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(54) **Vacuum cleaner with electronic controller**

(57) A cleaning apparatus includes a base. The base has a bottom surface, an access opening in the bottom surface, and wheels for wheeling the base over a floor while the bottom surface faces the floor. A cleaning attachment is configured to be attached to the base and

moved against a household surface to clean the surface. An electronic controller is configured to be inserted through the opening into an installed position in the base from which to control an operating condition of the apparatus.

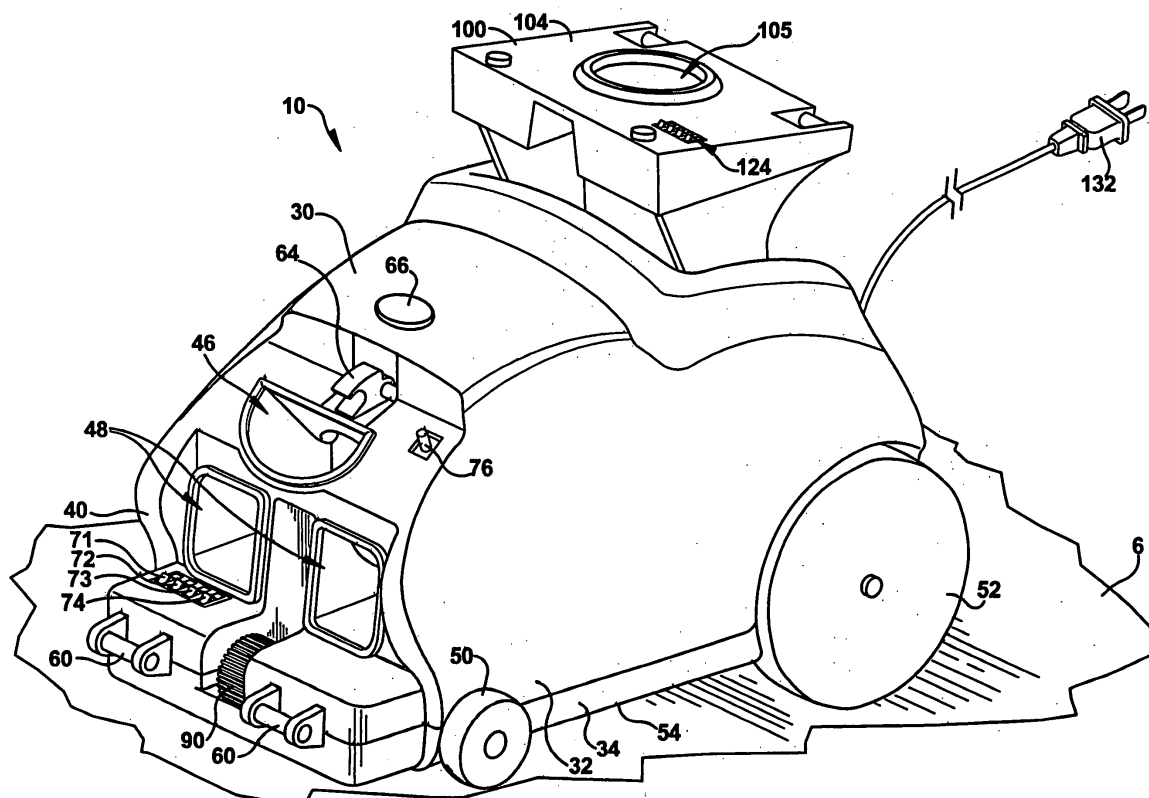


Fig. 2

Description

TECHNICAL FIELD

[0001] This application relates to vacuum cleaners.

BACKGROUND

[0002] A vacuum cleaner includes a base and different cleaning attachments and handles that are removably attachable to the base. The cleaning attachments include a vacuuming head for vacuuming a carpet, a shampooing head for shampooing the carpet, and an accessory hose for cleaning above-the-floor household surfaces. The handles include an upright handle for pushing the base over the carpet and a portable handle for lifting the base to reach above-the-floor surfaces.

SUMMARY

[0003] A cleaning apparatus includes a base. The base has a bottom surface, an access opening in the bottom surface, and wheels for wheeling the base over a floor while the bottom surface faces the floor. A cleaning attachment is configured to be attached to the base and moved against a household surface to clean the surface. An electronic controller is configured to be inserted through the opening into an installed position in the base from which to control an operating condition of the apparatus.

[0004] Preferably, the base and the controller each include an electrical connector. The connectors are configured such that movement of the controller toward and into its installed position moves the connector of the controller toward and into mechanical and electrical connection with the connector of the base. A cover is fixed to the controller so as to be moved into an installed position covering the opening by movement of the controller into its installed position. Indicia on the base indicate that the access opening is for insertion of the controller into the base. The cleaning attachment is a vacuuming head configured to be supported by the base to clean the floor as the base is wheeled over the floor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005]

Fig. 1 is a perspective view of a vacuum cleaner base and different cleaning attachments and handle assemblies that can be removably attached to the base;

Fig. 2 is a perspective view of the base, showing its external parts;

Fig. 3 is a perspective view of the base, showing its internal parts;

Fig. 4 is a perspective view of the base positioned upside-down, showing its controller cover plate re-

moved;

Fig. 5 is a view similar to Fig. 4, showing the cover plate installed on the base;

Fig. 6 is a sectional view showing one of the handles and one of the cleaning attachments attached to the base; and

Fig. 7 is a sectional view of another one of the handles attached to the base.

DESCRIPTION

Overview

[0006] The apparatus 1 shown in Fig. 1 has parts that are examples of the elements recited in the claims. The apparatus thus includes examples of how a person of ordinary skill in the art can make and use the claimed invention. It is described here to meet the requirements of enablement and best mode without imposing limitations that are not recited in the claims.

[0007] The apparatus 1 is a cleaning system used for cleaning household surfaces, such as a carpeted floor 6. The system 1 includes a base 10 and different cleaning attachments and handle assemblies that can be removably attached to the base 10. The cleaning attachments include a vacuuming head 12, a power head assembly 14, an accessory hose 16 and a shampooing head 18. The handle assemblies include an upright handle assembly 20 and a portable handle assembly 22. Any of the attachments 12, 14, 16 and 18 can be installed on the base 10 with any of the handle assemblies 20 and 22.

Base

[0008] As shown in Fig. 2, the base 10 has a housing 30 comprising upper and lower sections 32 and 34 that are fastened together. The housing 30 has a front face 40 with upper and lower inlet ports 46 and 48. Two front wheels 50 and two rear wheels 52 are rotatable connected to the housing 30 for wheeling the base 10 over the floor 6 in an orientation in which a bottom surface 54 of the housing 30 faces the floor 6. The base 10 has two perch pins 60 and a bear claw latch 64 with a release button 66 for securing the cleaning attachments to the base 10. It also has four electrical contacts 71, 72, 73 and 74 -- respectively designated ground, 5VDC-out, 24VDC-out and resistance-sense. An attachment sensor 76 on the housing 30, in this example a pushbutton switch, senses whether the upper inlet port 46 is covered by a cleaning attachment.

[0009] As shown in Fig. 3, a fan 80, with an inlet 82 and an outlet 84, is driven by a motor 88. The motor 88 also drives a drive pulley 90 through a drive train that includes shafts 93, belts 94, pulleys 95, a bevel gear 96 and an electrically actuated clutch 98. A drive assist motor 99 rotates the rear wheels 52 to propel the base 10.

[0010] A handle mounting bracket 100 is pivotally attached to the housing 30 by two prongs 102. The bracket

100 has a flat top surface 104 with an outlet port 105. The port 105 is connected to the fan outlet 84 by a flexible tube 106. An electronic position sensor 120, in this case a pushbutton switch, senses whether the bracket 100, and thus the upright handle assembly 20, is in an upright or inclined position. A multi-contact electrical base terminal 124 is located at the bracket's top surface 104.

[0011] A controller circuit 130 is electrically connected to the electrical components 71-74, 76, 88, 98, 99, 120 and 124 (Fig. 2 and 3) of the base 10 to monitor and control operation of the cleaner. The circuit 130 receives wall current through a power cord 132. It generates a 5VDC and 24VDC supply that is output through the 5VDC-out and 24VDC-out contacts 72 and 73. It senses electrical resistance applied across the sense contact 73 and ground contact 71 by whichever attachment is installed on the base 10. Since each attachment applies a unique resistance, the controller 130 can determine which attachment, if any, is installed.

[0012] As shown in Fig. 4, the controller 130 can be removably installed in the base 10 through an access opening 140 in the bottom 54 of the base housing 30. The opening 140 is configured specifically for installation and removal of the controller 130, as indicated by indicia, in this case lettering 143 on a label on the housing 30. The opening 140 facilitates replacement of the controller 130 by the user, which might occur if the controller 130 is damaged or an updated controller is supplied by the manufacturer. Due to its size and/or location, the opening 140 is not configured for and not suitable for replacement of the motor 88, fan 80 or other components of the base 10. In fact, due to their positions and/or sizes, those components cannot be removed through the access opening 140. The user is dissuaded from replacing those components, since doing so would require unfastening the upper housing section 32 from the lower housing section 34, which is more difficult than uncovering the access opening 140.

[0013] The controller 130 includes a printed circuit (PC) board 144 fixed to an electrical connector 146 that mates with an electrical connector 148 in the base 10. Movement of the PC board 144 through the opening 140 toward and into its installed position in the base 10 moves the PC board connector 146 toward and into mechanical and electrical connection with the base connector 148. The opposite is also true, that movement of the controller's connector 146 toward and into connection with the base's connector 148 moves the controller 130, including its PC board 144, into its installed position. In its installed position, the PC board 144 is fixed in place relative to the base housing 30, because its connector 146 is rigid and fixed to the PC board 144 and the base connector 148 is rigid and fixed to the base housing 30. The connectors 146 and 148 thus support the controller 130 in place, in addition to enabling the controller 130 to communicate with electrical components of the base 10.

[0014] The controller 130, as received from the manufacturer, is permanently fixed to a cover plate 150 shown

in Figs 4 and 5. This reduces the number of parts that the user has to separately handle and keep track of when replacing the controller 130. In its installed position, the plate 150 is in a recess 152 of the base housing 30, overlying the housing 30 and covering the opening 140. The plate 150 provides an indication, visible to the user when the plate 150 is installed, identifying the controller 130, such as indicating the model of the controller 130. The indication can be indicia such as lettering 153 or a symbol, or a color indicative of that model.

[0015] The plate 150 is configured such that movement of the plate 150 toward and into its installed position moves the controller 130 toward and into its installed position, which in turn moves the controller's electrical connector 146 toward and into mechanical and electrical connection with the base's electrical connector 148. The opposite is also true, in that movement of the controller 130 through the opening 140 toward and into its installed position moves the cover plate 150 toward and into its installed position.

[0016] The plate 150 can be secured to the housing 30 with screws 154. The controller 130, being secured to the plate 150, is fixed in its installed position by the screws 154 as well as by the mating connectors 146 and 148. The cover plate 150 is hidden from view when the base 10 is wheeled over the floor 6, because it is located at the bottom surface 54 of the base 10, which faces the floor 6.

Cleaning Attachments

[0017] The four cleaning attachments 12, 14, 16 and 18 are shown in Fig. 1. Each is configured to be removably attached to the base 10 and moved against a household surface to clean the surface. They are described individually as follows.

[0018] The vacuuming head 12 is supported by the base 10 as the base 10 is wheeled over the carpet 6. The head 12 has a brushroll 202 driven by the drive pulley 90 to rotate against the floor 6 to dislodge dirt from the floor 6. The fan 80 generates an air flow that carries the dirt from the floor 6, through the head 12 and the lower inlet ports 48, into the base 10. The dirt laden air is exhausted out of the base 10 through the outlet port 105. A headlight 210 of the vacuuming head 12 is powered by electricity supplied by the base 10 through the ground and 5VDC-out contacts 71 and 72 (Fig. 2).

[0019] The power head assembly 14 has a power head 300 with a brushroll 302 driven by a motor 304. The power head 300 is connected to a rigid tube 374, which is connected by a flexible tube 376 to a connector 378 that is removably attachable to the base 10. In operation, a user grasps the rigid tube 374 to push the power head 300 over the floor 6. The brushroll 302 rotates against the floor 6 to dislodge dirt. The fan 80 generates an air flow that carries the dirt from the floor 6, through the power head assembly 14 and the fan 80, and out the outlet port 105. A headlamp 390 on the power head 300 illuminates

the floor 6 in front of the power head 300. The headlamp 390 and motor 304 are respectively powered by 5VDC and 24VDC supplied by the base 10 through the electrical contacts 71-73 (Fig. 2).

[0020] The accessory hose 16 includes a flexible tube 400 extending from a connector 410 that is attachable to the base 10. In operation, the fan 80 draws air through the tube 400 and the upper inlet port 46 into the base 10, and exhausts the air out through the outlet port 105.

[0021] The shampooing head 18 has front and rear brushrolls 501 and 502 driven by the base's drive pulley 90 when the head 18 is supported on the base 10. Shampoo is deposited onto the carpet 6 by a shampoo-dispensing device 504 of the head 18 and brushed into the carpet 6 by the brushrolls 501 and 502 to entrain dirt from the carpet 6. The shampoo is lifted from the carpet 6 by the rear brushroll 502 and collected in a take-up tray 506 in the head 18.

Upright Handle Assembly

[0022] The upright handle assembly 20 is shown in Fig. 6. It includes an upright handle 602 attached to the base bracket 100 and a dirt receptacle 604 attached to the outlet port 105 to receive dirt laden air exhausted from the base 10. The upright handle assembly 20, the base 10 and the vacuuming head 12 together comprise an upright vacuum cleaner. This type of cleaner is configured for the user to stand upright while manually pushing the cleaner by its handle over the floor 6 to clean the floor 6.

[0023] The handle 602 has a handgrip 610. A force sensor 612 in the handgrip 610 senses the direction and magnitude of the force applied by the user to push/pull the cleaner over the floor.

[0024] The handle 602 also has a user interface panel 640. The panel 640 has user interfaces 642 (Fig. 1) comprising controls and displays with which the user communicates with the controller 130. The controls are for manually selecting operating conditions of the cleaner, such power on, motor speed, clutch engagement, and drive-assist activation. The displays display operating conditions of the cleaner, such as motor speed, brushroll activation, drive-assist activation, and fullness of the filter bag.

[0025] A multi-contact electrical terminal 630 on the handle 602 connects to the terminal 124 of the base 10 to enable the controller 130 to communicate with electrical components of the handle 602. Through the terminal 630, the handle 602 outputs a signal identifying itself to the controller 130 as an upright handle. Two hooks 634 and a lever 638 secure the handle 602 to the bracket 100 of the base 10.

[0026] During operation of the cleaner, the controller 130 inputs operating parameters of the cleaner from various sensors and switches of the cleaner. Specifically, from the force sensor 612 in the handgrip 610, the controller 130 inputs the direction and magnitude of force

manually applied to the handle 602. From the handle position sensor 120, the controller 130 determines whether the handle 602 is in the upright or inclined position. From the control panel 640, the controller 130 determines which switch the user presses and the type of handle installed. From the attachment sensor 76 (Fig. 2), the controller 130 determines whether the upper inlet port 46 is covered by a cleaning attachment. By sensing the electrical resistance across the ground and resistance-sense contacts 71 and 74 (Fig. 2), the controller 130 determines which cleaning attachment is installed.

[0027] The controller 130 controls operation of the cleaner based on the parameters input from the sensors and switches. For example, the controller 130 applies a higher default motor speed when the accessory hose 16 (Fig. 1) is attached than when the vacuuming head 12 is attached. The controller 130 engages the clutch 98 (Fig. 3) to couple the motor 88 to the drive pulley 90 only when a handle is installed while either the vacuuming head 12 or shampooing head 18 is installed. The controller 130 will not power the motor 88 if no handle is installed or no cleaning attachment is installed. The controller 130 powers the drive assist motor 99 (Fig. 3) to rotate the rear wheels 52 in a direction and at a speed that correspond respectively to the direction and magnitude of the force manually applied to the handle 602, to assist the user in moving the base 10 over the floor 6. The controller 130 activates the drive-assist motor 99 only when, concurrently, the vacuuming or shampooing head 12 or 18 is installed, the upright handle 602 is installed and inclined, and the drive-assist switch on the control panel 640 has been pressed.

Portable Handle Assembly

[0028] The portable handle assembly 22 is shown in Fig. 7. It includes a portable handle 702 and a dirt receptacle 704 comprising inner and outer filter bags. It enables the base 10 and the vacuuming head to be used as a portable vacuum cleaner. This type of cleaner is configured for the user to manually lift and move the cleaner by the handle 702 to clean vertical or above-the-floor household surfaces.

[0029] The portable handle 702 has features similar to those of the upright handle 704. For example, a multi-contact electrical terminal 730 of the handle 702 connects to the terminal 124 of the base 10 to enable the controller 130 to communicate with electrical components of the handle 702. The terminal 730 outputs a signal that identifies the handle 702 to the controller 130 as a portable handle. Two hooks 734 and a lever 738 secure the handle 702 to the bracket 100 of the base 10.

[0030] In contrast to the upright handle 602, the portable handle 702 projects forward over the base 10. It has a single rocker-type power switch 776 for powering the fan motor 88, with no control panel or displays.

[0031] This written description uses examples to disclose the invention, including the best mode, and also to

enable any person-skilled in the art to make and use the invention. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims.

Claims

1. A cleaning apparatus comprising:

a base having a bottom surface, an access opening in the bottom surface, and wheels for wheeling the base over a floor while the bottom surface faces the floor,
a cleaning attachment configured to be attached to the base and moved against a household surface to clean the surface; and
an electronic controller configured to be inserted through the opening into an installed position in the base from which to control an operating condition of the apparatus.

2. The apparatus of claim 1 wherein the base and the controller each include an electrical connector configured such that movement of the controller toward and into its installed position moves the connector of the controller toward and into mechanical and electrical connection with the connector of the base.

3. The apparatus of claim 1 further comprising a cover fixed to the controller so as to be moved into an installed position covering the opening by movement of the controller into its installed position.

4. The apparatus of claim 1 further comprising indicia on the base indicating that the opening is for insertion of the controller into the base.

5. The apparatus of claim 1 further comprising a motor that is in the base and not removable from the base through the opening.

6. The apparatus of claim 1 wherein the cleaning attachment is a vacuuming head configured to be supported by the base to clean the floor as the base is wheeled over the floor.

7. A cleaning apparatus comprising:

a base having an access opening and an electrical connector;
a cleaning attachment configured to be attached to the base and moved against a household sur-

face to clean the surface; and
an electronic controller configured to be inserted through the opening into an installed position in the base to control an operating condition of the apparatus, and having an electrical connector configured to be moved toward and into mechanical and electrical connection with the connector of the base by movement of the controller toward and into its installed position.

8. The apparatus of claim 7 further comprising a cover fixed to the controller so as to be moved into an installed position covering the opening by movement of the controller into its installed position.

9. The apparatus of claim 7 further comprising indicia on the base indicating that the opening is for insertion of the controller into the base.

10. The apparatus of claim 7 further comprising a motor that is located in the base and not removable from the base through the opening.

11. The apparatus of claim 7 wherein the cleaning attachment is a vacuuming head configured to be supported by the base to clean the floor as the base is wheeled over the floor.

12. A cleaning apparatus comprising:

a base having an access opening;
a cleaning attachment configured to be attached to the base and moved against a household surface to clean the surface;
an electronic controller configured to be inserted through the opening into an installed position in the base from which to control an operating condition of the apparatus; and
a cover fixed to the controller so as to be moved into an installed position covering the opening by movement of the controller into its installed position.

13. The apparatus of claim 12 further comprising indicia on the base indicating that the opening is for insertion of the controller into the base.

14. The apparatus of claim 12 further comprising a motor that is located in the base and not removable from the base through the opening.

15. The apparatus of claim 12 wherein the cover includes an indication that identifies the controller and is visible to a user when the cover is in its installed position.

16. The apparatus of claim 12 wherein the cleaning attachment is a vacuuming head configured to be sup-

ported by the base to clean the floor as the base is wheeled over the floor.

17. A cleaning apparatus comprising:

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a base having an access opening;

a cleaning attachment configured to be attached to the base and moved against a household surface to clean the surface;

an electronic controller configured to be inserted through the opening into an installed position in the base from which the controller controls an operating condition of the motor; and

and indicia indicating that the access opening is for insertion of the controller into the base.

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18. The apparatus of claim 17 further comprising a motor that is located in the base and not removable from the base through the opening.

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19. The apparatus of claim 17 wherein the cleaning attachment is a vacuuming head configured to be supported by the base to clean the floor as the base is wheeled over the floor.

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20. A cleaning apparatus comprising:

a base having an access opening;

a cleaning attachment configured to be attached to the base and moved against a household surface to clean the surface;

an electronic controller configured to be inserted through the opening into an installed position in the base from which the controller controls an operating condition of the apparatus; and

a cover attached to the controller, configured to have an installed position covering the opening, and having an indication that identifies the controller and being visible to a user when the cover is in its installed position.

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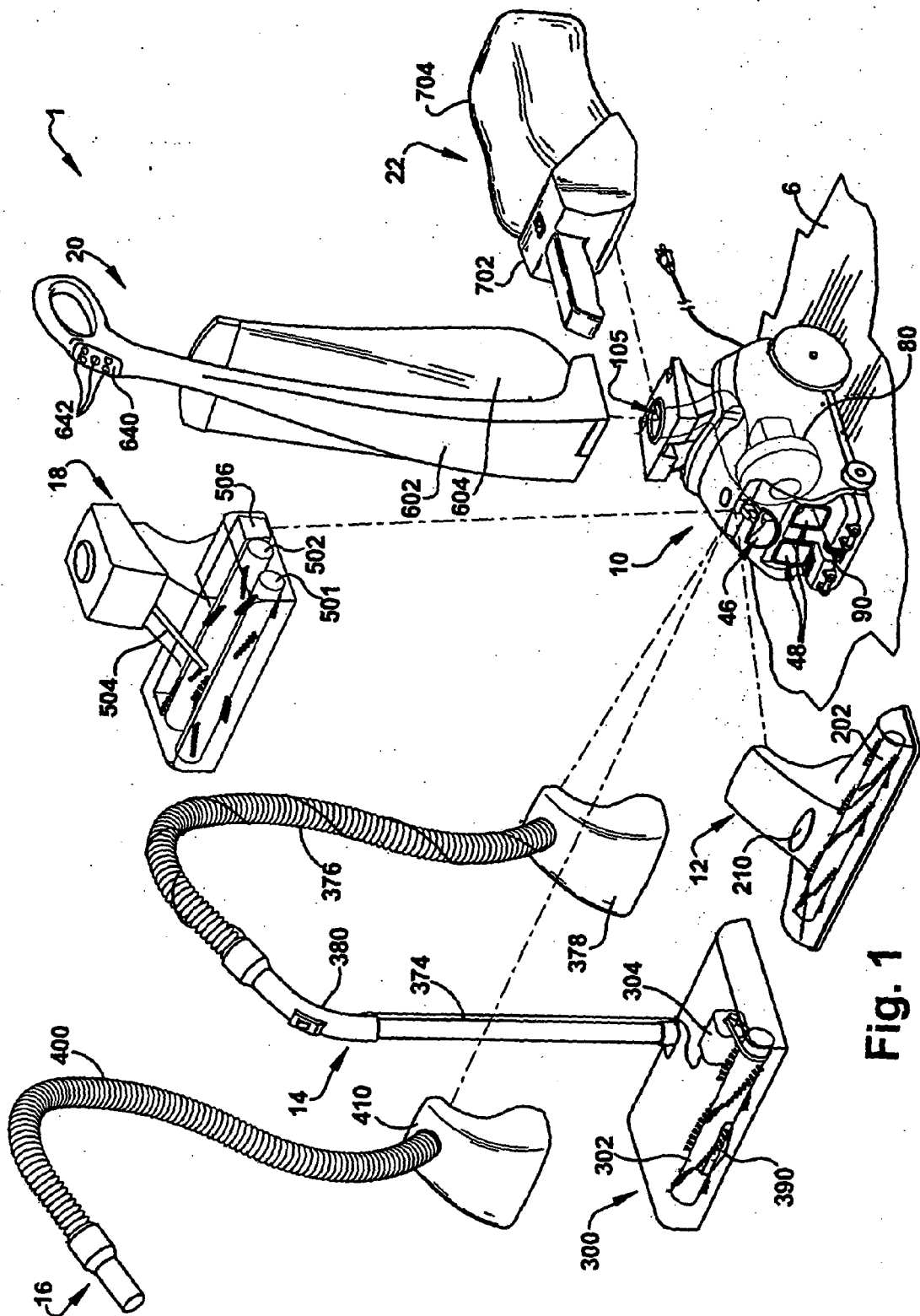


Fig. 1

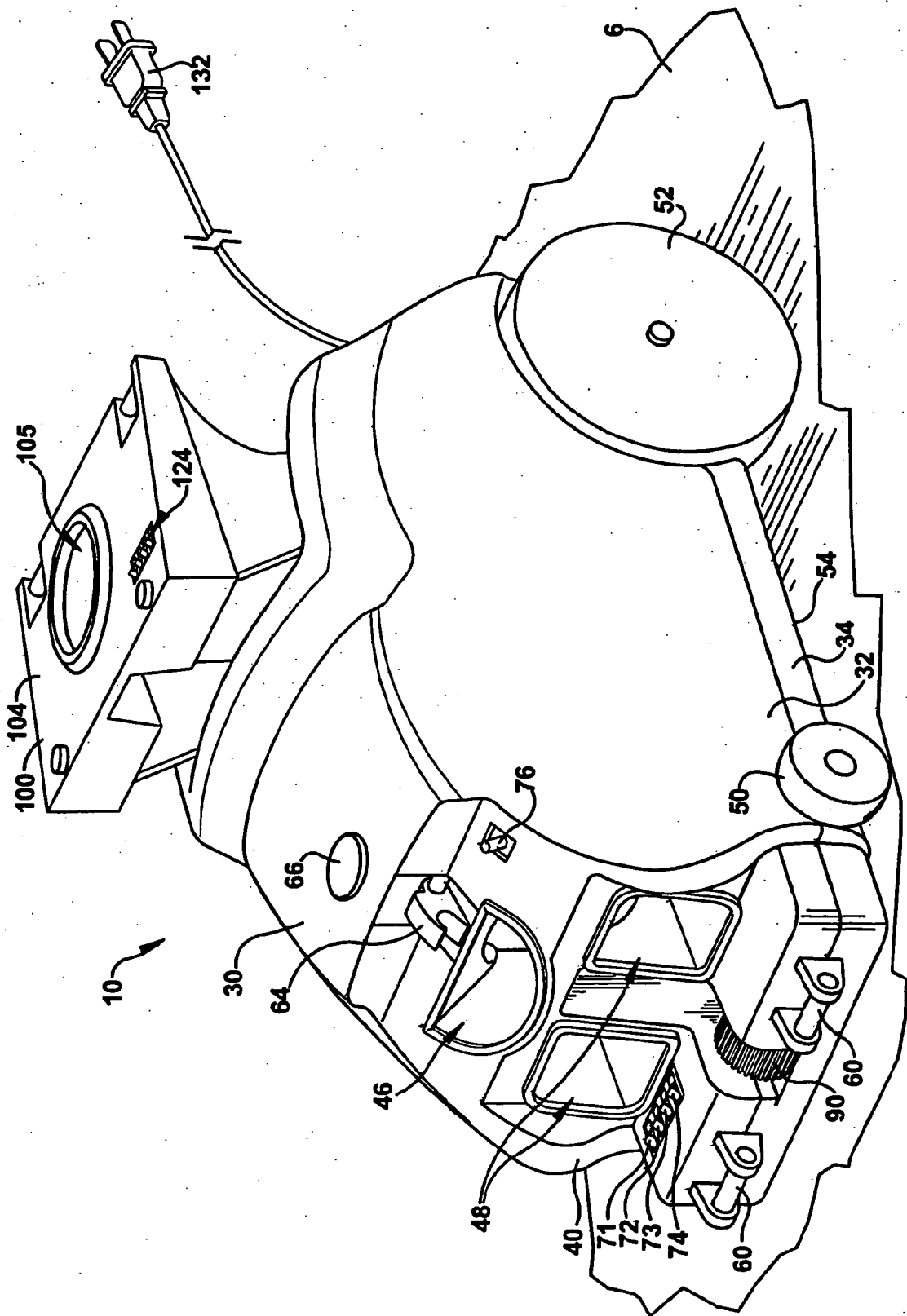


Fig. 2

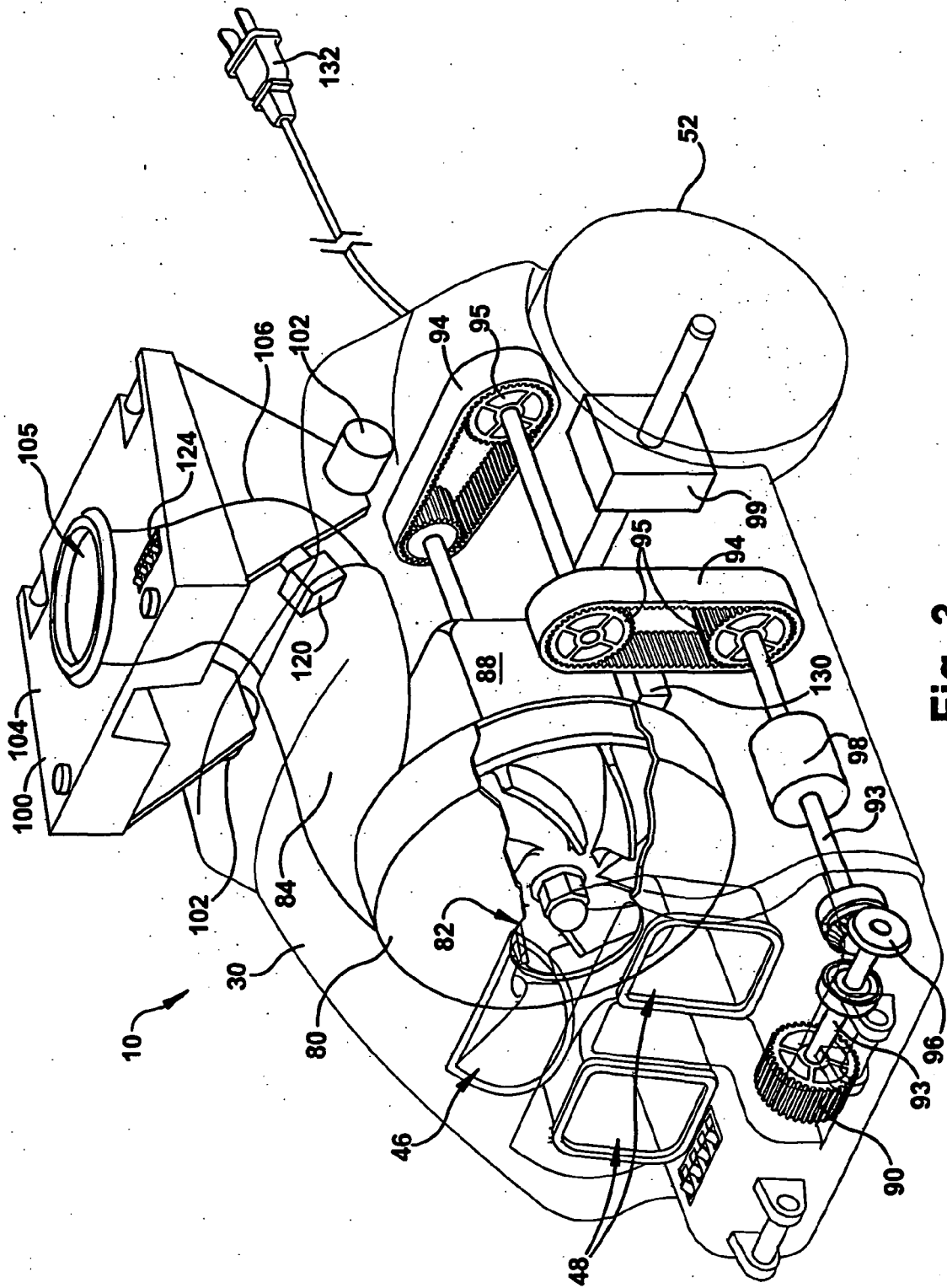


Fig. 3

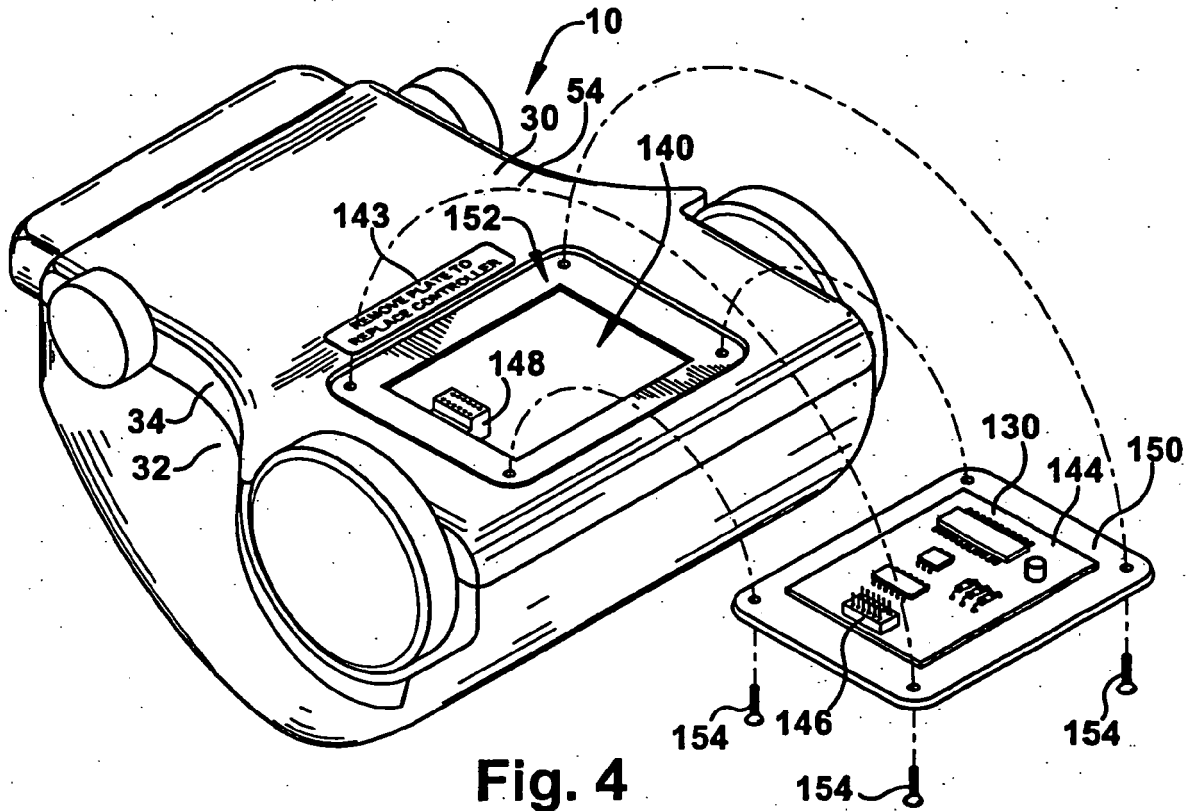


Fig. 4

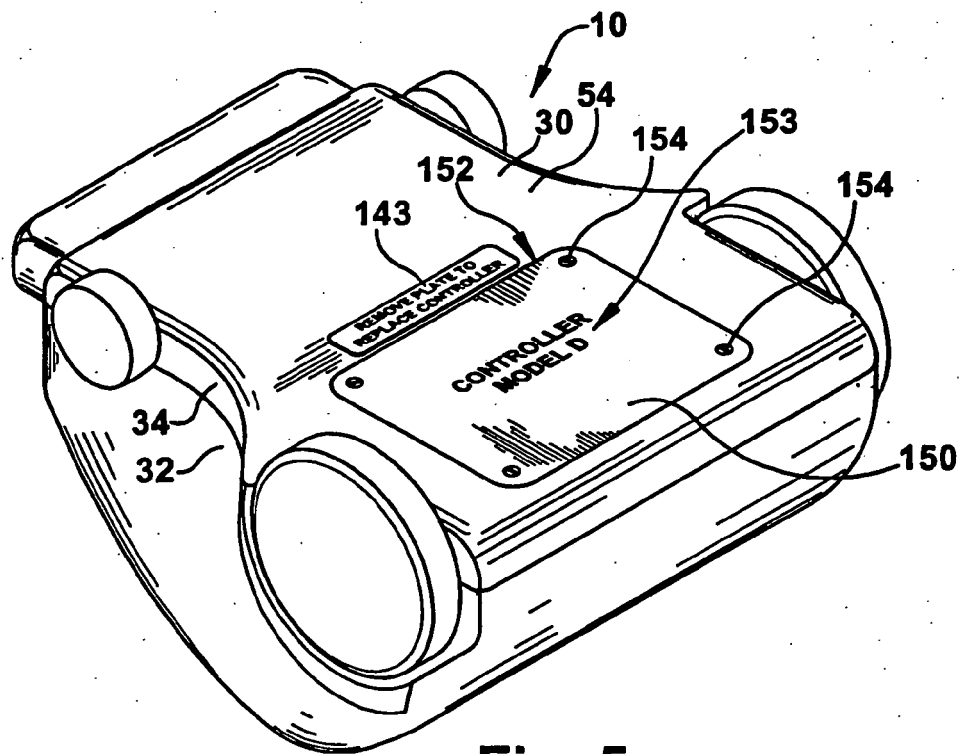


Fig. 5

