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(54) **SUCTION HEAD WITH IMPROVED ADHERENCE TO THE SURFACE TO BE VACUUMED**

(57) A suction head for a vacuum cleaner or the like is described, said suction head comprising: a base plate with a base plate channel open towards a surface to be vacuumed, a suction channel in fluid communication with the base plate channel, main wheels for moving said suction head on the surface to be vacuumed, and a bracket for connecting said main wheels to said base plate, wherein said bracket is connected to said base plate in a rotatable manner so that said base plate is tiltable with respect to the main wheels.

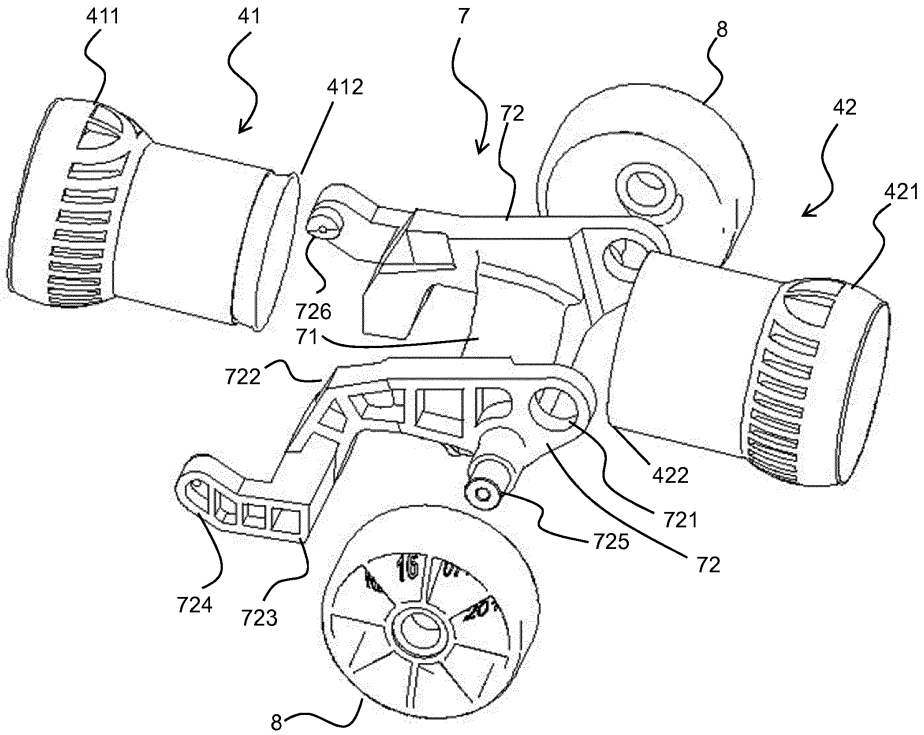

Fig. 5

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Description

BACKGROUND

[0001] The present invention relates to a suction head to be fitted to an electric household appliance for performing cleaning by means of suction, such as a vacuum cleaner, an electric broom, a multi-purpose drum vacuum cleaner or a vacuum cleaner robot, for sucking up dust and/or fluids and/or dirt from a surface. In particular, the present invention relates to a suction head with improved characteristics as regards adherence to the surface to be vacuumed both during the forwards movement and during the opposite backwards movement.

STATE OF THE ART

[0002] As is known, a vacuum cleaner, an electric broom or a similar electric household appliance for performing cleaning by means of suction comprises a suction head for sucking up dust, dirt or fluids from a surface. In the sector of electric household appliances, a suction head is generally referred to by the term "brush". For the purpose of the present description, therefore, the terms "suction head", "brush", "suction nozzle" or simply "nozzle" are considered to be equivalent. Again for the purpose of the present invention, the term "vacuum cleaner" will be used with a broad meaning so as to include all those apparatus, for professional or domestic use, which perform cleaning by means of suction. Therefore, the term "vacuum cleaner" will comprise a vacuum cleaner, an electric broom, a so-called multi-purpose drum vacuum cleaner, a vacuum cleaner robot, a centralized suction system for domestic or industrial use and a steam delivery and suction apparatus.

[0003] Basically a known suction head comprises a base plate shaped so as to have at least one base plate channel open towards a surface to be vacuumed, a suction channel in fluid communication with the base plate channel and optionally a covering body. The covering body can be engaged with the base plate, the suction channel or both of them. The other end of the suction channel communicates with a suction tube.

[0004] A suction head is known, for example, from EP 2 944 242 and from EP 1 600 091 in the name of the same Applicant.

[0005] Further suction heads are know from EP 2 092 869 A2 and EP 0235 614 A1.

SUMMARY OF THE INVENTION

[0006] In the present description and the claims the expression "suction efficiency" will be understood as meaning essentially the ratio, in percentage terms, of vacuumed material to material to be vacuumed. The vacuuming tests are carried out in accordance with the provisions of the standard EN 60312-1:2013-05.

[0007] Although different suction heads which perform the function of sucking dust and/or fluids and/or dirt from a surface in a sufficiently efficient manner are available on the market, the Applicant has noticed that there exists the need to improve the performance of the known suction heads. In particular, the Applicant has noticed the need to increase the efficiency for suction of dust and dirt from a surface.

[0008] The Applicant has noted that the adherence of a suction head during use, namely when the suction head is pushed forwards and backwards over a surface to be vacuumed, varies. In particular, generally, the adherence of the suction head is greater during the forwards movement and less during the opposite movement, namely when the suction head is pulled backwards. The reason for this is that, during the backwards movement, the user raises the rear part of the suction head, using the gripping handle as a lever. During this backwards movement, since the adherence is less, the suction efficiency deteriorates significantly and a considerable amount of power is used. In fact, the power supplying the motor remains the same, but is only partially used since part of it is dispersed owing to the leakages between the surface to be vacuumed and the base plate.

[0009] The Applicant has carefully considered the cross-section of the suction channel and has noted that in the known solutions there are discontinuous and/or narrow zones which prevent a regular suction flow. Owing to these discontinuous zones and significant variations in cross-section, the vacuuming efficiency is significantly reduced compared to that which can be obtained depending on the power of the motor.

[0010] Another problem consists in the fact that these discontinuous zones and variations in cross-section increase the noise level, which is bothersome for users.

[0011] The main object defined by the Applicant is to improve the adherence of a suction head both during the forwards movement and during the backwards return movement.

[0012] According to the Applicant, this object may be achieved by ensuring that, whatever the inclination of the suction tube with respect to the surface to be vacuumed, the base plate is able to remain in contact with the surface to be vacuumed.

[0013] According to the present invention, the aforementioned object is achieved by ensuring that the wheel axis is rotatable about an axis of rotation situated in the region of the base plate. Advantageously a cradle-shaped bracket may be provided for rotatably connecting the wheels to the base plate. Advantageously, two ball joints and a suction channel section configured to have a length such that it adapts to the inclination of the cradle bracket may be provided.

[0014] According to an embodiment, the invention relates to a suction head for a vacuum cleaner or the like, comprising:

a base plate with a base plate channel open towards a surface to be vacuumed,

a suction channel in fluid communication with the base plate channel,
main wheels for moving said suction head on the surface to be vacuumed, and
a bracket for connecting said main wheels to said base plate,
wherein said bracket is connected to said base plate in a rotatable manner so that said base plate is tiltable with respect to the main wheels.

[0015] According to embodiments, the projection onto the ground of the main wheels is situated, relative to the advancing direction, at the rear of the footprint of the base plate.

[0016] According to an embodiment, the suction channel comprises an inner tube and an outer tube telescopically coupled together.

[0017] According to an embodiment, the suction channel comprises a spherical inlet head and a spherical outlet head, wherein said spherical inlet head is configured to cooperate with a cowling of the base plate and wherein said spherical outlet head is configured to cooperate with a spherical cavity of a suction tube so as to form a first ball joint and a second ball joint.

[0018] In embodiments, the suction channel is rotatably supported by said bracket while in other embodiments it is not. Therefore, the rotatable support of the suction channel is not an essential feature.

[0019] According to an embodiment, the bracket comprises a central cradle and two arms, wherein each arm comprises means for rotatably attaching the main wheels and means for rotatably attaching the spherical cavity.

[0020] According to an embodiment, the base plate further comprises wheels whose projection onto the ground lies within the footprint of the base plate.

[0021] According to an embodiment, the axis of rotation of the base plate and the bracket is a horizontal axis substantially parallel to the front edge or rear edge of the base plate and defined by a straight line passing through the center of the exit section of an elbow and terminating at the height of the gripping handle relative to the floor. The gripping handle is typically at a height H of about 800 mm.

[0022] According to an embodiment, the axis of rotation of the main wheels is lower than the axis of rotation of said bracket and said suction tube.

[0023] According to an embodiment, the axis of rotation of the main wheels is in front of the axis of rotation of the bracket and the suction tube.

BRIEF DESCRIPTION OF DRAWINGS

[0024] The present invention will become clearer from the following detailed description, provided purely by way of a non-limiting example, to be read with reference to the accompanying drawings, in which:

- Figure 1 shows a schematic cross-sectional view of a suction head according to a embodiment of the present invention in a first configuration;
- Figure 2 shows a schematic cross-sectional view of a suction head according to an embodiment of the present invention in a second configuration;
- Figure 3 shows an exploded view of the suction head according to an embodiment of the invention which shows the base plate, the suction channel, the cradle bracket and other components separated from each other;
- Figure 4 shows an exploded view of an embodiment of the base plate, consisting of three parts;
- Figure 5 is an exploded view of the cradle bracket, the telescopic suction channel and the main wheels;
- Figure 6 is a top plan view of the base plate according to Figure 4;
- Figure 7 shows cross-sectional views of the base plate along the respective lines marked in Figure 6;
- Figure 8 is a plan view, from below, of the base plate according to Figure 4;
- Figures 9 and 10 show the inner tube and the outer tube of the suction channel;
- Figures 9F and 10F are two cross-sections along the line F-F of Figures 9 and 10, respectively;
- Figure 11 is a schematic top plan view of the suction head according to an embodiment of the invention; and
- Figures 11C, 11D and 11E are cross-sections through the suction duct along the lines C, D and E in Figure 11.

DETAILED DESCRIPTION

[0025] In the various figures, for the sake of clarity, some components not considered essential for the present invention have been omitted. In particular, the pedal and the associated control mechanism for moving a bristled support or a rubber fin which could be present in some embodiments are not shown. The suction head is denoted overall by the reference number 1.

[0026] In the present description a number of expressions will be used with reference to the air flow path during suction. For example, the term "inlet" of a certain component indicates a section, an area, a zone or a point where the suction air enters into the component when the suction head is mounted on a vacuum cleaner and this is in use. Similarly, the term "outlet" of a certain component indicates a section, an area, a zone or a point where the suction air exits the component when the suction head is mounted on a vacuum cleaner and this is in use.

[0027] The relative terms "lower" and "upper" refer to the suction head in its operating configuration, namely when resting on a surface to be vacuumed.

[0028] Finally, the terms "front" and "rear" relate to the suction head in its operating configuration: "front" indicates a component which is situated or directed in the direction of advancing movement of the suction head and

"rear" indicates a component which is situated or directed in the return direction.

[0029] With reference to the various figures, the suction head 1 comprises a base plate 2 with at least one base plate channel 3 open downwards, namely towards a surface to be vacuumed. The suction head 1 also comprises a suction channel 4 and a suction tube 5 which form a suction duct.

[0030] With reference in particular to Figures 4, 6, 7 and 8, the base plate 2 and the base plate channel 3 will be initially described. The base plate 2 comprises a substantially flat plate 22 with a bottom side directed towards the surface to be vacuumed/cleaned and an opposite top side. The bottom side is substantially closed, but is open in the region of the channel 3. The channel runs substantially along the entire length of the base plate 2. The channel is defined by two (front and rear) side walls and by an end wall. The channel 3 is open in its central part. In one embodiment (shown in Figure 8), the base plate channel has a greater width in the central part and a width which tapers towards the ends. In the embodiment of Figure 8, the front wall (and therefore the front edge) is preferably substantially straight and parallel to the front edge of the base plate. Two velvet strips 26 may be provided in the central part, one close to the front edge and one close to the rear edge of the channel 3.

[0031] Preferably, the depth of the channel of the base plate 3 varies and increases from the ends (Figure 7A) in the direction towards the center (Figure 7B-D). As already mentioned, the channel 3 is open in its central part (Figures 7E and 7F).

[0032] The base plate 2 also comprises a substantially spherical cowling which can be fixed to the base plate 2 or is formed as one piece together with the base plate 2. As will become clear below, the cowling 21 is part of a first ball joint J1 for rotatably connecting the base plate 2 to the suction duct 4.

[0033] Preferably, the substantially spherical cowling 21 is formed as two parts: an upper dome-shaped shell 211 and a lower shell 212. Figure 4 shows the upper dome-shaped shell 211 and the lower shell 212. The substantially flat plate 22, the upper shell 211 and the lower shell 212 form the base plate 2 consisting of three parts. The two parts 211, 212 of the cowling 21 may be joined together using known means, for example interlocking elements and/or screws.

[0034] The suction channel 4 is in fluid communication with the channel 3 of the base plate 2 (Figures 1 and 2). As shown in the exploded view of Figure 3, the suction channel 4 according to the present invention comprises a first section 41 and a second section 42. The first section is also called "inner tube" 41 and the second section is also called "outer tube" 42. In other embodiments the outer/inner relationship could also be reversed and therefore the first section 41 could become the outer tube and the second section 42 could become the inner tube.

[0035] Preferably, the first section 41 comprises an inlet 411 with spherical head configured to be received and retained inside the cowling 21 which is correspondingly shaped. The spherical inlet 411 of the first section 41 and the spherical cowling 21 form the first ball joint J1.

[0036] As clearly shown in Figures 5, 9 and 9F, the first section 41 terminates in a sealing lip 412 so as to ensure a seal between the inner tube 41 and the outer tube 42 in any relative position thereof.

[0037] The second section 42 comprises an outlet with spherical head 421 configured to be received inside a spherical cavity 51 of the suction tube 5. The spherical head 421 of the second section 42 and the spherical cavity 51 inside which it is received form a second ball joint J2.

[0038] According to a preferred embodiment, in order to ensure sealing between spherical head 421 and spherical cavity 51 a sealing ring 52 is inserted as shown in Figure 4.

[0039] Preferably, the suction tube 5 also comprises a cylindrical outlet section 53. Preferably, the cylindrical section 53 is configured to be joined together with an angled elbow 6, as shown in Figure 3.

[0040] Advantageously, the suction head 1 of the present invention comprises a cradle-shaped bracket 7 for rotatably connecting the main wheels 8 to the base plate 2 and for rotatably supporting the suction tube 5 and the suction duct 4.

[0041] As shown in Figure 5, according to an embodiment of the present invention, the bracket 7 is a symmetrical member with a central cradle 71 and two side arms 72. Each arm 72 comprises a hole 721 configured to receive a pin 54 projecting outwards from the spherical cavity 51 of the suction tube 5. It is important to emphasize that the same result can be obtained if hole 721 is replaced by a pin and pin 54 is replaced by a hole. In this way, the suction tube 5 is rotatable with respect to the cradle bracket 7.

[0042] Each arm 72 of the cradle bracket 7 preferably also comprises a lower projecting pin 725 on which one of the two main wheels may be rotatably mounted. Preferably, the wheel may be retained with a screw (not shown) screwed into a central hole of the projecting pin.

[0043] Preferably, each arm 72 comprises a first elbow 722, a second elbow 723 and a free end 724. The free end 724 is rotatably fixed to the base plate 2. For example, a hole may be provided in the proximity of the free end 724 and a pin also inserted inside a hole 21 in the base plate 2. Alternatively, a pin 726 projecting inwards in the proximity of the free end 724 and a hole 21 in the base plate may be provided (Figure 4).

[0044] According to a preferred embodiment, the base plate 2 comprises two additional wheels 23 which are rotatably fixed in the proximity of the rear edge of the base plate 2. These wheels 23 prevent in particular the base plate 2, which is optimized to remain adhering to the surface to be vacuumed, from sinking when used on fibrous surfaces such as carpets, rugs or mats. Preferably, a wheel box 24 is provided for each wheel in order to prevent the dirt from the outside (deposited on the

surface to be vacuumed) from entering into the brush body.

[0045] Figure 11 is a top plan view of the suction head 1 according to the embodiment shown in the other figures. Figure 11 is in particular of significance for showing the position of the axes of rotation. Starting from the left, the axis of rotation 100 of the cradle-shaped bracket 7 and the base plate 2, the axis of rotation 101 of the first ball joint J1 where in center of ball joint J1 is sphere central rotational point which lies onto axis 101, the axis of rotation 102 of the main wheels 8, the axis of rotation 103 of the suction tube 5 and the cradle bracket 7 and the axis of rotation 104 of the second ball joint J2 where in center of ball joint J2 is sphere central rotational point which lies onto axis 104 are shown. According to the present invention, it is also possible to use space movement of the spherical joint(s) instead of rotation.

[0046] As can be understood from Figure 11, the main wheels 8 and their axis are located at the rear of the base plate, i.e. lie outside of the footprint of the base plate 2. The base plate 2 is hinged together with the bracket 7 along an axis which is substantially central, namely substantially along (or in the proximity of) of the middle of the base plate 2.

[0047] Figures 11C, 11D and 11E are cross-sections along the lines C-C, D-D and E-E, respectively.

[0048] Figure 11C in particular shows the position of the axis of rotation of the cradle bracket 7 with respect to the base plate 2. According to the embodiment shown, which is also preferred, this axis of rotation 100 is situated in the vicinity of the base plate channel 3.

[0049] With reference also to Figure 2, the position of the axis of rotation 100 is preferably defined also by the point where the user grips the tube in order to move the suction head and vacuum the floor and is such as to eliminate or limit the moment caused by the movement of the suction head forwards or backwards. Conventionally, the gripping handle is at a height H of about 700-900 mm, typically about 800 mm from the surface to be vacuumed. The position of the axis 100 is defined by a segment which starts from the gripping handle (at the height H) and passes through the centre 61 of the outlet section of the angled elbow 6. The axis 100 (which is parallel to the front edge or rear edge of the base plate) passes through a point of the base plate close to the surface of the floor. Preferably, the axis 100 intersects a segment S-S'. S is the gripping point (at about 800 mm from the floor), and S' is the centre of the base plate channel 3. Preferably the segment S-S' passes through (or close to) the center 61 of the outlet section of the tube 6.

[0050] The Applicant considers that this positioning of the axis 100 is advantageous since the influence of the dragging movement is minimized when the suction head is pulled backwards.

[0051] Figure 11 shows the axis of rotation 102 of the main wheels 8 and the axis of rotation 103 of the bracket 7 and the suction tube 5.

[0052] Figure 11E shows the suction duct in a certain configuration from among the plurality of configurations which the duct may assume owing to the various degrees of freedom provided by the ball joints J1 and J2, the telescopic relationship between the two sections 41 and 42 of the suction channel 4, the cradle-shaped bracket 7 and the possibility of rotation of the suction tube 5 and its angled elbow 6. Figure 11E shows the axes of rotation 101 and 104 of the first ball joint J1 (front joint) and the second ball joint J2 (rear joint).

[0053] The position shown in Figure 11E is substantially the same as the position shown in Figure 1. Figure 2 shows a different configuration. In any case it is interesting to note that the entire suction duct, whatever its configuration, does not have narrowed zones or sudden changes in cross-section. This improves the suction performance and reduces the suction noise. Therefore, also in the case of low-power motors, the performance level is very high, substantially corresponding to the performance of more powerful equipment.

[0054] The suction head 1 according to the present invention adheres to the surface to be vacuumed in any situation and in any configuration.

[0055] When the suction head 1 is pushed forwards, the base plate 2 remains in contact with the surface to be vacuumed because the base plate is free to maintain this configuration thanks to the front ball joint J1 and because the base plate 2 is able to tilt relative to the axis 102 of the main wheels 8 and the suction tube 4. Tilting of the base plate 2 results in a variation in the length of the suction channel 4. In turn, the variation in length of the suction channel 4 is made possible by the fact that the suction channel 4 consists of two sections (41 and 42), which are telescopically inserted inside each other. Preferably, the first (front) section 41 is the smaller-diameter section (inner tube) and the second section 42 is the larger-diameter section (outer tube).

[0056] The force exerted by the user is transmitted onto the axis of the wheels 102 and/or onto the axis of rotation 103 of the suction tube 5 and the cradle bracket 7. As mentioned above, the axis of rotation 103 of the suction tube 5 and the cradle bracket 7 is situated at the rear of the axis of rotation 102 of the main wheels 8 at a small distance therefrom. Therefore, the moment due to the force applied onto the axis of rotation 103 of the suction tube 5 and the cradle bracket 7 is small. In any case, it is desirable to have a moment such that an additional force may be applied to the base plate 2. For this reason, according to a preferred embodiment of the invention, the axis 103 is situated above the axis 102, relative to the plane of the floor to be vacuumed.

[0057] In this way, the forwards thrusting force applied to the elbow 6 creates a moment around the axis of the wheels 102 and during the forwards movement pushes the base plate towards the floor.

[0058] Advantageously, the suction channel 4 may be kept substantially horizontal (Figure 1) and this allows the suction head 1 to be used in small spaces (underneath furniture, for example).

[0059] Preferably, the cradle-shaped bracket 7 may rotate through an angle of between about 10° and 40°, more preferably an angle of between about 15° and 30° and even more preferably about 20°.

[0060] The suction tube 5 may rotate preferably through an angle of about 10°-30°, more preferably about 15°-20° and even more preferably through an angle of about 13° (from - 7° to + 6°).

[0061] A rigid or flexible tube (not shown) may be connected to the outlet end of the joint 5 or the elbow 6. As an alternative to the elbow shown in Figures 1 and 2, any other joint which is straight, differently angled, rigid or flexible, may be associated with the tube 53 of the suction tube 5.

[0062] A brush body 10 may be fixed to one or more of the base plate 2, the inner tube 41 of the suction channel 4 or the outer tube 42 of the suction channel 4. The suction head 1 may also comprise a cover 11. As can be seen from Figures 1 and 2, both in the configuration shown in Figure 1 and in the configuration shown in Figure 2, the air flow path from the base plate channel 3 to the suction channel 4 and to the suction tube 5 does not have major discontinuous or narrow zones. This is due to the novel telescopic relationship between the two sections 41, 42 of the suction channel 4, in which the first section 41 (which receives air from the base plate channel 3) forms the inner tube 41, while the second section 42 forms the outer tube. The outer tube 42 has preferably a circular cross-section. Between the inner tube 41 and the outer tube 42 there is a sealing lip 412 for ensuring a gentle transition between the two tubes 41, 42 and for ensuring a fluid-tight seal and minimizing leakages.

Claims

1. A suction head (1) for a vacuum cleaner or the like comprising:

- a base plate (2) with a base plate channel (3) open towards a surface to be vacuumed,
- a suction channel (4) in fluid communication with the base plate channel (3),
- main wheels (8) for moving said suction head on the surface to be vacuumed, and
- a bracket (7) for connecting said main wheels (8) to said base plate (2),

wherein said bracket (7) is connected to said base plate (2) in a rotatable manner so that said base plate (2) is tiltable with respect to the main wheels (8),
wherein said suction channel (4) comprises an inner tube (41) and an outer tube (42) telescopically coupled together,
wherein said suction channel (4) is rotatably supported by said bracket (7).

2. The suction head (1) of claim 1, wherein the projection onto the ground of said main wheels (8) is situated, relative to the advancing direction, at the rear of the footprint of the base plate (2).

3. The suction head (1) of claim 1, wherein said suction channel (4) comprises a spherical inlet head (411) and a spherical outlet head (421), wherein said spherical inlet head (411) is configured to cooperate with a cowling (21) of the base plate (2) and wherein said spherical outlet head (421) is configured to cooperate with a spherical cavity (51) of a suction tube (5) so as to form a first ball joint (J1) and a second ball joint (J2).

4. The suction head (1) of claim 1, wherein said bracket (7) comprises a central cradle (71) and two arms (72), wherein each arm (72) comprises means (725) for rotatably attaching the main wheels (8) and means (721) for rotatably attaching said spherical cavity (51).

5. The suction head (1) of any one of the preceding claims, wherein said base plate further comprises wheels (23) whose projection onto the ground lies within the footprint of the base plate (2).

6. The suction head (1) of any one of the preceding claims, wherein the axis of rotation (100) of said base plate (2) and said bracket (7) is a horizontal axis substantially parallel to the front edge or rear edge of the base plate and defined by a straight line passing through the center (61) of the exit section of an elbow (6) and terminating at the height (H) of the gripping handle relative to the floor.

7. The suction head (1) of claim 1, wherein an axis of rotation (102) of the main wheels (8) is lower than an axis of rotation (103) of said bracket (7) and said suction tube (5).

8. The suction head (1) of claim 7, wherein the axis of rotation (102) of the main wheels (8) is in front of the axis of rotation (103) of said bracket (7) and said suction tube (5).

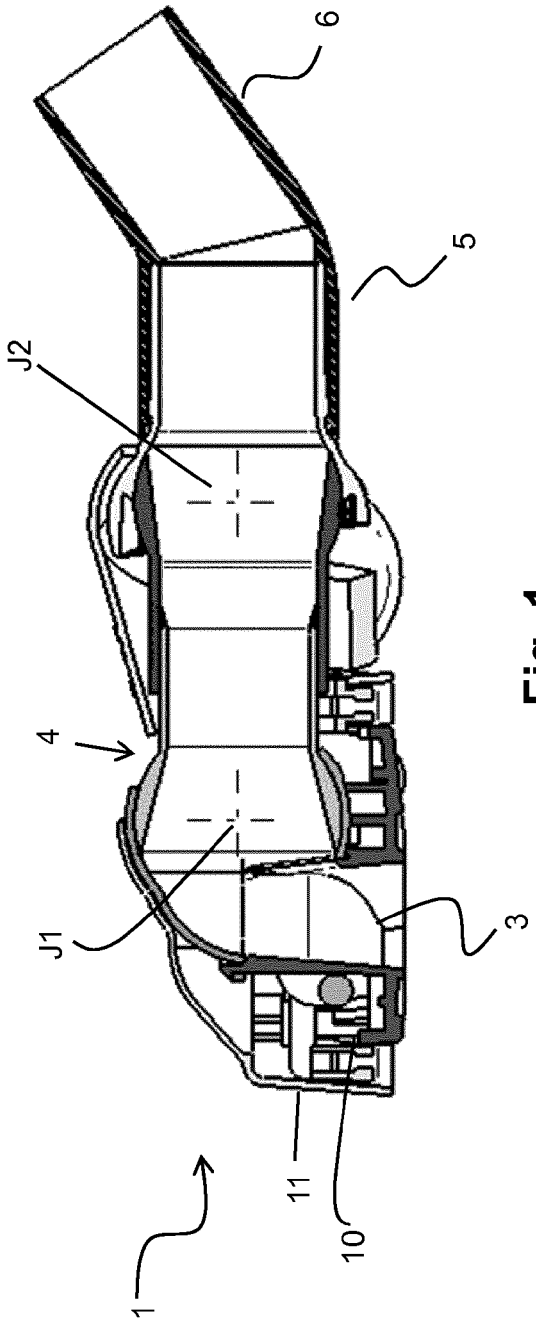

Fig. 1

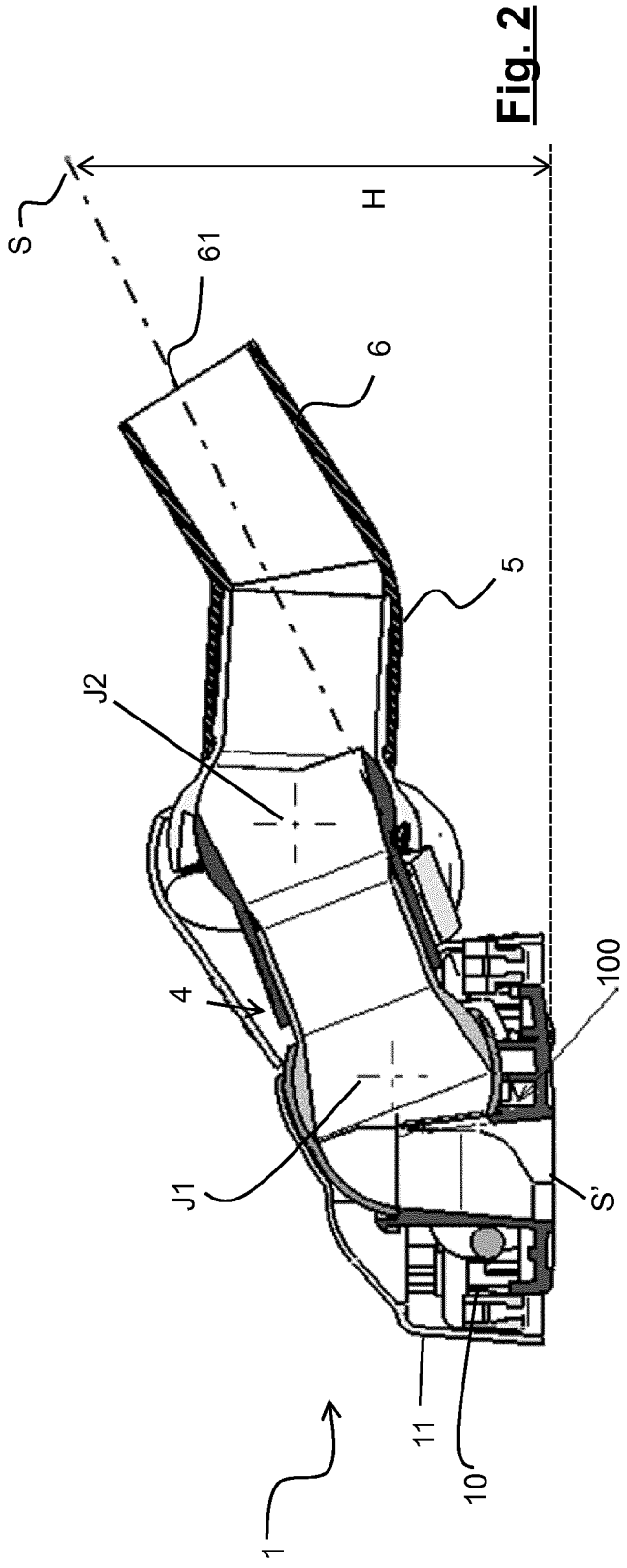

Fig. 2

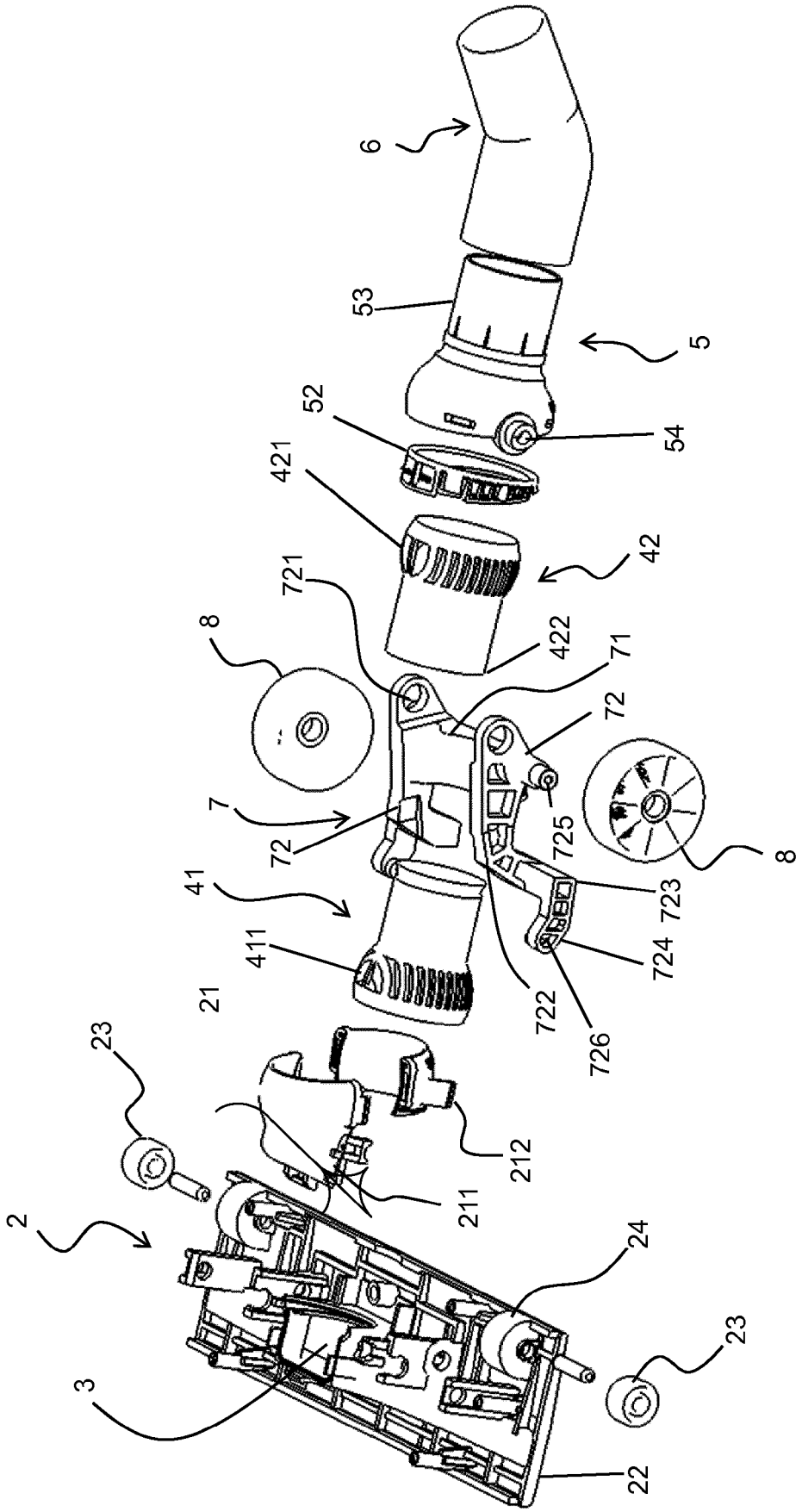
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Fig. 3

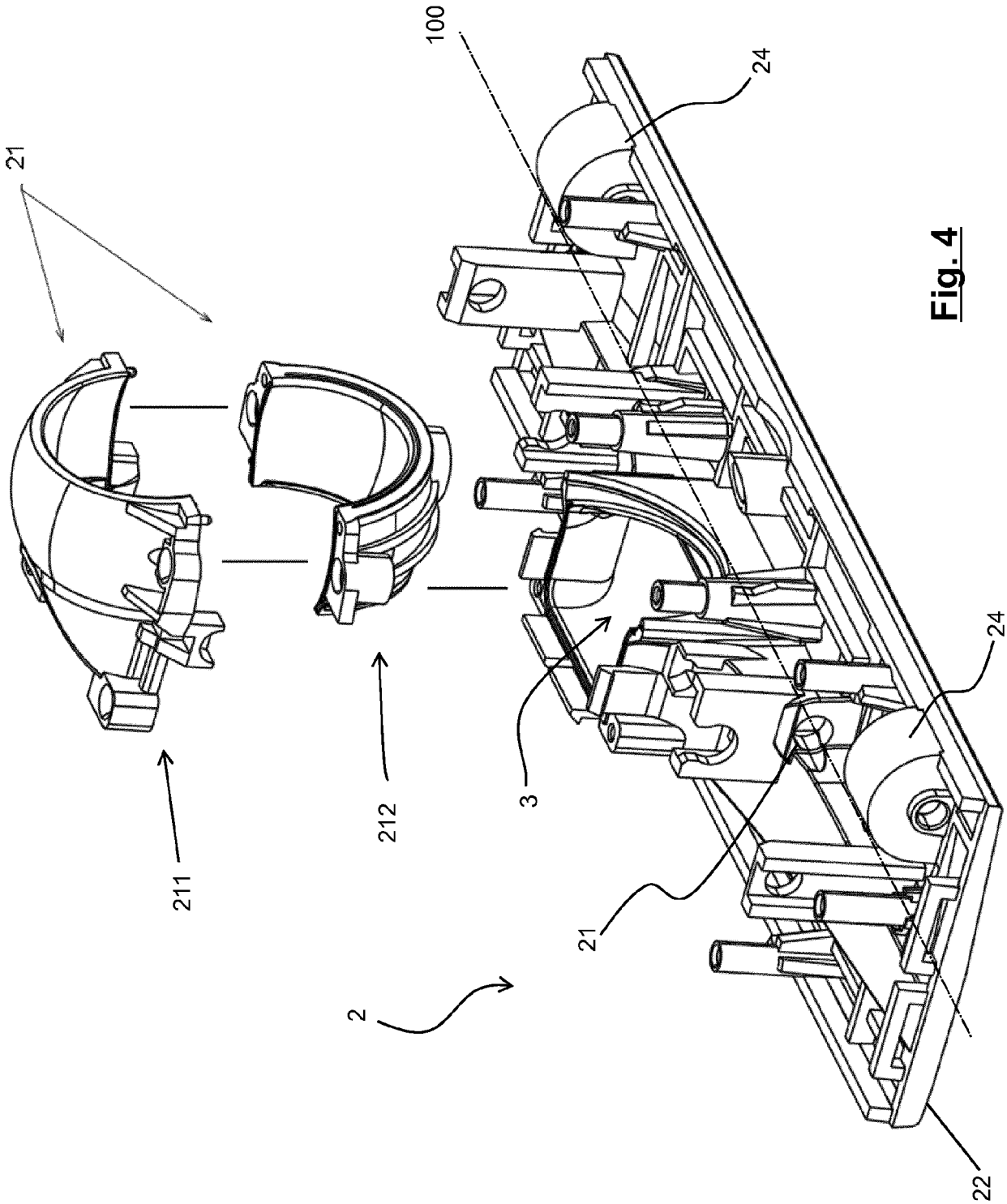

Fig. 4

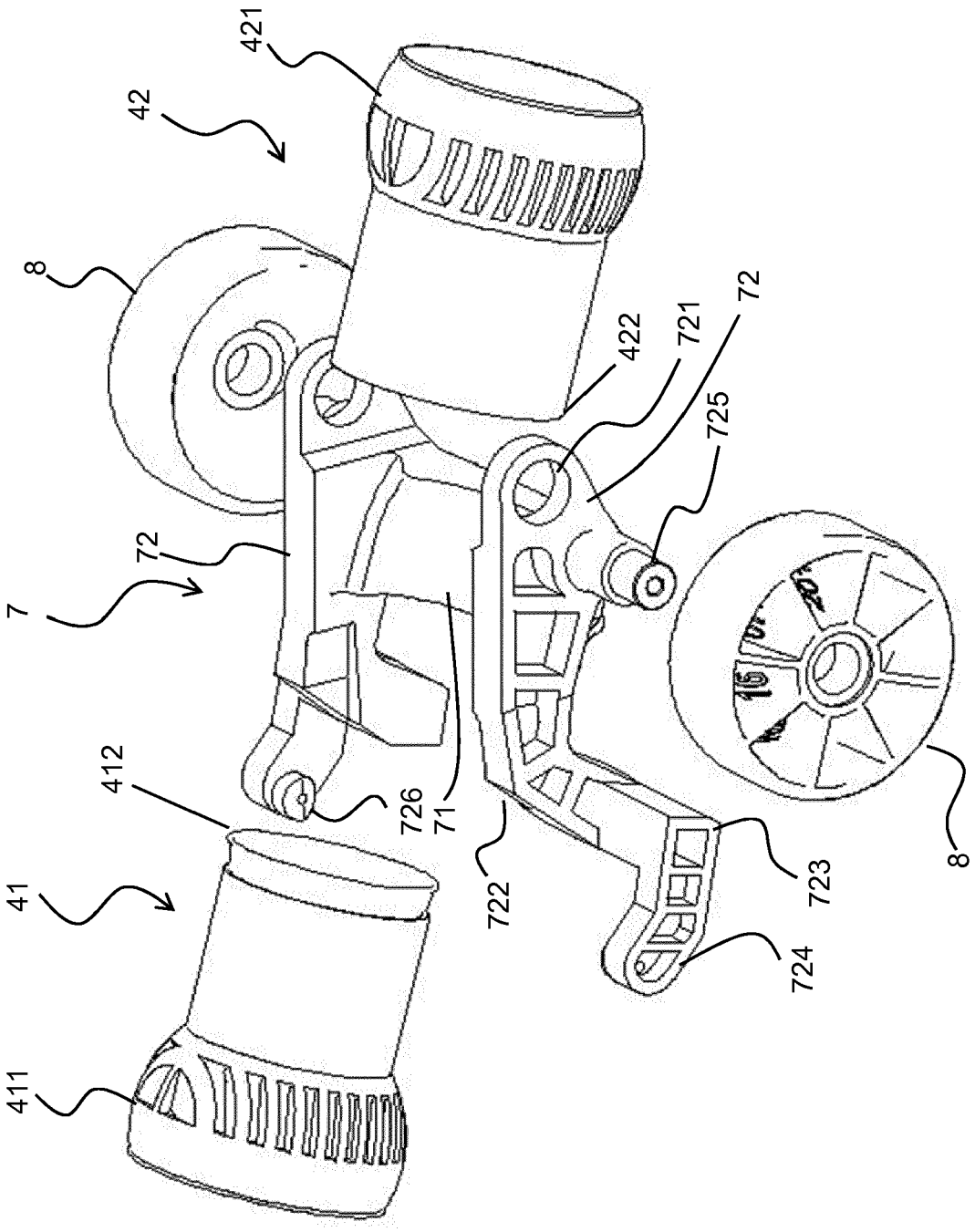

Fig. 5

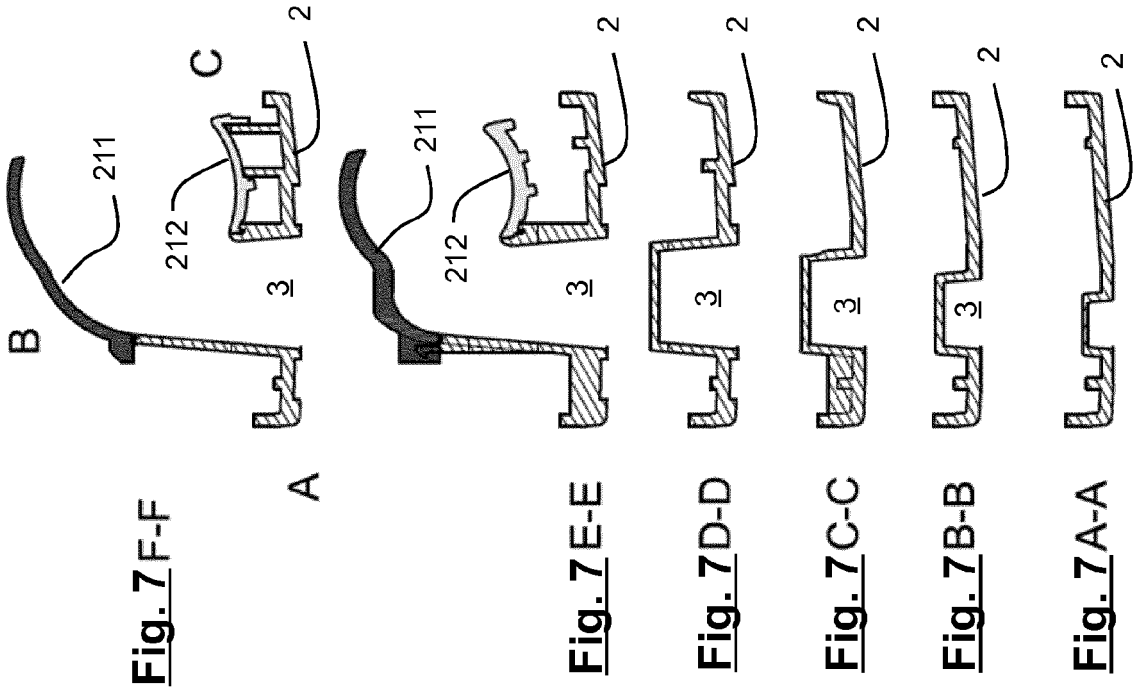

Fig. 7F-F

Fig. 7E-E

Fig. 7D-D

Fig. 7C-C

Fig. 7B-B

Fig. 7A-A

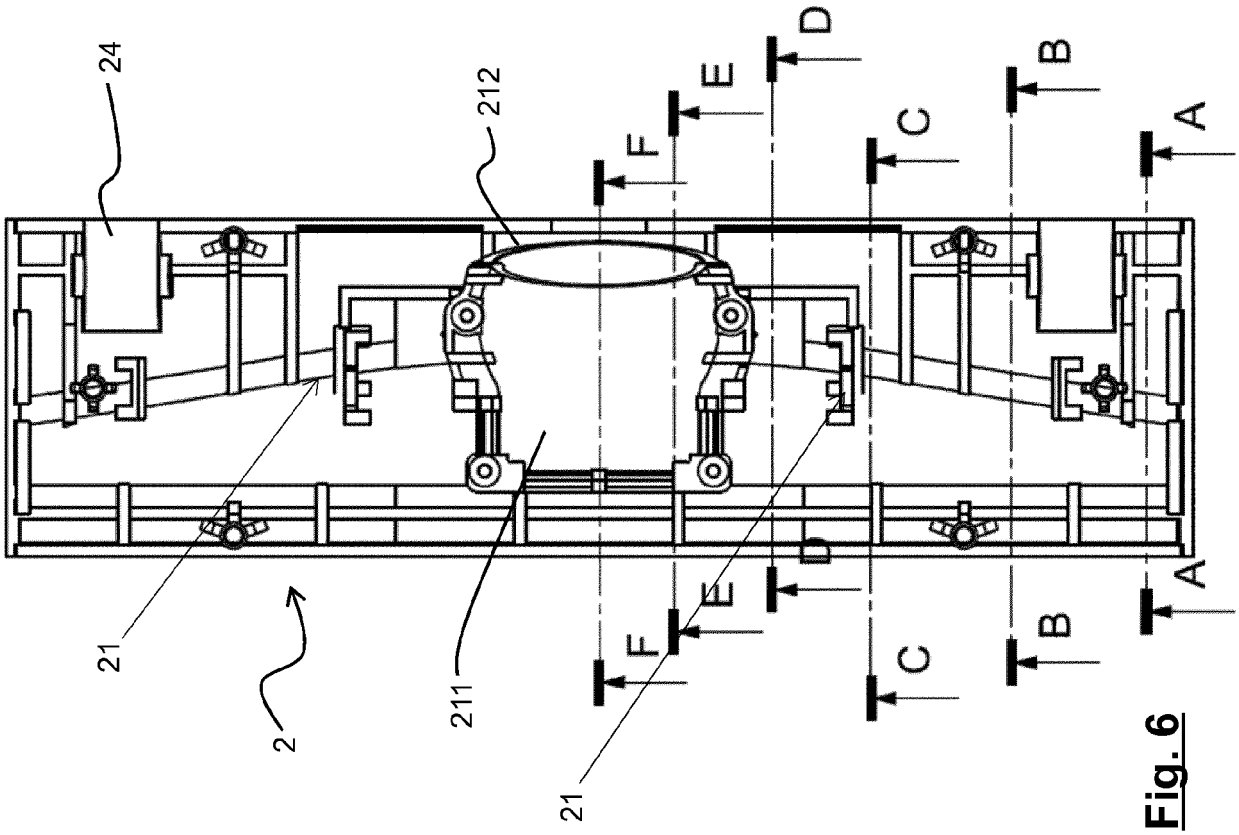

Fig. 6

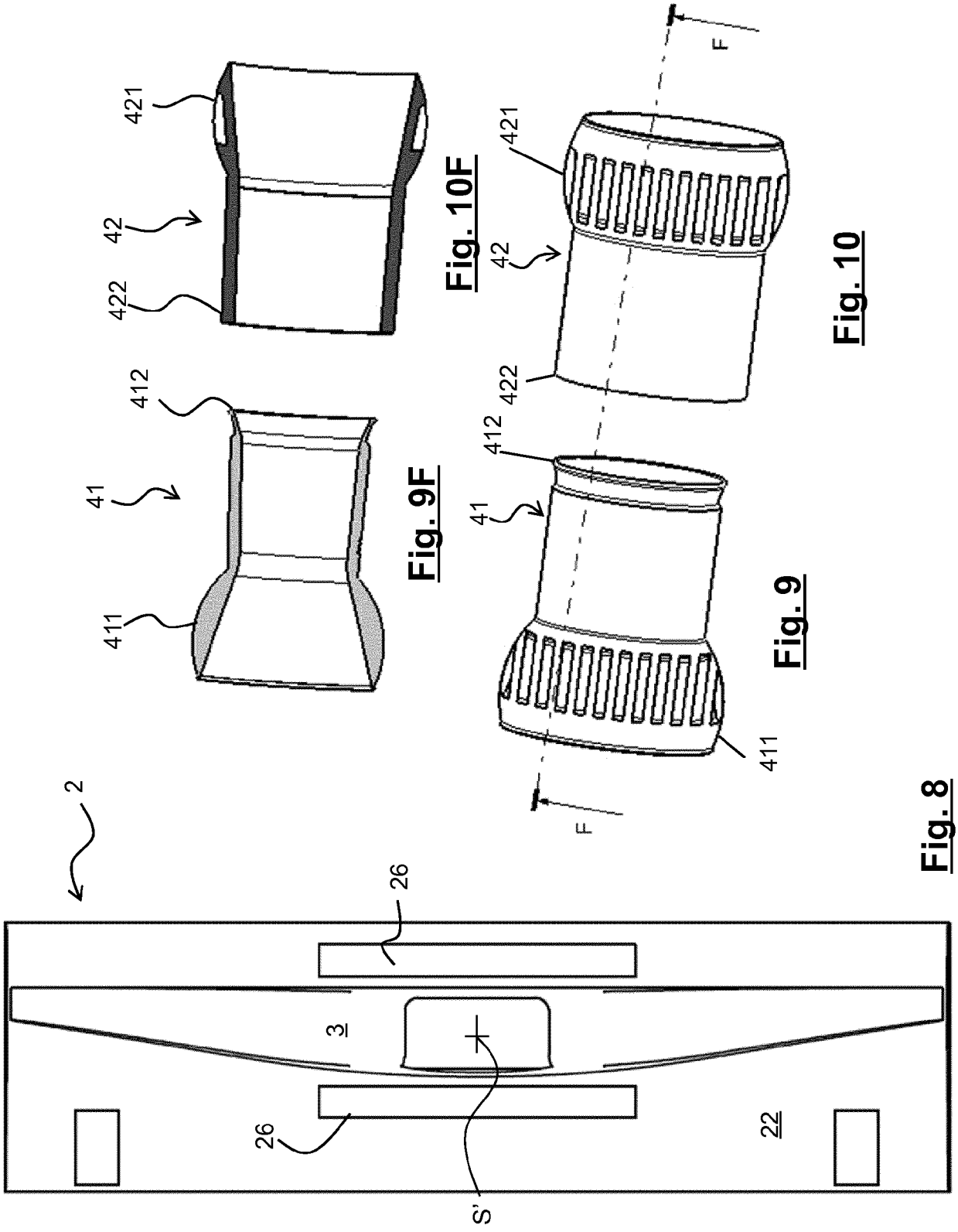

Fig. 8

Fig. 9

Fig. 10

Fig. 9F

Fig. 10F

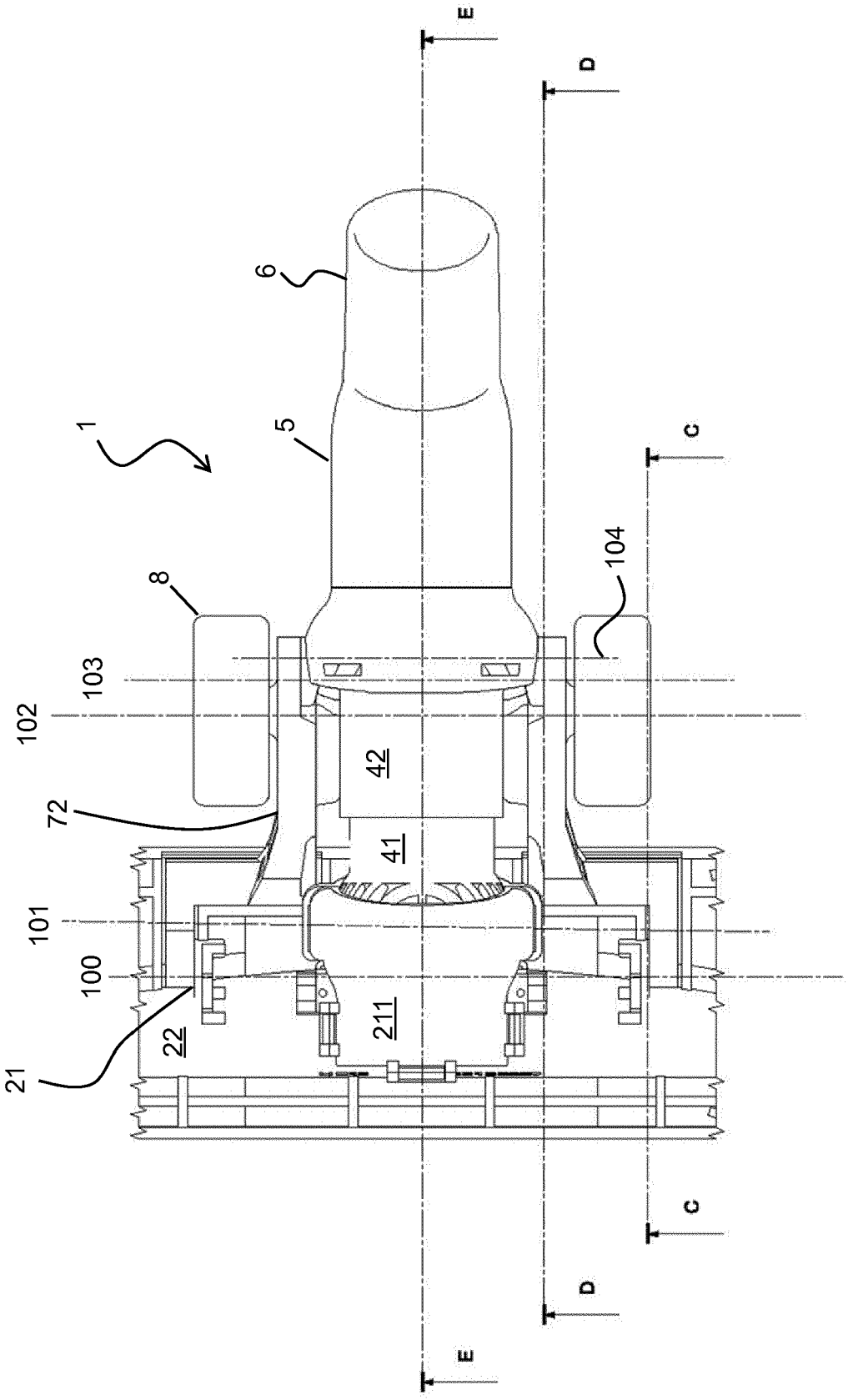

Fig. 11

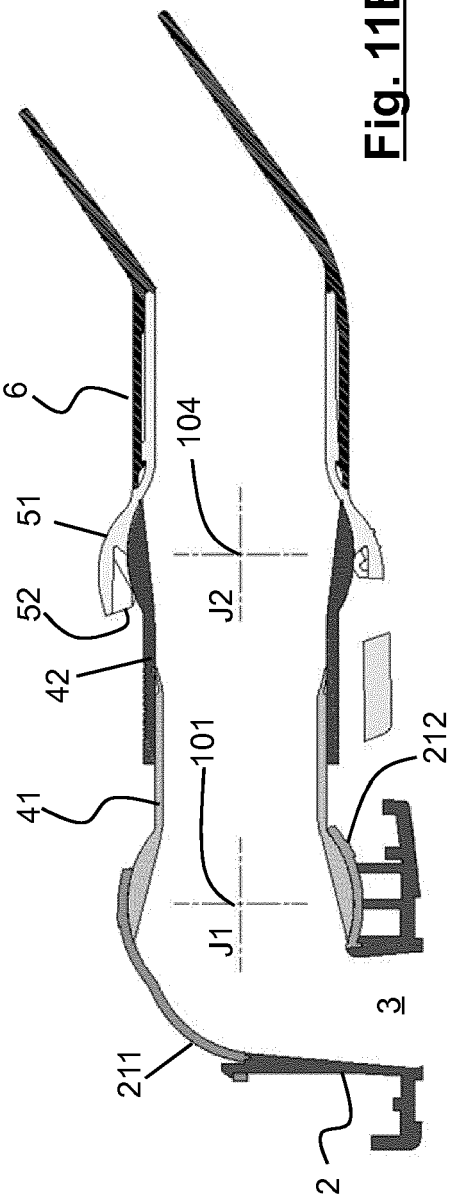

Fig. 11E

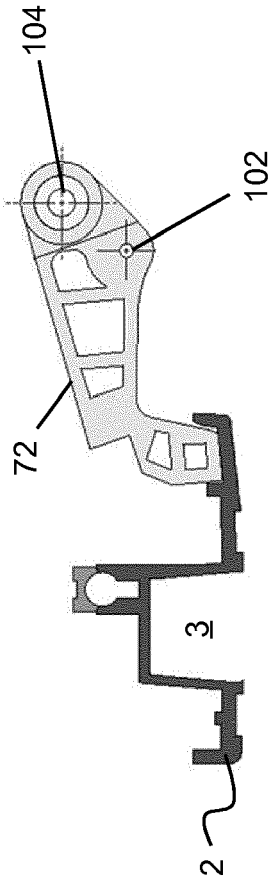

Fig. 11D

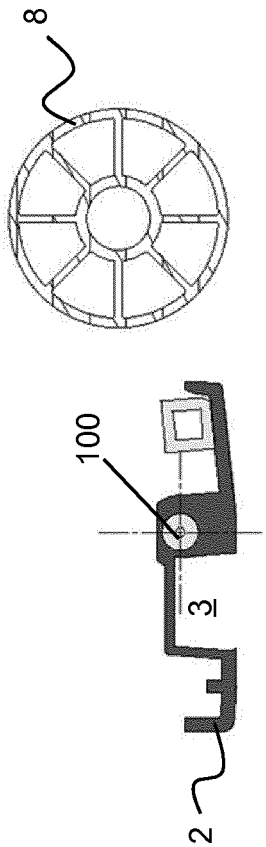

Fig. 11C

REFERENCES CITED IN THE DESCRIPTION

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