May 30, 1967 R. J. KENNY ETAL 3,322,331

AIR IMPELLER AND HOUSING UNITS

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FIG. 1

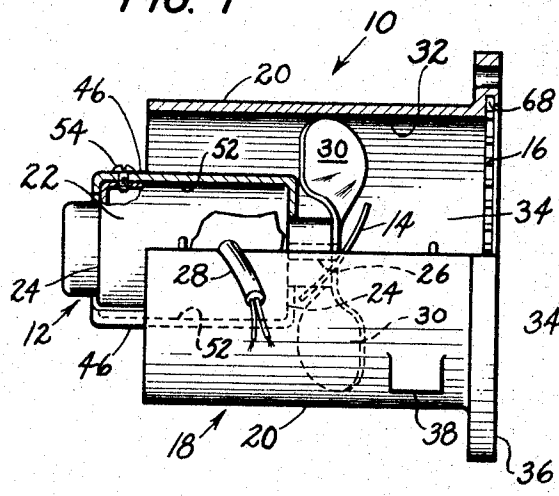


FIG. 2

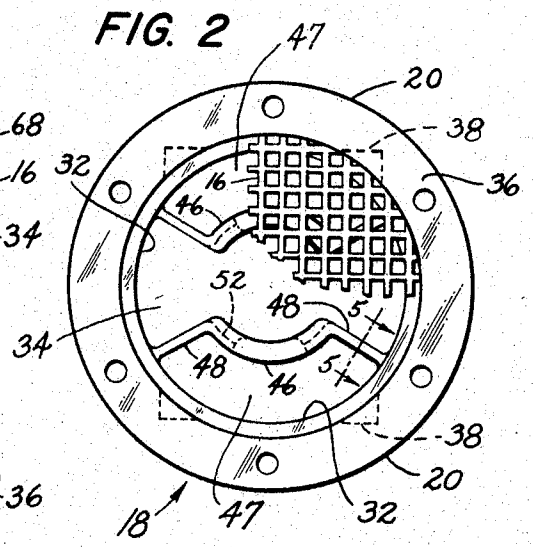


FIG. 3

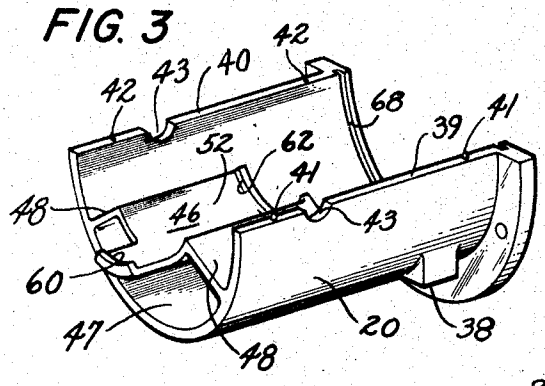


FIG. 4

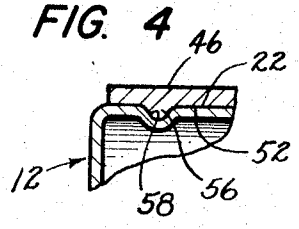
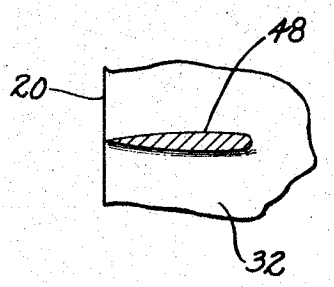


FIG. 5



INVENTORS
Robert J. Kenny
Donald F. White

BY
McCormick, Paulding & Huber

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FIG. 6

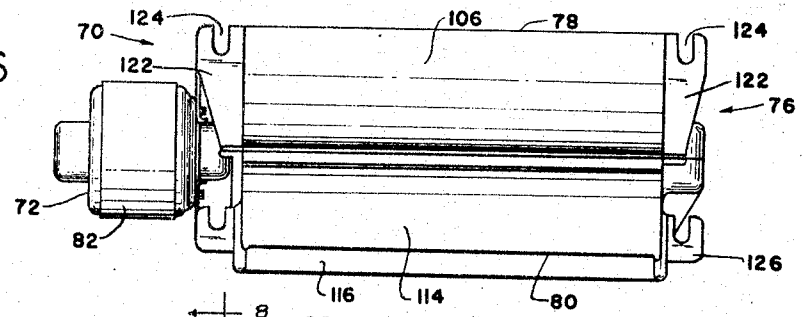


FIG. 7

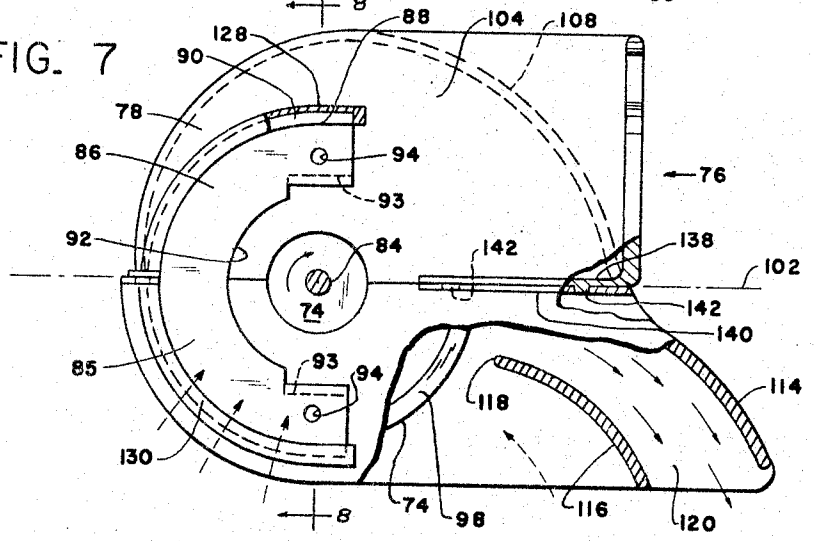
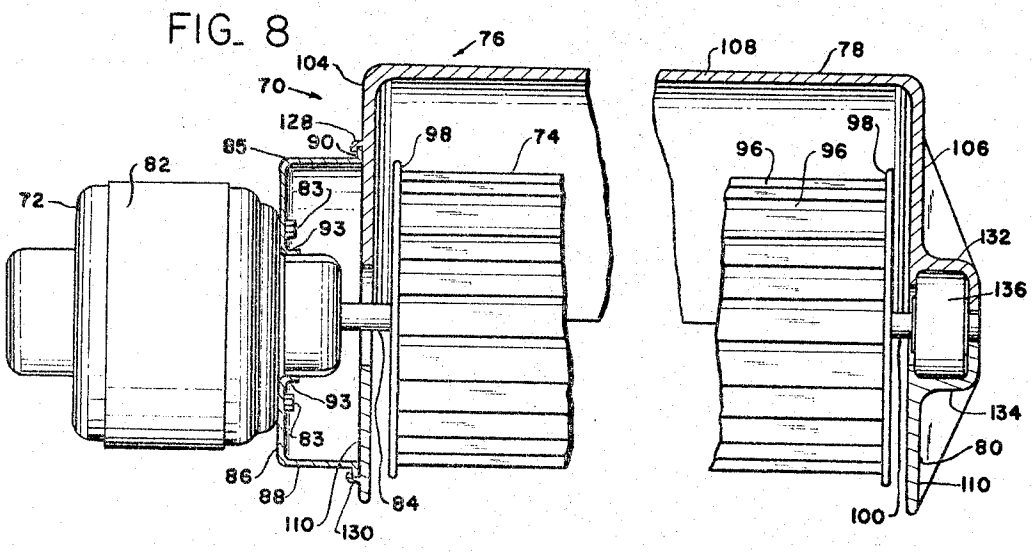


FIG. 8



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AIR IMPELLER AND HOUSING UNITS

Robert J. Kenny, Litchfield, and Donald F. White, Torrington, Conn., assignors to The Torrington Manufacturing Company, Torrington, Conn., a corporation of Connecticut

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17 Claims. (Cl. 230—117)

This invention relates to improvements in air impeller units and deals more particularly with improvements in air impeller units of the type having a housing including an integrally formed motor supporting structure.

The alignment and assembly operations normally required in the manufacture of small air impeller units contribute substantially to unit production cost.

Molding processes are frequently employed in producing components for such air impeller units. However, a molding machine having sufficient capacity to produce the impeller component for a given unit may lack the capacity to produce a one-piece housing component to contain it. Consequently, the capital investment for the molding equipment required to produce a given air impeller unit may be determined by the size of the largest component in the unit—namely the housing.

Accordingly, the general object of the invention is to provide an air impeller and a housing of improved half-section construction to facilitate rapid assembly and reduce the alignment operations normally associated with assembly.

Another object of this invention is to provide an air impeller construction which in comparison to present units of the same general type omits parts and is of lower manufacturing cost, while nevertheless exhibiting characteristics the same or better than such present air impeller units.

A further object of the invention is to provide an improved air impeller unit wherein the size differential between the housing and other molded parts in the unit is substantially reduced, thereby facilitating a reduction in production equipment capacity requirements for producing the unit.

The drawing shows a preferred embodiment of the invention and such embodiments will be described, but it it will be understood that various changes may be made from the construction disclosed, and that the drawing and description are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawing:

FIG. 1 is a side view partially in elevation and partially in section showing an air impeller unit of the axial flow fan type embodying the present invention.

FIG. 2 is an end view of the housing of the fan unit of FIG. 1, with a portion of an inlet screen broken away to reveal the motor cradle construction.

FIG. 3 is a perspective view of a half section of a housing of the fan unit of FIG. 1.

FIG. 4 is an enlarged fragmentary sectional view of an end portion of a motor cradle with the motor in place therein.

FIG. 5 is a fragmentary sectional view taken along the line 5—5 of FIG. 2.

FIG. 6 is a side elevational view showing the invention embodied in a blower of the transverse flow type.

FIG. 7 is an end view of the blower of FIG. 6 showing the motor retaining flange in assembly with the housing, a portion of the housing being broken away to reveal the interior thereof.

FIG. 8 is a sectional view through the housing and the motor retaining flange and taken along the line 8—8 of FIG. 7.

With reference particularly to FIG. 1, an axial flow fan embodying the present invention and indicated generally by the numeral 10 comprises a motor 12, at least one air impeller or fan 14, an inlet screen 16, and a housing 18 formed by a pair of substantially identical housing half sections 20, 20. The half sections are adapted to be joined together to secure all of the other components in assembly and in relative alignment.

The motor 10 which is preferably electrically powered has a generally cylindrical casing 22 and radially disposed end portions 24, 24 and includes a shaft 26 which coaxially extends from at least one of the end portions. An insulated power cord 28 is provided for connecting the motor with a source of electrical power.

The fan unit of the present invention may include fans mounted at opposite ends of the motor, but preferably the device includes a single fan 14 driven by the rotatably motor shaft 26. Preferably the fan 14 is molded from plastic material and includes a plurality of radially extending blades 30, 30 each of which is set at a pitch angle to the shaft axis. This pitch angle may vary with performance requirements. It should be noted that when the fan is mounted upon the shaft the blades 30, 30 extend radially beyond the motor casing 22.

The fan housing 18 is preferably formed by a pair of substantially identical generally semicylindrical half sections 20, 20 molded from plastic. Each of the housing half sections defines a generally semicylindrical inner wall surface 32, 32 which wall surfaces together define a generally cylindrical fan chamber 34 when the half sections are joined together in assembly. It should be understood that the term generally semicylindrical, as it is used here is intended to include modified cylindrical forms, such as bell shapes. Thus, in practicing the invention, the half sections 20, 20 may be formed with the fan chamber 34 including at least one coaxially extending bell-mouth portion diverging to a chamber end opening to receive the incoming air.

A semiannular flanged surface 36 is formed at one end of the half section 20, 20 to provide mounting means for securing the unit to a flange on a supply duct or the like. A means for mounting the unit axially parallel to a mounting surface is provided by a pair of bosses 38, 38 also integrally formed on the outer surfaces of the half sections.

The two half sections abut along parallel axially extending edge surfaces 39 and 40 when joined together in assembly. Accurate and rapid alignment of the half sections during assembly is facilitated by a pair of pins 41, 41 extending normal to the edge surface 39, and preferably integrally formed therewith. The pins 41, 41 cooperate with alignment holes 42, 42 in the edge surface 40 of the mating half section to provide orientation means for properly locating each half section relative to the other when the sections are brought together in assembly.

In each of the edge surfaces 39 and 40 there is preferably formed a cord receiving recess 43 adapted to receive and lightly clamp an associated portion of the service cord 28. Thus, when two mating half sections are joined, two of the four recesses come into clamping engagement with an associated portion of the service cord 28, thereby securing the associated portion of the cord against movement relative to the motor 12. Securing the cord in this manner tends to prevent stress at the point of electrical connection with the motor and may eliminate the need for the grommet or fastener customarily provided for this purpose.

The recesses 43, 43 are preferably formed when the housing half sections are formed in the same mold. Thus, two diametrically opposed apertures in the housing wall are defined when the housing half sections 20, 20 are assembled. Only one of the apertures so formed is re-

quired to secure the service cord **28**, however, it has been found that the extra or unused aperture does not adversely affect the efficiency of a small fan unit. If desired, this extra aperture may be eliminated by molding the half sections without the clamping surfaces **43**, **43** and thereafter forming a single recess in each mating half section **20**, **20** by a secondary machining operation.

Each of the housing half sections **20**, **20** further includes a motor supporting cradle half section **46**, **46** maintained in radially spaced relation with the inner wall surface **32**, **32** to provide an air passageway **47** therebetween. Support means for maintaining the cradle half section in position is provided by at least one generally radially extending vane integral with both the housing half section and the cradle half section and providing connection therebetween. In the presently preferred embodiment of the invention two vanes **48**, **48** are employed.

The vanes **48**, **48** may be mere supporting elements or they may be formed with a generally airfoil-shaped cross-sectional contour to aid the efficient flow of air and minimize turbulence, as shown in FIG. 5. The vanes **48**, **48** may also take the form of twisted airfoils comprising substantially complementary extensions of the fan blades **30**, **30** thereby further serving a dual function in supporting the motor cradle and aiding in the efficient flow of air through the fan chamber **34**.

In accordance with the invention a means for securing the motor in the housing and supporting it in coaxial alignment therewith is provided by the motor supporting cradle. Each cradle half section **46** has a clamping means including a clamping surface **52**, complementing the contour of the associated motor casing **22**. The shape of the casing may vary, and such variations in casing configuration are contemplated within the scope of the invention; however, it should be apparent that the casing **22** and the associated clamping surfaces **52**, **52** may be constructed and arranged so that the clamping surfaces provide a clamping means for securing the motor **10** against axial, radial and rotational movement relative to the housing **18**.

Preferably and as shown in FIG. 1, each cradle half section **46** includes a generally axially extending clamping surface **52** adapted to engage the cylindrical casing **22**. Thus, the clamping surfaces **52**, **52** complement the cylindrical casing contour and cooperate in assembly to secure the motor **10** against radial movement relative to the housing **18**.

When a motor of the presently preferred cylindrical form is used in practicing the invention the cradle **46** further includes retaining means for securing the motor against axial and rotational movement relative to the clamping surfaces. Preferably and as shown, the retaining means comprises at least one fastener **54** which extends through at least one cradle section **46**, and the clamping surface **52** thereof and threadably engages the casing **22**.

Another preferred retaining means for securing the casing against rotational as well as axial or endwise movement comprises a protrusion or lug **56** integrally formed on the clamping surface **52** and adapted to be received in a generally complementary casing depression **58** and engage the casing **22** therein, as shown in FIG. 4.

It should be apparent that various arrangements and combinations of clamping surfaces and retaining means, which together comprise a clamping means, are possible within the scope of the invention. Thus, the cradle clamping surfaces and the associated casing may be constructed and arranged to secure the motor against radial and rotational movement with the cradle including a retaining means to secure against axial or endwise movement in one or both directions.

A preferred retaining means to prevent axial or endwise movement comprises at least one radial clamping surface extending generally radially inwardly from the clamping surface and adapted to engage an associated

end portion of the casing. In the presently preferred embodiment, this retaining means comprises abutment surfaces **60** and **62** which are respectively defined by axially spaced generally radially inwardly extending lips **64** and **66** integrally formed on the cradle section **46**, **46**. The abutment surfaces **60** and **62** are adapted to engage the end portions **24**, **24** of the casing **22**, as best seen in FIG. 1.

Each of the housing half sections **20**, **20** preferably also includes a recess **68** defined within the wall **32** proximate the inlet end of the fan chamber **34** and adapted to receive and engage an associated edge portion of the inlet screen **16**. When the housing half sections are joined, each recess cooperates with the other to secure the screen against axial and radial movement relative to the chamber **34**, thereby maintaining the screen **16** in axial spaced relation with respect to the fan **14**.

The two housing half sections may be secured in assembly by any suitable fastening means and may, for example, be bonded in assembly by an appropriate adhesive applied along abutting edge surfaces. Preferably, the two half sections **20**, **20** are ultrasonically welded together in assembly.

When the sections **20**, **20** are joined, the various aforedescribed clamping surfaces, clamping recesses and retaining means cooperate to secure the associated fan unit components in relative alignment with the housing and with each other, thereby eliminating numerous fasteners normally required to secure the components in assembly and substantially reducing the labor and time required for alignment and assembly.

In FIGS. 6 to 8 the invention is shown embodied in a transverse flow blower unit indicated generally at **70** and including a motor **72**, an air impeller or rotor **74**, and a housing indicated generally at **76** and formed by two half sections **78** and **80**. Like the housing sections of the previously described embodiment, the half sections **78** and **80** are adapted to be joined together to define a chamber for receiving the impeller and to retain all of the components in assembled relationship and in relative alignment.

The motor **72** has a casing **82** comprising a plurality of parts retained in assembled condition by studs **83**, **83** and includes a shaft **84** coaxially extending from at least one end portion thereof. To facilitate assembly with the housing, the motor also includes a generally radially outwardly extending flange portion which cooperates with clamping means on the housing **76**. The motor flange portion may be formed on the casing **82**, but preferably it is provided by an adapter fastened to the motor casing and forming an extension thereof.

In the presently preferred embodiment of the invention the motor **72** includes a generally semicylindrical cup-shaped adapter **85** preferably formed from metal and having a generally semicircular radially disposed end wall **86** adapted to engage an end portion of the motor. An integral generally semicylindrical wall **88** extends axially outwardly from the end wall **86** and includes an outer marginal edge portion which is turned radially outwardly to form a semiannular flange **90** which cooperates with the housing **76** in a manner that will be hereinafter evident.

To facilitate rapid assembly of the adapter with the motor the wall **86** includes a generally U-shaped central recess **92** which receives an associated end portion of the motor casing **82**. A pair of diametrically opposed tabs **93**, **93** bent axially outwardly from the wall **86** complement associated portions of the motor casing **82** to effect rapid alignment of the studs **83**, **83** with stud receiving openings **94**, **94** in the wall **86** when the adapter is brought into position on the motor.

The air impeller may comprise one or more rotor units coaxially aligned in end-to-end relationship within the housing. The illustrated blower **70** has a single conventional drum-shaped rotor **74** which generally comprises

a plurality of axially aligned circumaxially spaced blades **96, 96** mounted between a pair of support members **98, 98** which may, for example be rings or disks. The rotor **74** is coaxially mounted on the motor shaft **84** and preferably includes a shaft portion **100** which extends coaxially therefrom and which is journaled in the blower housing in a manner that will be hereinafter further discussed.

Considering now the housing and referring particularly to FIGS. 7 and 8, it will be noted that the two half sections **78** and **80** are adapted to be joined together in an axial plane indicated at **102** in FIG. 7. The half sections **78** and **80** are of approximately equal size but are of generally dissimilar configuration.

The upper half section of **78** generally comprises axially spaced radially disposed end walls **104** and **106** and an elongated semicylindrical wall **108** which extends axially therebetween to define a generally semicylindrical chamber for receiving the upper portion of the rotor **74**.

The lower half section **80** has two axially spaced radially disposed end walls **110** and **112** which respectively abut the walls **104** and **106** in the plane **102** when the two half sections are joined together in assembly. An elongated rear wall **114** which abuts the wall **108** in assembly extends axially between the walls **110** and **112** and curves arcuately outwardly and downwardly from the wall **108**. The lower half section **80** also includes an axially elongated inner wall **116** which extends between the end walls **110** and **112** in inwardly spaced relationship to the wall **114** and which includes an inner edge **118** which extends axially of the rotor **74** in close proximity to the perimeter thereof. The wall **116** curves arcuately outwardly and downwardly from the rotor generally complementing the contour of the wall **114** to define an air outlet or discharge passageway **120**.

At this point it should be noted that the lower half section **80** is open along its front and bottom portions to provide an inlet opening to permit air to flow transversely of the rotor, the general path of air flow into the blower being indicated by broken arrows in FIG. 7. The rotor **74** is arranged to rotate in a clockwise direction as shown in FIG. 7 thereby causing air to be discharged through the passageway **120** along a path of flow generally indicated by full line arrows.

To provide a means for mounting the blower on a wall surface or the like with the air outlet **120** projecting therethrough, the end walls **104** and **106** extend rearwardly or to the right for some distance beyond the upper portion of the wall **106** as viewed in FIG. 7 and terminate in generally vertically disposed outwardly extending mounting flanges **122, 122**. Each flange **122** is provided with a generally U-shaped fastener receiving opening **124**. Generally similar mounting flanges **126, 126** project outwardly from the end walls of the lower half section **80** and are disposed within the plane of the flanges **122, 122**.

Considering now the manner in which the motor **72** and its associated rotor **74** are maintained in assembled and aligned relationship with the housing **76** it will be noted that the end wall **104** has an outwardly projecting rib **128** integrally formed thereon. The rib **128** has a radially inwardly opening recess adapted to receive the upper half of the motor adapted flange **90** therein. The end wall **110** is provided with a generally similarly recessed rib **130** which is adapted to receive the lower half of the flange **90**. Thus, the ribs **128** and **130** cooperate to define clamping means for securing the motor against axial, radial and rotational movement relative to the housing **78** when the housing half sections are joined together in assembly.

To provide further support for the rotor **74** the housing end walls **106** and **110** respectively include axially outwardly projecting central portions **132** and **134**. Each of the aforesaid central portions defines a generally radially inwardly opening semicylindrical bearing retaining recess adapted to receive and retain an associated portion of a

cartridge bearing **136** which provides a journal for the shaft portion **100**.

Each of the housing half sections is provided with a plurality of outwardly extending flanges which engage associated flanges on the other half section in the plane **102** to facilitate housing assembly. A typical flange **138** which projects outwardly from the wall **104** and which engages an associated flange **140** on the wall **110** is shown in FIG. 7. Pins **142, 142** integrally formed on one of the flanges and received in associated openings in the other flange provide orientation means for rapidly and accurately aligning the two half sections during assembly.

The housing sections may be joined together by various means, however, like the sections of the previously described embodiment the sections of the housing **78** are preferably ultrasonically welded together.

The invention has been illustrated with reference to an axial flow fan unit and a transverse flow blower, however, it should be apparent that the air impeller and housing construction of the present invention will be applicable to other air moving units such as tubular centrifugal blowers and the like. Such unit constructions are contemplated within the scope of the invention.

The invention claimed is:

1. In an air impeller unit the combination comprising a motor including a casing and a shaft, at least one air impeller mounted upon said shaft and having air moving blades, and a housing comprising two half sections adapted to be joined together in assembly to define a chamber for receiving the impeller, at least one of said housing half sections including an inner wall surface adapted to be spaced radially from the impeller, a motor clamping means on each half section adapted to engage an associated portion of the motor, said clamping means and the motor portion engaged thereby being constructed and arranged to secure the motor against relative axial, radial and rotational movement, and said clamping means coming into clamping engagement with the motor when the housing half sections are joined together in assembly whereby the impeller is maintained in coaxial alignment with the motor within the chamber and in spaced relationship with said inner wall surface.

2. The combination defined in claim **1** wherein said half sections are made from a plastic material and ultrasonically welded together in assembly.

3. The combination defined in claim **1** including orientation means for locating one of the said half sections relative to the other of the said half sections when the said sections are joined together in assembly.

4. The combination defined in claim **1** wherein said motor clamping means comprises a motor supporting cradle half section associated with each of the said housing half sections and including a clamping surface for engaging an associated portion of said motor, and support means for maintaining each said cradle half section in radially inwardly spaced relationship with said wall surface to provide an air passageway therebetween.

5. The combination defined in claim **4** wherein said support means comprises at least one generally radially extending vane integral with said housing half section and said associated cradle half section providing connection therebetween.

6. The combination defined in claim **5** wherein said vane has a generally airfoil-shaped cross section.

7. The combination defined in claim **4** wherein said casing is generally cylindrical, said clamping surface extending generally axially thereof and wherein said clamping means includes retaining means for securing said casing against movement relative to said clamping surface.

8. The combination defined in claim **7** wherein said retaining means comprises at least one inwardly extending protrusion integrally formed on at least one said clamping surface and adapted to engage a complementary depression in said casing.

9. The combination defined in claim **7** wherein said

retaining means comprises at least one fastener adapted to extend through at least one of said cradle half sections and the clamping surface thereof and engage said casing.

10. The combination defined in claim **7** wherein said motor includes at least one generally radially disposed end portion and wherein said retaining means comprises at least one generally radially disposed abutment surface inwardly extending from said clamping surface and adapted to engage said end portion.

11. The combination defined in claim **1** wherein said half sections are substantially identical being adapted to be formed in a single mold.

12. The combination defined in claim **1** wherein said motor includes an electrical service cord and wherein each of the said half sections includes at least one generally axially extending edge surface adapted to abut an associated edge surface of the other of the said half sections when said sections are joined together in assembly, each said edge surface defining a clamping recess generally radially extending therethrough and adapted to receive and engage an associated portion of said cord, said recesses cooperating to clampingly engage said cord when said half sections are joined together in assembly.

13. The combination defined in claim **1** and including an inlet screen, each of the said half sections having a wall partially defining said chamber and including a generally radially inwardly opening groove therein adapted to receive an associated edge portion of said screen, each said groove cooperating with the other said groove to secure said screen against movement relative to said chamber when said half sections are joined together in assembly.

14. The combination defined in claim **1** wherein said motor includes a generally radially outwardly extending

flange and wherein said motor clamping means comprises a radially inwardly opening recess on each of the said half sections adapted to receive an associated portion of said flange.

15. The combination defined in claim **14** wherein said flange is provided by a part attached to said motor and separable therefrom.

16. The combination defined in claim **1** further including an impeller shaft projecting from said impeller in axial alignment with said motor shaft, and a bearing received upon said impeller shaft, each said half section defining an end wall including a generally radially inwardly opening bearing retaining recess adapted to receive an associated portion of said bearing, each said bearing retaining recess coming into clamping engagement with said bearing when said housing half sections are joined together in assembly.

17. The combination defined in claim **16** wherein said motor is secured to said housing externally thereof.

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ROBERT M. WALKER, *Primary Examiner.*