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and the length (L) of the radius (R) and the height (H) of the element (4) for dust pickup change along the longitudinal axis (A) with respect to at least a portion of the body (3), and the sum of the length (L) of the radius (R) and the height (H) of the element (4) along the longitudinal axis (A) of the body (3) adopts a fixed value.



Description

[0001] The present invention relates to a brush roller bar for a cleaning device, more particularly to a brush roller bar for a suction nozzle of a vacuum cleaner for cleaning surfaces such as floors, carpets, etc., comprising a rotatable, elongated brush roller bar, which is provided with brush means, wherein the brush roller bar is rotatably driven and adapted to rotate during cleaning to brush off debris and dust from the surface or to accomplish agitation of the surface.

[0002] The cleaner head of a cleaning device, such as a vacuum cleaner, a floor sweeper, or an autonomous robot cleaner may include a brush roller bar driven by a drive assembly. The drive assembly often includes a clutch for transmitting torque generated by the drive assembly to the brush roller bar. The driven torque can be generated by a turbine, electric motor or other means. The rotation of the brush roller bar when it is loaded by contact with the cleaned surface, causes its vibrations what generates undesirable noises.

[0003] The document WO 2014/027 186 A1 discloses a cleaner head comprising an agitator and a drive assembly for driving the agitator. The drive assembly comprises a dog for transmitting torque to the agitator. One of the dog and the agitator comprises a tapered head, a shank that extends from the head, and a screw thread formed around the shank. The other of the dog and the agitator comprises a bore having a countersink and a complementary screw thread formed around a wall of the bore. The shank projects into the bore and the two threads mate such that, as the dog rotates, the agitator screws on to the dog and the tapered head mates with the countersink. As a result, over the torque range typically generated by the drive assembly of most conventional cleaner heads, the axial force exerted by the dog on the agitator is of a magnitude that ensures that the agitator is held against the tapered head with sufficient force so as to reduce vibration and noise.

[0004] The document EP 1 043 947 A1 discloses a brush bar for a vacuum cleaner comprising a central core at least one radially extending flange and a plurality of bristles, the bristles being mounted on the at least one flange so that the bristles are spaced from the central core, wherein the or each flange extends radially outwardly from the central core to a distance more than the diameter of the central core. Since the bristles are mounted on a flange and spaced from the core of the brush bar, more space is provided in the dirty air inlet which helps to prevent clogging and to improve the air flow within the dirty air inlet and hence to improve the cleaning efficiency of the vacuum cleaner. Furthermore, since the brush bar is smaller than conventional brush bars, the overall weight of the brush bar and hence the cleaner head of the vacuum cleaner, is reduced. Reduced weight of the cleaner head allows the cleaner head to "float" with more sensitivity on a carpet to be cleaned.

[0005] The document WO 02/038 024 A1 discloses a

vacuum cleaner for floor surfaces, especially for smooth floors, comprising a housing in whose base a suction channel is configured that substantially extends at an angle to the working direction of the vacuum cleaner across the entire width of the housing. A cleaning roller is disposed above the suction channel and a part of its peripheral surface projects through the suction channel. Said cleaning roller is rotatably driven by a motor disposed in the housing. In order to achieve a satisfactory cleaning result also of smooth floors, the vacuum cleaner is provided with a cleaning and polishing attachment whose attachment housing is detachably mounted on base side on the housing. Said attachment comprises at least one rotatably driven cleaning and polishing tool that acts upon the floor surface, said cleaning and polishing tool being driven by the motor in the housing of the vacuum cleaner.

[0006] The objective problem to be solved by the present invention is to provide a brush roller bar for a cleaning device in which reduction of vibration and therefore noise reduction during it's working is achieved.

[0007] In accordance with the present invention, there is provided a roller bar for a suction nozzle, comprises a body having an outer lateral surface which is with a distance from the axis by a radius of a length (L). The body rotates about a longitudinal axis and is provided with at least one element of a height (H) for dust pickup that substantially radially and outwardly extends from the body. The element for dust pick up is preferably made of a flexible material, therefore the angle at which it protrudes from the body may differ ± 15 degrees from the right angle because of it deformation. The length (L) of the radius of the outer lateral surface of the body and the height (H) of the element for dust pick up change along the longitudinal axis with respect to at least portion of the body, and the sum of the length (L) of the radius and the height (H) of the element for dust pickup along the longitudinal axis of the body, adopts a fixed value. Along whole length of the roller bar the changes in the length (L) of the radius of the outer lateral surface of the body is compensated by changing the height (H) the along the longitudinal body in order to achieve fixed value of the sum of the length (L) and height (H) along the roller bar, therefore the free ends of the element for dust pickup are in the same distance from the longitudinal axis of the rotation. In that way whole width of the element for dust pick up, especially it free end is involved in the cleaning the surface during revolution of the roller bar by brushing the cleaned surface.

[0008] The efficiency of picking up the dust is one of the most important feature for a user of the vacuum cleaner. One of the method how to improve the efficiency is to equip the suction nozzle with rotating brush bar which brushes a surface improving efficiency of the cleaning. Cleaning device as a suction nozzle comprises a housing with an inlet and an outlet, and driven a roller bar rotatable mounted in the housing. The roller bar can be driven by a turbine rotated by the air stream produced by suction unit of the vacuum cleaner or can be driven by an electric

motor mounted in the nozzle. In both means, a torque is usually transmitted by a gear, usually by a belt transmission. On the other hand, rotating movement of the roller bar is significant source of the noise and excitation forces acting on the housing of the nozzle, therefore to achieve high efficiency of dust picking and limitation of the noise producing, present invention is provided.

[0009] The brush strip, especially their free ends interact with the cleaned surface i.e. carpet or with the ground during the rotation. The element for dust pick up is preferable made of flexible material, therefore this interaction generates the forces as a result of the bending of the element for dust pick up. General requirement for the quiet brush is to keep forces acting on the ends of the body constant during rotation of the roller. Constant forces act as a static load of the housing so they do not provide any dynamic excitation of the housing. Present invention is implemented to achieve the constant forces acting on the ends of the body, namely to reduce said dynamic forces. The body having the outer lateral surface which is with a distance from the axis by the radius of the variable length (L) along the longitudinal axis that causes that the height (H) of the element for dust pickup should be also variable along the longitudinal axis. Thus the element for dust pick up has variable bending stiffness along the roller bar as well, therefore the roller bar by changing geometry of the body by changing the length (L) and the height (H) of the strip can be tuned to arrive a constant forces or reduction dynamic forces coming from the brush strip stiffness acting on the ends of the body for decreasing the noise. The change of the body geometry does not increase the price of the brush and has neutral effect on the dust pick up efficiency as well.

[0010] In the preferred embodiment the roller bar has the body in which the length (L) of the radius and the height (H) of the element for dust pickup change along the longitudinal axis of the body.

[0011] In the preferred embodiment the body has an intermediate portion that is between two ends of the body and the length (L3) of the radius at the intermediate portion differs from the length (L2, L3) of the radius on the ends of the body (3). The length of the radius of the outer lateral surface of the body and position of the intermediate portion are parameters which can be used for tuning the roller bar to achieve the lower level of the noise.

[0012] Advantageously the roller bar has the element for dust pickup that is in the form of a brush strip or a lip or cloth. Therefore the efficiency of dust pick up can be improved additionally by choosing between the form of the element adapted to cleaned surface. In the preferred embodiment the roller bar has a brush strip which comprises a brush filament that is arranged in a plurality of tufts or the brush filament is evenly distributed, along the body of the roller bar. Therefore the effect of brushing the cleaned surface can be adjusted to achieve desired parameters of the dust pick up.

[0013] In the preferred embodiment the roller bar is formed by two truncated cones which are coaxially joined

by their bases and in this area having substantially the same radius length. The said connected bases form the intermediate portion with the length (L3) of the radius of the outer surface, and the tops of said truncated cones form the ends of the body with the radius of lengths (L1, L2). The length (L3) of the radius on the intermediate portion is greater than lengths (L1, L2) of the radius on the ends of the body. Advantageously the intermediate portion of the body is arranged in middle between the ends of the body. In another preferred embodiment, the said ends of the body have the same length (L1=L2) of the radius. The positive effect is that the roller bar is easy and cheap to produce, because of using injection molding. Also such shape of the body is favorable for balancing it. Because of the roller bar rotates fast, therefore it's important to balance it.

[0014] In one of the preferred embodiment the roller bar has the body equipped with the element for dust pick up whose the free ends defines while rotate about the longitudinal axis (A), a circular cylindrical surface of a radius of the fixed length (K), that equals the sum of the length (L) of the radius and the height (H) of the element for setting an influence exerted on a cleaning surface along the roller bar. Therefore the cleaned surface is brushed by the element for dust pick up on the whole width of the body during it rotation.

[0015] Advantageously the body has at least one the element for dust pick up which is arranged between the ends in the shape of a continuous curve along the longitudinal axis. Therefore the cleaned surface is brushed by the brush strip on the whole width of the body during it rotation.

[0016] Advantageously the roller bar has the element for dust pickup extends helically around the body from one of the ends of the body to the other of the ends of the body along the longitudinal axis. Alternatively the element for dust pickup is arranged along the longitudinal axis on the body as the continuous line in the form of a half cycle triangle waveform with the extremum point of said triangle waveform placed in the intermediate portion of the body or the element for dust pickup is arranged along the longitudinal axis on the body as the continuous line in the form of first half cycle of an approximately sine curve, wherein the extremum point of said sine curve is placed in intermediate portion of the body. Therefore in the same time only part of the element for dust pick up, namely part of the free ends of the elements has a contact with a cleaned surface for brushing it, therefore the torque needed to drive the roller bar is smaller.

[0017] Advantageously the roller bar has the body that comprises two substantially the same the element for dust pick up, rotated by 180 degrees about the longitudinal axis with respect to each other. Therefore deployment of the element for dust pick up on the body can be done more regularly what increases the dust picking efficiency and reduces vibrations generated by the roller bar.

[0018] Advantageously, the roller bar has the body

having the outer surface with the length of the radius that changes along the longitudinal axis of the body as well accordingly there is changed the height of the element for dust pick up along the said body. Said structure of the roller bar reduces its vibration and reduces noises during working.

[0019] Further benefits and advantages of the present invention will become apparent after a careful reading of the detailed description with appropriate reference to the accompanying drawings.

[0020] In the drawings:

Fig. 1 is a plan view of a roller bar in accordance with the preferred embodiment of the present invention.

Fig. 2 is a plan view of the roller bar in accordance with the preferred embodiment of the present invention.

[0021] With reference to Fig. 1 which is a plan view of a roller bar in example for a suction nozzle or autonomous robot cleaner in accordance with the preferred embodiment of the present invention, the roller bar 1 comprises a body 3 defined by substantially the same two truncated cones having the bases of the same length (L_3) of radius, located and connected coaxially by their bases. Said connected bases form the intermediate portion 5 with the radius of length L_3 of the outer surface 2. The tops of said truncated cones form the ends 6, 7 of the body 3 with the outer surface 2 of the substantially the same radius length $L_1 = L_2$. Truncated cones have substantially the same height therefore the intermediate portion 5 is placed in the middle between the ends 6, 7. The outer surface 2 of the body 3 is defined by the lateral surface of said truncated cones. The length L of the radius R of the outer surface 2 that changes linearly along the longitudinal axis A of the body 3. Further, the body 3 which rotates about the longitudinal axis A is equipped with two elements 4 for dust pick up which are in the form of brush strips, which are symmetrically rotated about 180 degrees with respect to each other and longitudinal axis A . The brush strips 4 are evenly arranged along the axis A and extend helically around the body 3 from one of the ends 6, 7 of the body 3 to the other of the ends 6, 7 of the body 3 along the longitudinal axis A , therefore at the same time a portion of the brush strip 4 has a contact with the cleaned surface 10. Both brush strips 4 of height H radially and outwardly extend from the body 3. The height H of the brush strip 4 changes linearly along the body 3, and in that the sum of the length of the radius L and the height H along the body 3 adopts a fixed value. Therefore changes of the length L of radius R is compensated by changing the height H of the brush strip to achieve constant length of radius K as the sum of the length L of radius R and the height H of the brush strip 4. moreover length (K) of radius is a distance between the free ends 8 of the brush strip 4 and longitudinal axis A , therefore during rotation the said free ends 8 defines a circular cylindrical surface with a radius of the length

K , while they are rotated about the longitudinal axis A for setting a contact with a cleaned surface 10 and/or producing a blast of air for easier pick up the dust. The free ends 8 are on the same distance from the longitudinal axis A , therefore the cleaned surface is brushed by the brush strip 4 on the whole width of the roller bar 1.

[0022] With reference to Fig. 2 there is shown the example of the preferred embodiment of the roller bar 1 as shown on Fig. 1, but rotated by about 90 degrees about the longitudinal axis A . The roller bar 1 comprises the body 3 defined by substantially the same two truncated cones having the bases of the radius length L_3 , located and connected coaxially by their bases. Said connected bases form the intermediate portion 5 with the radius R_1 of the outer surface 2. The tops of said truncated cones form the ends 6, 7 of the body 3 with the outer surface 2 with radii of the substantially the same length $L_1 = L_2$. Truncated cones have substantially the same height therefore the intermediate portion 5 is placed in the middle between the ends 6, 7. The outer surface 2 of the body 3 is defined by the lateral surface of said truncated cones. The length L of the radius R of the outer surface 2 changes linearly along the longitudinal axis A of the body 3. Further, the body 3 which rotates about the longitudinal axis A is equipped with two elements 4 for dust pick up in the form of brush strips 4 (one of them is not shown on this figure) which are symmetrically rotated about 180 degrees with respect to each other and longitudinal axis A . The brush strips 4 are evenly arranged helically around the body 3 from one of the ends 6, 7 along the longitudinal axis A of the body 3. Therefore at the same time only a part of the brush strip 4, namely part of its free end 8 has a contact with the cleaned surface 10. Both brush strips 4 of the height H substantially radially and outwardly extend from the body 3. The height H of the brush strip 4 and the length L of radius of the lateral outer surface 2 changes linearly along the body 3. The sum of the length L of the radius of the body 3 and the height H of the brush strip 4 along the body 3 adopts a fixed value. The changes of the length L of radius R is compensated by changing the height H of the brush strip to achieve constant value K which equals a distance between the free ends 8 of the brush strip 4 and longitudinal axis A , therefore during rotation the said free ends 8 defines a circular cylindrical surface with a radius of the length K while they rotate about the longitudinal axis A for setting a contact with a cleaned surface 10. The free ends 8 are on the same distance from the longitudinal axis A , therefore the cleaned surface is brushed by the brush strip 4 on the whole width of the roller bar 1.

List of reference signs:

[0023]

- 1 roller bar
- 2 outer surface
- 3 body

4 element for dust pick up
 5 intermediate portion
 6, 7 end of the body
 8 free end
 10 floor, cleaned surface
 11 continues curve
 12, 13 truncated cone
 A axis
 L, L1, L2, L3, length of the radius
 K length of the radius
 H height

Claims

1. A roller bar (1) for a suction nozzle, that rotates about a longitudinal axis (A), comprises a body (3) having an outer lateral surface (2) which is with a distance from the axis (A) by a radius (R) of a length (L), and at least one element (4) of a height (H) for dust pickup that substantially radially outwardly extending from the body (3) **characterized in that** the length (L) of the radius (R) and the height (H) of the element (4) for dust pickup change along the longitudinal axis (A) with respect to at least a portion of the body (3), and **in that** the sum of the length (L) of the radius (R) and the height (H) of the element (4) along the longitudinal axis (A) of the body (3) adopts a fixed value.
2. The roller bar according to claim 1, **characterized in that** the length (L) of the radius (R) and the height (H) of the element (4) for dust pickup change along the longitudinal axis (A) of the body (3).
3. The roller bar according to claim 1 or 2, **characterized in that** the body (3) has on the longitudinal axis (A) two the ends (6,7) and an intermediate portion (5), wherein the length (L3) of the radius (R) at the intermediate portion (5) differs from the length (L2, L3) of the radius (R) on the ends (6,7) of the body (3).
4. The roller bar according to any claims from 1 to 3, **characterized in that** the element (4) for dust pickup is a brush strip or a lip or cloth.
5. The roller bar according to claim 4, **characterized in that** the element (4) for dust pick up arranged as the brush strip comprises a brush filament which is arranged in a plurality of tufts or the brush filament is evenly distributed, along the longitudinal axis (A) of the body (3) of the roller bar (1).
6. The roller bar according to any of claims from 1 to 5, **characterized in that** the body (3) is formed by two truncated cones (12, 13), coaxially joined by their bases and in this area having substantially the same radius length, wherein said connected bases form

the intermediate portion (5) with the length (L3) of the radius (R) of the outer surface (2), and the tops of said truncated cones form the ends (6,7) of the body (3) with the radius (R) of lengths (L1, L2) and the length (L3) of the radius (R) on the intermediate portion (5) is greater than lengths (L1, L2) of the radius (R) on the ends (6,7) of the body (3).

7. The roller bar according to claim 6, **characterized in that** the intermediate portion (5) of the body (3) is arranged in the middle between the ends (6, 7) of the body (3).
8. The roller bar according to any of the preceding claims, **characterized in that** the free ends (8) of the element (4) for dust pickup defines while rotate about the longitudinal axis (A), a circular cylindrical surface of a radius of the fixed length (K), that equals the sum of the length (L) of the radius (R) and the height (H) of the element (4) for setting an influence exerted on a cleaning surface (10) along the roller bar (1).
9. The roller bar according to any of the preceding claims, **characterized in that** the body (3) has at least one the element (4) for dust pickup which is arranged in the shape of a continuous curve (11) along the longitudinal axis (A) and between the ends (6, 7).
10. The roller bar according to any of the preceding claims, **characterized in that** the element (4) for dust pickup extends helically around the body (3) from one of the ends (6, 7) of the body (3) to the other of the ends (6, 7) of the body (3) along the longitudinal axis (A).
11. The roller bar according to any of claims from 1 to 9, **characterized in that** the element (4) for dust pickup is arranged along the longitudinal axis (A) on the body (3) as the continuous line in the form of a half cycle triangle waveform, wherein the extremum point of said triangle waveform is placed in the intermediate portion (5) of the body (3).
12. The roller bar according to any of claims from 1 to 9, **characterized in that** the element (4) for dust pickup is arranged along the longitudinal axis (A) on the body (3) as the continuous line in the form of first half cycle of an approximately sine curve, wherein the extremum point of said sine curve is placed in intermediate portion (5) of the body (3).
13. The roller bar according to any of the preceding claims, **characterized in that** the body (3) comprises two substantially the same element (4) for dust pickup which are rotated by about 180 degrees about the longitudinal axis (A) with respect to each other.

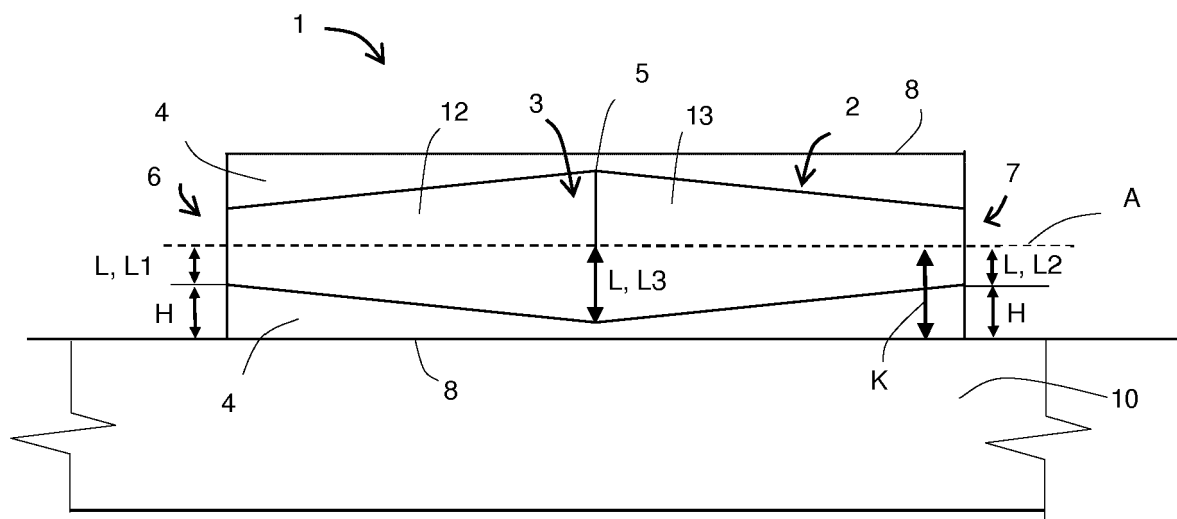


Fig. 1

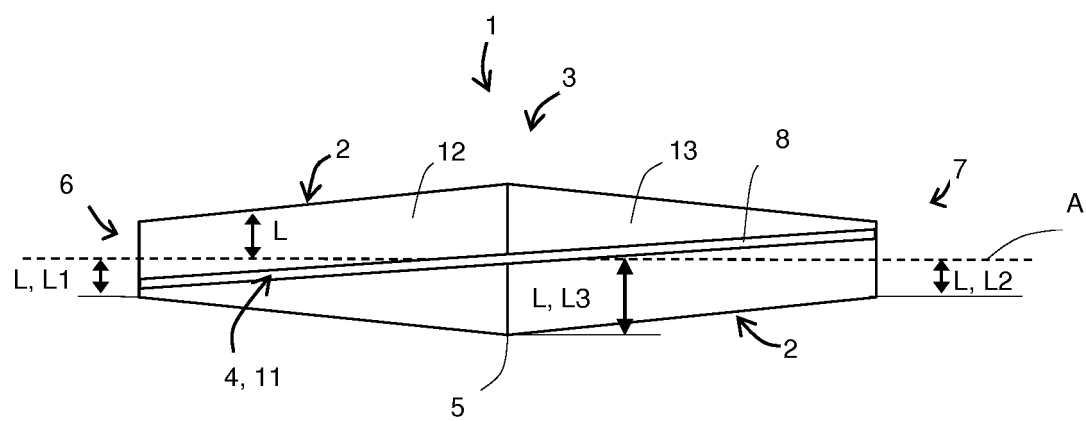


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 19 18 7459

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 1 043 947 A1 (NOTETRY LTD [GB]) 18 October 2000 (2000-10-18) * claims 1,3-5; figures 1-4 *	1-13	INV. A47L9/04
A	US 1 582 693 A (RIEBEL JR FRED) 27 April 1926 (1926-04-27) * claim 4; figures 1,2 *	1	
A	DE 538 356 C (MAUZ & PFEIFFER) 13 November 1931 (1931-11-13) * claims 1,5,9-11; figures 4,5,7 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			A47L A46B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 January 2020	Examiner Laurim, Jana
CATEGORY OF CITED DOCUMENTS 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 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 & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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EP 19 18 7459

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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21-01-2020

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