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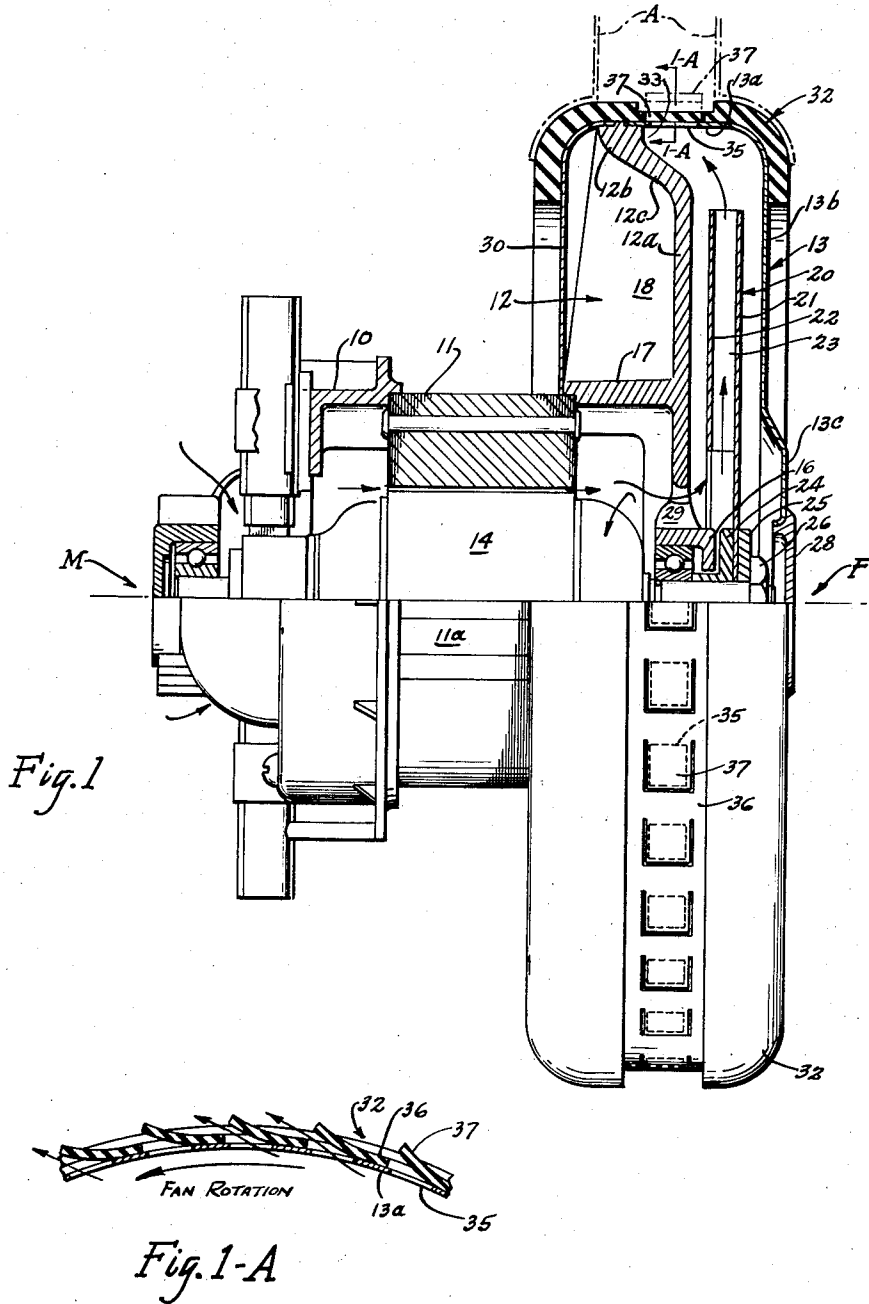
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VACUUM CLEANER MOTOR-FAN UNIT

Filed Dec. 27, 1956

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

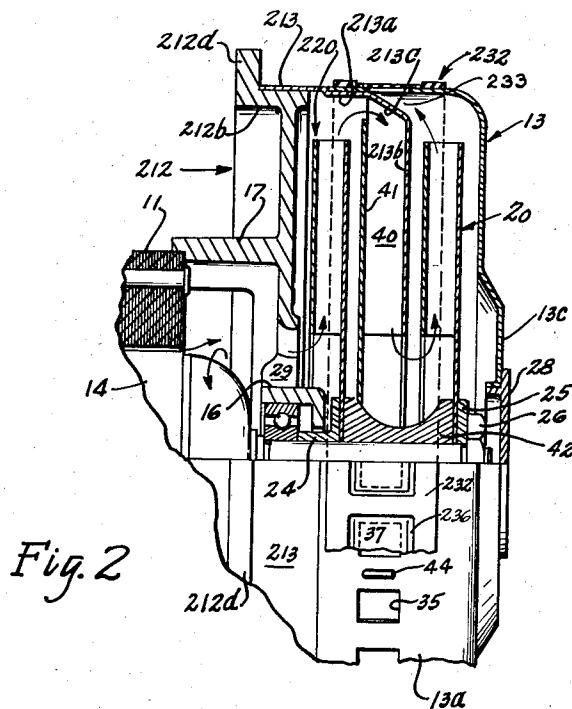


Fig. 2

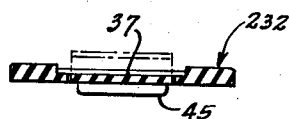


Fig. 2-A

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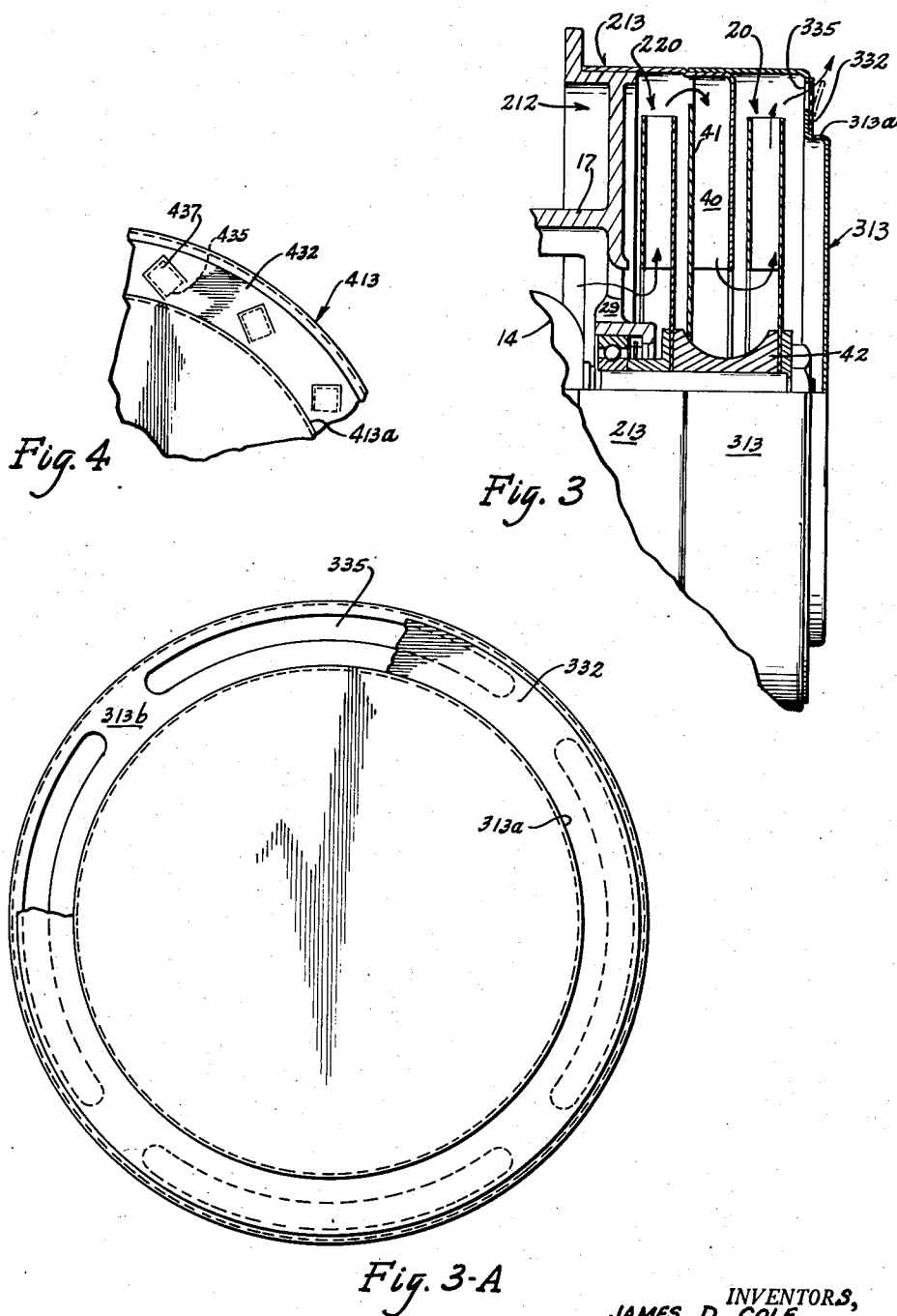
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VACUUM CLEANER MOTOR-FAN UNIT

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22 Claims. (Cl. 230—117)

The present invention is concerned generally with an electric motor-fan unit for vacuum cleaner applications and more particularly to such unit providing novel structure determining the course of air flow therethrough.

In vacuum cleaner units, the electric motor and fan structure of the prior art, still generally used, provides a flow path for the volume of cleaning air passing first through the fan assembly and then from the fan exhaust through or around the motor for cooling the latter. However some prior structures have provided for air flow in the reverse sense, that is first through or about the motor and then into the inlet of the suction fan.

The present invention provides a novel structure for obtaining such reverse air flow, here for the specific purpose of obtaining better motor ventilation by directing the moving air first through the motor or around the motor elements before entering the fan assembly; and this in a durable structure adapted to simplicity in form and number of elements, low cost mass production and excellent cooling in operation. The disclosed structure attains such motor cooling that at given operating conditions, the operating temperature is lowered markedly in comparison with units of similar rating and analogous structure wherein the motor is cooled rather by a stream of cleaning air exhausting from the suction fan assembly. Consequently the entire unit may be given a higher electrical rating insofar as operating characteristics are concerned.

Furthermore in the fan assembly construction of the reverse flow unit here disclosed a novel type of fan assembly outlet or exhaust port construction is provided which in static operation, that is under conditions where the volume of cleaning air passing through the unit is substantially zero, cuts down localized air recirculation into and out of the fan chamber at the exhaust outlets and further presents a relatively smooth fan shell interior aspect to the air mass rotating therein to minimize energy losses under the defined static operating conditions. In consequence there is a lower load on the motor than is otherwise to be expected under static operating conditions in analogous units without such outlet construction; and therefore higher speed operation and a higher degree of static vacuum is obtainable. Such result is attained by mounting on the fan shell a plurality of elastic or resilient closure elements which automatically close upon the fan shell outlet openings as the volume of air passed therethrough decreases, but which are easily displaced to variable open positions for passage varying air volumes under the dynamic conditions of operation.

The general object of the invention is then to provide a reversed air flow electric motor and fan unit for a vacuum cleaner having relatively simple durable structure adapted to low cost mass production. Another object is the provision of a vacuum cleaner motor fan unit adapted to provide improved motor ventilation. A further object is the provision of an outlet or exhaust structure in the fan assembly particularly adapted and useful in a reversed flow electric motor fan unit for a

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vacuum cleaner, though having application in other fan assemblies.

Other objects and advantages will appear from the following description and the drawings wherein:

Fig. 1 is a side view of a single stage vacuum cleaner unit embodying the invention, certain portions being partly in axial section and broken away to show internal structure;

Fig. 1-A is a detail fragmentary view in section of the air outlet port structure of the unit of Fig. 1;

Fig. 2 is a fragmentary view of a two stage vacuum cleaner unit showing a modification of the fan shell structure;

Fig. 2-A is an enlarged view showing in section the form of the annular rubber member appearing in the outlet port structure of Fig. 2;

Fig. 3 is a fragmentary view of a two stage unit showing a still further modification;

Fig. 3-A is an end view of the vacuum cleaner unit of Fig. 3; and

Fig. 4 is a fragmentary view showing a modification of the outlet structure appearing in Figs. 3 and 3-A.

The basic structure of the unit, appearing more fully in Fig. 1, comprises an electric motor M and fan assembly F, the particular form disclosed in the drawings being in wide sense similar to that appearing in, but arranged for air flow in a sense reverse to that of in the Cole U.S. Patent 1,713,455 of July 19, 1955 as well as having other pertinent differences hereinafter described.

Thus the motor includes one end or bearing bracket 10 fitted onto the end of the field core 11, having an integrally externally finned bearing socket and also mounting the brushes in the case of a commutating motor; a second end or bearing bracket 12 fitted onto the other end of the core and having a disk-like radial extension 12a, which serves not only as an end wall of a fan chamber, but also as a support for a fan shell element 13 mounted on its rim 12b; and a rotor or armature 14 supported in bearings slip fitted into the bearing sockets of brackets 10 and 12 with one end extending through bracket 12 into the fan assembly F. Suitable means (not shown) are provided to secure the end brackets and field core together; which (especially with a commutating motor) may as shown in the aforementioned patent comprise bolts passed through arcuately slotted lugs projecting radially from the end bracket 10, and extending externally of the core into threaded engagement with the end bracket 12.

The end bracket 12 includes an integral centrally apertured, rearwardly open bearing socket formation 16 with the disk portion 12a extending radially therefrom, and also integral field core engaging and spacing means 17 projecting from the rear of the disk. A plurality of angularly spaced reinforcing or supporting webs 18 integrally join the rim 12b, means 17, disk portion 12a, and the joining portion 12c whereby the offset rim is merged into the disk portion.

A cylindrical ring or (as shown) a plurality of circularly spaced arcuate posts, rabbeted coaxially with the bearing socket 16 to embrace and fit the outer edge of the adjacent field core end circumferentially and endwise, are apt forms taken by means 17, whereby the bearing socket 16 and therewith the disk 12a is mounted in spaced relation to the core. The outer circumference of the rim 12b, from each end in toward a radially projecting separating shoulder, is machined to provide cylindrical surfaces for mounting shell elements as later described.

In the fan assembly F, the fan shell 13 is a drawn sheet metal cup having a cylindrical wall portion 13a fitted onto the rim 12b and a generally radial end wall 13b spaced from the front radial face of end bracket

12 to form therebetween a fan chamber. The cylindrical shell wall may be secured on the bracket by conventional means such as staking the wall inwardly at a few points into a recess or groove formed in the rim periphery, or by screws threaded radially through the wall into the rim.

A fan impeller 20 of well known form and mounting, comprised of two axially spaced thin sheet metal disks 21 and 22 of equal diameter with curved sheet metal blades or vanes 23 secured therebetween, is rotatably mounted within the fan chamber and clamped on the rotor shaft passed through a corresponding central aperture of disk 21 by a flanged spacer sleeve 24, clamping disk or washer 25 and clamping nut 26 threaded onto the rotor shaft end. The flange of the sleeve 24 and the like sized washer 25 give radially extensive support to the central area of the disk 21. With the sleeve 24 extending through the bearing socket central aperture to abut against a shoulder provided by the inner face of a bearing pressed onto the shaft, the impeller is held in selected axial and angular relation to the rotor, while the rotor and therewith the impeller may be yieldably axially located in the unit by biasing thrust spring elements operatively interposed between the bearing socket end walls and the bearings where the latter are slip fitted into their respective sockets.

Arcuate openings 29 in bracket 12 circumferentially spaced around socket 16 form an air inlet structure from the motor interior to the impeller inlet opening provided by the larger central opening of annular disk 22.

To permit ready access to the shaft end region in the fan chamber during assembly and fan balancing operations while attaining a desirable spacing of the shell radial end wall from the outer region of the impeller, a centrally apertured circular portion 13c is dished or drawn outwardly in the end wall, the inwardly flanged aperture therein being closed by a light press-fitted removable plug 28.

A second shell 30, formed of sheet metal with a short cylindrical wall or rim portion fitted onto the bracket rim 12b in manner similar to and opposite shell 13 and including a radial end wall with a central opening complementary to the peripheral shape of the core 11 and embracing the same, among other functions, provides a closure between the end bracket 12 and the core; whereby apart from any tolerated leakage, all air entering the fan is constrained to enter the brush end of the motor through the end bracket 10, thus initially passing over the finned bearing socket structure therein, the brushes and commutator, between the rotor and field core and around bearing socket 16.

Where a commutating motor is used as here shown, the shell 30 may serve to fix the core 11 against any relative rotational displacement during brush adjusting rotational shift of bracket 10, by engagement of its radial end wall with the core, for example by a projection of the shell in an external longitudinal core groove 11a, or by non-circular form of core exterior to which the opening of shell 30 conforms.

As a part of the fan outlet or exhaust structure and also of structure mounting the unit in its environment of use, an elastic molded rubber or synthetic plastic annular member 32 is fitted on the circumference of the fan assembly. In shells 13 and 30 the radial end walls merge through curved shell edge portions into the cylindrical walls, and an axial cross section of the annular member 32 as seen in Fig. 1 is more or less channel- or U-shaped, so that the member 32 conforms to and embraces the fan assembly not only circumferentially but also overlaps an outer edge portion of the radial walls in shells 13 and 30. Mounting rings or a plurality of circumferentially spaced paired mounting clips (for clarity of the drawing shown only in cross section by the dashed outline elements A in Fig. 1) embrace the unit through mediation of member 32, the radial parts of the mounting ele-

ments being bolted to surrounding environmental structure. Where a mounting ring is used adjacent shell 30, it may also serve as a partition separating an inlet air chamber of a vacuum cleaner from an outlet chamber.

For the outlet structure of the fan chamber, a circumferentially spaced series of square outlet ports or windows 35 are formed in the cylindrical wall 13a of shell 13, at a locus offset axially from the fan impeller, to lie outward of the circumferential channel 33 formed between rim 12b and portion 12c of bracket 12, and the cylindrical wall 13a, as a result of the rim offset. Member 32 is molded with a broad flat bottomed circumferential groove in its cylindrical portion, providing a band 36 of reduced thickness wider than, and overlapping the locus of, windows 35. In the band 36, the thickness of which is emphasized in the drawings for clarity, a series of similarly oriented identical squared U-shaped incisions form flaps 37 each located to overlap a corresponding window 35 as shown in Fig. 1-A and the lower half of Fig. 1. The free edge opposite the line of attachment or hinging of each flap is disposed on the side toward which the impeller rotates.

In consequence of such structure, under dynamic operating conditions, i.e. during actual cleaning flow air movement, the flaps 37 are displaced as indicated in Fig. 1-A, or in dashed lines 37 of Fig. 1, to allow escape of air in approximately tangential fashion from the fan chamber, the opening varying as required by the volume of air moved.

On the other hand under static conditions of operation, where no air or substantially no air is passing through the unit, the elastic flaps automatically move to their normally closed position, closing outlet windows 35 to prevent localized recirculation of air in and out of each opening 35; and to present a relatively smoother interior aspect to the fan shell to the air being translated in a circular path within the fan chamber. Thus under static conditions those energy losses are minimized that would otherwise occur from local recirculation at open discharge or outlet areas and through friction loss in the air moving around the fan chamber past open discharge areas. Hence the motor load is reduced; and a higher fan speed and higher degree of static vacuum may be obtained with a given commutating motor. Because of the better static vacuum thus obtainable, a single stage fan structure of acceptable diameter may be used in some applications where a two-stage assembly would have been required.

Further the offset location of the fan chamber outlets relative to the shell blade tips minimizes the siren effect common in fan structures of this general type when fan shell apertures are located radially of the fan tips.

The incisions forming flaps 37 are shown as resulting from the actual shearing of a small amount of material out the band 36, as a simple way of ensuring opening and complete closing of the flaps without hesitation by providing clearance between the flaps and the adjacent band structure. Also the flaps are shown as overlapping the edges of the openings which thereby serve as stops for the closing motion of the flaps.

The form of member 32 not only provides a vibration absorbing structure to minimize sound transmission between the unit and environment, but also is self-retaining in the contemplated use to prevent displacement of flaps 37 relative to windows 35 once the unit is assembled.

In the unit thus far described, not only does the structure provide effective motor ventilation by the air path through the motor toward fan, so that incoming cool air first ventilates the motor before entering the fan assembly, with excellent heat dissipation areas in the metal continuous with the bearing socket formations, as well as a novel air outlet structure for the fan assembly, but also it is adapted to low cost durable construction, for example die casting of member 12 and fabrication of shell 13 by known sheet metal forming operations.

Modification of Fig. 2

In Figs. 2 and 2-A there appears in fragmentary view a second form of fan assembly, wherein like numerals are used to designate elements identical with or closely similar to those of Fig. 1, and the motor structure not appearing may be like to that of Fig. 1.

In this modification, a drawn sheet metal shell 213 secured on the rim 212b of end bracket 212 and a shell 13 pressed in telescoped fit on the first shell provide first and second stage fan shells enclosing respectively the identical impellers 220 and 20. In this Figure 2, no shell 30 appears, so that air may be drawn not only through the interior of the motor but also around the exterior portions of the core 11 between the spacing posts 17 integrally formed on bracket 212. The rim 212b is not offset as in Fig. 1, and further has a radial flange 212d whereby the unit may be bolted, clamped or otherwise suitably secured to surrounding environmental structure.

The cylindric wall portion of fan shell 213 is reduced slightly at 213a to receive and provide a stop shoulder for the shell 13 press fitted thereon, and is integrally joined by the tapered portion 213c to the radial end wall 213b having a large central opening as an inlet to the second stage. A plurality of angularly spaced fixed vanes 40, secured to the end wall 213b and running from the tapered corner 213c inward to the central discharge opening of the end wall, carry an annular plate 41 circumferentially spaced from shell 213. A spool-shaped spacer sleeve 43 is interposed on the rotor shaft between the first and second stage impellers as part of the clamping means provided after the fashion of Fig. 1 by flanged sleeve 24, disk 25 and nut 26. The central opening of plate 41 approaches the end region of sleeve 42 closely and the latter has a circumferential groove curved in axial cross section to direct air the more efficiently from the inner discharge ends of channels formed between vanes 40 into the inlet eye of the impeller 20.

The second stage shell 13 is identical with that of Fig. 1, with the addition of a few elongated apertures 44 formed between adjacent outlet openings 35 at certain spaced locations for location of the elastic band member 232 providing a fan unit exhaust port control structure similar to that of member 32 in Fig. 1. The axial section of member 232 is shown enlarged in Fig. 2-A. A series of recesses corresponding in spacing to shell windows 35 are molded in the outer surface of member 232 to form panels 236 of reduced thickness, which panels are cut to form flaps 37. A plurality of elongated beads 45 are molded on the inner cylindrical surface of member 232 at locations corresponding to shell apertures 44, so that when the member 232 is stretched over and positioned on the shell, beads 45 enter openings 44 to retain the band structure in proper relation to the underlying shell.

Again in Fig. 2, the series of openings 35 are axially offset in locus from the impeller 20 to avoid siren effect, and the tapered wall portion 213c in conjunction with the cylindrical portion of shell 13 forms a circumferential channel 233 just outward of impeller 20 receiving air from the fan for discharge through the flap controlled or covered windows or discharge areas 35. The function of this discharge structure is that described for Fig. 1.

Modifications of Figs. 3 and 4

In Figs. 3 and 3-A there again appears a two stage fan modification generally similar to Fig. 2, and having parts like to those of Figs. 1 or 2 bearing like reference numerals. The end bracket 212, the first and second stage impellers 220 and 20 and clamping means therefor, the mounting of first and second stage fan shell elements 213 and 313 are identical with the corresponding items of Fig. 2.

The principal change in Fig. 3 appears in the outlet port structure of the fan unit, which discharges endwise through end wall openings 335 rather than through the

side wall of shell 313. Accordingly the taper 213c of the first stage shell in Fig. 2 is omitted. The shell 313, which may be drawn with a sharper corner between the radial end and cylindrical wall portions, has a large round outwardly dished portion not only to accommodate the shaft end elements, but also to provide a shoulder 313a locating a flat rubber or elastic synthetic plastic annulus 332 covering the series of elongated arcuate openings 335 formed in the annular radial flat 313b outward of the shoulder 313a at a side position adjacent to but just outward of the fan impeller periphery. The inner face of band 332 is cemented to flat 313b along a circumferential locus lying inward of the openings 335. Thus the free outer circumferential portion of the band serves as a flap varying the end outlet openings in manner similar to that of flaps 37 previously described.

Fig. 4 shows in rather schematic form a modification of the structure of Fig. 3 wherein a series of square outlet openings 435 are formed in the shell 413, which otherwise is similar to 313. As in Fig. 3, a shoulder 413a centers a flat elastic band 432, which however has incisions forming flaps 437 covering windows 435 after the manner of Figs. 1 and 2. In this case except for the flaps 437 the entire extent of band 432 may be cemented to the annular radial flat lying outward of shoulder 413a.

It is to be understood that the structure of Figs. 3 and 4 may be simplified to a single-stage fan structure where an end discharging single-stage assembly is desired.

We claim:

1. In an electric motor-fan unit for a vacuum cleaner, wherein air is drawn over motor elements for motor ventilation into the fan assembly, the structure comprising: a motor field core; a rotor therein having a shaft; a first end bracket and a second end bracket having bearings therein for supporting the rotor shaft; the first bracket having openings therethrough to admit a ventilating air stream to the interior of the motor; the second end bracket being an integral structure including a centrally apertured disk with the rotor shaft projecting there-through, a bearing receiving socket formation open toward the motorward side thereof, a cylindrical rim portion carried at the edge of the disk, and supporting and spacing means extending from the disk to the adjacent end of the core, the disk portion having apertures located between said socket and means as an air outlet from the motor interior; centrifugal fan impeller means on the projecting shaft end having a central opening adjacent the said outlet to receive air therefrom; and fan shell means secured on said rim portion forming with the second end bracket an enclosure for said impeller means; said fan shell means being provided with a series of air exhaust openings axially displaced from and radially outward of the peripheral discharge region of said impeller means.

2. A structure as described in claim 1, wherein an end wall of said shell means opposite the rotor shaft end is provided with a central opening with removable plug therein for access to the shaft end region.

3. A structure as described in claim 1, having second shell means mounted on the said rim portion opposite the first named shell means, said second shell means having a radial wall portion extending inwardly to embrace the core.

4. A structure as described in claim 1 wherein said impeller means is a single stage impeller and said fan shell means is a cup-shaped element with cylindrical wall portion fitted on said rim portion, said rim portion is axially offset toward the motor from said disk and joined thereto by a tapered portion thereby to form a circumferential air channel, and said series of air exhaust openings is formed in said cylindrical wall at said channel.

5. A structure as described in claim 4, having second shell means mounted on the said rim portion opposite the first named shell means, said second shell means hav-

ing a radial wall portion extending inwardly to embrace the core.

6. In combination with the structure described in claim 5, a fan outlet port structure comprising a band of elastic material surrounding the cylindrical shell wall, said band having formed therein outlet flaps each corresponding in location to a respective air exhaust opening in said cylindrical wall.

7. A structure as described in claim 6, wherein said band has end portions flanged inwardly to overlap outer marginal end portions of both said shell means, whereby said band is retained in proper relation to the shell exhaust openings, and the unit may be engaged between axially spaced mounting rings secured to surrounding environmental structure in a resilient mounting.

8. A structure as described in claim 1 wherein said fan shell means includes an end wall spaced endwise from said impeller means and has a series of angularly spaced openings formed therein to provide said exhaust openings, in combination with resilient outwardly opening outlet control flap means secured on said wall.

9. The combination of claim 8, wherein said end wall includes a round endwise projecting shoulder formation circumferentially spaced inward from the outer edge of the shell to define a radial flat annular external area with said series of exhaust openings formed therein and wherein said flap means is provided by an annular elastomeric disk secured at its inner annular margin on said area.

10. A structure as described in claim 8, wherein said exhaust openings are circularly arranged arcuate slots, and said flap means is an annular elastomeric disk overlapping said slots and secured along its inner annular margin to the end wall inwardly of said slots.

11. A structure as described in claim 8, wherein said outlet control flap means comprises an elastomeric disk member overlapping said exhaust openings and having incised therein a series of flap formations disposed over the locus of said exhaust openings.

12. A structure as set forth in claim 1, wherein said impeller means comprises a first and a second stage impeller and said shell means comprises a cylindrically and radially walled cup-shaped first stage shell with open end fitted on said rim portion and a cup-shaped second stage fan shell having open end fitted in partially telescoped relation on the first stage shell; the end wall of the first stage shell having a central opening as a discharge outlet to the second stage impeller and a plurality of air guide vanes secured thereto defining passageways from the peripheral region of the first stage impeller to said central opening, and the cylindrical wall of the first stage shell being joined to the end wall by a short tapered portion defining an annular channel adjacent the second stage shell; the second stage shell having a series of circumferentially spaced apertures axially offset from the second stage impeller at a locus radially outward of said channel to provide said exhaust openings; and a resilient band covering said exhaust openings having a series of flaps incised therein each to cover a respective opening.

13. In an electric motor-fan unit for a vacuum cleaner, wherein the air-flow to the fan assembly is drawn over motor elements for motor ventilation, the structure comprising: a motor field core; a rotor therein; a first end bracket and a second end bracket having bearings therein for supporting the rotor shaft; the first bracket having openings therethrough to admit a ventilating air stream to the interior of the motor; the second end bracket being an integral structure including a centrally apertured disk with the rotor shaft projecting therethrough, a bearing receiving socket formation open toward the motorward side thereof, and supporting and spacing means extending from the disk to the adjacent end of the core, the disk portion having apertures located between said socket and means as an air outlet from the motor interior; centrifugal fan impeller means on the projecting shaft end having a central opening adjacent the said outlet to receive air

therefrom; and fan shell means including a cup-shaped member with a cylindrical wall and end wall; mounting means providing a cylindrical surface to which the open end of the cup-shaped member is fitted for mounting the latter on the periphery of said disk, the last said means and cup-shaped member forming with the said disk an external enclosure for said impeller means; said cup-shaped member being provided in its cylindrical wall with a series of exhaust openings displaced axially toward the motor from, and radially outward of, the peripheral discharge region of said impeller means, said mounting means having a tapered wall portion inward of said cylindrical surface defining a circumferential channel receiving air from the impeller means for discharge through said exhaust openings.

14. In combination with the structure described in claim 13, a fan outlet port structure comprising a generally cylindrical band of elastomeric material surrounding the cylindrical shell wall, said band having formed therein outlet flaps each corresponding in location to a respective exhaust opening.

15. A structure as described in claim 14, wherein said band has integral spaced bead formations projecting from its inside cylindrical surface and the said cylindrical wall has correspondingly located apertures receiving the bead formations whereby said band is retained in proper relation to the shell exhaust openings.

16. In an electric motor-fan unit for a vacuum cleaner, wherein the air-flow to the fan assembly is drawn over motor elements for motor ventilation, the structure comprising: a motor field core; a rotor therein; a first end bracket and a second end bracket having bearings therein for supporting the rotor shaft; the first bracket having openings therethrough to admit a ventilating air stream to the interior of the motor; the second end bracket being an integral structure including a centrally apertured disk with the rotor shaft projecting therethrough, a bearing receiving socket formation open toward the motorward side thereof, and supporting and spacing means extending from the disk to the adjacent end of the core, the disk portion having apertures located between said socket and means as an air outlet from the motor interior; centrifugal fan impeller means on the projecting shaft end having a central opening adjacent the said outlet to receive air therefrom; and fan shell means including a cup-shaped member with a cylindrical wall and end wall; mounting means providing a cylindrical surface to which the open end of the cup-shaped member is fitted for mounting the latter on the periphery of said disk, the last said means and cup-shaped member forming with the said disk an external enclosure for said impeller means; said cup-shaped member being provided in its cylindrical wall with a series of exhaust openings.

17. A structure as set forth in claim 16, wherein said impeller means comprises a first and a second stage impeller and said shell means comprises a cylindrically and radially walled cup-shaped first stage shell with open end fitted on said rim and a second cup-shaped stage fan shell having open end fitted in partially telescoped relation on the first stage shell; the end wall of the first stage shell having a central opening as a discharge outlet to the second stage impeller and a plurality of air guide vanes secured thereto defining passageways from the peripheral region of the first stage impeller to said central opening, and the cylindrical wall of the first stage shell being joined to the end wall by a short tapered portion defining an annular channel with the second stage shell; the second stage shell having a series of circumferentially spaced apertures in the cylindrical wall of the cup-shaped member to provide said exhaust openings; and a resilient band covering said exhaust openings having a series of U-shaped incisions therein to form like oriented flaps each to cover a respective exhaust opening and disposed

to open outwardly toward the direction of impeller rotation.

18. In an electric motor driven vacuum cleaner fan assembly having a centrifugal impeller and a cylindrical cup-shaped fan housing member about the impeller, fan housing exhaust structure comprising: an angularly spaced circumferential series of exhaust openings formed in a cylindrical wall portion of said member, and elastomeric flap means secured on said member to cover the openings therein and being outwardly displaceable, with edges of the openings overlapped by said flap means.

19. In an electric motor driven vacuum cleaner fan assembly having a centrifugal impeller and a cylindrical cup-shaped fan housing member about the impeller, fan housing exhaust structure comprising: a circumferentially spaced series of exhaust openings formed in an end wall portion of said member, and a flat annular elastomeric element secured to said member to cover the openings therein and forming outwardly displaceable flap means, with the opening edges overlapped by said flap means.

20. In an electric motor driven vacuum cleaner fan assembly having a centrifugal impeller and a cylindrical fan housing about the impeller provided with fan housing exhaust openings, fan housing exhaust structure comprising: a series of exhaust openings circumferentially spaced in a wall portion of the said housing, and an annular member of flexible elastomeric material covering said series to form control flap means for said openings, said flap means being outwardly displaceable variably under varying exhaust air flow and self-returning to a closed position closing said openings upon cessation of flow through said openings.

21. In an electric motor driven vacuum cleaner fan assembly having a centrifugal impeller and a cylindrical cup-shaped fan housing member about the impeller fan housing exhaust structure comprising: a circumferentially spaced series of square exhaust openings formed in a cylindrical wall portion of said member, and a cylindrically annular elastomeric band stretched over said member to cover the openings and having a series of incisions therein forming outwardly displaceable flaps, each with free edges overlapping the edges of a corresponding opening.

22. In an electric motor driven vacuum cleaner fan assembly having a centrifugal impeller and a cylindrical fan housing about the impeller provided with fan housing exhaust openings, fan housing exhaust structure comprising: a series of exhaust openings circumferentially spaced in a wall portion of the said housing, and an annular elastomeric member disposed over said series and incised to form control flap means for said openings, said flap means being outwardly displaceable variably under varying exhaust air flow and self-returning to a closed position closing said openings upon termination of flow through said openings.

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