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(54) **VACUUM CLEANER NOZZLE**

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a nozzle for a vacuum cleaner, and to a vacuum cleaner having such a nozzle.

BACKGROUND OF THE INVENTION

[0002] EP1875846 and WO 2007/031819 disclose prior art nozzles for floor vacuum cleaners.

[0003] A good vacuum cleaner nozzle must have high cleaning performance, i.e. effective debris pick up, but at the same time be easy to handle and move across a surface to be cleaned, such as a carpet. In many conventional nozzles, high cleaning performance is obtained only at the expense of an increased resistance to motion across a surface and so requires an increased application of force by the user to move the nozzle. Furthermore, the nozzle may have unpleasant dynamic behaviour in the sense that it does not move particularly well across a surface when it is pushed and/or pulled. These disadvantages can make the vacuum cleaner difficult and tiring to use for prolonged periods.

SUMMARY OF THE INVENTION

[0004] It is an object of this invention to overcome or substantially alleviate the problems referred to above, and to provide a nozzle for a vacuum cleaner that combines optimum cleaning performance with minimal motion resistance and more desirable dynamic behaviour.

[0005] According to the present invention, there is provided a nozzle for a vacuum cleaner, comprising a soleplate with a suction channel slot therein for the suction of debris from a surface, a wheel mounted for rotation about an axis to support the nozzle on said surface, and a suction pipe connector for rotation about an axis that is coaxial with said wheel axis, the wheel having a radius (h) of at least 25mm, and wherein a distance (X) across the surface between a point of contact of the wheel with the surface that is directly beneath the wheel axis and a point midway between the leading and trailing edges of the suction channel slot is no greater than 80mm

[0006] In one embodiment, the nozzle comprises a housing in which the soleplate and suction channel slot are formed, and the wheel and suction pipe connector may be mounted to the housing for rotation about said wheel axis.

[0007] In another embodiment, the nozzle may comprise a housing in which the soleplate and suction channel slot are formed, the wheel and suction pipe connector being mounted for rotation relative to each other about the wheel axis, and the housing being mounted for rotation relative to the wheel and the suction pipe connector about a second axis parallel to and spaced from the first axis.

[0008] Preferably, a link arm extends between said wheel axis and the second axis, and is pivotally connected to each of the suction pipe connector and the housing.

[0009] In a preferred embodiment, the ratio of the radius of the wheel (h) to the sum of the distance X across the surface between a point of contact of the wheel with the surface that is directly beneath the wheel axis and a point midway between the leading and trailing edges of the suction channel slot and a distance (1/2 C) across the surface between the point midway between the leading and trailing edges of the suction channel slot and the leading edge of the suction channel slot is greater than 0.3.

[0010] According to the invention, there is also provided a vacuum cleaner including a suction pipe and a nozzle according to the invention, the suction pipe being connected to the nozzle via the suction pipe connector.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 illustrates a side cross-sectional elevation of a conventional vacuum cleaner nozzle;

Figure 2 illustrates the same side cross-sectional elevation as shown in Figure 1, but annotated to show torque T and movement of the wheel caused by wheel lift; and

Figure 3 illustrates a side cross-sectional elevation of a vacuum cleaner nozzle according to the present invention;

Figure 4 illustrates a side cross-sectional elevation of a nozzle according to another embodiment of the invention, in which the nozzle has a housing that is mounted for rotation about an axis that is spaced from the axis of rotation of the wheel axis; and

Figure 5 is a table to illustrate the performance of a nozzle having a ratio of greater than 0.3 compared to the performance of some conventional nozzles.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0012] A cross-sectional side elevation of a conventional nozzle 1 for a vacuum cleaner (not shown) is illustrated in Figures 1 and 2. The nozzle 1 comprises a main body or housing 2 having an elbow or suction pipe connector 3 attached to a rear end of the housing 2 for rotation relative to the housing 2 about an axis A. A suction pipe 4, which does not form part of the nozzle 1, is attachable to and extends upwardly from the suction pipe connector 3. The suction pipe 4 provides a conduit for the passage of dust and debris that has been sucked from a surface S and having been vacuumed through the nozzle 1. The suction pipe 4 also acts as a handle to enable a user to push the nozzle in a forward F direction and pull it in a rearward R direction during use.

[0013] In the first embodiment, a wheel 5 is mounted to the housing 2. It is also mounted to the suction pipe connector 3 for rotation about the same axis A as the suction pipe connector 3 to support and guide the nozzle 1 across the surface S.

[0014] The underside of the housing 2 is provided with a soleplate 6 which contacts the surface S being vacuumed. An elongate suction channel slot 7 is formed in the soleplate 6 and extends across the width of the housing 2 substantially at right angles to the forward F and rearward R directions of movement. The elongate suction channel slot 7 has parallel leading and trailing edges 7a, 7b that define the edges of the slot 7 in the soleplate 6. It will also be appreciated that the slot 7 may have a different shape.

[0015] Thread or debris pick-up strips 8 may be provided forwardly of the leading edge 7a and/or rearwardly of the trailing edge 7b to assist in releasing hair or threads from the surface S being vacuumed.

[0016] To achieve high dust pickup levels, it is necessary to maintain the suction channel slot 7 in contact with the surface S, i.e. the leading and trailing edges 7a, 7b should remain in contact with the surface S. Therefore, the position of the suction slot 7, the wheel axis A and the direction in which force is applied to the housing 2 via the suction pipe 4 and suction pipe connector 3 are all important factors, as they determine the behavior and the forces acting on the nozzle 1.

[0017] The main phenomenon behind dust pickup from a surface S such as a carpet is the opening of the pile. To be able to open the pile during movement of the nozzle 1 in a forward direction F, a vertical force has to be applied on the leading edge 7a of the suction slot 7. However the only force that is generated in this direction, apart from the force generated as a result of the weight of the nozzle 1 itself, is a horizontal friction force that is applied by the user via the suction pipe 4 to push the nozzle 1 across the carpet surface S. To transform this frictional force into a vertical force V on the leading edge 7a to open the pile, distance h (see Figure 2) is important. Distance h is the distance from the axis of rotation A of the wheel 5 to the surface S, and is equivalent to the radius of the wheel 5. As distance h increases, the higher the downward vertical force V of the suction edge against the pile will be as the vacuum cleaner is pushed in the forward direction F along the surface S by a user who applies a force to the nozzle 1 via the suction pipe 4 in a direction that extends along line P.

[0018] However, in the rearward stroke R of the nozzle 1, distance q (see Figure 2) is important. Distance q represents the length of a line that extends from the leading edge 7a of the suction slot 7 and intersects at right-angles with the line P along which the force F is applied to the nozzle 1 which is generated by a user as a result of pulling the suction pipe 4 across the carpet surface S.

[0019] When the user pulls the nozzle 1 rearwardly R, there is a tendency for the distance q to approach zero, i.e. a moment/torque T is generated (as indicated by ar-

row T in Figure 2) that causes the nozzle to pivot on the carpet surface S about the leading edge 7a of the suction slot 7 that results in the nozzle 1 tilting and the wheel 5 lifting off the ground (as shown by dotted lines indicated as 5a in Figure 2) until the torque T is at zero, which occurs when the the leading edge 7a and the wheel axis A both lie on the same line as the applied force P. For attaining high dust pickup levels this tilting action is undesirable because the trailing edge 7b of the suction slot 7 is no longer in contact with the carpet surface S, and so air will start seeping in through a bypass path, rather than through the carpet, and so this is undesirable and results in a reduction in suction performance. The tilting action also causes unpleasant bouncing, irregular movements of the nozzle 1.

[0020] Ideally, the distance q should be maintained as small as possible in order to minimise the undesirable tilting action explained in more detail above. At the same time, the distance h needs to be selected so as to maintain a vertical force V which will maintain the suction slot 7 against the pile when the nozzle 1 is pushed in a forward direction F.

[0021] The inventors have determined that to balance the requirement of preventing loss of suction when the nozzle 1 is pushed in the forward direction F, and the requirement to minimise or alleviate bouncing and irregular movement of the nozzle 1 (by maintaining a low distance q and keeping the aforementioned torque T at a minimum) when the nozzle 1 is pulled in the rearward direction R, a certain combination of wheel diameter h and the distance of the wheel to the centre of the suction channel 7 is important. By selecting these parameters carefully, it has been found that a good balance between effective dust pick up and the force required by a user to move the nozzle 1 easily when it is pushed in the forward F direction and also when it is being pulled in the rearward direction R is achieved.

[0022] Ideally, the inventors have found that the dimension q should be smaller than 24 mm to provide the best possible performance of the nozzle 1 when it is being pulled in the rearward direction R.

[0023] The distance q is related to the distance of the wheel axle A above the surface S (i.e. dimension h referred to above, which is equivalent to the radius of the wheel 5), and the dimension X (see Figure 3), which is the distance across the surface S between the point of contact Y of the wheel 5 with the surface S directly below the axis A, and a centre line M (see Figure 3) midway between the leading and trailing edges 7a, 7b of the suction channel slot 7, i.e. an imaginary centre line that is parallel to and equidistant from both the leading and the trailing edges 7a, 7b of the suction channel slot 7. If the suction channel slot has a width C, then the centre line M is positioned at $1/2C$ from the leading and trailing edges 7a, 7b. The inventors have found that by increasing the diameter h of the wheel 5, and by positioning the wheel axle A closer to the suction slot 7 to reduce the distance X, the smaller q will become, thereby reducing the torque

T and making it easier to pull the nozzle 1 across the rearward surface in the direction R.

[0024] It should be noted here that the suction channel slot 7 is ideally rectangular in shape, and extends across the width of the nozzle 1 in a direction at right angles to the forward F and backward R direction of movement of the nozzle 1, and parallel to the wheel axis A. However, it is possible that the suction channel slot may be shaped or extend at an angle in some way, in which case the measurement X referred to above should be taken from at a central point, midway between each end of the slot 7 in a direction across the width of the nozzle 1.

[0025] In order to achieve $q < 24$, the relation between the wheel radius h and dimension X should be:

$$\frac{h}{X + \frac{1}{2}C} > 0.3$$

[0026] In an embodiment of the invention, this formula is derived assuming the suction slot width C as 20mm. Preferably, the slot width C is in the region of 18 to 21mm.

[0027] The inventors have found that by making distance $X < 80\text{mm}$ and the wheel radius $h > 25\text{mm}$, the best possible suction efficiency and dynamic response is obtained when the nozzle 1 is pushed in either the forward direction F or pulled in the rearward direction R. However, it will be appreciated that although a ratio of less than 0.3 is included within these parameters for some slot widths C, parameters that provide a ratio of greater than 0.3 represent a preference as it further serves to improve the balance between dust pick up efficiency and movement of the nozzle 1.

[0028] By way of further explanation, if the ratio is less than 0.3, the force required to push the nozzle in the forward direction F is smaller, as would be the vertical force V acting on the leading edge 7a of the nozzle 1. Consequently, the dust pickup efficiency would reduce. However, a ratio of less than 0.3 results in a larger value for distance q, and so the torque required to cause the nozzle 1 to tilt increases when the nozzle 1 is being pulled in the rearward direction R. When the specified parameters are chosen so as to provide a ratio of greater than 0.3, the vertical force V on the leading edge 7a of the nozzle 1 for a given force applied by the user to push the nozzle 1 forward is higher than whenever parameters are chosen which are smaller than the specified ratio. Also, with a ratio greater than 0.3, distance q will be resulting in less torque T on the nozzle for the same friction force than whenever a setting is chosen outside the specified ratio.

[0029] In one embodiment of the invention, therefore, there is provided the nozzle 1 for a vacuum cleaner, comprising the housing 2 having the soleplate 6 with the suction channel slot 7 therein for the suction of debris from the surface S, the wheel 5 mounted to the housing 2 for

rotation about the axis 1 that extends substantially parallel to the leading and trailing edges 7a, 7b of said suction channel slot 7 to support the nozzle 1 on said surface S, and the suction pipe connector 3 mounted to the housing 2 for rotation about an axis that is coaxial with said wheel axis A. The ratio of the radius h of the wheel 5 to the distance X across a surface, between the point of contact Y of the wheel 5 with the surface S that is directly beneath the wheel axis 1, and the point midway between the leading and trailing edges 7a, 7b of the suction channel slot 7 is greater than 0.3. The parameters are selected so as to provide a ratio of greater than 0.3 when the width C of the suction slot 7 lies in the range of 18 to 21mm.

[0030] The embodiment shown in Figure 4 is the same as that shown in Figure 3, except that the wheel 5 is pivotally mounted to the suction pipe connector 3, and the housing 2 is pivotally mounted to the suction pipe connector 3 for rotation about a second axis B which is spaced from the wheel axis A. A link arm 10 extends between the axes A and B, and connects the housing 2 to the suction pipe connector 3. It will be appreciated that, in this embodiment, the housing 2 can pivot about axis B independently to movement of the suction pipe connector 3 and the wheel 5 about axis A, and so the housing 2 can assume a different angle during the forward F and backward R strokes.

[0031] Figure 5 is a table that provides a number of ratios obtained from the equation identified above with different vacuum cleaner nozzles 1 having differing values for distance X, wheel radius h and slot width C. It also demonstrates how dust pick up efficiency and motion resistance is optimised when the calculated ratio is greater than 0.3 "Nozzle 1" represents the nozzle according to the invention, whereas "nozzles 2, 3 and 4" represent those of the prior art. Although this table represents values obtained from a nozzle 1 having a double hinge arrangement, as described with reference to Figure 4, similar advantages are obtained with the nozzle 1 described with reference to Figure 3 in which there is only one pivot point.

[0032] It will be appreciated that the term "comprising" does not exclude other elements or steps, and that the indefinite article "a" or "an" does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to an advantage. Any reference signs in the claims should not be construed as limiting the scope of the claims.

Claims

1. A nozzle (1) for a vacuum cleaner, the nozzle (1) comprising a soleplate (6) with a suction channel slot (7) therein for the suction of debris from a surface (S), a wheel (5) mounted for rotation about a wheel axis (A) to support the nozzle (1) on said surface (S), and a suction pipe connector (3) for rotation about

an axis that is coaxial with said wheel axis (A), the wheel (5) having a radius (h) of at least 25mm, and **characterized in that** a distance (X) across the surface (S) between a point of contact of the wheel (5) with the surface (S) that is directly beneath the wheel axis and a point midway between a leading edge (7a) and a trailing edge (7b) of the suction channel slot (7) is no greater than 80mm.

2. The nozzle according to claim 1, comprising a housing (2) in which the soleplate (6) and suction channel slot (7) are formed, the wheel (5) and suction pipe connector (3) being mounted to the housing (2) for rotation about said wheel axis (A).
3. The nozzle according to claim 1, comprising a housing (2) in which the soleplate (6) and suction channel slot (7) are formed, the wheel (5) and suction pipe connector (3) being mounted for rotation relative to each other about the wheel axis (A), and the housing (2) being mounted for rotation relative to the wheel (5) and the suction pipe connector (3) about a second axis (B) parallel to and spaced from the wheel axis (A).
4. The nozzle according to claim 3, comprising a link arm extending between said wheel axis (A) and the second axis (B) and being pivotally connected to each of the suction pipe connector (3) and the housing (2).
5. The nozzle according to any preceding claim, where- in the ratio of the radius (h) of the wheel (5) to the sum of the distance (X) across the surface between a point of contact of the wheel (5) with the surface (S) that is directly beneath the wheel axis (A) and a point midway between the leading edge (7a) and the trailing edge (7b) of the suction channel slot (7), and a distance (1/2 C) across the surface between the point midway between the leading edge (7a) and the trailing edge (7b) of the suction channel slot (7), and the leading edge (7b) of the suction channel slot (7) is greater than 0.3.
6. A vacuum cleaner including a suction pipe (4) and the nozzle (1) according to claim 1 or claim 2 connected to the suction pipe (4) via the suction pipe connector (3).

Patentansprüche

1. Düse (1) für einen Staubsauger, wobei die Düse (1) eine Bügelsole (6) mit einem Saugkanalschlitz (7) darin zum Ansaugen von Schmutz und Staub von einer Oberfläche (S), ein zur Drehung um eine Radachse (A) montiertes Rad (5), um die Düse (1) auf der Oberfläche (S) zu halten, sowie ein Saugrohr-

anschlussstück (3) zur Drehung um eine koaxial mit der Radachse (A) angeordnete Achse umfasst, wobei das Rad (5) einen Radius (h) von mindestens 25 mm aufweist, **dadurch gekennzeichnet, dass** eine Distanz (X) über die Oberfläche (S) zwischen einem Kontaktpunkt des Rades (5) mit der Oberfläche (S), die sich unmittelbar unterhalb der Radachse befindet, und einem Punkt in der Mitte zwischen einer Vorderkante (7a) und einer Hinterkante (7b) des Saugkanalschlitzes (7) nicht größer als 80 mm ist.

2. Düse nach Anspruch 1, mit einem Gehäuse (2), in dem die Bügelsole (6) und der Saugkanalschlitz (7) ausgebildet sind, wobei das Rad (5) und das Saugrohranschlussstück (3) an dem Gehäuse (2) zur Rotation um die Radachse (A) angebracht sind.
3. Düse nach Anspruch 1, mit einem Gehäuse (2), in dem die Bügelsole (6) und der Saugkanalschlitz (7) ausgebildet sind, wobei das Rad (5) und das Saugrohranschlussstück (3) zur Rotation relativ zueinander um die Radachse (A) angebracht sind und das Gehäuse (2) zur Rotation relativ zu dem Rad (5) und dem Saugrohranschlussstück (3) um eine zweite Achse (B) parallel zu der ersten Achse (A) und von dieser beabstandet angebracht ist.
4. Düse nach Anspruch 3, mit einem Verbindungsarm, der sich zwischen der Radachse (A) und der zweiten Achse (B) erstreckt und mit sowohl dem Saugrohranschlussstück (3) als auch dem Gehäuse (2) schwenkbar verbunden ist.
5. Düse nach einem der vorangegangenen Ansprüche, wobei das Verhältnis des Radius (h) des Rades (5) zu der Summe der Distanz (X) über die Oberfläche zwischen einem Kontaktpunkt des Rades (5) mit der Oberfläche (S), die sich unmittelbar unterhalb der Radachse (A) befindet, und einem Punkt in der Mitte zwischen der Vorderkante (7a) und der Hinterkante (7b) des Saugkanalschlitzes (7), und einer Distanz (1/2 C) über die Oberfläche zwischen dem Punkt in der Mitte zwischen der Vorderkante (7a) und der Hinterkante (7b) des Saugkanalschlitzes (7) und der Vorderkante (7b) des Saugkanalschlitzes (7) größer als 0.3 ist.
6. Staubsauger mit einem Saugrohr (4) und der mit dem Saugrohr (4) über das Saugrohranschlussstück (3) verbundenen Düse (1) nach Anspruch 1 oder 2.

Revendications

1. Buse (1) d'aspirateur, la buse (1) comprenant une semelle (6) comportant à une fente de canal d'aspiration (7) pour l'aspiration de débris d'une surface (S), une roue (5) montée en rotation autour d'un axe

de roue (A) pour supporter la buse (1) sur ladite surface (S), et un raccord de tuyau d'aspiration (3) en rotation autour d'un axe qui est coaxial avec ledit axe de roue (A), la roue (5) ayant un rayon (h) d'au moins 25 mm, et **caractérisée en ce qu'une distance (X) à travers la surface (S) entre un point de contact de la roue (5) avec la surface (S) qui se trouve directement sous l'axe de roue et un point à mi-chemin entre un bord avant (7a) et un bord arrière (7b) de la fente du canal d'aspiration (7) n'est pas supérieure à 80 mm.**

2. Buse selon la revendication 1, comprenant un logement (2) dans lequel sont formées la semelle (6) et la fente de canal d'aspiration (7), la roue (5) et le raccord de tuyau d'aspiration (3) étant montés sur le logement (2) en rotation autour dudit axe de roue (A).
3. Buse selon la revendication 1, comprenant un logement (2) dans lequel sont formées la semelle (6) et la fente de canal d'aspiration (7), la roue (5) et le raccord de tuyau d'aspiration (3) étant montés en rotation l'un par rapport à l'autre autour de l'axe de roue (A), et le logement (2) étant monté en rotation par rapport à la roue (5) et au raccord de tuyau d'aspiration (3) autour d'un second axe (B) parallèle à l'axe de roue (A) et espacé par rapport à lui.
4. Buse selon la revendication 3, comprenant un bras de liaison s'étendant entre ledit axe de roue (A) et le second axe (B) et étant raccordé de manière pivotante à chacun du raccord de tuyau d'aspiration (3) et du logement (2).
5. Buse selon l'une quelconque des revendications précédentes, dans laquelle le rapport du rayon (h) de la roue (5) sur la somme de la distance (X) à travers la surface entre un point de contact de la roue (5) avec la surface (S) qui se trouve directement sous l'axe de roue (A) et un point à mi-chemin entre le bord avant (7a) et le bord arrière (7b) de la fente de canal d'aspiration (7), et une distance (1/2 C) à travers la surface entre le point à mi-chemin entre le bord avant (7a) et le bord arrière (7b) de la fente de canal d'aspiration (7), et le bord avant (7b) de la fente de canal d'aspiration (7) est supérieure à 0,3.
6. Aspirateur comprenant un tuyau d'aspiration (4) et la buse (1) selon la revendication 1 ou la revendication 2 raccordée au tuyau d'aspiration (4) par le biais du raccord de tuyau d'aspiration (3).

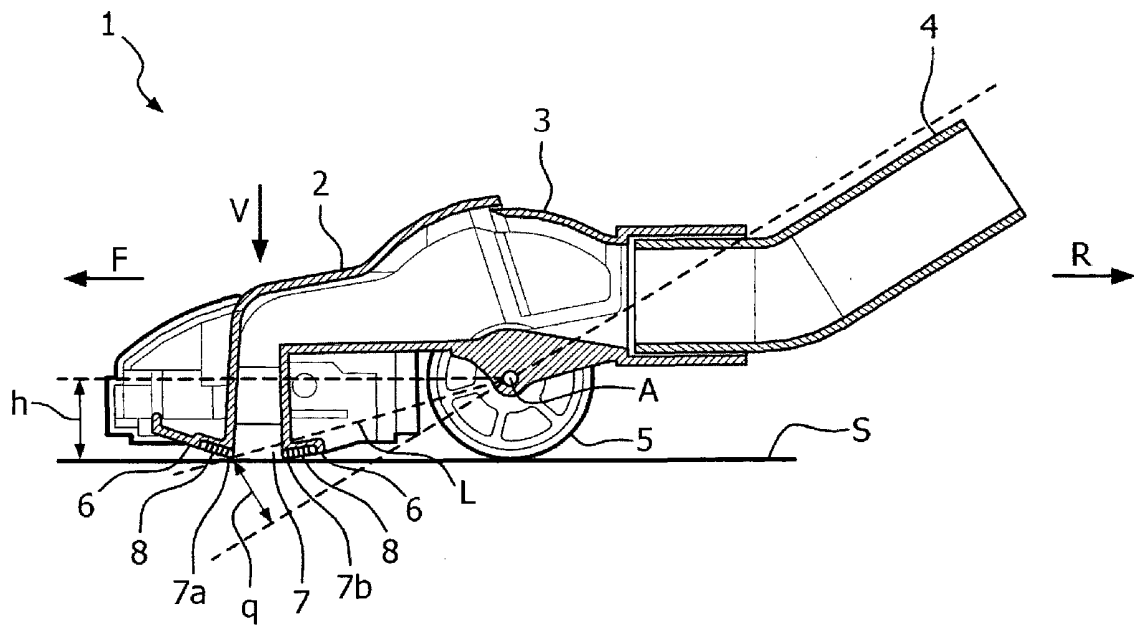


FIG. 1

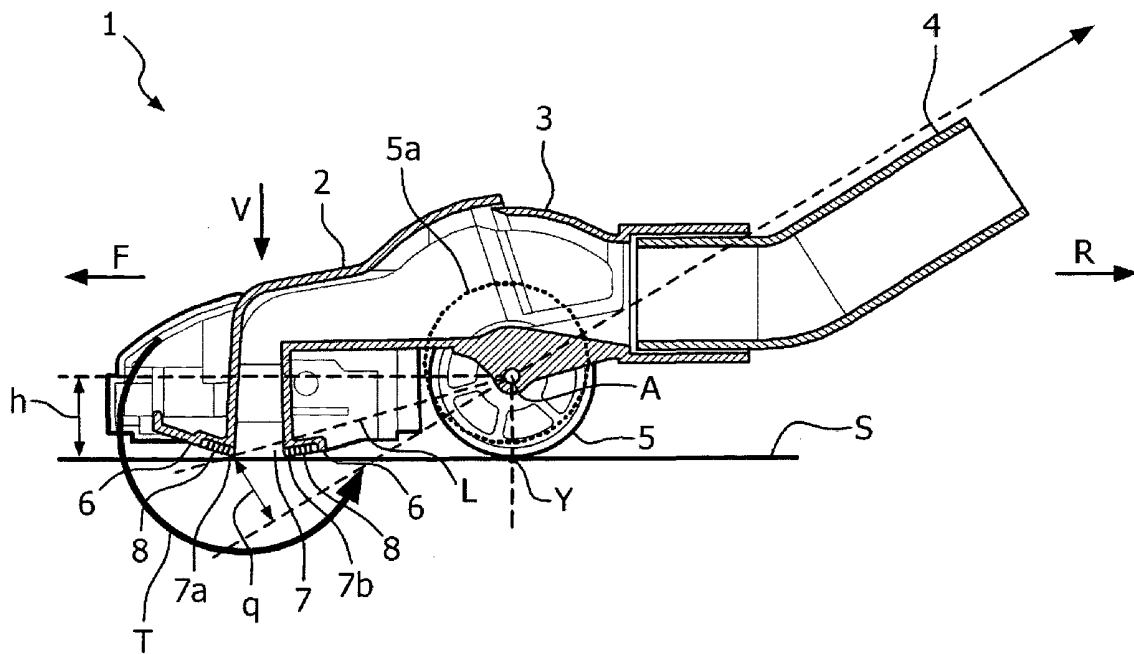


FIG. 2

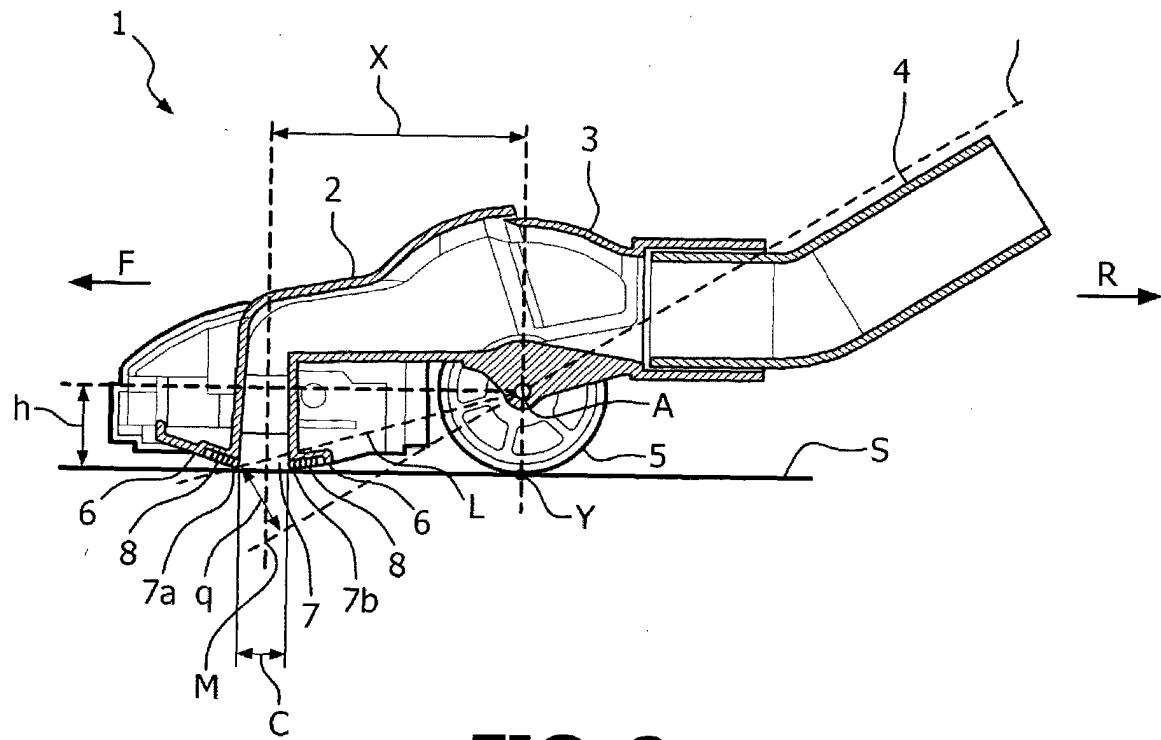


FIG. 3

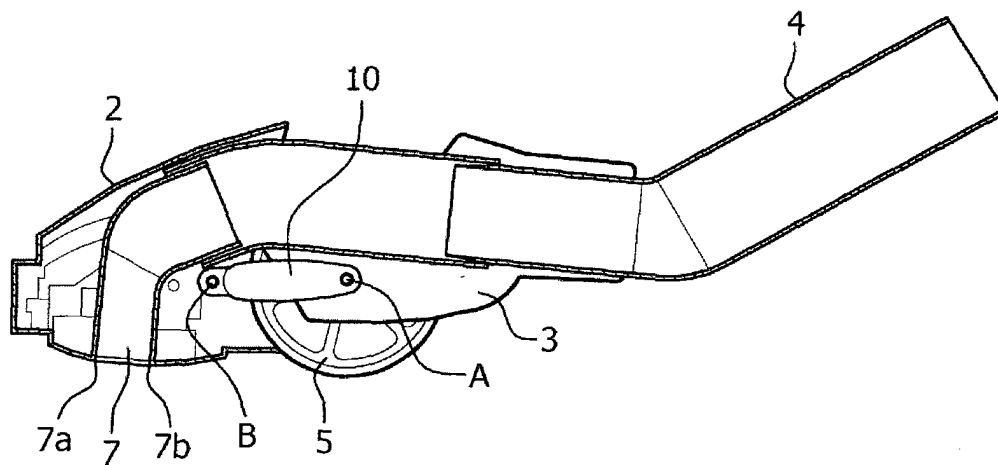


FIG. 4

Nozzle settings					Performance result		
	Distance X (mm)	Wheel radius h (mm)	Slotwidth C (mm)	$\frac{h}{X + 1/2 C} > 0.3$	Dust Pick Up (percentage sand picked up from carpet)	Motion Resistance (force needed to move nozzle over carpet)	Ratio between achieved dust pick up and occurring motion resistance of the nozzle
Nozzle 1	77	32.5	20	0.37	89%	40 N	2.23
Nozzle 2	120	30	21	0.23	86%	56 N	1.54
Nozzle 3	100	32	18	0.29	87%	57 N	1.53
Nozzle 4	112.5	18.5	25	0.15	89%	66 N	1.35

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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