

Jan. 30, 1968

YOSHITOMO IIZIMA

3,365,864

VACUUM CLEANER

Filed Feb. 24, 1964

4 Sheets-Sheet 1

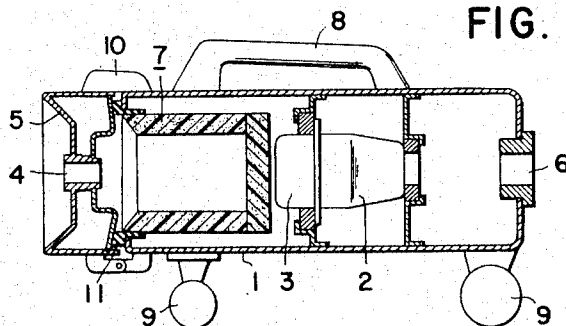
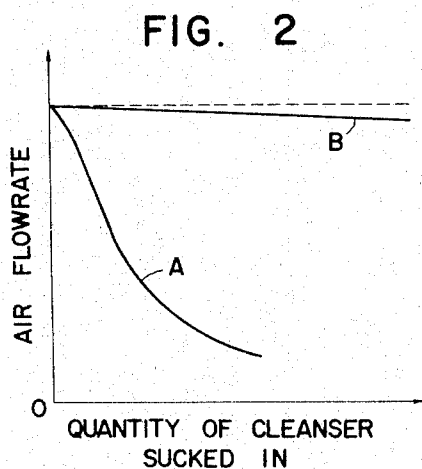
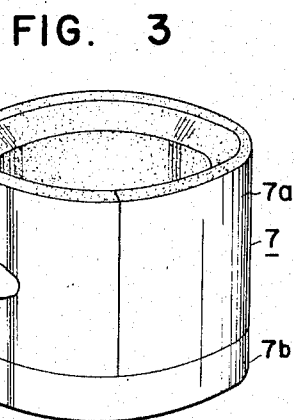


FIG. 6



FIG. 5

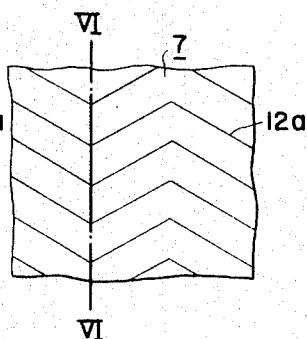
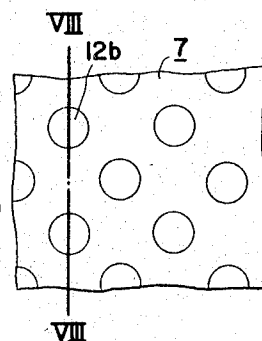


FIG. 8



FIG. 7



INVENTOR.
Yoshitomo Iizima

BY

Western & Western

Jan. 30, 1968

YOSHITOMO IIZIMA

3,365,864

VACUUM CLEANER

Filed Feb. 24, 1964

4 Sheets-Sheet 2

FIG. 4

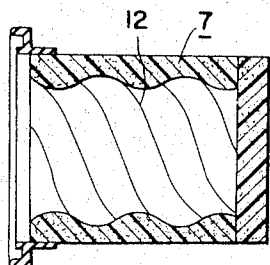


FIG. 9

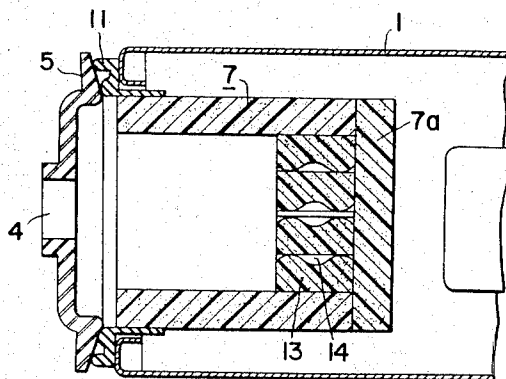


FIG. 10

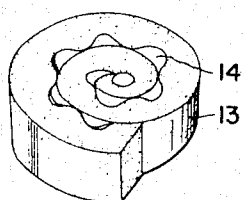


FIG. 11

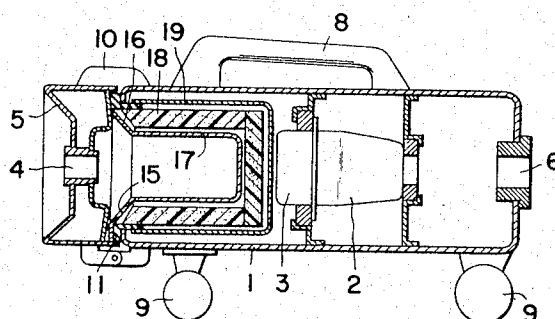


FIG. 13

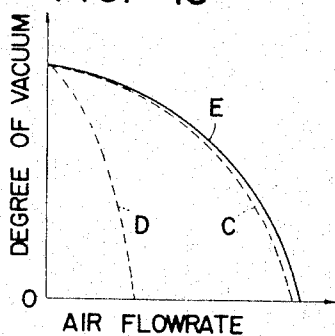
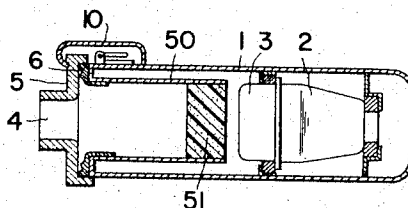


FIG. 20



INVENTOR.

Yoshitomo Iizima

BY

Western & Western

Jan. 30, 1968

YOSHITOMO IIZIMA

3,365,864

VACUUM CLEANER

Filed Feb. 24, 1964

4 Sheets-Sheet 3

FIG. 12

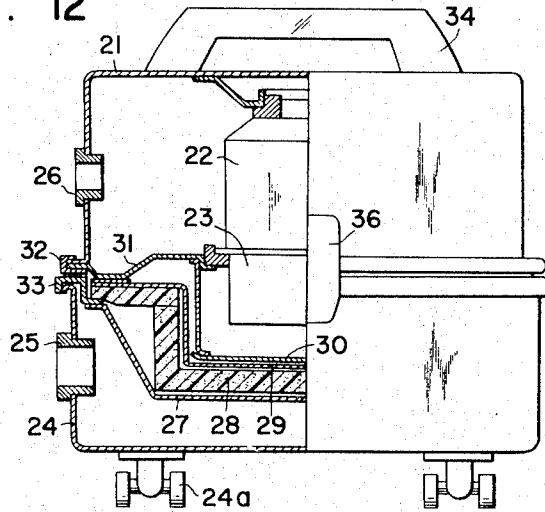
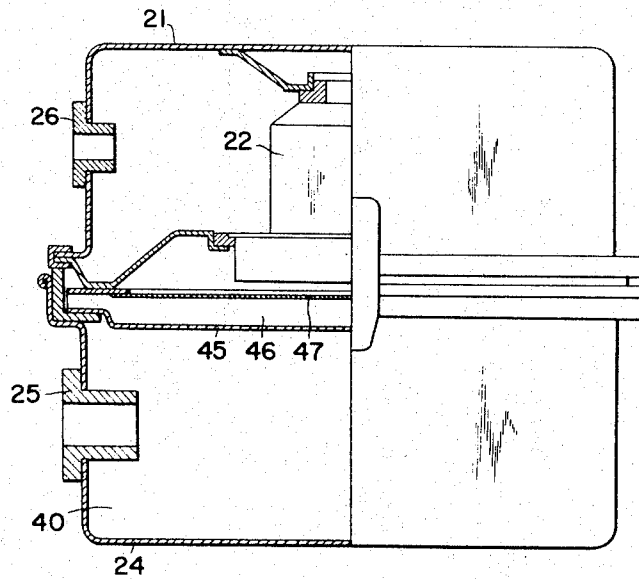


FIG. 14



INVENTOR
Yoshitomo Iizima

BY

Western & Western

Jan. 30, 1968

YOSHITOMO IIZIMA

3,365,864

VACUUM CLEANER

Filed Feb. 24, 1964

4 Sheets-Sheet 4

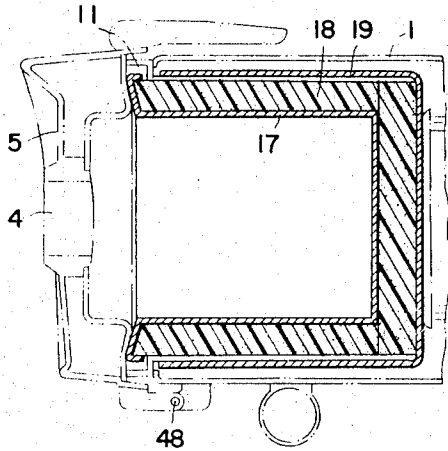


FIG. 15

FIG. 16

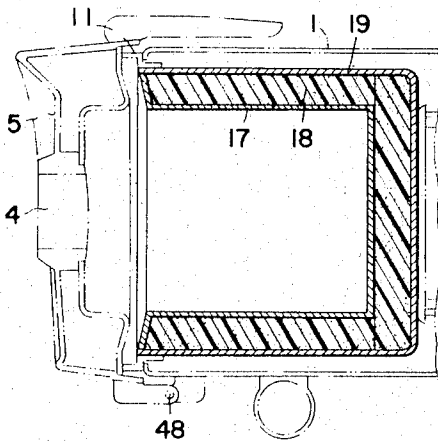


FIG. 17

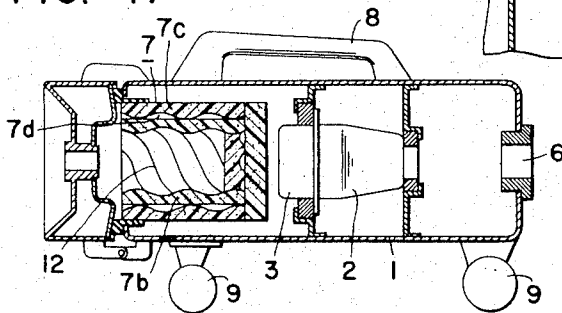


FIG. 18

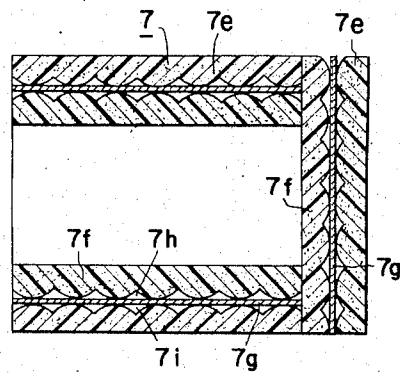
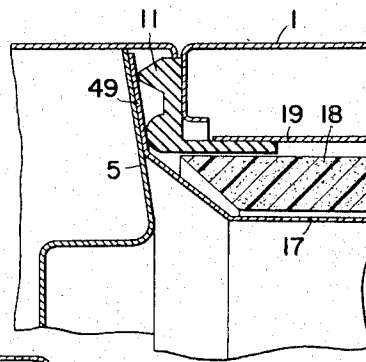


FIG. 19



INVENTOR.
Yoshitomo Iizima

BY

Western & Western

1

3,365,864

VACUUM CLEANER

Yoshitomo Iizima, Matsudo-shi, Japan, assignor to Tokyo Denki Kabushiki Kaisha, Tokyo-to, Japan, a joint-stock company of Japan

Filed Feb. 24, 1964, Ser. No. 346,920

Claims priority, application Japan, Feb. 23, 1963,

38/11,432

1 Claim. (Cl. 55—471)

This invention relates to vacuum cleaners and more particularly to a new vacuum cleaner having improved dust filtering and collecting means and having a highly increased dust filtering and collecting efficiency.

The dust filtering and collecting means used in a conventional vacuum cleaner generally has been formed from a gas-permeable and relatively thin fabric or paper, either singly or in combination. During use of such a dust collecting bag (hereinafter referred to as a dust bag), the dust sucked into the cleaner is arrested on the surface of the fabric or paper. Consequently, a conventional cleaner having described character has the disadvantage of the minute pores of the dust bag soon becoming clogged after only a relatively small quantity of fine dust has been introduced into the cleaner and thereby losing its capability to function as intended. That is, long before the space within the dust bag is fully occupied by coarse dust particles, the pores of the dust bag become clogged, and, consequently, the suction air flowrate of the vacuum cleaner is rapidly reduced, whereby the dust collecting efficiency drops. The above described characteristic of such dust bags has been fully confirmed by the results of experiments conducted by the present inventors as will be described hereinafter.

Furthermore, in the case of a dust bag of the above described construction, the fine dust particles introduced thereto cannot be arrested as desired, and the quantity of fine dust transmitted through the pores of the dust bag is of a substantial magnitude which cannot be neglected.

It is another disadvantage of the dust bag of the above described character that the disposal of its arrested dust is troublesome or is uneconomical. That is, in the case of the type wherein the inlet of the dust bag points downwardly, the dust, during this removal procedure, tends to scatter and soil the surrounding objects, and, moreover, is unsanitary. Furthermore the removal in a desired manner of the fine dust particles clogging the pores of the dust bag is considerably difficult.

Disposable dust bags such as those made of paper have the disadvantage of high price. Dust bags which can be washed with water have been proposed, but these are inconvenient because they cannot be used until they have been dried after washing.

It is a general object of the present invention to provide a vacuum cleaner in which the above described disadvantages have been eliminated.

More specifically, it is an object to provide a vacuum cleaner having dust arresting and collecting means which do not easily become clogged and, moreover, can be used repeatedly and have the capability of accomplishing highly efficient and economic dust collection.

It is another object to provide a vacuum cleaner of the above stated character having a dust arresting and collecting means which can filter and intercept almost all of the fine dust particles introduced thereto.

It is a further object to provide a vacuum cleaner of the above stated character having a dust arresting and collecting means from which the collected dust can be readily and sanitarily disposed of by washing.

The foregoing objects, as well as other objects and advantages as will presently become apparent have been

2

achieved by the present invention, which, briefly described, resides in a vacuum cleaner provided with a dust arresting and collecting means consisting of an air-permeable, thick, foam-containing, synthetic resin material formed into a cup-shaped structure, or some other suitable structure, which is adapted to entrap fine dust particles within the foam-containing, synthetic resin material, and from which the dust so entrapped and collected can be discharged by washing.

Because of the unique character of the dust arresting and collecting means according to the present invention, the fine dust particles are not intercepted on the other surface of the foam-containing, synthetic resin material but are entrapped in the interior thereof in the direction of the thickness thereof. Accordingly, efficient dust filtration and collection is afforded without clogging of the pores through which the carrier air passes. Furthermore, after easy disposal of the collected dust from the said means by washing, the means can be used again even before it is dry.

The nature, principle, and details of the invention will be more clearly apparent by reference to the following description with respect to preferred embodiments of the invention, taken in conjunction with the accompanying drawings in which like parts are designated by like reference characters, and in which:

FIG. 1 is an elevational view in longitudinal vertical section showing the essential construction of one embodiment of the vacuum cleaner according to the invention;

FIG. 2 is a graphical representation showing curves indicating a comparison of the performance of a conventional vacuum cleaner and that of the vacuum cleaner of the present invention;

FIG. 3 is a perspective view, with a part cut away, showing another example of the dust receptacle according to the invention;

FIG. 4 is an elevational view in longitudinal vertical section of still another example of the dust receptacle according to the invention;

FIG. 5 is a fragmentary view showing one part of a modification of the dust receptacle shown in FIG. 4;

FIG. 6 is a sectional view taken along the line VI—VI shown in FIG. 5;

FIG. 7 is a fragmentary view showing one part of another modification of the dust receptacle shown in FIG. 4;

FIG. 8 is a sectional view taken along the line VIII—VIII shown in FIG. 7;

FIG. 9 is a partial elevational view in longitudinal vertical section showing the dust receptacle and intake section of another embodiment of the vacuum cleaner of the invention;

FIG. 10 is a perspective view showing an essential part used in the vacuum cleaner shown in FIG. 9;

FIG. 11 is an elevational view in longitudinal vertical section showing the essential construction of another embodiment of the vacuum cleaner according to the invention;

FIG. 12 is an elevational view partly in vertical section showing the essential construction of still another embodiment of the vacuum cleaner of the tank type according to the invention;

FIG. 13 is a graphical representation indicating relationships between air flowrate and degree of vacuum;

FIG. 14 is an elevational view partly in vertical section showing the essential construction of a further embodiment of the vacuum cleaner of the tank type according to the invention.

FIGS. 15 and 16 are fragmentary views showing respectively different modifications of the embodiment of FIG. 11;

FIG. 17 is an elevational view in longitudinal vertical section showing a modification of the embodiments of FIGS. 4 and 9;

FIG. 18 is an elevational view in longitudinal vertical section of a modification of the embodiment of FIG. 4;

FIG. 19 is a fragmental sectional view of a further modification of the embodiment of FIG. 11; and

FIG. 20 is an elevational view in longitudinal vertical section showing still another embodiment of the present invention.

Referring to FIG. 1, the vacuum cleaner embodying the invention has a cleaner housing 1 containing therein a fan 3 driven by an electric motor 2, a front cover 5 having an intake port 4 and provided on one end of the housing 1, and a discharge port 6 on the other end. In the space formed between the fan 3 and front cover 5, there is disposed a dust receptacle 7, made of an air-permeable, thick, foam-containing, synthetic resin material formed into a cup-shaped structure.

Example of materials suitable for the dust receptacle 7 are those composed principally of synthetic resins such as urethane resins and styrene resins. As the said urethane resins may be used, for instance, polyurethane resins such as Moltphane sold by M. T. P. Kasei Co., Ltd., Japan. The dust receptacle 7 may, if so desired, be used in conjunction with a second dust bag (not shown) made of fabric or paper of known kind.

The vacuum cleaner shown in FIG. 1 is further provided with a handle 8, casters 9, a latch 10 for locking the front cover 5 in closed position, and a packing 11 fixed to entrance rim of the dust receptacle 7. The dust receptacle 7 is held in correct position within the housing 1 by clamping its packing 11 between the housing 1 and the front cover 5.

The vacuum cleaner of the above described construction operates in the following manner. Operation of the fan 3 causes air and dust to be sucked from a suction pipe (not shown), through the intake port 4, and into the dust receptacle 7. First, coarse dust particles are arrested on the interior surface of the cup-shaped dust receptacle and are trapped in the space in the interior of the receptacle 7. On the other hand, fine dust particles infiltrate further from the surface into the inner parts of the foam-containing, porous synthetic resin material and, in regions near the surface or deeper regions of the resin material, adhere to the interior surfaces of the foam voids or bubbles.

More explicitly, since the fine particles are arrested in a three-dimensional manner, that is, in the thickness direction, in the thick, foam-containing, synthetic resin material constituting the dust receptacle, the probability of the pores, that is, the air bubbles through which the air flows, becoming clogged by the mechanism of arresting the fine particles is extremely low. The reason for this is that, because of the presence of countless air bubbles within the resin material, an extremely large adhesion surface for fine dust particles is formed three-dimensionally by the air bubbles and the very thin synthetic resin films connecting these bubbles, wherefore the fine dust arresting action is accomplished in a highly effective manner.

Thus, the air which has passed through the dust receptacle 7 and has become dust-free then passes through the fan 3 and is forcibly discharged through the discharge port 6.

Accordingly, according to the construction of the embodiment of FIG. 1, since a large quantity of fine dust particles can be effectively entrapped without any large reduction due to clogging in the air flowrate, it is possible to maintain the dust collecting performance in an excellent state until the hollow space in the interior of the cup-shaped dust receptacle 7 becomes substantially full of coarse dust particles. It will be obvious that this means that the vacuum cleaner can be operated over a long period between dust disposal procedures.

For disposal of the dust in the dust receptacle 7 after much dust has been collected, the dust receptacle 7 is removed from the housing 1, the entrance opening thereof is directed downwardly, and the coarse dust particles are shaken out. Then the dust receptacle is immersed in a washing liquid and suitably massaged. In this manner it is possible to cause the fine dust particles entrapped within the foam-containing, synthetic resin material to flow out readily and rapidly into the washing liquid. It will be appreciated that since this procedure involves discharging fine dust by washing, there is no possibility of the fine dust being scattered to soil the surrounding objects, and that this procedure is, therefore, sanitary.

The dust receptacle washed in the above described manner can be installed again, without drying, in the housing 1 and reused.

The curves presented in FIG. 2 for the purpose of comparison between the performances of a representative vacuum cleaner of conventional type and of a vacuum cleaner according to the present invention are based on tests conducted with powder cleanser used to simulate dust. Each curve indicates progressive variation (lowering) of air flowrate (abscissa) with the quantity of cleanser (ordinate) sucked into the vacuum cleaner, curve A being that for the conventional cleaner, and curve B being that for the cleaner of this invention. For the purpose of this comparison, the tests were carried out with exactly the same apparatus other than the dust receptacles and under the same conditions.

It will be observed from FIG. 2 that, in the case of the conventional cleaner (curve A), its air flowrate tends to decrease rapidly when only a small quantity of dirt has been sucked in, wherefore it is clear that its dust-collecting capacity is greatly limited. In contrast, as can be observed from curve B, in the case of the cleaner of this invention, there is almost no change in the air flowrate with respect to its initial value even after a substantial quantity of dirt has been sucked in.

In another embodiment of the dust receptacle 7 according to the invention, the dust receptacle 7, as shown in FIG. 3 consists of a cylindrical part 7_a formed by circularly bending a foam-containing, synthetic resin material in plate form and bonding the butt seam and an end plate part 7_b of disk shape made of the same material as the cylindrical part 7_a and similarly bonded to one end surface of the cylindrical part 7_a. This construction is advantageous in that the dust receptacle 7 can be fabricated in a simple and easy manner at low cost from a plate stock material.

In another embodiment of the dust receptacle according to the invention as shown in FIG. 4, a corrugated surface 12 is formed on the interior wall of the cup-shaped dust receptacle. By providing such a corrugated form, it is possible to reduce the detrimental effect due to adhesion in a thin film state on the interior wall of the receptacle of waste substances of fibrous, readily-entangling nature such as cotton lint or fluff whereby the infiltration of the fine dust particles into the foam-containing, synthetic resin material is obstructed. Moreover, such a construction affords an interior wall area which is several times that of an even circular wall. Still another desirable feature of this construction is that the fine particles are thereby caused to impinge on the synthetic resin material at various angles, whereby the dust collecting efficiency is substantially higher than that in the case illustrated in FIG. 1.

The configuration of the corrugated surface 12 need not be limited to the helical arrangement illustrated in FIG. 4, but may be arranged in a zig-zag manner with waves 12_a of relatively sharp ridges and valley bottoms as shown in FIGS. 5 and 6, or the undulations may take the form of protruding mounds 12_b as shown in FIGS. 7 and 8.

In still another embodiment of the invention as shown in FIGS. 9 and 10, the dust receptacle 7 has within its

hollow interior, against its closed end, an auxiliary filter piece 13 consisting of a strip of the same material as the receptacle 7, the said strip being wound into a spiral as shown most clearly in FIG. 10. By this construction, the dust collecting effectiveness of the dust receptacle can be increased still more relative to that of the examples described hereinbefore of the invention. That is, the above described construction prevents any transmission of fine dust particles through the closed end part of the dust receptacle, particularly in cases where this closed end part is of the same thickness as or is thinner than the cylindrical part of the receptacle. Furthermore, by using a strip of material with corrugations on one or both surfaces thereof for the aforesaid wound strip 13 as shown in FIGS. 9 and 10, suitable spaces 14 can be formed between the wound layers, whereby the effective surface area of the auxiliary filter piece 13 is increased and functions to increase the dust collecting effectiveness.

In still another embodiment of the invention as shown in FIG. 11, the dust receptacle consists of an assembly of three different receptacles in concentric and successively encompassing arrangement. The innermost or first-stage receptacle 17 has the function of arresting and collecting only coarse waste matter such as cotton lint, paper waste, metal chips, and broken glass chips and may be of a character fully permitting passage of fine dust. Principal examples of materials suitable for fabrication of this first-stage receptacle 17 are coarse-weave fabrics of natural or man-made fibers, perforated or porous materials of synthetic resins or metal, and metal wire mesh material with relatively large mesh. Receptacle 17 is provided with a slant flange 15 at its opening. The intermediate or second-stage receptacle 18, which encompasses the first-stage receptacle 17, has the function of arresting and collecting fine dust particles and is fabricated from an air-permeable, foam-containing, synthetic resin material as used in the embodiments of the invention described hereinbefore. The outermost or third-stage receptacle 19, which encompasses the second-stage receptacle 18, has the function of thoroughly arresting and collecting any fine dust which may pass through the second-stage receptacle and is made of a fine-mesh material, examples of which are fabrics such as velveteen of known kind and synthetic-resin paper. Between flange 15 and the opening of receptacle 19, a packing 11 is inserted. As shown in FIG. 12, the receptacles 17, 18 and 19 are assembled integrally and airtight in housing 1 by clamping these receptacles between the housing and front cover 5 by means of flange 15 and packing 11. According to FIG. 11, the cleaner further is provided with a handle 8, casters 9 and a latch 10 to lock the front cover 5 in closed position.

During the operation of the vacuum cleaner shown in FIG. 11, the intake air containing waste material and dust first enters the hollow interior of the first-stage receptacle 17, and coarse particles are arrested by the coarse mesh of the receptacle 17, while fine dust particles pass therethrough and infiltrate into the second-stage receptacle 18 to be entrapped in the manner described hereinbefore. Any dust particles which may pass through the second-stage receptacle 18 are thoroughly arrested by the third-stage receptacle 19.

In contrast to conventional dust bags which tend to become clogged in a short time, as mentioned hereinbefore, the three-stage dust receptacle of the vacuum cleaner shown in FIG. 11 has a remarkable dust filtering and collecting capacity. Since the third-stage receptacle envelops the second-stage receptacle 18, the outer surface of the synthetic resin material of the second-stage receptacle 18 is caused by the passage of air during operation to rub against the inner surface of the third-stage receptacle 19. Consequently, the fine dust particles arrested on the inner surface of the third-stage receptacle 19 are prevented from tenaciously adhering to the said surface, being rendered into readily flowing particles. There-

fore, the fine dust particles arrested and collected in the third-stage receptacle 19 can also be discharged and disposed of in an easy manner.

The principles and teachings of the present invention can be effectively applied also to vacuum cleaners of the so-called tank type (also known as the pot type) as illustrated by further embodiments of the invention shown in FIGS. 12 and 14.

Referring to FIG. 12, the outer housing structure of the vacuum cleaner shown consists of the main body 21 containing a fan 23 driven by a motor 22, both mounted on a partition plate 31, and a pot-shaped dust collector 24 on which the main body 21 is detachably secured, with a packing 33 interposed therebetween, by a clamp latch 36. Between this dust collector 24 and the partition plate 31, there are clamped filter elements 27, 28, and 29 disposed in coaxially stacked arrangement in the sequence named from bottom to top and constituting, respectively, the first, second, and third filtration stages. In fabrication material and function, these filter elements 27, 28, and 29 are similar to the dust receptacles 17, 18, and 19, respectively, in the example described in conjunction with FIG. 11 except for their convex configuration on their upstream side.

The combination of filter elements 27, 28, and 29 is so supported that a space for collection of coarse dust and waste is formed between this combination and the bottom of the dust collector 24, which is provided with an intake port 25, and this combination is prevented from being forced against the fan 23 by a support frame 30.

The vacuum cleaner shown in FIG. 12 is further provided with an air discharge port 26, a shock absorbing rim 32 made of an elastic material provided on the bottom flange of the main body 21 and serving as the contact surface to contact the packing 33, a handle 34, and casters 24a.

In the operation of the vacuum cleaner of the above described construction, the larger particles of dust and waste drawn in together with air through the intake port 25 are arrested by the collector 24 and the first-stage filter element 27 and collect in the bottom of the dust collector 24. The fine dust particles, which tend to cause clogging in conventional vacuum cleaners, then pass through the first-stage filter element 27 and are entrapped by the second-stage and third-stage filter elements 28 and 29 similarly as in the case described with reference to FIG. 11.

It has been found by microscopic examination and measurement that almost all of the small quantity of dust particles adhering to the surface of the third-stage filter element 29 have grain sizes of the order of 50 microns, there being almost none of grain sizes of 10 microns or less, and no evidence of clogging of the filter material was observed. It has also been found that these dust particles can be readily disposed of from the filter element 29.

As a result of tests with a powdered cleanser, similar to those described hereinbefore, the curves of degree of vacuum versus air flowrate shown in FIG. 13 were obtained. Curves E, D, and C represent performances respectively of the case wherein the intake air contained no dust whatsoever, the case wherein a conventional dust bag was used, and the vacuum cleaner was operated to draw in a certain quantity of the powdered cleanser, and the case wherein the filter elements 27, 28 and 29 according to the present invention were used, and the same quantity of cleanser was drawn in. From these curves, it will be observed that, whereas the performance drops in the case of the conventional dust bag, there is almost no variation in performance in the case of the filter elements of the present invention.

In a still further embodiment of the invention as shown in FIG. 14, there are provided filter elements 45, 46, and 47 which are equivalent respectively to the filter elements 27, 28, and 29 described above in connection with the embodiment shown in FIG. 12. The filter elements 45, 46, and 47 are of substantially flat form, being formed from

plates or sheets of respectively the same materials as those used for the filter elements 27, 28, and 29. By this construction, these elements can be produced easily and at low cost and, moreover, can be easily and conveniently handled.

In the embodiment of FIG. 15 which is a modification of the embodiment of FIG. 11, the innermost first-stage receptacle 17 of large mesh and the second-stage receptacle 18 fabricated from an air-permeable, foam-containing synthetic resin material are bonded as a single body by gluing, welding or soldering. Of course, the third-stage receptacle 19 is supported so as to be detachable from the second-stage receptacle 18. According to the embodiment of FIG. 15, removal of collected dust can be easily accomplished by subjecting the assembly of the first- and second-stage receptacles to water-washing and by striking the third-stage receptacle 19, whereby handling is greatly facilitated. In this embodiment, numerals 11 and 48 indicate respectively a packing and a hinge for openably attaching the suction cover 5 having an intake port 4 to the housing.

In the embodiment of FIG. 16 which is another modification of the embodiment of FIG. 11, the first-, second-, and third-stage receptacles are bonded as a single body by gluing, welding or soldering. This embodiment includes a filtering member of one body, so that its handling is extremely easy.

The constructional idea of the above-mentioned embodiments of FIGS. 15 and 16 can be applied to the cases in which the filtering member is of a dish-shaped type or plate-shaped type.

The embodiment of FIG. 17 relates to the case, in which members similar to those of the embodiment of FIG. 1 are designated by the same reference characters, and the thick filtering member 7 consists of two layers of cup-shaped inner and outer members 7_b and 7_c, each being fabricated from an air-permeable, foam-containing, synthetic resin material, and at least the outer member being provided with a corrugated surface 12 so that a continuous air gap or discontinuous air gaps 7_d are formed between the facing surfaces of both members 7_b and 7_c. The said air gap is substantially larger than the bubbles or pores formed in the body of the members 7_b and 7_c.

The embodiment of FIG. 18 is a modification of the embodiment of FIG. 17 and relates to the case in which the filtering member 7 consists of three layers 7_e, 7_f and 7_g, the intermediate layer 7_g being made to be relatively thin, whereby air gaps 7_h and 7_i are formed on both sides of the intermediate layer 7_g. According to the embodiment of FIG. 18, since the velocity of the air which has passed through the body of the filtering member is decreased at the said air gaps, arresting and collection of fine dust are further improved.

The embodiment of FIG. 19 is a further modification of the embodiment of FIG. 11 and relates to the case in which the first-stage receptacle 17 is provided at its opening portion with a flange portion 49, the third-stage receptacle 19 is provided with a packing 11 overlapping the said flange portion 49, and the second-stage receptacle 18 fabricated from an air-permeable, foam-containing, synthetic material is disposed between the said first-stage and third-stage receptacles. The above-mentioned flange portion 49 and packing 11 are supported between, for example, the main housing 1 and the front cover 5.

In FIG. 20 is shown another embodiment of the present invention, in which the filtering member consists of a side wall 50 made of a substantially air-tight material and a thick base member 51 supported by the said side wall and fabricated from an air-permeable, foam-containing, synthetic resin material. Substantial gastightness of the side wall means that the gastightness of the side wall is greater than that of the member 51. For instance, the side wall may be made of a material such as fabric, vinyl

film, paper of small mesh and the like. According to this embodiment, the dimensions of the main body of the housing 1 can be reduced without decreasing the suction function.

Although, in the foregoing disclosure, the various aspects of the present invention have been described separately with respect to various embodiments of the invention for the sake of convenience in description, the various aspects of the invention can, of course, be suitably combined to provide a vacuum cleaner having their respective advantages.

It should also be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes and modifications of the examples of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention as set forth in the appended claim.

What is claimed is:

1. A vacuum cleaner comprising a housing having an open end and a discharge port in the other end and a front cover; an intake port in said front cover; a dust filtering device positioned in the housing; a fan for introducing suction air containing dust into said device positioned intermediate the filtering device and the discharge port; and an electric motor driving said fan; said dust filtering device consisting essentially of three individual filter receptacles in nested position, each having an inlet opening facing said intake port; the inner receptacle being of relatively large mesh and provided with a perimetrical flange of the inlet thereof clamped between said front cover and the housing at the open end thereof; the intermediate bag being of an air-permeable synthetic organic resin foam fine filter; and the outer bag being of fine mesh; and perimetrical packing means provided about the inlet of the outer receptacle interposed between said flange and the open end of the housing and being clamped between the cover and the open end of the housing holding all three receptacles in co-axial nested relation.

References Cited

UNITED STATES PATENTS

1,134,294	4/1915	Supanz	55-485
1,143,833	6/1915	Keller	55-373
1,198,945	9/1916	Moss	55-484
2,237,499	4/1941	Osterdahl	55-522
2,297,933	10/1942	Yonkers	55-522
2,721,625	10/1955	Lagerstrom	55-472
2,729,303	1/1956	McMahan	55-367
2,781,913	2/1957	Thompson	55-529
2,951,553	9/1960	Kirby	55-378
2,961,710	11/1960	Stark	55-97
2,964,127	12/1960	Korn	55-379
2,966,960	1/1961	Rochlin	55-97
2,999,562	9/1961	Lechtenberg	55-502
3,006,437	10/1961	Lowther	55-498
3,059,312	10/1962	Jamieson	55-522
3,144,315	8/1964	Hunn	55-486
3,172,743	3/1965	Kowalewski	55-473

FOREIGN PATENTS

980,777	1/1951	France.
1,268,970	1/1961	France.
1,314,475	12/1962	France.
1,079,958	4/1960	Germany.
816,520	7/1959	Great Britain.
884,480	12/1961	Great Britain.
907,236	10/1962	Great Britain.
909,893	11/1962	Great Britain.

HARRY B. THORNTON, *Primary Examiner*.

B. NOZICK, *Assistant Examiner*.