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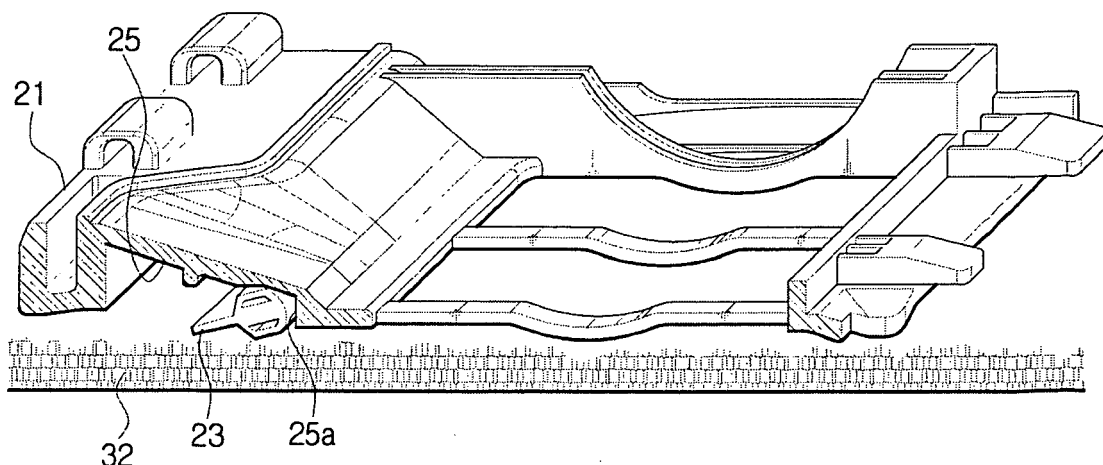
**86899 Landsberg (DE)**

(54) **Vacuum cleaner having moveable blade**

(57) A vacuum cleaner with a rotatable blade (23) is disclosed. The vacuum cleaner includes a body (21), a

blade (23) attached to a lower end of the body, and a rotating unit attached to the body (21) so as to rotate the blade (23).

**FIG. 3B**



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## Description

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

**[0001]** The present disclosure relates generally to a vacuum cleaner and, more particularly, to a moveable blade, which is attached to a lower end of the cleaner.

#### 2. Description of the Related Art

**[0002]** In general, a vacuum cleaner at an undersurface thereof has an inlet, which draws in dust or dirt, and a blade, which is projected downward to collect dust or dirt in the vicinity of the inlet, thereby increasing the cleaning efficiency.

**[0003]** FIG. 1 is a perspective view of an undersurface of a general vacuum cleaner, particularly, a robot vacuum cleaner.

**[0004]** As illustrated in FIG. 1, the robot cleaner includes a cleaner body 1, driving wheels 2, an inlet 3, an agitator 4, and a blade 5. To draw in and remove dust or dirt from a surface to be cleaned, the cleaner body 1 has a pan motor and a filter mounted therein. The driving wheels 2 are installed on an undersurface of the cleaner body 1 to move the cleaner. The inlet 3 is formed in the vicinity of the driving wheels 2 to draw in the dust or dirt from the surface to be cleaned. The agitator 4 is rotatably installed inside of the inlet 3 to wipe off the dust or dirt adhered to the surface to be cleaned and, thus, to allow the inlet to easily draw in the dust or dirt. The blade 5 is projected and disposed in the vicinity of the inlet 3 to collect the dust or dirt in an inlet direction.

**[0005]** The robot cleaner as described above senses cleaning areas and obstacles by a sensor 6 installed in the cleaner under a control of a controller (not shown), and travels around on the sensed cleaning areas. At this time, as the agitator 4 rotates, most of the dust or dirt attached to the surface to be cleaned in the sensed cleaning areas is drawn in through the inlet 3. The rest of the dust or dirt, which is not removed, is captured by the blade 5 and, thus, is collected in the inlet direction, so that it is secondarily drawn in through the inlet.

**[0006]** However, in this case, if the surface to be cleaned has a high friction force, as in a carpet or the like, a problem occurs, in that the projected blade produces friction with the surface to be cleaned and, thus, acts as a considerable load in moving the cleaner.

### SUMMARY OF THE INVENTION

**[0007]** An aspect of the present disclosure is to solve at least the above problems and/or disadvantages and to provide at least the advantages described below. Accordingly, an aspect of the present disclosure is to provide a cleaner capable of selectively jutting out a blade toward a surface to be cleaned, thereby increasing a

cleaning efficiency, when the surface to be cleaned has a low friction force, and rotating the blade in a body direction, thereby reducing a traveling load to the cleaner, when the surface to be cleaned has a high friction force.

**[0008]** In order to achieve the above-described aspects of the present disclosure, there is provided a cleaner including a body of the cleaner, a blade attached in the vicinity of an inlet at a lower end of the body, and a rotating unit to rotate the blade.

**[0009]** At this time, preferably, but not necessarily, the rotating unit rotates the blade toward a surface to be cleaned when a friction force of the surface to be cleaned is smaller than a first friction force between the blade and a carpet, and rotates the blade in a body direction when the friction force of the surface to be cleaned is larger than the first friction force.

**[0010]** The first friction force may be determined as the mean value to friction force values of low-ranking 20% among a plurality of friction force values between a plurality of carpets and the blade.

**[0011]** Also, an accommodating space may be formed in the body, so that the blade is inserted therein. A prominence may be formed in the accommodating space so as to restrict a rotation of the blade.

**[0012]** The rotating unit may include a rotating axis formed on the blade, a coupling hole formed in the body, so that the rotating axis of the blade is inserted therein, and an elastic member having one end connected to the blade and the other end connected to the body.

**[0013]** Preferably, but not necessarily, the elastic member has an elastic force less than a first friction force between the blade and a carpet and more than a second friction force between the blade and a floor.

**[0014]** The second friction force may be determined as the mean value to friction force values of high-ranking 20% among a plurality of friction force values between a plurality of floors and the blade.

**[0015]** More preferably, but not necessarily, the elastic force of the elastic member is a first friction force between the blade and a carpet.

**[0016]** Preferably, but not necessarily, the elastic member is a spiral spring.

**[0017]** A groove may be formed on the blade, so that the one end of the spiral spring is inserted therein.

**[0018]** Alternatively, the rotating unit may include a rotating axis rotatably coupled on the body, a frame formed, so that the blade is attached thereto and having an end fixed on the rotating axis, and an elastic member having one end connected to the frame and the other end connected to the body.

**[0019]** At this time, preferably, but not necessarily, the elastic member comprises a spring.

**[0020]** According to another aspect of the present disclosure, there is provided a cleaner including a body of the cleaner, and a blade attached in the vicinity of an inlet at a lower end of the body, so that an angle thereof to a surface to be cleaned is adjusted according a magnitude of a friction force of the surface to be cleaned.

**[0021]** At this time, preferably, but not necessarily, the blade is rotated in a direction perpendicular to the surface to be cleaned when the friction force of the surface to be cleaned is smaller than a first friction force between the blade and a carpet, and in a body direction when the friction force of the surface to be cleaned is larger than the first friction force.

**[0022]** An accommodating space may be formed in the body, so that the blade is inserted therein.

**[0023]** Also, preferably, but not necessarily, a prominence may be formed in the accommodating space so as to restrict a rotation of the blade.

#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0024]** The above aspect and other features of the present disclosure will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings, wherein;

FIG. 1 is a perspective view of an undersurface of a prior art cleaner, particularly, a robot cleaner;

FIG. 2A is a perspective view exemplifying a portion to which a blade is mounted to an undersurface of a cleaner according to an exemplary embodiment of the present disclosure;

FIG. 2B is a perspective view exemplifying only the blade of FIG. 2A in a magnified representation;

FIG. 3A is a perspective view exemplifying an operation of the blade of FIG. 2A when a surface to be cleaned has a small friction force;

FIG. 3B is a perspective view exemplifying an operation of the blade of FIG. 2A when a surface to be cleaned has a large friction force;

FIG. 4A is a partially cut-away view exemplifying a portion to which a blade is mounted in detail according to another exemplary embodiment of the present disclosure; and

FIG. 4B is a partially cut-away view exemplifying an operation of the blade of FIG. 4A when a surface to be cleaned has a large friction force.

**[0025]** Throughout the drawings, the same reference numerals will be understood to refer to the same elements, features, and structures.

#### DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

**[0026]** Hereinafter, a cleaner according to exemplary embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

**[0027]** FIG. 2A is a perspective view exemplifying a portion to which a blade is mounted to an undersurface of a cleaner according to an exemplary embodiment of the present disclosure; and FIG. 2B is a perspective view exemplifying only the blade of FIG. 2A in a magnified representation. Referring to FIG. 2A, the cleaner according to the exemplary embodiment of the present disclosure includes a blade 23, a rotating unit 24, and an accommodating space 25. The blade 23 is attached in the vicinity of an inlet 22 for drawing in dust or dirt from a surface to be cleaned at a lower end of a body 21 of the cleaner. The rotating unit 24 rotates the blade 23. The accommodating space 25 is formed in the body, so that the blade 23 is received therein.

**[0028]** The rotating unit 24 is provided with a rotating axis 23a, a coupling hole 21a, and a spiral spring 26. The rotating axis 23a is formed on both ends of the blade 23. The coupling hole 21a is formed in the body 21, so that the rotating axis 23a of the blade 23 is inserted therein. The spiral spring 26, as an elastic member, that has one end connected to the blade 23 and the other end connected to the body 21. Since the spiral spring 26 has the one end inserted to a groove 23b formed on the blade 23 and the other end connected to the body 21, it provides a rotation force to the blade 23. Also, a prominence 25a (see FIG. 3) is formed on the accommodating space 25 into which the blade 23 is inserted, so as to restrict a rotation of the blade 23.

**[0029]** An elastic force of the spiral spring 26 is set less than a first friction force between the blade 23 and a carpet and more than a second friction force between the blade 23 and a floor, such as a wooden floor or the like.

**[0030]** Accordingly, the rotating unit 24 rotates the blade 23 toward the surface to be cleaned when a friction force of the surface to be cleaned is smaller than the first friction force, and rotates the blade 23 in a direction towards body 21 when the friction force of the surface to be cleaned is larger than the first friction force.

**[0031]** FIG. 3A is a perspective view exemplifying an operation of the blade 23 if the friction force of the surface to be cleaned is smaller than the first friction force, for example, if the surface to be cleaned is a slippery floor 31. When the surface to be cleaned has a small friction force, as in the slippery floor 31, the blade 23 is rotated in a direction towards the slippery floor 31 by a rotation force of the spiral spring 26. At this time, the blade 23 is maintained in a state generally perpendicular to the floor 31 by the prominence 25a. According to this, the blade 23 collects dust or dirt from the floor 31.

**[0032]** FIG. 3B is a perspective view exemplifying an operation of the blade 23 if the friction force of the surface to be cleaned is larger than the first friction force, for example, if the surface to be cleaned is a carpet 32. In this case, since a friction force between the blade 23 and the carpet 32 is larger than a rotating force generated by the spiral spring 26, the blade 23 is rotated in a direction towards the body 21 and, thus, is received, at least partially, in the accommodating space 25.

**[0033]** According to this, the blade 23 comes in diagonal contact with the carpet 32 so as to reduce a traveling load to the cleaner.

**[0034]** FIG. 4A is a partially cut-away view exemplifying a portion to which a blade is mounted in detail among a cleaner according to another exemplary embodiment of the present disclosure.

**[0035]** Referring to FIG. 4A, the cleaner according to another exemplary embodiment of the present disclosure includes a blade 112, and a rotating unit 113. The blade 112 is attached in the vicinity of an inlet (not illustrated) for drawing in dust or dirt from a surface to be cleaned at a lower end of a body 111 of the cleaner. The rotating unit 113 rotates the blade 112 about a rotating axis 117 coupled on the body 111. To accommodate the rotating unit 112, an accommodating space 114 is formed in the body 111. A prominence 114a is formed to the accommodating space 114 so as to restrict a rotation of the rotating unit 113.

**[0036]** The rotating unit 113 is provided with the rotating axis 117, a rotating frame 115, and a spring 116. The rotating axis 117 is rotatably coupled to the body 111. The rotating frame 115 has an end fixed on the rotating axis 117, and is formed, so that the blade 112 is attached thereto. The spring 116, as an elastic member, has one end connected to the frame 115 and the other end connected to an undersurface of the accommodating space 114 of the body 111. A groove 115a is formed in the rotating frame 115, so that the blade 112 is vertically attached therein.

**[0037]** FIG. 4A illustrates an operation of the blade 112 if a friction force of the surface to be cleaned is smaller than the first friction force between the blade and the carpet as described above, for example, if the surface to be cleaned is a slippery floor 118. When the surface to be cleaned has a small friction force, as in the slippery floor 118, the rotating frame 115 is rotated in a direction towards the floor 118 by a tension force of the spring 116. At this time, the rotating frame 115 is maintained in a horizontal state to the floor 118 by the prominence 114a. According to this, the blade 112 attached to the rotating frame 115 collects dust or dirt from the floor 118.

**[0038]** FIG. 4B is a view exemplifying an operation of the blade 112 if the friction force of the surface to be cleaned is larger than the first friction force, for example, if the surface to be cleaned is a carpet 121. In this case, since a friction force between the blade 112 and the carpet 121 is larger than a rotating force of the rotating frame 115, the spring 116 is compressed. As a result, the rotating frame 115 is rotated in a direction towards body 111 and, thus, received, at least partially, into the accommodating space 114. According to this, the blade 112 attached to the rotating frame 115 also comes in diagonal contact with the carpet 121 so as to reduce a traveling load to the cleaner.

**[0039]** A magnitude of the first friction force by which the blade 113 is rotated is determined by measuring friction forces between the blade used in the exemplary em-

bodiment of the present disclosure and a plurality of carpets, which are sold on the market. That is, after friction force values between the plurality of carpets and the blade are measured, the mean value to friction force values of, for example, low-ranking 20% among the plurality of friction force values between the plurality of carpets and the blade can be determined as the first friction force. If the first friction force is determined in the manner as described above, the blade can be rotated on most of the carpets, which are sold on the market.

**[0040]** Also, a magnitude of the second friction force can be set by measuring friction force values between the blade and a plurality of floors, which are sold on the market, and then determining the mean value to friction force values of, for example, high-ranking 20% among the plurality of friction force values between the plurality of floors and the blade as the second friction force. If the second friction force is determined in the manner as described above, the blade can be maintained in a vertical position on most of the floors, which are sold on the market.

**[0041]** After the first and the second friction forces are determined, an elastic force of the spring is set, so that it is less than the first friction force and more than the second friction force. More preferably, but not necessarily, the elastic force of the spring is set to maintain a balance to the first friction force.

**[0042]** As apparent from the foregoing description, according to the exemplary embodiments of the present disclosure, the cleaner rotates the blade toward the surface to be cleaned to collect the dust or dirt from the surface to be cleaned, thereby increasing the cleaning efficiency, when the surface to be cleaned has the low friction force, and rotates the blade in the body direction to reduce the friction force, thereby reducing the traveling load to the cleaner, when the surface to be cleaned has the high friction force.

**[0043]** Although representative exemplary embodiments of the present disclosure have been shown and described in order to exemplify the principle of the present disclosure, the present disclosure is not limited to the specific exemplary embodiments. It will be understood that various modifications and changes can be made by one skilled in the art without departing from the scope of the disclosure as defined by the appended claims. Therefore, it shall be considered that such modifications, changes and equivalents thereof are all included within the scope of the present disclosure.

## Claims

### 1. A vacuum cleaner comprising:

- a body (21, 111) of the cleaner;
- a blade (23, 112) attached in the vicinity of an inlet (22) at a lower end of the body (21, 111); and
- a rotating unit (24, 113) to rotate the blade (23,

- 112).
2. The cleaner of claim 1, wherein the rotating unit (24, 113) rotates the blade (23, 112) toward a surface to be cleaned when a friction force of the surface to be cleaned is smaller than a first friction force between the blade (23, 112) and a carpet (32, 121), and rotates the blade (23, 112) in a body direction when the friction force of the surface to be cleaned is larger than the first friction force. 5
  3. The cleaner of claim 2, wherein the first friction force is determined as the mean value to friction force values of low-ranking 20% among a plurality of friction force values between a plurality of carpets (32, 121) and the blade (23, 112). 10
  4. The cleaner of any of claims 1-3, further comprising an accommodating space (25, 114) formed in the body (21, 111), so that the blade (23, 112) is at least partially received therein when the rotating unit (24, 113) rotates the blade (23, 112) in the body direction. 20
  5. The cleaner of claim 4, further comprising a prominence (25a, 114a) formed in the accommodating space (25, 114) so as to restrict a rotation of the blade (23, 112) when the rotating unit (24, 113) rotates the blade (23, 112) toward the surface to be cleaned. 25
  6. The cleaner of any of claims 1-5, wherein the rotating unit (24) comprises: 30
    - a rotating axis (23a) formed on the blade (23);
    - a coupling hole (21a) formed in the body (21), so that the rotating axis (23a) of the blade (23) is inserted therein; and
    - an elastic member (26) having one end connected to the blade (23) and the other end connected to the body (21). 35
  7. The cleaner of claim 6, wherein the elastic member (26) comprises a spiral spring. 40
  8. The cleaner of claim 6 or 7, wherein the blade (23) comprises a groove (23b) formed thereon, so that the one end of the elastic member (26) is inserted in the groove (23b). 45
  9. The cleaner of any of claims 1-5, wherein the rotating unit (113) comprises: 50
    - a rotating axis (117) rotatably coupled on the body (111);
    - a frame (115) formed, so that the blade (112) is attached thereto and having an end fixed on the rotating axis (117); and
    - an elastic member (116) having one end con- 55
- nected to the frame (115) and the other end connected to the body (111).
10. The cleaner of claim 9, wherein the elastic member (116) comprises a spring.
  11. The cleaner of any of claims 6-10, wherein the elastic member (26, 116) has an elastic force less than the first friction force between the blade (23, 112) and a carpet (32, 121) and more than a second friction force between the blade (23, 112) and a floor (21, 118).
  12. The cleaner of claim 11, wherein the second friction force is determined as the mean value to friction force values of high-ranking 20% among a plurality of friction force values between a plurality of floors (31, 118) and the blade (23, 112).
  13. The cleaner of any of claims 6-10, wherein the elastic member (26, 116) comprises an elastic force less than the first friction force between the blade (23, 112) and a carpet (32, 121).
  14. A vacuum cleaner comprising:
    - a body (21, 111) of the cleaner; and
    - a blade (23, 112) attached in the vicinity of an inlet (22) at a lower end of the body (21, 111), so that an angle of the blade (23, 112) to a surface to be cleaned is adjusted according a magnitude of a friction force between the blade (23, 112) and the surface to be cleaned.
  15. The cleaner of claim 14, wherein the blade (23, 112) is rotated in a direction perpendicular to the surface to be cleaned when the friction force of the surface to be cleaned is smaller than a first friction force between the blade (23, 112) and a carpet (32, 121), and the blade (23, 112) is rotated in a body direction when the friction force of the surface to be cleaned is larger than the first friction force.
  16. The cleaner of claim 14 or 15, further comprising an accommodating space (25, 114) formed in the body (21, 111), so that the blade (23, 112) is, at least partially, received therein when the blade (23, 112) is rotated in a body direction.
  17. The cleaner of claim 16, further comprising a prominence (25a, 114a) formed in the accommodating space (25, 114) so as to restrict a rotation of the blade (23, 112) when the blade (23, 112) is rotated in a direction perpendicular to the surface to be cleaned.
  18. The cleaner of any of the preceding claims, wherein the cleaner is a robot vacuum cleaner.

FIG. 1

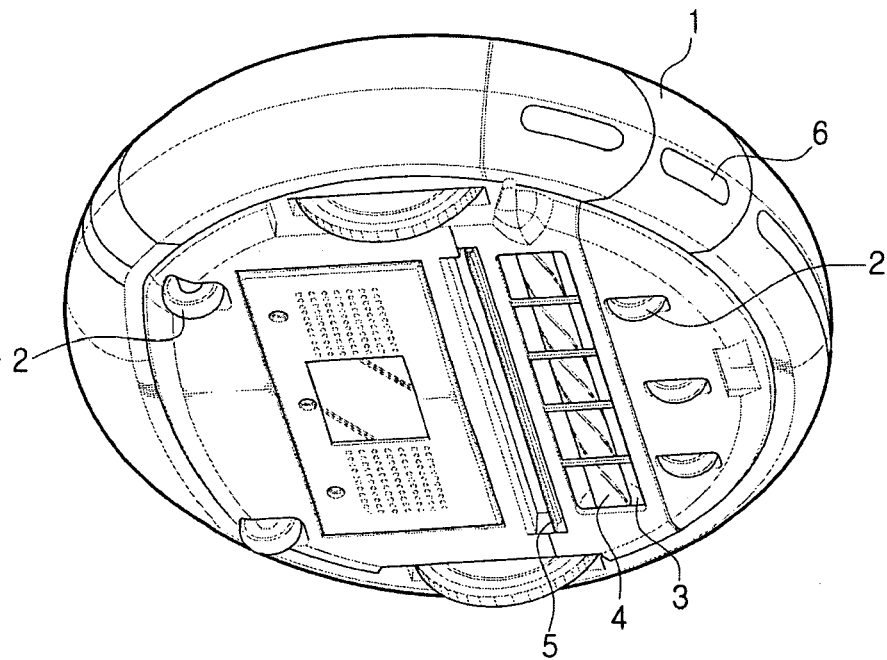


FIG. 2A

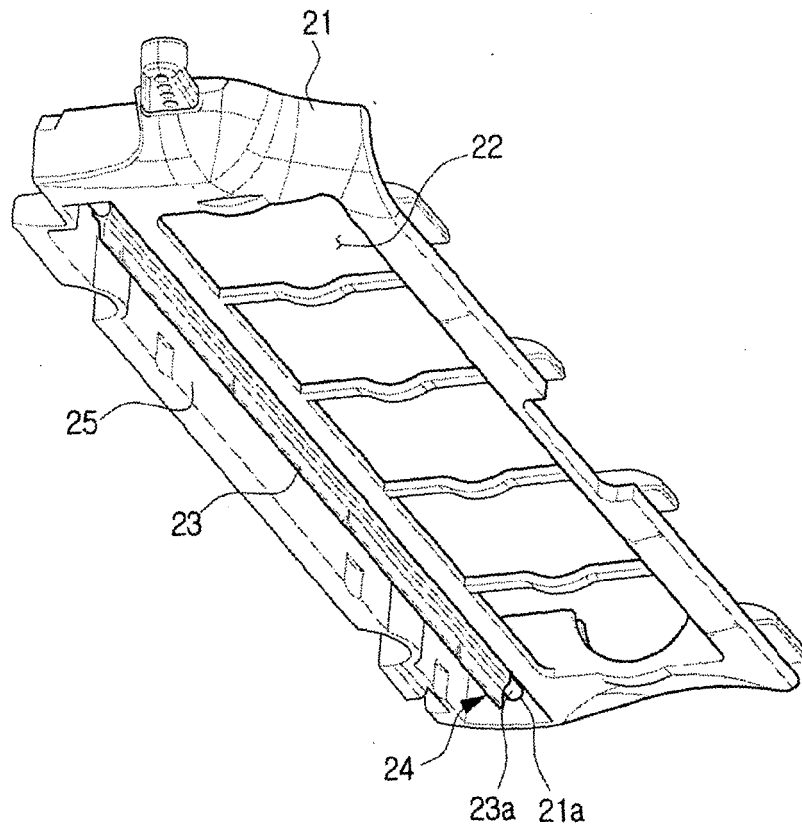


FIG. 2B

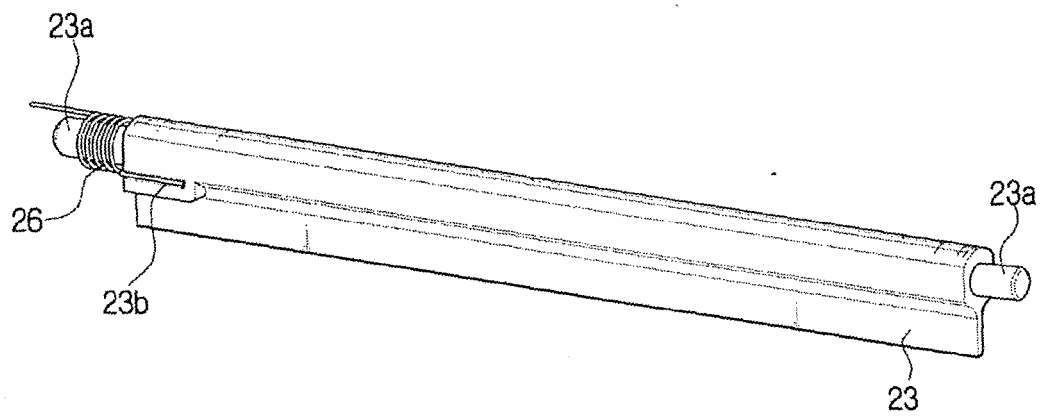


FIG. 3A

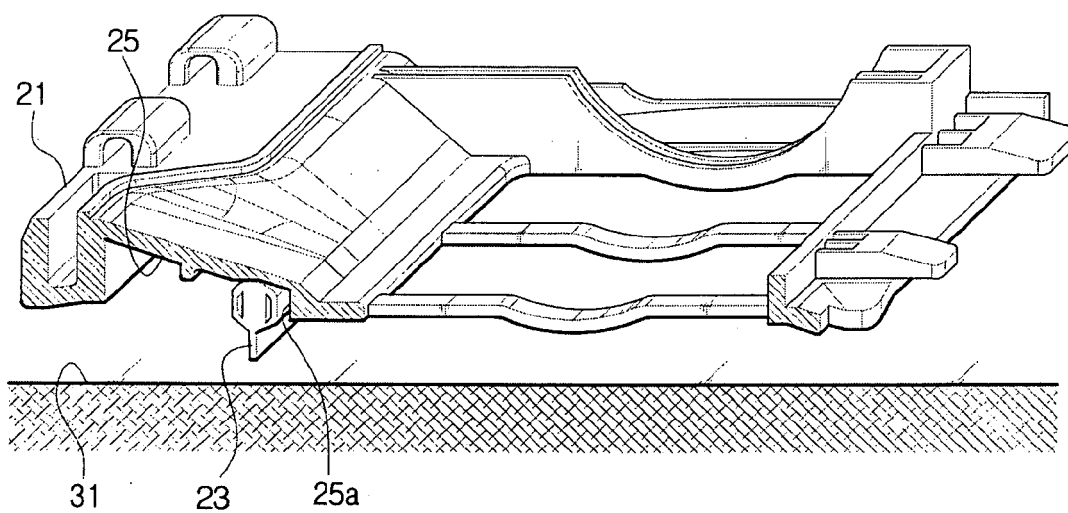


FIG. 3B

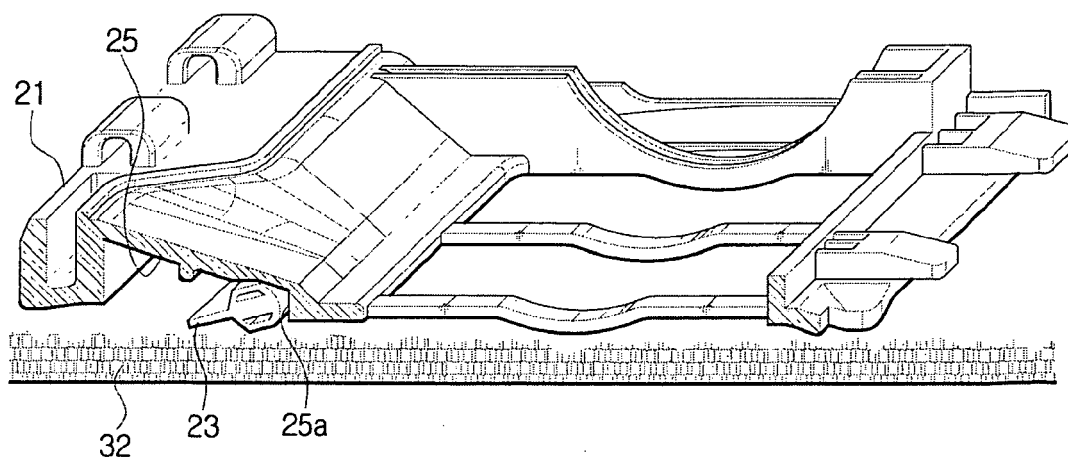




FIG. 4A

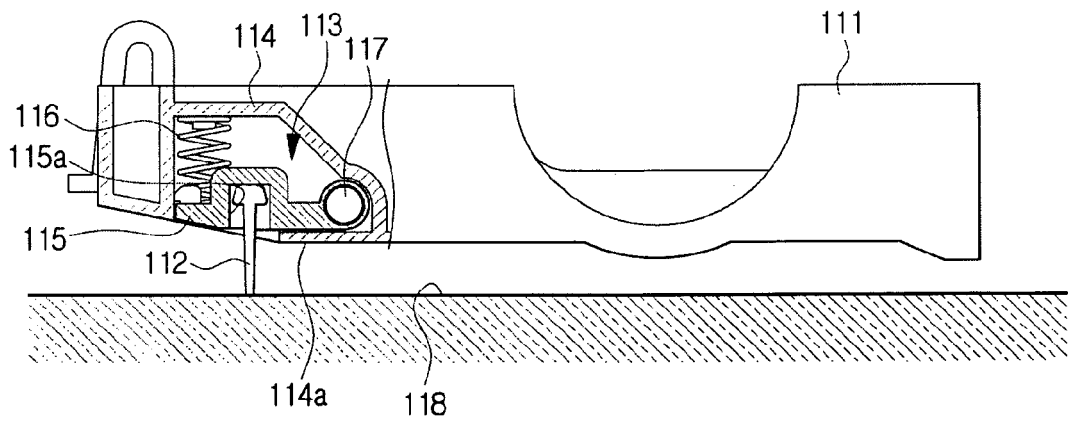
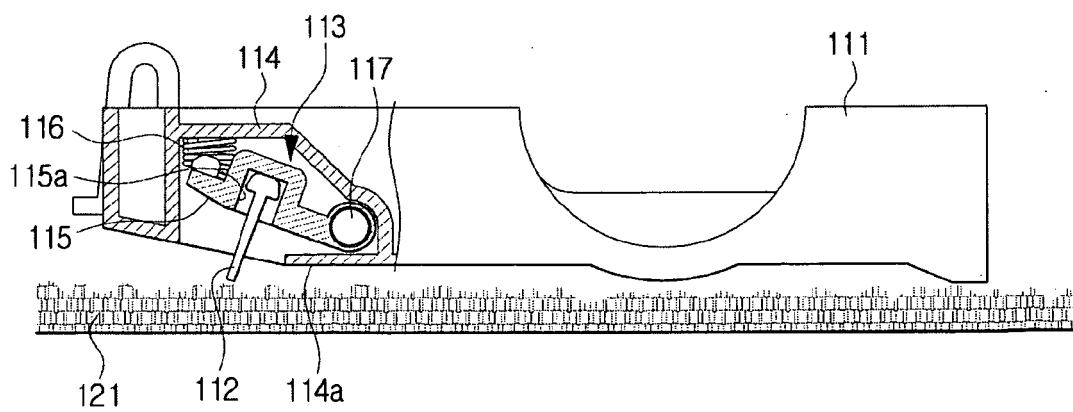


FIG. 4B





European Patent  
Office

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Application Number  
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<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

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**ANNEX TO THE EUROPEAN SEARCH REPORT  
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EP 07 01 4911

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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