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COMPACT AXIAL FLOW FAN

Filed July 5, 1966

FIG. 1

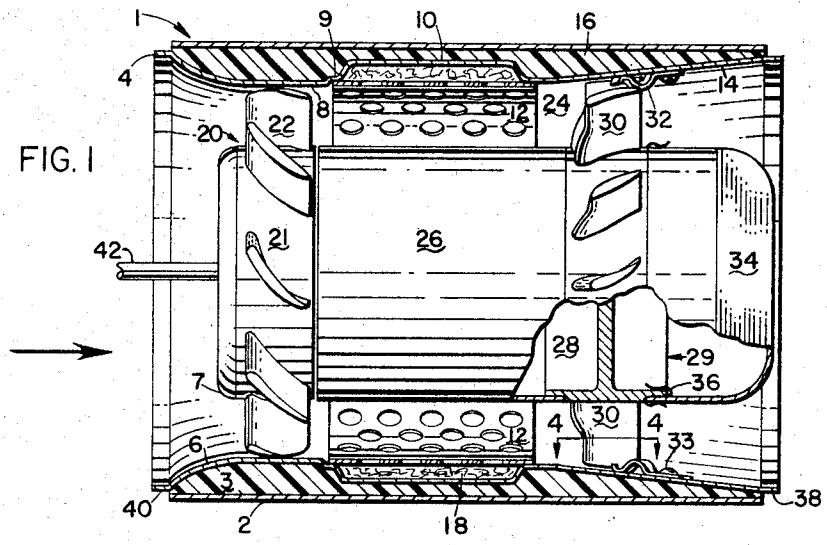


FIG. 2

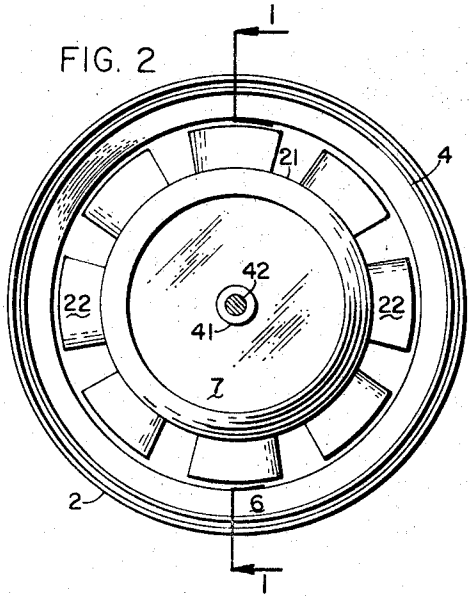
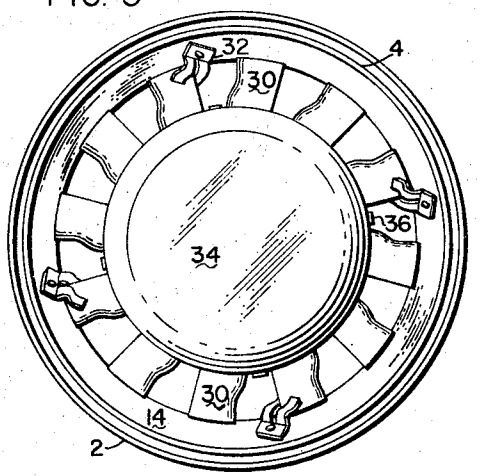


FIG. 3



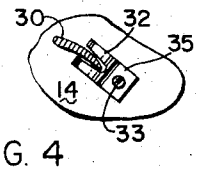


FIG. 4

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COMPACT AXIAL FLOW FAN

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This invention relates to air handling apparatus, and more particularly to such apparatus comprising a fan mounted within an elongated chamber for inducing an axial flow of air therethrough.

This invention is especially concerned with such fan assemblies which are utilized for circulating a stream of hot or cold air as part of an air conditioning installation. Fans of this type normally consist of a heavy casing enclosing a fan wheel, and supporting a stator vane assembly located on the discharge side of the fan. The casing and stator vane assembly is conventionally an integrated unit, with the stator vane assembly being welded to or cast with the casing. The proper attachment of the stator assembly to the inside of a fan casing has conventionally required the holding of very close dimensional tolerances on these two parts, which requires costly, high quality manufacturing and machining operations. Also, the normal procedure has been to apply a layer of insulating material to the fan casing at the time of installation in order to prevent heat transfer when hot or cold air is being circulated by the fan. This necessarily results in longer and costlier installations.

In order to prevent the undesirable transmission of fan noises on commercial and residential installations, sound attenuators have conventionally been secured to the fan outlet as a separate attachment. This procedure is objectionable to the extent that it adds to the overall length of the air handling apparatus, and creates an additional task which must be accomplished by the contractor at the time that the fan is installed.

With the aforesaid shortcomings of known air handling equipment in mind, we have developed an axial flow air handling device, the salient features of which are its light weight, ease of assembly, and compactness made possible by an integrated sound absorber and heat insulating barrier.

More specifically, a primary objective of this invention is to provide air handling apparatus of the axial flow type incorporating a housing comprised of spaced apart, outer and inner, lightweight metal casings, with the space between said casings being filled with thermally insulating, load bearing foamed-in-place plastic.

A second objective is to provide a fan housing as in the aforesaid objective wherein the inner casing is formed to include an air inlet section, a fan shroud section, a recessed portion for the containment of sound absorbing material, and a diffusing portion.

A further objective is to provide an air handling device having a conically shaped diffuser section to which a stator assembly is snugly secured by moving a stator ring having conically tipped stator vanes axially into the diffuser section until the vane tips are tightly fitted against the diffuser wall.

These and other objects and advantages of our invention will become readily apparent as the following description is read in conjunction with the accompanying drawing of which:

FIGURE 1 is a front elevation view, partially in section, of our improved air handling device;

FIGURE 2 is a left end view of the air handling device of FIGURE 1;

FIGURE 3 is a right end view of the air handling device of FIGURE 1; and

FIGURE 4 is a section view taken along line 4—4 of FIGURE 1 showing a stator vane and the clip means employed for securing the stator assembly to the diffuser section of the fan housing.

Referring to FIGURES 1–3 of the drawing, our improved air handling device has as a distinctive feature thereof a housing **1** which is characterized by its light weight, low cost, structural strength, and insulating ability. A relatively thin, sheet metal outer casing **2** encloses an equally lightweight inner casing **4** so as to form therebetween an annular space **3**. Housing **1** is given structural and heat insulating qualities by filling annular space **3** with foamed-in-place plastic **16**, preferably polyurethane. This plastic material adheres to the walls of casings **2** and **4** so as to form a strong, monolithic structure. A fan **20** is supported within inner casing **4** by means of drive shaft **42**. Inner casing **4** is formed so as to include at one end thereof a bell-shaped air inlet section **6**, a cylindrical fan shroud portion **8**, a recessed portion **10** for sound absorbing material, and a diffuser section **14**. Since casing **4** is made of lightweight sheet metal, it is easily formed to the diverse shape shown. Thus, manufacturing is simplified and cost is reduced by forming single piece **4** to serve a variety of necessary functions. The space within recess **10** is filled with acoustical material **18** such as fiberglass, glass wool, felt or the like. Sound insulating material **18** is held in place within recess **10** by means of cylindrically shaped, perforated plate or wire mesh screen **12**. In order that metal retainer **12** may be seated flush with the wall of casing **4** so as to produce minimum interference with the stream of air leaving fan **20**, the wall of casing **4** is indented at **9** adjacent the discharge side of the fan.

For purposes of illustration fan **20** has been shown as a vane axial fan having a plurality of blades **22** extending generally radially outwards from wheel portion **21**. A rounded nose piece **7** is secured to the inlet side of fan wheel **21**, and forms with bell shaped inlet section **6**, a smoothly contoured annular passageway for the entrance of air to the blades **22**. It is noteworthy that the type or shape of fan employed is of no particular significance to this invention. Thus, a centrifugal fan wheel could be employed just as well as the axial flow fan wheel shown. In such a case, the air would be discharged radially outwards by the centrifugal fan and then turned in an axial flow direction by fan shroud portion **8** of casing **4**.

In order to provide for a suitable passageway for smooth flow of air discharging from fan **20**, an inner cylindrical air flow guide member **26** is supported concentrically within inner casing **4**. Member **26** is supported within casing **4** from a stator assembly **29** and forms with the adjacent portion of casing **4** an annular passageway **24** for the flow of air.

Stator assembly **29** is comprised of a ring or hub **28** from which a plurality of stator vanes **30** extend generally

radially outwards. Vanes 30 serve to straighten the swirling air exiting from annular passage 24 in the conventional manner. In order that stator assembly 29 may be easily assembled within diffuser section 14 despite normal dimensional variations in the manufacture of these parts, the walls of diffuser section 14 and the tips of stator vanes 30 are tapered. As is indicated in FIGURE 1, the walls of diffuser section 14 flare outwardly in the form of a frustum of a cone. The tips of stator vanes 30 are inclined to coincide with the conical angle of the walls of diffuser section 14. In assembling the air handling apparatus, stator assembly 29 is moved axially within inner casing 4 until a snug fit is obtained between the stator vanes 30 and the walls of diffuser section 14. Stator assembly 29 is then secured in place by means of clips 32 which are attached to the walls of diffuser section 14 by means of fasteners 33. As is best shown in FIGURE 4, clips 32 are forked to fit over the edge of stator vanes 30, and have a flat portion 35 through which fasteners 33 pass.

Cylindrical member 26 is attached to the upstream side of stator ring 28 with respect to the direction of air flow. In addition, a rounded tail piece or end cap 34 is secured to the downstream side of stator ring 28 by means of Z-shaped clips 36.

Inner casing 4 is also provided with cylindrical portions 38 and 40 at its discharge and inlet ends in order to facilitate the connection of the air handling apparatus to an air duct. The fan arrangement shown is particularly suitable for connection to a flanged outlet on an air conditioner housing. In such an application, duct connection portion 40 would be connected to the outlet of the air conditioner housing, and fan drive shaft 42 would be connected to either a bearing block and pulley wheel or a drive motor located within the air conditioner housing. With respect to the means for driving fan 20, it is to be noted that the use of a drive shaft 42 connected to an external power source is illustrative only, and that various drive arrangements may be employed. For example, a motor could be supported within cylindrical member 26 and directly connected to the fan hub 21. Or, alternatively, fan 20 could be belt driven by means of a motor mounted on external casing 2.

When fan 20 is placed in operation, a stream of air is drawn in smoothly over rounded nose piece 7 and bell-shaped inlet 6 into housing 1 and passes through blades 22 into annular passage 24. Sound absorbing material 18 immediately adjacent the discharge side of fan 20 functions to absorb the noises generated by the operation of the fan, and thus minimizes the amount of sound transmitted through the air to regions upstream and downstream of the air handling apparatus. The loose, porous bed of fibrous material 18 is particularly effective to absorb sound. Because of its superior noise dampening qualities, material 18 is employed in recess 10 rather than relying solely on foam plastic material 16 to prevent both sound and heat transmission. After discharging from the sound absorbing zone, the air is decelerated by stator vanes 30 and diffuser section 14 which convert velocity pressure to static pressure. The air is then discharged in an even flow over rounded tail piece 34.

It will be apparent from the foregoing discussion that we have provided an air handling apparatus which represents a significant improvement over prior art devices by virtue of its compact design and ease of assembly. Compactness is achieved by incorporating in a unitary assembly the insulating and sound dampening features conventionally furnished as add-on elements at the time of installation. Foamed-in-place plastic 16 not only provides fully effective thermal insulation to prevent condensation on outer casing 2 when cold air is being handled, but also furnishes a load bearing structure permitting the use of light weight, low-cost materials for casing 2 and 4. Integrating the sound attenuator with the fan housing by means of recess 10 in inner casing 4 results in a low cost assembly which takes up substantially less space than would be required if a separate sound absorber, as disclosed in U.S. Patent 2,990,906, were installed at the air handling unit outlet. The conical shape of diffuser section 14 and of the tips of stator vanes 30 further simplifies manufacturing operations by eliminating the need for maintaining close dimensional tolerances on these components.

It is anticipated that various modifications of our improved air handling apparatus will occur to those skilled in the art, and we thus desire that our invention be limited only by the scope of the following claims.

We claim:

1. Air handling apparatus comprising: a first lightweight, substantially cylindrical casing, a second lightweight casing spaced inwardly from said first casing and concentric therewith so as to form an annular space therebetween; a fan wheel having a plurality of blades positioned within said second casing with its axis of rotation being coextensive with the longitudinal axis of said first and second casings; said second casing being formed to include a bell-shaped air inlet section upstream of said fan wheel, a cylindrical portion enclosing said fan blades, a recessed portion containing sound absorbing material downstream from said fan blades, and a diffuser section.

2. Air handling apparatus as recited in claim 1, wherein said sound absorbing material is in the form of glass fibers and is held in place by a perforated, cylindrical cover overlying said recessed portion.

3. Air handling apparatus as recited in claim 1, and further including load bearing, foamed-in-place plastic in said annular space.

4. Air handling apparatus as defined in claim 1 wherein said diffuser section comprises an outwardly flaring, fusto-conically shaped wall; and further including a stator assembly within said diffuser section comprising a ring from which a plurality of stator vanes extend outwardly, the tips of said vanes being tapered to coincide with the conical angle of said diffuser wall, said stator ring being positioned axially within said diffuser section at a point where said stator vanes fit snugly to said frusto-conically shaped wall.

5. Apparatus as defined in claim 4 wherein said stator vanes are secured to said frusto-conically shaped wall by means of clips fitted over said vanes and fastened to said wall.

6. Apparatus as defined in claim 4 and further including a cylindrical member secured to said stator ring and extending longitudinally between said stator ring and said fan wheel within said second casing so as to form therewith an annular passage for the flow of air.

7. Air handling apparatus comprising: a generally cylindrical housing having an inner wall shaped to include a fan blade enclosing section and a diffuser section; a fan wheel having a plurality of blades supported within said fan blade enclosing section, the axis of rotation of said fan wheel being coextensive with the longitudinal axis of said housing; said diffuser section having outwardly diverging walls in the form of a frustum of a cone; and a stator assembly comprising a ring and a plurality of vanes extending generally radially outwardly therefrom, the tips of said vanes being inclined at the same angle as the diverging walls of said diffuser section, and said stator assembly being so positioned axially within said diffuser section that said vane tips fit tightly against said diverging walls.

8. Air handling apparatus as defined in claim 7 wherein said vanes are secured at their outer extremities to said diffuser section by means of clips extending over said vanes and fastened to said outwardly diverging walls.

9. Air handling apparatus as defined in claim 7, and further including a cylindrical, air guide member positioned within said housing in spaced relation thereto and secured to the upstream side of said ring.

10. Air handling apparatus as defined in claim 9, and further including a rounded end cap positioned within said

diffuser section and secured to the downstream side of said ring.

References Cited

UNITED STATES PATENTS

1,762,358	6/1930	Schmidt	230—120
2,225,398	12/1940	Hamblin	230—232

2,637,487	5/1953	Sawyer	230—120
2,690,294	9/1954	Cary	230—120

FOREIGN PATENTS

622,927	2/1958	Canada.
1,031,949	6/1966	Great Britain.

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