Nov. 23, 1971 HIROSHI OHNO ET AL 3,621,640

ELECTRIC VACUUM CLEANER

Filed Oct. 8, 1969 6 Sheets-Sheet 1

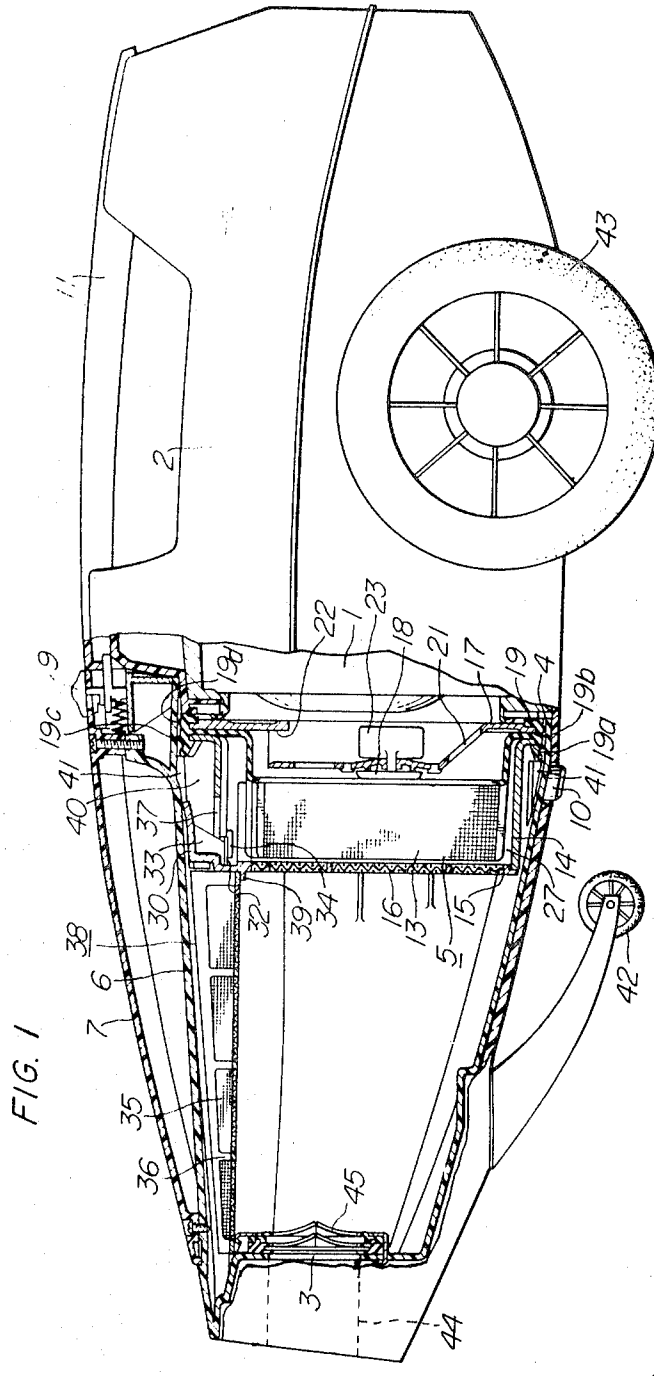

FIG. 1

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K. SAWADA,
C. TAKEDA &
K. OKANO

INVENTOR

BY Stevens, Davis, Miller & Mosher

ATTORNEY

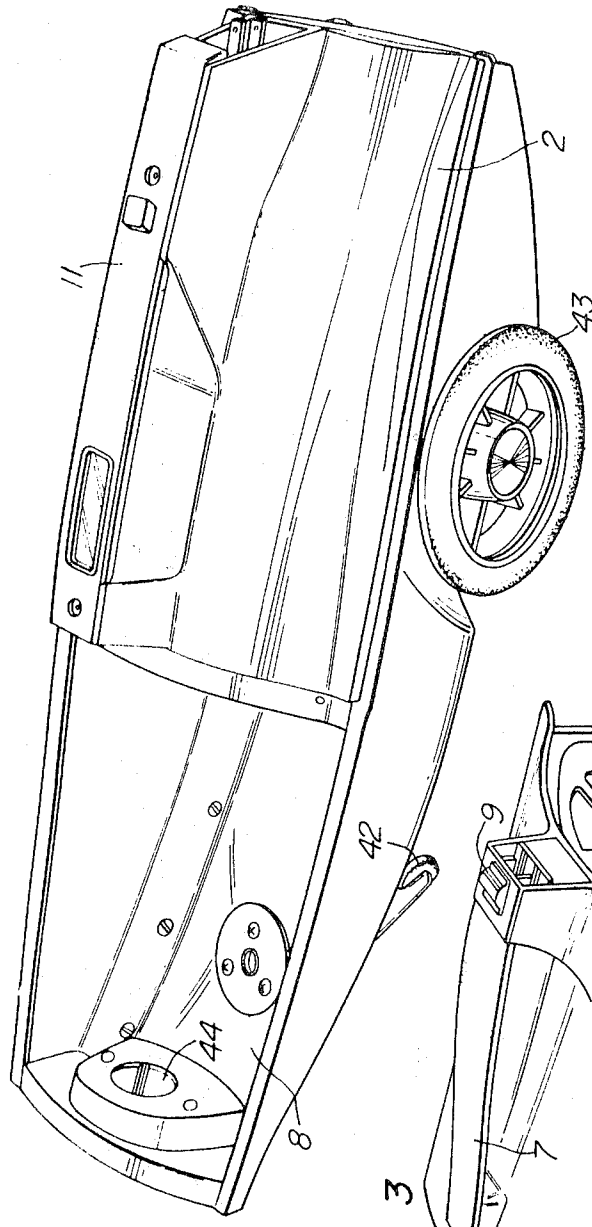

FIG. 2

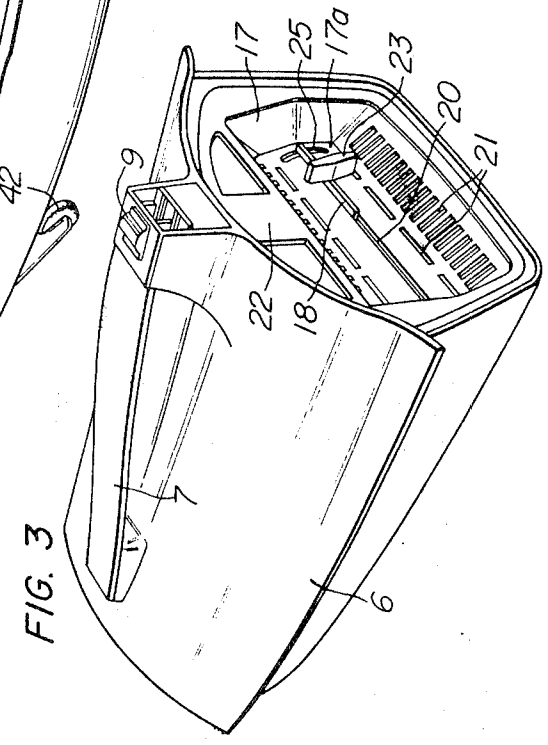

FIG. 3

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FIG. 4

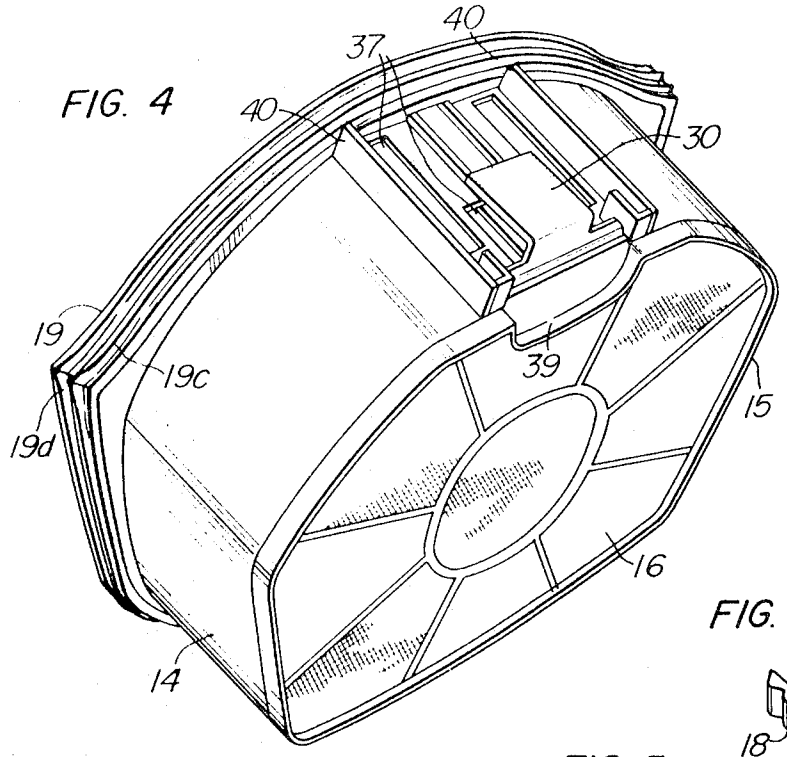

FIG. 5d

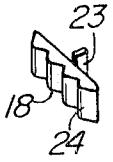

FIG. 5c

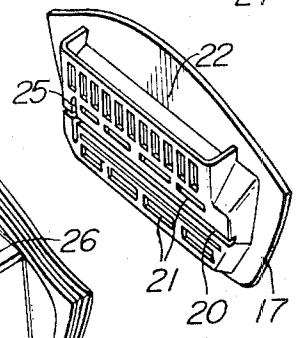

FIG. 5b

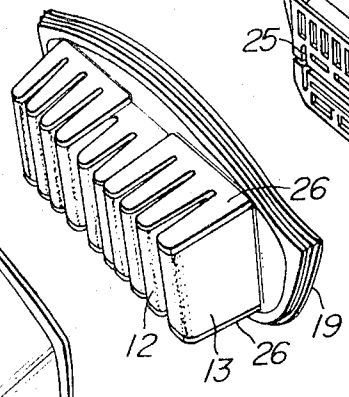

FIG. 5a

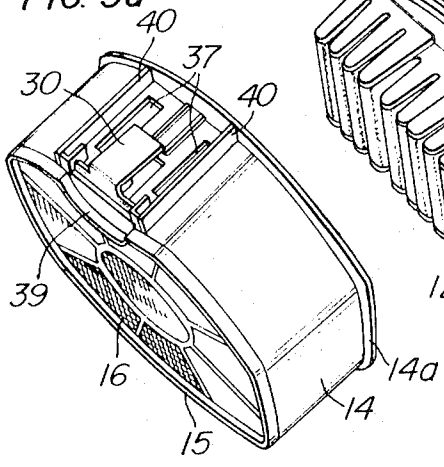

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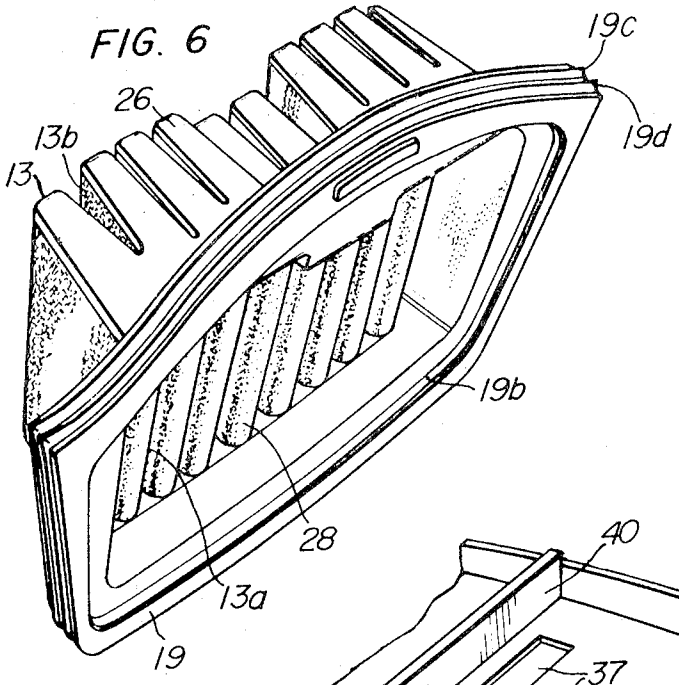
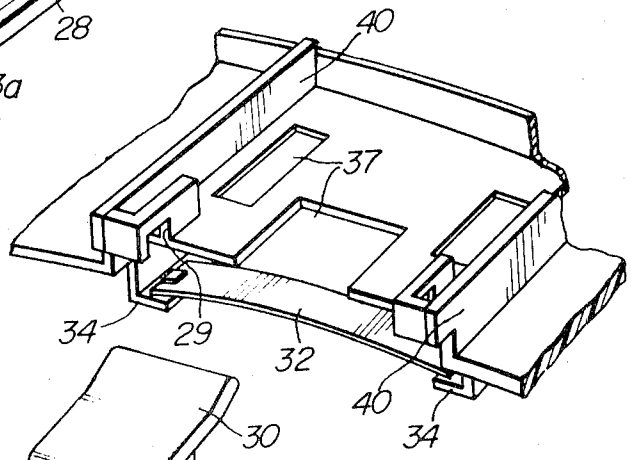
FIG. 6





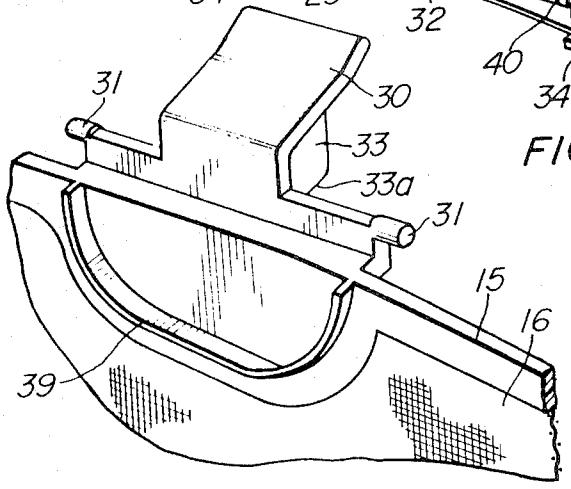


FIG. 7

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FIG. 8

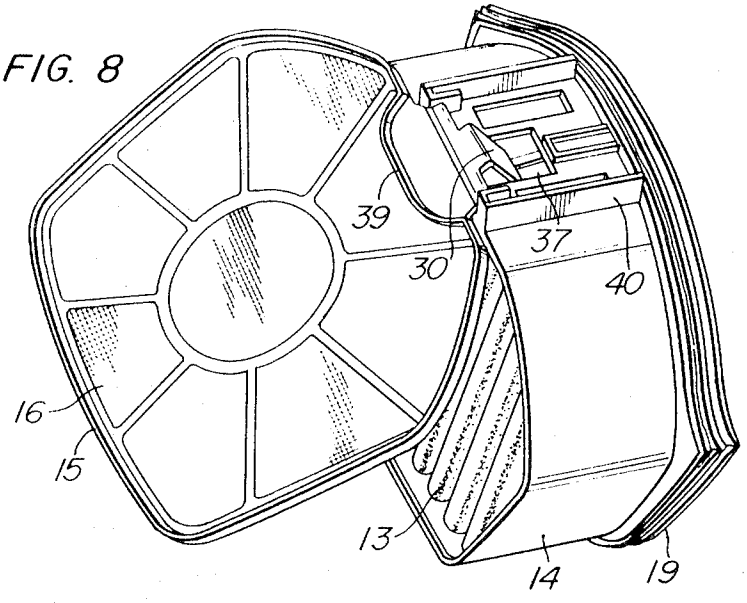

FIG. 9

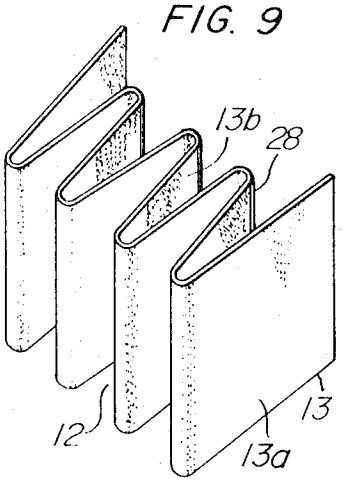

FIG. 11

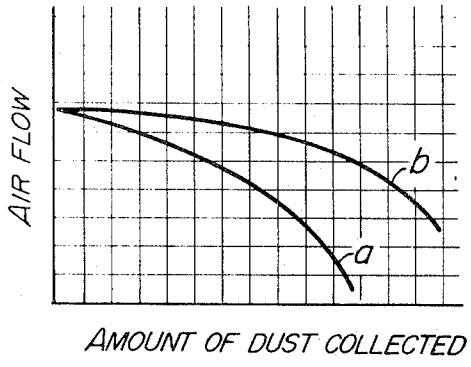

FIG. 10

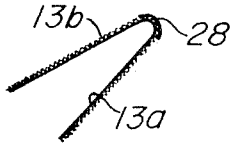

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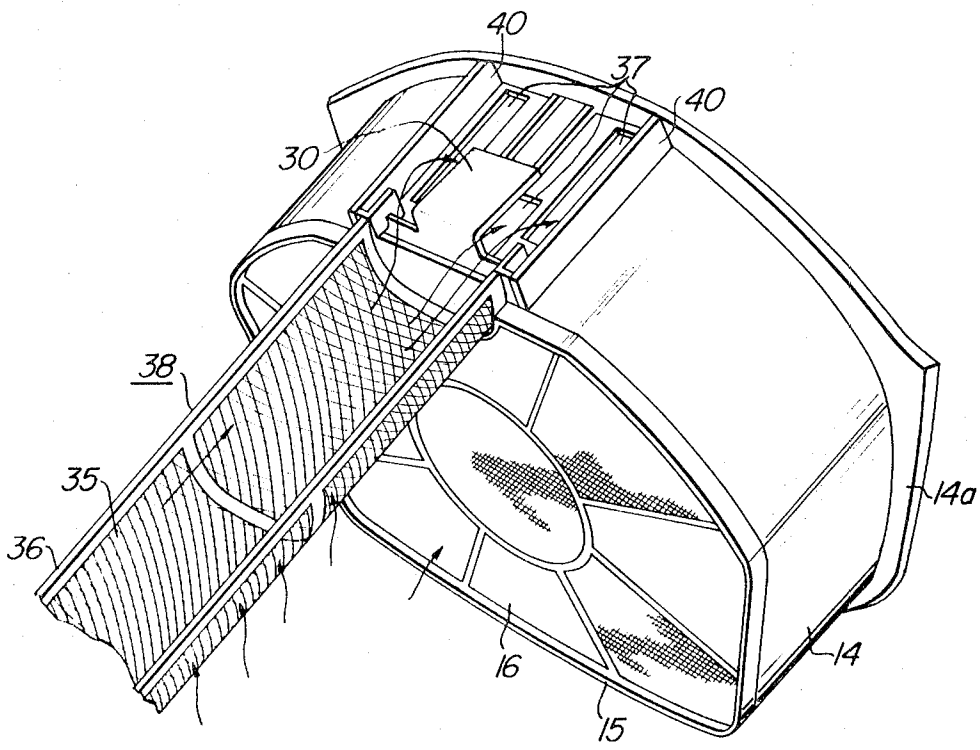
FIG. 12



United States Patent Office 3,621,640 Patented Nov. 23, 1971

3,621,640

ELECTRIC VACUUM CLEANER

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Claims priority, application Japan, Oct. 14, 1968, 43/76,275, 43/76,276, 43/79,739, (utility model) 43/91,452
Int. Cl. B01d 46/02
U.S. Cl. 55—300 11 Claims

ABSTRACT OF THE DISCLOSURE

A vacuum cleaner comprising a body housing an electric fan and a dust collecting vessel removably mounted in said body, said dust collecting vessel having a suction port at a front end thereof and a widely open rear end where a dust removing unit composed of a prefilter of rough meshes, a main filter of fine meshes and means for causing vibration of said main filter to shake off dust attached thereto is removably mounted. The dust collecting vessel is further provided with a bypass channel which compensates for a decrease of air flow through said prefilter due to dust accumulation, whereby a large dust collecting capacity is obtained.

This invention relates to an electric vacuum cleaner and more particularly an electric vacuum cleaner comprising a body housing an electric fan and a dust collecting vessel detachably mounted in said housing.

With respect to conventional electric vacuum cleaners of such a type that an electric fan composed of a fan rotor and a motor for driving the rotor inhales dust together with air into a body thereof through a suction port and the dust is caught by and collected in a dust bag mounted within the body between the suction port and the electric fan, there are disadvantages that, when the dust bag which has become full of accumulated dust is taken out from the body of the cleaner by opening a front end cover and the dust is discharged from the bag, hands are unavoidably soiled with the dust and that since the dust bag is generally made of a cloth material adapted to catch dust of large and small particle sizes, the bag usually gets clogged with fine dust within a short period of usage resulting in a droppage of drawing function of the cleaner, whereby the bag must often be removed and cleaned.

To avoid the abovementioned earlier clogging of the conventional bag filters, there has been invented a cleaner wherein the air including dust is first passed through a primary filter of rough meshes so that dust of larger particles are caught and collected by the primary filter and dust of fine particles which have passed through the primary filter are caught and collected by a secondary filter of fine meshes. In this case the dust collected by the secondary filter are removed therefrom and dropped onto the primary filter by a deformation of the secondary filter caused by a dust removing means. However, in the cleaner of this type, the primary filter, the secondary filter and the dust removing means are all independently mounted in a body of the cleaner, and therefore, when the dust is to be discharged, the cleaner must as a whole be carried to a spot of a dust bin and there the primary and secondary filters must separately be taken out from the body of the cleaner. Such a process is very troublesome, and still the disadvantage that hands are soiled by the dust in the operation of discharging the same is not removed. Furthermore, since the secondary filter is made

of a cloth material, the dust removing means is required to give direct deformation to all portions of the filter, and therfore, the dust removing means must be of a large size. And still, there remains the disadvantage that the secondary filter made of a cloth material gets clogged within a very short period.

Accordingly, it is the main object of this invention to remove such disadvantages in the conventional electric vacuum cleaners that hands are soiled with dust when it is discharged from the cleaner and that the troublesome dismounting and mounting of the separate primary and secondary filters are required every time the collected dust is discharged and to provide an improved electric vacuum cleaner which allows sanitary and easy discharge of the collected dust.

The abovementioned main object of this invention is accomplished by an electric vacuum cleaner comprising a body housing an electric fan and a dust collecting vessel detachably mounted in said body and having a suction port at a front end thereof and an open rear end for discharging dust therefrom, characterized by a dust removing unit detachably mounted at the rear end of said dust collecting vessel and including an assembly of a prefilter of rough meshes for catching large dust, a main filter of fine meshes for catching fine dust which have passed through said prefilter and a dust shaking-off means adapted to cause vibration of said main filter so as to shake off the dust from said main filter.

Another object of this invention is to provide an improved structure of a filtering unit including a prefilter, a main filter and means for shaking off dust from said main filter, whereby large and fine dust particles are separately caught and collected for the purpose of high dust collecting efficiency on one hand and the collected dust particles are easily discharged with no necessity of disassembling said unit on the other hand.

Still another object of this invention is to provide the abovementioned unit in a very simple and light structure.

A further object of this invention is to provide an improved structure of said main filter which is easily removed of dust caught thereby and less liable to get clogged.

A further object of this invention is to provide an improved dust collecting vessel provided with a bypass air passage which substantially lengthens the period of operation between dust discharges.

Other objects and advantages of this invention will become apparent from the following description of a preferred embodiment of this invention made with reference to the accompanying drawing.

In the drawing,

FIG. 1 is an elevational view of an embodiment of electric vacuum cleaners according to this invention, wherein essential portions thereof are shown in an axial section;

FIG. 2 is a perspective view of the body of the cleaner shown in FIG. 1, wherein the dust collecting vessel and the accompanying dust removing unit are removed;

FIG. 3 is a perspective view of the dust collecting vessel mounted with the dust removing unit;

FIG. 4 is an enlarged perspective view of the dust removing unit;

FIGS. *5a–5d* are perspective views of various parts constituting the dust removing unit, wherein FIG. *5a* shows a casing and the prefilter mounted thereto, FIG. *5b* the main filter, FIG. *5c* a perforated end plate and FIG. *5d* a slider;

FIG. 6 is an enlarged perspective view of the main filler;

FIG. 7 is a further enlarged perspective view of means for pivotally mounting the prefilter to the casing;

FIG. 8 is an enlarged perspective view of the dust removing means shown in a condition when the prefilter is swung open;

FIG. 9 is a perspective view of a filter element of the main filter;

FIG. 10 is a cross section of a part of the filter element shown in FIG. 9;

FIG. 11 is a graph showing performances of two cleaners of different structure; and

FIG. 12 discloses the by-pass filter.

The electric vacuum cleaner shown in the drawing comprises a body **2** housing an electric fan **1** and having an air outlet port (not shown) at a rear end thereof and a dust collecting vessel **6** having an air inlet port **3** at a front end thereof and an open rear end **4** where a dust removing unit **5** is mounted. The dust collecting vessel **6** is provided with a handle **7**, whereby the vessel is carried to be easily dismounted from a trough-like receiving portion **8** (FIG. 2) provided at a front lower portion of the body or mounted to the receiving portion. When the dust collecting vessel **6** is mounted at the receiving portion **8**, a projection **10** provided at a rear portion of the bottom of the vessel is engaged into a coöperating hole provided at the bottom of the receiving portion and a sliding lock **9** is shifted into engagement with a front end of a handle **11** of the body **2**.

The dust removing unit **5** comprises a main filter **13** of an angularly folded elastic sheet having fine meshes, a substantially cylindrical case **14** housing the main filter therein, a prefilter **16** of a net having rough meshes and expanded by a frame **15** which is pivotally mounted at a front end of the casing, a perforated end plate **17** mounted adjacent a rear end of the casing and a slider **18** which is slidably mounted at the perforated end plate. The casing **14** and the perforated end plate **17** are releasably engaged into annular grooves **19***a* and **19***b* of a packing frame **19** made of an elastic material which holds the main filter **13** along the periphery thereof, whereby the prefilter **16**, main filter **13** and slider **18** are assembled into the dust removing unit. The annular grooves **19***a* and **19***b* are provided along front and rear sides of a flange portion extending inwardly from a central portion of the frame **19**, said flange portion ending into a pair of serrated portions for carrying the folded sheet of the main filter as described in more detail later. The packing frame **19** is also provided with spaced annular ribs **19***c* and **19***d* at an outer periphery thereof. These ribs keep air tightness at the periphery of the dust removing unit when it is mounted at the rear end of the dust collecting vessel.

The perforated end plate **17** has a central concave portion **17***a* seen from the rear end of the dust removing unit, at which is provided an elongated opening **20** extending horizontally or at right angle to the vertically arranged folds of the main filter and a plurality of perforations **21** provided at upper and lower regions of the elongated opening. The upper end of the central concave portion **17***a* is offset from an upper peripheral portion of the plate **17** to define an opening and a gripping portion **22** by which the dust removing unit **5** is carried to be dismounted from or mounted to the rear end of the dust collecting vessel **6**. The slider **18** includes a knob **23** and a plurality of projections **24**. The slider is mounted to the elongated opening **20** of the perforated end plate **17** to be slidable therealong by the knob **23** being passed through an opening **25** provided at an end portion of the elongated opening **20**. The projections **24** are adapted to traverse rear edges of angular folds **12** of the main filter **13** and snap the edges to cause deformation and vibration of the main filter as the slider **18** is reciprocated along the elongated opening **20** by gripping the knob **23** with fingers, whereby fine dust particles which are being caught by the main filter are shaken off therefrom and dropped at the bottom of the casing **14**. Since a plurality of projections **24** are provided, the abovementioned reciprocation of the slider **18** applies a number of successive snappings to respective folds **12** in the direction perpendicular thereto, whereby large vibrations and deformations are imparted to the main filter to effectively shake off the dust caught therein.

The main filter **13** or the sheet of the filtering element is manufactured as follows: Fibers such as Nylon fibers are cut to a length of 10–15 cm. and these fibers are applied needling to be entangled with one another. Then a latex or other elastic material in liquid form such as rubber or synthetic resins are sprayed on the needled sheet of fibers, which thereafter is vulcanized under a heated and pressurized condition so that the fibers are coated with thin layers of the elastic material as well as connected with one another by the elastic material, whereby an elastic sheet **13***a* having fine meshes is obtained. After applying a bonding agent on the surface of the sheet, the sheet is then bonded to a napped cloth **13***b* having relatively rough meshes of about 20 mesh (international standard), whereby the filtering element of about 10 mesh is obtained. This sheet element is then angularly and alternately folded under a heated and pressurized condition to form a number of folds **12**. The folded element is then mounted between the upper and lower serrated portions **26** of the packing frame **19** made of an elastic material such as rubber or polyvinyl chloride and bonded thereto to produce a main filter assembly as shown in FIG. 5*b*. By such a structure that the main filter **13** is an alternatively folded element, there are obtained such advantages that a relatively large filtering area is available within a restricted space in casing **14**, that a fine dust collecting chamber **27** is provided within the space occupied by the main filter without requiring any additional axial length for such a chamber and that large vibration and deformation of the filtering element are allowed for a better dust shaking-off performance due to snapping thereof. The angularly folded edges of the main filter **13** which are subjected to the snapping action of the slider **18** are provided with reinforcing layers **28** (FIG. 10) of, for example, thermoplastic resins applied by plastering thereof. These layers prevent loosening of fibers at the edge portions due to the snapping.

In FIG. 7, there is shown the structure of the pivotal mounting of the frame **15** of the prefilter **16** to the casing **14**. As seen in FIG. 7, an upper front end portion of the casing is somewhat cut off as at **37**, and at both sides thereof there are arranged a pair of bearing notches **29** formed in a pair of rib members **40** provided at the upper front end portion. The rib members are also each carrying an angled projection **34** extending a little downward, and a spring plate **32** which is normally arcuate to be slightly upwardly convex is supported by the angled projections **34**. On the other hand, the frame **15** of the prefilter **16** is provided with such a fitting portion at an upper portion thereof that presents a pair of pins **31** extending from opposite ends thereof and adapted to engage with the bearing notches **29**, a push lever **30** and a cam **33** having a horizontal cam surface **33***a*. If said pair of pins **31** are engaged into the notches **29** by temporally strongly urging down the spring plate **32** to pass the cam surface **33***a* over the spring plate, the pins **31** are kept in pivotal engagement with the notches **29** by the cam **33** being resiliently urged upward by the normally convex spring plate **32**, whereby it is also effected that the prelifter **16** is normally resiliently urged to its closed position abutting against the front end of the casing **14** by the lever action of the cam **33**. In this structure of pivotal mounting, the prelifter **16** can be readily swung open as shown in FIG. 8 by the push lever **30** being pushed downward against the spring plate **32** by a finger, especially a thumb of the hand carrying the main filter assembly or the casing **14**. When the force applied by a finger to the push lever **30** is removed, the prefilter **16**

is of course automatically closed by the gravity thereof as well as by the elastic force applied by the spring plate 32 to the cam 33. The frame 15 is provided with an opening bordered with an arcuate rib 39, which cooperates with a trough-like bypass channel 38 of the dust collecting vessel as described hereinunder.

As shown in FIGS. 1 and 12, the dust collecting vessel 6 is provided with the bypass channel 38 which is defined by an auxiliary filter 35 made of a net having meshes as rough as the prefilter 16 and supported by a lattice member 36. The bypass channel 38 extends from the front end of the dust collecting vessel with gradually increasing cross section to a point where the prefilter 16 is provided, and there the channel is in communication with a space left above the casing 14 through the opening defined by the rib 39. Said space is in communication with the fine dust collecting chamber 27 through the openings 37. By the provision of the bypass channel 38, an air passage extending from the suction port 3 to the main filter 13 is guaranteed unless the dust collecting vessel is wholly packed with large dust or the meshes of the auxiliary filter are substantially clogged. When the amount of dust collected in the dust collecting vessel 6 is not large, the air inhaled from the suction port 3 mainly passes through the prefilter 16 to the mani filter 13, but as the dust collected in the vessel 6 and therefore the flow resistance through the dust increases, the air is more bypassed through the bypass channel 38 so as to maintain a substantially constant air flow.

When the dust removing unit 5 is mounted at the open rear end of the dust collecting vessel 6, the rib 39 exactly engages with the rear edge of the trough-like bypass channel and the upper surface of the ribs 40 exactly engage with the innerwall of the dust collecting vessel 6 to define a chamber which is a continuation of the bypass channel and is in communication with the front region of the main filter 13 through the openings 37. Axial position of the dust removing unit 5 with respect to the dust collecting vessel 6 is determined by a plurality of stoppers 41 arranged at upper and lower portions of the inner wall of the vessel 6, against which the packing frame 19 of the dust removing unit abuts.

The body 2 of the cleaner is carried by front and rear wheels 42 and 43 to be easily transported. Reference numeral 44 designates a suction bore through which an end of a suction hose is inserted. At the suction port 3, there is provided a check valve 45 which is opened when the end of the suction hose is inserted and automatically closed when the hose was removed. By the provision of the check valve, it is avoided that the dust collected in the dust collecting vessel 6 is spilled out while the vessel or the cleaner is transported.

In the following, the operation and use of the electric cleaner according to this invention are explained:

When the electric fan 1 is operated, air including dust is inhaled through the suction hose attached to the bore 44 and the suction port 3 into the dust collecting vessel 6. Out of the dust inhaled with the air, large dust particles are caught by the prefilter 16 and fine dust particles which have passed through the prefilter are caught by the main filter 13, whereby only clean air passes through the perforations 21 of the end plate 17 to the electric fan 1, and then is exhaused from the air outlet port. Accordingly, in the dust collecting vessel 6, large dust particles and fine dust particles are gradually stacked up in front of the prefilter 16 and the main filter 13, respectively. As the layer of the large dust particles becomes thicker and therefore the air flow resistance therethrough becomes greater, the air is increasingly bypassed through the bypass channel 38. Therefore, the cleaner can be operated effectively until the dust collecting vessel is fully charged with the accumulated dust.

The large and fine dust particles thus collected by the cleaner are discharged in the following manner: First, the sliding lock 9 is unlocked and the dust collecting vessel 6 is removed from the receiving portion 8 of the body of the cleaner by carrying the handle 7 by hand. Then, the dust collecting vessel, as being carried by hand, is transported to a dust bin, where the dust removing unit 5 is removed from the open rear end 4 of the dust collecting vessel by being held at the gripping portion 22 between fingers, and the large dust collected in the dust collecting vessel is discharged from the widely open rear end thereof. Then, the slider 18 is reciprocated by the knob 23 being held between fingers, whereby the main filter 13 is caused to vibrate and deform and the fine dust particles caught on the surface thereof are shaken off and fall on the bottom of the fine dust collecting chamber 27. Thereafter, the push lever 30 is pushed by a finger to swing open the prefilter 16 as shown in FIG. 8, and the fine dust particles collected in the chamber 27 are discharged from the open front end of the casing 14. The reciprocation of the slider 18 may be performed before the dust removing unit 5 is removed from the dust collecting vessel 6. After the fine dust particles have been discharged from the fine dust collecting chamber 27, the push lever 30 is released thereby to automatically close the front end of the casing 14 by the prefilter 16. Thus, the dust collecting unit 5 is again mounted at the open rear end of the dust collecting vessel 6. The dust collecting vessel mounted with the dust removing unit is then transported back to the body of the cleaner and restored to the receiving portion 8 thereof.

It is known that the dust particles in ordinary houses are as much as 85 percent fibrous dust particles. Therefore, in the electric cleaner according to this invention, the dust collecting vessel 6 will usually be filled with large dust particles though the main filter 13 is scarcely clogged with fine dust particles. In this case, the only necessary operation is to remove the dust removing unit 5 from the open end of the dust collecting vessel 6 and to discharge the large dust particles collected therein.

Since it is merely required to transport the relatively light dust collecting vessel and the dust removing unit mounted therein by the handle 7, a very little labor is required. While the dust collecting vessel is being transported, there is no fear that the dust particles are spilled out of the vessel since the suction port 3 is closed by the check valve 45.

The dust particles collected in the dust collecting vessel 6 are readily discharged therefrom by removing the dust removing unit 5 by holding the latter between fingers and tilting the vessel 6, while the fine dust particles collected in the fine dust collecting chamber 27 are also readily discharged therefrom by pushing the push lever 30 by a finger of the hand causing the dust removing unit 5 to swing open the prefilter 16 and tilting the dust removing unit. Therefore, it is prefectly avoided that hands get in direct contact with dust in the dust discharging operation, and therefore, the operation can be very sanitarily accomplished.

In addition to the readiness of discharging dust, in the embodiment provided with the bypass channel 38 defined by the auxiliary filter 35, the period during which the cleaner is effectively operated without the discharge of collected dust is substantially greater as compared with a conventional cleaner having no such bypass channel as shown in FIG. 11, wherein curve (a) shows the performance of a cleaner having no bypass channel and curve (b) shows the performance of the cleaner having the bypass channel according to this invention. As already described, the air passage through the prefilter 16 is gradually blocked as the dust particles are stacked as a layer upon the prefilter and the flow resistance therethrough is correspondingly increased. However, the bypass channel 38 which is arranged in the axial direction of the cylindrical dust collecting vessel over the substantially whole length thereof and opened to the inside of the vessel therealong is not blocked unless the dust collecting vessel is wholly packed up with dust. Therefore, a de-

crease of air flow through the prefilter **16** due to increased stack up of dust is compensated by a correspondingly increased bypass air flow through the bypass channel **38**. Therefore, the air flow drops relatively gradually as curve (b) in FIG. 11 and it is avoided that the air flow drops abruptly as curve (a) in FIG. 11. Since the bypass channel **38** and the auxiliary filter **35** are provided along the uppermost region of the dust collecting vessel **6**, it is less liable that the auxiliary filter is clogged with dust, and the bypass channel is conveniently arranged without substantially increasing the volume of the cleaner.

The main filter **13** in the form of an alternately corrugated elastic sheet presents a large elasticity and is caused a good vibration of the whole for shaking off the dust attached thereto by a snapping action applied to an edge portion thereof. Furthermore, since the slider **18** for applying the snapping action to the main filter has a plurality of projections, the reciprocation of the slider in a small stroke and low speed can cause a high frequency vibration of the whole filter. The main filter **13** or the filtering element as shown in FIG. 9 is formed by a pressing process under a heated and pressurized condition and is mounted between the serrated members **26** of the packing frame **19** which is also produced by a pressing or injection process of rubber, polyvinyl chloride, etc. to provide the main filter assembly. Therefore, the cost of production of the main filter assembly of this invention is much lower than that of conventional bag filters. By supporting the main filter **13** by the packing frame **19** made of an elastic material, the vibrating characteristic of the main filter is more improved. Furthermore, since the main filter **13** is provided with the reinforcing layer **28** at the rear edge portions of the folds, it is avoided that the fibers constituting the filter are loosened in a long period of operation by the snapping action of the slider.

Since the main filter **13** is made of two layers of the sheet **13***a* of needled fibers bonded with an elastic material and the napped cloth **13***b*, collection of fine dust particles is performed three dimensionally. Furthermore, since the meshes defined by the needled fibers are deformed by an impact applied thereto, fine dust particles caught in the meshes are effectively pushed off by applying impacts or vibration to the main filter. The combination of such layers **13***a* and **13***b* is effective for the production of a filtering element having a required dust collecting rate and flow resistance. If a filtering material is to be consistituted only by the sheet of needled fibers such as the layer **13***a*, it is certainly possible to obtain an element having a determined dust collecting rate and flow resistance. However, in this case it is relatively difficult to obtain a high dust collecting rate wtih a low flow resistance as compared with cloth material. Therefore, it is preferable to combine the layer **13***a* having a relatively lower flow resistance with the layer **13***b* to compensate the dust collecting rate thereby to obtain a balanced flow resistance and dust collecting rate.

We claim:

1. A vacuum cleaner comprising a body provided with an inlet and outlet and housing an electric fan, a dust collecting vessel detachably mounted in said body for collecting large particles of dust, a gas discharging opening formed on a rear end of said vessel and said vessel being joined to a front end of said body, said vessel having a suction port at a front end thereof in flow communication with the inlet of the body and a handle at an upper side thereof, and a dust removing unit detachably mounted in said vessel at said gas discharging opening of said dust collecting vessel so as to close said gas discharging opening, said unit having a casing with a handle, a prefilter of rough meshes including means which is adapted to open and close an open front end of said casing by means of a push lever provided thereon, a main filter of fine meshes which is adapted to catch fine dust particles having passed through said prefilter and closing an open rear end of said casing, and means to shake off the dust from said main filter, said prefilter, said main filter and said dust shaking-off means being assembled together into a unitary structure.

2. An electric cleaner according to claim **1**, wherein said main filter is composed of a sheet of a base material made of a number of fibers entangled and connected with one another by an elastic agent and a cloth material attached to a front surface of said sheet.

3. An electric cleaner according to claim **1**, wherein said dust collecting vessel is provided with a bypass channel communicating a region located between said suction port and said prefilter to an inlet region of said main filter, said bypass channel being defined by a trough-like auxiliary filter of rough meshes.

4. An electric cleaner according to claim **1**, wherein said dust collecting vessel is provided with a handle for carrying it.

5. An electric cleaner according to claim **1**, wherein said suction port is provided with a check valve for preventing spill out of the dusts contained in said dust collecting vessel.

6. An electric cleaner according to claim **1**, wherein said main filter is an alternately folded sheet of a filtering material presenting a number of parallel arranged folds and being housed in a substantially cylindrical casing of said dust removing unit, said prefilter being mounted at a front end of said casing to releasably cover a front opening of said casing, said dust shaking-off means being a slider mounted on said casing to be slidable substantially perpendicularly to said folds, said slider having a plurality of projections at a front side thereof adapted to snap rear edges of said folds and a knob at a rear side thereof.

7. An electric cleaner according to claim **6**, wherein said main filter is provided with a reinforcing layer at the rear edge portions of said folds subjected to snapping by said slider.

8. An electric cleaner according to claim **6**, wherein said prefilter is pivotally mounted at the front end of said casing to be swung open by a pushing action of a finger.

9. An electric cleaner according to claim **6**, wherein said main filter of the alternately folded sheet of a filtering material is held by a packing frame provided with serrated portions adapted to correspondingly close axial ends of said folds.

10. A vacuum cleaner comprising a body provided with an inlet and outlet and housing an electric fan, a dust collecting vessel detachably mounted in said body for collecting large particles of dust, a gas discharging opening formed on a rear end of said vessel and said vessel being joined to a front end of said body, said vessel having a suction port at a front end thereof in flow communication with the inlet of the body and a handle at an upper side thereof, and a dust removing unit detachably mounted in said vessel at said gas discharging opening of said dust collecting vessel so as to close said gas discharging opening, said unit having a casing with a handle, a packing frame, a prefilter of rough meshes including means which is adapted to open and close an open front end of said casing by means of a push lever provided thereon, a main filter of fine meshes which is adapted to catch fine dust particles having passed through said prefilter and closing an open rear end of said casing, and means to shake off the dust from said main filter, said prefilter, said main filter and said dust shaking-off means being assembled together into a unitary structure, wherein said casing has a flange portion along its rear end circumference and a slider is mounted on a perforated plate defining a rear end cover of said casing, said flange portion of said casing and said perforated plate being mounted into annular grooves provided in said packing frame and assembled as said dust removing unit, said

packing frame being made of an elastic material and having annular ribs at a peripheral portion thereof for air-tight mounting of said dust removing unit to said dust collecting vessel.

11. A vacuum cleaner, comprising:

(a) a body provided wtih an inlet and outlet;

(b) an electric fan mounted in said body;

(c) a dust collecting vessel detachably mounted in said body, comprising:

(1) a suction port at one end thereof in flow communication with the inlet of the body,

(2) an open end for discharging gas therefrom,

(3) a dust demoving unit mounted in said vessel, having

(a) a substantially cylindrical casing having a flange portion along one end circumference thereof,

(b) a packing frame of an elastic material having annular ribs at a peripheral portion thereof for airtight mounting of said dust removing unit to said dust collecting vessel and further having serrated portions,

(c) a preforated plate defining a cover for said one end of said casing, wherein said flange portion and said perforated plate are mounted into said annular grooves in said packing frame,

(d) a pre-filter of rough mesh mounted at the end opposite said one end of said casing including means to releasably cover a front opening of said casing,

(e) a main filter of fine mesh mounted in the

casing to filter the air comprising an alternately folded sheet of a filtering material representing a number of parallelly arranged folds held by said packing frame such that said serrated portions correspondingly close axial ends of said folds,

(f) and means to shake off dust from said main filter, including a slider mounted on said perforated plate and slidable substantially perpendicularly to the folds, said slider having a plurality of projections at one side thereof to snap adjacent edges of said folds, said slider also having a knob opposite the side having said plurality of projections.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,621,640 Dated November 23, 1971

Inventor(s) Hiroshi OHNO et al

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the claim for Convention Priority, Patent Appln. N° 43/79739 was filed --October 30, 1968-- and not "October 14, 1968".

Signed and sealed this 23rd day of May 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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