May 26, 1970 TAKEO HORI 3,513,500

COMPACT HAND VACUUM CLEANER

Filed Jan. 25, 1968 3 Sheets-Sheet 1

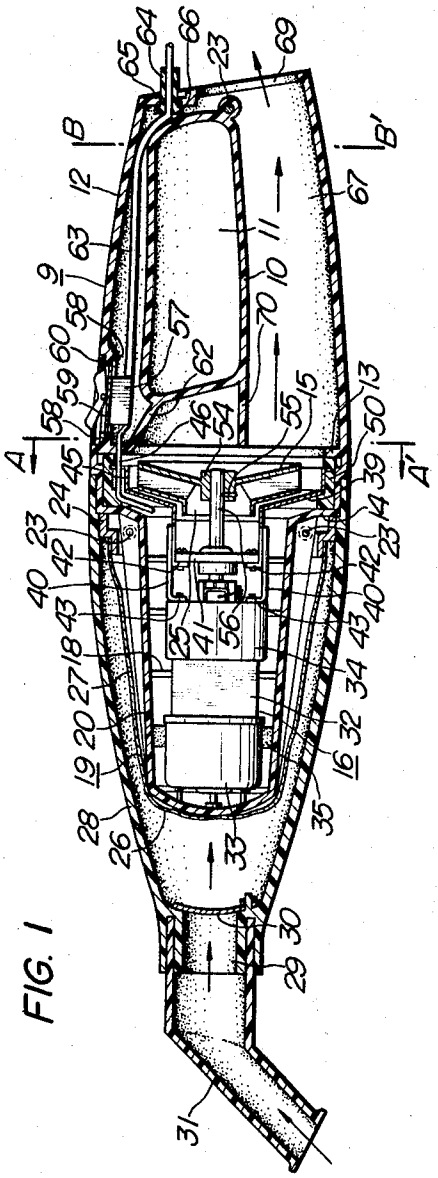


FIG. 1

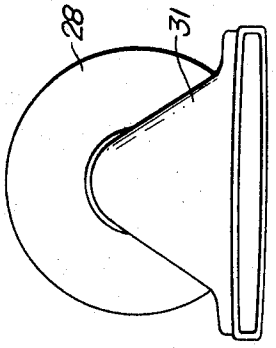


FIG. 2

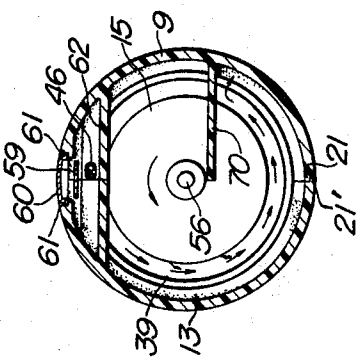


FIG. 3

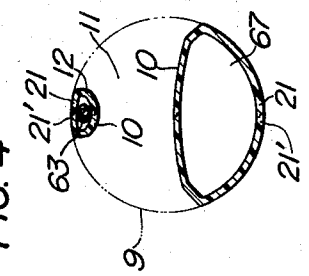


FIG. 4

INVENTOR
TAKEO HORI

BY Stevens, Davis, Miller & Mosher

ATTORNEYS

May 26, 1970 TAKEO HORI 3,513,500

COMPACT HAND VACUUM CLEANER

Filed Jan. 25, 1968 3 Sheets-Sheet 2

FIG. 5

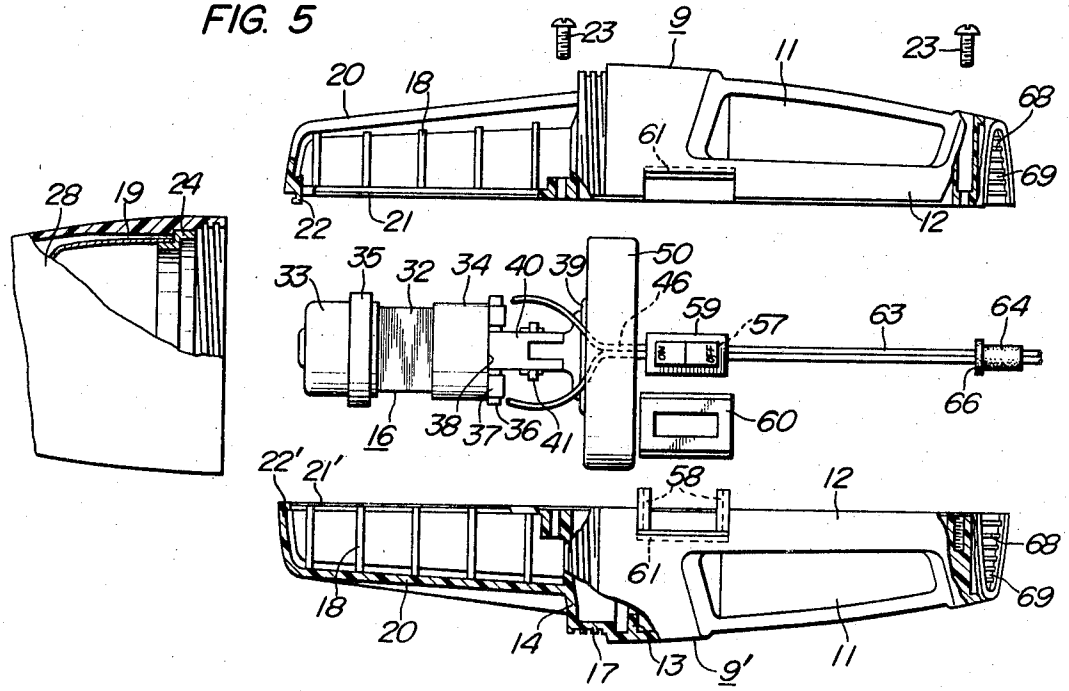
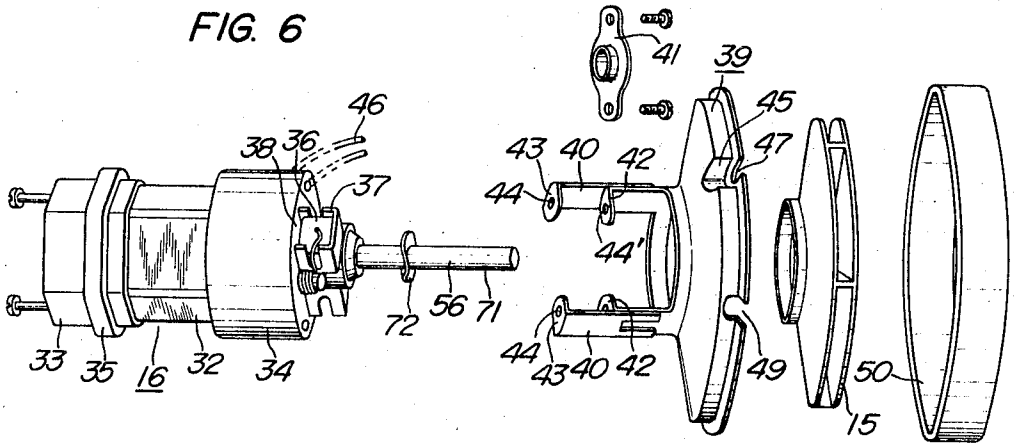


FIG. 6



INVENTOR
TAKEO HORI

BY

ATTORNEYS

May 26, 1970 TAKEO HORI 3,513,500

COMPACT HAND VACUUM CLEANER

Filed Jan. 25, 1968 3 Sheets-Sheet 3

FIG. 8

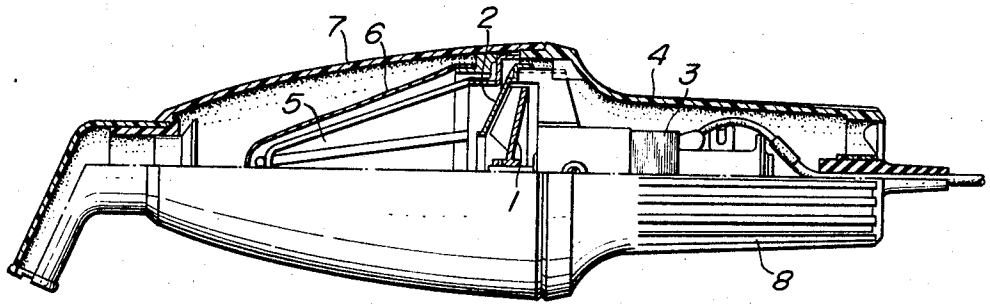
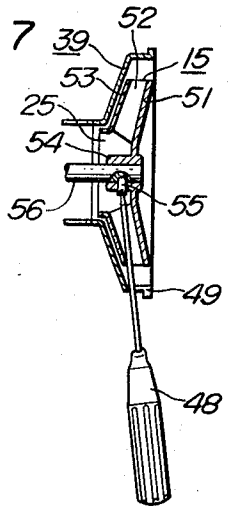


FIG. 7



INVENTOR
TAKEO HORI

BY Stevens, Davis, Miller & Mosher

ATTORNEYS

United States Patent Office 3,513,500 Patented May 26, 1970

3,513,500

COMPACT HAND VACUUM CLEANER

Takeo Hori, Fukuoka-shi, Japan, assignor to Matsushita Electric Industrial Co., Ltd., Osaka, Japan

Filed Jan. 25, 1968, Ser. No. 700,582
Claims priority, application Japan, Mar. 1, 1967, 42/13,544; Mar. 2, 1967, 42/18,200 thru 42/18,211
Int. Cl. A47l 5/24
U.S. Cl. 15—344 6 Claims

ABSTRACT OF THE DISCLOSURE

A compact hand vacuum cleaner of the type comprising a rotary fan and an electric motor for driving said fan, housed in a casing, in which said casing has a transverse hollow extending through the upper portion thereof to shape an integral grip above and to define an air passageway below said transverse hollow, and said fan and said fan driving motor are arranged forwardly of said air passageway and secured to said casing through vibration dampening means and enclosed by a filter bag which has its open end secured at the middle portion of said casing and its closed end portion extending forwardly or in a direction opposite to the air sucking direction, the closed end of said filter bag forming a substantially flat surface the area of which is larger than the area of an air suction opening for said fan so as to prevent the clogging of the filter bag and increase the suction of the cleaner.

BACKGROUND OF THE INVENTION

Field of the invention

The present invention relates to a compact hand vacuum cleaner adapted to be used for domestic services and for cleaning the interior of automobiles, and more particularly relates to a hand vacuum cleaner of the type described which is superior to conventional ones in dust collecting capability and provided with means to dampen the vibration of the drive motor from being propagated to the grip portion.

Description of the prior art

In the past, there has been known a hand vacuum cleaner which is of the type in which a filter bag is mounted with its closed end portion extending in a direction opposite to the air sucking direction so as to accumulate the dust sucked in a dust accumulation hood enclosing said filter bag and a grip is provided by the peripheral wall of a casing in which a drive motor is housed. Namely, in the prior art hand vacuum cleaner shown in FIG. 8 of the accompanying drawings, a drive motor **3** having a fan **1** and a fan cover **2** connected thereto is disposed in a cup-shaped casing **4** and to the open end of the casing **4** is removably connected a dust accumulating hood **7** enclosing a filter bag supporting framework **5** consisting of, e.g. a metal screen, which is protruding from the open end of said casing in a direction opposite to the air sucking direction and having a tapered filter bag **6** mounted thereover, and the exterior wall of said casing **4** is provided with a knurl **8** for the handgrip of the user. Such construction of the prior art hand vacuum cleaner, however, had the drawbacks that the air sucking force of the fan is progressively reduced as a result of clogging of the filter bag, that the stability of the vacuum cleaner in the hand of the operator is poor because of the configuration of the grip and the vibration stemming from the drive motor is propagated to the operator's hand giving the operator an uncomfortable feeling, and further that the air sucked in the vacuum cleaner cannot be discharged from the outlet smoothly because the air passageway is

defined by the peripheral wall of the drive motor and the inner surface of the casing and the air sucked in the vacuum cleaner during passage through said air passageway makes a spiral motion around the drive motor, as a result of which pressure is built up interior of the casing making it impossible to obtain sufficient suction. The above-described drawbacks of the prior art hand vacuum cleaner may be eliminated by modifying the shape of the filter bag, modifying the configuration of the casing by forming a transverse hollow through the upper portion of said casing so as to shape a grip above and define an air passageway below said transverse hollow, and relocating the drive motor forwardly of said air pasageway as proposed by the present invention.

SUMMARY OF THE INVENTION

The present invention contemplates the provision of a compact hand vacuum cleaner which is characterized by a substantially cylindrical casing of synthetic resin material composed of vertically splittable symmetrical halves and having a hollow extending transversely through the upper portion thereof so as to shape a grip above and define an air passageway below said transverse hollow, a filter bag supporting framework of lattice structure composed of vertically splittable symmetrical halves which are molded of a synthetic resin material integrally with the respective halves of the casing, a suction unit comprising a drive motor, a fan and a fan cover and mounted in said filter bag supporting framework, said suction unit being securely held in position by being clamped by the halves of said filter bag supporting framework and said casing, a current guide plate adapted to lead the current produced by said suction unit into said air passageway, and a filter bag having a substantially flat closes end surface and a peripheral surface connected successively to and tapered towards said closed end surface and superposed on said filter bag supporting framework, the area of said substantially flat end being larger than the area of an air suction opening in said suction unit.

It is, therefore an object of the present invention to provide a hand vacuum cleaner which can be gripped easily, is capable of sucking a large amount of air to produce an excellent dust collecting effect and is free of clogging of the filter bag by the dust sucked.

It is another object of the present invention to provide a hand vacuum cleaner in which the air sucked by a fan flows rectilinearly, instead of spirally as in the conventional hand vacuum cleaner, so as to be discharged smoothly.

It is still another object of the present invention to provide a hand vacuum cleaner which makes it possible to avoid clogging of the felt end surface of a filter bag by dust.

It is still another object of the present invention to provide a hand vacuum cleaner in which means is provided to prevent the vibration of a suction unit, comprising a drive motor, a fan and a fan cover, from being propagated directly to the grip.

It is still another object of the present invention to provide a hand vacuum cleaner in which the supporting structure for a drive motor, a fan and a fan cover is simplified.

It is still another object of the present invention to provide a hand vacuum cleaner in which the lead wires of a power cord are connected to a drive motor in a safe manner.

It is still another object of the present invention to provide a hand vacuum cleaner in which means is provided for easy connection of a fan with a drive motor.

It is still another object of the present invention to pro-

vide a hand vacuum cleaner of which the casing and the filter bag supporting structure can be shaped and assembled simply.

It is still another object of the present invention to provide a hand vacuum cleaner in which a control switch is mounted in the upper portion of the casing thereof to provide for easy operation of said switch.

It is still another object of the present invention to provide a hand vacuum cleaner in which a control switch is installed air-tightly to prevent air leakage thereat.

It is still another object of the present invention to provide a hand vacuum cleaner in which a power cord supporting bushing is secured rigidly.

It is still another object of the present invention to provide a hand vacuum cleaner in which the drive shaft of a drive motor is securely held against displacement in the thrust direction so as to maintain the distance between a fan and a fan cover constant.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 are a side elevational view in vertical cross section and a front elevational view respectively of a compact hand vacuum cleaner embodying the present invention;

FIG. 3 is a transverse cross sectional view taken on the line A–A′ of FIG. 1;

FIG. 4 is a transverse cross sectional view taken on the line B–B′ of FIG. 1;

FIG. 5 is an exploded plan view, partly broken away, showing the essential construction of the hand vacuum cleaner;

FIG. 6 is an exploded perspective view showing a suction unit composed of a drive motor, a fan and a fan cover;

FIG. 7 is a vertical cross sectional view illustrating the manner in which the fan is mounted on the drive shaft of the drive motor; and

FIG. 8 is a side elevational view, partly in section, of a conventional hand vacuum cleaner.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention will be described in detail hereunder with reference to a preferred embodiment thereof illustrated in the accompanying drawings.

As shown in FIG. 5, the casing of the hand vacuum cleaner is composed of vertically splittable symmetrical halves **9** and **9′** of a substantially uniform wall thickness. The casing halves **9** and **9′** are each molded in such a configuration that, when they are combined together, a transverse hollow **11** is formed extending through the rear upper portion of the casing so as to shape a grip **12**, which hollow defined by a horizontal wall **10** located at a level slightly above the middle of the height of that portion of the casing. At the center of the inner surface of each half **9** or **9′** are formed integral semicircular ribs **13** and **14** so as to define a semicircular recess **17** to provide for mounting of a suction unit composed of a fan **15** and a drive motor **16**. A filter bag supporting framework **20** of lattice structure, which is composed of lateral and longitudinal ribs **18**, is molded of a synthetic resin material integrally with and successively to the aforesaid suction unit mounting recess **17**. This filter bag supporting framework **20** is adapted to hold the drive motor **16** inside thereof and to support a filter bag **19** on the exterior wall. The halves **9** and **9′** of the casing are combined together by engaging interlocking steps **21** and **21′** formed in the peripheral edges and engaging interlocking hooks **22** and **22′** formed at the forward end extremities thereof, and tightened together at the central and the rear portions by means of tightening screws **23**. The filter bag **19** has a ring **24** of elastic material, such as rubber, provided at the peripheral edge of the open end thereof. When mounted on the filter bag supporting framework **20**, the filter bag **19** is stretched by said supporting framework with its closed end facing in a direction opposite to the air sucking direction. In this case, the closed end of the filter bag forms a substantially flat surface as at **26**, the area of which is larger than the area of a suction opening **25** in the fan **15** which will be more fully described hereinafter. The filter bag **19** is tapered from the open end towards the substantially flat closed end **26** as indicated by **27**. Reference numeral **28** represents a dust accumulating hood which surrounds the filter bag **19**. The dust accumulating hood **28** is detachably connected to the casing as by screw threaded engagement and at its front end an opening **29** is formed, into which a suction port member or a beak **31** is fitted. At the inner end of the opening **29** of the dust accumulating hood **28** is provided a check valve **30** consisting of a thin rubber plate. The suction unit is basically composed of the fan **15** and the drive motor **16** arranged forwardly of said fan **15** with respect to the air sucking direction. The drive motor **16** has its core **32** clamped by brackets **33** and **34** and the bracket **33** is in turn supported by the filter bag supporting framework **20** through the intermediary of a rubber ring **35**. The bracket **34** is formed of a synthetic resin material integrally with a brush holder **38** on which are mounted guiders **37** for the brushes **36** of the drive motor **16**. A fan cover **39** has a plurality of mounting legs **40** provided on the front surface thereof. Each of the mounting legs **40** is formed with a bent lug **42** for the mounting of a bearing **41** for the drive shaft of the drive motor **16** and a bent lug **43** for the mounting of the drive motor **16**. The lugs **42** and **43** are respectively formed therein with tapped through-holes **44** and **44′**. The drive motor is fixedly mounted on the fan cover **39** by means of screws which are extending through the brackets **33** and **34** and having their threaded ends screw-threaded into the tapped through-holes **44**. The bearing **41** is fixed to the lugs **42** by screws screw threaded into the tapped through-holes **44′**. The mounting legs **40** may be formed integrally with the fan cover **39**, or may alternatively be provided separately and fixed to the fan cover **39** by means of spot welding or other suitable means. A notch **45** is formed in the peripheral wall of the fan cover **39** and a notch **47** is formed in the flange of said fan cover in register with said notch **45**, for the passage of a power cord. Another notch **49** is formed in the peripheral wall of the fan cover **39** to provide for insertion of a screw driver **48**. The fan cover **39** is secured in the casing by fitting its peripheral edge in the aforementioned suction unit mounting recess **17** through the intermediary of a buffer ring **50** of elastic material, such as a rubber band, having a U-shaped cross sectional configuration. The fan **15** is disposed inside of the fan cover **39** with a slight space therebetween and, as shown in FIG. 7, is composed of a base plate **51**, fan blades **52** fixed on said base plate and a cover plate **53** mounted integrally on said fan blades and having a suction opening **25** formed in the center thereof. This fan **15** is mounted on the drive shaft **56** of the drive motor **16** by means of a screw **55** which is screw threaded into said drive shaft through a boss **54** of the base member **51**. Although in the embodiment shown, the fan **15** is provided wtih the cover plate **53**, such cover plate does not have to be provided. When the fan is not provided with the cover plate **53**, the central opening in the fan cover **39** should be regarded as the suction opening **25**. A control switch is mounted on a support plate **59** which has the opposite edges fitted in respective grooves **58**, **58** formed in the confronting edges of a switch mounting hole bored in the top wall of the casing. Reference numeral **60** designates a decorative frame for the control switch **57**, which is fitted around the control switch **57** and secured to the top wall of the casing with the opposite edges thereof fitted in respective grooves **61**, **61** formed in the other confronting edges of the switch mounting hole. The control switch is located adjacent to the grip **12** and shielded from the air passage portion by a partition wall **62** integral with the

casing. The power cord **63** is extending through the interior hollow of the grip **12** and has one end connected to the control switch **57**. Reference numeral **64** designates a bushing for the power cord, which has its flange **66** clamped between the end wall **65** and the wall **10** of the casing, whereby said bushing is securely held in position.

An air passageway **67**, defined by the wall **10** and the bottom wall of the casing, is tapered towards the rear end of the casing but the cross sectional area of the narrowest portion thereof is made larger than the area of the air suction opening **25** in tht fan **15** as shown in FIG. 4. The air passageway is in communication with the outlet opening **69** in the rear end wall of the casing, which outlet opening is covered by a grill structure composed of vertically extending rods **68** as best shown in FIG. 5 A current guide plate **70**, as shown in FIGS. 1 and 3, is provided behind the suction unit mounting portion **17**. This current guide plate **70** is formed integrally with the wall **10** of the casing defining the air passageway **67** and extending transversely from one side wall of the casing to substantially the center line of the fan **15** as shown in FIG. 3, so that the current produced by the fan **15** and flowing in the direction of the arrows in FIG. 3 will be led into the air passageway by said current guide plate **70**. In the embodiment shown, the fan **15** is rotated in a counterclockwise direction as viewed from the backside of the cleaner and therefore the current guide plate **70** is provided on the right hand side wall of the casing so as to lead the current into the air passageway **67**. The drive motor **16**, as described previously, is supported at its peripheral wall by the filter bag supporting framework **20** through the rubber ring **35**. Indicated by **71** is a hole formed in the drive shaft **56** of the drive motor **16** to receive the tip end of the stop screw **55** by which the fan **15** is fixed to said drive shaft. Reference numeral **72** represents a corrugated washer mounted on the drive shaft **56** of the drive motor to be interposed between said drive shaft and the bearing **41**.

In operating the hand vacuum cleaner of the construction described above, the fan **15** is driven at a high rate by the drive motor **16** and the air interior of the fan cover **39** is blown out by the fan **15** tangentially of said fan, producing a vacuum in the central portion of the fan so that air is sucked into the fan through the air suction opening **25**. Accordingly, air outside of the vacuum cleaner is sucked, along with dusts, into the cleaner body through the beak **31**, forcibly opening the check valve **30**. The dust thus sucked into the cleaner is screened by the filter bag **19** and accumulated in the air space defined by the tapered peripheral wall **27** of the filter bag and the inner surface of the dust accumulating hood **28**. The air passing through the filter bag is sucked by the fan **15** and flows through the air passageway **67** to be discharged through the outlet opening **69**. Upon completion of the cleaning operation, the dust accumulating hood **28** is removed from the casing together with the filter bag **19** and then the filter bag **19** is taken out of the dust accumulating hood **28**, whereby the dust accumlated between said dust accumulating hood and said filter bag can be readily discarded.

According to the present invention, since the drive motor **16** is disposed in a compact form within the filter bag **19** which is stretched in a direction opposite to the air sucking direction forwardly of the fan **15** and no operating parts are present in the rear portion of the casing, the air passageway **67** can have a larger cross sectional area than the suction opening **25** in the fan **15**. Moreover, since the transverse hollow **11** is formed above the air passageway **67** to shape the grip and said air passageway **67** is formed in substantially the lower half portion of the fan **15**, the air blown by the fan **15** can be discharged smoothly from the outlet opening **69** through the air passageway **67** without making a spiral motion in said air passageway. Still further, since the cross sectional area of the air passageway **67** is made larger than the area of the suction opening **25** in the fan **15**, suction and discharge of air are effected smoothly without interfering with the performance of the fan **15** and accordingly an efficient cleaning effect can be obtained. Another advantage of the inventive vacuum cleaner is that, since the grip is provided independently of the air passageway or at a portion of the casing other than the portions in which the air stream is present, rational space utilization of this portion can be attained and a grip of small diameter can be provided which will enable the operator to hold the vacuum cleaner easily with little fatigue remaining in the hand of the operator after use, and further the appearance of the vacuum cleaner can be improved. Still further, since the drive motor **16** is disposed in the filter bag **19** as described, the entire length of the vacuum cleaner can be shortened, rendering the cleaner compact in form. Still further, since the current guide plate **70** is provided behind the fan **15**, the air blown by the fan **15**, particularly the air directed in another direction than into the air passageway **67**, is smoothly led into said air passageway by being guided by said current guide plate and smoothly discharged through the outlet opening. The current guide plate **70** also serves to prevent the air from making a spiral motion immediately behind the fan **15**, so that the smooth discharge of the air is further promoted. Therefore, pressure will not build up in the air passageway and efficient operation of the fan can be secured.

Still another advantage of the inventive vacuum cleaner is that, since the surface of the filter bag **19** is composed of the tapered portion **27** and the substantially flat end portion **26**, the dust sucked is accumulated in the interspace between the tapered peripheral surface **27** of the filter bag and the dust accumulating hood **28**, or in other words, the dust is accumulated only on the tapered peripheral surface **27** of the filter bag and the flat end portion **26** of the filter bag will not be covered by the dust even when a large amount of dust is sucked in. Moreover, since the surface area of the flat end portion **26** is larger than the area of the suction opening **25** in the fan **15** as described, lowering of the flow rate can be minimized and the performance of the fan will not be impaired by the dust sucked. Consequently, high cleaning efficiency can be maintained over a prolonged period.

The hand vacuum cleaner according to the present invention can be assembled in the following manner. First of all, the bearing **41** is mounted on the bent lugs **42** of the mounting legs **40**, provided on the fan cover **39**, by means of screws and then the drive motor **16** is secured to the fan cover **39** by means of tightening bolts which are inserted through the bracket **33**, the core **32** and the bracket **34** from the outer end wall of the bracket **33** and screw threaded into the tapped holes in the bent lugs **43** of the mounting legs **40**. Then, the rubber ring **35** is fitted around the bracket **33**. The lead wires **46** from the drive motor **16** are passed through the notches **45** and **47** in the fan cover **39** and thereafter the fan **15** is fixed to the drive shaft **56** of the drive motor **16** by tightening the stop screw **55** through the boss **54** by such means as a screw driver **48** inserted through the notch **49** in the fan cover **39**, in the manner illustrated in FIG. 7. Upon completion of this, the buffer ring **50** is fitted around the peripheral edge of the fan cover **39**. The control switch **57** is connected to the terminal ends of the respective lead wires **46** from the drive motor and the power cord **63** passing through the bushing **64** is connected to said control switch **57**. The suction unit thus assembled is secured at the bracket **33** and the fan cover **39** by the filter bag supporting framework **20** and the suction unit mounting recess **17** respectively, while the control switch **57** and the decorative frame **60** are fitted in the respective grooves **58** and **61** in the wall edges of the casing respectively. The bushing **64** is positioned between the wall **10** and the end wall **65** of the casing and then the halves **9** and **9'** of the

casing are put together by interlocking the interlocking steps **21** and **21'** in the peripheral edges of the respective halves and tightened together by screws **23**. Thus, the suction unit is securely accommodated within the casing, and the control switch **57**, the decorative frame **60** and the bushing **64** are secured in the prescribed positions respectively. Thereafter, the filter bag **19** is placed around the supporting framework **20** and the dust accumulating hood **28** is screw threaded on the casing.

In the embodiment described hereinabove, the bracket **34** on the fan side of the drive motor **16** is formed of a synthetic resin material integrally with the brush holder **38** on which the guiders **37** for the brushes **36** are mounted. Therefore, the number of parts can be reduced and accordingly labor required for the assembling work can be saved. In addition, such construction is advantageous in obtaining a good commutating result because the center of the brush holder **38** can be held in alignment with the center of the core **32** and the relative position of the brushes **36** and the surface of the commutator can be maintained constant. Furthermore, according to the construction of the inventive vacuum cleaner, mounting of the drive motor **16** on the fan cover **39** and assembling of the drive motor **16** can be accomplished simultaneously by passing the tightening bolts through the bracket **33**, core **32** and bracket **34** and screw threading said bolts into the respective tapered holes in the lugs **43** of the mounting legs **40** on the fan cover **39**. The bearing **41** is also mounted on the fan cover **39** by making use of the mounting legs **40**, without requiring any additional fixture. Again, this is advantageous in reducing the number of parts, saving labor required for the assembling work and lowering the cost of the vacuum cleaner.

The boss at which the fan **15** is secured to the drive shaft of the drive motor by the screw **55**, is formed to extend inwardly of the base plate **15**, that is, towards the drive motor. This enables the entire width of the fan to be reduced so as to be smaller than the type of fan which has its boss extending rearwardly, and accordingly enables the length of the drive shaft of the drive motor to be shortened, so that the vibration of the drive shaft can be minimized.

The lead wires **46** from the drive motor **16** are passed through the notches **45** and **47** formed in the peripheral edge of the fan cover **39**, instead of routing them outside of the fan cover. Such arrangement is effective in reducing the diameter of the vacuum cleaner, rendering said vacuum cleaner compact in form.

Furthermore, according to the invention, since the fan cover **39** on which the drive motor is mounted has the peripheral edge thereof received in the annular recess **17**, defined by the ribs **13** and **14** on the inner surface of the casing, through the intermediary of the buffer ring **50**, the suction unit composed of the drive motor **16** and the fan cover **39** can be rigidly held in position, and the air outlet side of the casing can be completely sealed from the air suction side at the fan cover mounting portion and thereby air is not permitted to move into the air suction side from the air outlet side at said portion. The use of the buffer ring **50**, therefore, is effective not only in dampening the vibration of the suction unit but also in in maintaining the vacuum produced by the fan. Of course, the notches **49** and **47** in the peripheral edge portion of the fan cover are shielded by the buffer ring **50**.

The suction unit previously assembled in the manner described hereabove is supported by the filter bag supporting framework **20** and the casing, through the rubber ring **35** fitted around the drive motor **16** and the above-described buffer ring **50**, in a completely floating state, so that the vibration generated by the operating parts in the suction unit can be dampened completely.

Still further, according to the invention, the drive motor **16**, fan cover **39**, fan **15**, control switch **57**, power cord **63** and bushing **64**, are assembled or connected with each other before they are accommodated in the casing, so that

they can be mounted in the casing all at once by only combining and tightening the casing halves **9** and **9'** together by the tightening screws **23**. This enables the assembling work to be simplified remarkably compared with a conventional hand vacuum cleaner which is assembled by fixing the component parts in the casing individually. In addition, according to the invention, the suction unit can be secured rigidly in the casing in a very simple manner without necessitating the use of screws or other fixing means, by only fitting a half of the circumference of the buffer ring **50**, mounted on the peripheral edge of the fan cover, in the semicircular mounting recess **17** in one half of the casing and thereafter putting another half of the casing together with said first half in such a manner that another half of the circumference of the buffer ring is received in the semicircular mounting recess in said other half of the casing.

The control switch **57** can also be rigidly mounted in the casing wall very simply, without using additional fittings, by putting the halves **9** and **9'** of the casing together while receiving the opposite edges of the switch mounting platet **59** in the respective grooves **58, 58** and the opposite edges of the decorative frame **60** in the respective grooves **61, 61** formed in the wall edges of the respective casing halves. The control switch is completely shielded from the air passage portion by the partition wall **62**, so that the operator will not be bothered by the draft gushing through the gaps between the switch and the decorative frame and further the insulation failure of the switch can be prevented which would otherwise be caused by the very fine dust having passed through the filter bag **19**.

The bushing **64** through which the power cord **63** is passed into the grip **12** for connection with the switch **57**, has its flange **66** clamped between the end wall **65** and the wall **10** of the casing and therefore is always held in position positively.

In the conventional vacuum cleaner of this type, the dimensions of the bracket **34** on the fan side of the drive motor **16** are not always uniform due to the contraction or distortion during shaping of the synthetic material of which said bracket is molded and such irregularities in dimension, particularly the irregularities in the thrust of the drive shaft **56** caused by said dimensional irregularities, make it impossible to obtain a uniform performance of the vacuum cleaner since the distance between the fan **15** and the fan cover **39** is variable. According to the present invention, however, since the corrugated washer **72** is interposed between the drive shaft **56** of the drive motor and the bearing **41**, no thrust is produced in any case despite the possible irregularities in dimension of the bracket **34** and further, since the corrugated washer **72** urges the drive shaft **56** forwardly with respect to the air sucking direction, the distance between the fan **15** and the fan cover **34** can be maintained constant at all times, whereby vacuum cleaners of uniform performance can be produced. The distance between the fan and the fan cover will ont change even during operation and the corrugated washer **72** will not be subject to an unreasonable force because the fan **15** is always subject to a force which urges said fan forwardly with respect to the air sucking direction.

What is claimed is:

1. A compact hand vacuum cleaner comprising a generally cylindrical casing, said casing having a front and a rear portion, said casing have a generally rectangular transverse hollow extending therethrough, said transverse hollow in said casing forming a grip, an air passageway disposed underneath said grip, an air guide plate, said air guide plate extending forwardly from said air passageway, an air outlet disposed in said rear portion of said casing, a suction unit connected to said casing in axial alignment therewith, said suction unit comprising an electric motor, said electric motor having a shaft, a fan attached to said shaft, said fan having a suction opening, a

bowl-shaped fan cover, said fan cover having a brim portion and a latticed framework bottom portion, means connecting said fan cover to said motor adjacent said bottom portion of said fan cover, means disposing said brim portion of said fan cover in said front end of said casing, buffer ring means disposed between said brim portion of said fan cover and said casing, filter bag means covering said framework bottom portion and supported thereby, said filter bag means having a bottom and a brim, said filter bag means having a flat portion adjacent said bottom and a tapered portion between said bottom and said brim, a dust accumulating hood, said hood having an air inlet beak, said hood being disposed exterior to said filter bag means, means connecting said hood to said front portion of said casing so that said hood and said casing are readily detachable, said cross sectional area of said air passageway being larger than said suction opening and said flat portion of said filter bag means being larger than said suction opening.

2. A compact hand vacuum cleaner as set forth in claim 1 further including means to secure said motor to the wall of said fan cover to receive said motor in an annular recess formed on the inner surface of said fan cover, said means comprising a buffer ring between the core of said motor and said framework bottom portion so as to dampen the vibration of the suction unit.

3. A compact hand vacuum cleaner as set forth in claim 1 further including bolt means to fixedly connect said motor to said fan cover, said shaft of said motor being journaled through a bearing, said bolt means extending through a first bracket, the core of said motor and a second bracket having their end extremeties screw threaded into tapped through-holes in respective bent legs of a plurality of mounting legs, said mounting legs being disposed on the front side of said fan cover, said bearing being fixed to other lugs of said mounting legs by screws, said bracket being formed as a synthetic resin material, said second bracket being integrally formed with a brush holder, said brush holder containing guiders for brushes thereon.

4. A compact hand vacuum cleaner as set forth in claim 1, including lead wires, said lead wires being passed from said motor to a first notch formed in the peripheral wall of said fan cover and through a second notch formed in the flange of said fan cover, said first and second notches being shrouded by said buffer ring means, said buffer ring means being fitted around the peripheral edge of said fan cover.

5. A compact hand vacuum cleaner as set forth in claim 1, said fan including a boss extending forwardly towards said drive motor, said fan being provided with a stop screw by which said fan is fixed to said drive shaft of said drive motor, a notch formed in the peripheral wall of said fan cover to provide for screw threading said stop screw, said notch being shrouded by a buffer ring fitted around the peripheral edge of said fan cover.

6. A compact hand vacuum cleaner as set forth in claim 1, wherein said casing and said framework means are integrally molded of a synthetic resin material and are splittable into symmetrical halves so that said suction unit may be mounted in said framework means by putting said symmetrical halves together with said suction unit therebetween.

References Cited

UNITED STATES PATENTS

2,454,569	11/1948	Rector	15—412 X
3,334,370	8/1967	Boyd	15—327

FOREIGN PATENTS

570,906	9/1958	Belgium.

ROBERT W. MICHELL, Primary Examiner

U.S. Cl. X.R.

15—412