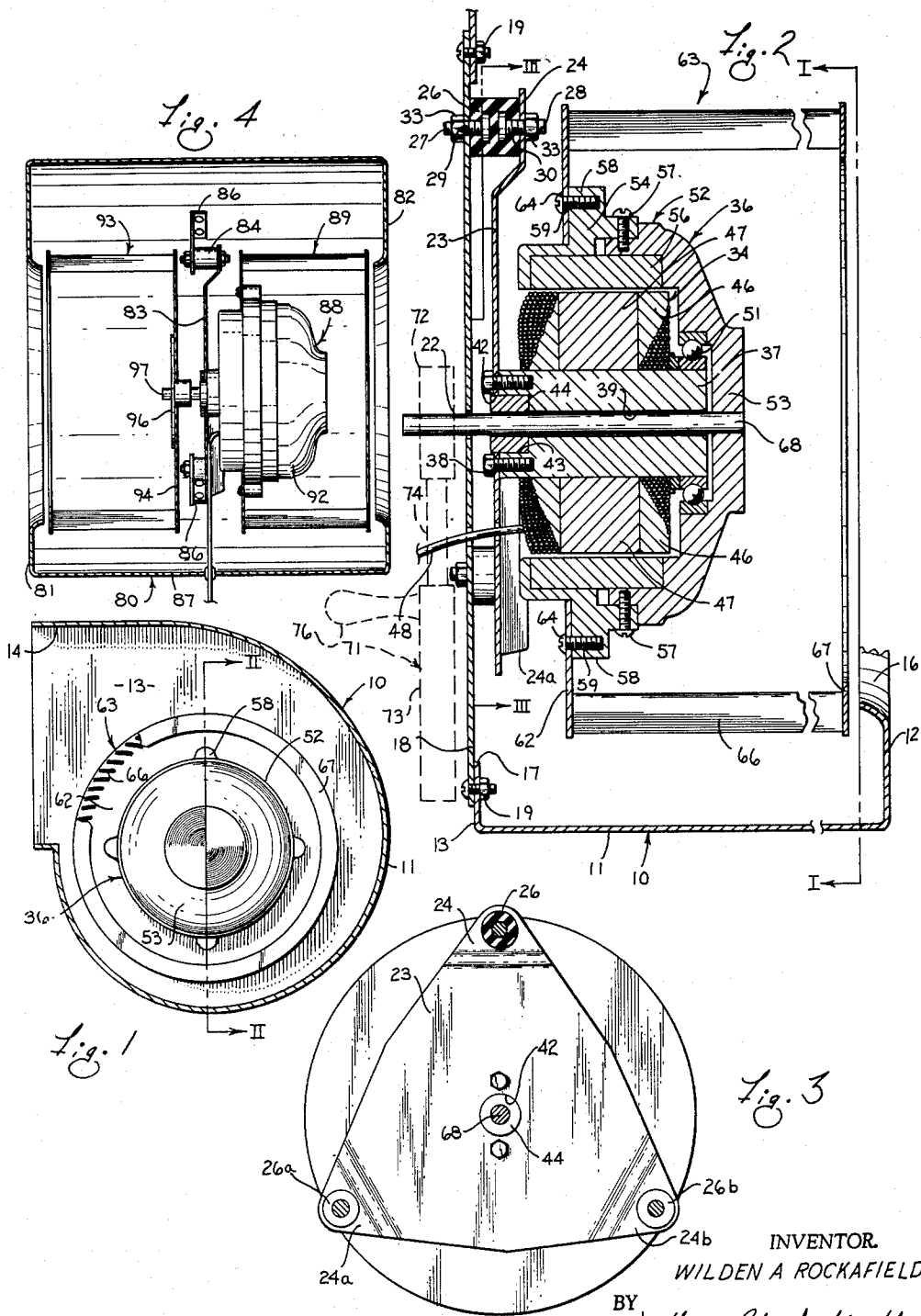


March 30, 1965

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3,175,755

FAN CONSTRUCTION
Filed June 20, 1962



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FAN CONSTRUCTION

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Filed June 20, 1962, Ser. No. 203,796

6 Claims. (Cl. 230-117)

This invention relates in general to a centrifugal fan construction and, more particularly, to a type thereof wherein the impeller is supported upon and rotates with the external rotor of a motor having an internal stator secured to and supported upon the blower housing.

Rotating field or "inside out" motors have been previously mounted within fan housings to support and rotate the impellers of centrifugal blowers. However, the particular structural arrangement of the motor and its support, as described hereinafter, have not, to the best of my knowledge, been previously utilized. Moreover, the functions made possible by this structural arrangement have not been previously available.

The circumstances which have given rise to this development have existed for many years. More specifically, there are many situations where mechanically operated air moving equipment is essential to human comfort or even survival. Examples are endless, are well known and need no detailing. Air moving devices, such as centrifugal blowers, which are used for ventilation purposes, are often driven by electric motors. Thus, unless there is some auxiliary means for operating the fans including manual means, a power failure can in many readily conceivable instances result in a very serious condition.

One recently appearing example of such instances lies in the use of ventilating units in bomb shelters and fallout shelters. In the case of an attack, even a "near miss" from an explosion could destroy the prime source of electrical energy for a long period of time, such as several days or even several weeks. Without some form of alternate, including manual, means for operating their ventilating unit, the occupants of a shelter could be made very uncomfortable at the least and could possibly be asphyxiated. A similar situation has long existed in mines where a partial cave-in, not serious by itself, can still destroy the power supply to below-ground fans.

Accordingly, a primary object of this invention has been the provision of a centrifugal fan construction having an impeller mounted upon the external rotor of an electric motor wherein the stator is disposed within the rotor and is secured to and supported within the fan housing.

A further object of this invention has been the provision of a centrifugal fan construction, as aforesaid, in which the motor has a shaft secured to the rotor and extending through the stator for connection to an auxiliary, including manual, driving means or to another mechanical device for rotation by the motor with the impeller.

A further object of this invention has been the provision of a motor having an external rotor which is supported upon the stator by a special bearing structure and which has mounting structure particularly suited for supporting a centrifugal blower wheel.

A further object of this invention is the provision of a centrifugal blower which is normally driven by an electric motor, but which is capable of satisfactory operation from other sources, including manual, in the event of a power failure.

A further object of this invention has been the provision of a centrifugal blower, as aforesaid, having two impellers, one of which is mounted upon the external rotor of the motor and the other of which is mounted

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upon a shaft connected to the external rotor and extending through the stator of the motor.

A further object of this invention has been the provision of a centrifugal blower, as aforesaid, which can be produced economically, which can be small and compact in size, which can be manufactured according to existing production procedures, which will operate with a minimum of maintenance, which is capable of safe, reliable and continuous operation for long periods of time, which is quiet in operation and which can be controlled by a simple electrical switch.

Other objects and purposes of this invention will become apparent to persons familiar with this type of equipment upon reading the following descriptive material and examining the accompanying drawings, in which:

FIGURE 1 is a vertical cross-sectional view of a centrifugal fan construction embodying the invention, the section being taken transaxially of the impeller, substantially as indicated by the cutting line I—I in FIGURE 2.

FIGURE 2 is a broken sectional view substantially as taken along the line II—II in FIGURE 1.

FIGURE 3 is a sectional view taken along the line III—III in FIGURE 2.

FIGURE 4 is a vertical cross-sectional view of a double inlet fan construction embodying the invention, the section being taken substantially along the rotational axis of the impellers.

For the purpose of convenience in description, the terms "inner," "outer" and words of similar import as used herein will have reference to the geometric center of a blower unit embodying the invention or parts thereof.

General description

The objects and purposes of the invention, including those set forth above, have been met by providing a centrifugal blower including a blower housing having, in one preferred embodiment, a single inlet in one side wall thereof. The internal stator of a rotating field type motor is rigidly secured to a mounting plate which is in turn resiliently supported upon the other side wall of the blower housing.

A centrifugal blower wheel is supported upon the external rotor of the electric motor for rotation therewith. A shaft, which is connected to the rotor, extends through an opening in the stator and through the said other side wall of the blower housing so that it can be engaged for rotating the impeller from other power sources or so that it can be connected to auxiliary equipment, which is then driven by the electric motor.

In a modified construction, a double width housing is utilized and the mounting plate is supported by brackets which are preferably secured to the scroll sheet of the housing midway between the side walls thereof. There are two impellers, one of which is mounted upon the external rotor of the motor and the other of which is mounted upon the shaft extension on the opposite side of the mounting plate.

Detailed construction

The blower unit disclosed in FIGURE 1 illustrates a preferred embodiment of the invention, which includes a housing 10 having a scroll sheet 11 connected to a pair of side walls 12 and 13 (FIGURE 2). The housing 10 has an outlet opening 14 in a substantially conventional manner. The side wall 12 has an inlet opening 16 which may be of conventional construction. The side wall 13 has a large circular opening 17 which is coaxial with the inlet opening 16 and which is substantially fully covered by the circular side plate 18, which is removably mounted upon the side wall 13 by means such as nuts and bolts 19. The side plate 18 has a concentric shaft opening 22 for reasons appearing hereinafter.

A mounting plate 23 (FIGURES 2 and 3), which is substantially triangular in this embodiment, has corners, 24, 24a and 24b which are offset from the central portion of the mounting plate in the same direction. Three resiliently flexible sound and vibration insulating members 26, 26a and 26b are respectively mounted upon the offset corners 24, 24a and 24b of the mounting plate 23. The insulator 26, for example, has a pair of coaxial bolts 27 and 28 the heads of which are embedded in the insulator 26 and spaced from each other. The threaded ends of the two bolts 27 and 28 extend respectively through an opening 29 in the side plate 18 and an opening 30 through the corner portion 24 of the mounting plate 23. The bolts 27 and 28 are engaged by nuts 33 for the purpose of securing the insulator 26 to and between the side plate 18 and the mounting plate 23. The insulators 26a and 26b are similarly secured to and between the corresponding portions of the side plate 18 and mounting plate 23 so that said insulators are uniformly disposed around and spaced from the shaft opening 22 in the side plate 18.

The stator 34 of a motor 36, which may be a rotating field type, is rigidly secured to the mounting plate 23. More specifically, the core 37 of the stator 34 is rigidly secured to the central portion of the mounting plate 23 by means such as the bolts 38. The core 37 has a central shaft opening 39 which is coaxial with the central opening 42 in the mounting plate 23 and with the shaft opening 22 in the side plate 18. The shaft opening 39 in the core 37 has an enlarged portion 43 adjacent the mounting plate 23, in which a bearing 44 is disposed.

The windings 46 on the radial projections 47 of the core 37 are connected to input conductors 48 which may extend through appropriate openings in the mounting plate 23 and side plate 18. A bearing 51 is mounted upon the end of the core 37 remote from the mounting plate 23. A rotor 52 includes a peripheral casing 54 and an end bell 53, which is rotatably supported by the bearing 51 upon the core 37. The field magnets or windings 56 of the rotor 52 are contained within the casing 54 and are mounted in any conventional manner. The end bell 53 is mounted on the casing 54 by any convenient means, such as the screws 57.

The casing 54 has a plurality, here four, of radially outwardly projecting ears 58, which have parallel, threaded openings 59 therein. The annular back plate 62 of a centrifugal impeller 63 encircles the casing 54 and is secured to the ears 58 by the screws 64. In this particular embodiment, the impeller 63 has forwardly curved blades 66 which are rigidly secured to and extend between the back plate 62 and a ring 67, which is located adjacent to and coaxial with the inlet opening 16 in the side wall 12.

The shaft 68 (FIGURE 2), which is coaxially secured to and is supported upon the end bell 53, extends coaxially through the shaft opening 39 in the core 37, the bearing 44 and the shaft opening 22 in the side plate 18. Thus, the bearing 44, by its engagement of the shaft 68, helps to stabilize and support the rotor 52, hence the impeller 63 mounted thereon.

An auxiliary mechanism, which is indicated by broken lines at 71 in FIGURE 2, is provided for auxiliary, here manual, rotation of the rotor 52, if the motor 36 fails. The manual mechanism 71 may include sheaves 72 and 73 connected by a belt 74. The large sheave 73, which may be rotatably supported upon a portion of the housing 10, has a handle 76 for effecting manual engagement thereof.

Operation

It will be seen from the above, detailed description that operation of the blower unit disclosed in FIGURES 1 and 2 can be effected merely by connecting the input conductors 48 to a suitable source of electrical energy. The exact characteristics of the electrical motor utilized are immaterial to this invention. That is, the motor may be of any conventional type wherein the rotor is on the out-

side of the stator. Moreover, the motor may be either single phase or three phase, depending upon the particular usage which is desired.

Removal of the motor 36 and rotor 52 from the housing 10 is easily effected by removing the nuts and bolts 19 which connect the side plate 18 to the side wall 13. The entire assembly including the side plate 18, mounting plate 23, motor 36 and impeller 63 can be removed from within the housing 10 through the opening 17 in the side wall 13. Air passing through the impeller 63 tends to cool the motor 36. Openings may be provided in the end bell 53 and casing 54 in a conventional manner to increase the circulation of air through the motor if desired.

Although an impeller having forwardly curved blades is disclosed in this application, it will be recognized that other types of centrifugal impellers may be used in place of the multiblade impeller disclosed herein.

FIGURE 4 illustrates a modification of the invention wherein a double width housing 80 is provided with two inlet side walls 81 and 82. The mounting plate 83 may be identical in construction and function with the mounting plate 23 of FIGURE 2. However, the insulators 84, which may be identical with the insulator 26, are secured to brackets 86, which in turn are secured to the scroll sheet 87 of the housing 80 midway between the inlet side walls thereof. The motor 88, which is supported upon the mounting plate 83, and the impeller 89, which is supported upon the rotor 92 of the motor 88, may be substantially identical with their counterparts 36, 63 and 52, respectively, in FIGURE 2.

A second impeller 93 is provided with a backplate 94 having a hub 96 which is mounted upon the shaft 97 of the motor 88. Accordingly, operation of the motor 88 effects simultaneous rotation of both impellers 89 and 93. Accordingly, the operation of the double width blower unit disclosed in FIGURE 4 may be substantially the same as the operation of the single width blower unit disclosed in FIGURES 1 and 2.

Although a particular preferred embodiment of the invention has been disclosed above for illustrative purposes, it will be recognized that variations or modifications of such disclosure, which come within the scope of the appended claims, are fully contemplated.

What is claimed is:

1. In a centrifugal fan construction including a fan housing having a pair of end walls and a scroll wall with an inlet opening through at least one of said end walls thereof, the combination comprising:

a motor including a stator having a shaft opening extending therethrough and an overhung rotor encircling said stator;

support means rigidly secured to said stator and mounted with respect to said scroll wall so that said shaft opening in said stator is substantially perpendicular to said end walls and coaxial with the inlet opening;

bearing means including a bearing mounted radially externally of said stator rotatably supporting said rotor upon said stator;

a shaft rigidly secured to said rotor and rotatable therewith, said shaft extending through and beyond said shaft opening;

an impeller having blade supporting means and a plurality of blades secured thereto, said blade supporting means being secured to and rotatable with said rotor.

2. The fan construction of claim 1 wherein said stator includes a solid core extending the axial length of said stator and through which said shaft opening extends;

wherein said support means includes a substantially flat plate rigidly secured to one end of said solid core, mounting means connected to said scroll wall and resilient means connected between said flat plate and said fan housing, whereby said motor is resiliently mounted with respect to said fan housing;

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wherein said bearing means includes a bearing located in the other end of said core;
 wherein said rotor has a plurality of radial projections on its peripheral surface; and
 wherein said blade supporting means includes a circular backplate rigidly secured to said blades and to said projections.

3. In a centrifugal fan construction including a fan housing having a pair of end walls, the combination comprising:

a motor including a stator having a shaft opening extending therethrough and an overhung rotor encircling said stator;
 support means rigidly secured to said stator;
 resilient means connected between said support means and one of said end walls to support said stator so that said shaft opening in said stator is substantially perpendicular to said end walls;
 a shaft rigidly secured to said rotor and rotatable therewith, said shaft extending through and beyond said shaft opening and said one end wall;
 a first bearing fixed within and at one end of said stator and supporting said shaft for rotation therewithin;
 a second bearing of diameter greater than said first bearing surrounding and supported upon said stator adjacent the other end thereof, said second bearing lying within and providing substantially the entire radial support for said rotor; and
 impeller means supported on and rotatable with said rotor.

4. In a centrifugal fan construction including a fan housing having a pair of end walls, the combination comprising:

a motor including a stator having a solid core, said core having a shaft opening extending therethrough;
 a rotor encircling said stator and overhanging said stator from one end thereof;
 a mounting plate rigidly fixed to the axial face of said core at the other end of said stator and extending substantially parallel to one of said end walls;
 a plurality of resilient mounting pads secured to said mounting plate at substantially equally spaced points said point being spaced from said core, said mounting pads extending from said mounting plate in a direction opposite to that in which said core extends and being secured to said one end wall so that said mounting plate lies within said housing and said shaft opening extends perpendicularly to said one end wall;
 a shaft rigidly secured to said rotor, said shaft extending through and beyond said shaft opening and through axially aligned openings in said mounting plate and said one end wall;
 bearing means encircling said one end of said stator and rotatably supporting said rotor upon said stator; and
 impeller means supported on and rotatable with said rotor.

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5. In a centrifugal fan construction including a fan housing having a pair of end walls, the combination comprising:

a motor having an internal stator consisting of a solid internal core and windings surrounding said core, said core extending beyond the axial ends of said windings and having a central coaxial opening;
 a support member, secured to and within said housing and affixed to one end of said core so that the axis of said central opening extends substantially perpendicular to one of said end walls;
 a shaft extending through said central opening and projecting beyond both axial ends of said core and through said one end wall;
 bearing means within said central opening supporting said shaft for rotation within said core;
 a rotor having a peripheral casing surrounding said windings, said casing being open at the end thereof adjacent said support member and being closed at the other end thereof by a substantially radially extending end bell secured to said shaft and extending adjacent to and in opposing relation to the other axial end of said core, said core and said end bell having spaced and radially opposed, annular surfaces adjacent said other axial end of said core, said annular surfaces being coaxial with said shaft, the annular surface on said end bell being located radially outwardly of the annular surface on said core;
 a bearing unit mounted on and between said annular surfaces for rotatably supporting said end bell on said core; and
 impeller means supported on and rotatable with said rotor.

6. A centrifugal fan construction according to claim 5, in which said rotor has radially outwardly extending mounting means on its periphery;

said impeller means includes a plurality of blades connected together at one axial end by an annular ring and connected together at the other axial end by an annular backplate, said backplate being sleeved on said rotor and releasably affixed to said mounting means.

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