the arcuate hole 12. Although the width 12w is indicated in the central region 12c in FIG. 5, the present specification uses the width 12w to describe the widths of all the inner peripheral side portion 12i, the outer peripheral side portion 12o, and the central region 12c of the hole 12.

[0022] The blades 14 inserted and fixed in the holes 12 each include the inner peripheral side portion 14i, an outer peripheral side portion 14o, and a central region 14c as illustrated in FIG. 5. The inner peripheral side portion 14i is a part of the blade 14 disposed in a region on the inner peripheral side of the outer periphery 10o. That is, the inner peripheral side portion 14i of the blade 14 is disposed in the inner peripheral side portion 12i of the hole 12. The outer peripheral side portion 14o is a part of the blade 14 disposed in a region on the outer peripheral side of the outer periphery 10o. That is, the outer peripheral side portion 14o of the blade 14 is disposed in the outer peripheral side portion 12o of the hole 12. The central region 14c is a part of the blade 14 disposed between the inner peripheral side portion 14i and the outer peripheral side portion 14o. That is, the central region 14c of the blade 14 is disposed in the central region 12c of the hole 12. The width 12w of the hole 12 in the central region 12c is larger than the plate thickness 14w of the blade 14. Note that the width of the hole 12 is the dimension in the direction perpendicular to the direction of extension of the arcuate hole 12 and parallel to the surface of the holding plate 10.

[0023] The holding plate 10 includes a first contact portion 18i, a second contact portion 18o, and a third contact portion 18c, at which the blade 14 is supported in contact with the holding plate 10, on the inner peripheral

[0030] The first non-contact portion 20a is formed on the side facing the convex curved surface of the blade 14 in the region between the first contact portion 18i and the second contact portion 18o on the inner peripheral surface of the hole 12. The first non-contact portion 20a includes a side of the central region 12c that faces the convex curved surface of the blade 14. The first non-contact portion 20a includes a side of the inner peripheral side portion 12i that faces the convex curved surface of the blade 14 relative to the tip 12is. The first non-contact portion 20a is a region in which a gap is secured between the inner peripheral surface of the hole 12 and the blade 14. The inner peripheral surface of the hole 12 in the first non-contact portion 20a has a concave curved shape following the convex curved surface of the blade 14. The first non-contact portion 20a is formed as a result of the formation of the first contact portion 18i and the second contact portion 18o when the outer peripheral edge region 10e' is crushed toward the blade 14.

[0031] The second non-contact portion 20b is formed on the side facing the concave curved surface of the blade 14 in the region between the first contact portion 18i and the second contact portion 18o on the inner peripheral surface of the hole 12. Specifically, the second non-contact portion 20b is formed on the side facing the concave curved surface of the blade 14 in the region between the second contact portion 18o and the third contact portion 18c on the inner peripheral surface of the hole 12. The second non-contact portion 20b includes a side of the central region 12c that faces the concave curved surface of the blade 14. The second non-contact portion 20b is a region in which a gap is secured between the inner peripheral surface of the hole 12 and the blade 14. The second non-

contact portion 20b is formed as a result of the formation of the first contact portion 18i, the second contact portion 18o, and the third contact portion 18c when the outer peripheral edge region 10e' is crushed toward the blade 14.

[0032] The inner peripheral surface of the hole 12 in the second non-contact portion 20b is a region not contributing to holding of the blade 14 and thus may be of any shape as long as the gap is secured between the inner peripheral surface of the hole 12 and the blade 14. The inner peripheral surface of the hole 12 in the second non-contact portion 20b has a linear shape in the first embodiment. The inner peripheral surface of the hole 12 in the second non-contact portion 20b may have a shape close to the linear shape. The inner peripheral surface of the hole 12 having the linear shape is preferable because this facilitates machining of the hole 12' before deformed into the hole 12 and makes it easy to secure the gap between the inner peripheral surface of the hole 12 and the blade 14.

[0033] The third non-contact portion 20c is formed on the side facing the concave curved surface of the blade 14 in the region between the first contact portion 18i and the second contact portion 18o on the inner peripheral surface of the hole 12. Specifically, the third non-contact portion 20c is formed on the side facing the concave curved surface of the blade 14 in the region between the first contact portion 18i and the third contact portion 18c on the inner peripheral surface of the hole 12. The third non-contact portion 20c includes a side of the inner peripheral side portion 12i that faces the concave curved surface of the blade 14. More specifically, the third non-contact portion 20c is formed in the region of the recess 12ix on the inner peripheral surface of the hole 12. The

of the rotary shaft 16, are formed in an outer periphery 30o of the holding plate 30. That is, the outer periphery 30o is a region in which the arcuate holes 12 are formed. The holding plate 30 is in a state in which the blades 14 are fixed in the holes 12. The hole 12 has a shape similar to the shape of the blade 14 as seen from the shaft direction of the blade 14. The holding plate 30 includes the outer peripheral edge region 30e in a region on the outer peripheral side relative to the outer periphery 30o. The outer peripheral edge region 30e includes the edge of the holding plate 30. The outer peripheral edge region 30e includes the outer peripheral edge protrusions 32 at the edge of the holding plate 30.

[0057] A method of manufacturing the cross flow fan according to the second embodiment having the above configuration will be described. The method of manufacturing the cross flow fan according to the second embodiment is obtained by changing the blade fixing step S16 of the method of manufacturing the cross flow fan 100 according to the first embodiment.

[0058] In the blade fixing step according to the second embodiment, the outer peripheral edge region 30e' of the holding plate 30' in which the blades 14 are inserted in the holes 12' is crushed toward the blades 14 to deform the holding plate 30' and fix the blades 14. In the blade fixing step according to the second embodiment, the outer peripheral edge protrusions 32' are crushed toward the blades 14 inserted in the holes 12' to be deformed such that the outer peripheral edge protrusions 32' protrude toward the holes 12'. In the blade fixing step according to the second embodiment, the outer peripheral edge protrusions 32' are deformed into the outer peripheral edge protrusions 32. In the blade fixing step according to the

second embodiment, the outer peripheral edge region 30e' is deformed into the outer peripheral edge region 30e. In the blade fixing step according to the second embodiment, the holding plate 30' is deformed into the holding plate 30.

[0059] As described above, in the cross flow fan according to the second embodiment, the outer peripheral edge region 30e is formed in the holding plate 30 and the outer peripheral edge region 30e includes the outer peripheral edge protrusions 32 at the edge of the holding plate 30. Accordingly, the cross flow fan according to the second embodiment firmly fixes the outer peripheral side portion 14o of the blade 14 at the outer peripheral side portion 12o of the hole 12. That is, the cross flow fan according to the second embodiment holds the blades 14 with a stronger force by the holding plate 30. As a result, the cross flow fan according to the second embodiment further reduces motion of the blades 14 in the holes 12 of the holding plate 30 such as vibration of the blades 14 in the holes 12 of the holding plate 30, when the blades 14 are rotated around the rotary shaft 16. Moreover, the cross flow fan according to the second embodiment can better maintain the air blowing performance when the blades 14 are rotated around the rotary shaft 16.

[0060] Third Embodiment.

FIG. 10 is a front view of part of a holding plate 40' used in a cross flow fan according to a third embodiment, as viewed from the direction along the rotary shaft 16. FIG. 11 is a front view of a holding plate 40 of the cross flow fan according to the third embodiment, as viewed from the direction along the rotary shaft 16. Note that in FIGS. 10 and 11, reference numerals are assigned only to some parts and not assigned to the other parts. The cross flow fan according to the third embodiment is obtained by

deformed into the holding plate 40.

[0066] As described above, the holding plate 40 of the cross flow fan according to the third embodiment is provided with the outer peripheral holes 42 each in the region of the outer periphery 40o on the side facing the concave curved surface of the blade 14 relative to the outer peripheral side portion 12o of the hole 12. Accordingly, the cross flow fan according to the third embodiment firmly fixes the outer peripheral side portion 14o of the blade 14 at the outer peripheral side portion 12o of the hole 12. That is, the cross flow fan according to the third embodiment holds the blades 14 with a stronger force by the holding plate 40. As a result, the cross flow fan according to the third embodiment further reduces motion of the blades 14 in the holes 12 of the holding plate 40 such as vibration of the blades 14 in the holes 12 of the holding plate 40, when the blades 14 are rotated around the rotary shaft 16. Moreover, the cross flow fan according to the third embodiment can better maintain the air blowing performance when the blades 14 are rotated around the rotary shaft 16.

[0067] Fourth Embodiment.

FIG. 12 is a view illustrating an example of the shape of an end in the direction along the rotary shaft 16 of a blade 54 used in a cross flow fan according to a fourth embodiment. The cross flow fan according to the fourth embodiment is obtained by changing the blades 14 of the cross flow fan 100 according to the first embodiment to the blades 54. In the cross flow fan according to the fourth embodiment, configurations similar to those of the first embodiment are assigned a group of reference numerals identical to those of the first embodiment and thus will not be described in detail.

[0068] An inner peripheral side portion 54i and an outer

peripheral side portion 54o of the blade 54 are chamfered at an end of the blade 54 in the direction of extension of the rotary shaft, or in a Z direction illustrated in FIG. 12. That is, the blade 54 includes a chamfered portion 56 processed in a chamfered shape at the end of the blade in the Z direction. The direction of extension of the rotary shaft is the aforementioned first direction and the longitudinal direction of the blade 54. The chamfered portion 56 monotonically reduces the cross sectional area of the end of the blade 54 in the Z direction relative to the cross sectional area of the central portion of the blade 54 in the Z direction. Specifically, the cross sectional area of the end of the blade 54 in the Z direction is smaller than the cross sectional area of the central portion of the blade 54 in the Z direction by the product of the plate thickness of the blade 54 and the chamfered length in the direction orthogonal to the Z direction of the blade 54. The chamfered portion 56 thus allows the blade 54 to be easily inserted into the hole 12 in the blade inserting step of a method of manufacturing the cross flow fan. That is, the chamfered portion 56 improves insertability of the blade 54 into the hole 12 in the blade inserting step of the method of manufacturing the cross flow fan.

[0069] The end of the blade 54 in the Z direction is processed into the chamfered shape in the fourth embodiment, but may be processed into an arcuate shape instead. In this case, the blade 54 includes an arcuate portion processed into the arcuate shape at the end of the blade in the Z direction. As with the chamfered portion 56, the arcuate portion monotonically reduces the cross sectional area of the end of the blade 54 in the Z direction relative to the cross sectional area of the central portion of the

[0071] The blade 54 has a substantially uniform plate thickness in the first to fourth embodiments described above, but it may be of a blade shape with a thick center, for example. In this case, it is sufficient if the shape of the hole 12 is changed in accordance with the shape of the blade and the hole 12 has a width not allowing contact with the thickest portion of the blade.

[0072] The configurations illustrated in the aforementioned first, second, third, and fourth embodiments merely illustrate an example of the content of the present invention, and can thus be combined with another known technique or partially omitted and/or modified without departing from the scope of the present invention.

Reference Signs List

[0073] 10, 10', 30, 30', 40, 40' holding plate; 10o, 10o', 30o, 30o', 40o, 40o' outer periphery; 10e, 10e', 30e, 30e', 40e, 40e' outer peripheral edge region; 12, 12' hole; 12c, 12c' central region; 12i, 12i' inner peripheral side portion; 12is, 12is' tip; 12ix, 12ix' recess; 12iy, 12iy' protrusion; 12o, 12o' outer peripheral side portion; 12w, 12w' width; 14, 54 blade; 14c, 54c central region; 14i, 54i inner peripheral side portion; 14is, 14os tip; 14o, 54o outer peripheral side portion; 14w plate thickness; 16 rotary shaft; 18i first contact portion; 18o second contact portion; 18c third contact portion; 20a first non-contact portion; 20b second non-contact portion; 20c third non-contact portion; 32, 32' outer peripheral edge protrusion; 42, 42' outer peripheral hole; 56 chamfered portion; 100 cross flow fan; Ri inner peripheral surface; Ro outer peripheral surface; θi mounting angle; θo exit angle.

CLAIMS

1. A cross flow fan comprising:

a rotary shaft;

at least a pair of holding plates disposed at an interval in a direction in which the rotary shaft extends; and

an arcuate blade inserted into a plurality of arcuate holes formed in an outer periphery of the holding plates, wherein

the holding plates each include

an outer peripheral edge region provided in a region on an outer peripheral side relative to the holes, and

a contact portion to support the blade in contact with the blade in the arcuate holes, and

the contact portion includes

a first contact portion to support an end of an inner peripheral side portion of the blade that is in contact with an end of an inner peripheral side portion of the holes, and

a second contact portion to support an end of an outer peripheral side portion of the blade that is in contact with an end of an outer peripheral side portion of the holes,

the holding plates are not in contact with the blade in a first region that is a region formed on a side facing a concave curved surface of the blade in the holes and is a region between the first contact portion and the second contact portion, and

the holding plates are not in contact with the blade in a second region that is a region formed on a side facing a convex curved surface of the blade in the holes and is a

region between the first contact portion and the second contact portion.

2. A cross flow fan comprising:

a rotary shaft;

at least a pair of holding plates disposed at an interval in a direction in which the rotary shaft extends; and

an arcuate blade inserted into a plurality of arcuate holes formed in an outer periphery of the holding plates, wherein

the holding plates each include

an outer peripheral edge region provided in a region on an outer peripheral side relative to the holes,

a contact portion to support the blade in contact with the blade, and

a non-contact portion not in contact with the blade, and

a region facing a convex curved surface of the blade in the holes has a shape following the convex curved surface of the blade and is part of the non-contact portion.

3. The cross flow fan according to claim 1, wherein the first region includes a region having a linear shape.

4. A cross flow fan comprising:

a rotary shaft;

at least a pair of holding plates disposed at an interval in a direction in which the rotary shaft extends; and

an arcuate blade inserted into a plurality of arcuate holes formed in an outer periphery of the holding plates,

wherein

the holding plates each include

an outer peripheral edge region provided in a region on an outer peripheral side relative to the holes,

a contact portion to support the blade in contact with the blade, and

a non-contact portion not in contact with the blade, and

a recess is provided on an inner peripheral side of the region facing the concave curved surface of the blade in the holes.

5. A cross flow fan comprising:

a rotary shaft;

at least a pair of holding plates disposed at an interval in a direction in which the rotary shaft extends; and

an arcuate blade inserted into a plurality of arcuate holes formed in an outer periphery of the holding plates, wherein

the holding plates each include

an outer peripheral edge region provided in a region on an outer peripheral side relative to the holes,

a contact portion to support the blade in contact with the blade, and

a non-contact portion not in contact with the blade, and

the outer peripheral edge region includes an outer peripheral edge protrusion in a region toward the outer peripheral side portion of the holes relative to the rotary shaft.

6. The cross flow fan according to any one of claims 1 to

5, wherein the outer periphery of the holding plates includes an outer peripheral hole in a region on a side facing the concave curved surface of the blade relative to the outer peripheral side portion of the holes.

7. The cross flow fan according to any one of claims 1 to 6, wherein an end of the blade in the direction in which the rotary shaft extends has a chamfered shape or an arcuate shape.

8. The cross flow fan according to any one of claims 1 to 6, wherein a central region between the inner peripheral side portion and the outer peripheral side portion of the blade of an end of the blade in the direction in which the rotary shaft extends has a shape extending beyond the inner peripheral side portion and the outer peripheral side portion in the direction in which the rotary shaft extends.

9. A method of manufacturing a cross flow fan including a rotary shaft, at least a pair of holding plates disposed at an interval in a direction in which the rotary shaft extends, and a blade fixed to the holding plates, the method comprising:

a hole forming step of forming a plurality of arcuate holes in an outer periphery of the holding plates to allow insertion of the blade into the holes;

a blade inserting step of inserting the blade into the arcuate holes; and

a blade fixing step of crushing a region on an outer peripheral side of the holding plates relative to the holes toward the blade inserted into the holes, so as to form, in the holding plates, a contact portion at which the blade is supported in contact with the holding plates and a non-

contact portion at which the blade is not in contact with the holding plates, and fixing the blade to the holding plates, wherein

the hole forming step includes forming a region facing a convex curved surface of the blade in the holes in the blade fixing step into a concave curved shape following the convex curved surface of the blade, and

the blade fixing step includes forming the region formed in the concave curved shape into part of the non-contact portion.

10. A method of manufacturing a cross flow fan including a rotary shaft, at least a pair of holding plates disposed at an interval in a direction in which the rotary shaft extends, and a blade fixed to the holding plates, the method comprising:

a hole forming step of forming a plurality of arcuate holes in an outer periphery of the holding plates to allow insertion of the blade into the holes;

a blade inserting step of inserting the blade into the arcuate holes; and

a blade fixing step of crushing a region on an outer peripheral side of the holding plates relative to the holes toward the blade inserted into the holes, so as to form, in the holding plates, a contact portion at which the blade is supported in contact with the holding plates and a non-contact portion at which the blade is not in contact with the holding plates, and fixing the blade to the holding plates, wherein

in the hole forming step, a recess is provided on an inner peripheral side of the region facing the concave curved surface of the blade in the holes in the blade fixing step.

11. A method of manufacturing a cross flow fan including a rotary shaft, at least a pair of holding plates disposed at an interval in a direction in which the rotary shaft extends, and a blade fixed to the holding plates, the method comprising:

a hole forming step of forming a plurality of arcuate holes in an outer periphery of the holding plates to allow insertion of the blade into the holes;

a blade inserting step of inserting the blade into the arcuate holes; and

a blade fixing step of crushing a region on an outer peripheral side of the holding plates relative to the holes toward the blade inserted into the holes, so as to form, in the holding plates, a contact portion at which the blade is supported in contact with the holding plates and a non-contact portion at which the blade is not in contact with the holding plates, and fixing the blade to the holding plates, wherein

an outer peripheral protrusion is provided in a region on the outer peripheral side of the holding plates relative to the holes, and

the blade fixing step includes crushing the outer peripheral protrusion toward the blade inserted into the holes so as to deform the outer peripheral protrusion such that the outer peripheral protrusion protrudes toward the holes.