

Our Ref.: MD-673 (505543)

- 1 -

FAN

The present invention relates to a fan wherein an output shaft of an electric motor which extends outside from an outer shell has an end provided with an impeller, a casing suited to such a fan, an electric motor outer shell suited to such a fan, and a vibration isolating fixing device suited to such a fan.

For example, in a crossflow fan shown in Figure 26, an electric motor 31 for rotating an impeller 30 is provided on one end of a fan casing 32, and electrical equipments 33 such as a capacitor for operating the motor 31, and a relay for switching impedance to change the speed of the motor 31 are provided on the other end. If such a fan swings the fan casing 32 to change a supply air direction, the motor 31 houses reduction gears 34 of worms and worm wheels as shown in Figure 27, and the impeller 30 and the fan casing 32 are moved by the single motor 31.

However, the fan having such a structure is not good in that not only the electric motor 31 is complicated and

This Sheet Has Been Replaced



expensive but also the reduction gears and other components are difficult to maintain. The conventional fan has a disadvantage of being large as a whole because of the provision of the electrical equipments 33 outside the fan casing 32. In order to cope with these problems, an improved fan has been developed wherein an electric motor 31 for rotating impellers 30 and an electric motor 35 for swinging fan casings 32 are independently provided, and wherein the motor 31 for rotating the impellers 30 and the motor 35 for swinging the fan casings 32 are arranged side by side as shown in Figure 28. In the improved fan, electrical equipments 33 including the motor 35 for swinging the fan casings 32 are arranged around the motor 31 for rotating the impellers 30, allowing the entire length of the fan to be shorter than the fan previously stated.

The improved fan has created some problems. The side by side arrangement of the motor 35 for swinging the fan casings 32 and the electrical equipments 33 such as a capacitor and a relay with respect to the motor 31 for rotating the impellers 30 makes the width of the fan larger, the wiring routes for electrical wiring complicated, and a space to mount narrow so as to have difficulty in mounting the electrical equipments 33.

In many case, a casing suited to such a fan has an elongated shape. The casing is constituted by two side plates provided at both ends of the casing, and two

opposed guide plate fixedly extended between the side plates and providing an elongated inlet and an elongated outlet in a longitudinal direction. The guide plates are inwardly curved strip members, and one of the guide
5 plates has a greater width than the other guide plate. The respective guide plates have respective ends fixed to the respective side plates. The respective guide plates which extend between the side plates and are fixed to the side plates at the respective ends has a strip shape,
10 providing firm fixing to the connections between the guide plates and the side plates. The most frequently adopted method to fix the guide plates to the side plates is soldering, which is carried out as shown in Figures 29 and 30 for instance.

15 Specifically, three projecting pieces 232 which receive an edge of one of the guide plates 231, and two projecting pieces 234 which receive an edge of the other guide plate 233 are lanced from an inner side of each of the side plates 230 by press working so as to be located
20 in a circumferential direction. The guide plate 231 has an inner side of the edge carried on the three projecting pieces 232 and fixed to the respective projecting pieces 232 by spot welding while the guide plate has an end surface abutted against the inner side of the side plate
25 230. The other guide plate 233 has an inner side of the edge contacted with two projecting pieces 234 and fixed to the respective projecting pieces 234 by spot welding

while the other guide plate has an end surface abutted against the inner side of the side plate 230.

In the conventional casing, the projecting pieces 232 and 234 have planar surfaces though the guide plates 231 and 233 have curved inner surfaces. In addition, each of the side plates 230, and the guide plates 231 and 233 are difficult to be held at a proper position in welding. It is easy to provide a minute gap between the end surfaces of the guide plates 231, 233 and each of the side plates 230. If the casing is constructed in a swingable manner to change a supply air direction, there has been a problem in that poor contact between the end surfaces of the guide plates 231, 233 and each of the side plates 230 by vibration causes noise called chatter easily. Fixing by spot welding with the guide plates 231, 233 and a side plate 230 abutted has created problems in that assembly is complicated and painting can be done only after assembly.

Although coupling by bending as disclosed in e.g. JP-A-5277870 and JP-A-63256230 can be adopted to eliminate assembly by e.g. welding, the technique disclosed in the publications can not be applied to the casing without modification because the end portions do not confront each other at the coupled portions between the guide plate 231, 233 and a side plate 230.

Some electric motors have an output shaft extended from an outer shell thereof by a long length. For

example, an electric motor for rotating an impeller in a crossflow fan has an output shaft 330 extended by an extended length as shown in Figure 31, and an electrical equipment 331, an electric motor 333 and a swing
5 mechanism for swinging an impeller casing 332 are incorporated in a space provided by the extended output shaft. Such a type of electric motor is used for not only a fan but also various devices. For example, JP-A-5344963 discloses a device which rotates an impeller in a
10 refrigerator by an electric motor mounted outside the refrigerator wherein the electric motor has an output shaft extended to pass through an a thermal insulation wall of the refrigerator. The long output shaft suffers whirling or flexure on application of an external force
15 during e.g. transportation, and plastic deformation on application of a strong external force.

The electric motor disclosed in the publication has a structure to avoid shaft whirling. In the electric motor of the publication, the output shaft which extends
20 from the electric motor passes through a guide formed in the thermal insulation wall. The guide is formed in a cylindrical shape, and has an inner wall at an end thereof formed with projections to prevent the output shaft from whirling.

25 The measures to avoid the output shaft whirling by the guide as adopted in the conventional electric motor with a long output shaft can not be applied to an

electric motor which has a driven member such as an
impeller directly mounted to an end portion of the output
shaft thereof. This is because the electric motor for a
fan as shown does not have an output shaft passed through
5 a partition wall and so on. In addition, electric motors
which have an outer shell made of casting or die casting
mostly have the outer shell assembled from two parts of a
frame and a bracket, or three parts of two end brackets
and a frame. Since these parts have to be individually
10 produced, the cost for preparation of the outer shell is
high.

Vibration isolating fitting devices which interpose
a functional member between a device and a supporting
member to fit the device to absorb vibration and couple a
15 fitting portion of the device and the supporting member
by a bolt and a nut have been widely applied to vehicles
and so on. Such conventional vibration isolating fitting
devices have a structure to basically sandwich a frame or
another element by divided vibration isolating members
20 for supporting as disclosed in e.g. JP-U-6067447, JP-A-
6224050 and JP-A-5332381.

In one of the conventional vibration isolating
fitting devices shown in Figure 32 which is used for
mounting a fan 430 to supporting members 421, each of the
25 supporting members 421 is sandwiched by vibro-isolating
members 422, 423 divided as in the publications, a longer
threaded portion of a bolt 425 passes through a hole in

the vibro-isolating member 423, a mounting hole in the supporting member 421 and a hole in the vibro-isolating member 422, and a nut 428 is engaged with the longer threaded portion to fix the vibro-isolating members 422, 5 423 to the supporting member 421. The bolt 425 has a seat 427, and the longer threaded portion and a shorter threaded portion are formed on the bolt on both sides of the seat 427. The bolt 425 which has been fixed to the supporting member 421 has the shorter threaded portion 10 passes through a mounting hole in each of fitting portions 424 of the fan 430. When each of the fitted portions contacts with the seat 427 of the bolt 425, a nut 426 is engaged with the bolt to fix the fan 430.

Such conventional vibration isolating fitting 15 devices create a problem if the vibration isolating fitting devices are treated independently of the device to be supported and the supporting members 421, the device to be supported is independently treated, and the device to be supported is fitted to the supporting 20 members 421 later on. The vibration isolating fitting devices are put in the same package as the device to be supported in such a state that the respective nuts 426 are temporarily coupled to the respective bolts 425 which has been mounted to the fitting portions 424 of the 25 device to be supported, or the vibration isolating devices are stored in a parts box and so on. If the vibration isolating devices are provided in a temporarily

coupled state, missing of parts can be avoided. However when the vibration isolating devices are mounted to the supporting members 421, the vibration isolating devices have to be disassembled from such a temporarily coupled
5 state and be assembled in a proper state, making the mounting operation troublesome and deteriorating operability. If the vibration isolating devices are put in the same package as the device to be supported, some parts could be missing, the vibro-isolating members 422,
10 423 are not properly used, and some parts are eliminated, creating improper mounting.

The present invention can solve these problems. It is a first object of the present invention to provide a space for housing parts between a side surface of an
15 outer shell of an electric motor with an output shaft extending therefrom and a side surface of an impeller to collectively arrange electrical parts for operation of a fan, reducing the width of the fan, improving maintenance and reducing cost.

20 It is a second object of the present invention to provide the space for housing parts for the fan without difficulty. It is a third object of the present invention to effectively utilize the space for housing parts for the fan and simplify mounting of the electrical
25 parts.

It is a fourth object of the present invention to adopt assembly by caulking to provide a fan casing

capable of preventing noise from generating and being painted before assembly. It is a fifth object of the present invention to improve the assembly of the fan casing.

5 It is a sixth object of the present invention to prevent a long extended output shaft of an electric motor from whirling by providing an electric motor with a simple structure. It is a seventh object of the present invention to not only prevent a long extended
10 output shaft of an electric motor from whirling by providing the electric motor per se with a simple structure but also reduce cost. It is an eighth object of the present invention to provide an electric motor capable of reducing the cost for an outer shell thereof
15 and improving assembly of the outer shell, and having the outer shell with axial misalignment minimized.

 It is a ninth object of the present invention to provide a vibration isolating fitting device capable of mounting vibration isolating members to a fitting portion
20 in a proper mounting state without use of special parts and being easily assembled. It is a tenth object of the present invention to make the mounting of the vibration isolating fitting device adequate to ensure a required vibration isolating function.

25 According to a first aspect of the present invention, there is provided a fan wherein an output shaft of an electric motor which extends out of an outer

shell has an end provided with an impeller, wherein the output shaft extending out of the outer shell has a great projection length, wherein there is provided a mounting plate through which the output shaft passes and which
5 confronts a side of the outer shell, and wherein a space for housing electrical parts is provided between the mounting plate and the motor so as to collectively arrange electrical parts required for operation of the fan.

10 According to a second aspect of the present invention, there is provided a fan wherein output shafts of an electric motor which extend out of both sides of an outer shell have respective ends provided with respective impellers, wherein there are provided two fan casings
15 which surround the impellers and swing to change a supply air direction, wherein at least one of the output shafts which extend out of the outer shell has a great projection length, wherein there is provided a mounting plate through which the one output shaft with the great
20 projection length passes and which confronts a side of the outer shell, and wherein a space for housing electrical parts is provided between the mounting plate and the motor so as to collectively arrange an electric motor for swinging the two fan casings and other
25 electrical parts required for operation of the fan.

According to a third aspect of the present invention, the output shaft of the motor which extends

out of the outer shell except for the end is entirely rotatably covered by a protection sleeve formed with the outer shell in a one-piece construction, and the protection sleeve has an end supported by the mounting
5 plate in the first and second aspects.

According to a fourth aspect of the present invention, the outer shell has a spacer projecting therefrom, and the spacer has a projection edge fixed to the mounting plate in the first through third aspects.

10 According to a fifth aspect of the present invention, the mounting plate is formed in an L-character shape so as to be constituted by a vertical piece confronting the outer shell of the motor and a mounting piece extending substantially perpendicularly from the
15 vertical piece toward the motor, and the electrical parts are mounted to both of the vertical piece and the mounting piece in the first through fourth aspect.

According to a sixth aspect of the present invention, the mounting plate has the electrical parts
20 mounted thereon before mounting of the mounting plate in the first through fifth aspect.

According to a seventh aspect of the present invention, there is provided a casing for a fan, which inspires air in a radial direction from a part of a
25 peripheral portion of an impeller rotating therein, passes the air along the remaining part of the peripheral portion and blows out the air in a radial direction,

which includes two side plates and a guide plate, each of the side plates having a substantially disk shape of side portion and a substantially cylindrical flange outwardly extending from the peripheral edge of the side plate in an axial direction of the fan, the guide plate arranged near to the peripheral portion of the impeller to change a supply air direction, the guide plate extending between the side plates, fixed to the side plates and keeping the side plates apart from each other at a distance in a confronting state, wherein the guide plate has ends confronting the respective side plates, each of the ends provided with caulking structure constituted by a first abutting surface to contact with a peripheral portion of the side portion of one of the side plates, a second abutting surface to contact with a peripheral portion of the flange and a bent portion to contact with a free edge of the flange, and wherein the flange of each of the side plates is engaged with the caulking structure, and the bent portion is bent to embrace the flange so as to fix the guide plate to each of the side plates in a caulking state.

According to an eighth aspect of the present invention, the flange has a cutout formed therein at a portion to be engaged with the caulking structure of one of the side plates so as to reduce a projection length in the seventh aspect.

According to a ninth aspect of the present

invention, there is provided a casing for a fan, which
inspires air in a radial direction from a apart of a
peripheral portion of an impeller rotating in casing,
passes the air along the remaining part of the peripheral
5 portion and blows out the air in a radial direction, and
which includes two side plates and a guide plate, each of
the side plates having a substantially disk shape of side
portion, the guide plate arranged near to the peripheral
portion of the impeller to change a supply air direction,
10 the guide plate extending between the side plates, fixed
to the side plates and keeping the side plates apart from
each other at a distance in a confronting state, wherein
the side portion of each of the side plates has an
elongated engagement slot formed therein so as to have an
15 inner edge formed with a flange outwardly extending in an
axial direction of the fan, wherein the guide plate has
ends confronting the respective side plates, each of the
ends provided with a caulking structure constituted by a
first abutting surface to contact with the inner edge of
20 the engagement slot, a second abutting surface to contact
with an outer surface of the flange and a bent portion to
contact with a free edge of the flange, the caulking
structure engageable with the engagement slot, and
wherein the flange of each of the side plates is bent to
25 embrace the flange so as to fix the guide plates to each
of the side plates in a caulking state.

According to a tenth aspect of the present

invention, there is provided an electric motor wherein an output shaft extends out of an outer shell by an increased length, and the output shaft has an end provided with a driven member, and wherein the outer
5 shell has a protection sleeve formed therewith in a one-piece construction to rotatably cover the entire output shaft in close proximity thereto except for the end of the output shaft.

According to an eleventh aspect of the present
10 invention, the protection sleeve has an end formed with a projection around and closely to the output shaft in the tenth aspect.

According to a twelfth aspect of the present invention, the outer shell is constituted by two outer
15 shell elements having the same shape which are divided at an imaginary plane perpendicular to the output shaft, which are made of casting or die-casting, and which are jointed to confront each other.

According to a thirteenth aspect of the present
20 invention, each of the outer shell elements has an abutting surface at which the outer shell elements are joined, and the abutting surface has engagement structures formed thereon in a symmetrical relation in the twelfth aspect.

25 According to a fourteenth aspect of the present invention, the engagement structures comprise a projection and a recess engageable with the projection in

the thirteenth aspect.

According to a fifteenth aspect of the present invention, the engagement structures comprise a ridge and a groove engageable with the ridge in the thirteenth
5 aspect.

According to a sixteenth aspect of the present invention, each of the outer shell elements has an outer periphery formed with a mounting leg in a one-piece construction, and each mounting leg has an abutting
10 surface at which the outer shell elements are jointed, and the abutting surface has engagement structures formed thereon in a symmetrical relation in any one of the twelfth through fifteenth aspects.

According to a seventeenth aspect of the present
15 invention, there is provided a vibration isolating mounting device which uses a bolt and a nut to mount a mounting piece to a supporting member so as to confront the supporting member, which is constituted by a first vibro-isolating element arranged on one side of the
20 mounting piece and a second vibro-isolating element arranged on the other side of the mounting piece, which confronts the mounting piece to the supporting member so as to interpose the second vibro-isolating element between the mounting piece and the supporting member,
25 wherein the bolt is passed through the first vibro-isolating element, the mounting piece, the second vibro-isolating element and the supporting member, and the nut

is engaged with the bolt to tighten the first vibro-isolating element, the mounting piece, the second vibro-isolating element and the supporting member, wherein one of the first vibro-isolating element and the second
5 vibro-isolating element has one end formed with a cylindrical supporter which is acceptable in an engagement hole formed in the mounting piece and has a through hole formed at a central portion thereof to accept the bolt, wherein the other of the first vibro-
10 isolating element and the second vibro-isolating element has an engagement structure to put the cylindrical supporter in engagement and capture, and wherein the first vibro-isolating element and the second vibro-isolating element can be mounted to the mounting piece so
15 as to sandwich the mounting piece therebetween even if the bolt is not passed and the nut is not engaged with the bolt.

According to an eighteenth aspect of the present invention, the cylindrical supporter of the vibro-
20 isolating mounting device works as a stopper to prevent the first vibro-isolating element and the second vibro-isolating element from being excessively compressed in the seventeenth aspect.

According to a nineteenth aspect of the present
25 invention, the vibration isolating mounting device has a stopper arranged between the first vibro-isolating element and the second vibro-isolating element to prevent

the first vibro-isolating element and the second vibro-isolating element from being excessively compressed in the seventeenth aspect.

According to a twentieth aspect of the present
5 invention, the stopper of the vibration isolating mounting device is formed in a cylindrical shape so as to provide a bolt passing portion for passing the bolt, and the stopper has a length which is shorter than the sum of a thickness of the first vibro-isolating element and that
10 of the second vibro-isolating element in the nineteenth aspect.

In accordance with the first and second aspects, the space for collectively arranging the electrical parts required for operation of the fan can be provided between
15 the side of the outer shell with the output shaft extending therefrom and the side of the impeller to reduce the fan in width, improve maintenance and reduce cost.

In accordance with the third aspect, the space for
20 arranging the electrical parts can be provide without trouble in addition to the presence of the advantages offered by the first or the second aspect.

In accordance with the fourth aspect, mounting of the electrical parts can be simplified in addition to the
25 presence of the advantages offered by any one of the first through third aspects.

In accordance with the fifth aspect, the space for

arranging electrical parts can be more effectively utilized in addition to the presence of the advantages offered by any one of the first through fourth aspects.

5 In accordance with the sixth aspect, mounting of the electrical parts or operation for electrical wiring can be simplified, improving operation required for assembling in addition to the presence of the advantages offered by any one of the first through fifth aspects.

10 In accordance with the seventh aspect, assembly by caulking can be adopted to minimize the occurrence of noise and to provide a fan casing which can be painted before assembly.

In accordance with the eighth aspect, assembly of the casing can be improved in addition to the presence of
15 the advantages offered by the seventh aspect.

In accordance with the ninth aspect, assembly by caulking can be adopted to minimize the occurrence of noise and to provide a fan casing which is can be painted before assembly and can be assembled easily.

20 In accordance with the tenth and eleventh aspect, the output shaft of the electric motor which extends at an increased length can be prevented from whirling by a simple structure which is provided on the electric motor per se.

25 In accordance with the twelfth aspect, the output shaft of the electric motor which extends at an increased lengths can be prevented from whirling by a simple

structure which is provided on the electric motor per se, and the outer shell can be constituted by the two outer shell elements having the same shape. Cost can be reduced.

5 In accordance with the thirteenth through seventeenth aspects, the cost required for the outer shell of the electric motor can be reduced, and the outer shell can have easy assembly and improved assembly precision.

10 In accordance with the seventeenth aspect, the vibro-isolating elements can be mounted to the mounting piece in a proper way without need for a special part, providing the vibration isolating fitting device with good assembly.

15 In accordance with the eighteenth aspect, the vibration isolating fitting device can be properly mounted by a simple structure, ensuring the vibration isolating function in addition to the presence of the advantages offered by the seventeenth aspect.

20 In accordance with the nineteenth aspect, the vibration isolating fitting device can be properly mounted with the vibration isolating function ensured in addition to the advantage offered by the seventeenth aspect.

25 In accordance with the twentieth aspect, the vibro-isolating elements can be mounted to the mounting piece in a proper mounting way without need for a special part,

the vibration isolating fitting device can have good assembly, and mounting of the vibration isolating fitting device can be properly made with the vibration isolating function ensured.

5 In the drawings;

Figure 1 is a perspective view showing the fan according to first and second embodiments of the present invention as a whole;

Figure 2 is a perspective view wherein the driving
10 portion of the fan according to the first embodiment is disassembled to show the inside thereof;

Figure 3 is a perspective view showing some of the disassembled parts of Figure 2 at a different angle;

Figure 4 is a front view showing the other parts of
15 the driving portion of the fan according to the first embodiment;

Figure 5 is a perspective view showing essential parts of the fan according to the second embodiment in a disassembled state;

20 Figure 6 is a perspective view show in essential parts of the fan casing according to the second embodiment before assembling;

Figure 7 is a side view showing essential parts of the fan casing according to the second embodiment before
25 assembly;

Figure 8 is a side view showing the fan casing according to the second embodiment;

Figure 9 is a cross-sectional view showing essential parts of the fan casing according the second embodiment;

Figure 10 is a cross-sectional view showing essential parts of the fan casing according to the second
5 embodiment;

Figure 11 a perspective view showing outer shell elements of the electric motor according to a third embodiment;

Figure 12 is a side view of an outer shell element
10 of Figure 11;

Figure 13 is a cross-sectional view of the outer shell elements of Figure 11;

Figure 14 is a side view showing an outer shell element of Figure 11 as viewed from a confronting surface
15 side thereof;

Figure 15 is a perspective view showing the outer shell element Figure 14 as viewed from the confronting surface side;

Figure 16 is a side view showing an outer shell
20 element according a third embodiment as viewed from a confronting surface side thereof;

Figure 17 is a perspective view of the outer shell element of Figure 16 as viewed from the confronting surface side;

25 Figure 18 is a side view showing an outer shell element according to a fourth embodiment as viewed from a confronting surface side thereof;

Figure 19 is a perspective view showing the outer shell element of Figure 18 as viewed from the confronting surface side;

Figure 20 is a perspective view showing the
5 vibration isolating fitting device according to a fifth embodiment in a disassembled state;

Figure 21 is a perspective view showing how to mount the vibro-isolating elements according to the fifth embodiment;

10 Figure 22 is an enlarged perspective view of a portion of the vibration isolating fitting device according to the fifth embodiment;

Figure 23 is an end view of the second vibro-isolating element according to the fifth embodiment;

15 Figure 24 is a cross-sectional view showing how to mount the vibration isolating fitting device according to the fifth embodiment;

Figure 25 is a cross-sectional view showing how to mount the vibration isolating fitting device according to
20 a sixth embodiment;

Figure 26 is a perspective view a conventional fan as a whole;

Figure 27 is a perspective view showing the conventional fan motor in a disassembled state;

25 Figure 28 is a front view showing a portion of the structure of another conventional fan;

Figure 29 is a perspective view showing essential

parts of a conventional fan casing before assembly;

Figure 30 is a side view showing the inner surface of a side plate of the fan casing;

Figure 31 is a front view showing a portion of a
5 conventional fan electric motor; and

Figure 32 is a perspective view showing a conventional vibration isolating fitting device in a disassembled state.

Now, a first embodiment of the present invention
10 will be described in detail, referring to the accompanying drawings.

In Figures 1-4 is shown the fan according to the first embodiment. The fan is called a crossflow fan wherein impellers 2 rotating in elongated fan casings 1
15 inspire air in the impellers 2 from a part of the peripheral portion of each of the impellers in a radial direction, and the air is blow out in a radial direction after having passed along the remaining part of the peripheral portion of each of the impellers as shown in
20 Figure 1. The fan shown is of a double casing type, wherein each pair of the impeller 2 and the fan casings 1 is provided on both sides of a driving portion 5 which is provided at a central portion of the fan to mainly include an electric motor 3 for rotating the impellers 2
25 and an electric motor 4 for swinging the casings 1. Since the right and left portions of the fan have the same basic structure, the structure about only one of

identical parts will be explained, and the other one of the identical parts will be indicated by the same reference numeral though explanation will be omitted.

The electric motor 3 which is arranged in the driving portion 5 to rotate the impellers 2 is provided at the central portion of a frame 6 of the fan in a longitudinal direction. The motor 3 has output shafts 7 extended from both side surfaces of an outer shell 8 thereof as shown in Figure 3, and at least one of the output shafts 7 (the lefthand one in Figure 3) has a greater projection length. The outer shell 8 of the motor 3 is prepared by casting or aluminum die casting, and is constituted by confronting and jointing two outer shell elements divided at a plane perpendicular to the output shafts 7. The outer shell 8 has both surfaces formed with axial holes to extend the output shaft 7 outside. Each of the axial holes has an outer periphery surrounded by a protection sleeve 9 which extends in an axial direction. The protection sleeve 9 is formed with the outer shell 8 in a one-piece construction so as to provide a cylindrical portion having an inner diameter slightly greater than the outer diameter of the output shafts 7. A portion of each of the output shafts 7 extending from the outer shell 8 is covered by the protection sleeve 9 except for an end portion with the impeller 2 carried thereon as shown in Figure 3. The protection sleeve 9 which covers the output shaft 7

having the greater projection length has a projection edge as a small diameter portion 10 with an outer diameter reduced in comparison with the remaining portion of the protection sleeve.

5 Three spacers 11 are formed with the outer shell 8 in a one-piece construction with the side surface of the outer shell 8 on the side of the output shaft 7 having the greater protection length so as to project from the side surface side by side with the protection sleeve 9
10 and surround the protection sleeve 9. The projection edge of each of the spacers 11 is located at the same position as the root of the small diameter portion 10 of the protection sleeve 9, and has an end surface formed with a mounting hole 12 (see Figure 3). An L-character
15 shape of mounting plate 15 which is constituted by a vertical side 13 confronting the outer shell 8 of the motor 3 and a mounting piece 14 extending substantially perpendicularly from the vertical piece 13 toward the motor 3 has the vertical piece 13 bolted to the
20 projection edge of each of the spacers 11 to provide a space 16 for housing parts, which is held by the spacers 11 between the side surface of the outer shell 8 of the motor 3 and the vertical piece. The vertical piece 13 of the mounting plate 15 has a substantially central portion
25 formed with an engagement hole 17 for engagement with the small diameter portion 10 of the protection sleeve 9, and the edge portion of the protection sleeve 9 is supported

by the engagement hole 17.

A capacitor 18 for operating the motor 3, a relay 19 for changing the rotational speed of the motor, electrical equipments such as an electric motor 4 for swinging the fan casings 1, and a swinging mechanism for swinging the fan casings 1 are mounted to the mounting plate 15 so as to be collectively housed in the space 16 for housing parts. Specifically, the motor 4 is bolted to the vertical piece 13, and the capacitor 18, the relay 19 and a relay case 20 are fixed to the mounting piece 14 by boldding, utilizing the space 16 more effectively as shown in Figure 3. The motor 4 includes reduction gears. The reduction gears have a rotational shaft extended toward one of the fan casings 1 from a notch 21 formed an edge portion of the vertical piece 13. The rotational shaft has an edge mounted to a crank 22 of the swinging mechanism. The crank 22 is coupled to a swinging rod 23, and a connecting rod 24 coupled to the swinging rod 23 is coupled to the two fan casings 1, swinging the two fan casings 1 to change a supplied air direction by the single motor 4. The space 16 and the motor 3 are entirely covered by a driving portion cover 25 which is detachably mounted to the fan.

If mounting the electrical parts to the mounting plate 15 is carried out before mounting the mounting plate 15 to the spacers 11 of the outer shell 8 of the motor 3, and if main electrical wiring is completed, the

mounting plate 15 can be treated as in a circuit board with electrical parts mounted thereon, operation is simplified in comparison with mounting electrical equipments or electrical wiring in a narrow space, and wiring routes are simplified, providing good operability. Since the output shaft 7 which extends from the outer shell by a longer length has most portions covered by the protection sleeve 9, and since the projection edge of the protection sleeve 9 is supported by the mounting plate 15 through the engagement hole 17 to support the output shaft at both ends thereof, the protection sleeve can prevent the output shaft from whirling, flexing or being deformed even if an external force is applied to the output shaft during e.g. transportation.

As stated, the protection sleeve 9 and the spacers 11 work to ensure the space 16 without interfering with other functional parts. Since the space 16 is not exposed to the supplied air and is covered by the driving portion cover 25, the dirt and dust are restrained from adhering to the electrical parts. In the fan, the space 16 where the electrical parts required for operation of the fan are collectively arranged can be ensured between the side of the outer shell 8 of the motor with the output shaft 7 extending therefrom and the side of one of the impellers 2, and the motor 4 for swinging the fan casings 1 is independently arranged, improving maintenance and reducing cost.

As stated earlier, the output shaft 7 which has such a greater projection length in order to ensure the space 16 is protected from an external force by the protection sleeve 9, and the output shaft 7 passes through the mounting plate 15. As shown in Figure 4, the engagement hole 17 in the mounting plate 15 may be formed to have a diameter slightly greater than the outer diameter of the output shaft 7 so as to prevent the output shaft 7 from whirling only by the mounting plate 15 without the protection sleeve 9, simplifying the structure. The mounting plate 15 may be mounted to the frame 6 of the fan. The mounting plate 15 may have plural surfaces so as to effectively utilize the space 16.

Next, a second embodiment according to the present invention will be described in detail, referring to the accompanying drawings. In Figures 1 and 5-10 is shown the fan according to the second embodiment. The fan is called a crossflow fan wherein air is inspired from a part of the peripheral portion of the impeller 2 rotating in each of the elongated casings 1 into the impeller 2 in a radial direction, and the inspired air passes along the remaining part of the peripheral portion of the impeller and is blown out in a radial direction as shown in Figure 1. The fan shown is of a double casing type, wherein a pair of an impeller 2 and a casing 1 made of sheet metal is provided on each of the right and left sides of a driving portion 5 which is arranged at a central portion

of the fan and includes an electric motor 203 for rotating the impeller 1 and an electric motor 204 for swinging the casings 1 as main components. Since the right and left portions of the fan have the same basic structure, the structure about only one of identical parts will be explained, and the other one of the identical parts will be indicated by the same reference numeral though explanation will be omitted.

The casing 1 is constituted by two side plates 206 forming both ends thereof in a longitudinal direction, and two opposing plates of a first guide plate 209 and a second guide plate 210 extended between and fixed to the side plates 206, having an elongated inlet 207 and an elongated outlet 208 in the longitudinal direction and formed so as to be inwardly curved as shown in Figure 5. Each of the side plates 206 has a substantially disk shape of side portion 212 with a round hole 211 formed at a central portion thereof as a bearing, and a substantially cylindrical flange 213 provided on a circumferential edge of the side portion. The flange 213 extends from the side plate 206 in an axial direction of the side plate to provide the side plate 206 with required rigidity. The two guide plates 209, 210 are extended between and fixed to the side plates 206 to keep the side plates 206 apart from each other at a certain distance in a confronting state, providing the casing 1 for rotatably housing the impeller 2. One of the two

guide plates 209, 210 is wider than the other, the wider guide plate have a longitudinal edge 214 as an inlet edge outwardly bent in an arc shape as shown in Figure 8, and has both edges thereof in the longitudinal direction
5 fixed to the side plates 206 along the circumferential edge thereon. The other guide plate 210 is narrower than the one guide plate 209, has a longitudinal edge 214 as another inlet edge outwardly bent in an arc shape, and has both ends thereof in the longitudinal direction fixed
10 to each of the side portions 212 at a portion inside of the circumferential edge of each of the side plates 206.

Before being assembled to the side plates 206, the first guide plate 209 has each of both ends thereof in the longitudinal direction provided with a caulking
15 structure which is constituted by a first abutting surface 215 to contact with a peripheral portion of the side portion 212 of one of the side plates 206, a second abutting surface 216 to contact with a peripheral portion of the flange 213, and an inwardly bent portion to
20 contact with the free edge of the flange 213. On the other hand, the flange 213 of each of the side plates 206 which is coupled to one of the ends of the first guide plate 209 has a cutout 218 formed therein to reduce the projection length of that portion (see Figures 6 and 7).

25 The side portion 212 of each of the side plates 206 which is coupled to the second guide plate 210 has an engagement slot 220 formed therein to be elongated in a

circumferential direction thereof so as to have a flange 219 extended from an inner edge of the slot outward in the axial direction as shown in Figure 6. Each of both ends of the second guide plate 210 to be coupled to the side plates is provided with a caulking structure which is constituted by a first abutting surface 221 to contact with the inner edge of the engagement slot 220 of one of the side plates 206, a second abutting surface 222 to contact with an outer portion of the flange 219, and an inwardly bent portion 223 to contact with the free edge of the flange 219, and is engageable with the engagement slot 220 of the side plate 206.

Assembling the two guide plates 209, 210 to the two side plates 206 is carried out as follows: With respect to the first wider guide plate 209, a channeled portion which is defined by the first abutting surface 215 to contact with the peripheral portion of the side portion 212 of one of the side plates 206, the second abutting surface 216 to contact with the peripheral portion of the flange 213 at the cutout 218 of the side plate 206, and the inwardly bent portion 217 to contact with the flange 213 is engaged with the flange 213 from outward. The inwardly bent portion 217 of the caulking structure is bent to closely contact with an inner peripheral surface of the flange 213, caulking the bent portion and the flange so as to embrace the flange by the caulking structure (see Figure 9). With regard to the other end

of the first guide plate, similar process is carried out to caulk the inwardly bent portion and the flange 213 at the cutout 218 of the other side plate 206 to complete assembly. If the second abutting surface 216 to contact
5 with the peripheral portion of the flange 213 is formed so as to have a wider length in the axial direction, similar caulking can be carried out without provision of the cutout 218 in the flange 213. However, positioning the guide plate 209 becomes slightly troublesome in
10 assembly in comparison with the second embodiment wherein the cutout 218 prevents the caulking structure from shifting in the circumferential direction.

With regard to the second narrower guide plate 210, the caulking structure at one of the ends of the guide
15 plate is engaged with the engagement slot 220 in one of the side plates 206 from inwardly of the one side plate. A channeled portion which is defined by the first abutting surface 221 to contact with the inner edge of the engagement slot 220, the second abutting surface 222
20 to contact with the outer portion of the flange 219 extending from the inner edge of the engagement slot outwardly of the side plate, and the inwardly bent portion 223 to contact with the free edge of the flange 219 is engagement with the flange 219 from outwardly of
25 the side plate. The bent portion 223 of the caulking structure is bent to closely contact with an inner peripheral surface of the flange 219, caulking the bent

portion and the flange so as to embrace the flange 219 by the caulking structure (see Figure 10). With regard to the other edge of the second guide plate, similar process is carried out to caulk the flange 219 to the engagement
5 slot 220 in the other side plate to complete assembly. Also in the assembly of the second guide plate 210, engagement of the caulking structure with the engagement slot 220 can properly position the caulking structure, positioning the guide plate 210 during assembly.

10 The casing 1 thus assembled has no gap at connecting portions between each of the guide plates 209, 210 and each of the side plates 206, and has the connecting portions provided with an overlapped structure difficult to vibrate. Even if the casing is swung to change the
15 supply air direction, almost no noise called chatter causes. In each of the caulking structure in a caulked state, the first abutting surfaces 215, 221 and the bent portions 217, 223 sandwich the side portion 212 of each of the side plates 206 from inside and outside, and the
20 first abutting surfaces 215, 221 and the bent portions 217, 223 sandwich the flanges 213, 219 to firmly couple the guide plates 209, 210 and the side plates 206, providing a structure difficult to vibrate. Since the casing 1 is assembled without spot welding, the
25 respective parts can be painted before assembly. Painting and keeping of quality at a required level are easier than painting the assembled parts in a large size.

Now, a third embodiment according to the present invention will be described in detail, referring to the accompanying drawings.

In Figures 11-17 is shown the electric motor outer
5 shell according to the third embodiment, which is
suitable to the fan according to each of the first and
second embodiments. The electric motor outer shell 301
according to the third embodiment can be applied to an
electric motor which rotates impellers 302 in a crossflow
10 fan and which has output shafts 303 extending out of the
outer shell 301 by an increased length as shown in Figure
13. The outer shell 301 is prepared by casting or
aluminum die casting, and is constituted by confronting
to outer shell elements 304 divided in two parts at a
15 plane perpendicular to the output shafts 303 and having
the same shape, and jointing the outer shell elements.
Each of the outer shell elements 304 has an end formed
with a hole 305 for outwardly extending one of the output
shafts 303. The hole 305 has an inner side surrounded by
20 a bearing housing portion 306 and an outer side
surrounded by a protection sleeve 307 extending in the
axial direction. The protection sleeve 307 is formed
with each of the outer shell 301 in a one-piece
construction so as to provide a cylindrical portion
25 having an inner diameter slightly greater than the outer
diameter of the extending output shaft 303. A portion of
each of the output shafts 303 which extends from the

outer shell 301 is rotatably covered by the protection sleeve 301 except for an end portion of each of the output shafts with the impeller 302 as a driven member carried thereon as shown in Figure 13. The protection
5 sleeve 307 has the inner periphery of a projection edge thereof formed with a projection 308 around and near to the extending output shaft 303.

Each of the outer shell elements 304 has two mounting legs 309 arranged side by side in a circumferential
10 direction thereof so as to project in a radial direction for mounting of the electric motor. Each of the outer shell elements 304 has an abutting surface 310 formed with an engagement structure of projections 311 and recesses 312, which are symmetrical with each other with
15 respect to a center line of the outer shell elements 304 as shown in Figures 14 and 15. The engagement structure may be constituted by ridges 313 curved in the circumferential direction and grooves 314 engageable with the ridges as shown in Figures 16 and 17. Each of the
20 outer shell elements 304 has three flanges 316 arranged side by side at portions near to the abutting surface 310 thereon in the circumferential direction, which have holes 315 to tighten therethrough in such a state that the outer shell elements 304 are jointed at the abutting
25 surfaces 310 thereof.

The outer shell 301 of the electric motor is constituted by confronting the outer shell elements 304

having the same shape, contacting the abutting surfaces 310 thereof to bring each of the engagement structures into engagement and tightening the flanges 316 of each of the outer shell elements with bolts. Each of the output
5 shafts 303 of the electric motor extends outwardly through the protection sleeve 307, and has the exposed edge formed with the driven member such as the impeller 302. The outer shell 301 can be produced with a single mold. During assembly, engagement of the engagement
10 structures formed on the abutting surfaces 310 leads to positioning of the outer shell elements 304, making the positioning easily without use of e.g. a surface plate. Since the outer shell is constituted by the two outer shell elements 304 having the same shape, the mounting
15 surfaces of the mounting legs 309 can be made flat easily, and the outer shell elements are difficult to be out of alignment, providing the outer shell 301 with good assembly precision. Since each of the output shafts 303 which extend out of the outer shell 301 has almost the
20 entire portion covered by the protection sleeve 307, the inner wall of the protection sleeve 307 prevents the output shaft from whirling or flexing even if an external force is applied to the output shaft during e.g. transportation. In particular, the provision of the
25 projection 308 on the protection sleeve 307 at a portion near to the output shaft 303 can constrain even slight whirling of the output shaft 303. The provision of the

protection sleeves 7 on the outer shell 301 in a one-piece construction can minimize limitations required to the installing location of the motor, and provide a simpler structure and easier assembly in comparison with
5 a case wherein separate members are used to prevent each of the output shafts from whirling.

Each of the protection sleeve 307 may be formed with the outer shell 301 constituted by divided parts. The protection sleeve may be provided on an electric motor
10 which has a single output shaft 303 extending therefrom. The protection sleeve may be applied to an electric motor which can be used as a driving source for various devices wherein a driven member is not the impeller 302.

In Figures 18 and 19 is shown the electric motor
15 outer shell according to a fourth embodiment. As seen from these Figures, the electric motor outer shell according to this embodiment is the same as the electric motor 301 according to the third embodiment in terms of a basic structure. Parts identical to these in the third
20 embodiment are indicated by the same reference numerals as the third embodiment, and explanation of these parts will be omitted.

In the electric motor outer shell according to this embodiment, engagement structures like those provided on
25 the abutting surfaces 310 in the third embodiment are provided on opposed surfaces of the mounting legs 309 of the outer shell elements 304 in a symmetrical relation.

Each of the engagement structures according to this embodiment is constituted by a projection 317 and a recess 318 engageable with the projection, the projection and the recess are arranged in a symmetrical relation
5 with respect to the center line of the outer shell elements 304, and the projection 317 is provided on one of the legs 309 of one of the outer shell elements while the recess 318 is provided on the other leg 309 of the one outer shell element. The engagement structures
10 according to this embodiment can offer advantages similar to the engagement structures according to the third embodiment. According to this embodiment, the mounting surface of the legs 309 can be made flat more easily. The outer shell 301 according to this embodiment may also
15 have the engagement structures on the abutting surfaces 310 according to the third embodiment.

Now, a fifth embodiment of the present invention will be described in detail, referring the accompanying drawings.

20 In Figures 20-24 is shown a vibration isolating fitting device according to the fifth embodiment which is suitable to the fan according to the present invention. The vibration isolating fitting device is used to mount a device 401 such as the fan according to the present
25 invention to e.g. ceiling. As shown in Figure 20, the device 401 has a plurality of mounting pieces 402 in a flange shape, which are coupled to mounting flanges 403

as supporting members such as the ceiling. Each of the supporting pieces is coupled to a corresponding mounting flange by a bolt 406 and a nut 407 with a first vibro-isolating element 404 and a second vibro-isolating
5 element 405 interposed therebetween. Each of the mounting pieces 402 and each of the mounting flange 403 have an engagement hole 408 having a greater diameter than the bolt 406 so as to be in alignment each other.

The first vibro-isolating element 404 and the second
10 vibro-isolating element 405 have the same basic structure. As shown in Figure 22, each of the first and second vibro-isolating elements has an elastic material 409 such as a vibro-isolating rubber and a spring offering a vibro-isolating function, which has both end
15 surfaces sandwiched by metal fittings 410, 413, 418. In the first vibro-isolating element 404, the elastic material 409 in a cylindrical shape has an end formed with the metal fitting 410 in a disk shape and the other end formed with the metal fitting 413 which has a sleeve
20 shape of cylindrical supporter 411 extending from a central portion thereof. The elastic material 409 have a cylindrical projection 419 formed thereon, which is arranged in the cylindrical supporter. The disk shape of metal fitting 410 has a through hole 412 formed therein
25 to pass the bolt 406. The elastic material 409 has a central hole 417 formed therein to have a greater diameter than the through hole 412. The central hole 417

may be formed so as to accept a stopper 416. The cylindrical support 411 has an outer diameter enough to enter the engagement hole 408 of a mounting piece 402, and a length enough to project out of the mounting piece 5 402. The cylindrical projection 419 of the elastic material 409 is fitted the inner wall of the cylindrical supporter.

In the second vibro-isolating element 405, the cylindrical elastic material 409 has both ends formed 10 with the metal fittings 410 and 418 in a disk shape. One of the metal fittings 410 has a central portion formed with the through hole 412 to accept the bolt 406. The other metal fitting 418 has a central portion formed with an engagement hole 414 to accept the cylindrical 15 supporter 411 of the metal fitting 413 of the first vibro-isolating element 404. The engagement hole 414 has projections 415 inwardly projecting from opposite locations thereof to slightly reduce the diameter of the engagement hole as shown in Figure 23. The projections 20 415 can be elastically deformed to be caught on the periphery of the cylindrical support 411 when the cylindrical supporter is passed into the engagement hole. The elastic material 409 has a central hole formed to be constituted by two stepped portions, one of which has the 25 same shape as the engagement hole 414 in the metal fitting 418 and the other 420 of which is formed to have an inner diameter enough to accept the bolt 406. The

latter portion 420 of the central hole may be formed to accept the stopper 416. The engagement hole 414, the projections 415 and the central hole in the elastic material 409 having the same shape as the engagement hole
5 414 provide an engagement structure to put the cylindrical supporter 411 in engagement and capture.

The central hole of the elastic material 409 in the first vibro-isolating element 404 and that in the second vibro-isolating element 405 have the stopper 416 in a
10 sleeve shape arranged therein (see Figures 22 and 24). The stopper 416 has a central portion formed with a through hole to accept the bolt 406, and has an end contacted with the inner edge of the hole 417 in the projection 419 of the first vibro-isolating element 404
15 and the other end arranged in the hole 420 in the elastic material 409 of the second vibro-isolating element 405 with a gap 431. The cylindrical supporter 411 may be provided on the second vibro-isolating element 405, and the engagement structure may be provided on the first
20 vibro-isolating element 404.

The vibration isolating fitting device having such a structure is used so that the first vibro-isolating element 404 has the cylindrical supporter 411 passed into the engagement hole 408 in each of the mounting pieces
25 402 from one side of the mounting piece so as to be projected from the other side of the mounting piece 402, and the stopper 416 is inserted into the projected end of

the cylindrical supporter 411 until the stopper has an end contacted with the metal fitting 410 of the first vibro-isolating element. After that, the engagement structure of the second vibro-isolating element 405 is engaged with the projected cylindrical supporter 411 to sandwich the mounting piece 402 between the first vibro-isolating element 404 and the second vibro-isolating element 405. At this time, the cylindrical supporter 411 has the periphery elastically caught by the projections 415 of the engagement hole 414 to bring the first and second vibro-isolating elements 404, 405 in coupling, providing coupling difficult to be easily disengaged (see Figure 21). Then, the metal fitting 410 of the second vibro-isolating element 405 is contacted with each of the mounting flange 403 as the supporting members, the engagement hole 408 in the mounting flange is aligned with the through hole 412 of the second vibro-isolating element, the bolt 406 is passed through both holes, and the nut 407 is engaged with the bolt to fixedly clamp the first vibro-isolating element 401, the mounting piece 402, the second vibro-isolating element 405 and the mounting flange 403, mounting the device 401 in a vibration isolating state.

If the bolt 406 and the nut 407 are excessively tightened, the elastic material 409 in each of the vibro-isolating elements is excessively compressed, reducing the vibration isolating function. In the vibration

isolating fitting device, the stopper has a length which is shorter than the sum of the thickness of the first vibro-isolating element 404 and that of the second vibro-isolating element 405. In the case of excessive
5 tightening, the gap 431 on the other end of the stopper 416 disappears to make further tightening of the bolt 406 and the nut 407 impossible, preventing the bolt 406 and the nut 407 from being excessively tightened. Although the vibration isolating function is mainly offered to
10 vibration in the center line direction of the bolt 406, the projection 419 of the elastic material 409 in the cylindrical supporter 411 effectively functions to vibration in a direction perpendicular to the center line of the bolt 406.

15 The vibration isolating fitting device can be supplied in such a state that the first and second vibro-isolating elements 404, 405 are mounted to each of the mounting pieces 402 to the device 401 in a proper mounting way as stated earlier. The vibration isolating
20 fitting device has not any need of remounting the vibro-isolating elements in a proper mounting way during mounting of the device, and provides simple mounting operation and good operability. The vibration isolating fitting device can be free from an improper mounting
25 wherein the first and second vibro-isolating elements 404, 405 are eliminated.

In Figure 25 is shown the vibration isolating

fitting device according to a sixth embodiment. As seen from these Figures, the sixth embodiment has the same basic structure as the fifth embodiment. Identical parts to those of the fifth embodiment are indicated by the same reference numerals as the fifth embodiment, and explanation on these parts will be omitted.

In the vibration isolating fitting device according to the sixth embodiment, the stopper 416 shown in the fifth embodiment has is replaced by the cylindrical supporter 411 of the first vibro-isolating element 404 in an extended length. The cylindrical supporter 411 functions to prevent the bolt 406 and the nut 407 from being excessively tightened, eliminating the stopper 416 has a separate part. Such arrangement can decrease the number of required parts, reducing cost. The sixth embodiment is the same as the fifth embodiment in terms of other structure, function and advantages.



CLAIMS:

1. A fan comprising:
 - an electric motor having an output shaft and an outer shell;
 - 5 an output shaft extending out of the outer shell;
 - an impeller carried on an end of the output shaft;
 - the output shaft having an increased projection length;
 - a mounting plate through which the output shaft
 - 10 passes and which confronts a side of the outer shell with the output shaft extending therefrom; and
 - a space provided between the mounting plate and the motor to collectively arrange electrical parts required for operation of the fan.
- 15 2. The fan according to Claim 1, further comprising:
 - the motor having a second output shaft;
 - the second output shaft extending form a side
 - opposite to the side of the outer shell with the first output shaft extending therefrom;
 - 20 the second output shaft having an end provided with an impeller;
 - a plurality of fan casings surrounding the respective impellers and swinging to change a supply air direction;
 - at least the first output shaft having the increased
 - 25 projection length;
 - the electrical parts including an electric motor for swinging the fan casings.



3. The fan according to Claim 1 or 2, wherein the first output shaft has an entire portion except for the end rotatably covered by a protection sleeve which is formed with the outer shell in a one-piece construction, the protection sleeve having an end supported by the mounting plate.
4. The fan according to any one of Claims 1-3, further a spacer projecting out of the outer shell to fix the mounting plate to the spacer.
5. The fan according to any one of Claims 1-4, wherein the mounting plate is formed in an L-character shape so as to be constituted by a first piece confronting the outer shell of the motor and a second piece extending substantially perpendicularly from the first piece toward the motor, the first piece and the second piece having the electrical parts mounted thereto.
6. The fan according to any one of Claims 1-5, wherein the mounting plate have the electrical parts mounted thereto before mounting of the mounting plate.
7. The fan according to Claim 1, further comprising a casing for surrounding the impeller;
- the casing inspiring air in a radial direction from a part of a peripheral portion of the impeller rotating therein, passing the air along the remaining part of the peripheral portion and blowing out the air in a radial direction;

the casing including two side plates and a guide



plate, each of the side plates having a substantially disk shape of side portion and a substantially cylindrical flange outwardly extending from a peripheral edge of the side plate in an axial direction of the

5 motor, the guide plate arranged near to the peripheral portion of the impeller to change a supply air direction, the guide plate extending between the side plates, fixed to the side plates and keeping the side plates apart from each other at a distance in a confronting state; and

10 the guide plate having ends confronting the respective side plates, each of the ends provided with a caulking structure constituted by a first abutting surface to contact with a peripheral portion of the side portion of one of the side plates, a second abutting

15 surface to contact with a peripheral portion of the flange and a bent portion to contact with a free edge of the flange;

wherein the flange of each of the side plates is engaged with the caulking structure, and the bent portion

20 is bent to embrace the flange so as to fix the guide plates to each of the side plates in a caulking state.

8. The fan according to Claim 7, wherein the flange has a cutout formed therein at a portion thereof to be engaged with the caulking structure of one of the side

25 plates so as to reduce a projection length.

9. The fan according to Claim 1, further comprising a casing for surrounding the impeller;



the casing inspiring air in a radial direction from a part of a peripheral portion of the impeller rotating therein, passing the air along the remaining part of the peripheral portion and blowing out the air in a radial
5 direction;

the casing including two side plates and a guide plate, each of the side plates having a substantially disk shape of side portion, the guide plate arranged near to the peripheral portion of the impeller to change a
10 supply air direction, the guide plate extending between the side plates, fixed to the side plates and keeping the side plates apart from each other at a distance in a confronting state;

the side portion of each of the side plates having an
15 elongated engagement slot formed therein so as to have an inner edge formed with a flange outwardly extending in an axial direction of the motor; and

the guide plate having ends confronting the respective side plates, each of the ends provided with a
20 caulking structure constituted by a first abutting surface to contact with the inner edge of the engagement slot, a second abutting surface to contact with an outer surface of the flange and a bent portion to contact with a free edge of the flange, the caulking structure
25 engageable with the engagement slot;

wherein the flange of each of the side plates is engaged with the caulking structure, and the bent portion



is bent to embrace the flange so as to fix the guide plates to each of the side plates in a caulking state.

10. The fan according to Claim 1, wherein the outer shell has a protection sleeve formed therewith in a one-piece
5 construction to rotatably cover the entire output shaft in close proximity thereto except for the end of the output shaft.

11. The fan according to Claim 10, wherein the protection sleeve has an end formed with a projection around and
10 closely to the output shaft.

12. The fan according to Claim 10 or 11, wherein the outer shell is constituted by two outer shell elements having the same shape which are divided at an imaginary plane perpendicular to the output shaft, which are made
15 of casting or die-casting, and which are jointed to confront each other.

13. The fan according to Claim 12, wherein each of the outer shell elements has an abutting surface at which the outer shell elements are jointed, and the abutting
20 surface has engagement structures formed thereon in a symmetrical relation.

14. The fan according to Claim 13, wherein the engagement structures comprise a projection and a recess engageable with the projection.

25 15. The fan according to Claim 13, wherein the engagement structures comprise a ridge and a groove engageable with the ridge.



16. The fan according to any one of Claims 12-15, wherein each of the outer shell elements has an outer periphery formed with a mounting leg in a one-piece construction, and each mounting leg has an abutting surface at which
5 the outer shell elements are jointed, and the abutting surface has engagement structures formed thereon in a symmetrical relation.

17. The fan according to Claim 1, wherein there is provided a vibration isolating mounting device which uses
10 a bolt and a nut to mount a mounting piece to a supporting member so as to confront the supporting member, which is constituted by a first vibro-isolating element arranged on one side of the mounting piece and a second vibro-isolating element arranged on the other side
15 of the mounting piece, which confronts the mounting piece to the supporting member so as to interpose the second vibro-isolating element between the mounting piece and the supporting member, wherein the bolt is passed through the first vibro-isolating element, the mounting piece,
20 the second vibro-isolating element and the supporting member, and the nut is engaged with the bolt to tighten the first vibro-isolating element, the mounting piece, the second vibro-isolating element and the supporting member, wherein one of the first vibro-isolating element
25 and the second vibro-isolating element has one end formed with a cylindrical supporter which is acceptable in an engagement hole formed in the mounting piece and has a



through hole formed at a central portion thereof to accept the bolt, wherein the other of the first vibro-isolating element and the second vibro-isolating element has an engagement structure to put the cylindrical
5 supporter in engagement and capture, and wherein the first vibro-isolating element and the second vibro-isolating element can be mounted to the mounting piece so as to sandwich the mounting piece therebetween even if the bolt is not passed and the nut is not engaged with
10 the bolt.

18. The fan according to Claim 17, wherein the cylindrical supporter of the vibration isolating mounting device works as a stopper to prevent the first vibro-isolating element and the second vibro-isolating element
15 from being excessively compressed.

19. The fan according to Claim 17, wherein the vibration isolating mounting device has a stopper arranged between the first vibro-isolating element and the second vibro-isolating element to prevent the first vibro-isolating
20 element and the second vibro-isolating element from being excessively compressed.

20. The fan according to Claim 19, wherein the stopper of the vibration isolating mounting device is formed in a cylindrical shape so as to provide a bolt passing portion
25 for passing the bolt, and the stopper has a length which is shorter than the sum of a thickness of the first vibro-isolating element and that of the second vibro-



- 52 -

isolating element.