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(71) Applicant: **Samsung Electronics Co., Ltd.**
Suwon-si
Gyeonggi-do (KR)

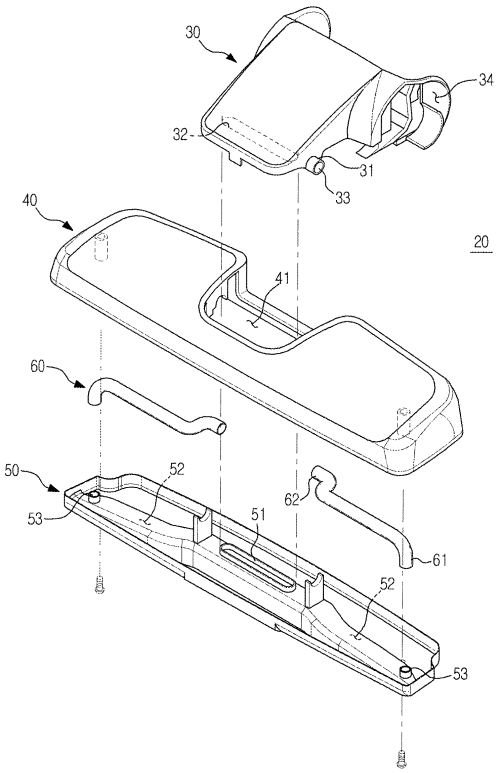
(72) Inventors:
- **Hong, Seung Gee**
  Gweonseon-gu, Suwon-si
  Gyeonggi-do (KR)
- **Lee, Hyun Ju**
  Gwangju (KR)
- **Joo, Jae Man**
  Paldal-gu, Suwon-si
  Gyeonggi-do (KR)
- **Lee, Jun Hwa**
  Yeongtong-gu, Suwon-si
  Gyeonggi-do (KR)

(74) Representative: **Grünecker, Kinkeldey,**
Stockmair & Schwanhäusser
Anwaltssozietät
Leopoldstrasse 4
80802 München (DE)

(54) **Vacuum cleaner**

(57) Disclosed herein is a vacuum cleaner constructed in a structure to reduce the generation of noise due to air flowing along a guide channel. The vacuum cleaner includes a suction plate having a main suction port to suction dust from a surface to be cleaned and a guide channel to guide air to the main suction port, a suction duct communicating with the main suction port, and a connection unit to allow the guide channel to communicate with the suction duct such that some of the air introduced into the guide channel is bypassed to the suction duct.

FIG. 2



EP 2 060 219 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a vacuum cleaner, and, more particularly, to a vacuum cleaner that is capable of reducing a suction noise generated during the operation.

2. Description of the Related Art

[0002] A vacuum cleaner is an apparatus that suctions dirt from a surface to be cleaned using a suction force generated by the driving of a vacuum source mounted in a cleaner body. The vacuum cleaner includes a cleaner body having a vacuum source mounted therein, a suction nozzle to suction dirt from a surface to be cleaned, and an extension channel to guide the dirt suctioned from the suction nozzle to the cleaner body.

[0003] Generally, the suction nozzle is provided approximately at the middle thereof with a single suction port or a plurality of suction ports to which a suction force is transmitted to suction dirt. Consequently, the suction force is high at the middle of the suction nozzle where the suction port is formed, whereas the suction force decreases toward opposite sides of the suction nozzle. As a result, dirt is easily suctioned from the surface at the middle of the suction nozzle, whereby the cleaning efficiency is high. On the other hand, the cleaning efficiency is low at the opposite side parts of the suction nozzle. To solve this problem, there has been proposed a structure in which a guide channel is formed at opposite sides of the suction port such that the suction force through the suction port can be transmitted to the opposite sides of the suction port. However, air introduced into the guide channel formed at the opposite sides of the suction port is collected in the suction port at once, with the result that a great noise is generated by the increase in flow speed of air and whirlpools generated by the collision of air.

[0004] A vacuum cleaner to reduce the generation of such noise is disclosed in Korean Patent Application Publication No. 10-2007-32443, which provides a vacuum cleaner including a suction nozzle, wherein the suction nozzle includes a lower housing, an upper housing, and noise reduction rib. The lower housing is provided at the middle thereof with a suction port of a predetermined height. At opposite sides of the suction port is formed a guide channel to suction air from the sides of the suction port. The upper housing defines a channel to move the air introduced through the suction port to an extension connector of the vacuum cleaner when the upper housing is coupled to the lower housing. The noise reduction rib is mounted at the suction port to prevent the collision of the air from the guide channel, thereby reducing noise.

[0005] In the conventional vacuum cleaner, however, the guide channel are provided at the outside edges thereof with openings, with the result that the air introduced from the front and rear of the guide channel joins the air introduced from the sides of the guide channel, whereby high whirlpools are created, and therefore, a great noise is generated.

[0006] Also, the suction port is located at the middle of the guide channel, with the result that the flow turbulence of air occurs, when the air flows to the suction port along the guide channel, whereby noise increases.

SUMMARY OF THE INVENTION

[0007] Therefore, it is an aspect of the invention to provide a vacuum cleaner constructed in a structure to reduce the generation of noise due to air flowing along a guide channel.

[0008] In accordance with one aspect, the present invention provides a vacuum cleaner including a suction plate having a main suction port to suction dust from a surface to be cleaned and a guide channel to guide air to the main suction port, a suction duct communicating with the main suction port, and a connection unit to allow the guide channel to communicate with the suction duct such that some of the air introduced into the guide channel is bypassed to the suction duct.

[0009] Preferably, the guide channel has an auxiliary suction port, and the suction duct has a first opening communicating with the main suction port and a second opening communicating with the auxiliary suction port by the connection unit.

[0010] Preferably, the guide channel extends in the longitudinal direction of the suction plate, the main suction port includes at least one main suction port formed at the middle of the guide channel, and the auxiliary suction port includes at least one pair of auxiliary suction ports formed at opposite ends of the guide channel.

[0011] Preferably, the suction duct has a hinge shaft by which the suction duct is hingedly rotated with respect to the suction plate by a predetermined angle, and the second opening is defined in the hinge shaft.

[0012] Preferably, the auxiliary suction port includes pluralities of auxiliary suction ports formed at opposite sides of the main suction port, and the connection unit includes a first connection part to collect air introduced through the auxiliary suction ports and a second connection part to guide the air in the first connection part to the suction duct.

[0013] Preferably, the guide channel is depressed from the bottom of the suction plate such that edge regions of the guide channel have the same height.

[0014] In accordance with another aspect, the present invention provides a vacuum cleaner including a suction unit having a suction port to suction dust from a surface to be cleaned, wherein the suction unit includes a guide channel depressed from the bottom of the suction unit to guide the flow of air to the suction port, and the guide channel has a step protrusion formed at the edge thereof.

[0015] Preferably, the guide channel extends in the

longitudinal direction, and the step protrusion includes side step protrusions formed at opposite ends of the guide channel to reduce the introduction of air in the side direction of the suction unit.

[0016] Preferably, the suction unit further includes a suction plate having at least one main suction port formed at the middle of the guide channel to suction dust from the surface and at least one auxiliary suction port spaced a predetermined distance from the main suction port, the guide channel being formed at the suction plate, a suction duct having a first opening communicating with the at least one main suction port and a second opening communicating with the at least one auxiliary suction port, and a connection pipe to connect the auxiliary suction port and the second opening.

[0017] In accordance with another aspect, the present invention provides a vacuum cleaner including a suction plate having a guide channel to guide the flow of air, at least one main suction port formed at the middle of the guide channel to suction dust from the surface and at least one auxiliary suction port spaced a predetermined distance from the main suction port, a suction duct having a first opening communicating with the at least one main suction port and a second opening communicating with the at least one auxiliary suction port, and a connection pipe to connect the auxiliary suction port and the second opening.

[0018] In accordance with a further aspect, the present invention provides a vacuum cleaner including a suction plate having guide channels depressed by a predetermined depth to guide the flow of air and at least one main suction port formed on the guide channel to suction dust and a suction duct to guide the flow of the dust introduced through the main suction port, wherein the suction plate includes at least one auxiliary suction port spaced a predetermined distance from the at least one main suction port to reduce noise generated by the flow of the air.

[0019] Preferably, the vacuum cleaner further includes a connection unit to allow the air suctioned through the auxiliary suction port to be bypassed to the suction duct.

[0020] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings, of which:

FIG. 1 is a schematic view illustrating a vacuum cleaner according to a first embodiment of the present invention;

FIG. 2 is an exploded perspective view illustrating the structure of a suction unit of the vacuum cleaner according to the first embodiment of the present invention;

FIG. 3 is a perspective view illustrating the coupling between a suction plate and a suction duct of FIG. 2;

FIG. 4 is a perspective view of the suction unit included in the vacuum cleaner according to the first embodiment of the present invention when viewed from the bottom thereof;

FIG. 5 is a sectional view illustrating the flow in the suction unit of the vacuum cleaner according to the first embodiment of the present invention;

FIG. 6 is a perspective view illustrating the coupling between a suction plate and a suction duct of a vacuum cleaner according to a second embodiment of the present invention;

FIG. 7 is a perspective view of a suction unit included in a vacuum cleaner according to a third embodiment of the present invention when viewed from the bottom thereof; and

FIGS. 8A and 8B are graphs illustrating noises generated from a conventional vacuum cleaner and the vacuum cleaner according to the third embodiment of the present invention, respectively.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] Reference will now be made in detail to the embodiment of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The embodiment is described below to explain the present invention by referring to the figures.

[0023] FIG. 1 is a schematic view illustrating a vacuum cleaner according to a first embodiment of the present invention, FIG. 2 is an exploded perspective view illustrating the structure of a suction unit of the vacuum cleaner according to the first embodiment of the present invention, FIG. 3 is a perspective view illustrating the coupling between a suction plate and a suction duct of FIG. 2, FIG. 4 is a perspective view of the suction unit included in the vacuum cleaner according to the first embodiment of the present invention when viewed from the bottom thereof, and FIG. 5 is a sectional view illustrating the flow in the suction unit of the vacuum cleaner according to the first embodiment of the present invention.

[0024] As shown in FIG. 1, the vacuum cleaner includes a cleaner body 10 and a connection pipe 11 and a connection hose 12 to guide air moved by a suction force generated by the driving of the cleaner body 10.

[0025] To one end of the connection pipe 11 is mounted a grip 13. At one side of the grip 13 is provided a manipulation part 14 to manipulate the functions of the vacuum cleaner. To the other end of the connection pipe 11 is coupled to a suction unit 20 to suction foreign matter from a surface to be cleaned by the suction force generated by the driving of the cleaner body 10.

[0026] When a user manipulates the manipulation part

14 provided at the grip 13, air is suctioned into the cleaner body through the suction unit 20, the connection pipe 11, and the connection hose 12 by the suction force generated by the driving of the cleaner body 10. At this time, foreign matter, such as dust, existing on a surface to be cleaned is suctioned together with the air and is collected into a dust bag (not shown) of the cleaner body 10.

[0027] As shown in FIGS. 2 and 3, the suction unit 20 includes a cover 40 forming the external appearance of the suction unit, a suction plate 50 mounted at the bottom of the cover 40, the suction plate 50 having suction ports 51 and 53 to suction foreign matter from a surface to be cleaned, and a suction duct 30 to guide air, containing dust suctioned from the suction plate 50 to the connection pipe 11.

[0028] At the top of the cover 40 may be mounted a button unit (not shown) to allow a user to select a hard floor cleaning function or a carpet cleaning function. Also, a brush unit (not shown) constructed to move vertically according to the operation of the button unit may be provided. When a hard floor is to be cleaned, the user operates the button unit such that the brush unit protrudes from the suction plate 50. When a carpet is to be cleaned, the user inserts the brush unit into the suction unit 20. The button unit and the brush unit are well known in the art, and therefore, an illustration and description thereof will not be given.

[0029] In the middle of the cover 40, the suction duct 30 to guide foreign matter introduced through the main suction port 51 to the cleaner body 10 is hingedly coupled to the top of the suction plate 50.

[0030] Although not shown, the vacuum cleaner according to the first embodiment may further include a guide member to assist the air, suctioned through the main suction port 51, to be smoothly introduced into the suction duct 30 through a first opening 32 in spite of the rotation of the suction duct 30.

[0031] The suction duct 30 has a pair of hinge shafts 31 for coupling with the suction plate 50. The first opening 32 is formed at the middle bottom of the suction duct 30 to receive air introduced from the main suction port 51 of the suction plate 50. Also, each hinge shaft 31 is hollow to define a second opening 33 to receive air introduced from the corresponding auxiliary suction port 53, which will be described in the following.

[0032] At the rear side of the suction duct 30 is formed a wheel installation part 34 in which wheels for smooth movement of the suction unit 20 are installed.

[0033] The cover 40 is coupled to the top of the suction plate 50 to seal the interior of the suction duct 20 from the outside. The cover 40 has a cut-out part 41 cut in a shape corresponding to the suction duct 30. Through the cut-out part 41, the suction duct 30 is exposed from the suction duct 20.

[0034] The suction plate 50 is provided at the middle thereof with a main suction port 51 to suction air, containing dirt, from a surface to be cleaned. The main suction port 51 is formed approximately in the shape of a rectangle. Also, the main suction port 51 has a predetermined height. The main suction port 51 may be realized by a single hole having various shapes. Of course, the main suction port 51 may be also realized by a plurality of holes having various shapes.

[0035] At opposite sides of the main suction port 51 is formed a guide channel 52 extending from the main suction port 51 to opposite ends of the suction plate 50 in the longitudinal direction of the suction plate 50 such that the guide channel 52 is arranged in a symmetrical fashion. The guide channel 52 has a predetermined width in the width direction of the suction plate 50. The guide channel 52 is depressed from the bottom of the suction plate 50 such that the guide channel 52 has a predetermined height from the bottom of the suction plate 50. The height of the guide channel 52 gradually increases from the opposite ends of the suction plate 50 toward the main suction port 51.

[0036] Consequently, when the vacuum cleaner is operated, a suction force is generated, with the result that air, containing dirt, flows along the guide channel 52, is introduced into the suction unit 20 through the main suction port 51, formed at the middle of the suction plate 50, and the first opening 32, coupled to the main suction port 51, and is then guided into the cleaner body 10.

[0037] During the cleaning process, the air flows to the main suction port 51 along the guide channel 52 by the suction force of the vacuum cleaner, with the result that a flow noise is generated. Specifically, air current (air current A) introduced into the guide channel 52 from the front of the suction duct 20, air current (air current B) introduced into the guide channel 52 from the rear of the suction duct 20, and air current (air current C) introduced into the guide channel 52 from the sides of the suction duct 20 are mixed with one another in the guide channel 52, with the result that a flow disturbance occurs, and therefore, a great noise is generated.

[0038] To reduce the noise generated by the flow disturbance, the vacuum cleaner according the first embodiment of the present invention is constructed in a structure in which some of the air introduced into the guide channel 52 does not flow along the guide channel 52 but is guided to the suction duct 30.

[0039] Specifically, the vacuum cleaner according the first embodiment of the present invention includes connection units 60 to allow the guide channel 52 to communicate with the suction duct 30 such that some of the air introduced into the guide channel 52 is bypassed to the suction duct 30.

[0040] The connection units 60 connect the guide channel 52 to the suction duct 30. To this end, the auxiliary suction ports 53 are formed at the outer ends of the guide channel 52 corresponding to the connection units 60, and the second openings 33 are formed at the suction duct 30 such that the second openings 33 are spaced apart from the first opening 32. Each connection unit 60 is formed in the shape of a pipe. One end 61 of each connection unit 60 is connected to the corresponding

auxiliary suction port 53, and the other end 62 of each connection unit 60 is connected to the corresponding second opening 33, such that the auxiliary suction ports 53 communicate with the corresponding second openings 33.

[0041] Each connection unit 60 is realized by a flexible pipe, which maintains the secure connection between the auxiliary suction ports 53 and the corresponding second openings 33 irrespective of movement of the suction unit 20 and the hinged rotation of the suction duct 30.

[0042] Preferably, as shown in FIG. 2, the second openings 33 are defined in the respective hinge shafts 31, formed for the hinged rotation of the suction duct 30, to prevent the leakage of the suctioned air from between the auxiliary suction ports 53 and the corresponding second openings 33 irrespective of the movement of the suction unit.

[0043] The flow turbulence in the guide channel is great at the outer edges of the guide channel where the air currents A, B, and C join one another. Consequently, the auxiliary suction ports 53 are preferably formed at the outer edges of the guide channel. At this time, the guide channel 52 is formed such that the heights of the edges, i.e. the front edge 54, the rear edge 55, and the side edge 56, of the guide channel 52 are approximately the same. This structure reduces the flow turbulence occurring by decreasing the height of the side edge of the guide channel to increase the amount of air introduced from the side as in the conventional art to, thereby reducing noise.

[0044] In the first embodiment of the present invention, the guide channel is constructed such that the height of the side edge 56 of the guide channel is the same as those of the front and rear edges of the guide channel, although the guide channel may be constructed such that the height of the side edge of the guide channel is less than those of the front and rear edges of the guide channel as in the conventional art.

[0045] Also, the sectional area of each auxiliary suction port 53 is less than that of the end 61 of each connection unit 60 and that of each second opening 33, such that relatively-large dust particles are caught at the auxiliary suction ports 53, thereby minimizing a phenomenon of dust being caught in the connection units 60.

[0046] By the provision of the above-described structure, it is possible to reduce noise generated by the flow turbulence of air flowing along the guide channel without the reduction of a suction efficiency of the vacuum cleaner.

[0047] Hereinafter, the operation of the vacuum cleaner with the above-described construction will be described.

[0048] When the vacuum cleaner is driven, a suction force is generated, and therefore, the suction unit 20 suctions air containing dust from a surface to be cleaned.

[0049] At this time, the air is introduced from the front, rear, and sides of the suction unit 20, flows along the guide channel 52, and is then introduced into the suction unit 20 through the main suction port 51.

[0050] In the guide channel 51 occurs flow turbulence due to the air introduced from the front, rear, and sides of the suction unit 20. Some of the air introduced into the guide channel 52 is bypassed to the suction duct 30 through the auxiliary suction ports 53, whereby the flow turbulence in the guide channel is reduced, and therefore, noise is reduced.

[0051] Next, a vacuum cleaner according to a second embodiment of the present invention will be described.

[0052] Components of the second embodiment identical to those of the first embodiment are denoted by the same reference numerals, and a description thereof will not be given.

[0053] FIG. 6 is a perspective view illustrating the coupling between a suction plate and a suction duct of a vacuum cleaner according to a second embodiment of the present invention.

[0054] A cover 40 and a suction duct 30 of a suction unit 20 of the vacuum cleaner according to the second embodiment of the present invention are identical to those of the vacuum cleaner according to the first embodiment of the present invention, but the second embodiment is different in the construction of a suction plate 70 and connection units 80 from the first embodiment.

[0055] As shown in FIG. 6, the suction plate 70 has pluralities of auxiliary suction ports 73 formed in line about a main suction port 71.

[0056] Specifically, the auxiliary suction ports 73 are formed at opposite sides of the main suction port 71 such that the auxiliary suction ports 73 are arranged along guide channel 72 at predetermined intervals.

[0057] Each connection unit 80 includes a first connection part 81 formed approximately in the shape of a rectangular pipe to collect air introduced through the auxiliary suction ports 73 and a second connection part 82 to connect one side of the first connection part 81 and the corresponding second opening 33 of the suction duct 30.

[0058] In this embodiment, the amount of air suctioned through the auxiliary suction ports 73 increases as compared with the first embodiment, thereby improving the noise reduction efficiency in the guide channel 72.

[0059] Next, a vacuum cleaner according to a third embodiment of the present invention will be described.

[0060] The third embodiment is different from the first and second embodiments in that it is possible to reduce the noise in the guide channel without using the connection units.

[0061] FIG. 7 is perspective view of a suction unit included in a vacuum cleaner according to a third embodiment of the present invention when viewed from the bottom thereof.

[0062] The suction unit 20" according to the third embodiment of the present invention includes a cover 40 forming the external appearance of the suction unit, a suction plate 90 mounted at the bottom of the cover 40, the suction plate 90 having a suction port 91 to suction foreign matter from a surface to be cleaned, and a suction

duct 30' to guide air, containing dust, suctioned from the suction plate 90 to the connection pipe 11.

[0063] In the third embodiment, no auxiliary suction ports are not formed at the suction plate, and no second openings are formed at the hinge shafts of the suction duct.

[0064] The suction plate 90, forming the bottom of the suction unit 20" according to the third embodiment, is provided with guide channel 92 which is depressed from the bottom of the suction plate 90 to guide the flow of air to at least one suction port 91 formed at the middle of the suction plate 90.

[0065] The guide channel 92 is formed in the longitudinal direction of the suction plate 90 in a symmetrical fashion such that the guide channel 92 extends from the suction port 91 to opposite ends of the suction plate 90.

[0066] At each outer edge of the guide channel are formed step protrusions 93, 94, and 95. The step protrusions 93 and 94, which are formed at the front and rear of the guide channel 92, are the same height as the step protrusion 95, which is formed at the longitudinal outside end of the guide channel 92.

[0067] Consequently, it is possible to reduce the flow of air introduced from the side (in the direction indicated by an arrow D), which is one of the noise generating causes, by removing the side edge openings of the suction plate, formed to suction air from the side in the conventional vacuum cleaner, and forming the side step protrusions 95, being the same height as the front and rear step protrusions 93 and 94 of the guide channel 92, thereby reducing noise.

[0068] FIGS. 8A and 8B are graphs illustrating noises generated from a conventional vacuum cleaner and the vacuum cleaner according to the third embodiment of the present invention, respectively.

[0069] In the conventional vacuum cleaner, the side suction parts are formed to improve the cleaning efficiency in the side direction, and therefore, the flow turbulence in the guide channel is increased by the flow of air introduced from the front, rear, and sides, with the result that the noise is distributed as shown in FIG. 8A.

[0070] In the third embodiment of the present invention, on the other hand, the step protrusions 95 are formed at the longitudinal outside ends of the guide channel 92, unlike the conventional art, to reduce the amount of air introduced from the sides, which is a principal cause of the flow turbulence, with the result that the noise is distributed as shown in FIG. 8B, and therefore, the noise is reduced as compared with the conventional art.

[0071] Specifically, the maximum noise generated from the conventional vacuum cleaner was 53 dBA, as shown in part I of FIG. 8A, whereas the maximum noise generated from the vacuum cleaner according to the present invention was 49 dBA, as shown in part I' of FIG. 8A. Consequently, the present invention has noise reduction efficiency as compared with the conventional art.

[0072] Of course, the step protrusions formed at the edges of the guide channel may be applied equally to the first and second embodiments to improve noise reduction efficiency.

[0073] Also, the connection units according to the present invention are not restricted to the previously described shape but the connection units may be constructed in various structures so long as the connection units allow the guide channel to communicate with the suction duct.

[0074] Also, the guide channel may be formed in various shapes, and the guide channel may be constructed in various structures to simplify the flow of air introduced into the guide channel.

[0075] Also, the above-described vacuum cleaner is constructed in a structure in which the suction unit is separated from the cleaner body; however, the present invention may be also applied to a vacuum cleaner constructed in a structure in which the suction unit is integrated with the cleaner body.

[0076] As apparent from the above description, the vacuum cleaner according to the present invention includes the bypass channels connecting the guide channel to the suction duct. Consequently, the present invention has the effect of minimizing the flow turbulence in the guide channel and thus reducing noise.

[0077] Also, the step protrusions are formed at the edges of the guide channel to restrain the excessive increase in flow speed of air flowing in a specific direction. Consequently, the present invention has the effect of minimizing the flow turbulence in the guide channel and thus reducing noise.

[0078] Although a few embodiments of the present invention have been shown and described, it would be appreciated by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

Claims

1. A vacuum cleaner comprising:

   a suction plate having a main suction port to suction dust from a surface to be cleaned and a guide channel to guide air to the main suction port;
   a suction duct communicating with the main suction port; and
   a connection unit to allow the guide channel to communicate with the suction duct such that some of the air introduced into the guide channel is bypassed to the suction duct.

2. The vacuum cleaner according to claim 1, wherein the guide channel has an auxiliary suction port, and the suction duct has a first opening communicating with the main suction port and a second opening communicating with the auxiliary suction port by the

connection unit.

3. The vacuum cleaner according to claim 2, wherein the guide channel extends in the longitudinal direction of the suction plate, the main suction port includes at least one main suction port formed at the middle of the guide channel, and the auxiliary suction port includes at least one pair of auxiliary suction ports formed at opposite ends of the guide channel.

4. The vacuum cleaner according to claim 2, wherein the suction duct has a hinge shaft by which the suction duct is hingedly rotated with respect to the suction plate by a predetermined angle, and the second opening is defined in the hinge shaft.

5. The vacuum cleaner according to claim 2, wherein the auxiliary suction port includes pluralities of auxiliary suction ports formed at opposite sides of the main suction port, and the connection unit includes a first connection part to collect air introduced through the auxiliary suction ports and a second connection part to guide the air in the first connection part to the suction duct.

6. The vacuum cleaner according to claim 1, wherein the guide channel is depressed from the bottom of the suction plate such that edge regions of the guide channel have the same height.

7. A vacuum cleaner comprising a suction unit having a suction port to suction dust from a surface to be cleaned, wherein

the suction unit includes a guide channel depressed from the bottom of the suction unit to guide the flow of air to the suction port, and the guide channel has a step protrusion formed at the edge thereof.

8. The vacuum cleaner according to claim 7, wherein the guide channel extends in the longitudinal direction, and the step protrusion includes side step protrusions formed at opposite ends of the guide channel to reduce the introduction of air in the side direction of the suction unit.

9. The vacuum cleaner according to claim 7, wherein the suction unit further includes

a suction plate having at least one main suction port formed at the middle of the guide channel to suction dust from the surface and at least one auxiliary suction port spaced a predetermined distance from the main suction port, the guide channel being formed at the suction plate,
a suction duct having a first opening communicating with the at least one main suction port and a second opening communicating with the at least one auxiliary suction port, and
a connection pipe to connect the auxiliary suction port and the second opening.

10. A vacuum cleaner comprising:

a suction plate having a guide channel to guide the flow of air, at least one main suction port formed at the middle of the guide channel to suction dust from the surface and at least one auxiliary suction port spaced a predetermined distance from the main suction port;
a suction duct having a first opening communicating with the at least one main suction port and a second opening communicating with the at least one auxiliary suction port; and
a connection pipe to connect the auxiliary suction port and the second opening.

11. A vacuum cleaner comprising:

a suction plate having guide channels depressed by a predetermined depth to guide the flow of air and at least one main suction port formed on the guide channel to suction dust; and
a suction duct to guide the flow of the dust introduced through the main suction port, wherein
the suction plate includes at least one auxiliary suction port spaced a predetermined distance from the at least one main suction port to reduce noise generated by the flow of the air.

12. The vacuum cleaner according to claim 11, further comprising:

a connection unit to allow the air suctioned through the auxiliary suction port to be bypassed to the suction duct.

FIG. 1

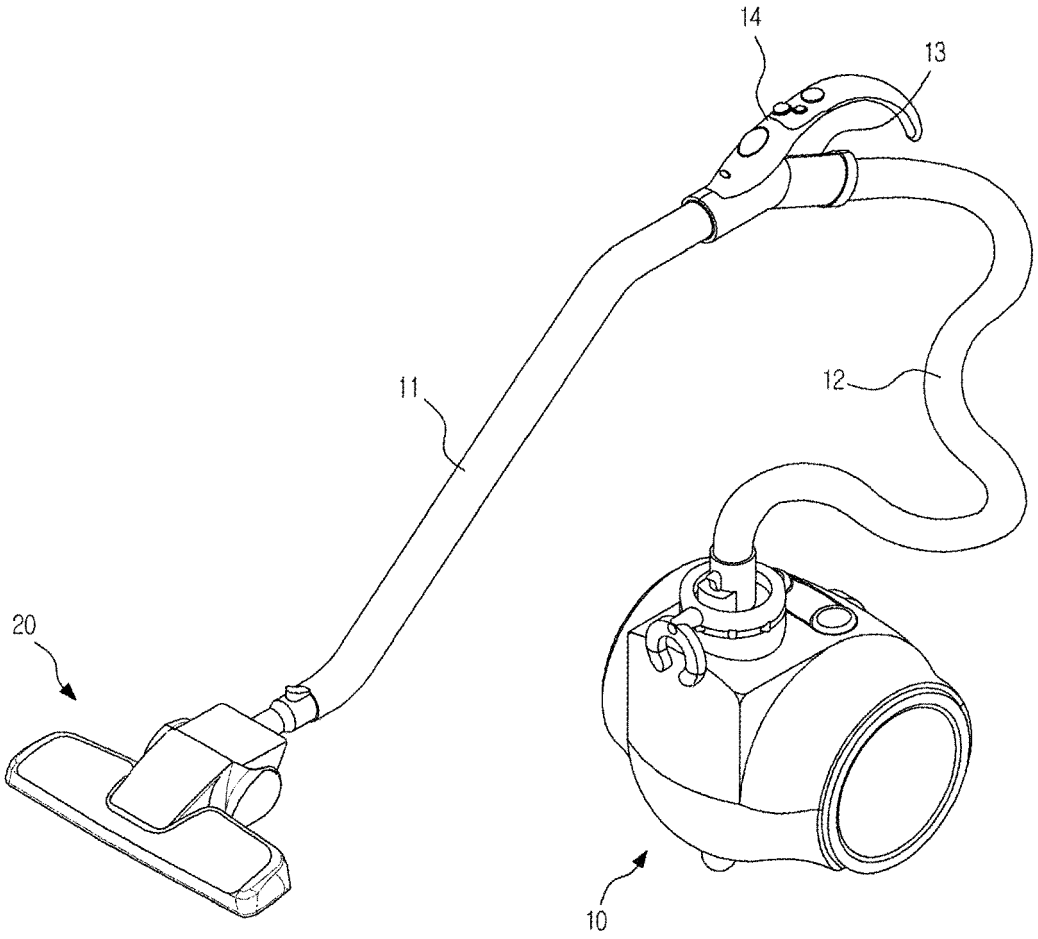


FIG. 2

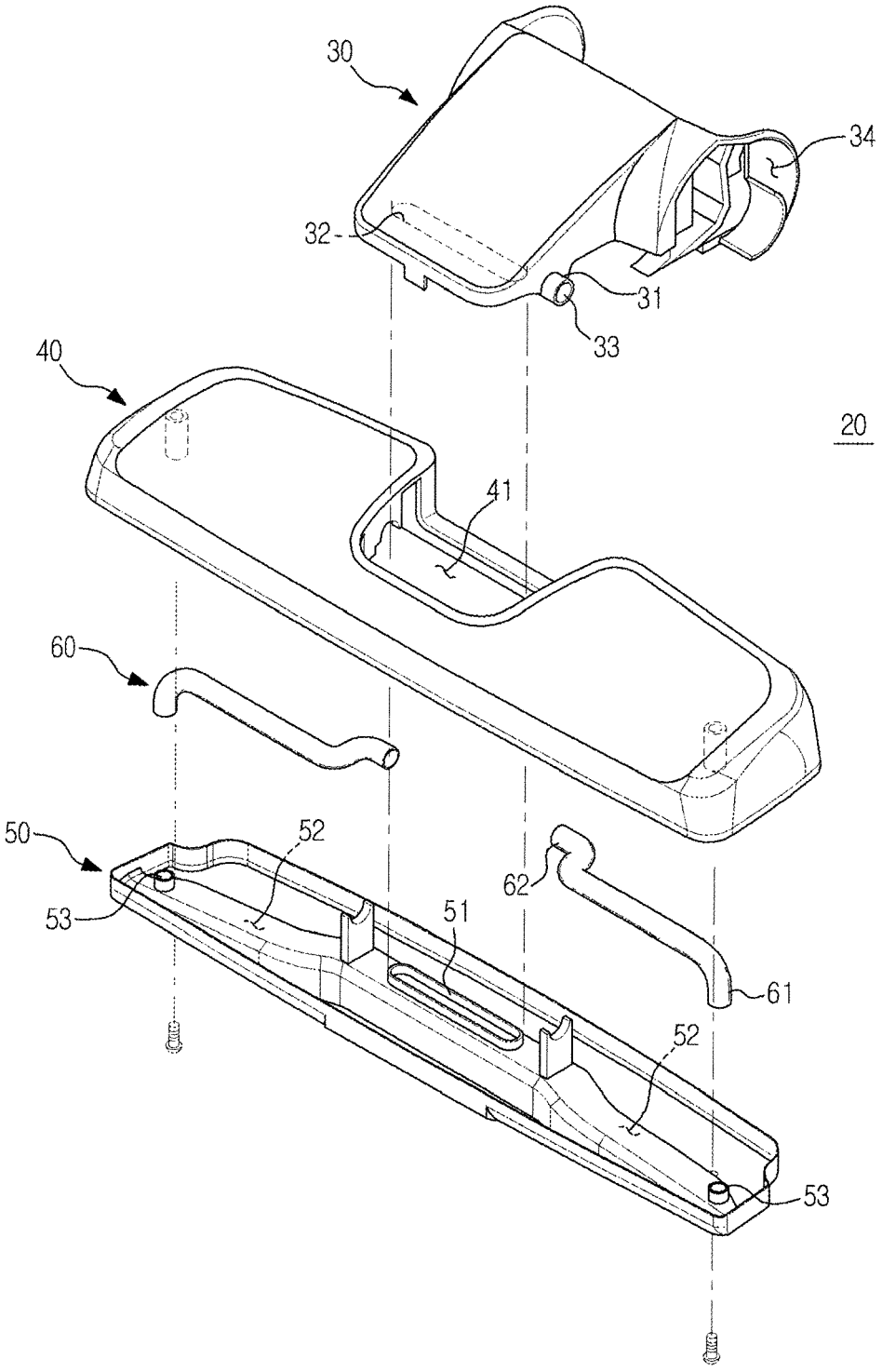


FIG. 3

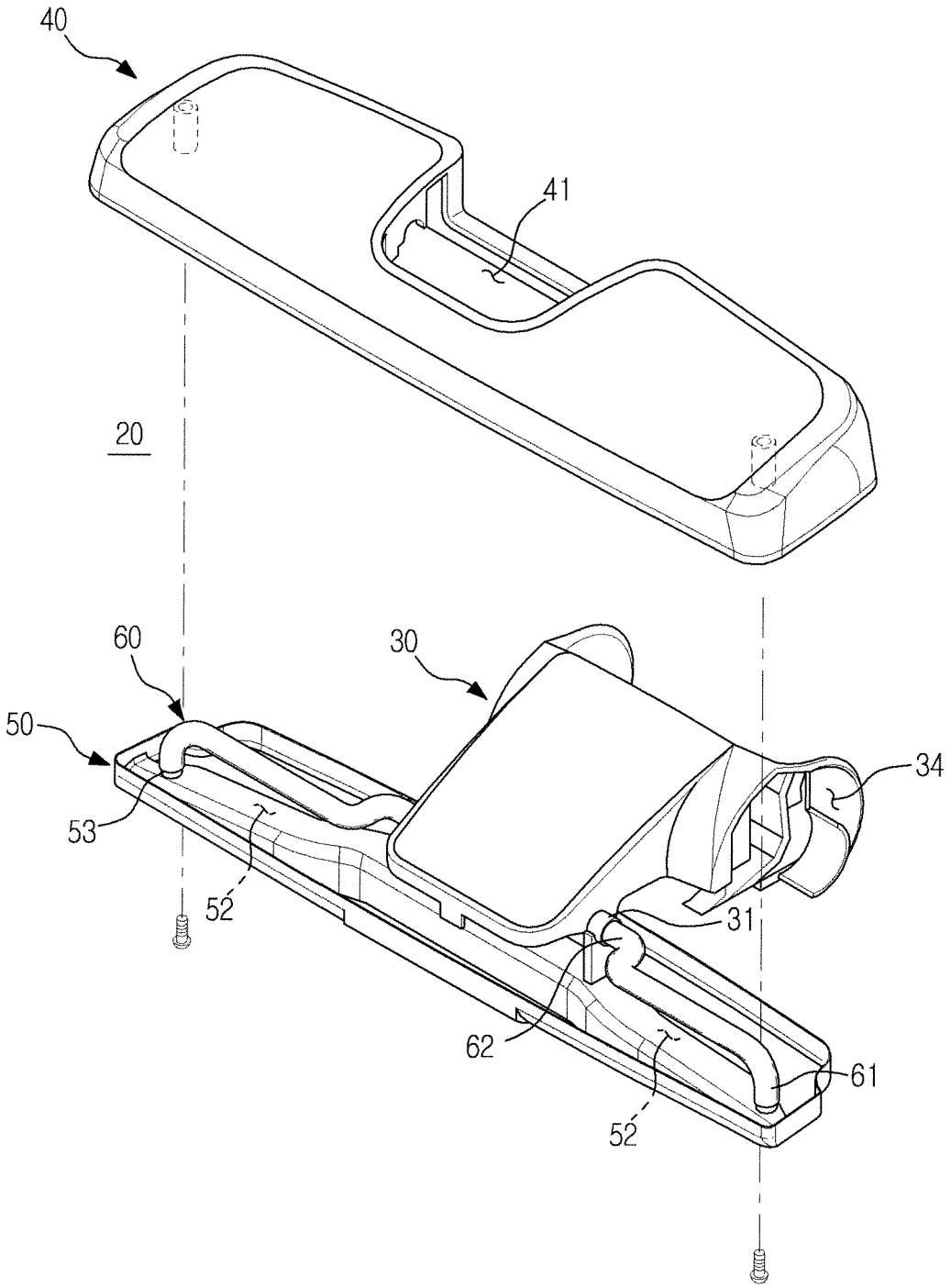


FIG. 4

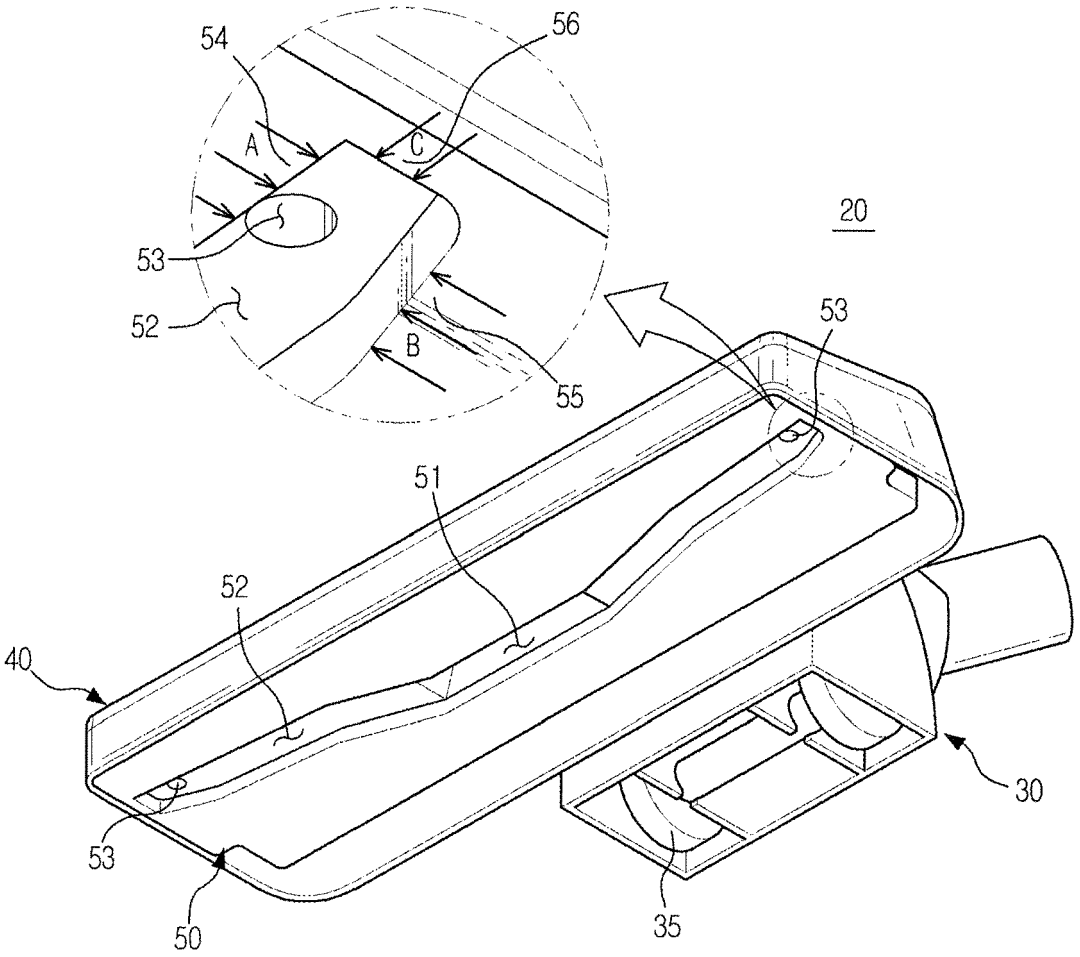


FIG. 5

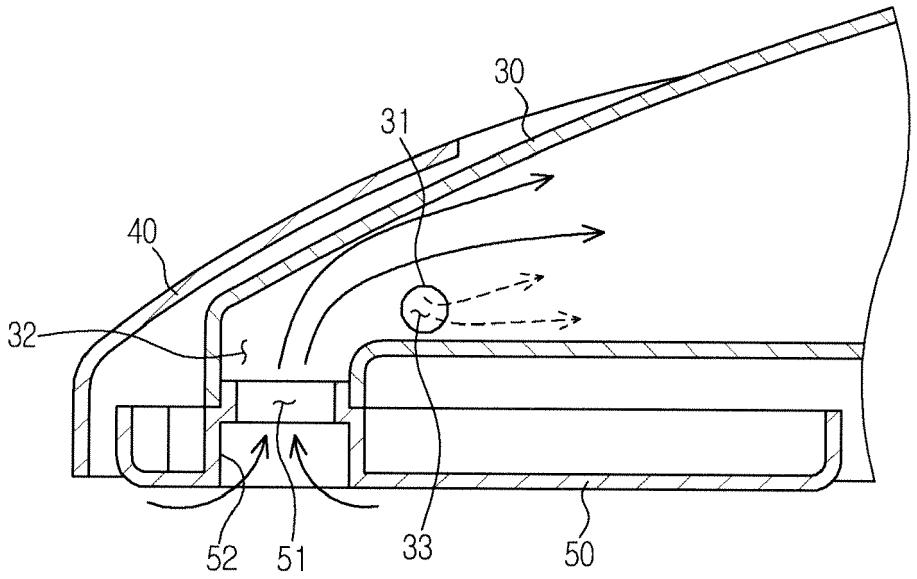


FIG. 6

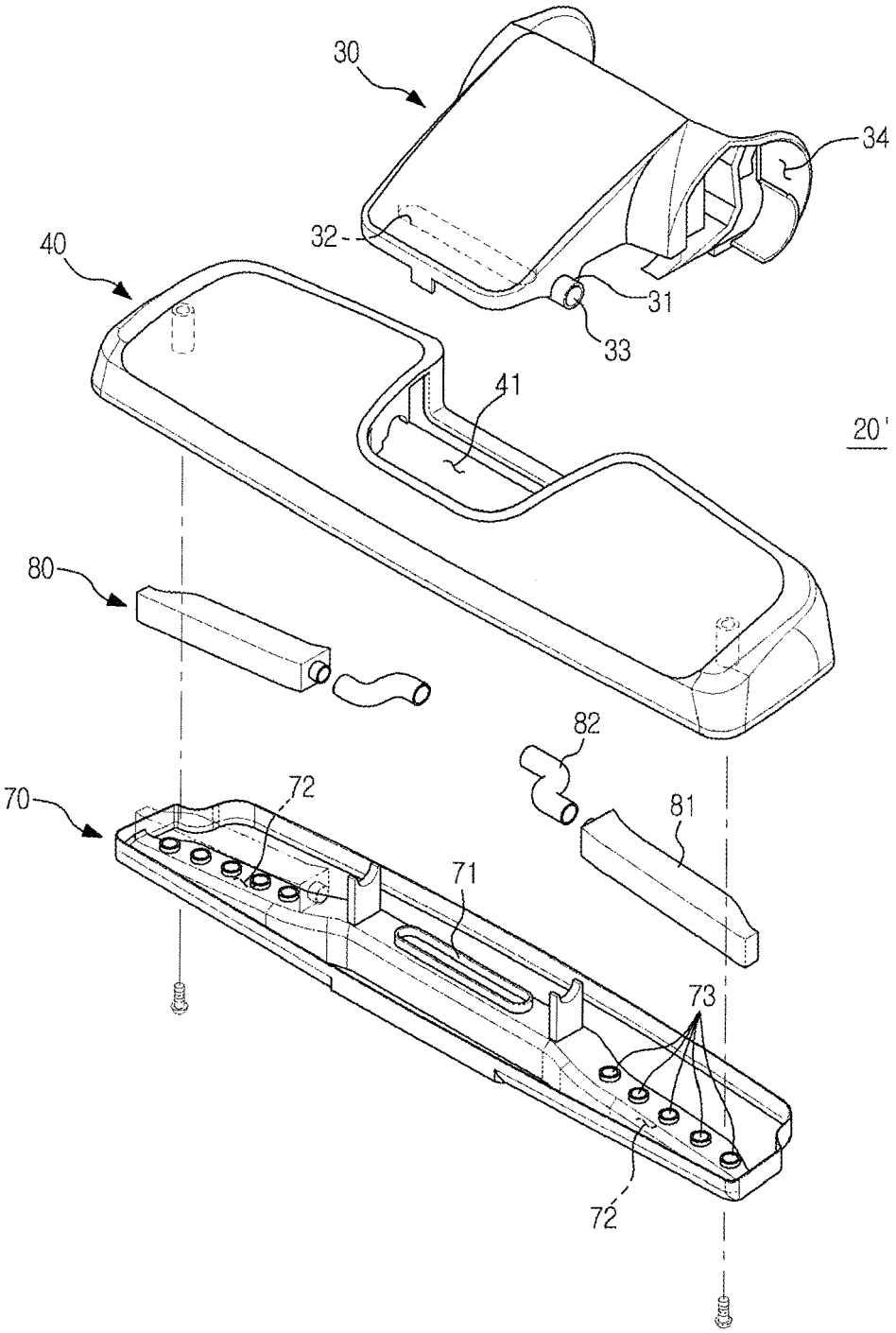


FIG. 7

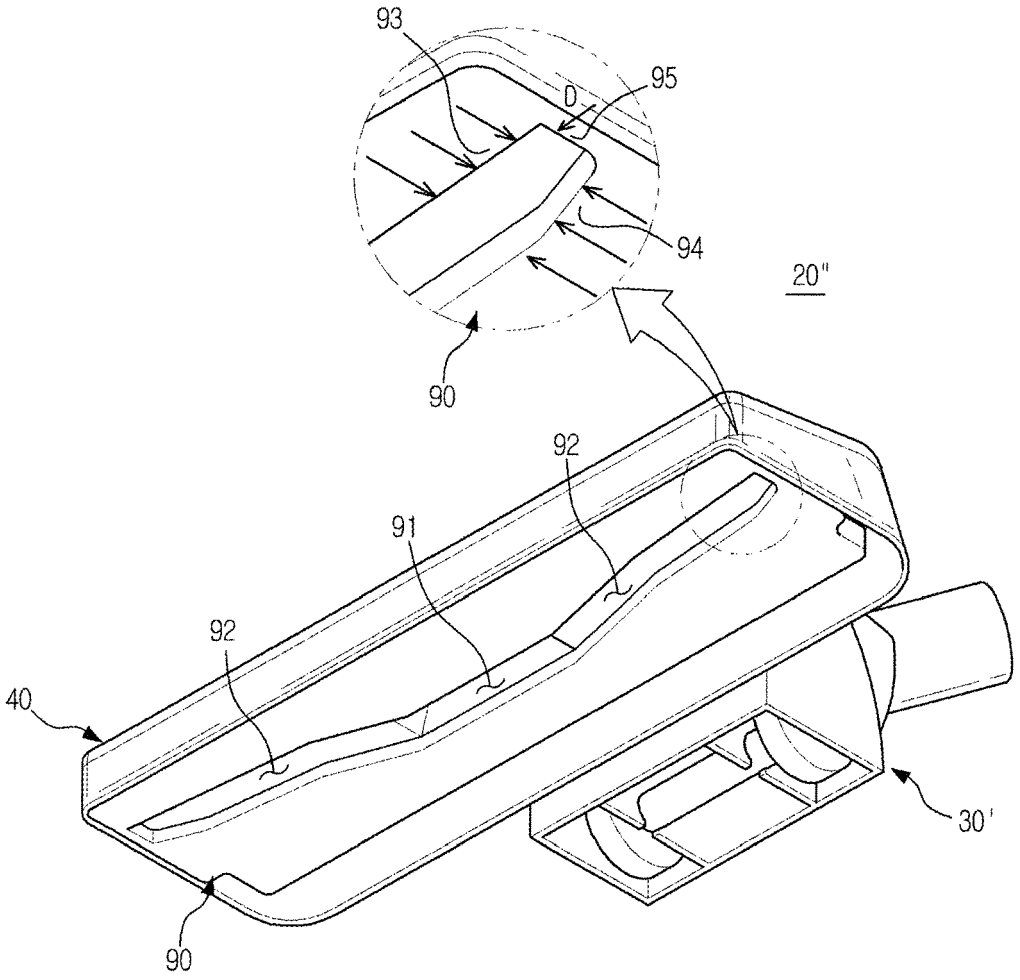


FIG. 8A

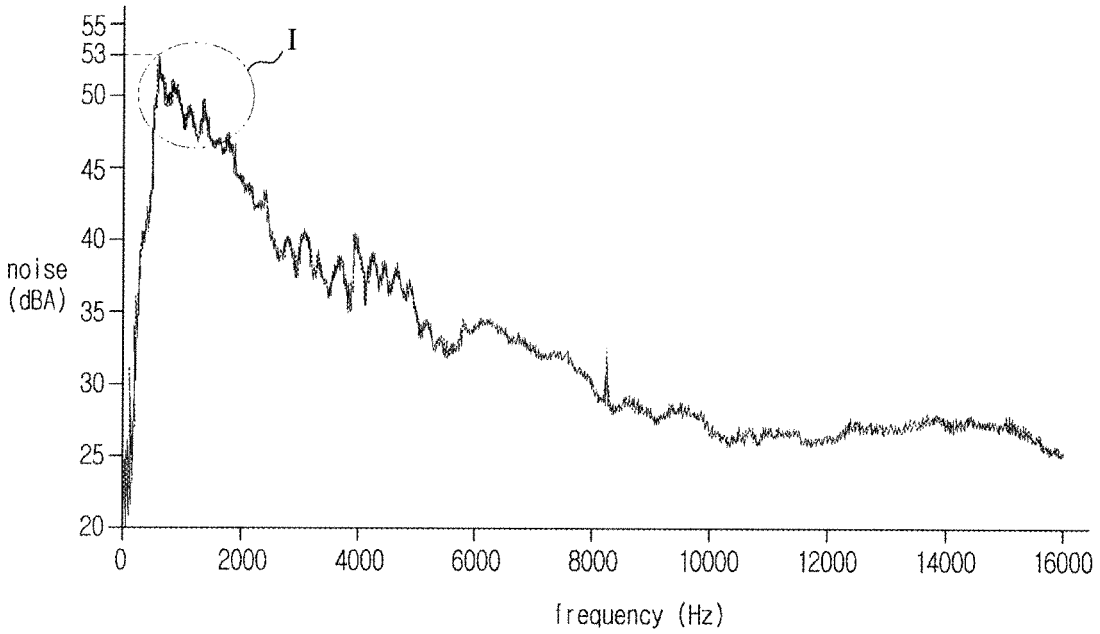
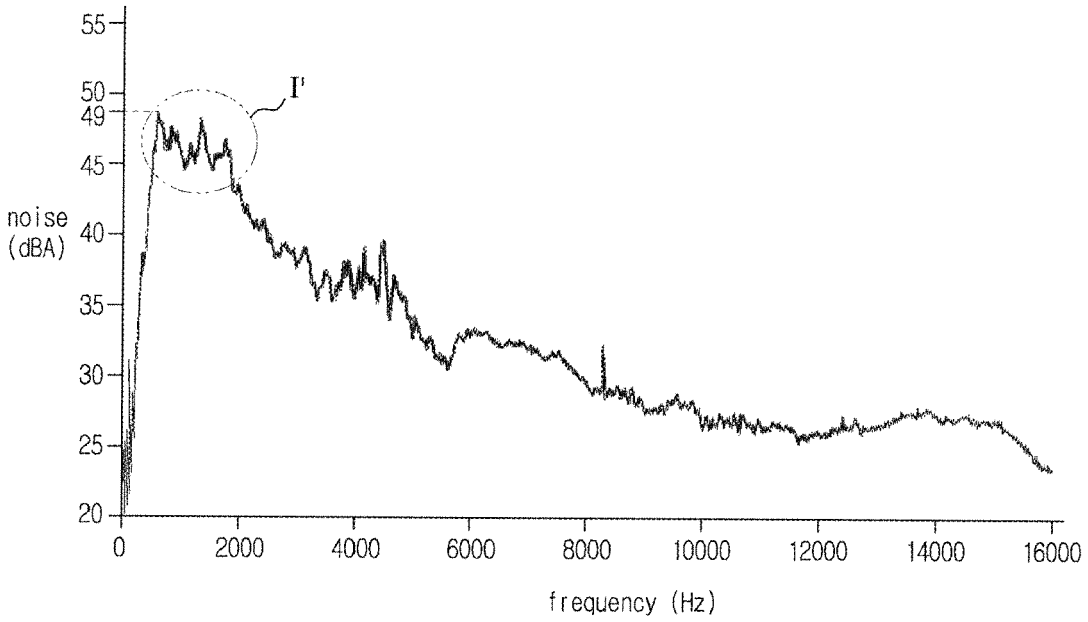

55
53
50
45
40
35
30
25
20
noise
(dBA)
I
0
2000
4000
6000
8000
10000
12000
14000
16000
frequency (Hz)

FIG. 8B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49
45
40
35
30
25
20
noise
(dBA)
I'
0
2000
4000
6000
8000
10000
12000
14000
16000
frequency (Hz)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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