

## DESCRIPTION

### SOUND-INSULATING PACKAGE

#### TECHNICAL FIELD

**[0001]** The present invention relates to a sound-insulating package which can prevent noise of a noise source housed inside from leaking outside through an opening part, and in particular, to a sound-insulating structure of a door included in a sound-insulating package.

#### BACKGROUND ART

**[0002]** Conventionally, because of excellence in efficiency and the like, screw compressors have been utilized in various fields. In each of such screw compressors, noise which exceeds 100 dB is generated from mechanical parts. Therefore, in consideration of working environment for a worker, enclosing the mechanical parts of each of the screw compressors by a case-like sound-insulating package for the purpose of sound-insulating is conducted in general.

**[0003]** In addition, even in a case where the periphery of each of the screw compressors is enclosed by the sound-insulating package, in order to ensure convenience in assembling work and maintenance work of the mechanical parts, it is required to provide an opening part for the sound-insulating package. Additionally, in order to allow the opening part to be closed after finishing the maintenance work and the like, the opening part is provided with a door or a lid.

**[0004]** However, even by providing the door or the lid, noise leaking through the opening part cannot be eliminated. This is because if the

door is unstably fixed or even a slight step difference on the periphery of the door or the lid is present, a gap between the periphery of the door or the lid and a main body is caused, thereby deteriorating sound-insulating performance of the door or the lid.

**[0005]** Therefore, sound-insulating packages which hardly cause the above-mentioned deterioration of the sound-insulating performance have been proposed in Patent Document 1 and Patent Document 2.

**[0006]** For example, in Patent Document 1, a sound-insulating package which allows a reliable reduction in noise leakage, which is attained by stably sealing a gap regardless of a closure degree, has been disclosed. The above-mentioned sound-insulating package in Patent Document 1 includes: a main body having an opening part and housing a noise source therein; a tabular door closing the opening part; and a seal member provided around the door on a surface of an inner side. This sound-insulating package includes a folded part to maintain a state in which a thickness of the seal member in a state in which the opening part is closed is thinner than a thickness in which the opening part is opened, and the folded part and a frame of the main body contact each other, thereby determining an interval between the door in the closed state and the main body and maintaining the interval.

**[0007]** In addition, in Patent Document 2, a sound-insulating package which has an opening/closing door and allows a waterproof structure of a housing, which can completely inhibit entering of rain water, to be provided, has been disclosed.

**[0008]** In the above-mentioned sound-insulating package in Patent

Document 2, an opening part of a main body of the housing is opened and closed by a pivotably supported door, a protrusion is formed around the opening part, a seal member which is pressed against the protrusion is provided on an inner surface of the door, an outer seal member is provided around the opening part except for a door supporting part of the main body of the housing, an inner seal member is provided along the door supporting part of the door, the protrusion closely contacts the seal member in a state in which the door is closed, a frame edge of the door except for the door supporting part closely contacts the outer seal member, and the inner seal member closely contacts the main body of the housing.

#### PRIOR ART DOCUMENTS

#### PATENT DOCUMENTS

#### **[0009]**

Patent Document 1: Japanese Patent Laid-open Publication No. 2014-219662

Patent Document 2: Japanese Patent Laid-open Publication No. 2004-063785

#### SUMMARY OF INVENTION

#### PROBLEMS TO BE SOLVED BY THE INVENTION

**[0010]** Incidentally, although as a material of a seal member (packings), a material such as rubber is used in general, the rubber does not prevent sound transmission at 100%. Therefore, as in Patent Document 1, using

the configuration in which the folded part of the package and the frame of the main body contact each other and the seal member in combination is effective to reduce noise leakage.

**[0011]** However, in recent years, the need for screw compressors each having a large size has been growing and in accordance therewith, a size of a package tends to increase. Even when the size of the package is increased as mentioned above, since various countermeasures to cope with sound leaking through an opening part such as a duct can be adopted, a reduction in noise leaking from the duct and the like is comparatively easy.

**[0012]** On the other hand, however, it is concerned that the noise based on sound leaking from a gap of a door rather increases in accordance with an increase in the size of the package. In proportion to an increase in a size of the door, a distortion amount of the door increases and a gap formed between the door and an opening part also becomes long. In this case, an area of a leaking portion which causes the noise leakage increases, and it is highly likely that leaking of the noise is worsened.

**[0013]** In addition, although as with the sound-insulating package in Patent Document 2, there is a method in which a plurality of seal members are used, the method has problems such as a problem of costs and a problem in that it takes time to conduct assembly.

**[0014]** In view of the above-mentioned problems, the present invention has been devised, and an object of the present invention is to provide a sound-insulating package which can reliably prevent sound from leaking outside from a gap even when a size of the sound-insulating package is

increased, without increasing manufacturing costs and labor for assembly.

#### MEANS FOR SOLVING THE PROBLEMS

**[0015]** In order to solve the above-mentioned problems, in a sound-insulating package of the present invention, the following technical means are devised. In other words, the sound-insulating package of the present invention includes: a package main body which houses a noise source inside and includes an opening part; a door which is operable to close the opening part of the package main body; and a sound-insulating structure which is provided between the package main body and the door and is operable to insulate noise of the noise source, and around the opening part, opening peripheral surfaces, all of which are located on a same plane, are formed, and on an outer peripheral side of the door, folded pieces which are folded toward a side of the package main body and whose all of end portions on the side of the package main body are located on a same plane are provided, the sound-insulating structure including: packings which are provided onto the folded pieces on the side of the package main body and contact the opening peripheral surfaces when the opening part is closed by the door; and sound absorption members which are provided further on a door central side than the folded pieces and become thinner by contacting the opening peripheral surfaces when the opening part is closed by the door than when the opening part is opened.

**[0016]** Note that preferably, it is desirable that each of the folded pieces

includes: on a periphery of the door main body being provided in a central portion of the door, a first folded piece which is folded toward the side of the package main body and is formed in a direction intersecting a surface of the package main body, and on a leading end of each of the first folded pieces, a second folded piece which is folded toward an inner side in a width direction and is formed in a direction parallel with each of the opening peripheral surfaces, each of the packings is attached onto each of the second folded pieces, and each of the sound absorption members is formed to be thicker than a thickness from the door main body up to each of the second folded pieces.

**[0017]** Note that preferably, it is desirable that on one end side of the door in a width direction, hinges which pivotably support the door to the package main body in a rotatable manner are provided, on another end side of the door in the width direction, fixing parts which fix the door to the package main body are provided, the hinges whose number is two are provided at upper and lower portions of the door, and the opening peripheral surfaces are extended further up to the door central side of the door than positions where the hinges are provided.

**[0018]** Note that preferably, it is desirable that as the packings, rubber packings, each of which has a fitting part being attached onto each of the second folded pieces, with each of the second folded pieces being interposed, and a hollow part whose inside is made hollow, are used.

#### EFFECT OF THE INVENTION

**[0019]** By employing a sound-insulating package of the present

invention, even when a size of a sound-insulating package is increased, sound is reliably prevented from leaking outside from a gap without increasing manufacturing costs and labor for assembly.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0020]** Fig. 1 is an external view of a sound-insulating package of the present embodiment;

Fig. 2 is a diagram illustrating an A portion in Fig. 1 in an enlarged manner and illustrating an opening part of the sound-insulating package;

Fig. 3 is a schematic view illustrating a manner in which a cross-sectional structure of the sound-insulating package changes in accordance with opening and closing of the opening part (first embodiment);

Fig. 4A is a schematic view of a cross section viewed along line B-B in Fig. 2, illustrating a cross-sectional structure of a portion where a hinge is provided in a state in which a door is opened (second embodiment);

Fig. 4B is a schematic view of a cross section viewed along line B-B in Fig. 2, illustrating a cross-sectional structure of the portion where the hinge is provided in a state in which the door is closed (second embodiment);

Fig. 5A is a schematic view of a cross section viewed along line C-C in Fig. 2, illustrating a cross-sectional structure of a portion where the hinge is not provided in the state in which the door is opened (second embodiment);

Fig. 5B is a schematic view of a cross section viewed along line C-C in Fig. 2, illustrating a cross-sectional structure of the portion where the hinge is not provided in the state in which the door is closed (second embodiment).

#### DESCRIPTION OF EMBODIMENTS

**[0021]** Hereinafter, embodiments of a sound-insulating package 1 according to the present invention will be described in detail with reference to the accompanying drawings.

**[0022]** The sound-insulating package 1 of the present invention includes: a package main body 3 which houses a noise source inside and has an opening part 2; a door 4 which is operable to close the opening part 2 of the package main body 3; and a sound-insulating structure 5 which is provided between the package main body 3 and the door 4 and is operable to insulate noise of the noise source. This sound-insulating package 1 is equipped in such a way as to enclose the periphery of the noise source, thereby serving as a housing which is operable to shield the noise source from outside, and prevents the noise emitted from the noise source from leaking outside.

**[0023]** Specifically, the sound-insulating package 1 is provided with the opening part 2 so as to allow maintenance and various operations to be implemented from outside for equipment of the noise source housed thereinside. Additionally, the opening part 2 is provided with the door 4 which is operable to close this opening part 2, and between the package main body 3 and the door 4, the sound-insulating structure 5 which is

operable to prevent the noise of the noise source from leaking outside from a gap of the opening part 2.

**[0024]** Note that although as the opening part 2 which is provided with the sound-insulating structure 5 of the present invention, a small window obtained by opening a part of a wall surface of the housing is also included, one wall surface of a plurality of wall surfaces constituting the housing is detached and an opening formed by detaching the one wall surface is also included as the opening part 2 of the present invention. In the present embodiment, by citing an example in which the opening formed by detaching the wall surface is the opening part 2, the sound-insulating package 1 of the present invention will be described in detail.

**[0025]** Next, the package main body 3, the opening part 2 of the package main body 3, and the door 4 which is operable to close the opening part 2, which constitute the sound-insulating package 1, will be described.

**[0026]** First, the noise source housed in the package main body 3 will be described.

**[0027]** In the package main body 3, equipment or the like which has a mechanism emitting large noise in operation is housed as the noise source. As the above-mentioned equipment emitting the noise, besides a screw compressor cited in the present embodiment, equipment having a pump whose operating sound is large or the like is cited.

**[0028]** The package main body 3 is provided in such a way as to enclose the above-mentioned noise source and shields an inside, where the noise source is housed, from outside, thereby inhibiting the noise from leaking outside. Specifically, the package main body 3 of the present

embodiment includes: a base panel 6 on which the noise source can be placed; a plurality of frame parts 7 which is equipped on an outer peripheral side of the base panel 6 in such a way as to enclose the noise source from the periphery thereof; the door 4 which is equipped between the frame parts 7 arranged in parallel with each other and is operable to close a void space (the opening part 2) formed between the frame parts 7; and a top panel 8 which is equipped on upper portions of the frame parts 7 and the door 4.

**[0029]** In other words, the package main body 3 has a structure in which the noise is confined inside the housing, by equipping members such as the above-mentioned base panel 6, frame parts 7, door 4, and top panel 8 on upper, lower, right, left, front, and rear sides of the noise source.

**[0030]** Note that in a case of the sound-insulating package 1 of the present embodiment, hinges 9 and fixing parts 10 are provided between the door 4 and the frame parts 7 and by using these members, the door 4 can be attached to the frame parts 7 as a hinged door. In other words, in the sound-insulating package 1 of the present embodiment, the void space between the frame parts 7 is used as the opening part 2 and this opening part 2 is openable and closable by the door 4.

**[0031]** Hereinafter, the base panel 6, the top panel 8, pillars, and the door 4 which constitute the package main body 3 in the sound-insulating package 1 of the present embodiment will be described.

**[0032]** As shown in Fig. 2, the base panel 6 is a rectangular (platy) member whose dimension in a vertical direction is small, as compared

with dimensions in a horizontal direction (a front-back direction and a right-left direction) and is formed to be of a rectangular shape which is long in the right-left direction, viewed from above. Note that the base panel 6 may be of other shape such as a substantially square shape. In a central portion of the base panel 6, the noise source, not shown, is placed.

**[0033]** In addition, on an upper surface of the above-mentioned base panel 6 on an outer peripheral side, the plurality of frame parts 7 is equipped along the vertical direction or the horizontal direction. These frame parts 7 whose number is plural are equipped in such a way as to be in parallel with each other and to be spaced apart from each other in the horizontal direction or the vertical direction. Between the frame parts 7, arranged in parallel with each other, of the plurality of frame parts 7, the door 4 is provided.

**[0034]** Specifically, the above-mentioned frame parts 7 include vertical frames 11 which are equipped along the vertical direction and horizontal frames 12 which are equipped along the horizontal direction.

**[0035]** The vertical frames 11 are long rod-like members which are provided in a standing manner on the outer peripheral side of the base panel 6 and are members referred to as pillars in general. Lower ends of the vertical frames 11 are fixed on the outer periphery of the base panel 6 by using bolts or the like. In addition, upper ends of the vertical frames 11 are fixed on a lower surface of the top panel 8 on an outer peripheral side by using bolts or the like. In other words, the vertical frames 11 are attached in a state in which two points of the base panel 6 and the top

panel 8 are coupled in the vertical direction (a state in which upper and lower portions are connected).

**[0036]** The horizontal frames 12 are members which couple the vertical frames 11 in the horizontal direction which are equipped in such a way as to face each other and as the horizontal frames 12, L-shaped angles or the like are used in general. The horizontal frames 12 include a horizontal frame 12 which is laid in the horizontal direction between the upper ends of the above-mentioned vertical frames 11 and a horizontal frame 12 which is laid in the horizontal direction between the lower ends of the vertical frames 11.

**[0037]** In other words, the above-mentioned frame parts 7 are formed by combining, in a parallel cross pattern, a pair of the vertical frames 11 which are equipped to be in parallel with each other and to be spaced apart from each other in the horizontal direction and face in the vertical direction and a pair of the horizontal frames 12 which are equipped to be in parallel with each other and to be spaced apart in the vertical direction and face in the horizontal direction. Additionally, in the central portion of the frame parts 7 combined in the parallel cross pattern, the opening part 2 is formed.

**[0038]** In other words, the "opening part 2" in the sound-insulating package 1 of the present embodiment is a portion which is enclosed by the horizontal frames 12 and the vertical frames 11 which are mutually combined in the parallel cross pattern, and an "opening peripheral surfaces 13" formed around the opening part 2 is nothing less than a surface of the horizontal frames 12 and the vertical frames 11 combined

in the parallel cross pattern (a surface facing outside).

**[0039]** In an example shown in Fig. 1, for example, five vertical frames 11 are provided in a standing manner on a front face side (front side in Fig. 1) in such a way as to be equally spaced apart in the right-left direction and similarly, five vertical frames 11 are provided in a standing manner on a rear face side (depth side in Fig. 1). In addition, among these vertical frames 11, between the vertical frames 11 neighboring in the right-left direction and the front-back direction, the horizontal frames 12 are laid respectively between upper end sides and between lower end sides. In other words, in the sound-insulating package 1 shown in Fig. 1, respectively between the vertical frames 11 whose number is ten, the horizontal frames 12 whose number is 16 are laid, and eight opening parts 2 in total can be formed.

**[0040]** Note that with reference to Fig. 2, by citing an opening part 2 on a leftmost side among four opening parts 2 on a front face (which open forward) as an example, relationship between the opening part 2 and the sound-insulating structure 5 will be described.

**[0041]** As shown in Fig. 2, the vertical frame 11 on a left side of the above-mentioned opening part 2 is provided with hinges 9 which pivotably support the later-described door 4. One hinge 9 is provided at an upper portion of the vertical frame 11 and another hinge 9 is provided at a lower portion thereof, respectively, and the two hinges 9 in total are provided at the upper and lower portions. In addition, the vertical frame 11 on a left side of the above-mentioned opening part 2 (the "left side" here means a left side in a state in which the door 4 is opened in Fig. 2)

is provided with fixing parts 10 which fix the door 4 to the vertical frame 11. In an example shown in Fig. 2, the fixing parts 10 are provided at substantially the same heights at which the hinges 9 are provided and a number thereof is the same as that of the hinges (the two pieces in total at the upper and lower portions).

**[0042]** The above-mentioned hinges 9 are members which pivotably support the door 4 with respect to the frame parts 7 of the package main body 3. Each of the hinges 9 in the present embodiment has a first member 9a which is attached on a side of the vertical frame 11 and a second member 9b which is attached on a side of the door 4. The first member 9a is rotatable with respect to this second member 9b around an axis facing in the vertical direction and allows pivotable supporting of the door 4 to the package main body 3.

**[0043]** In addition, hooks of the fixing parts 10 which are provided for one of the door 4 or the package main body 3 are hooked in an engageable and disengageable manner to hook stoppers which are provided for another of the door 4 or the package main body 3, thereby enabling the door 4 to be fixed to the package main body 3.

**[0044]** Note that it is desirable that the number of the above-mentioned hinges 9 fixing parts 10 provided is two, rather than three or more. If the hinges 9 and the fixing parts 10 whose each number is three or more are provided, there may be a case where the door 4 is not easily opened and closed because influence of tolerance is exerted thereon, and it is also likely that distortion of the door 4 is increased and a gap between the frame parts 7 and the door 4 is increased 8 (an area in which sound leaks

is increased). In addition, since there may be a case where packings 17 cannot be provided in portions where the hinges 9 are provided as described later, it is desirable that the number of the provided hinges 9 is small. Therefore, in a case where enhancement in sound-insulating performance is considered, it is preferable that the number of each of the hinges 9 and fixing parts 10 provided is limited to two.

**[0045]** The top panel 8 is a member which is equipped further on an upper side than the frame parts 7 and the door 4 and is operable to close an upper opening of the housing which is formed by the frame parts 7 and the door 4. The top panel 8 is a platy member, whose dimensions in the front-back direction and the right-left direction are substantially the same as those of the base panel 6, and is provided along the horizontal direction in such a way as to have a distance above the base panel 6 and to be in parallel with the base panel 6.

**[0046]** The door 4 is a platy member which is operable to close the opening part 2 of the above-mentioned package main body 3 and is formed in such a way that a dimension thereof in the right-left direction and a dimension thereof in the vertical direction are slightly wide, as compared with those of the opening part 2. In other words, an outer peripheral side of the above-mentioned door 4 is attached in a position in such a way as to be superposable on the frame parts 7 of the package main body 3 when the door is closed and can contact the opening peripheral surfaces 13 of the opening part 2 in a surface state. Additionally, between the outer peripheral side of this door 4 and the opening peripheral surfaces 13 (surface of the frame parts 7) of the

package main body 3, the sound-insulating structure 5 which is the feature of the present invention is provided.

**[0047]** Specifically, as shown in Fig. 2, the above-mentioned door 4 has a door main body 14 (main body part of the door 4) which is of a rectangular shape long in the vertical direction when viewed from a front face. In other words, this door main body 14 is formed as a quadrangular metal plate which is vertically long and has short upper and lower sides, as compared with right and left sides.

**[0048]** In addition, on an outer peripheral side of the door main body 14, folded pieces 15 which extend in a direction intersecting the door main body 14 and are formed by using a metal plate are provided. These folded pieces 15 are provided on upper, lower, right, and left sides of the door main body 14 and are provided in such a way as to be each folded at an angle of  $90^\circ$  toward a side of the package main body 3 with four upper, lower, right, and left sides of the door main body 14 as borders. For example, with the state in which the door is closed considered as reference, the folded piece 15 on the upper side is a member which extends from an upper side of the door main body 14 toward a rear side in a horizontal direction (when the door 4 is closed, a direction from the outside of the windbreaking package 1 toward an inside, that is, when the door 4 is closed, a direction from a front surface of the door 4 toward a back surface thereof) and is connected to the door main body 14 in such a way as to intersect the door main body 14 at an angle of  $90^\circ$  with the upper side as a border. In addition, the folded piece 15 on the right side is a member which extends from a right side of the door main body

14 toward a rear side in a horizontal direction and is connected to the door main body 14 in such a way as to intersect the door main body 14 at an angle of 90° with the upper side as a border.

**[0049]** All of end portions of the folded pieces 15 on the upper, lower, right, and left sides on a side of the package main body 3 (end portions on a side opposite to a side of the door main body 14) are located on the same plane and are attached in such a way that folded ends of the folded pieces 15 are separated from the opening peripheral surfaces 13 at the same distance when the opening part 2 is closed by the door 4.

**[0050]** Incidentally, the sound-insulating package 1 of the present invention is characterized in that between the package main body 3 (a surface of the frame parts 7 or the opening peripheral surfaces 13) and the door 4, the sound-insulating structure 5 which is operable to insulate the noise of the noise source is provided. This sound-insulating structure 5 conducts sound-insulating by being combined with both of sound absorption members 16 and packings 17, instead of being singly used by using sound absorption members or packings (seal members).

**[0051]** Specifically, in the sound-insulating package 1 of the present invention, all of the opening peripheral surfaces 13 are located on the same plane and all of surfaces of the vertical frames 11 and the horizontal frames 12 which enclose the opening part 2 are located on the same plane.

**[0052]** Additionally, the above-mentioned packings 17 are attached onto the end portions of the folded pieces 15 on a side of the package main body 3 and can contact the opening peripheral surfaces 13 of the package main body 3 (the surfaces of the vertical frames 11 and

horizontal frames 12) when the opening part 2 is closed by the door 4. In addition, the sound absorption members 16 are provided further on a door central side than the folded pieces 15 and a thickness of each of sound absorption members 16 becomes thinner by contacting the opening peripheral surfaces 13 when the opening part 2 is closed by the door 4 than a thickness of each of the sound absorption members 16 is when the opening part 2 is opened by the door 4. In other words, by causing both of the packings 17 and the sound absorption members 16 to contact the surfaces of the vertical frames 11 and the horizontal frames 12, the sound-insulating package 1 of the present invention conducts the sound-insulating by using both of the sound absorption members 16 and the packings 17.

**[0053]** Note that for providing the above-mentioned packings 17 and sound absorption members 16, embodiments described below are considered.

**[0054]** [First Embodiment]

As shown in Fig. 3, a sound-insulating package 1 of a first embodiment has folded pieces 15 on the periphery of a door main body 14 (outer periphery of a door 4), which are folded toward a side of a package main body 3 and formed in a direction intersecting a surface of the package main body 3. As described above, these folded pieces 15 are provided on four sides of the door 4 on an upper side, a lower side, a right side, and a left side. All of end portions (folded leading ends) of these folded pieces 15 on the four sides on a side of the package main body 3 are located on the same plane, and the above-mentioned packings 17 are

attached onto the end portions which are located on the same plane.

**[0055]** In addition, the packings 17 which are provided for the sound-insulating package 1 of the first embodiment are provided on the end portions of the folded pieces 15, which are located on the same plane, and the whole periphery of an opening part 2, excluding portions where hinges 9 are provided. In other words, in the sound-insulating package 1 of the present embodiment, although sound absorption members 16 are provided on the portions where the hinges 9 are provided, the packings 17 are not provided on the portions where the hinges 9 are provided.

**[0056]** Specifically, the packings 17 are formed by using resin (members) having elasticity such as rubber. In addition, the packings 17 are formed to have hollow internal structures and when pressed toward the side of the package main body 3, the packings 17 are elastically deformable. By employing the elastically deformable packings 17 as mentioned above, even in a case where a gap is present between the end portions of the folded pieces 15 and opening peripheral surfaces 13, since the elastically deformed packings 17 enter the gap and close the gap, noise is prevented from leaking outside through the opening part 2.

**[0057]** On the other hand, the sound absorption members 16 provided in the sound-insulating package 1 of the first embodiment are members which are provided further on a door central side than the folded pieces 15 and a thickness of each of the sound absorption members 16 becomes thinner by contacting the opening peripheral surfaces 13 when the opening part 2 is closed by the door 4 than a thickness of each of the

sound absorption members 16 is when the opening part 2 is opened by the door 4, thereby allowing a gap between the opening peripheral surfaces 13 and the door 4 to be closed.

**[0058]** Specifically, these sound absorption members 16 are members having flexibility and compressibility, such as a foamable polyurethane foam material and are attached further on a central side (door central side) of the door main body 14 than the folded pieces 15. Note that although in Fig. 2, illustration of the sound absorption members 16 is omitted, as described above, the sound absorption members 16 are provided further on the door central side than the folded pieces 15. In addition, it is preferable that each of the sound absorption members 16 has a shape slightly larger than each of the "opening peripheral surfaces 13" formed around the opening part 2 and are provided in such a way as to substantially cover a rear surface of the door 4. In other words, it is preferable that the sound absorption members 16 cover the entire surface on a central side of the door main body 14. However, when a portion where the sound absorption members 16 are not attached is only a part of the door main body 14 on the central side, it is also likely that sound absorbability is not much lowered. Therefore, a case where the sound absorption members 16 are not provided on the entire surface of the door central side, that is, also a case where the sound absorption members 16 are provided on a part on the door central side is embraced in the sound-insulating package 1 of the present invention.

**[0059]** In addition, it is desirable that when the opening part 2 is closed by the door 4, the sound absorption members 16 are sandwiched between

the door 4 and the opening part 2 and each of the sound absorption members 16 has a thickness which can be compressed. Specifically, it is preferable that each of the sound absorption members 16 is formed to be thicker than a thickness from the door main body 14 up to each of end portions of the folded pieces 15, that is, a thickness along a front-back direction of the door 4. By forming the sound absorption members 16 having the above-mentioned thickness, since an end surface of the sound absorption members 16 on the side of the package main body 3 protrudes further than end portions of the packings 17 on the side of the package main body 3, and when the opening part 2 is closed by the door 4, the packings 17 contact the opening peripheral surfaces 13 in a surface state and in conjunction therewith, the sound absorption members 16 are also compressed, the gap between the opening peripheral surfaces 13 and the door 4 can be filled by using the sound absorption members 16, thus allowing a stable sound insulation characteristic (sound absorbability) to be exhibited.

**[0060]** As shown in the above-described first embodiment, since by providing the sound-insulating structure 5, which includes both of the packings 17 and the sound absorption members 16, between the package main body 3 and the door 4, the packings 17 and the sound absorption members 16 reliably prevent the noise leaking from the gap of the opening part 2, it is made possible to provide the sound-insulating package 1 which is operable to reliably insulate the noise of the noise source.

**[0061]** In addition, since the sound-insulating package 1 of the first embodiment has a simple structure in which the packings 17 are merely

provided at the leading ends of the folded pieces 15 of the door 4, manufacturing costs and labor for assembly are not increased.

**[0062]** Therefore, even when a size of the sound-insulating package 1 is increased, sound is reliably prevented from leaking outside from the gap without increasing the manufacturing costs and the labor for assembly.

**[0063]** [Second Embodiment]

A sound-insulating package 1 of a second embodiment has folded pieces 15 on the periphery of a door main body 14 as with the sound-insulating package 1 of the first embodiment.

**[0064]** The sound-insulating package 1 of the second embodiment is different from the sound-insulating package 1 of the first embodiment in that leading ends of folded pieces 15 provided on the periphery of the door main body 14 are folded toward a side of a package main body 3 once and the folded leading ends (folded ends) are further folded toward a direction parallel with opening peripheral surfaces 13 (folding at a second time is made), instead of being folded toward the side of the package main body 3 only once.

**[0065]** In other words, each of the folded pieces 15 provided for the sound-insulating package 1 of the second embodiment has a first folded piece 18 which is folded toward the side of the package main body 3 and is formed in a direction intersecting a surface of the package main body 3 on the periphery of the door main body 14 and a second folded piece 19 which is folded toward an inner side in a width direction and is formed on a leading end of the first folded piece 18 in a direction parallel with

each of opening peripheral surfaces 13. Additionally, packings 17 are attached onto the second folded pieces 19, and each of sound absorption members is formed to be thicker than a thickness from the door main body 14 up to each of the second folded pieces 19.

**[0066]** Note that portions where the above-mentioned first and second folded pieces 18 and 19 are provided are limited to portions where hinges 9 are not provided (a cross section viewed along line C-C in Fig. 2). In portions where the hinges 9 are provided (a cross section viewed along line B-B in Fig. 2), due to hinderance of the hinges 9, the second folded pieces 19 are not attached and the above-mentioned packings 17 are also not provided.

**[0067]** Hereinafter, as to the portions where the hinges 9 are provided and the portions where the hinges 9 are not provided, cross-sectional structures of the package main body 3 and a door 4 will be described.

**[0068]** Figs. 4A and 4B illustrate a cross section viewed along line B-B in Fig. 2 and the cross-sectional structures of the package main body 3 and the door 4 in the portions where the hinges 9 are provided in the above-described sound-insulating package 1 of the second embodiment. Note that Fig. 4A illustrates a state in which the door 4 is opened and Fig. 4B illustrates a state in which the door 4 is closed.

**[0069]** As shown in Figs. 4A and 4B, the package main body 3 has the above-mentioned frame parts 7 around an opening part 2. These frame parts 7 constitute a rectangular frame-like member and are provided in such a way as to enclose the periphery of the opening part 2, with the opening part 2 located in a central portion thereof. Among the frame

parts 7, frame parts 7 which are located on a side remote from the opening part 2 (outer peripheral side) are provided in positions where surfaces thereof are flush with a surface of the door main body 14, and frame parts 7 which are located on a side close to the opening part 2 are provided in such a way as to be recessed toward the side of the package main body 3. In other words, the frame parts 7 have opening peripheral surfaces 13 in positions recessed from the surface of the door main body 14 by one step. Additionally, the above-mentioned hinges 9 are provided for these opening peripheral surfaces 13.

**[0070]** Each of the hinges 9 has a first member 9a which is attached onto each of the opening peripheral surfaces 13 and a second member 9b which is attached onto the door main body 14. The first member 9a and the second member 9b of each of the hinges 9 are rotatable around an axis facing in a vertical direction.

**[0071]** The door 4 has first folded pieces 18, on the periphery of the door main body 14, which are folded toward the side of the package main body 3 and are formed in the direction intersecting the surface of the package main body 3. End portions of these first folded pieces 18 on the side of the package main body 3 are terminated in the middle way prior to reaching the opening peripheral surfaces 13 and the packings 17 are not attached onto these end portions.

**[0072]** In addition, the door main body 14 located further on a door central side than the folded pieces 15 is provided with the sound absorption members 16 which become thinner by contacting the opening peripheral surfaces 13 when the opening part 2 is closed by the door 4

than a thickness thereof when the opening part 2 is opened by the door 4. Specifically, the opening peripheral surfaces 13 are extended further up to the door central side than positions where the hinges 9 are provided, and the above-mentioned sound absorption members 16 contact these extended portions.

**[0073]** In the portions where the above-mentioned hinges 9 are provided, the sound absorption members 16 are provided and the packings 17 are not provided. In contrast to this, in the portions where the hinges 9 are not provided, both of the sound absorption members 16 and the packings 17 are provided.

**[0074]** Figs. 5A and 5B illustrate a cross section viewed along line C-C in Fig. 2 and cross-sectional structures of the package main body 3 and the door 4 in the portions where the hinges 9 are not provided in the above-described sound-insulating package 1 of the second embodiment. Note that Fig. 5A illustrates a state in which the door 4 is opened and Fig. 5B illustrates a state in which the door 4 is closed.

**[0075]** As shown in Figs. 5A and 5B, the package main body 3 in the portions where the hinges 9 are not provided, as with the portions where the hinges 9 are provide, has the above-mentioned frame parts 7 around the opening part 2 and the opening peripheral surfaces 13 around the opening part 2 in positions recessed from the surface of the door main body 14 by one step.

**[0076]** On the other hand, on the periphery of the door main body 14, not only the first folded pieces 18 which are folded toward the side of the package main body 3 and are formed in the direction intersecting the

surface of the package main body 3 but also the second folded pieces 19 which are folded toward an inner side in a width direction and are formed on the leading ends of the first folded pieces 18 in a direction parallel with the opening peripheral surfaces 13, and the packings 17 are attached onto these second folded pieces 19.

**[0077]** As each of the packings 17 provided in the sound-insulating package 1 of the second embodiment, a rubber packing or the like, which has a fitting part 20 which is attached onto each of the second folded pieces 19, with each of the second folded pieces 19 interposed, and a hollow part 21 whose inside is made hollow so as to be easily deformed, is used.

**[0078]** Note that when a folding angle of each of the first folded pieces 18 is  $90^\circ$ , each of the above-mentioned second folded pieces 19 is folded further at  $90^\circ$  from a lower end of each of the first folded pieces 18 (in such a way to have a U-shaped cross section (U-shaped type)), instead of being folded further at  $270^\circ$  (that is,  $-90^\circ$ ) from the lower end of each of the first folded pieces 18.

**[0079]** In other words, in the portions where the above-mentioned hinges 9 are not provided, the sound absorption members 16 and the packings 17 are provided, and the sound-insulating structure 5 which includes both of the packings 17 and the sound absorption members 16 is equipped. By providing the above-described sound-insulating structure 5 between the package main body 3 and the door 4, the packings 17 and the sound absorption members 16 reliably prevent noise from leaking from a gap of the opening part 2, thus allowing the sound-

insulating package 1, which is operable to reliably insulate noise of a noise source, to be provided.

**[0080]** In particular, in a case where the door 4 which is opened and closed via the hinges 9, between the door 4 opened and closed via the hinges 9 and the package main body 3, a gap develops since the door 4 inevitably inclines by its own weight. Therefore, in a case where the hinges 9 which easily cause the gap are used, the sound-insulating package 1 of the second embodiment is suitably used in particular.

**[0081]** In addition, in the sound-insulating package 1 of the second embodiment, the packings 17 are provided onto the second folded pieces 19 which are formed toward the direction parallel with the opening peripheral surfaces 13 and each of the packings 17 is equipped between the members which face each other in a surface state, thus allowing sound insulation effect to be further effectively exhibited.

**[0082]** Furthermore, as in the first embodiment, since the sound-insulating package 1 of the second embodiment also has a simple structure in which the packings 17 are merely provided on the leading ends of the folded pieces 15 of the door 4, manufacturing costs and labor for assembly are not increased.

**[0083]** Therefore, even when a size of the sound-insulating package 1 is increased, sound is reliably prevented from leaking outside from the gap without increasing the manufacturing costs and the labor for assembly.

**[0084]** Note that it should be appreciated that the embodiments disclosed herein are illustrative and not restrictive in every respect. In

particular, matters which are not explicitly disclosed in the embodiments disclosed herein, for example, operating conditions and operating provisions, various parameters, dimensions of components, weights, volumes, and the like are matters which do not depart from the scope which those skilled in the art ordinarily implement, and values at which a person having ordinary skill in the art can easily arrive are adopted.

#### DESCRIPTION OF SYMBOLS

**[0085]** 1: Sound insulating package, 2: Opening part, 3: Package main body, 4: Door, 5: Sound insulating structure, 6: Base panel, 7: Frame part, 8: Top panel, 9: Hinge, 9a: First hinge member, 9b: Second hinge member, 10: Fixing part, 11: Vertical frame, 12: Horizontal frame, 13: Opening peripheral surface, 14: Door main body, 15: Folded piece, 16: Sound absorption member, 17: Packing, 18: First folded piece, 19: Second folded piece, 20: Fitting part, 21: Hollow part

## CLAIMS

1. A sound-insulating package comprising:
  - a package main body which houses a noise source inside and includes an opening part;
  - a door which is operable to close the opening part of the package main body; and
  - a sound-insulating structure which is provided between the package main body and the door and is operable to insulate noise of the noise source, wherein
    - around the opening part, opening peripheral surfaces, all of which are located on a same plane, are formed,
    - on an outer peripheral side of the door, folded pieces which are folded toward a side of the package main body and whose all of end portions on the side of the package main body are located on a same plane are provided,
    - the sound-insulating structure including:
      - packings which are provided onto the folded pieces on the side of the package main body and contact the opening peripheral surfaces when the opening part is closed by the door; and
      - sound absorption members which are provided further on a door central side than the folded pieces and become thinner by contacting the opening peripheral surfaces when the opening part is closed by the door than when the opening part is opened.
2. The sound-insulating package according to claim 1, wherein each of the folded pieces includes:
  - on a periphery of the door main body being provided in a central portion of the door, a first folded piece which is folded toward the side of the package main body and is formed in a direction intersecting a surface of the package main body, and
  - on a leading end of each of the first folded pieces, a second folded piece which is folded toward an inner side in a width direction and is formed in a direction parallel with each of the opening peripheral surfaces,
  - each of the packings is attached onto each of the second folded

pieces, and

each of the sound absorption members is formed to be thicker than a thickness from the door main body up to each of the second folded pieces.

3. The sound-insulating package according to claim 1 or 2, wherein on one end side of the door in a width direction, hinges which pivotably support the door to the package main body in a rotatable manner are provided,

on another end side of the door in the width direction, fixing parts which fix the door to the package main body are provided,

the hinges whose number is two are provided at upper and lower portions of the door, and

the opening peripheral surfaces are extended further up to the door central side of the door than positions where the hinges are provided.

4. The sound-insulating package according to claim 2, wherein as the packings, rubber packings, each of which has a fitting part being attached onto each of the second folded pieces, with each of the second folded pieces being interposed, and a hollow part whose inside is made hollow, are used.