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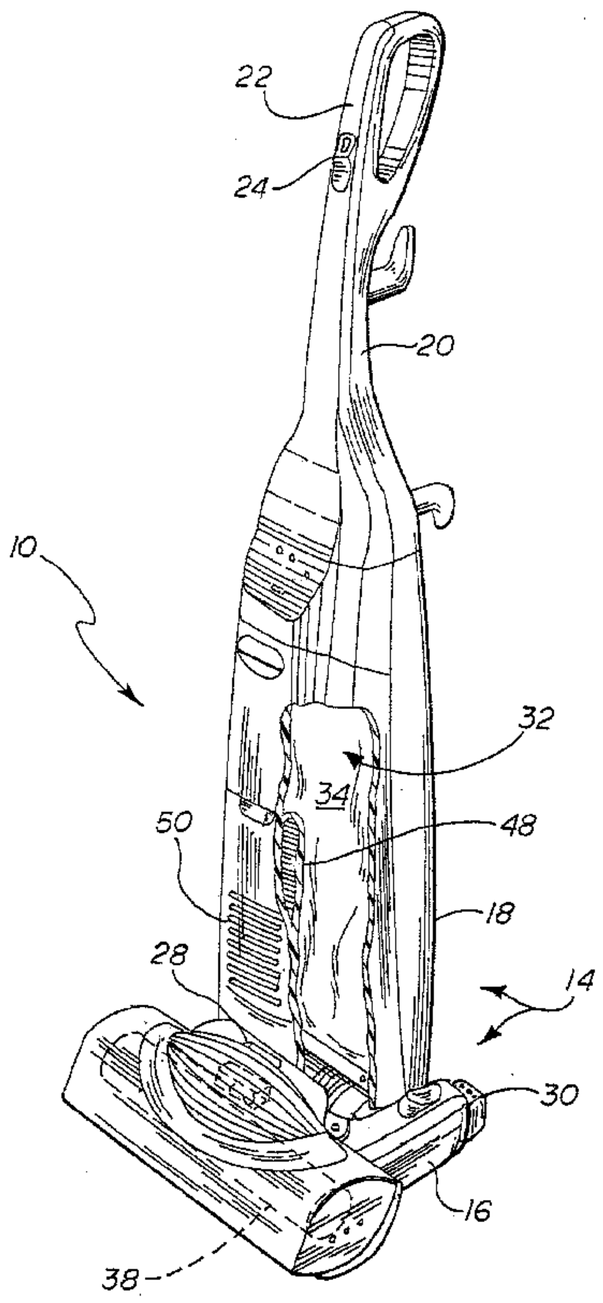
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(54) **REFROIDISSEMENT D'AIR D'ASPIRATEUR**

(54) **AIR COOLING OF VACUUM CLEANER SYSTEM**



(57) A vacuum cleaner includes a housing having a hammerhead-shaped nozzle assembly with an agitator cavity formed in the nozzle assembly. An agitator is received in the agitator cavity and an agitator drive motor is held in that agitator. A suction fan is driven by a separate suction fan drive motor carried on the housing. An airflow pathway extending through the agitator and over the agitator drive motor communicates with a suction intake port leading to the suction fan. A light source may also be provided in the housing so that the airflow pathway directs air over the light source. A temperature sensor may also be provided in the airflow pathway between the agitator drive motor and the suction intake port. A method of cooling a light source and/or drive motor is also disclosed.

AIR COOLING OF VACUUM CLEANER SYSTEMS

Abstract of the Disclosure

A vacuum cleaner includes a housing having a hammerhead-shaped nozzle assembly with an agitator cavity formed in the nozzle assembly. An agitator is received in the agitator cavity and an agitator drive motor is held in that agitator. A suction fan is driven by a separate suction fan drive motor carried on the housing. An airflow pathway extending through the agitator and over the agitator drive motor communicates with a suction intake port leading to the suction fan. A light source may also be provided in the housing so that the airflow pathway directs air over the light source. A temperature sensor may also be provided in the airflow pathway between the agitator drive motor and the suction intake port. A method of cooling a light source and/or drive motor is also disclosed.

Technical Field

The present invention relates generally to the vacuum cleaner art and, more particularly, to a vacuum cleaner incorporating an agitator with an internal drive motor.

Background of the Invention

A vacuum cleaner is an electro-mechanical appliance utilized to effect the dry removal of dust, dirt and other small debris from carpets, rugs, fabrics or other surfaces in both domestic and industrial environments. In order to achieve the desired dirt and dust removal, a rotary agitator is provided to beat dirt and dust from the nap of the carpet and a pressure drop or vacuum is used to force air entrained with this dirt and dust into the nozzle of the vacuum cleaner. The particulate-laden air is then drawn through a bag-like filter or a cyclonic separation chamber and filter combination which traps the dirt and dust, while the substantially clean air is exhausted by an electrically operated fan that is driven by an on board motor. It is this fan and motor arrangement that generates the drop in air pressure necessary to provide the desired cleaning action. Thus, the fan and motor arrangement is commonly known as the vacuum or suction generator.

Many advanced, high performance vacuum cleaners incorporate a dual motor system. In such a system, a separate agitator drive motor is provided in addition to the motor of the suction generator. In most designs the separate agitator drive motor is mounted on the nozzle assembly adjacent the agitator. A gear drive or more commonly a pulley and belt arrangement transmits the power from the agitator

motor drive shaft to the agitator.

While very effective for its intended purpose, the mounting of a separate agitator drive motor in front of or behind the agitator necessitates a significant increase in the fore-aft length of the nozzle assembly in order to accommodate the motor. This not only increases the overall weight of the nozzle assembly but also the wheelbase and/or the body overhang beyond the wheels. All of these characteristics negatively impact the ease of manipulation of the vacuum cleaner in and around furniture and, therefore, are a detriment.

In contrast, it is possible to mount the agitator drive motor above the agitator. In this situation, no increase in the length of the nozzle assembly and/or the wheelbase thereof is necessary to accommodate the agitator motor. The height of the nozzle assembly must, however, be increased significantly to provide motor clearance. This unacceptably restricts the use of the vacuum cleaner as the resulting higher profile will not clear many overhanging obstructions such as bed frames, tables and chair seats. Accordingly, this is generally recognized to be an unacceptable solution.

Another possible alternative is the mounting of the separate agitator drive motor within the agitator itself. Such an arrangement makes use of what would otherwise be lost space within the agitator. Further, it allows the agitator motor to be accommodated without any substantial increase in the height or length of the nozzle assembly. Thus, the vacuum cleaner may be more easily manipulated on a shorter wheel base and is of lighter overall weight. It also includes the desired low profile which allows cleaning under bed frames, tables, chairs and other such objects.

Efforts have been made in the past to provide such a design. In U.S. patent 1,953,340 to Doemling, the agitator drive motor is positioned in the lumen of the agitator. The motor is cooled by drawing air with the suction generator through a hollow support shaft into the agitator lumen, then over the agitator motor and then through holes in the agitator wall into the agitator cavity. In U.S. Patents 4,268,769 and 4,384,386 to Dorner et al., the agitator drive motor positioned in the lumen of the agitator is cooled by using the agitator itself as a heat sink.

While providing the handling advantages noted above, the internal agitator motor drive arrangements of the prior art fail to furnish sufficient cooling to the agitator motor to effectively allow long term heavy duty cycle operation. Hence, the arrangements were found to be unsatisfactory. A need is therefore identified for an internal agitator drive motor arrangement which provides all the handling benefits noted above and incorporates an improved agitator motor cooling arrangement to support long term heavy duty operation.

Brief Description of the Drawing

The accompanying drawing incorporated in and forming a part of the specification, illustrates several aspects of the present invention and together with the description serves to explain the principles of the invention. In the drawing:

Figure 1 is a perspective view of the vacuum cleaner of the present invention;

Figure 2 is a transverse sectional view of the vacuum cleaner along lines 2-2 of Figure 4;

Figure 2a is a detailed crossectional view of the agitator and gear

drive showing the engagement therebetween;

Figure 3 is a longitudinal sectional view of the vacuum cleaner;

Figure 4 is a partially sectional top view thereof; and

Figure 5 is a schematical, partially sectional plan view showing the air path through the suction fan motor compartment.

Reference will now be made in detail to the present preferred embodiment of the invention, an example of which is illustrated in the accompanying drawing.

Detailed Description of the Invention

Reference is now made to Figure 1 showing the vacuum cleaner 10 of the present invention. It should be appreciated that while an upright vacuum cleaner 10 is illustrated, canister vacuum cleaners incorporating a driven rotary agitator in what is referred to in the art as a "power nozzle" may also utilize and benefit from the novel internal agitator drive motor arrangement and air cooling system of the present invention described further below.

The overall basic design of the upright vacuum cleaner 10 is generally well known in the art. In the typical arrangement, the upright vacuum cleaner 10 includes a housing 14 that comprises the nozzle assembly 16 and the canister assembly 18. The canister assembly 18 further includes the handle 20 and the hand grip 22. The hand grip 22 carries a control switch 24 for turning the vacuum cleaner 10 on and off. Of course, electrical power is supplied to the vacuum cleaner 10 from a standard electrical wall outlet through a cord (not shown).

At the lower portion of the canister assembly 18, rear wheels 26 are provided to support the weight of the vacuum cleaner 10 (see also

Figure 3). A second set of wheels 27 allow the operator to raise and lower the nozzle assembly 16 through selective manipulation of the height adjustment switch 28. Such a height adjustment mechanism is well known in the art and is exemplified, for example, by the arrangement incorporated into the Kenmore Progressive vacuum cleaner currently available in the marketplace. To allow for convenient storage of the vacuum cleaner 10, a foot latch 30 functions to lock the canister assembly 18 in an upright position, as shown in Figure 1. When the foot latch 30 is released, the canister assembly 18 may be pivoted relative to the nozzle assembly 16 as the vacuum cleaner 10 is manipulated to clean the floor.

The canister assembly 18 also carries an internal chamber 32 that houses a suction generator 33 (i.e. a state of the art fan and motor combination) and a dust bag 34 for removing dirt or dust entrained in the air stream as it passes from the nozzle assembly 16 to the suction generator. The canister assembly 18 may also carry a final filtration cartridge 48 to trap small particulates and prevent their reintroduction into the environment through the exhaust air stream.

The nozzle assembly 16 includes a nozzle and agitator cavity 36 that houses a rotating agitator brush 38. The agitator brush 38 shown is rotatably driven by a motor 40 and cooperating gear drive 42 housed within the agitator and described in greater detail below (see Figures 2 and 3). In the illustrated vacuum cleaner 10, the scrubbing action of the rotary agitator brush 38 and the negative air pressure created by the suction generator 33 cooperate to brush and beat dirt and dust from the nap of the carpet being cleaned and then draw the dirt and dust laden air from the agitator cavity 36 to the dust bag 34. Specifically, the dirt and

dust laden air passes serially through a suction inlet 44 and hose 46 and/or an integrally molded conduit in the nozzle assembly 16 and/or canister assembly 18 as is known in the art. Next, it is delivered into the dust bag 34 held in the chamber 32. The bag 34 serves to trap the suspended dirt, dust and other particles inside while allowing the now clean air to pass freely through the porous wall thereof and then through the suction generator 33, final filtration cartridge 48 and ultimately to the environment through the exhaust port 50.

Reference is now made to Figures 2 and 3 which show the mounting of the agitator motor 40 and associated gear drive 42 in the agitator 38 in detail. As shown, the agitator 38 is mounted for rotation relative to the nozzle assembly 16. Specifically, a first end of the agitator 38 includes an end cap 52 which is supported on bearings 54 on a stub shaft 55 held in mounting block 56 keyed into slot 58 in the side of the nozzle assembly 16. An end cap 60 at the opposite end of the agitator 38 is supported on bearings 62 mounted on the housing 64 of the motor 40. As should be appreciated, the motor 40 is fixed to the nozzle assembly 16 by means of the mounting block 66 fixed to the motor housing 64 and keyed in the slot 68 in the side of the nozzle assembly.

The motor 40 drives a shaft 70 including gear teeth 72. The drive shaft 70 extends through a bearing 74 held in the hub 76 of the planetary gear set carrier 78. In the most preferred embodiment a fan 80 is keyed or otherwise secured to the distal end of the drive shaft 70.

The planetary gear set carrier 78 includes three stub shafts 82 that each carry a planetary gear 84. Each of the planetary gears 84 include teeth that mesh with the gear teeth 72 of the drive shaft 70.

Additionally, the planetary gears 82 mesh with the teeth of an annular gear 86 that is fixed to the agitator motor housing 64 by pin or other means. Thus, it should be appreciated that as the drive shaft 70 is driven by the motor 40, the planetary gears 84 are driven around the annular gear 86, thereby causing the planetary gear set carrier 78 to rotate. Planetary gear set carrier 78 also includes a drive ring 88 and associated rubber drive boot 87 which includes a series of spaced channels 89 that receive and engage axial ribs 91 projecting inwardly radially from the inner wall of the agitator 38 (see also Figure 2a). Thus, the rotation of the planetary gear set carrier 78 is transmitted by the drive ring 88 and drive boot 87 directly to and causes like rotation of the agitator 38. The rubber drive boot 87 provides the necessary damping to insure the smooth transmission of power to the agitator. Simultaneously with the rotation of the planetary gear set carrier 78 and agitator 38, the drive shaft 70 also drives the fan 80 at a ratio of between 4-1 to 10-1 (eg. 6-1) with respect to the agitator 38. The resulting rapid rotation of the fan 80 helps to ensure proper cooling of the agitator motor 40 during its operation.

More specifically, the vacuum cleaner 10 of the present invention incorporates a novel air cooling system or circuit, which will now be described in detail. Specifically, air is drawn into the vacuum cleaner 10 through a vent 90 at the upper rear face of the nozzle assembly 16 by operation of the suction generator 33 (note action arrow A in Figures 2-4). Specifically, the air first passes through a filter 92 of foam rubber or other appropriate material into the illumination compartment 94 defined between the upper transparent window 96 and the lower transparent window 98 which allow viewing of the operation

of the agitator 38. This air then passes over and around the light source 100 so as to provide cooling thereto (note action arrows B in Figure 2). Next, the air is drawn through the passageway 102 in the nozzle assembly 16 and around and through an opening 104 in the end cap 52 (note action arrow C). The air then moves through the lumen of the agitator 38 to the fan 80 driven by means of the agitator drive motor 40 (note action arrows D). The fan 80 forces the air through openings 106 in the planetary gear set carrier 78 and then around the annular gear 86 before it passes through the housing 64 of the motor 40 (note action arrows E and F).

After passing the over the windings and other internal components (not shown) of the agitator motor 40 for purposes of heat exchange and cooling, the air passes through the passageway 108 into the manifold 110 (note action arrow G). Manifold 110 includes an outlet (not shown) in fluid communication with the agitator cavity 36. Of course, as noted above, the agitator cavity 36 is in direct fluid communication with a suction inlet 44 (see Figure 3) that leads through the hose 46 (see Figure 4) into the dust bag 34 in chamber 32. From there the air is drawn into the suction fan motor compartment 116 (see action arrow H in Figure 5) through the filter 117 where the air passes over the power supply board 118 to provide heat exchange cooling thereof before passing into the housing of the suction motor 33 to provide cooling. From there the air is exhausted through a passageway through the final filtration cartridge 48 and ultimately to the environment through the exhaust port 50.

From the above description, it should be appreciated that air is ducted and directed through the vacuum cleaner 10 so as to cool in

series, the light source 100, the agitator drive motor 40, the power board 118, and the suction fan motor 33. At all points, good positive air flow is provided by means of the negative pressure generated by the suction generator 33. In addition, any resistance to air flow through the lumen of the agitator 38 and around the gear drive 42 is essentially eliminated by means of the high speed fan 80. As the air that is drawn through the nozzle assembly 16 to cool the light source 100 and the agitator drive motor 40 is fed back to the agitator cavity 36, there is no drain on the performance of the suction generator 33: i.e. the same amount of air is being pulled through the agitator cavity 36 or cleaning area as would be if the cooling of the light source 100 and agitator motor 40 were not taking place.

As a further advantage, since the air being supplied to cool the light source 100 and agitator drive motor 40 comes through a vent 90 adjacent the top rear of the nozzle assembly 16, and passes through the filter 92, only clean air is utilized. Thus, the illumination compartment 94 between the upper lower windows 96, 98 remains clean for good visibility and easy and convenient inspection of the operation of the agitator 38. Similarly, the lumen of the agitator 38 remains clean as do the various openings along the air passageway. This ensures good air flow for cooling of the agitator motor 40 over a long surface life.

The foregoing description of a preferred embodiment of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiment was chosen and described to provide the best illustration of the principles of the

invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally and equitably entitled.

In the Claims

1. A method of cooling a drive motor and a light source of a vacuum cleaner including a suction intake port, comprising:

directing air through an airflow pathway over said light source and said drive motor to said suction intake port.

2. A method of cooling a drive motor and a light source of a vacuum cleaner including a suction intake port, comprising:

drawing air through an intake vent;

directing air through an airflow pathway serially over said light source and said drive motor; and

discharging air from said airflow pathway into said suction intake port.

3. A method of cooling an agitator drive motor mounted in an agitator of a vacuum cleaner including a suction intake port, comprising:

directing air through an airflow pathway in said agitator across said agitator drive motor; and

discharging air from said airflow pathway into said suction intake port.

4. A method of cooling a light source in a vacuum cleaner including an intake vent and a suction intake port, comprising:

drawing air through said intake vent;

directing air through an airflow pathway over said light source; and

discharging air from said airflow pathway into said suction intake port.

5. A vacuum cleaner, comprising:

a housing including a nozzle assembly;

an agitator cavity formed in said nozzle assembly;

an agitator received in said agitator cavity;

a suction fan and suction fan drive motor connected to a suction intake port in fluid communication with said agitator cavity, said suction fan and suction fan drive motor being carried on said housing;

an agitator drive motor received in said agitator; and

an airflow pathway through said agitator over said agitator drive motor in fluid communication with said suction intake port.

6. The vacuum cleaner of claim 5, wherein said airflow

pathway includes an intake vent in said housing.

7. The vacuum cleaner of claim 6, wherein said vacuum cleaner further includes a light source in said housing and said airflow pathway directs air over said light source.

8. The vacuum cleaner of claim 7, further including a temperature sensor in said airflow pathway between said agitator drive motor and said suction intake port.

9. The vacuum cleaner of claim 5, wherein said agitator drive motor includes a drive shaft connected (a) to a gear assembly in said agitator for driving said agitator, and (b) a fan in said agitator for forcing air over said agitator motor.

10. The vacuum cleaner of claim 9, wherein said fan is secured to said drive shaft.

11. A vacuum cleaner, comprising:

a housing including a nozzle assembly;

a suction fan and suction fan drive motor carried on said housing and in fluid communication with an intake port;

an airflow pathway leading from an intake vent in said housing to said intake port; and

a light source carried on said housing and positioned in said airflow pathway whereby flow of air through said airflow pathway cools said light source.

12. A method of cooling a light source, an agitator drive motor, a power board and a suction fan motor of a vacuum cleaner including a suction intake port, comprising:

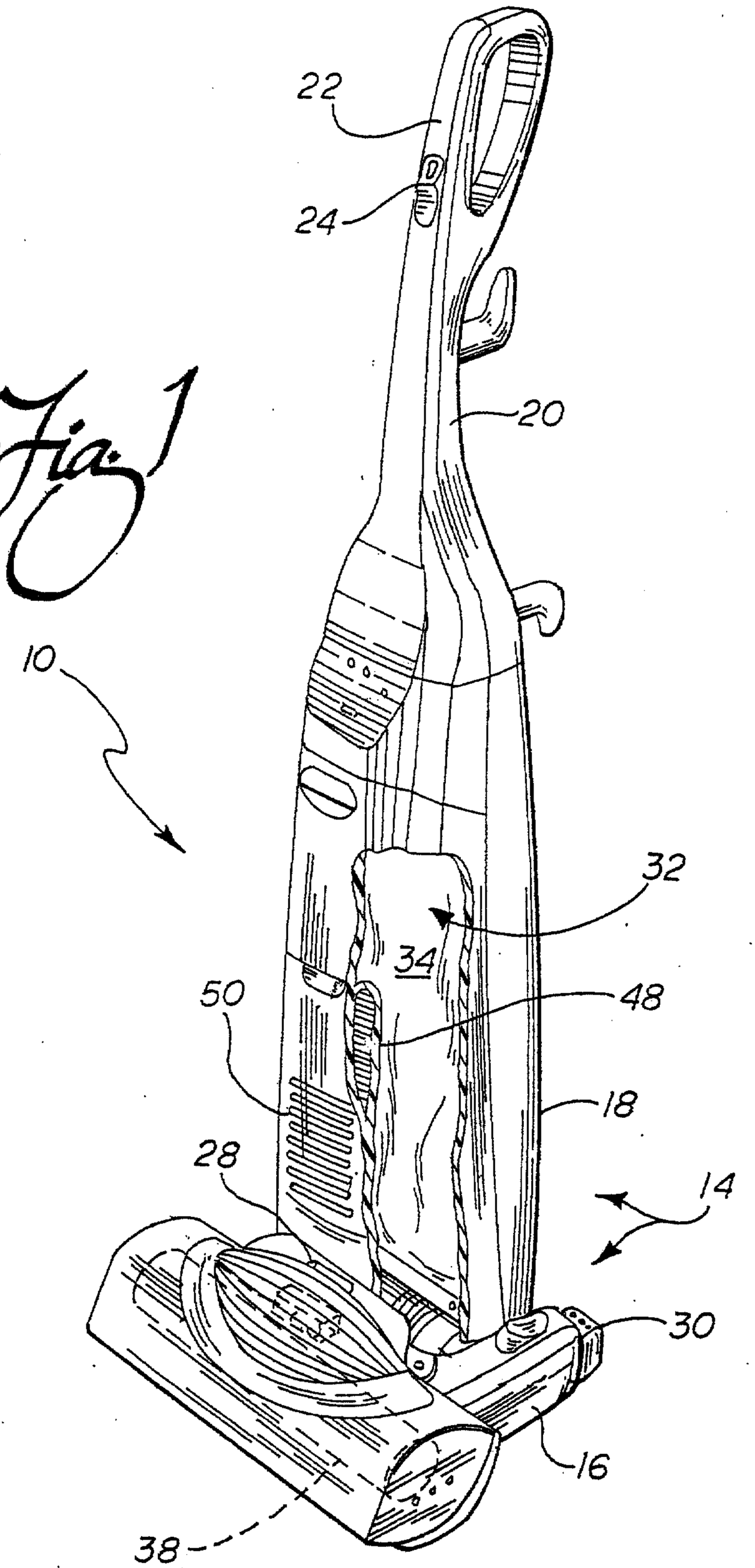
drawing clean air through an intake vent;

directing clean air through an airflow pathway serially over said light source, said agitator drive motor, said power board and said suction fan motor; and

discharging air from said airflow pathway into said suction intake port.

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Fig. 1



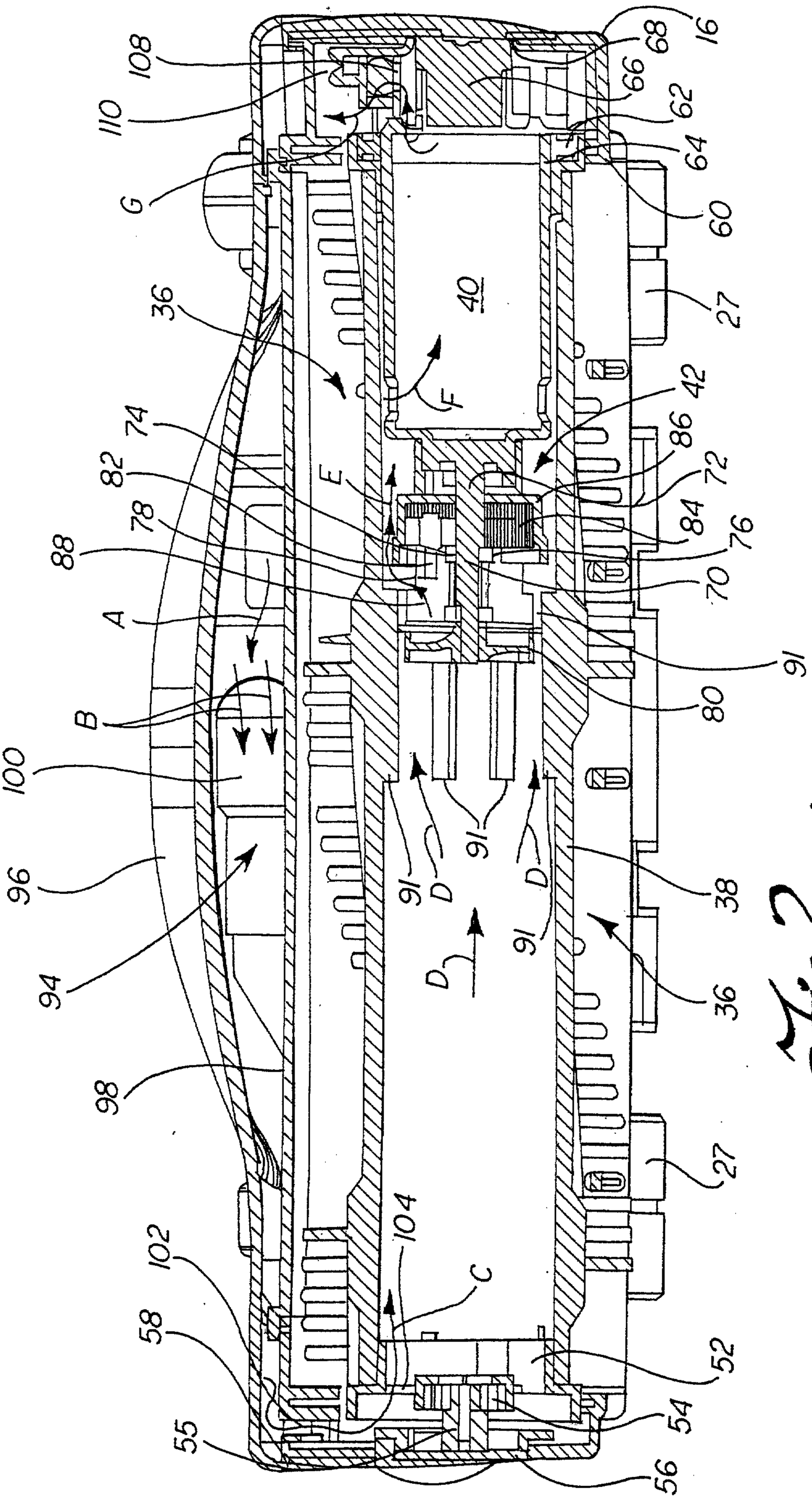

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Fig 2

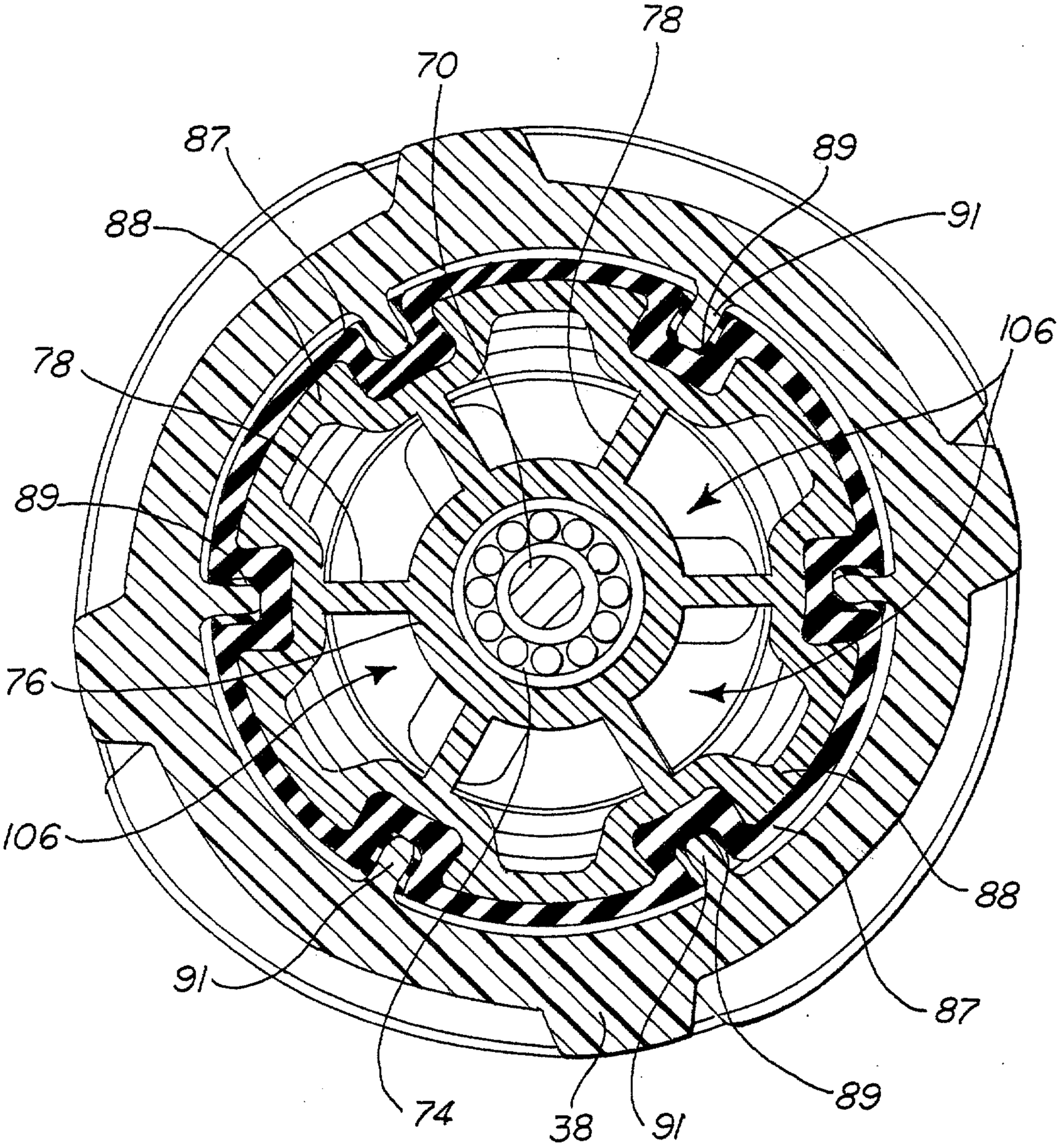


Fig. 2a

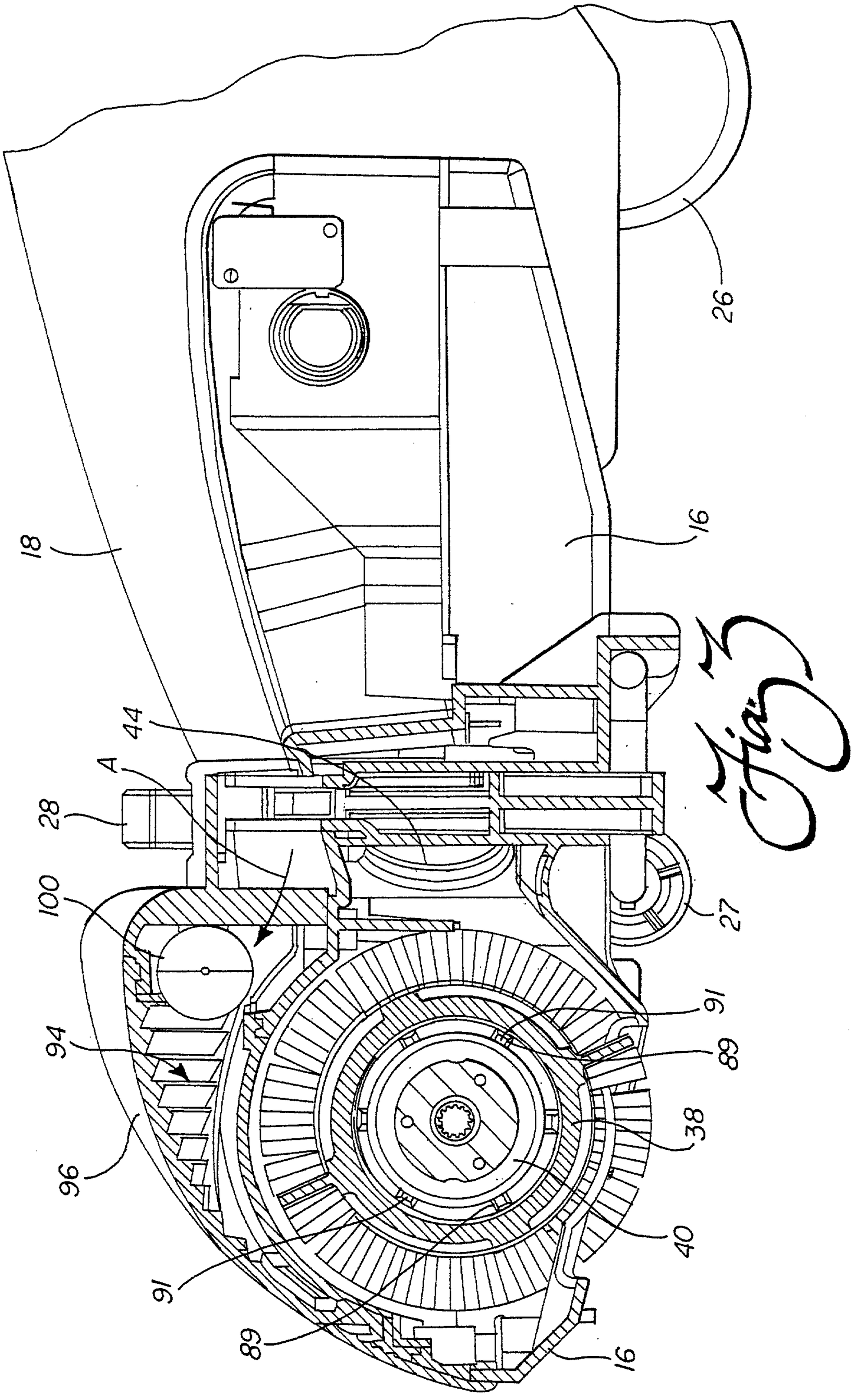


Fig 2

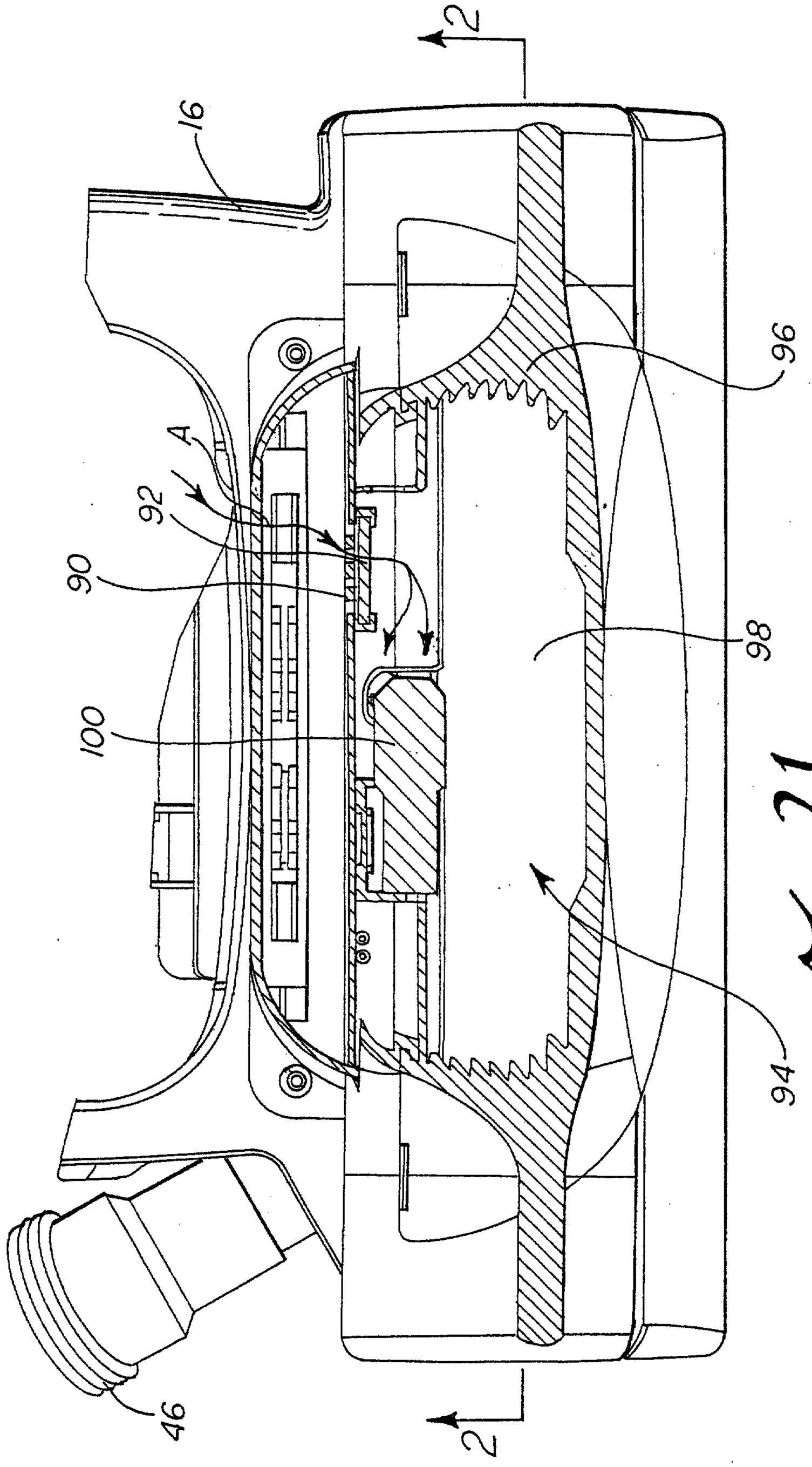


Fig 1

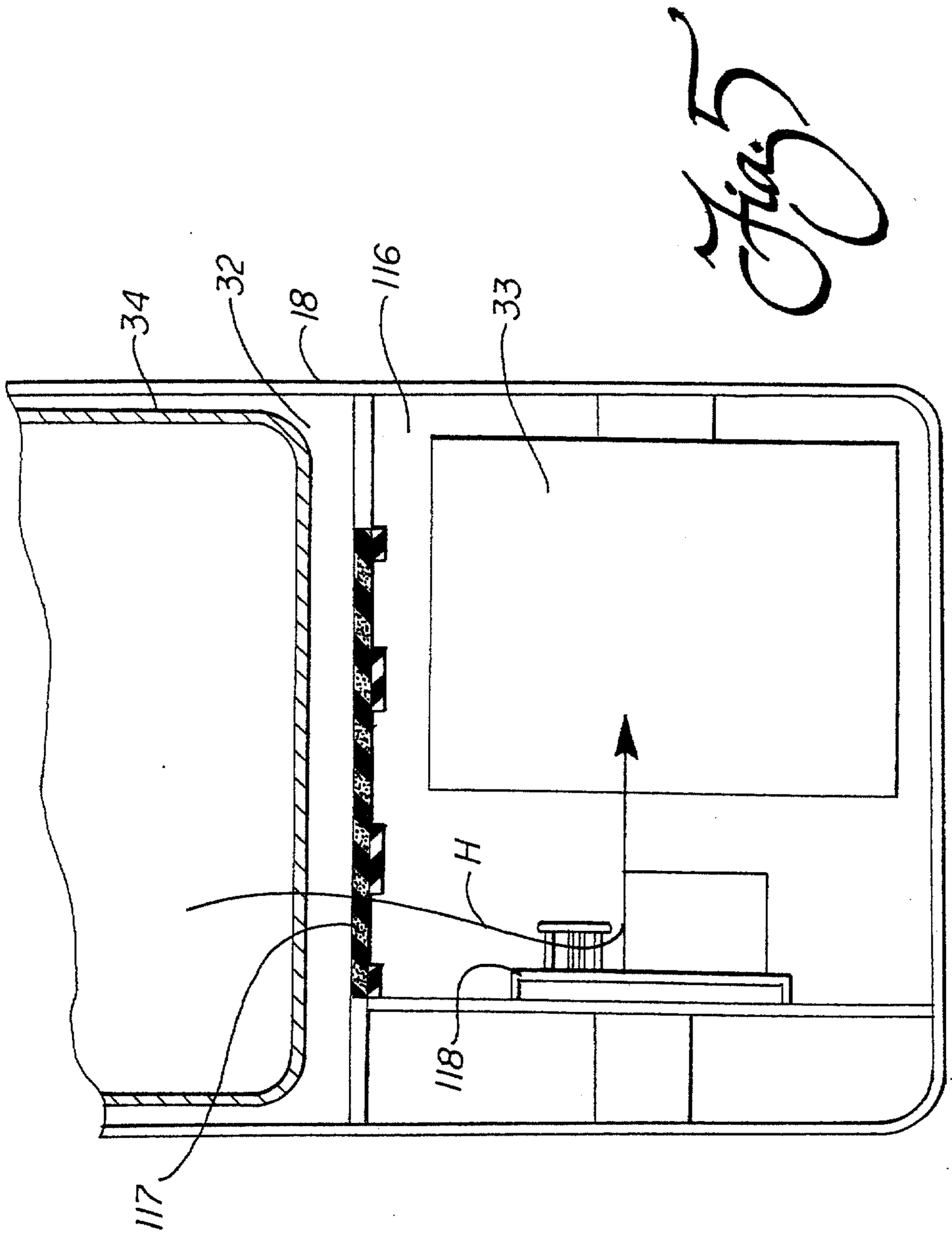
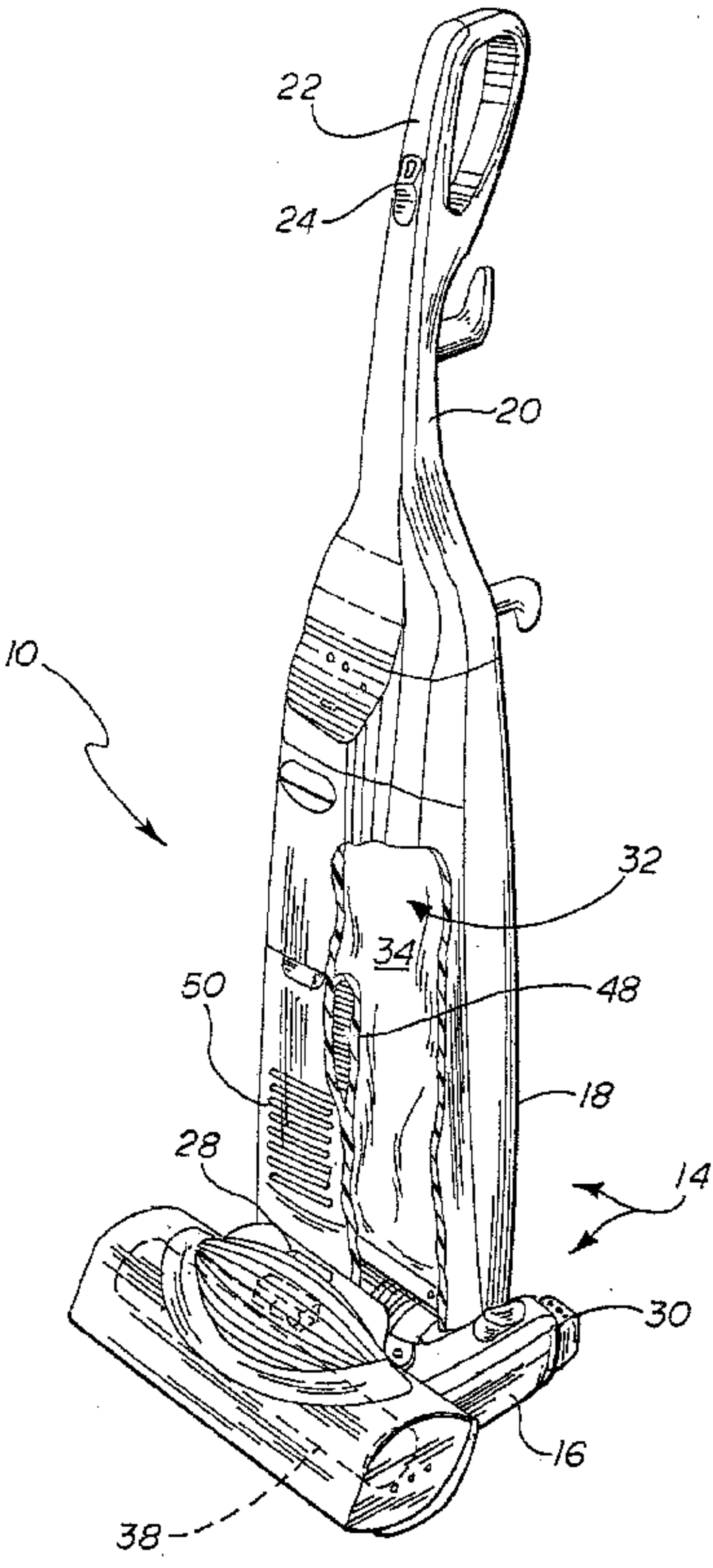


Fig 5


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