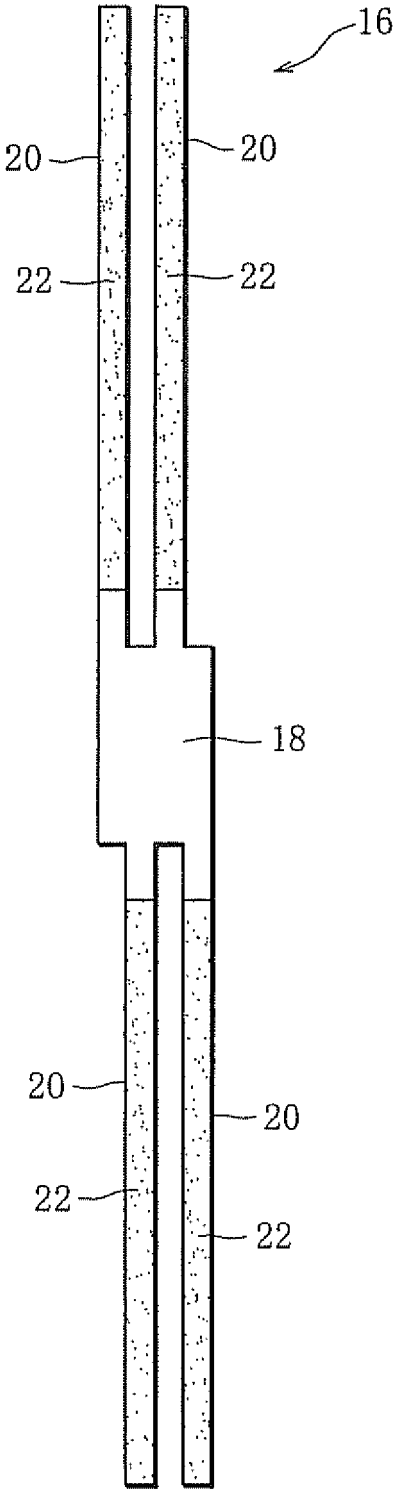


FIG. 5A

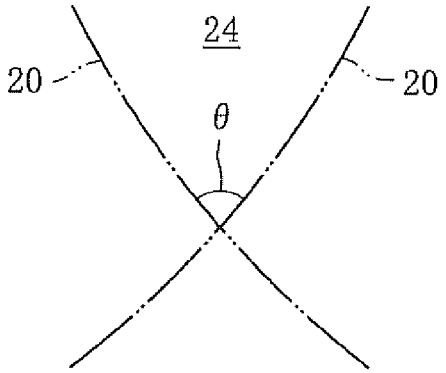



FIG. 5B

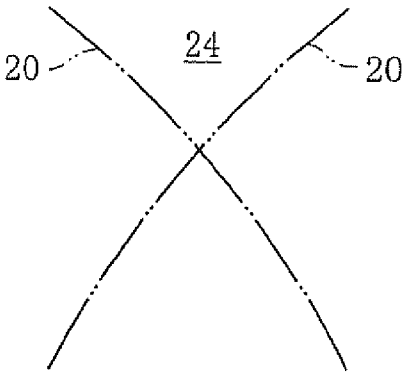
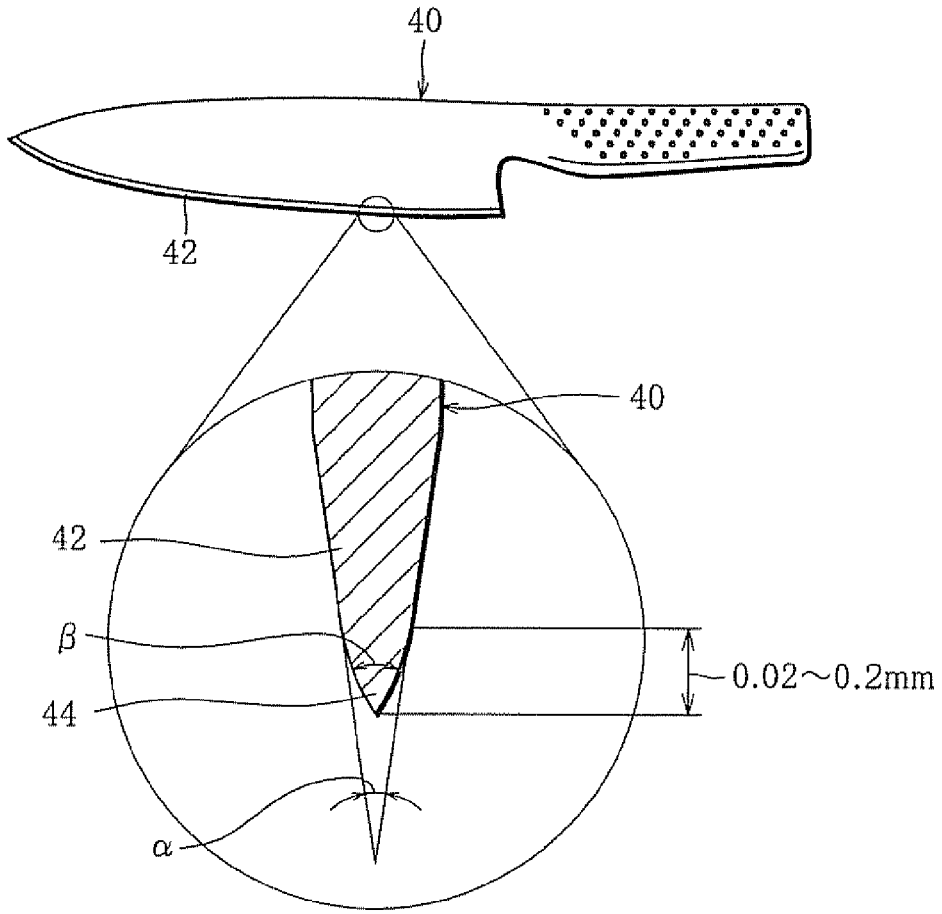



FIG. 6



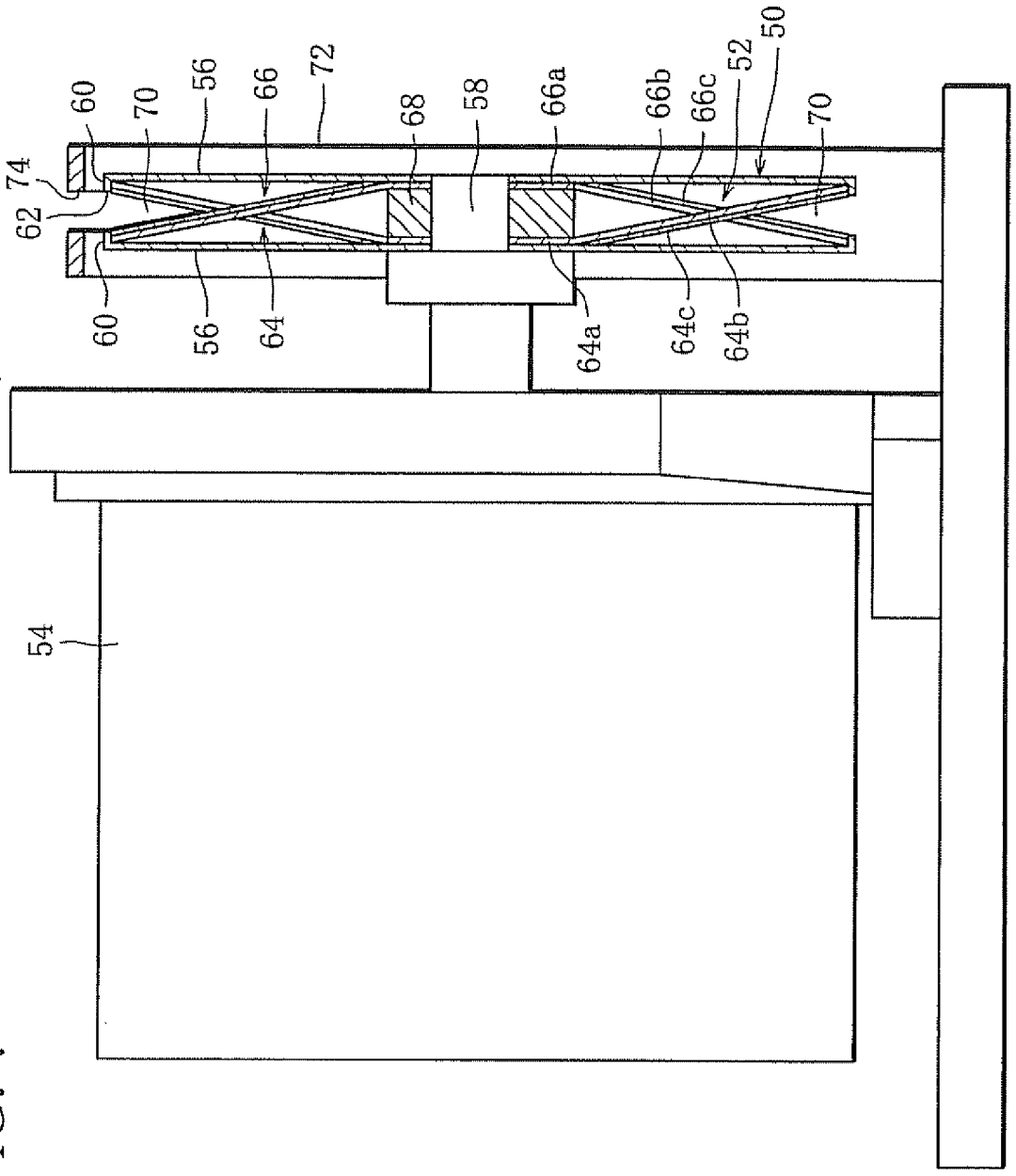



FIG. 7

FIG. 8

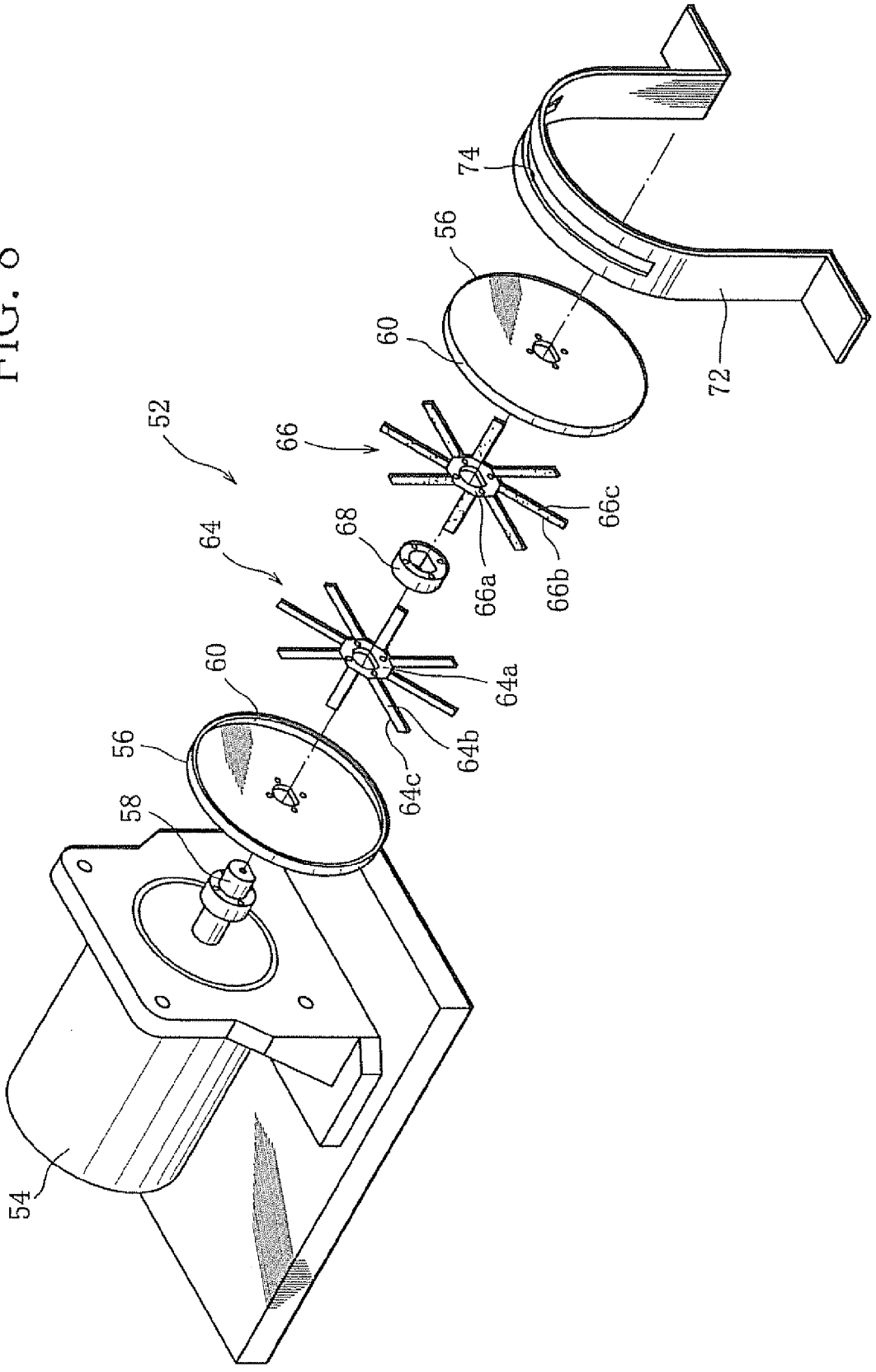
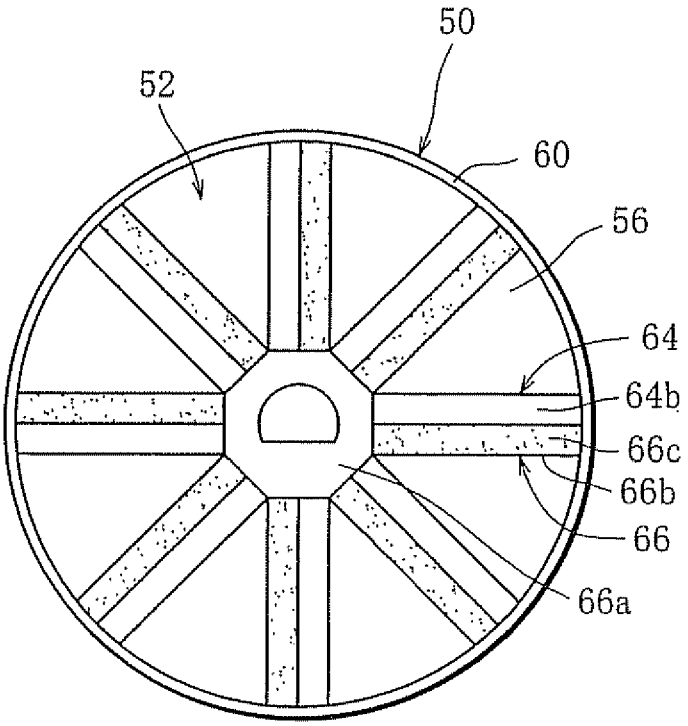


FIG. 9



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Application Number
EP 05 10 9140

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