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(54) **ELECTRIC VACUUM CLEANER**

ELEKTRISCHER STAUBSAUGER

ASPIRATEUR ÉLECTRIQUE

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Description

TECHNICAL FIELD

[0001] Embodiments described herein relate generally to an electric vacuum cleaner including an air passage communicating with a suction side of an electric blower.

BACKGROUND

[0002] Conventionally, an electric vacuum cleaner includes a cleaner main body housing an electric blower, and is constituted such that an air passage into which dust is sucked by driving of the electric blower communicates with a suction side of the electric blower. Such an electric vacuum cleaner has been desired to have a constitution in which it is possible to notify the performance level of cleaning in order to eliminate the tediousness of cleaning for a user.

[0003] For example, a constitution in which a cleaning operation is converted into a charge to be calculated on the basis of information on a cleaning time and a cleaning place, to notify the user is known.

[0004] Therefore, an electric vacuum cleaner has been desired to have a constitution to more effectively notify the performance level of cleaning to a user.

CITATION LIST

Patent Literature

[0005] Patent Document 1: Japanese Laid-Open Patent Publication No. 2004-272650 US2005/0166355 discloses an electric vacuum cleaner having a sensor that detects dust sucked by a suction nozzle.

SUMMARY OF INVENTION

Technical Problem

[0006] An object of the present invention is to provide an electric vacuum cleaner capable of effectively notifying the performance level of cleaning to a user.

Solution to Problem

[0007] An electric vacuum cleaner according to an embodiment includes a cleaner main body housing an electric blower. Further, the electric vacuum cleaner includes an air passage communicating with a suction side of the electric blower. Moreover, the electric vacuum cleaner includes a suction part movable on a surface to be cleaned, the suction part partitioning a part of the air passage. Further, the electric vacuum cleaner includes a dust amount detecting unit that detects a dust amount passing through the inside of the air passage by driving of the electric blower. Moreover, the electric vacuum cleaner includes a calculating unit that calculates a clean-

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efficiency on the basis of an integrated amount of the dust amount detected by the dust amount detecting unit, a moving amount on the surface to be cleaned of the suction part, and a moving time on the surface to be cleaned of the suction part. And, the electric vacuum cleaner includes a notifying unit which is capable of notifying the cleaning efficiency calculated by the calculating unit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

Fig. 1 is a block diagram showing an internal structure of an electric vacuum cleaner according to a first embodiment.

Fig. 2 is a vertical cross-sectional view showing a part of the electric vacuum cleaner.

Fig. 3 is a perspective view showing the electric vacuum cleaner.

Fig. 4 is a flowchart showing an entire control of the electric vacuum cleaner.

Fig. 5 is a flowchart showing a first control of the electric vacuum cleaner.

Fig. 6 is a flowchart showing a second control of the electric vacuum cleaner.

Fig. 7 is an explanatory diagram showing a notification by a notifying unit of the electric vacuum cleaner.

Fig. 8 is a block diagram showing an internal structure of an electric vacuum cleaner according to a second embodiment.

Fig. 9 is a flowchart showing an entire control of the electric vacuum cleaner.

Fig. 10 is an explanatory diagram showing a notification by a notifying unit of the electric vacuum cleaner.

Fig. 11 is a block diagram showing an internal structure of an electric vacuum cleaner according to a third embodiment.

Fig. 12 is a flowchart showing an entire control of the electric vacuum cleaner.

Fig. 13 is a block diagram showing an internal structure of an electric vacuum cleaner according to a fourth embodiment.

Fig. 14 is a top view showing the electric vacuum cleaner.

Fig. 15 is a bottom view showing the electric vacuum cleaner.

Fig. 16 is a flowchart showing a cleaning control of the electric vacuum cleaner.

DETAILED DESCRIPTION

[0009] Hereinafter, a constitution of a first embodiment will be described with reference to the drawings.

[0010] In Fig. 3, the reference numeral 11 denotes a so-called canister type electric vacuum cleaner, and this electric vacuum cleaner 11 includes a cleaner main body 12 and an air passage forming body 13 which is a tube part, which is a separate body from the cleaner main body 12, and is detachably connected to the cleaner main body 12.

[0011] The cleaner main body 12 includes a hollow main body case 15 capable of turning and traveling on a surface to be cleaned, and a main body dust collecting chamber (not shown) and an electric blower chamber are partitioned in the front and back of the inside of the main body case 15. Moreover, an electric blower 18 is housed in the electric blower chamber, and a suction side of the electric blower 18 communicates with the main body dust collecting chamber. Further, a dust collecting part of a filter, a dust collecting bag, a dust collecting device (a dust collecting cup), and the like is disposed in the main body dust collecting chamber. Then, in the front portion of the main body case 15, a main body suction port 19 communicating with the main body dust collecting chamber, to which a base end side of the air passage forming body 13 is connected, is opened. Moreover, a display unit 20 such as a liquid crystal panel serving as a notifying unit is disposed on the upper part of the main body case 15. In addition, hereinafter, a description will be made given that a direction along a traveling direction of the electric vacuum cleaner 11 (the cleaner main body 12) is considered as a longitudinal direction, and the horizontal direction (both-side direction) intersecting with (orthogonal to) the longitudinal direction is considered as a width direction.

[0012] Further, the air passage forming body 13 has a long-shaped hose body 21, an extension tube 22 detachably connected to the hose body 21, and a floor brush 23 which is a suction port body as a suction part, which is detachably connected to the extension tube 22, that forms an air passage W communicating with the suction side of the electric blower 18 inside thereof. In addition, the air passage forming body 13 may be used so as to detach the floor brush 23, for example, and may be used so as to detach the floor brush 23 and the extension tube 22.

[0013] The hose body 21 integrally has a long tubular hose main body 25, a connecting tube part 26 formed so

as to communicate with the base end side (downstream end side) which is one end side of the hose main body 25, and a hand operation part 27 which is formed so as to communicate with the tip end side (upstream end side) which is the other end side of the hose main body 25, and, for example, is for gripping and operating the air passage forming body 13.

[0014] The hose main body 25 is formed of flexible synthetic resin or the like into a cylindrical accordion shape, and wiring (not shown) for electrically connecting the hand operation part 27 side and the cleaner main body 12 side is attached internally and spirally outside the air passage W.

[0015] The connecting tube part 26 is a portion to be inserted to connect to the main body suction port 19, and is cylindrically formed of synthetic resin or the like harder than the hose main body 25. Further, in the connecting tube part 26, terminals (not shown) electrically connected to the wiring disposed inside the hose main body 25 are disposed, and these terminals are electrically connected to the cleaner main body 12 side due to the connecting tube part 26 being inserted to connect to the main body suction port 19.

[0016] Further, the hand operation part 27 is substantially cylindrically formed of synthetic resin or the like harder than the hose main body 25, and a grip part 37 which is gripped by a user is formed from the upstream end side to the downstream end side in a projecting manner. A plurality of set buttons 38 serving as a setting unit for setting an operation of the electric blower 18 and the like are disposed in the grip part 37.

[0017] Further, the floor brush 23 is capable of framing a part (upper end side) of the air passage W, and includes a connecting tube 41 whose one end side is communicatively connected to the tip end side (upstream end side) of the extension tube 22, a horizontally long case body 42 which is connected to the other end side of the connecting tube 41 so as to be rotationally movable vertically or circumferentially, or the like and traveling wheels or the like (not shown) which are provided so as to be freely rotatable to the case body 42, and ground a surface to be cleaned to be driven to rotate to enable the floor brush 23 to move (travel) on the surface to be cleaned. Moreover, a suction port communicating with the other end side of the connecting tube 41 is formed in the lower portion of the case body 42 facing the floor surface. In addition, a rotary brush serving as a rotary cleaning body is disposed rotatably at the suction port of the floor brush 23, and a rotary motor or the like serving as a cleaning body driving unit for rotary-driving the rotary brush may be disposed inside the case body 42.

[0018] Next, the internal structure of the electric vacuum cleaner 11 will be described.

[0019] The electric vacuum cleaner 11 includes a control unit 45 such as a microcomputer which receives power feeding from a commercial AC power source e serving as a power source part shown in Fig. 1 via a power cord 44 housed in the main body case 15 so as to be able to

be pulled in and out. In addition, as a power source part, for example, a battery such as a secondary battery built-in the main body case 15 of the cleaner main body 12 may be used.

[0020] The control unit 45 includes an operation judging part 51 serving as an operation judging unit electrically connected to the set buttons 38, a power control part 52 serving as a power control unit which is electrically connected to the operation judging part 51, and controls the operation of the electric blower 18, a processing part 54 serving as a processing unit which is electrically connected to an optical sensor 53 serving as a dust amount detecting unit that detects a dust amount passing through the air passage W by the driving of the electric blower 18, a dust amount integrating part 55 serving as a dust amount integrating unit electrically connected to the processing part 54, a driving time integrating part 56 serving as a driving time integrating unit that detects a driving time of the electric blower 18 (a time in which the electric blower 18 is continuously driven from the start of driving), a moving amount/time integrating part 57 serving as a moving amount/time integrating unit that integrates a moving amount (travel distance) on the surface to be cleaned and its time of the floor brush 23, a suction time integrating part 58 that integrates a suction time of actually sucking dust, a cleaning efficiency calculating part 59 serving as a calculating unit that calculates a cleaning efficiency, and a display control part 60 serving as a notifying control unit which is electrically connected to the cleaning efficiency calculating part 59, and controls the operation of the display unit 20, and the like. In addition, the control unit 45 may include a cleaning body driving unit control part or the like that controls driving of the rotary motor or the like, for example, in the case where the above-described rotary motor or the like is disposed in the floor brush 23. Further, the respective parts composing the control unit 45 may be respectively integrated or separate bodies, and may be disposed at arbitrary positions such as in the inside of the main body case 15 of the cleaner main body 12, for example.

[0021] The operation judging part 51 is to judge an operation of the set buttons 38 by a user, to set an operation mode of the electric blower 18 with respect to the power control part 52 according to an operation of these set buttons 38.

[0022] Further, the power control part 52 is capable of controlling, for example, a phase angle of the electric blower 18 via a control element (not shown) or the like according to an operation mode set by the operation judging part 51.

[0023] Further, as shown in Figs. 1 and 2, the optical sensor 53 includes a light-emitting part 61 serving as a light-emitting unit that emits infrared light, for example, and a light-receiving part 62 serving as a light-receiving unit that receives the infrared light emitted by the light-emitting part 61 at positions opposed to one another, and it is possible to output a signal corresponding to a dust amount passing through the air passage W to the

processing part 54 in accordance with an amount of light received by the light-receiving part 62 of the infrared light from the light-emitting part 61.

[0024] The light-emitting part 61 has a light-emitting element 61a such as an LED that outputs light such as infrared light, and one and another light-emitting side lenses 61b and 61c serving as light-emitting side light guiding members that guide the light emitted from the light-emitting element 61a into the air passage W.

[0025] The light-emitting element 61a is disposed downward at the upper part of the main body suction port 19 of the main body case 15 of the cleaner main body 12, for example, and is constituted to output infrared light downward thereof.

[0026] Further, the one light-emitting side lens 61b is disposed on the inner surface of the main body suction port 19 on the lower side that is the output side of infrared light of the light-emitting element 61a.

[0027] Further, the other light-emitting side lens 61c is disposed at a position opposed to the lower side of the light-emitting element 61a (the light-emitting side lens 61b) in a state in which the connecting tube part 26 of the air passage forming body 13 is connected to the main body suction port 19. This other light-emitting side lens 61c is fit into a light-emitting side hole part 61d perforated along the radial direction in the connecting tube part 26, so as to airtightly seal the light-emitting side hole part 61d, and its one end side faces the light-emitting element 61a side (the light-emitting side lens 61b side) and the other end side faces the inside of the air passage W. That is, the air inside the air passage W does not flow out to the outside of the air passage W from the light-emitting side hole part 61d in any case.

[0028] In the same way, the light-receiving part 62 has a light-receiving element 62a such as a phototransistor that detects infrared light output from the light-emitting part 61, and one and another light-receiving side lenses 62b and 62c serving as light-receiving side light guiding members that guide the light output from the light-emitting part 61 to the light-receiving element 62a.

[0029] The light-receiving element 62a is disposed upward, i. e. , toward the light-emitting element 61a side at the lower portion of the main body suction port 19 of the main body case 15 of the cleaner main body 12, for example, and is constituted to receive the infrared light output from the light-emitting element 61a, to output a signal corresponding to an amount of the light received.

[0030] Further, the one light-receiving side lens 62b is disposed on the inner surface of the main body suction port 19 on the upper side that is the input side of infrared light with respect to the light-emitting element 62a.

[0031] Further, the other light-receiving side lens 62c is disposed at a position opposed to the upper side of the light-receiving element 62a (the light-receiving side lens 62b) in a state in which the connecting tube part 26 of the air passage forming body 13 is connected to the main body suction port 19. This other light-receiving side lens 62c is fit into a light-receiving side hole part 62d

perforated along the radial direction in the connecting tube part 26, so as to airtightly seal the light-receiving side hole part 62d, and its one end side faces the light-receiving element 62a side (the light-receiving side lens 62b side) and the other end side faces the inside of the air passage W. That is, the air inside the air passage W does not flow out to the outside of the air passage W from the light-receiving side hole part 62d in any case.

[0032] Then, with respect to the optical sensor 53, in the case where a dust amount passing through the inside of the air passage W is relatively large (little), dust blocking the light emission from the light-emitting element 61a of the light-emitting part 61 increases (decreases), thereby relatively decreasing (increasing) the amount of light received by the light-receiving element 62a of the light-receiving part 62. Therefore, it is possible to detect a dust amount passing through the inside of the air passage W according to an increase or a decrease in the amount of light received.

[0033] Further, the processing part 54 has a light-emission control part 64 that controls a light-emission amount or the like of the light-emitting element 61a of the light-emitting part 61, and a light-reception processing part 65 that processes a signal from the light-receiving part 62, and is electrically connected to the dust amount integrating part 55. Then, the light-reception processing part 65 is constituted to amplify a signal from the light-receiving element 62a of the light-receiving part 62 which is output according to the amount of light received, to output the signal to the cleaning efficiency calculating part 59.

[0034] The dust amount integrating part 55 is to calculate an integrated amount of the dust amount during driving of the electric blower 18 by integration of the signal processed by the light-reception processing part 65 of the processing part 54.

[0035] Further, the driving time integrating part 56 has a function, for example, a timer or the like and is reset at the start of driving of the electric blower 18, and integrates a time in which the electric blower 18 is driven, or a time until the stopping of the electric blower 18, to calculate the time.

[0036] Further, the moving amount/time integrating part 57 is electrically connected to a grounded detecting part 67 and a moving amount detecting part 68 disposed in the floor brush 23. The grounded detecting part 67 is a switch or the like projected on the lower portion of the case body 42 of the floor brush 23, and is turned on or off by contacting the surface to be cleaned, to be able to detect grounding of the surface to be cleaned. Further, the moving amount detecting part 68 is a sensor or the like which detects a rotation number or a rotational speed or the like of the traveling wheel of the case body 42, for example, to be able to detect a moving speed and distance of the floor brush 23. Then, the moving amount/time integrating part 57 integrates the moving speed and distance of the floor brush 23 detected by the moving amount detecting part 68 in a state in which the grounding of the floor brush 23 is detected by the grounded detect-

ing part 67, to calculate a moving amount on the surface to be cleaned of the floor brush 23, and integrates time in which the grounding of the floor brush 23 is detected by the grounded detecting part 67, to calculate a moving time on the surface to be cleaned of the floor brush 23.

[0037] Further, the suction time integrating part 58 has a function, for example, a timer or the like and is reset at the start of driving of the electric blower 18, and integrates a time in which a dust amount detected by the optical sensor 53 is greater than or equal to a predetermined amount set in advance, to calculate an actual (practical) dust suction time.

[0038] Further, the cleaning efficiency calculating part 59 has a function of detecting attachment and detachment of the floor brush 23 with respect to the air passage W (Fig. 3), and is to calculate a cleaning efficiency on the basis of an integrated amount of the dust amount calculated by the dust amount integrating part 55, a moving amount and a moving time on the surface to be cleaned of the floor brush 23 which are calculated by the moving amount/time integrating part 57, a driving time of the electric blower 18 calculated by the driving time integrating part 56, a suction time calculated by the suction time integrating part 58, and the like. Then, the cleaning efficiency calculating part 59 is electrically connected to a data storage part 69 such as a nonvolatile memory, and calculates a current work efficiency index on the basis of an average value of previous several cleaning efficiencies in cleaning stored in the data storage part 69 or cleaning efficiencies, etc., in cleaning for a certain past period.

[0039] In addition, as the function of detecting attachment and detachment of the floor brush 23, a dedicated detecting part may be provided to the control unit 45, or may be included in any one of the other respective parts in the control unit 45.

[0040] Further, the display control part 60 is to control the display unit 20 so as to display a cleaning efficiency and a work efficiency index calculated by the cleaning efficiency calculating part 59.

[0041] Next, the operation of the first embodiment will be described with reference to a flowchart shown in Fig. 4 as well.

[0042] When a user connects (plugs) a power cord 44 into a socket or the like of a wall surface in a state in which the dust collecting part is attached to the inside of the main body case 15 of the cleaner main body 12, a power source (a voltage) is supplied (applied) from the commercial AC power source e with respect to the control unit 45.

[0043] Then, the control unit 45 is brought into a wait state for operating input of the set buttons 38. That is, the control unit 45 determines whether the electric vacuum cleaner 11 is started up, in other words, whether the set button 38 for starting up the electric blower 18 has been operated (by the operation judging part 51) (Step 1).

[0044] In this Step 1, in the case where the control unit 45 determines that the electric vacuum cleaner 11 is not

started up (the set button 38 has not been operated), Step 1 is repeated, and in the case where the control unit 45 determines that the electric vacuum cleaner 11 is started up (the set button 38 has been operated), the control unit 45 starts up the electric vacuum cleaner 11 (the electric blower 18) in a set operation mode (by the power control part 52) (Step 2), and determines whether the floor brush 23 is connected to the air passage W (the tip end (upstream end) of the extension tube 22) (by the cleaning efficiency calculating part 59) (Step 3).

[0045] In this Step 3, in the case where the control unit 45 determines that the floor brush 23 is connected to the air passage W, the first control shown in Fig. 5 is performed (Step 4), and in the case where the control unit 45 determines that the floor brush 23 is not connected to the air passage W, the second control shown in Fig. 6 is performed (Step 5). The dust sucked along with the air into the air passage W by driving of the electric blower 18 passes through the air passage forming body 13 and the main body suction port 19, to flow into the dust collecting part, to be trapped in the dust collecting part. The air with which the dust is trapped is sucked into the electric blower 18, to be discharged from the electric blower 18 while cooling the electric blower 18, to be discharged to the outside of the main body case 15 of the cleaner main body 12.

[0046] Then, after Step 4 and Step 5, the control unit 45 determines whether the electric vacuum cleaner 11 (electric blower 18) is stopped, in other words, whether the set button 38 for stopping the electric blower 18 has been operated (by the operation judging part 51) (Step 6). Then, in this Step 6, in the case where the control unit 45 determines that the electric vacuum cleaner 11 is not stopped (the set button 38 has not been operated), the process returns to Step 3, and in the case where the control unit 45 determines that the electric vacuum cleaner 11 is stopped (the set button 38 has been operated), the control unit 45 stops the electric blower 18 (by the power control part 52) (Step 7), to complete the cleaning. In addition, in the present embodiment, it is judged whether the floor brush 23 is connected or detached only at the time of starting up the electric vacuum cleaner 11. However, this judgment can be released in the first control and the second control at an arbitrary timing, and it is possible to switch between the first control and the second control according to a connection or a detachment of the floor brush 23 judged at that time.

[0047] Next, the first control will be described with reference to a flowchart shown in Fig. 5 as well.

[0048] The control unit 45 clears a display on the display unit 20 (by the display control part 60) (Step 11), and then, the control unit 45 determines whether the electric vacuum cleaner 11 appropriately sucks the air, in other words, whether the electric blower 18 is functioning (Step 12).

[0049] In this Step 12, in the case where the control unit 45 determines that the electric blower 18 is not functioning, for example, a case where the electric vacuum

cleaner 11 does not suck the air due to clogging, etc., of the dust collecting part or a case where the air passage W is blocked with foreign matter or the like, the process returns to Step 12. In the case where the control unit 45 determines that the electric blower 18 is functioning, the control unit 45 determines whether the floor brush 23 is grounded on the surface to be cleaned (by the grounded detecting part 67) (Step 13).

[0050] In this Step 13, in the case where the control unit 45 determines that the floor brush 23 is not grounded on the surface to be cleaned, the process returns to Step 13 (or Step 12), and in the case where the control unit 45 determines that the floor brush 23 is grounded on the surface to be cleaned, the control unit 45 determines whether the floor brush 23 is moving at a speed faster than or equal to a predetermined speed set in advance (by the moving amount detecting part 68) (Step 14).

[0051] Then, in this Step 14, in the case where the control unit 45 determines that the floor brush 23 is not moving at a speed faster than or equal to the predetermined speed set in advance, the process returns to Step 13 (or Step 12), and in the case where the control unit 45 determines that the floor brush 23 is moving at a speed faster than or equal to the predetermined speed set in advance, the control unit 45 integrates a moving amount and a moving time on the surface to be cleaned of the floor brush 23 (by the moving amount/time integrating part 57) (Step 15).

[0052] Next, the control unit 45 determines whether the dust amount detected by the optical sensor 53 is greater than or equal to a predetermined amount set in advance (Step 16). In this Step 16, in the case where the control unit 45 determines that the dust amount detected by the optical sensor 53 is greater than or equal to the predetermined amount set in advance, the control unit 45 integrates the dust amount (by the dust amount integrating part 55) (Step 17), and the process proceeds to Step 18. Further, in this Step 16, in the case where the control unit 45 determines that the dust amount detected by the optical sensor 53 is not greater than or equal to the predetermined amount set in advance, the process directly proceeds to Step 18.

[0053] Then, the control unit 45 integrates a driving time of the electric blower 18 (by the driving time integrating part 56) (Step 18), and calculates a cleaning efficiency by the cleaning efficiency calculating part 59 on the basis of the moving amount and the moving time on the surface to be cleaned of the floor brush 23 integrated in Step 15, and the integrated amount of the dust amount integrated in Step 17 (Step 19). Specifically, given that the integrated amount of the dust amount calculated by the dust amount integrating part 55 is D, the moving amount and the moving time on the surface to be cleaned of the floor brush 23 calculated by the moving amount/time integrating part 57 are respectively L, T1, the cleaning efficiency calculating part 59 calculates a cleaning efficiency $H = D/(L \cdot T1)$. Thereafter, the control unit 45 determines whether an average value is stored

in the data storage part 69 (Step 20). In this Step 20, in the case where the control unit 45 determines that an average value is stored in the data storage part 69, the control unit 45 calculates a work efficiency index by the cleaning efficiency calculating part 59, and controls the display unit 20 (by the display control part 60), to display the work efficiency index along with the cleaning efficiency as shown in Fig. 7 (Step 21), and the process proceeds to Step 6. Specifically, the cleaning efficiency calculating part 59 calculates a work efficiency index $K = H/A$ given that an average value of previous several cleaning efficiencies in cleaning stored in the data storage part 69, or cleaning efficiencies, etc., in cleaning for a certain past period is A. On the other hand, in Step 20, in the case where the control unit 45 determines that an average value is not stored in the data storage part 69, the control unit 45 controls the display unit 20 (by the display control part 60), to display only the cleaning efficiency (Step 22), and the process proceeds to Step 6.

[0054] Next, the second control shown in the above-described Step 5 will be described with reference to a flowchart shown in Fig. 6 as well.

[0055] After the processings of Step 31 and Step 32 which are the same as Step 11 and Step 12, the control unit 45 integrates an actual dust suction time (by the suction time integrating part 58) (Step 33).

[0056] Next, the control unit 45 determines whether the dust amount detected by the optical sensor 53 is greater than or equal to a predetermined amount set in advance (via the processing part 54) (Step 34). In this Step 34, in the case where the control unit 45 determines that the dust amount detected by the optical sensor 53 is greater than or equal to the predetermined amount set in advance, the control unit 45 integrates the dust amount (by the dust amount integrating part 55) (Step 35), and the process proceeds to Step 36. Further, in this Step 34, in the case where the control unit 45 determines that the dust amount detected by the optical sensor 53 is not greater than or equal to the predetermined amount set in advance, the process directly proceeds to Step 36.

[0057] Then, the control unit 45 integrates a driving time of the electric blower 18 (by the driving time integrating part 56) (Step 36), and calculates a cleaning efficiency by the cleaning efficiency calculating part 59 on the basis of the suction time integrated in Step 33, the integrated amount of the dust amount integrated in Step 35, and the driving time integrated in Step 36 (Step 37). Specifically, given that the integrated amount of the dust amount calculated by the dust amount integrating part 55 is D, the driving time of the electric blower 18 calculated by the driving time integrating part 56 is T2, and the suction time calculated by the suction time integrating part 58 is T3, the cleaning efficiency calculating part 59 calculates a cleaning efficiency $H = D/(T2 \cdot T3)$. Thereafter, after the control unit 45 performs the controls in Steps 38 to 40 which are the same as the above-described Steps 20 to 22, the process proceeds to Step 6.

[0058] As described above, in accordance with the first

embodiment, the cleaning efficiency calculating part 59 divides the integrated amount of the dust amount by a product of the moving amount and the moving time of the floor brush 23, to calculate a cleaning efficiency.

Therefore, with respect to the integrated amount of the dust amount, the less the moving amount or the moving time of the floor brush 23, the higher the calculated cleaning efficiency. Generally, at the time of cleaning a same cleaning region, there is no large fluctuation in an integrated amount of the dust amount. Therefore, the above-described calculated cleaning efficiency may be an index of whether the cleaning region is efficiently cleaned up.

[0059] Further, the cleaning efficiency calculating part 59 divides an integrated amount of the dust amount by a product of a driving time and an actual suction time of the electric blower 18, to calculate a cleaning efficiency. Therefore, with respect to the integrated amount of the dust amount, the less the driving time or the actual suction time of the electric blower 18, the higher the calculated cleaning efficiency. Therefore, even in the case where cleaning is carried out with the floor brush 23 being detached, the above-described calculated cleaning efficiency may be an index of whether the cleaning region is efficiently cleaned up.

[0060] Next, a second embodiment will be described with reference to Figs. 8 to 10. In addition, the same components and operations as those in the first embodiment described above are denoted with the same reference numerals, and description thereof will be omitted.

[0061] According to this second embodiment, in the above-described first embodiment, the electric vacuum cleaner 11 includes a detecting unit 71 (Fig. 8) capable of detecting a type of a cleaning region (cleaning area).

[0062] As the detecting unit 71, a sensor or the like detecting a type of a cleaning region by reading a to-be-detected member (not shown) such as a bar-code or an IC tag, which is disposed at a specific position in each cleaning region such as a room, at the time of passing through it, is used.

[0063] Further, the detecting unit 71 is electrically connected to a cleaning region judging part 72 serving as a judging part of the control unit 45. The cleaning region judging part 72 is electrically connected to the cleaning efficiency calculating part 59, and judges a type of the cleaning region detected by the detecting unit 71, and is capable of outputting the judged result to the cleaning efficiency calculating part 59.

[0064] Then, as in a flowchart shown in Fig. 9, between Step 2 and Step 3, the control unit 45 detects a type of the cleaning region by the detecting unit 71, to judge the type (by the cleaning region judging part 72) (Step 45). As a result, in the first control and the second control respectively, a cleaning efficiency or a work efficiency index is displayed for each type of a cleaning region. For example, in Fig. 10, cleaning efficiencies and work efficiency indices of the respective cleaning regions are displayed so as to be arranged up and down.

[0065] In this way, in accordance with the second em-

bodiment, a cleaning efficiency or a work efficiency index is calculated by the cleaning efficiency calculating part 59 for each type of a cleaning region detected by the detecting unit 71, and the calculated cleaning efficiency or work efficiency index is displayed on the display unit 20, thereby accumulating data for each cleaning region individually, which makes it possible to more reliably evaluate and notify the performance level of cleaning.

[0066] Further, because the detecting unit 71 automatically detects a type of a cleaning region when a user merely carries out cleaning, an input work or the like is not necessary, which improves its convenience.

[0067] In addition, in the above-described second embodiment, the detecting unit 71 may detect, for example, a type of a surface to be cleaned, for example, which one of a flooring, a carpet, a tatami and the like the surface to be cleaned is, or may respectively detect a type and a cleaning region of the surface to be cleaned. Then, the same operation and effect as the second embodiment described above can be obtained such that cleaning efficiencies or work efficiency indices are displayed on the display unit 20 so as to correspond to each of at least one of these detected types of the surfaces to be cleaned and types of the cleaning regions.

[0068] Next, a third embodiment will be described with reference to Figs. 11 and 12. In addition, the same components and operations as those in each embodiment described above are denoted with the same reference numerals, and description thereof will be omitted.

[0069] According to this third embodiment, in the above-described first embodiment, the electric vacuum cleaner 11 includes a setting unit 75 (Fig. 11) by which it is possible for a user to manually set a type of a cleaning region (cleaning area).

[0070] The setting unit 75 is disposed, for example, at the hand operation part 27 or on the upper part of the main body case 15 of the cleaner main body 12, and is electrically connected to the operation judging part 51 of the control unit 45. The operation judging part 51 judges respective setting operations of the set buttons 38 and the setting unit 75, and outputs a result of the setting operation of the set button 38 to the power control part 52, and outputs a result of the setting operation of the setting unit 75 to the cleaning region judging part 72. The cleaning region judging part 72 judges a type of the cleaning region detected by the setting unit 75, and is capable of outputting the judged result to the cleaning efficiency calculating part 59. For example, as the setting unit 75, operation keys or the like with which a user determines a name specified for each cleaning region as a number, etc., to input it, is used.

[0071] Then, as in a flowchart shown in Fig. 12, between Step 2 and Step 3, the control unit 45 judges a type of a surface to be cleaned input via the setting unit 75 by the user (by the operation judging part 51 and the cleaning region judging part 72) (Step 47). As a result, in the first control and the second control respectively, in the same way as in the second embodiment described

above, a cleaning efficiency or a work efficiency index is displayed for each type of a cleaning region.

[0072] In this way, according to the third embodiment, a cleaning efficiency or a work efficiency index is calculated by the cleaning efficiency calculating part 59 for each type of a cleaning region input by the setting unit 75, and the calculated cleaning efficiency or work efficiency index is displayed on the display unit 20, thereby accumulating data for each cleaning region individually, which makes it possible to more reliably evaluate and notify the performance level of cleaning.

[0073] Further, because the user directly inputs a cleaning region with the setting unit 75, it is possible to more reliably judge the cleaning region.

[0074] In addition, in the third embodiment, the setting unit 75 may allow input of a type of a surface to be cleaned, for example, which of a flooring, a carpet, a tatami, and the like the surface to be cleaned is, or may allow respective input of a type and a cleaning region of the surface to be cleaned. Then, the same operation and effect as the third embodiment described above can be obtained such that cleaning efficiencies or work efficiency indices are displayed on the display unit 20 so as to correspond to each of at least one of these set types of the surfaces to be cleaned and types of the cleaning regions.

[0075] Further, in the respective embodiments described above, the processings in Step 16 and Step 17 may be executed before the processings in Steps 13 to 15 described above. That is, it does not matter in which order these processings in Steps 13 to 15 and the processings in Step 16 and Step 17 are executed.

[0076] Then, according to at least one of the embodiments described above, in a state in which the floor brush 23 is detached from the air passage W, the cleaning efficiency calculating part 59 calculates a cleaning efficiency on the basis of a driving time of the electric blower 18, an actual suction time in which dust greater than or equal to a predetermined amount set in advance is sucked into the air passage W, and an integrated amount of the dust amount detected by the optical sensor 53. Therefore, even in the case where cleaning is performed with the floor brush 23 being detached, it is possible to effectively notify the performance level of cleaning to the user in the same way as in the case where cleaning is performed by use of the floor brush 23.

[0077] Moreover, because it is possible to express a performance level of cleaning by a user with the cleaning efficiencies and the work efficiency indices described above, to provide a sense of achievement, not only is it possible to eliminate the tediousness of a cleaning operation, but also it is possible to prompt an improvement in cleaning efficiency or the like, which makes it possible to contribute to energy saving.

[0078] Next, a fourth embodiment will be described with reference to Figs. 13 to 16. In addition, the same components and operations as those in each embodiment described above are denoted with the same reference numerals, and description thereof will be omitted.

[0079] The electric vacuum cleaner 11 of the fourth embodiment is a so-called robot type (autonomous moving (autonomous travel) type) electric vacuum cleaner including a cleaner main body 77 serving as a suction part in place of the cleaner main body 12 and the air passage forming body 13 (the floor brush 23) of the respective embodiments described above.

[0080] That is, as shown in Figs. 13 to 16, the cleaner main body 77 includes, for example, a hollow main body case 81, the electric blower 18 housed in the main body case 81, a dust collecting part 82 provided in the main body case 81 so as to communicate with the suction side of the electric blower 18, a plurality of driving wheels 83 serving as a driving part that makes the cleaner main body 77 autonomously travel, that is, for autonomous travel, a motor 84 serving as a driving unit that drives these driving wheels 83, a turn wheel 85 which is turnably attached to the lower portion of the main body case 81, a plurality of sensors 86 serving as a detecting unit attached to the main body case 81, the control unit 45, and a secondary battery 87 which is a battery composing the power source part. In addition, the cleaner main body 77 may be further equipped with a side brush or the like serving as a turnable cleaning part at the lower portion of the main body case 81. Further, with respect to the cleaner main body 77, the vertical direction in Figs. 14 and 15, for example, is the longitudinal direction.

[0081] The main body case 81 is made of, for example, synthetic resin or the like, and formed in the shape of a flat column (disk) or the like, and a suction port 91 as a dust collection port, which is long in the width direction, laterally long, is opened at a central part in the width direction on a rear part side of a circular lower surface 81a. Further, the display unit 20, an operation part 92, and the like are disposed, for example, in the central part of the upper part of the main body case 81. The operation part 92 is for a user to perform an input operation externally, and is composed of, for example, a touch panel or the like.

[0082] The suction port 91 communicates with the dust collecting part 82. A shaft-shaped rotary brush 93 as a rotary cleaning body is axially supported rotatably on the suction port 91 and is rotationally driven by a rotary motor 94 as a cleaning body driving unit installed in the main body case 81.

[0083] In the rotary brush 93, for example, a plurality of cleaning body parts are radially spirally projected in a wall shape and attached on an outer circumferential surface of a long shaft part. A lower side of the rotary brush 93 projects downward from the suction port 91 to the lower surface 81a of the main body case 81, and tip ends of the cleaning body parts positioned on the lower side with the electric vacuum cleaner 11 laid on the surface to be cleaned come into contact with the surface to be cleaned.

[0084] The dust collecting part 82 traps dust which is vacuumed from the suction port 91 by driving of the electric blower 18. The dust collecting part 82 may, for ex-

ample, filtration-trap dust with use of, for example, a dust collecting bag such as a paper pack or a filter, or separate and trap dust by inertia separation such as centrifugal separation (cyclone separation) or linear separation, and can be arbitrarily constituted. Additionally, the dust collecting part 82 is positioned on a rear part of the main body case 81 above the suction port 91 and can be detachable from the main body case 81. Moreover, the optical sensor 53 is disposed at a position between the dust collecting part 82 and the suction port 91.

[0085] At least a lower part of each driving wheel 83 projects downward from the lower surface 81a of the main body case 81, comes into contact with the surface to be cleaned with the electric vacuum cleaner 11 laid on the surface to be cleaned and is rotatable. Additionally, the driving wheels 83 are positioned, for example, in front of the suction port 91, on both sides of an approximately central part of the main body case 81 in the longitudinal direction, and rotate along the longitudinal direction.

[0086] The motors 84 are arranged so as to, for example, respectively correspond to the driving wheels 83, and can respectively make the driving wheels 83 independently drive. The motor 84 may be directly connected to each driving wheel 83, or connected to each driving wheel 83 via a transmitting unit (not shown) such as a gear or a belt.

[0087] The turn wheel 85 is positioned at an approximately central part of the main body case 81 in the width direction in the front of the main body case 81 and is a driven wheel turnable along the surface to be cleaned.

[0088] Further, the sensor 86 is a ranging sensor, for example, an ultrasonic sensor or an infrared ray sensor or the like, or a contact sensor which directly contacts an obstacle to be a bumper, or the like. The sensor 86 is disposed in a front portion, a side portion, or a lower portion and the like of the cleaner main body 77 (the main body case 81), and is capable of respectively detecting the presence or absence of an obstacle (a wall) in front of the cleaner main body 77 (the main body case 81), an obstacle (a wall) on a side, or an obstacle (a stage) in the lower portion and the like, and distances between those and the cleaner main body 77 (the main body case 81), and the like.

[0089] Further, the control unit 45 is electrically connected to the electric blower 18, the rotary motor 94, the respective motors 84, the sensor 86, and the like, and is capable of controlling driving of the electric blower 18, the rotary motor 94, the respective motors 84, and the like on the basis of detected results by the sensor 86. Moreover, a plurality of cleaning modes of the electric vacuum cleaner 11 are set in the control unit 45, and these cleaning modes can be selected by an external input of the operation part 92 by a user. As these cleaning modes, for example, a normal cleaning mode which is a main cleaning mode in which an entire cleaning region is cleaned while autonomously moving (autonomously traveling), a careful cleaning mode which is an intensive cleaning mode in which an entire cleaning region is

cleaned several times, for example, twice while autonomously moving (autonomously traveling), a partial cleaning mode in which only a predetermined place of a cleaning region is spot-cleaned, and the like are stored in advance. In addition, in a careful cleaning mode, cleaning may be more effectively carried out such that a moving (traveling) pattern of the electric vacuum cleaner 11 (the cleaner main body 77) may be changed in a direction or the like in which the patterns, for example, may be intersected with (orthogonal to) one another every time of cleaning (the first cleaning time and the second cleaning time).

[0090] Then, the control unit 45 includes, in addition to the power control part 52, the processing part 54, the dust amount integrating part 55, the driving time integrating part 56, the moving amount/time integrating part 57, the suction time integrating part 58, the cleaning efficiency calculating part 59, the display control part 60, the data storage part 69, and the like which are described above, an operation judging part 96 electrically connected to the operation part 92, a rotary motor control part 97 serving as a cleaning body driving unit control part or the like that controls operation of the rotary motor 94, a travel control part 98 serving as a movement control part that controls a movement (travel) of the electric vacuum cleaner 11 (the cleaner main body 77) by controlling operations of the respective motors 84, and a travel processing part 99 electrically connected to the sensor 86, and the like. In addition, the respective parts composing the control unit 45 may be respectively integrated or separate bodies, and, for example, may be disposed at arbitrary positions such as the inside of the main body case 15 of the cleaner main body 12.

[0091] The operation judging part 96 is to judge an operation of the operation part 92, to set a cleaning mode with respect to the power control part 52, the rotary motor control part 97, and the travel control part 98.

[0092] Further, the rotary motor control part 97 is capable of controlling, for example, a phase angle of the rotary motor 94 via a control element (not shown) or the like according to a cleaning mode set by the operation judging part 96.

[0093] Further, the moving amount/time integrating part 57 is electrically connected to the rotary motor control part 97, for example, and is a sensor or the like serving as a rotation number detecting unit that detects a rotation number or a rotational speed, or the like of the rotary motor 94 (the driving wheels 83) driven by the rotary motor control part 97 in a grounded state on a surface to be cleaned, to be able to detect a moving speed and a distance of the electric vacuum cleaner 11 (the cleaner main body 77). Then, the moving amount/time integrating part 57 integrates the detected moving speed and distance of the electric vacuum cleaner 11 (the cleaner main body 77), to calculate a moving amount on the surface to be cleaned of the electric vacuum cleaner 11 (the cleaner main body 77), and calculate a moving time on the surface to be cleaned of the electric vacuum cleaner 11 (the

cleaner main body 77). In addition, it is possible to detect whether the respective driving wheels 83 are grounded on the surface to be cleaned by detecting a load current value of the rotary motor 94, for example, or by separately providing a grounded detecting part on the lower surface 81a of the main body case 81 or the like.

[0094] Further, the cleaning efficiency calculating part 59 is to calculate a cleaning efficiency on the basis of an integrated amount of the dust amount calculated by the dust amount integrating part 55, a moving amount and a moving time on the surface to be cleaned of the electric vacuum cleaner 11 (the cleaner main body 77) which are calculated by the moving amount/time integrating part 57, a driving time of the electric blower 18 calculated by the driving time integrating part 56, and a suction time calculated by the suction time integrating part 58, and the like.

[0095] Further, the secondary battery 87 is to supply power to the control unit 45, the electric blower 18, the rotary motor 94, the respective motors 84, the sensor 86, and the like. The secondary battery 87 is disposed at a position behind the turn wheel 85, for example. Then, the secondary battery 87 is electrically connected to charging terminals 101 and 101 located at the lower surface 81a of the main body case 81 on both sides of the turn wheel 85. When the charging terminals 101 and 101 are connected to a predetermined charging stand (not shown) installed at a predetermined position or the like indoors (room), for example, it is possible to charge the secondary battery 87.

[0096] Next, the operation of the fourth embodiment will be described with reference to a flowchart shown in Fig. 16 as well.

[0097] When the electric vacuum cleaner 11 is brought into a state of starting up in a state in which a user has turned on a power switch (not shown), or in a case where it reaches a predetermined time set in advance in a state in which the power switch has been turned on or the like, the control unit 45 starts up the electric blower 18 in a set cleaning mode (by the power control part 52) (Step 51), and drives the driving wheels 83 and 83 by driving the motors 84 and 84 (by the travel control part 98) while processing the information such as distances from obstacles detected by the sensor 86 (by the travel processing part 99), to make the electric vacuum cleaner 11 (the cleaner main body 77) autonomously move (autonomously travel) according to the set cleaning mode (Step 52).

[0098] Next, the control unit 45 clears a display on the display unit 20 (by the display control part 60) (Step 53), and the control unit 45 determines whether the electric vacuum cleaner 11 appropriately sucks the air, in other words, whether the electric blower 18 is functioning (Step 54).

[0099] In this Step 54, in the case where the control unit 45 determines that the electric blower 18 is not functioning, for example, a case where the electric vacuum cleaner 11 does not suck the air due to clogging, etc., of

the dust collecting part 82 or a case where the suction port 91 is blocked with foreign matter or the like, the process returns to Step 54. In the case where the control unit 45 determines that the electric blower 18 is functioning, the control unit 45 determines whether the electric vacuum cleaner 11 (the cleaner main body 77) is moving at a speed faster than or equal to a predetermined speed set in advance (by the moving amount detecting part 68) (Step 55). In addition, the dust sucked along with the air from the suction port 91 by driving of the electric blower 18 is trapped in the dust collecting part 82. The air with which the dust is trapped is sucked into the electric blower 18, to be discharged from the electric blower 18 while cooling the electric blower 18, to be discharged to the outside of the main body case 81 of the cleaner main body 77.

[0100] Then, in Step 55, in the case where the control unit 45 determines that the electric vacuum cleaner 11 (the cleaner main body 77) is not moving at the speed faster than or equal to the predetermined speed set in advance, the process is returned to Step 55 (or Step 54), and in the case where the control unit 45 determines that the electric vacuum cleaner 11 (the cleaner main body 77) is moving at the speed faster than or equal to the predetermined speed set in advance, the control unit 45 integrates the moving amount and the moving time on the surface to be cleaned of the electric vacuum cleaner 11 (the cleaner main body 77) (by the moving amount/time integrating part 57) (Step 56).

[0101] Next, the control unit 45 determines whether the dust amount detected by the optical sensor 53 is greater than or equal to a predetermined amount set in advance (Step 57). In this Step 57, in the case where the control unit 45 determines that the dust amount detected by the optical sensor 53 is greater than or equal to the predetermined amount set in advance, the control unit 45 integrates a dust amount (by the dust amount integrating part 55) (Step 58), and integrates a driving time of the electric blower 18 (by the driving time integrating part 56) (Step 59). Further, in this Step 57, in the case where the control unit 45 determines that the dust amount detected by the optical sensor 53 is not greater than or equal to the predetermined amount set in advance, the process directly proceeds to Step 59.

[0102] Then, the control unit 45 determines whether the electric vacuum cleaner 11 (the electric blower 18) is continuously driven (Step 60), and in the case where the control unit 45 determines that the electric vacuum cleaner 11 (the electric blower 18) is continuously driven, the process returns to Step 54. Further, in this Step 60, in the case where the control unit 45 determines that the driving is completed, the control unit 45 stops the electric blower 18, and moves the electric vacuum cleaner 11 (the cleaner main body 77) to the charging stand, and completes the cleaning in a state in which the charging terminals 101 and 101 are connected to the charging stand (Step 61). Next, the control unit 45 calculates a cleaning efficiency by the cleaning efficiency calculating

part 59 on the basis of the moving amount and the moving time on the surface to be cleaned of the electric vacuum cleaner 11 (the cleaner main body 77) integrated in Step 56, and the integrated amount of the dust amount integrated in Step 58 (Step 62). Because a method for calculating a cleaning efficiency in Step 62 is the same as that in the above-described Step 19, this will be omitted. Thereafter, the control unit 45 determines whether an average value is stored in the data storage part 69 (Step 63). In this Step 63, in the case where the control unit 45 determines that an average value is stored in the data storage part 69, the control unit 45 calculates a work efficiency index by the cleaning efficiency calculating part 59, and controls the display unit 20 (by the display control part 60), to display the work efficiency index along with the cleaning efficiency (Step 64). Because a method for calculating a work efficiency index in Step 64 is the same as that in the above-described Step 21, this will be omitted. On the other hand, in Step 63, in the case where the control unit 45 determines that an average value is not stored in the data storage part 69, the control unit 45 controls the display unit 20 (by the display control part 60), to display only the cleaning efficiency (Step 65).

[0103] In this way, according to the fourth embodiment, the cleaning efficiency calculating part 59 divides the integrated amount of the dust amount by a product of the moving amount and the moving time of the cleaner main body 77, to calculate a cleaning efficiency. Therefore, with respect to the integrated amount of the dust amount, the less the moving amount or the moving time of the cleaner main body 77, the higher the calculated cleaning efficiency. Generally, at the time of cleaning a same cleaning region, there is no large fluctuation in an integrated amount of dust amount. Therefore, the above-described calculated cleaning efficiency may be an index of whether the cleaning region is efficiently cleaned up.

[0104] Moreover, because it is possible to express a performance level of cleaning with the cleaning efficiencies and the work efficiency indices described above, it is possible to prompt a user to improve the cleaning efficiency or the like by changing the setting for a cleaning mode or the like, which makes it possible to contribute to energy saving. That is, in the case where the cleaning efficiency in, for example, a careful cleaning mode is relatively low, or in the case where the cleaning efficiency in a normal cleaning mode is relatively low, it is possible to determine that an autonomous moving distance of the cleaner main body 77 is inefficient. Therefore, it is possible to increase a cleaning efficiency by changing the setting of a cleaning mode, such as by setting to a normal cleaning mode, or by setting to a partial cleaning mode, and it is possible to select an appropriate cleaning mode.

[0105] In addition, in the fourth embodiment described above, a cleaning mode may be, not only selected from the modes stored in advance, but also set arbitrarily by a user, for example. Further, not only setting of a moving (traveling) pattern of the cleaner main body 77, but also setting, etc., of an input (an operation mode) of the elec-

tric blower 18 may be included in the setting of a cleaning mode.

[0106] Moreover, in the same way as in the second and third embodiments, the invention may be constituted so that a type of a cleaning region (cleaning area) is automatically detected or manually input by a user, to calculate a cleaning efficiency or a work efficiency index for each type of a cleaning region by the cleaning efficiency calculating part 59, and the calculated cleaning efficiency or work efficiency index may be displayed on the display unit 20. In this case as well, the same operation and effect as the second and third embodiments described above can be obtained.

[0107] Then, the constitution in which the electric vacuum cleaner 11 (the cleaner main body 77) autonomously moves (autonomously travels) may include not only the constitution in which the electric vacuum cleaner 11 (the cleaner main body 77) moves (travels) while detecting an obstacle or the like by the sensor 86, but also a constitution (self-traveling constitution) in which the electric vacuum cleaner 11 (the cleaner main body 77) automatically moves (travels) along a moving (traveling) pattern set in advance, for example, and the like.

[0108] Further, the electric vacuum cleaner 11 (the cleaner main body 77) autonomously moving (autonomously traveling) may be manually operated by use of a remote controller or the like.

[0109] Then, according to at least one of the embodiments described above, a cleaning efficiency is calculated by the cleaning efficiency calculating part 59 on the basis of an integrated amount of the dust amount detected by the optical sensor 53, a moving amount on a surface to be cleaned of the floor brush 23 or the cleaner main body 77, and a moving time on the surface to be cleaned of the floor brush 23 or the cleaner main body 77, and the calculated cleaning efficiency is displayed on the display unit 20, thereby it is possible to effectively notify the performance level of cleaning to a user with this cleaning efficiency.

[0110] Moreover, when there is an average value of previous several cleaning efficiencies in cleaning stored in the data storage part 69 or cleaning efficiencies, etc., in cleaning for a certain past period, the cleaning efficiency calculating part 59 divides the cleaning efficiencies by the average value to calculate a work efficiency index, and the calculated work efficiency index is displayed on the display unit 20, thereby it is possible to allow a user to recognize whether the cleaning efficiency is improved as compared with that in the past cleaning, which makes it possible to more effectively notify the performance level of cleaning to the user.

[0111] In addition, in the respective embodiments, the display unit 20 displays the cleaning efficiencies and the work efficiency indices during cleaning respectively in real time. However, the display unit 20 may be constituted to display those at the completion of cleaning, i.e., when stopping the electric blower 18 (the electric vacuum cleaner 11).

[0112] Further, as a notifying unit, not only the display unit 20 which visually displays, but also a notifying unit that acoustically notifies with sound or the like, for example, or a combination, etc., thereof may be used.

5 [0113] Moreover, the control unit 45 may automatically control input of the motors of the electric blower 18 or the floor brush 23 so as to correspond to a dust amount detected by the optical sensor 53.

10 [0114] Then, a large or small measure of the dust amount detected by the optical sensor 53 may be displayed on the display unit 20, etc., during driving or the like of the electric blower 18.

15 [0115] Moreover, the electric vacuum cleaner 11 is not limited to a canister type or a robot type, and an upright type having the floor brush 23 connected to the lower portion of the cleaner main body 12 or a handy-type may be used in response thereto.

20 Claims

1. An electric vacuum cleaner (11) comprising:

a cleaner main body (12, 77) housing an electric blower (18);
an air passage (W) communicating with a suction side of the electric blower (18);
a suction part (23, 77) movable on a surface to be cleaned, the suction part partitioning a part of the air passage (W); and
a dust amount detecting unit (53) that detects a dust amount passing through an inside of the air passage (W) by driving of the electric blower (18); **characterized by:**

35 a calculating unit (59) that calculates a cleaning efficiency on the basis of an integrated amount of the dust amount detected by the dust amount detecting unit (53), a moving amount on the surface to be cleaned of the suction part (23, 77), and a moving time on the surface to be cleaned of the suction part (23, 77); and
a notifying unit (20) which is capable of notifying the cleaning efficiency calculated by the calculating unit (59).

2. The electric vacuum cleaner according to Claim 1, wherein
the suction part is the cleaner main body (77) which is capable of autonomously moving on the surface to be cleaned.

50 3. The electric vacuum cleaner according to Claim 1, wherein
the suction part is a suction port body (23) which is a separate body from the cleaner main body (12) to partition a part of the air passage, and is capable of

moving on the surface to be cleaned.

4. The electric vacuum cleaner according to Claim 3, wherein
the suction port body (23) is detachable from the air passage (W), and
in a state in which the suction port body (23) is detached from the air passage (W), the calculating unit calculates a cleaning efficiency on the basis of a driving time of the electric blower (18), a suction time in which dust greater than or equal to a predetermined amount set in advance is sucked into the air passage (W), and an integrated amount of the dust amount detected by the dust amount detecting unit (53).
5. The electric vacuum cleaner according to any one of Claims 1 to 4, further comprising a detecting unit (71) which is capable of detecting at least one of a type of the surface to be cleaned and a type of a cleaning region, wherein
the calculating unit (59) calculates cleaning efficiencies so as to correspond to each of at least one of the type of the surface to be cleaned and the type of the cleaning region, which is detected by the detecting unit; and
the notifying unit (20) is capable of notifying the respective cleaning efficiencies calculated by the calculating unit.
6. The electric vacuum cleaner according to any one of Claims 1 to 5, further comprising a setting unit (75) which is capable of setting at least one of a type of the surface to be cleaned and a type of the cleaning region, wherein
the calculating unit (59) calculates cleaning efficiencies so as to correspond to each of at least one of the type of the surface to be cleaned and the type of the cleaning region, which is set by the setting unit; and
the notifying unit (20) is capable of notifying the respective cleaning efficiencies calculated by the calculating unit.

Patentansprüche

1. Elektrischer Staubsauger (11), aufweisend:

einen Staubsaugergrundkörper (12, 77), in dem ein elektrisches Gebläse (18) untergebracht ist;
einen Luftkanal (W), der mit einer Saugseite des elektrischen Gebläses (18) strömungsmäßig verbunden ist;
ein Saugteil (23, 77), das sich auf einer zu reinigenden Fläche bewegen lässt, wobei das Saugteil einen Teil des Luftkanals (W) aufteilt; und
eine Staubmengenerfassungseinheit (53), die

eine Staubmenge erfasst, die einen Innenraum des Luftkanals (W) durch Antreiben des elektrischen Gebläses (18) durchquert; **gekennzeichnet durch:**

eine Berechnungseinheit (59), die eine Reinigungseffizienz auf der Grundlage eines integrierten Betrages der Staubmenge, die durch die Staubmengenerfassungseinheit (53) erfasst ist, eines Bewegungsbetrags des Saugteils (23, 77) auf der zu reinigenden Fläche und einer Bewegungszeit des Saugteils (23, 77) auf der zu reinigenden Fläche berechnet; und
eine Meldeeinheit (20), die in der Lage ist, die Reinigungseffizienz zu melden, die durch die Berechnungseinheit (59) berechnet ist.

2. Elektrischer Staubsauger nach Anspruch 1, wobei das Saugteil der Staubsaugergrundkörper (77) ist, der in der Lage ist, sich autonom auf der zu reinigenden Fläche zu bewegen.
3. Elektrischer Staubsauger nach Anspruch 1, wobei das Saugteil ein Sauganschlusskörper (23) ist, der ein Körper ist, der von dem Staubsaugergrundkörper (12) unabhängig ist, um einen Teil des Luftkanals aufzuteilen, und der in der Lage ist, sich auf der zu reinigenden Fläche zu bewegen.
4. Elektrischer Staubsauger nach Anspruch 3, wobei der Sauganschlusskörper (23) von dem Luftkanal (W) abnehmbar ist, und
die Berechnungseinheit in einem Zustand, in dem der Sauganschlusskörper (23) von dem Luftkanal (W) abgenommen ist, eine Reinigungseffizienz auf der Grundlage einer Antriebszeit des elektrischen Gebläses (18), einer Saugzeit, in der Staub in einer Menge, die größer oder gleich einer im Voraus eingestellten vorbestimmten Menge ist, in den Luftkanal (W) eingesaugt wird, und eines integrierten Betrages der Staubmenge, die durch die Staubmengenerfassungseinheit (53) erfasst ist, berechnet.
5. Elektrischer Staubsauger nach einem beliebigen der Ansprüche 1 bis 4, ferner mit einer Erfassungseinheit (71), die in der Lage ist, wenigstens eines von einer Art der zu reinigenden Fläche und einer Art eines Reinigungsgebiets zu erfassen, wobei
die Berechnungseinheit (59) Reinigungseffizienzen berechnet, um jeder von wenigstens einer von der Art der zu reinigenden Fläche und der Art des Reinigungsgebiets zu entsprechen, die durch die Erfassungseinheit erfasst ist; und
die Meldeeinheit (20) in der Lage ist, die entsprechenden Reinigungseffizienzen zu melden, die durch die Berechnungseinheit berechnet sind.

6. Elektrischer Staubsauger nach einem beliebigen der Ansprüche 1 bis 5, ferner mit einer Einstelleinheit (75), die in der Lage ist, wenigstens eine von einer Art der zu reinigenden Fläche und einer Art des Reinigungsgebiets einzustellen, wobei die Berechnungseinheit (59) Reinigungseffizienzen berechnet, um jeder von wenigstens einer von der Art der zu reinigenden Fläche und der Art des Reinigungsgebiets zu entsprechen, die durch die Einstelleinheit eingestellt ist; und die Meldeeinheit (20) in der Lage ist, die entsprechenden Reinigungseffizienzen, die durch die Berechnungseinheit berechnet sind, zu melden.

Revendications

1. Un aspirateur électrique (11) comprenant :

un corps principal d'aspirateur (12, 77) abritant un souffleur électrique (18) ;
un passage d'air (W) communiquant avec un côté d'aspiration du souffleur électrique (18);
une pièce d'aspiration (23, 77) mobile sur une surface à nettoyer, la pièce d'aspiration divisant une partie du passage d'air (W); et
un dispositif de détection de quantité de poussière (53) qui détecte une quantité de poussière en passant par l'intérieur du passage d'air (W) en entraînant le souffleur électrique (18) ; **caractérisé en ce que :**

une dispositif de calcul (59) qui calcule une efficacité de nettoyage sur la base d'une quantité intégrée de poussière quantité détectée par le dispositif de détection de la quantité de poussière (53), une quantité en mouvement sur la surface à nettoyer de la pièce d'aspiration (23, 77), et un temps de déplacement sur la surface à nettoyer de la pièce d'aspiration (23, 77) ; et un dispositif de notification (20) qui est capable d'envoyer une notification sur l'efficacité de nettoyage calculée par le dispositif de calcul (59).

2. L'aspirateur électrique selon la revendication 1, dans laquelle la pièce d'aspiration est le corps principal de l'aspirateur (77) qui est capable de se déplacer de manière autonome sur la surface à nettoyer.
3. L'aspirateur électrique selon la revendication 1, dans laquelle la pièce d'aspiration est un corps du port d'aspiration (23) qui est un corps séparé du corps principal de l'aspirateur (12) servant à la partition d'une partie du passage d'air, et est capable de se déplacer sur la surface à nettoyer.

4. L'aspirateur électrique selon la revendication 3, dans laquelle le corps du port d'aspiration est détachable du passage d'air (W), et dans un état dans lequel le corps du port d'aspiration (23) est détaché du passage d'air (W), le dispositif de calcul calcule une efficacité de nettoyage sur la base d'un temps d'entraînement du souffleur électrique (18), un temps d'aspiration dans lequel la poussière supérieure à ou égale à une quantité prédéterminée réglée à l'avance est aspirée dans le passage d'air (W), et une quantité intégrée de quantité de poussière détectée par le dispositif de détection de la quantité de poussière (53).

5. L'aspirateur électrique selon l'une quelconque des revendications 1 à 4, comprenant en outre une unité de détection (71) qui est capable de détecter au moins un type de surface à nettoyer et un type de zone de nettoyage, dans laquelle le dispositif de calcul (59) calcule les efficacités de nettoyage de manière à correspondre à chacun d'au moins un type de la surface à nettoyer et le type de la zone de nettoyage, qui est détectée par le dispositif de détection ; et le dispositif de notification (20) est capable d'envoyer une notification sur les efficacités de nettoyage respectives calculées par le dispositif de calcul.

6. L'aspirateur électrique selon l'une quelconque des revendications 1 à 5, comprenant en outre un dispositif de réglage (75) qui est capable de régler au moins un type de surface à nettoyer et un type de la zone de nettoyage, dans laquelle le dispositif de calcul (59) calcule les efficacités de nettoyage de manière à correspondre à chacun d'au moins un type de la surface à nettoyer et le type de la zone de nettoyage, qui est défini par le dispositif de réglage ; et le dispositif de notification (20) est capable d'envoyer une notification sur les efficacités de nettoyage respectives calculées par le dispositif de calcul.

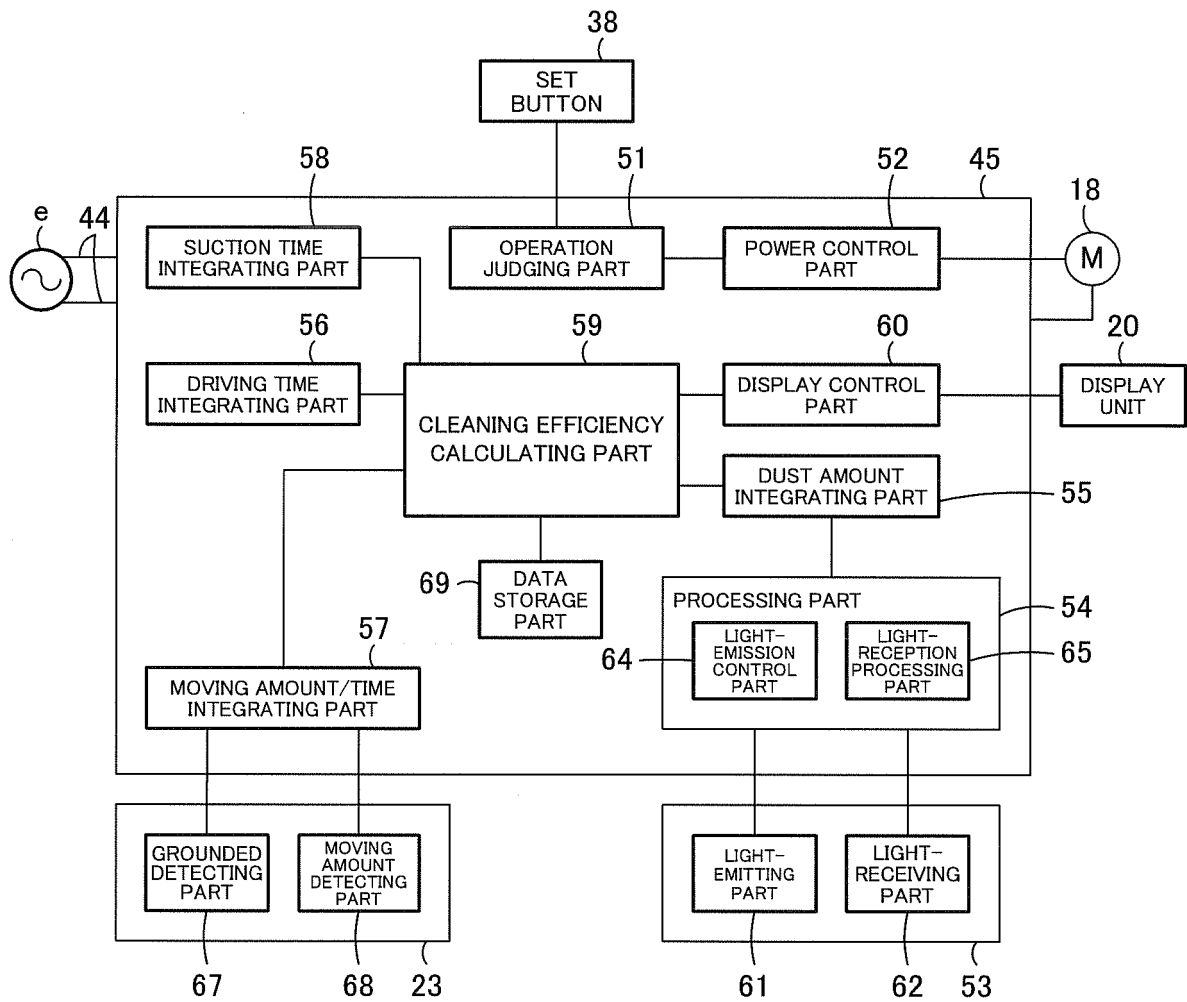


FIG. 1

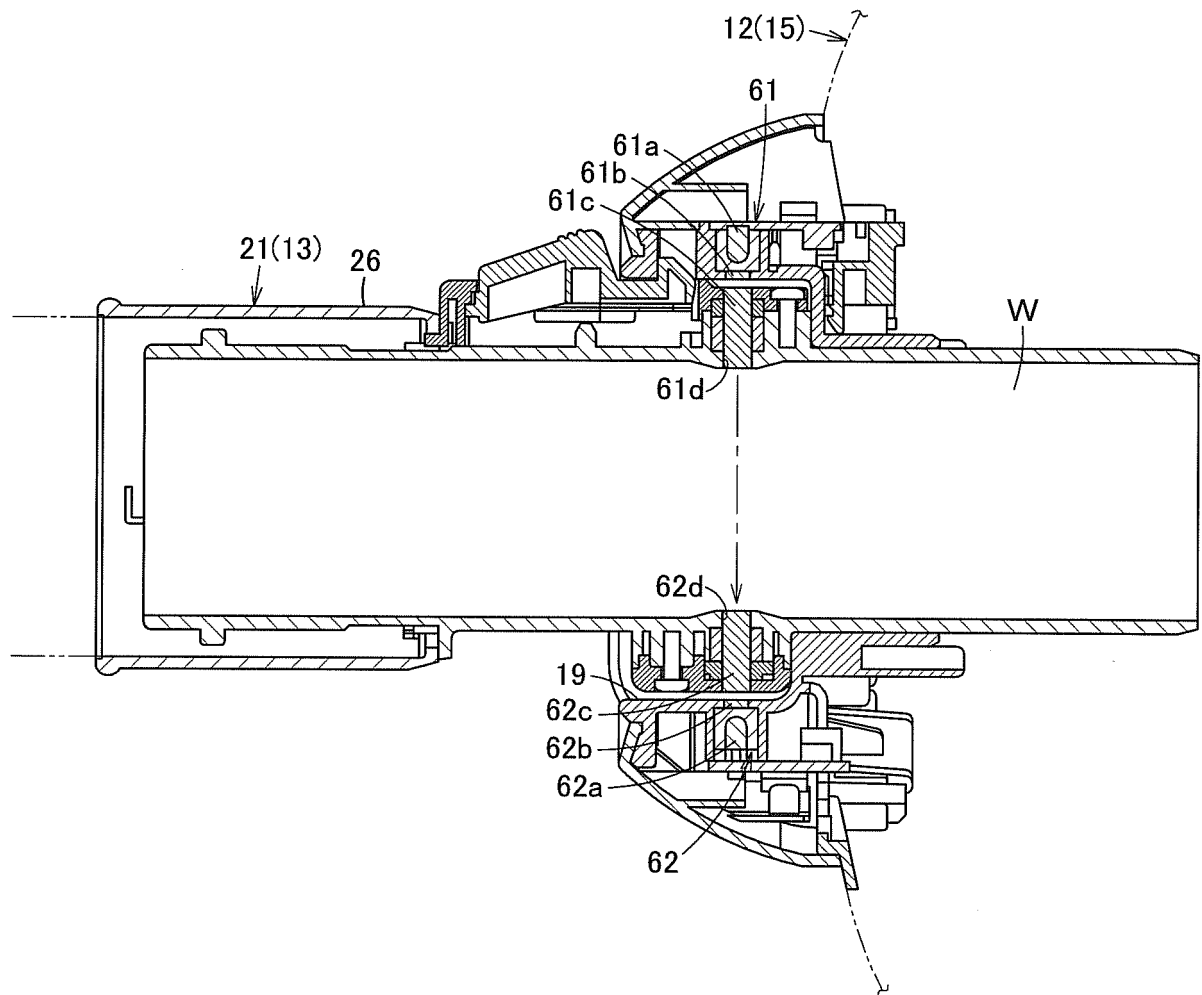


FIG. 2

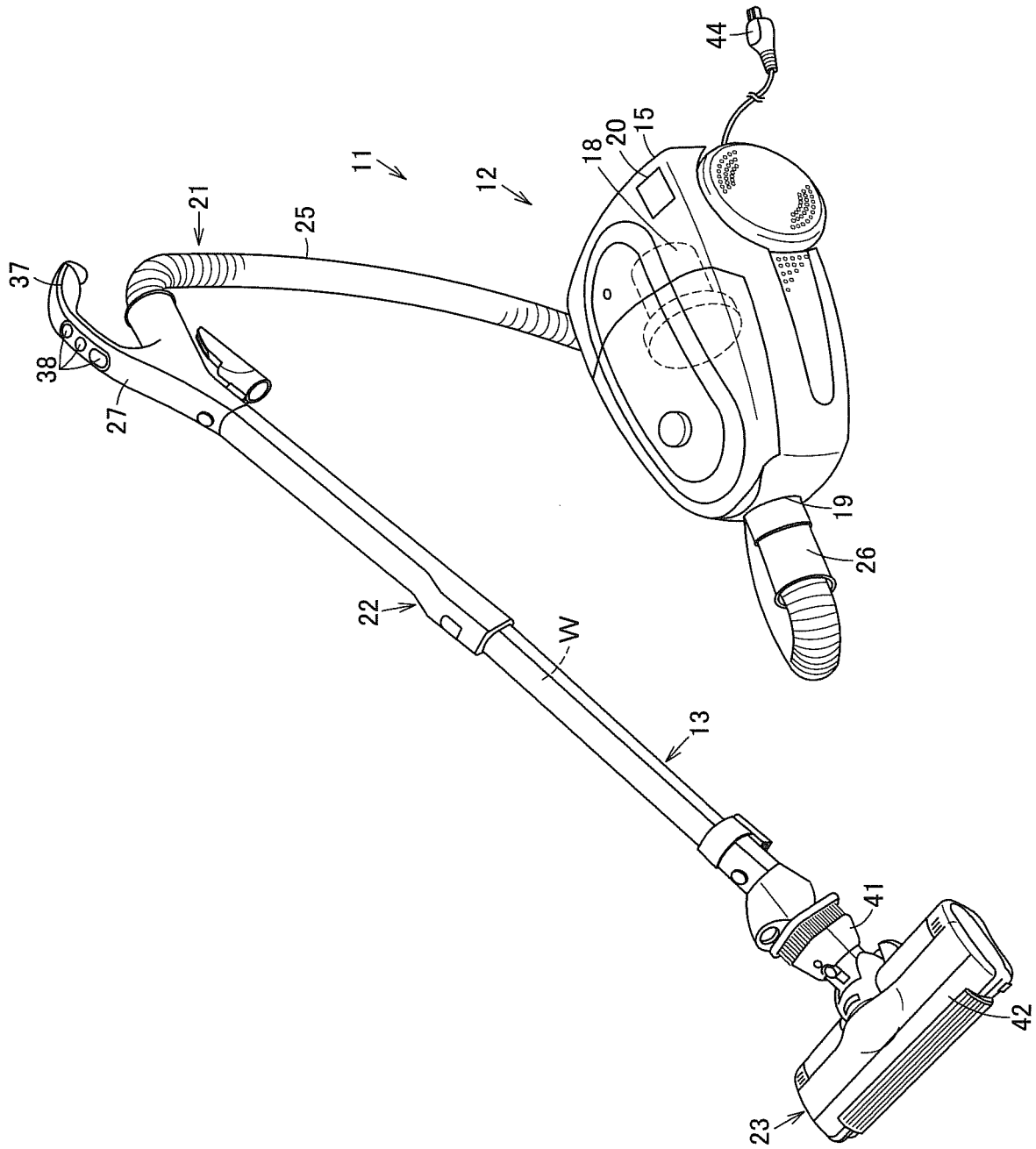


FIG. 3

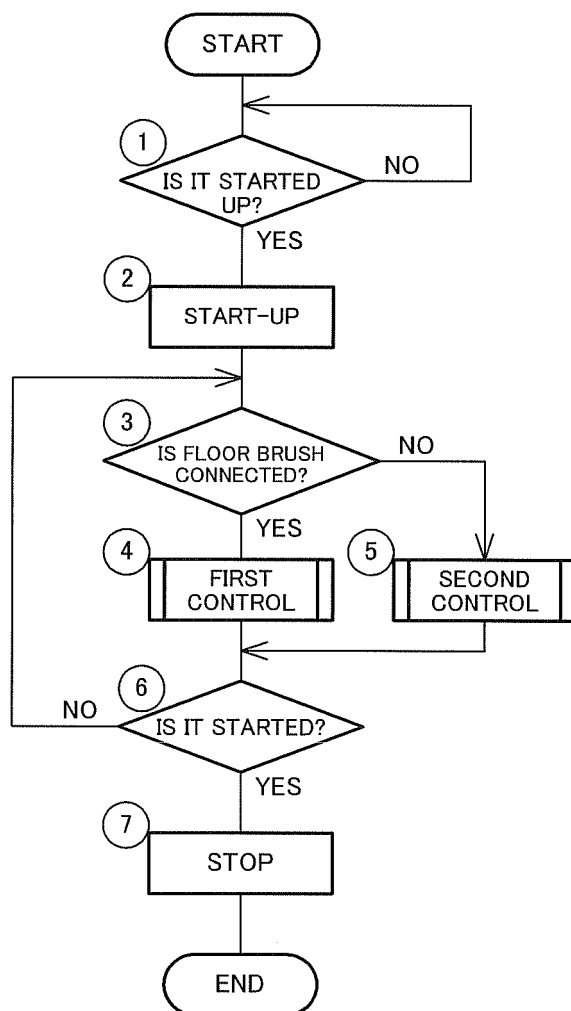


FIG. 4

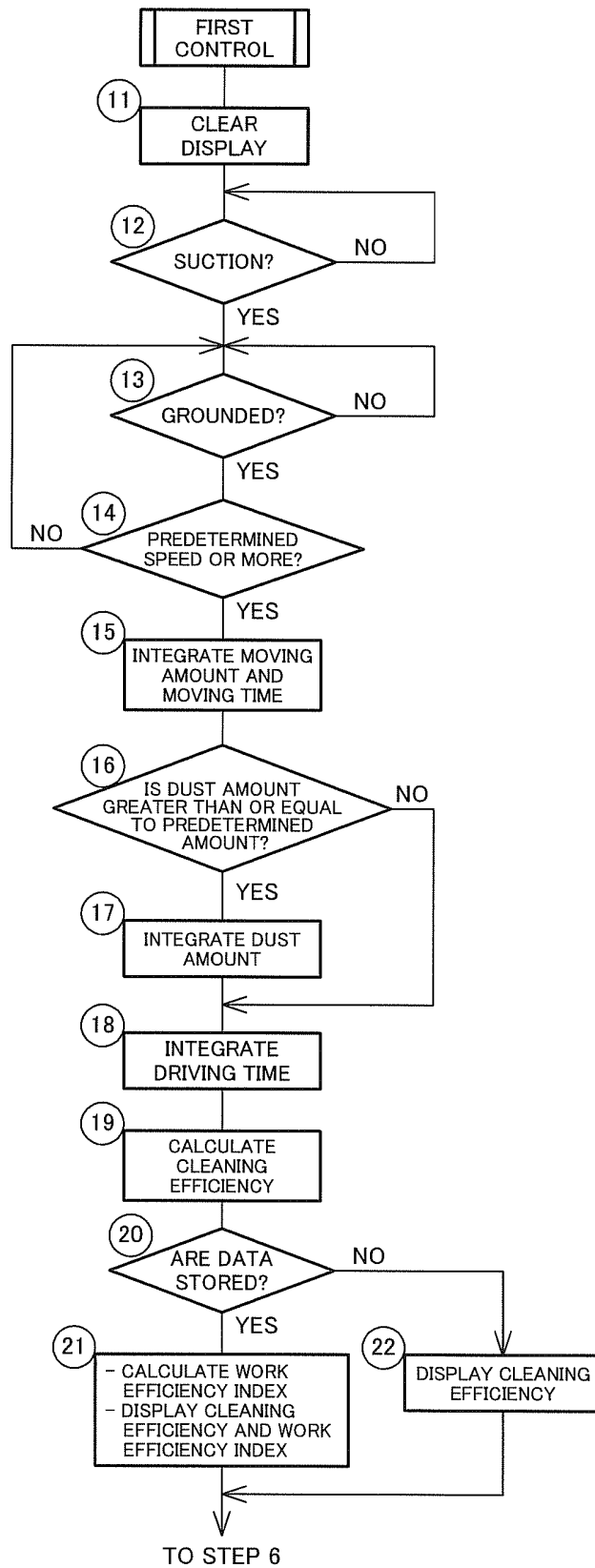


FIG. 5

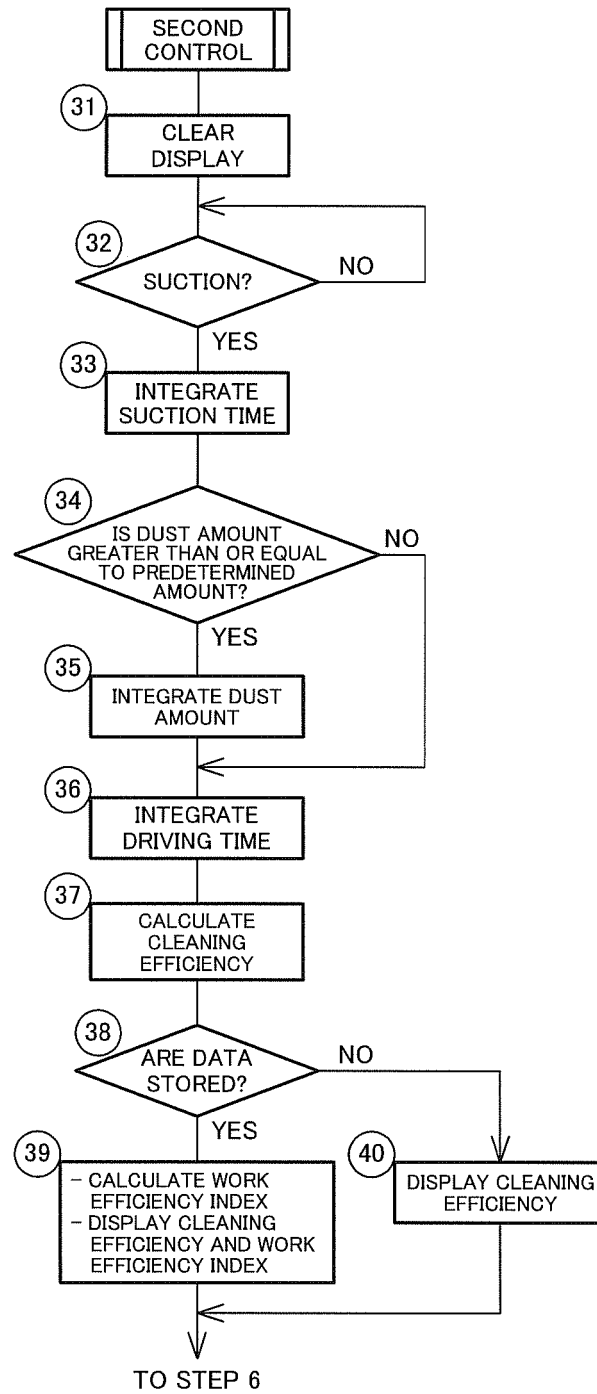


FIG. 6

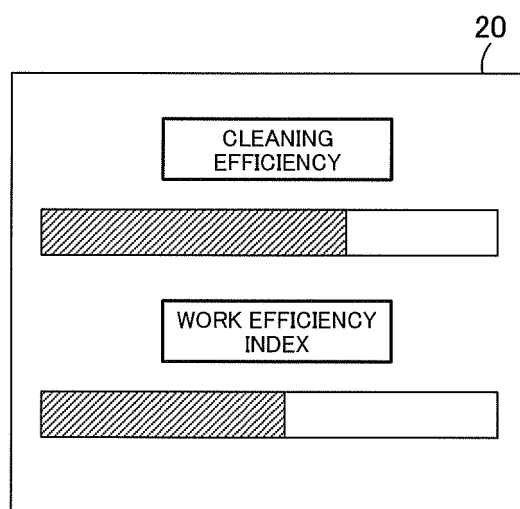


FIG. 7

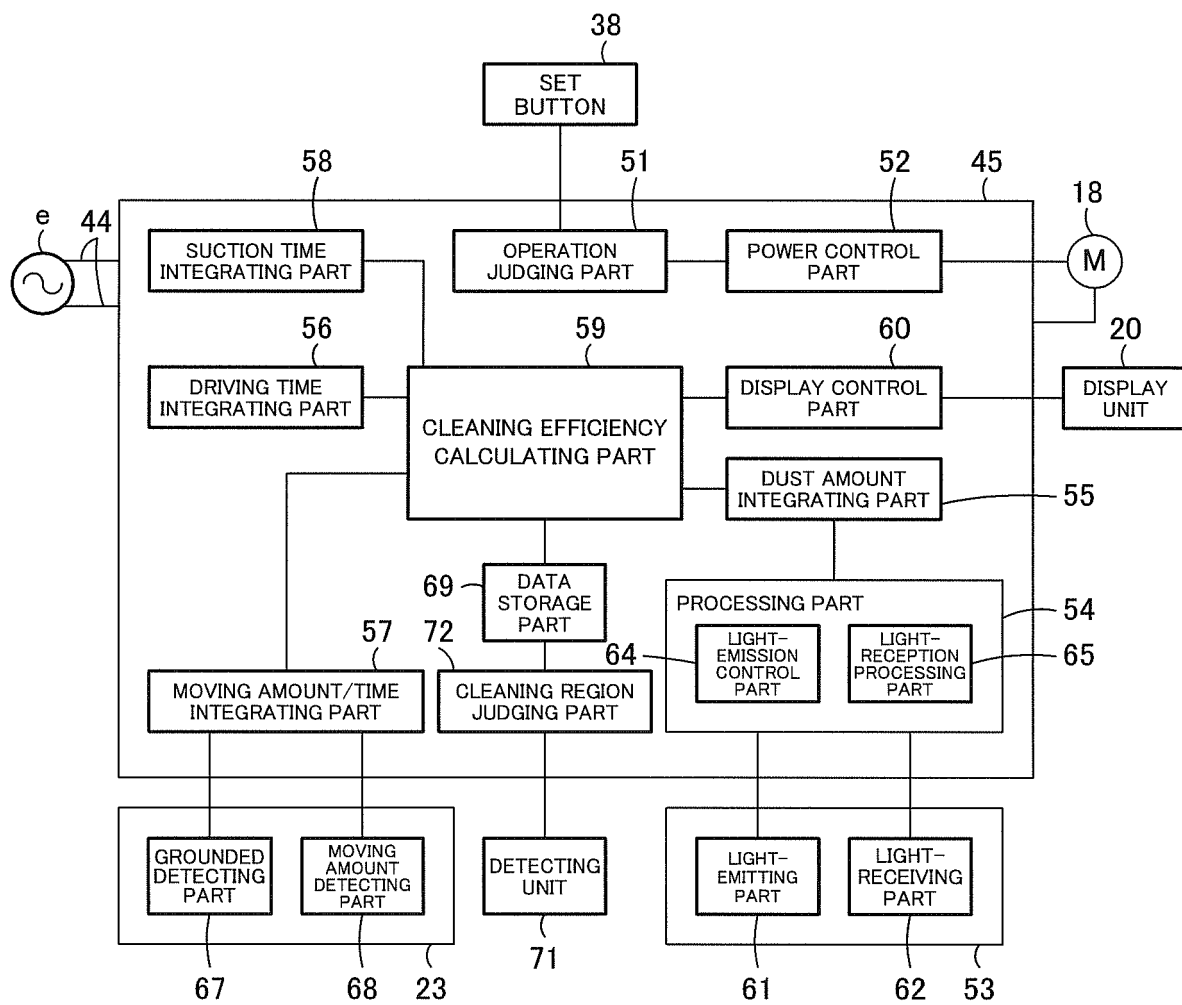


FIG. 8

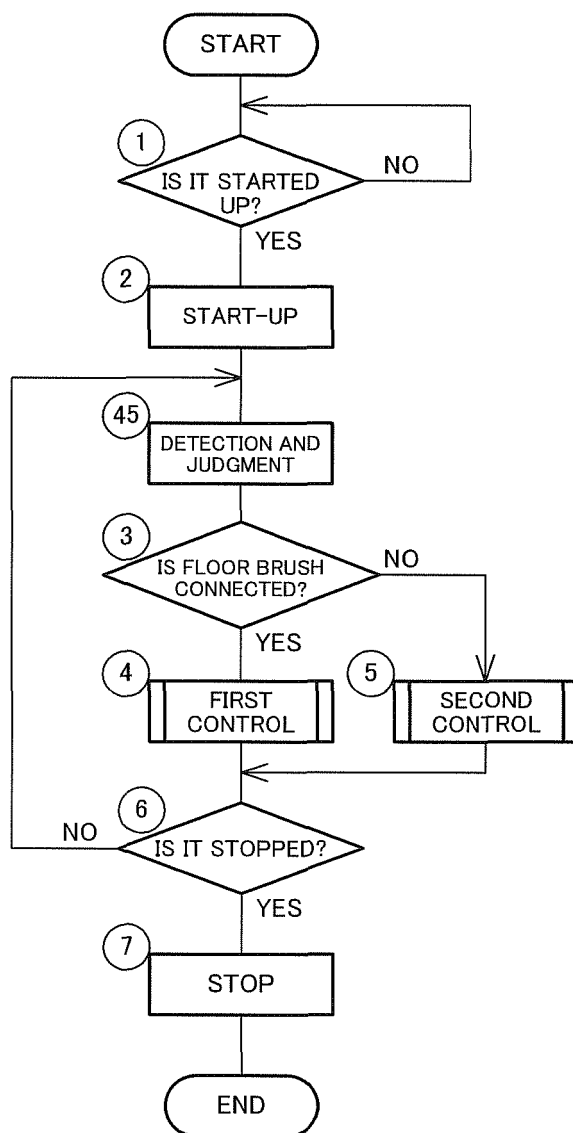


FIG. 9

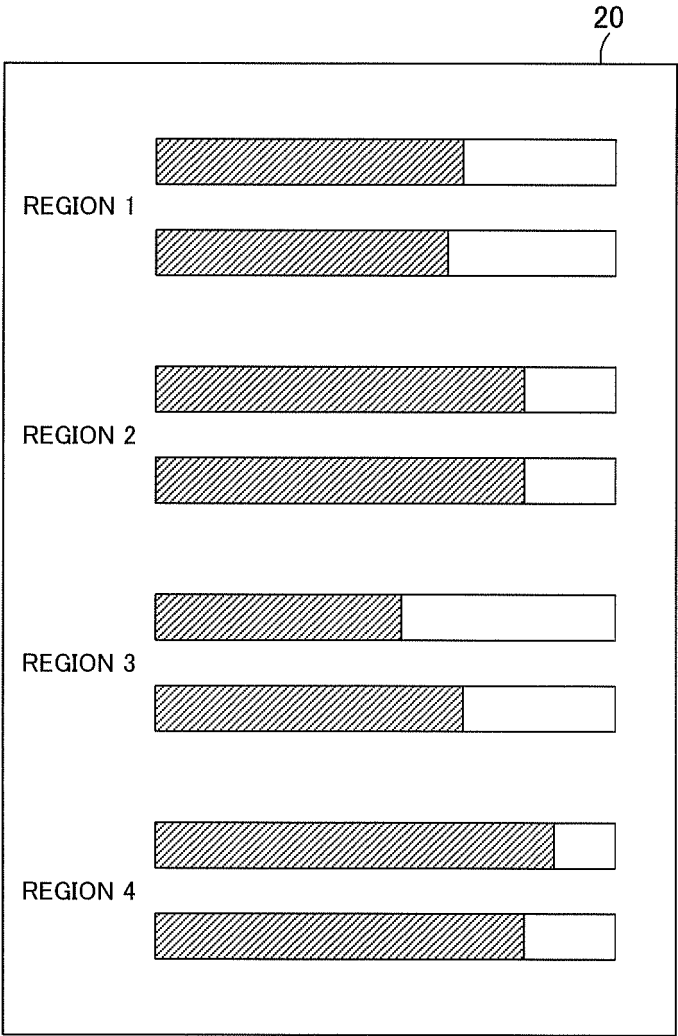


FIG. 10

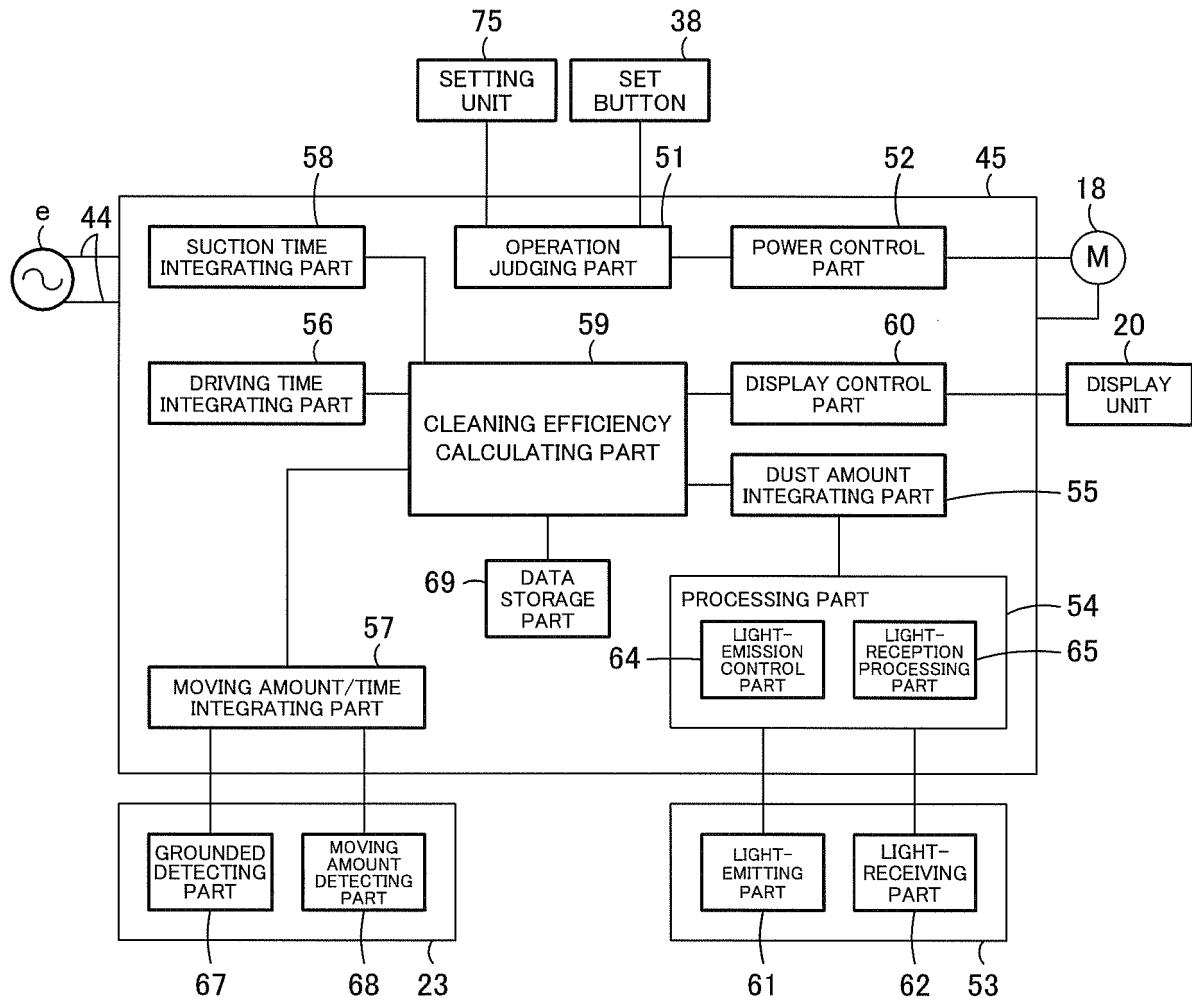


FIG. 11

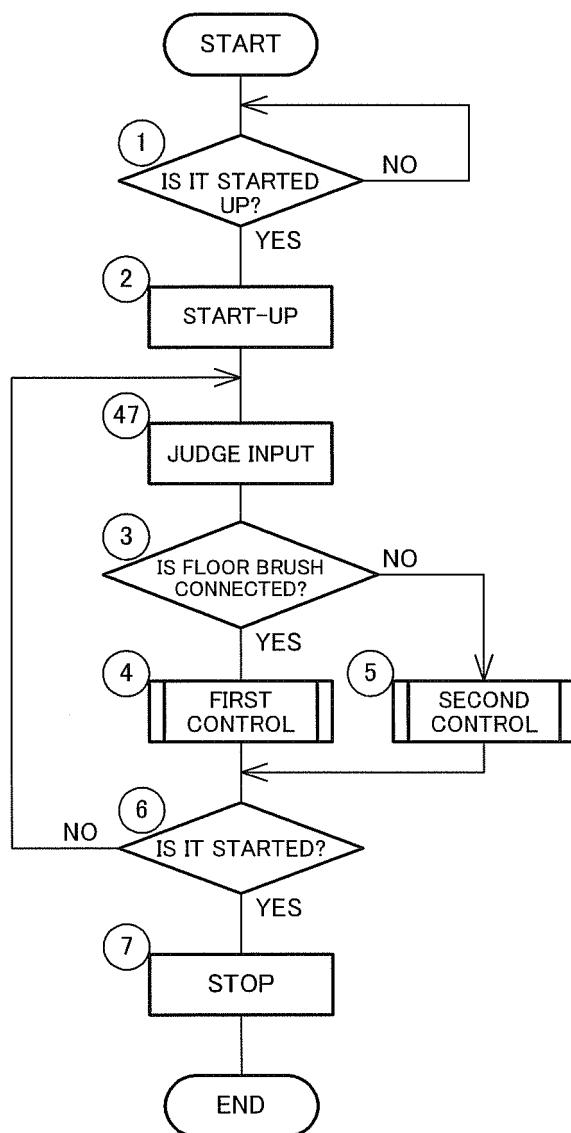


FIG. 12

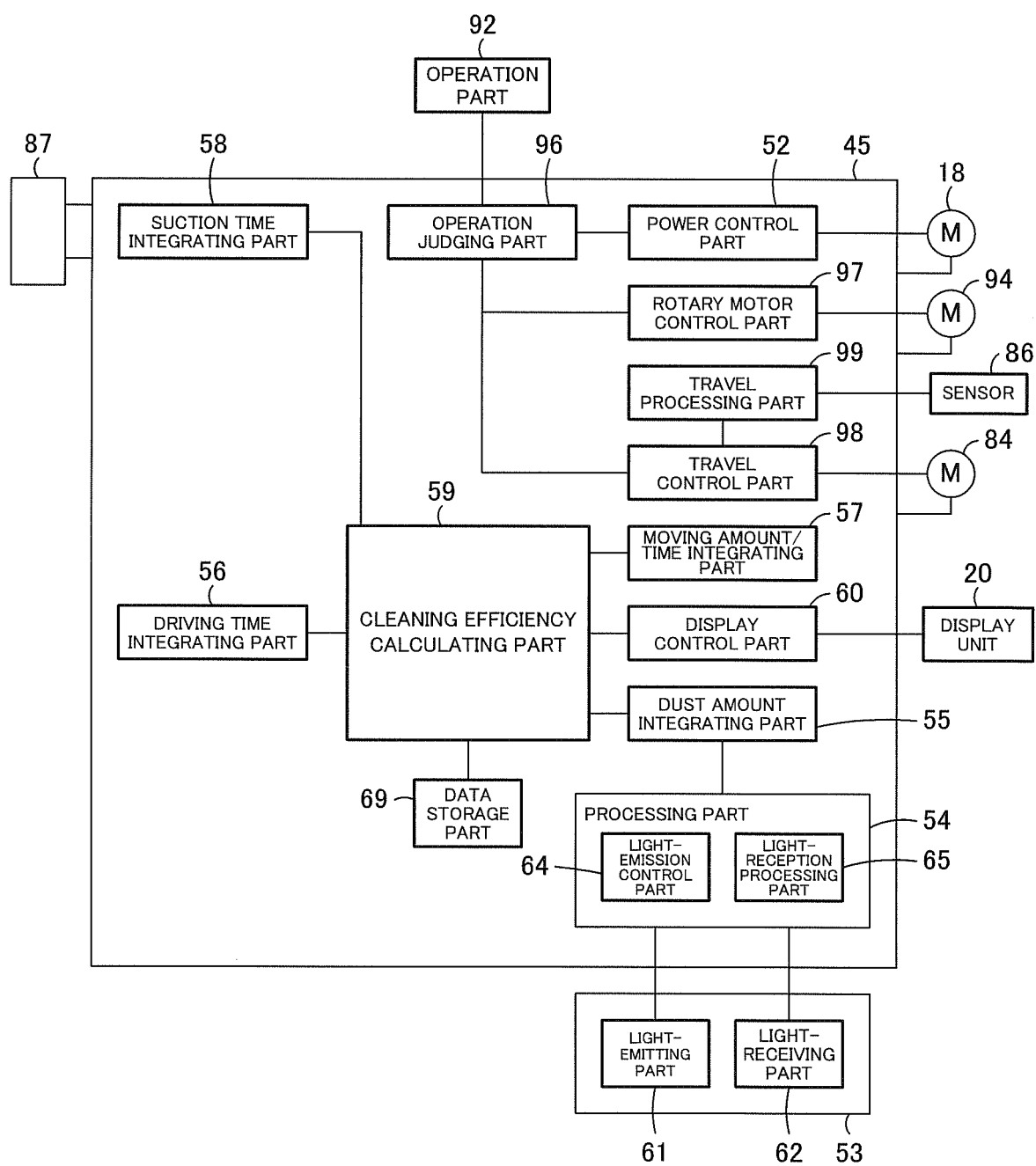


FIG. 13

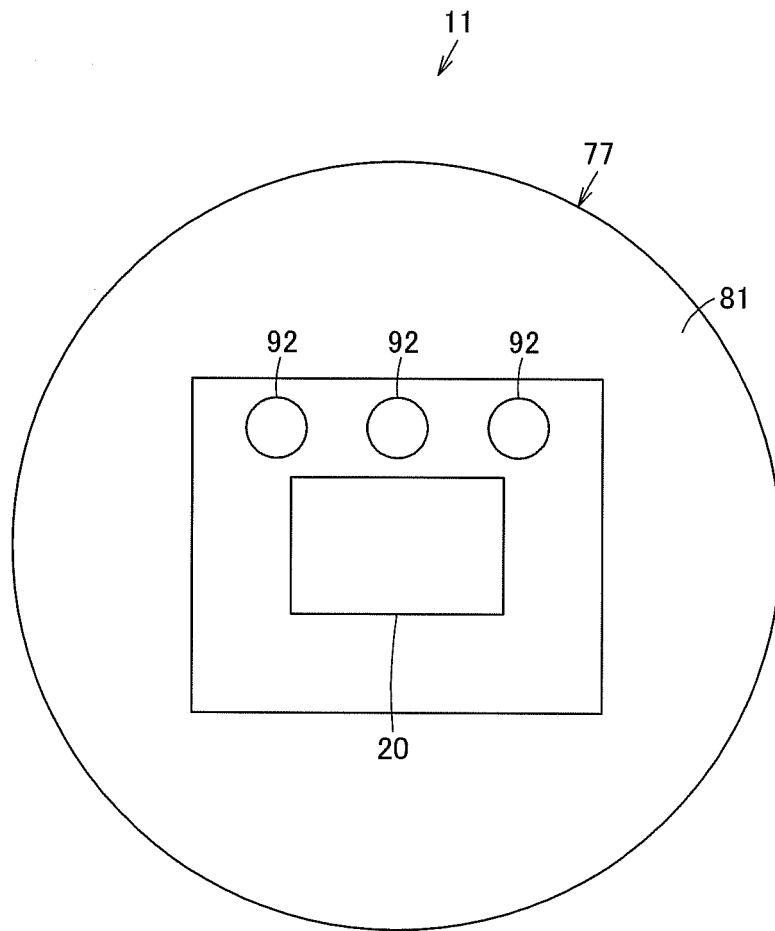


FIG. 14

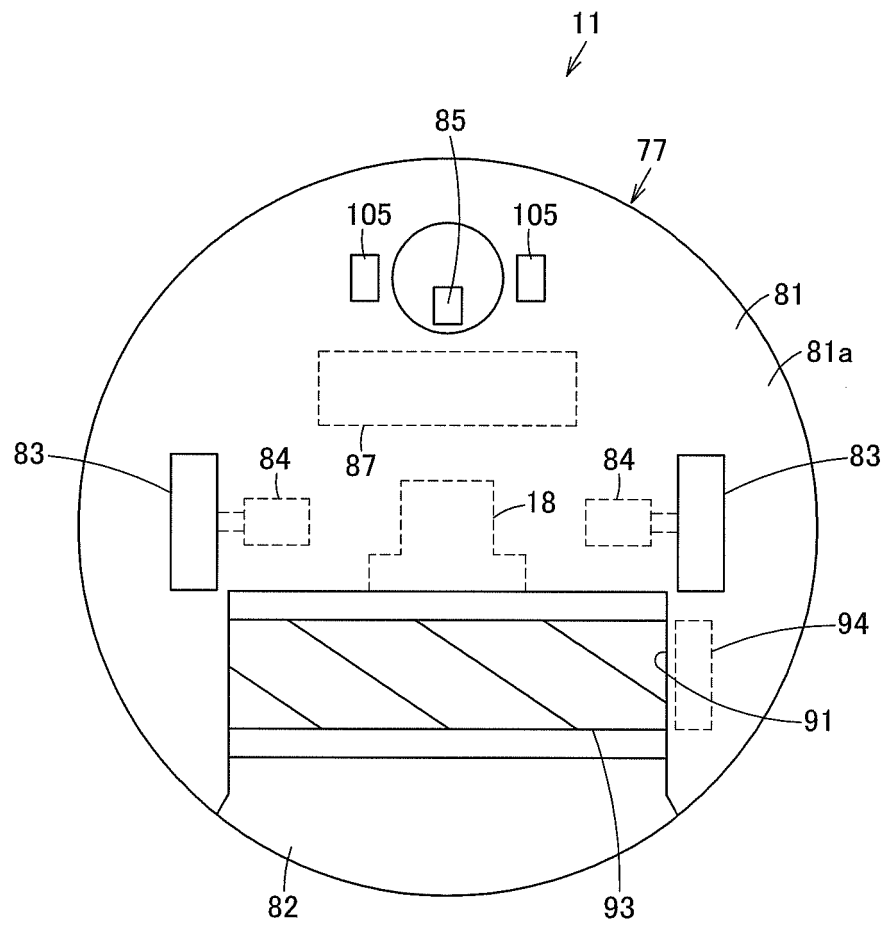


FIG. 15

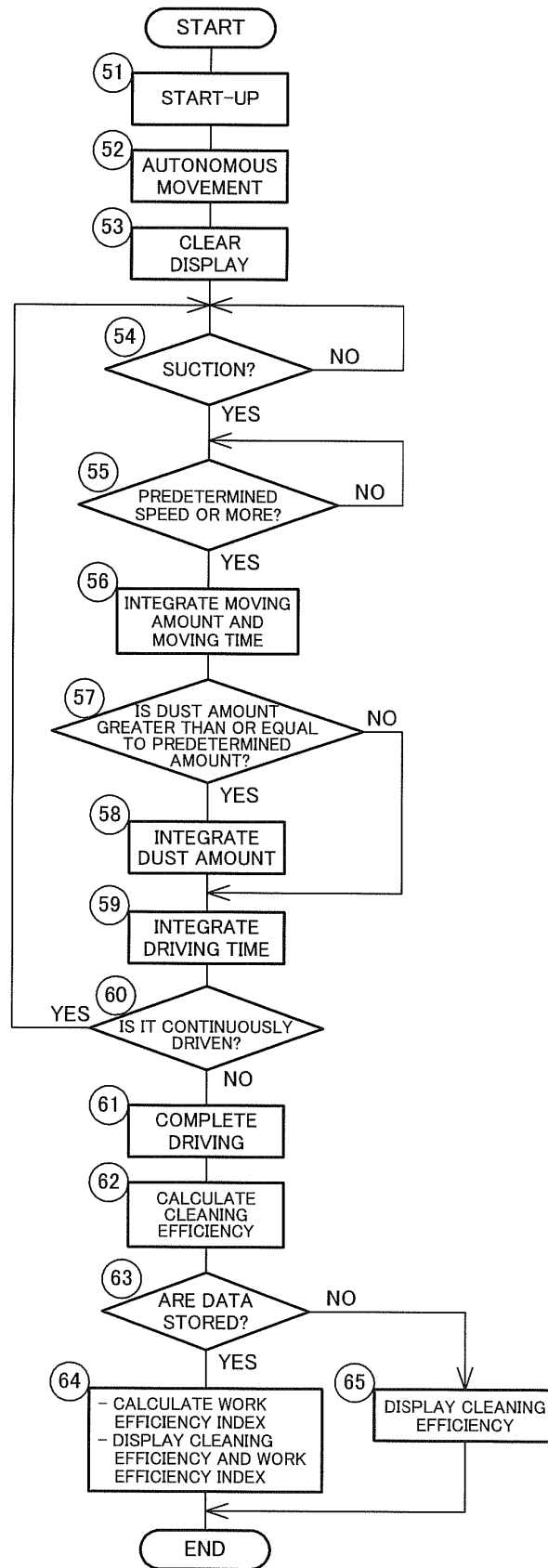


FIG. 16

REFERENCES CITED IN THE DESCRIPTION

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