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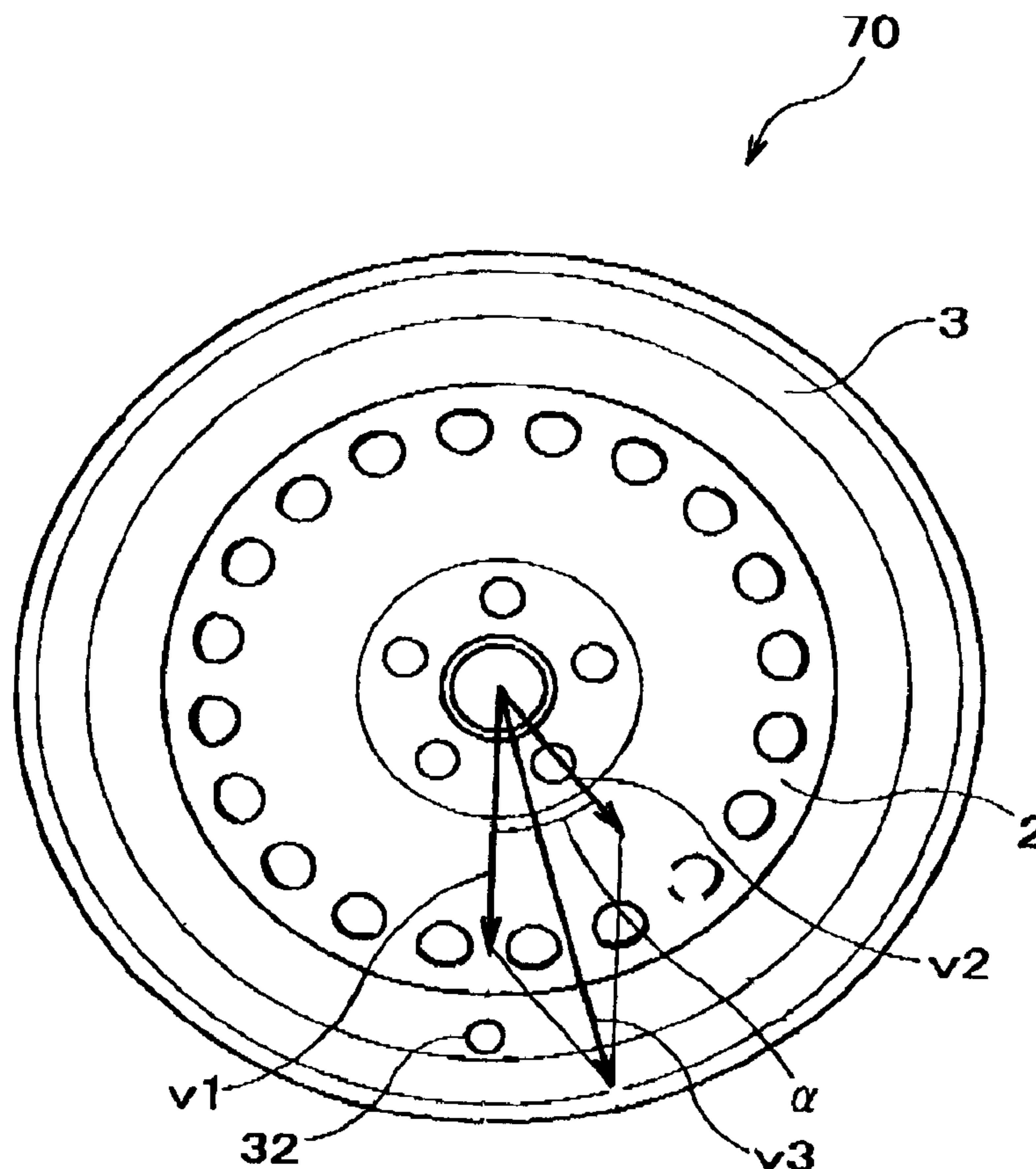
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(54) Title: BALANCE ADJUSTED WHEEL



(57) Abrégé/Abstract:

There is provided a wheel having a disk which is formed by dividing a rolled plate lengthways and crossways into a plurality of portions and using such a portion as the disk, the disk having a thick part at an edge thereof, and the wheel having a rim provided

(57) **Abrégé(suite)/Abstract(continued):**

with an air valve insertion hole, the disk and the rim being fixed together with the air valve insertion hole is at a location such that a radial direction defined from the center of the wheel to the air valve insertion hole is at a predetermined angle relative to a radial direction defined from the center of the wheel to the thick part of the disk. Balance of the wheel is adjusted so that unbalance may be produced in the desired direction by setting the air valve insertion hole, into which the air valve is attached, at a suitable location.

ABSTRACT OF THE DISCLOSURE

There is provided a wheel having a disk which is formed by dividing a rolled plate lengthways and crossways into a plurality of portions and using such a portion as the
5 disk, the disk having a thick part at an edge thereof, and the wheel having a rim provided with an air valve insertion hole, the disk and the rim being fixed together with the air valve insertion hole is at a location such that a radial direction defined from the center of the wheel to the air valve insertion hole is at a predetermined angle relative to a radial direction defined from the center of the wheel to the thick part of the disk.

10 Balance of the wheel is adjusted so that unbalance may be produced in the desired direction by setting the air valve insertion hole, into which the air valve is attached, at a suitable location.

BALANCE ADJUSTED WHEEL

FIELD OF THE INVENTION

The present invention relates to a static balance-adjusted wheel for a vehicle and the
5 like, a method for manufacturing a static balance adjusted wheel, and a method for adjusting
the balance of a wheel.

BACKGROUND OF THE INVENTION

In the case of wheels (tire/wheel assembly) for vehicles and the like, balance in the
10 circumferential direction of the rotation axis and in the direction of the rotation axis must be
adjusted when the tire and wheel are in the assembled condition.

The condition in which balance in the circumferential direction of the rotation axis is
not adjusted is called static unbalance, which causes vibration of the vehicle body in the
vertical direction. The condition in which balance in the direction of the rotation axis is not
15 adjusted is called dynamic unbalance, which causes vibration of the vehicle body in the
vertical and lateral directions as well as steering shimmy.

Methods for adjusting the balance of the tire/wheel assembly are known. In a
conventional method, a wheel and a tire are assembled by matching the direction of the radial
force variation (RFV), which is a part with high strength in the radial direction of a tire, with
20 the direction of the low point, which is the location with smallest diameter in the peripheral
direction of the wheel. Since the lightest point, which is the lightest direction in the
peripheral direction of a tire, does not agree with the heaviest point, which is the heaviest
direction in the peripheral direction of a wheel, further balance weights must be attached to
the wheel onto which a tire is assembled in order to balance the tire/wheel assembly.

25 For determining a location to which the balance weight is to be attached, the direction
and amount of the unbalance of the tire/wheel assembly is measured using an unbalance-
measuring instrument. Depending on the measurement result, the balance weight, which will
match with an unbalanced direction and an unbalanced amount of the assembled tire/wheel
assembly, is chosen, and it is attached to the periphery of the wheel face. Then, the balance
30 of a the tire/wheel assembly is adjusted by repeating the positioning of the balance weight

and measurement of the unbalanced amount of a the tire/wheel assembly until the unbalanced amount of the tire/wheel assembly is below a predetermined value.

For this balance adjusting operation, many processes and complicated steps are needed. Furthermore, when the balance weight is attached to the outer surface of the wheel, the appearance of the wheel is spoiled. Therefore, it is desirable that the size of the balance weight be as small as possible, and it is most desirable that the balance of the tire/wheel assembly be adjusted without attaching the balance weight, and it is further desirable that the location to which a balance weight is attached may be determined without measuring balance even if the balance weight must be attached.

With the wheel, since the heaviest point of the wheel tends to accord with the direction of the air valve, when assembling the tire onto the wheel, the location where the balance weight is attached may be determined by considering the location of the air valve as a marker. With conventional wheels, however, the heaviest point does not necessarily accord with the located direction of an air valve. The location of the air valve thus cannot be used as marker showing the heaviest point.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a balance adjusted wheel, and/or to improve the appearance of a wheel, and/or to improve the assembly efficiency of a wheel and a tire.

The peak of thickness, which exists near the center in the width direction of a rolled plate, has been recognized by the inventors as a feature which can be used in order to overcome the above-described problems. Control of the balance of a wheel can be achieved by combining the deviation of the balance of the disk caused by the variation in the thickness of the rolled plate with the deviation of the balance caused by the weight of the air valve.

According to one aspect of the present invention, there is provided a wheel having a disk which is formed by dividing a rolled plate lengthways and crossways into a plurality of portions and using such portions as the disk, the disk having a thick part at an edge thereof, and the wheel having a rim provided with an air valve insertion hole, the disk and the rim being fixed together with the air valve insertion hole is at a location such that a radial direction defined from the center of the wheel to the air valve insertion hole is at a

predetermined angle relative to a radial direction defined from the center of the wheel to the thick part of the disk.

With this aspect of the invention, when the unbalance caused by the thick part and the unbalance caused by the air valve are expressed with vectors from the center of the wheel, respectively, the heaviest point of the wheel will be located in the direction which compounds those vectors. Balance of the wheel thus can be adjusted so that unbalance may be produced at the desired direction by setting the air valve insertion hole, into which the air valve is attached, at a suitable location.

Viewed another way, the air valve insertion hole may be located at a position relative to the disk selected based on the position of the thick part of the disk.

Since the wheel in which unbalance has been produced towards a desired direction may be obtained, plural wheels from which unbalanced direction differs can be manufactured. Therefore, when the tire is assembled with the wheel, a wheel may be selected which has the same angle between the low point direction and the heaviest direction viewed from the center of the wheel as the angle between the RFV direction and the lightest point direction viewed from the center of the tire, so that unbalance of the tire/wheel assembly is offset by the heaviest point and lightest point. The balance of tire/wheel assembly thus will be adjusted with minimum effort.

According to another aspect of the present invention, there is provided a wheel having a disk which is formed by dividing a rolled plate lengthways and crossways into a plurality of portions and using such portions as the disk, the disk having a thick part at an edge thereof, and the wheel having a rim provided with an air valve insertion hole, wherein the disk and the rim are fixed together so that the thick part of the disk is aligned with respect to the air valve insertion hole.

With this aspect of the present invention, since the thick part, which tends to become the heaviest point, is aligned with respect to the air valve, the air valve indicates the heaviest point. The assembling operation of the tire/wheel assembly thus can be adjusted with ease by using the location of the air valve as a marker showing the heaviest point.

According to a manufacturing method of the present invention, there is provided a method for manufacturing a wheel in which a rolled plate is used, the method comprising the steps of: forming a disk from a divided portion which is obtained by dividing the rolled plate

lengthways and crossways, the divided portion having a thick part at an edge thereof whereby the disk has said thick part at a side edge; and engaging the disk to a rim provided with an air valve insertion hole with the latter being at a location such that a radial direction from the center of the wheel to the air valve insertion hole is at a predetermined angle relative to a radial direction from the center of the wheel to the thick part of the disk.

With the present assembling method, when the unbalance caused by the thick part and the unbalance caused by the air valve are expressed with a vector which is extended from the center of the wheel, respectively, a wheel in which the heaviest point thereof is positioned in the direction of a vector obtained by combining the thick part and air valve vectors can be manufactured. Therefore, the wheel having the desired balance can be manufactured by determining the predetermined angle between the radial direction from the center of the wheel to the air valve insertion hole and the radial direction from the center of the wheel to the thick part of the disk.

According to another manufacturing method of the present invention, there is provided a method for manufacturing a wheel in which a rolled plate is used, the method comprising the steps of: forming a disk from a divided portion which is obtained by dividing the rolled plate lengthways and crossways, the divided portion having a thick part at an edge thereof whereby the disk has said thick part at a side edge; and engaging the disk to a rim provided with an air valve insertion hole, wherein the disk is engaged to the rim so that the thick part of the disk is aligned with respect to the air valve insertion hole.

With this method, since the air valve is aligned with the thick part of the disk, which is the heavy part of the disk, a wheel in which the location of the air valve indicates the heaviest point can be manufactured.

According to the a further aspect, the invention provides a method for balancing a wheel which is formed by fixing together a rim and a disk obtained by dividing a rolled plate lengthways and crossways into a plurality of portions, such portions having a thick part at an edge thereof whereby said disk of the wheel has said thick part at said edge, and the rim having an air valve insertion hole, the method comprising fixing together the rim and the disk in a relative position in which a radial direction from the center of the rim to the air valve insertion hole is at a predetermined angle relative to a radial direction from the center of the disk to the thick part of the disk.

With the present wheel balancing method, since the air valve can be provided in a radial direction, from the center of the rim, which is shifted by the predetermined angle with respect to the thick part radial direction, from the center of the disk, the heaviest point of the wheel will be positioned in the direction of a vector obtained by combining the "unbalance", i.e. those respectively extending from the center of the rim toward the air valve and extending from the center of the disk toward the thick part.

It is to be noted, joining may be performed by any method by which the rim and the disk can be joined without damaging the function of the wheel, and various known methods, for example, welding, brazing, bolting, adhesion by adhesive agent, etc., may be used.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 A is an illustrating view explaining the blanking of the wheel from a rolled steel plate;

FIG. 1 B is a sectional view taking along line X-X of FIG. 1 A;

FIG. 2A shows a raw rolled steel plate divided into several rolls;

FIG. 2B shows a blank having a practically square shape obtained by cutting the rolled steel plate roll according to the size of the raw material of the disk;

FIG. 3 is a plane view showing the configuration of the disk raw material obtained by punching and cutting the blank;

FIG. 4 is an exploded perspective view of a wheel according to the present invention; and

FIG. 5 is a front view of the wheel according to a second embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

The wheel according to the preferred embodiment of the present invention will be explained by referring to FIG. 4. FIG. 4 is an exploded perspective view of a wheel according to the present invention.

As shown in FIG. 4, a wheel 1 is composed of a disk 2, which is bolted onto an un-illustrated axle shaft and receives the driving force of the axle shaft, and a rim 3, onto the outer circumference of which a tire is fitted and the inner diameter part of which is welded and bonded to the disk 2.

The disk 2 is made by drawing a rolled steel plate into a cup-like shape, and on the cup-like disk surface 2a there are provided bolt insertion holes 21, through which bolts are inserted when fixing the disk 2 to the axle shaft, ventilation holes 22, for cooling the brake that is positioned inside the wheel, and a center hole 23, for aligning the center of the wheel.

5 A wall surface part 2b of the cup-like shaped disk 2 has a corrugated-shape (convexo-concave shape) at an edge thereof. This is because a corrugated-shape is formed on the cutting surface of the rolled steel plate when the rolled steel plate is divided into a plurality of portions, and is because this corrugated-shape is remaining after forming the cup-like shaped disk 2. The protruding parts among the edge parts of the wall surface part 2b are weld parts
10 24, which are welded to the rim 3. Since the disk 2 is made of a rolled steel plate, the disk 2 has a thick portion having a large thickness and a thin portion having a small thickness. The thick portion having a large thickness is called a thick part, and it is comparatively heavy. On the other hand, the thin portion having a small thickness is called a thin part, and it is comparatively light. As far as the disk 2 is connected, therefore, the unbalance of weight has
15 arisen by the existence of the thin part and thick part. The difference in the thickness between the thick part and thin part is about 30-50 micrometers when the rolled steel plate used as the wheel of the a vehicle has 2.6 - 3.2 mm thickness. With the wheel 1 of FIG. 4, a notch 25 is provided in the thinnest part along the edge of the wall-surface part 2b as a marker of the thin part.

20 The rim 3 has a substantially cylindrical shape and the outer circumferential surface thereof is arranged so that a tire can be mounted thereto. A rim flanges 31 is provided on both side edges of the rim 3 for preventing the mounted tire from falling off. An air valve insertion hole 32, into which the air valve for putting air into the tire is inserted, is provided on the rim flange 31 located in an outside in a width direction of the vehicle. With the rim 3,
25 the products variation is small and the static unbalance amount of the rim 3 is low in spite of large weight thereof. The weight of the side of the air valve insertion hole 32, however, tends to become heavier after assembling the tire/wheel assembly. This is because the air valve is inserted into the air valve insertion hole 32. The wheel 1 is formed by welding the weld parts 24 of the disk 2 to the inside periphery of the rim 3 after fitting the disk 2 into the hole of the
30 rim 3.

The method for manufacturing the wheel according to the preferred embodiment of the present invention will be explained. FIG. 1A is an illustrating view explaining the blanking of the wheels from the rolled steel plate. FIG. 1 B is a sectional view taking along line X-X of FIG. 1 A. With the wheel 1 of the present invention, since rolled plates, such as a rolled steel plate, are used as the raw material of the disk 2, the wheel 1 is manufactured while utilizing the property of the rolled plate efficiently. In this embodiment, any known type of rim may be used for the rim 3 as long as it can be fitted and bonded to the disk 2.

As shown in FIG. 1 A, since the width of a raw rolled steel plate 50 is substantially larger than the disk diameter of the wheel 1, two raw disk materials are generally obtained from the width direction of the raw rolled steel plate 50 by blanking. As shown in FIG. 1 B, however, since both ends in a width direction of the rolled steel plate tends to be lengthened at the time of rolling, the thickness of the rolled steel plate, near the center in a width direction of the raw rolled steel plate 50 is thick, and near the edge is thin.

When two raw disk materials are blanked from the raw rolled steel plate in the manner shown in FIG. 1A, the thickness of one side, located near the center of the raw rolled steel plate is thick and the thickness of the other side located near the edge in a width direction of the raw rolled steel plate is thin. The unbalance of weight thus arises by these variations in thickness. This unbalance has been ignored until now, because it has been thought that there was very little unbalance in the wheel and that the adjustment of the balance of wheel must be done after a wheel is assembled with a tire.

FIG. 2 shows a production process of a wheel according to the present invention. As shown in FIG 2 A, the raw rolled steel plate 50 is divided into several rolls, for example such as rolled steel plate rolls 51 and 51, depending on the size of the disk to be blanked as a raw material.

As shown in FIG. 2B, the blank 52 having practically square shape is obtained by cutting the rolled steel plate roll 51 according to the size of the raw material of the disk 2. FIG. 3 is a plan view showing the configuration of a disk raw material 53 obtained by punching and cutting the blank 52. In this FIG. 3, the transverse direction is the rolling direction of the rolled steel plate, and the upper part of this figure is a thin part in which the thickness of a rolled steel plate is thin, and the lower part of this figure is a thick part in which the thickness of the rolled steel plate is thick.

The disk raw material 53 is obtained by performing the following process. First, four corners of the blank 52 having the square shape are cut off in practically arcuate shape. Next, the blank 52 is punched so that the bolt insertion holes 21, the ventilation holes 22, and the center hole 23 are formed on the blank 52. Then, a notching 25 which is a mark showing the thin part is formed at the thin part side of the blank 52. The disk raw material 53 is thus obtained. The disk 2 shown in FIG. 4 is formed by drawing the raw disk material 53 into a cup-like configuration. Formation of the bolt insertion holes 21, the ventilation holes 22, and the center hole 23 may be performed after drawing the disk raw material 53 into the cup-like configuration. In an alternative method, the notching 25 used as the mark of the thin part may be formed instead at the thick part side as a marker showing the thick part.

As described above, any known type of rim may be used as the rim 3 as long as the air valve insertion hole 32 is formed on the rim flange 31, which is located in the external surface side of the vehicle.

The disk 2 is fitted and bonded to the rim 3 by welding the weld parts 24 of the disk 2 to the inside periphery of the rim 3 after fitting the disk 2 into the inside periphery of the rim 3. In this case, the disk 2 is engaged into the rim 3 in the condition that the position of the notching 25, viewed from the center of the disk 2, is opposed by 180 degrees to the position of the air valve insertion hole 32, so that the thick part and the air valve are positioned in the same place.

The wheel 1 can thus be manufactured in the above-described manner. With this wheel 1, the direction of the air valve becomes the heaviest point in the condition when the air valve is attached to the wheel 1, because the position of the thick part of the disk 2 and the position of the air valve insertion hole 32 of rim 3 overlapped each other.

The location of the air valve is thus used as marker at the time of adjusting the balance of the tire/wheel assembly after assembling a tire with the wheel 1. Since the location of the air valve and the location of the heaviest point overlap, the location of the air valve can be used as the marker in the case of assembling. When the tire is assembled onto the wheel on in the condition that with the heaviest point of the wheel and the lightest point of the tire overlap, for making the mass of balance weight smaller, for example, the location of the air valve thus may be used as the marker.

Another embodiment of the present invention will be described below. FIG. 5 is a front view of the wheel according to another preferred embodiment of the present invention. In the following explanation, the parts that are practically the same as those described as the first preferred embodiment shall be indicated with the same symbols and detailed description thereof shall be omitted.

With a wheel 70 according to another embodiment of the invention, the rim 3 and the disk 2 are joined together without aligning the thick part of the disk 2 and the air valve insertion hole 32 of the rim 3. But, the rim 3 and the disk 2 are joined together while locating the air valve at the location where only the angle α shifted from the direction of the thick part.

With FIG. 5, vector v_1 which elongates from the center of the disk 2 to the air valve insertion hole 32 indicates the unbalance of the rim 3. Here, this vector v_1 indicates the direction of the unbalance at the time when the air valve is inserted into the air valve insertion hole 32. Vector v_2 which elongates from the center of the disk 2 to the thick part of the disk 2 indicates the unbalance of the disk 2. By the existence of these two unbalances, the unbalance, which is equivalent to the vector v_3 obtained by compounding vectors v_1 and v_2 , will be arisen as for the wheel 1 as a whole. When the disk 2 is engaged into the rim 3 so that the direction of the thick part of the disk 2 and the direction of the air valve insertion hole 32 of the rim 3 have a suitable angle, and then fix the disk 2 and the rim 3 are fixed to each other by welding, the wheel having the desired unbalance can thus be manufactured.

In this embodiment, additionally, a plurality of wheels may be manufactured and prepared by changing the angle α in, for example, 10 angle steps. In this case, firstly, the angle between the direction from the center of the tire to the RFV and the direction from the center of the tire to the lightest point of the tire is checked, about the tire to be mounted on the wheel. Next, the wheel is selected whose angle between the direction from the center of the wheel to the low point and the direction from the center of the wheel to the heaviest direction is nearly equal to the angle between the direction from the center of the tire to the RFV and the direction from the center of the tire to the lightest point of the tire. Then, the selected wheel is joined with the tire.

Consequently, the size of a balance weight to be attached to the wheel can be reduced and this enables the improvement of the appearance of the tire/wheel assembly.

The embodiments of the present invention are described above. The present invention is not restricted to the above-described embodiments. It cannot be overemphasized that design changes are possible suitably in the scope of and meaning of the invention. This invention is also not limited to the form of the above-mentioned implementation.

5 As an application of the present invention, for example, the other techniques and devices, which change the weight balance of the disk or rim, for adjusting the balance of tire/wheel assembly, may be combined with the present invention.

As described above, the following notable advantages may be obtained with at least the preferred embodiments of the present invention.

10 With one aspect of the present invention, since the wheels having the desired balance may be obtained by suitably combining the unbalance caused by the thick part of the disk with the unbalance caused by the air valve, the balance of the wheel may be adjusted by the minimum adjusting operations.

15 With another aspects of the present invention, since the direction of the air valve of the wheel serves as a heavy point, the air valve is used as the marker showing the heavy point at the time of assembling the tire onto the wheel. Then an improved efficiency of the balance weight attaching operations can be attained.

20 With an assembling method of the present invention, the wheel having the desired balance may be obtained by suitably assembling the unbalance caused by the thick part of the disk with the unbalance caused by the air valve.

With another assembling method of the present invention, since the direction of the thick part which is the heaviest direction of the disk accords with the direction of the air valve, the wheel in which the direction of the air valve surely becomes the heaviest point may be obtained.

25 With a method for adjusting the balance of wheel, balance of the wheel may be adjusted by combining the unbalance of the disk with the unbalance of the air valve attached to the rim.

What is claimed is:

1. A wheel having a disk with a graduated transverse thickness from a thick part at a first side to a thin part at a second side, the wheel including an air valve insertion hole
5 disposed at a predetermined angle location with respect to the thick part of the disk as measured from the center of the disk.
2. A wheel having a disk with a graduated transverse thickness from a thick part at a first side to a thin part at a second side, wherein the thick part of the disk measured from the
10 center of the disk and a location on the wheel of an air valve insertion hole are overlapped.
3. A method for manufacturing a wheel in which a rolled plate of varying transverse thickness is used, comprising the steps of:
15 forming a disk to provide a thick part at a first side of the disk and a thin part at a second side thereof; and
attaching the disk to a wheel rim in a condition that the thick part of the disk, as measured from the center of the disk, is disposed in a predetermined angular relation with respect to an air valve insertion hole in the wheel rim.
- 20 4. A method for manufacturing a wheel in which a rolled plate of varying thickness is used, comprising the steps of:
forming a disk to provide a thick part at a first side of the disk and a thin part at a second side thereof; and
attaching the disk to a wheel rim in a condition that the location of the thick part
25 of the disk measured from the center of the disk and a location of an air valve insertion hole are overlapped.
5. A method for adjusting the balance of a wheel having a wheel rim fixed to a disk having a graduated transverse thickness from a thick part at a first side of the disk to a thin part on a second opposite side thereof, the method including the step that:

fixing the wheel rim to the disk, an air valve insertion hole on the rim being disposed at a predetermined shifted angle from a location of the thick part of the disk as measured from the center of the disk.

6. A wheel, comprising:

5 a disk formed by drawing a plate obtained from dividing, in a rolling direction, a rolled plate of graduated transverse thickness from a thick part at a first side of the disk to a thin part on a second opposite side thereof into a plurality of plates; and

a wheel rim, having an air valve insertion hole, said disk being attached to said wheel rim so that said air valve insertion hole is disposed at a predetermined angle
10 location with respect to the thick part of said disk as measured from the center of said disk.

7. The wheel according to claim 6, wherein a notch is provided at one of: i) the thin part and ii) the thick part of said disk.

15 8. A wheel, comprising:

a disk formed by drawing a plate obtained from dividing in the rolling direction a rolled plate of varying transverse thickness from a thick part at a first side of the disk to a thin part on a second opposite side thereof; and

a wheel rim having an air valve insertion hole, said disk being attached to said
20 wheel rim so that the thick part of said disk measured from the center of said disk and a location on said wheel rim of said air valve insertion hole are overlapped.

9. The wheel according to claim 8, wherein a notch is provided at one of: i) the thin part and ii) the thick part of the disk.

25

10. The method according to claim 3, further comprising providing a notch at one of: i) the thin part and ii) the thick part of the disk.

11. The method according to claim 4, further comprising providing a notch at one of: i) the thin part and ii) the thick part of the disk.

FIG 1 A)

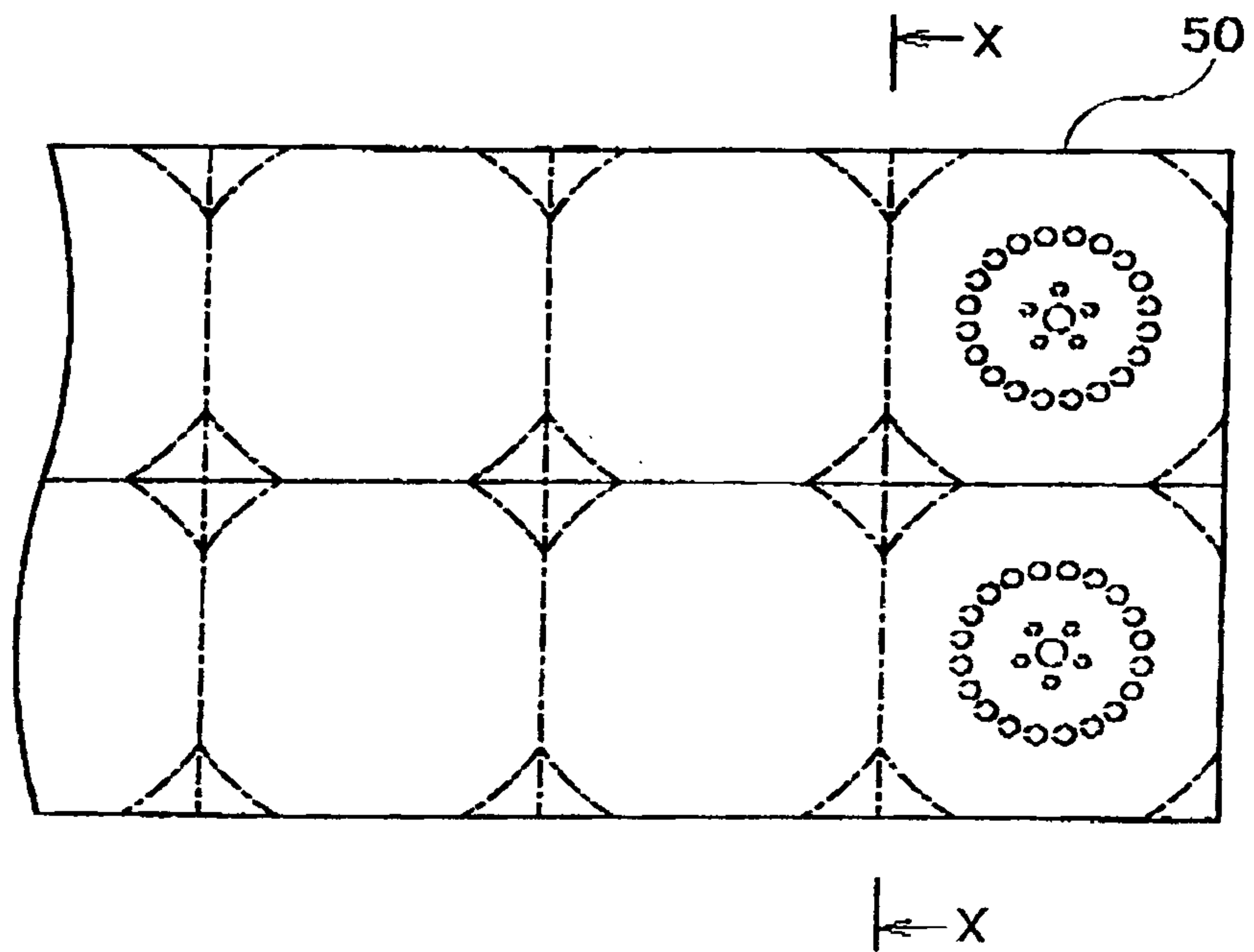


FIG 1 B)

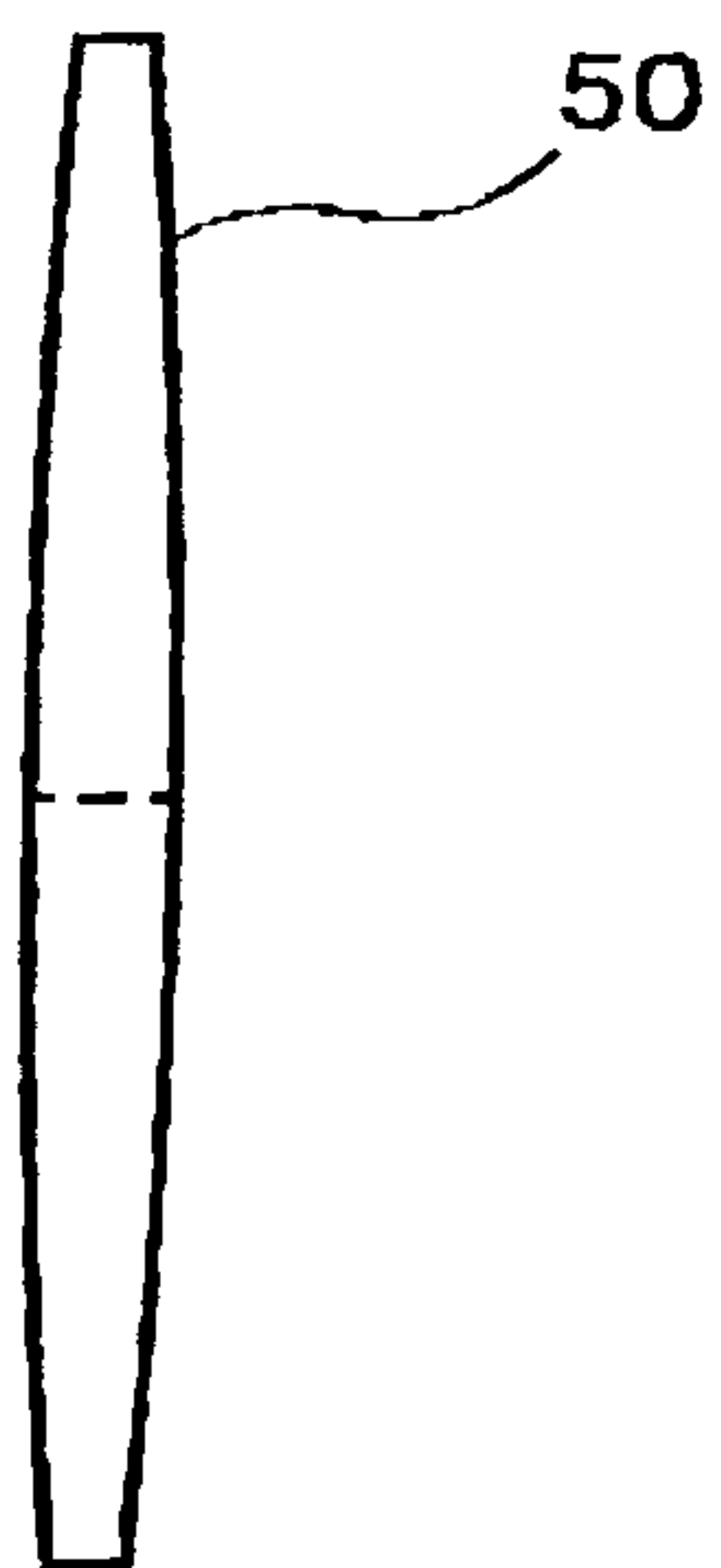


FIG 2 A)

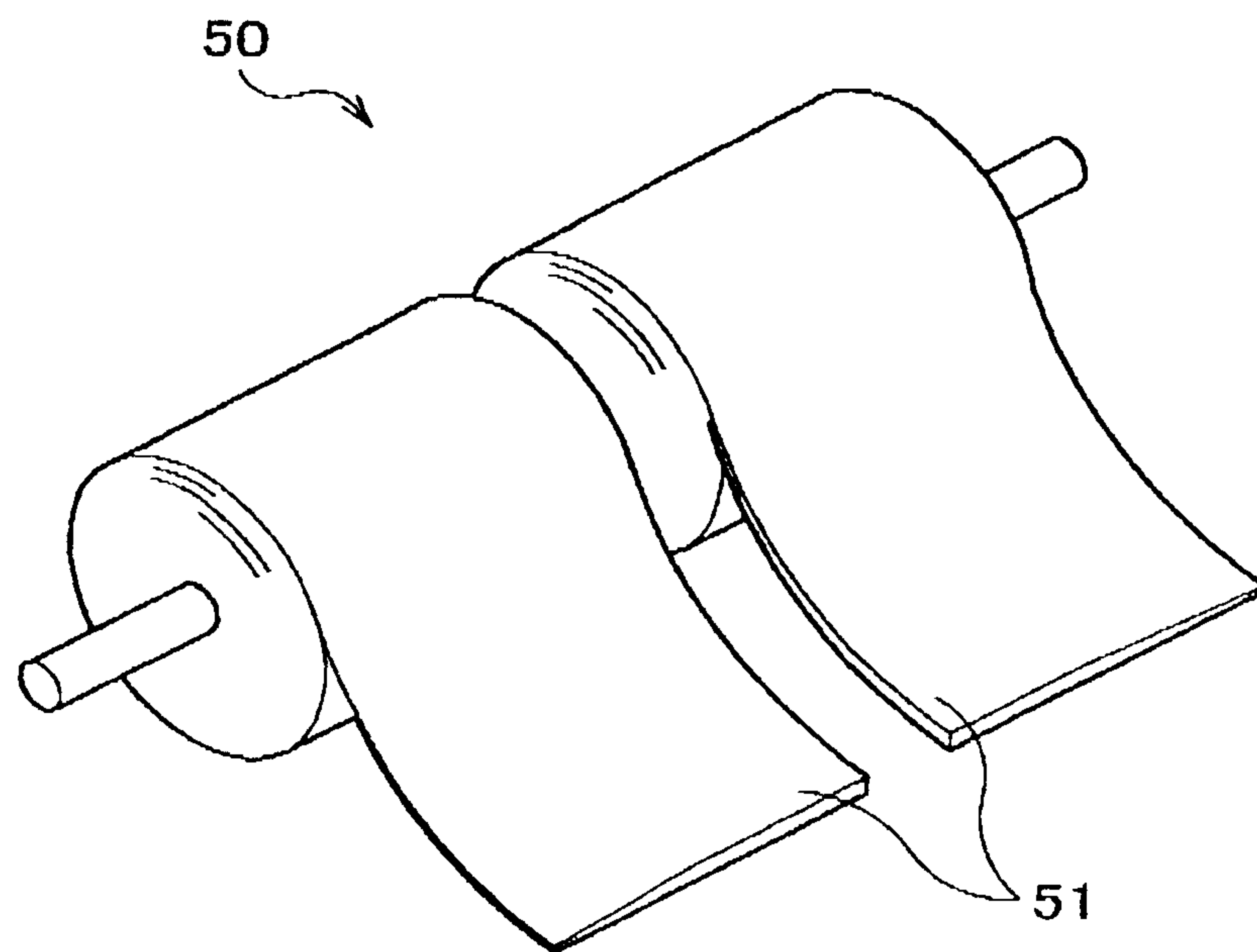


FIG 2 B)

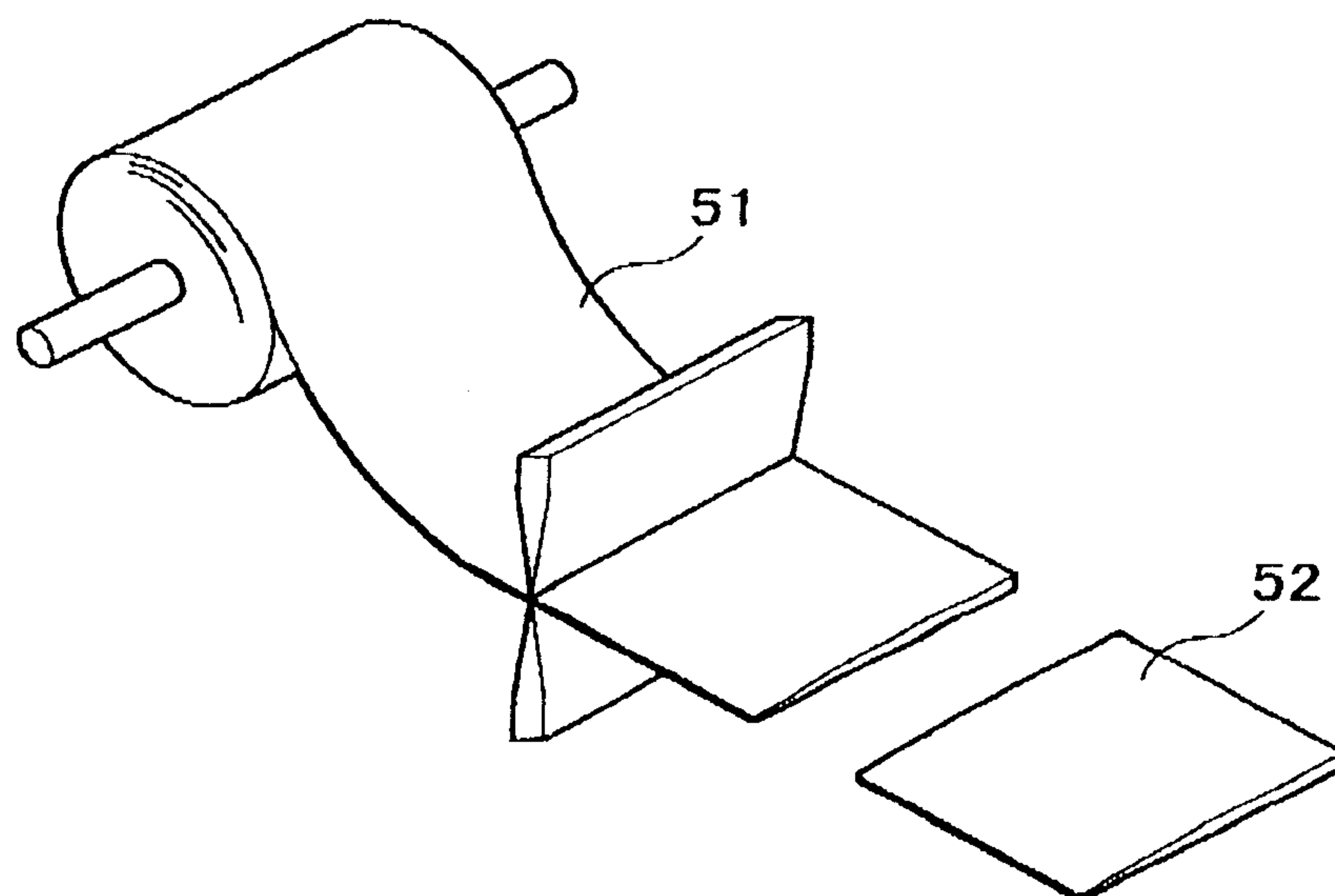


FIG. 3

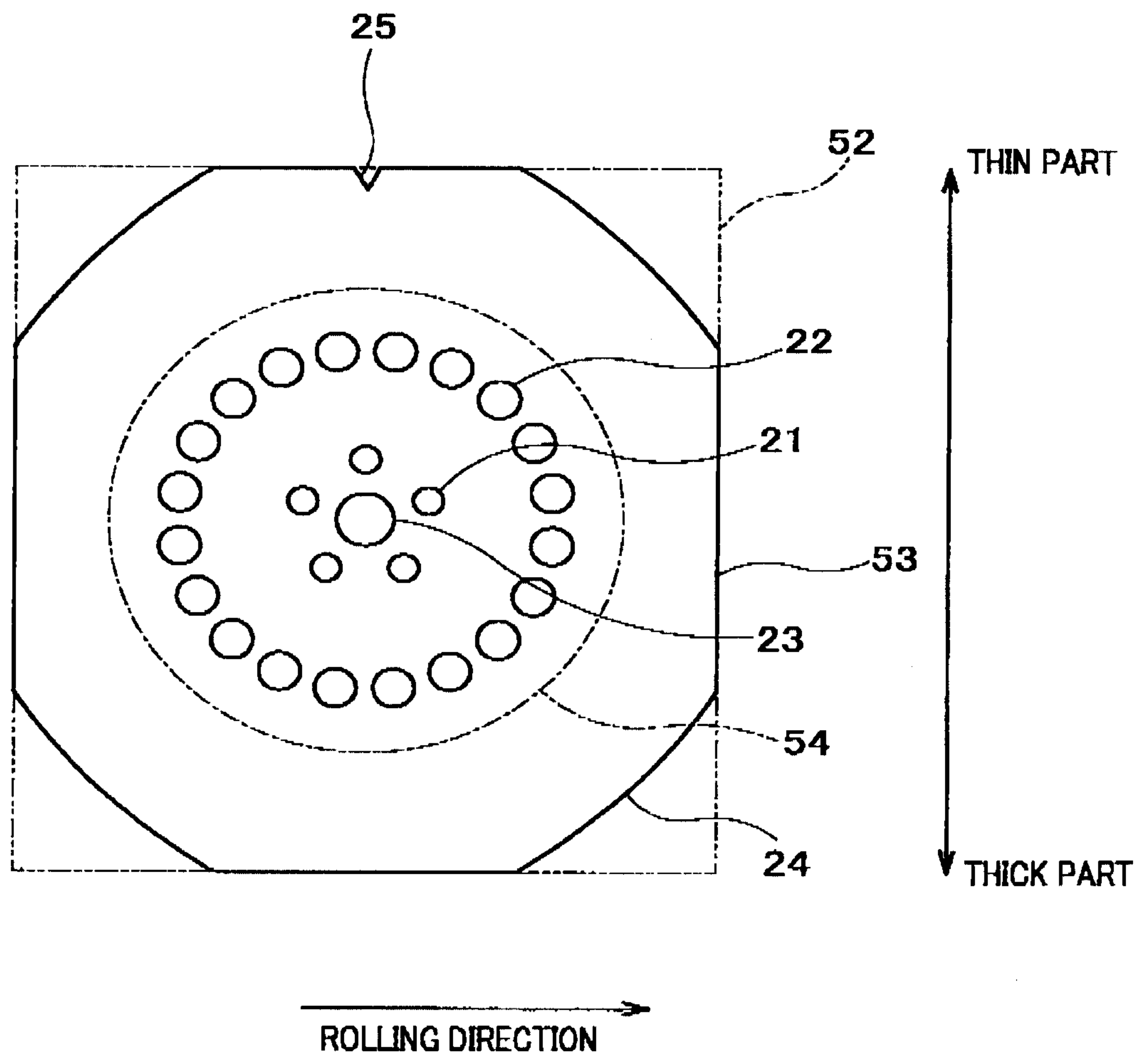


FIG.4

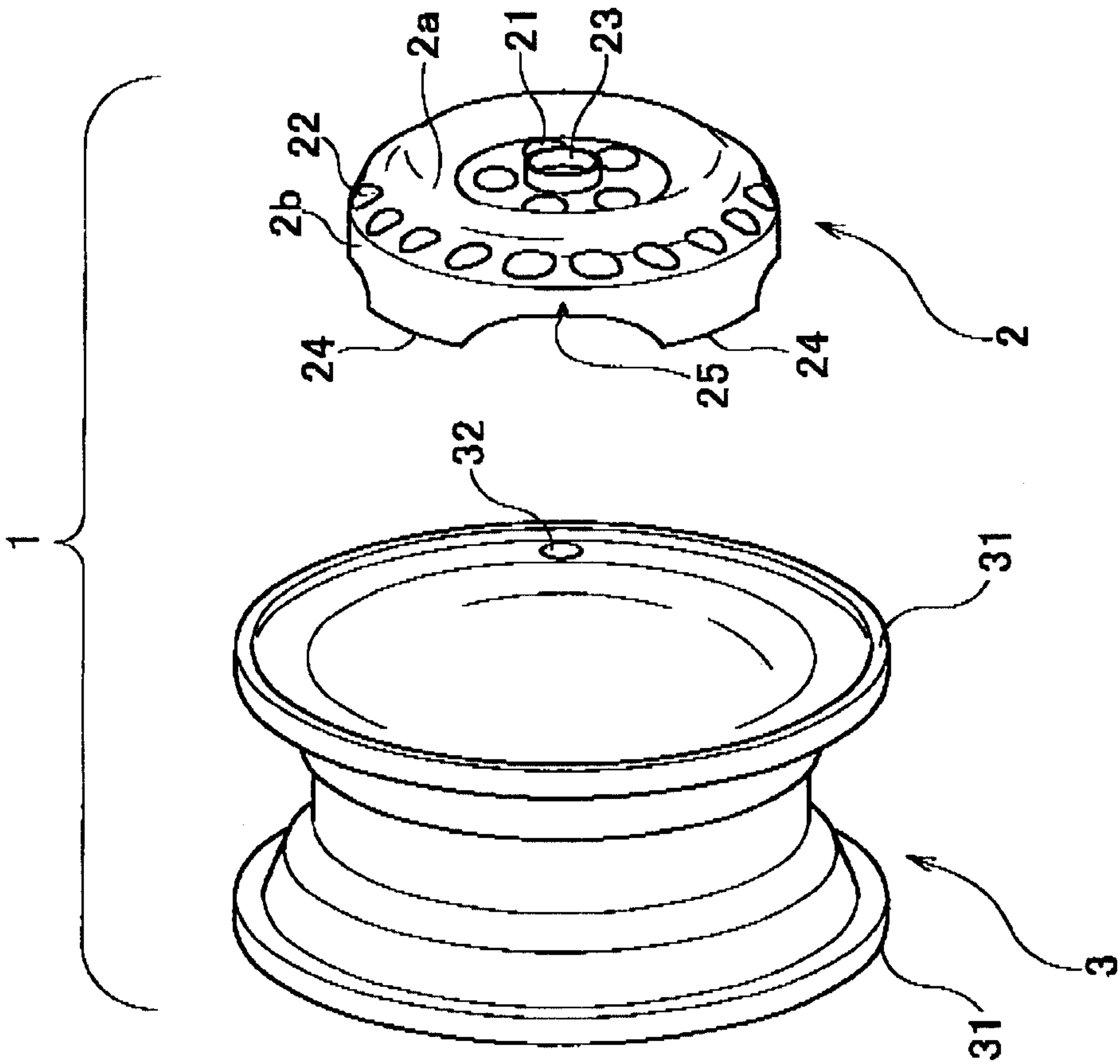


FIG. 5

