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ELECTRICALLY HEATED FAN-HEATER

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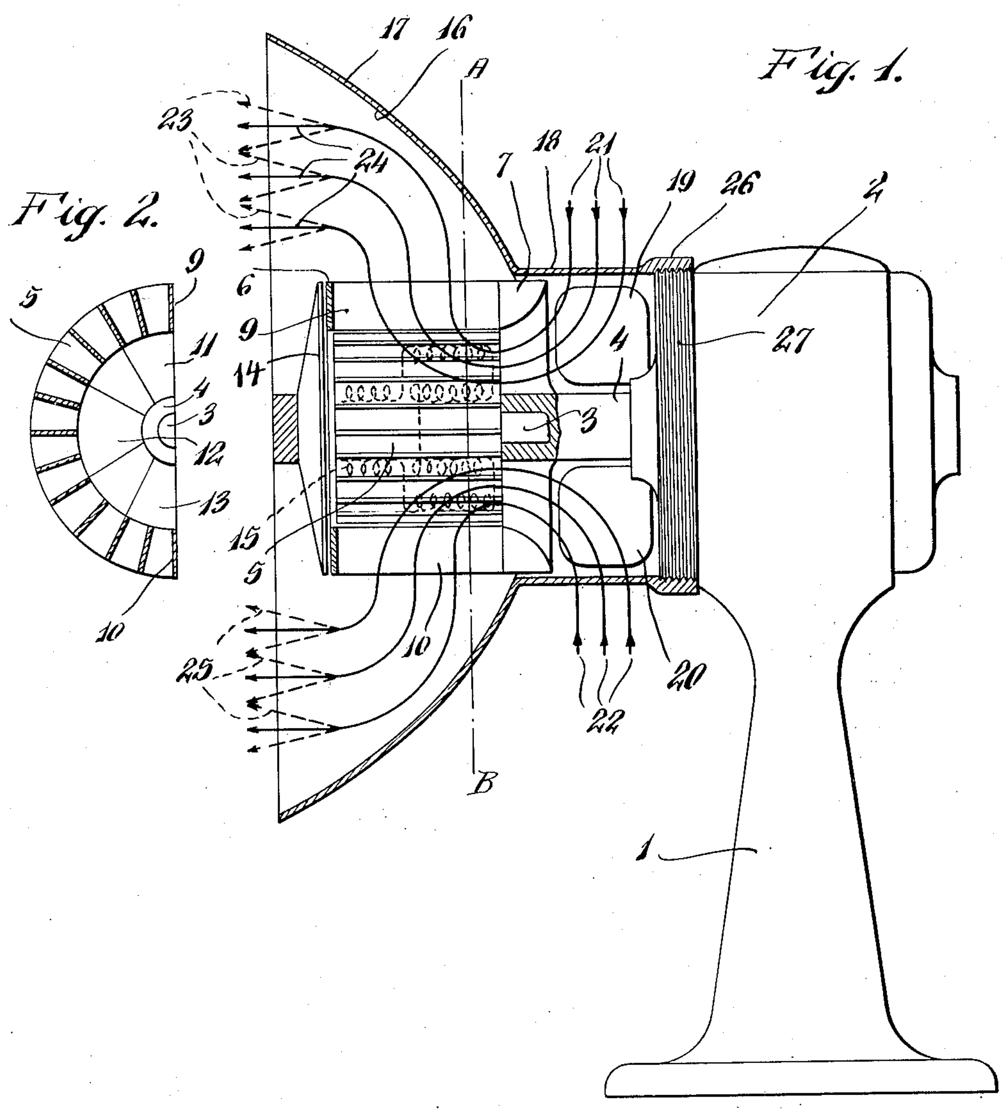


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## ELECTRICALLY HEATED FAN-HEATER

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7 Claims. (Cl. 219—39)

1

The present invention relates to ventilating and heating art, relates in particular to such art by electrical means, and relates specifically to electrical heating units provided with electric fans.

This application is a division of application Serial No. 511,957, filed November 27, 1943, now abandoned.

Among the objects of the invention are: to provide an electrically heated fan-heater which may be used to circulate cool air in warm weather and to circulate warm air in cool weather; to provide in an electrically heated fan-heater a structure which permits optional focusing of the air circulated so that the circulated air may be directed to a restricted location, or it may be spread out, by simple manual adjustment of the device during operation, and to provide an electrically heated fan-heater structure which is comparatively noiseless in operation so that it may be used in places where noise is objectionable, such as in the presence of sleeping persons, hospital patients and under similar conditions.

In the prior art, portable electric ventilating fans have been supplied with screw-type air-propellers revolving in free air. These screw-type propellers have large windage losses, considerable radial component of air propulsion, and operating in open air have the property of creating large eddy currents in the immediate vicinity of the propeller and confining a considerable amount of the air circulation to the general neighborhood of the fan itself instead of circulating all the air about the room under ventilation.

In addition to the low operating efficiency of these screw-type air-propellers, they have a high moment of inertia which calls for considerable accelerating torque to bring the propeller up to operating speed and which torque is not required after operating speed is attained. This combination of useless power requirements necessitates a larger motor than would have to be employed in the absence of them.

In addition, the metallic-bladed screw-type air-propeller produces a considerable noise which is distasteful to a large portion of the users of portable ventilating electric fans.

In the present invention, a high efficiency radial flow turbine type of air blower is employed which is known to operate at a high efficiency and is practically noiseless in operation.

In some embodiments of this invention a screw-type air-propeller may be used in cooperation with the radial flow rotor, if and when desired.

Further, in the present invention with such a type of air-impeller, a deflecting surface is used

2

in which the column of the air-flow may be converged or diverged, as desired under the circumstances, and any adjustment, between convergence of the air-flow and divergence thereof, may be made manually while the rotor is in operation.

Further, the internal air space of such a rotor as employed in the present invention, may be provided with an electrical heating coil and thus the present invention may be used to provide cool air in warm weather and warm air in cool weather, at will.

Further and other objects will be pointed out and apparent in the reading of the description hereinunder, particularly when taken in connection with the drawings in which Fig. 1 is an elevation of an embodiment of my invention shown partly in section, and Fig. 2 is a fragmentary section of the rotor employed taken along the line A—B.

Referring to Fig. 1, **1** is a stand supporting an electric motor **2**, having shaft extension **3** onto which is fixed a hub **4**, carrying with it a radial-flow air-impeller rotor **5**.

Referring to Fig. 2, which is a half section of the rotor **5** taken along the line A—B, Fig. 1, looking east. Fig. 2 is a section of the rotor per se, without any of the surrounding parts included, and is thus illustrated for the sake of clearness. The rotor **5** is not necessarily of a novel structure, in so far as the radial air-flow blades are concerned, but may be of any suitable conventional construction having end rings **6** and **7**, Fig. 1, supporting intermediate blades such as **9** and **10**, Figs. 1 and 2. The shape of the impeller blades of this rotor may have any suitable form, but for simplicity, are illustrated in the figure as being radial, though they may advantageously have curved impelling surfaces.

Referring to Fig. 1, end ring **7** has made integrally with it hub **4** and said hub **4** is attached to ring **7** by means of spokes such as **11**, **12** and **13**, Fig. 2. These spokes may be formed into a screw-type air-propeller, if and when desired, and while a screw-type propeller of such a small diameter is not very effective in producing radial air-flow, it does in effect and fact serve to reduce the resistance of axial air-flow which would otherwise be present if the said spokes were formed differently.

End ring **6**, Fig. 1, may be a complete disk which serves to close the outboard end of the rotor **5**, or the outboard end of the rotor **5** may be of a ring construction such as illustrated, and substantially closed by means of a lid **14**. Lid **14** may have fixed to it an electrical heating coil indicted by the dotted helices 15, which are so disposed within the rotor 5 that a greater watt dissipation is obtained from the said helices in that part of the rotor space having a greater amount of air intake. In other words, the heating coils are disposed in such a way that the watt dissipation is proportional to the ability of the air currents to remove the heat from the region.

Referring to Fig. 1, an air deflecting surface 16 surrounds the rotor 5. The surface 16 is preferably formed by a surface revolution, being that of a paraboloid or any other suitable surface which has a suitable deflecting surface for the radial air currents from rotor 5. The surface 16 is supported by shell 17 which is provided with a hollow cylinder 18 having a plurality of openings such as 19 and 20 to permit the influx of free air, indicated by the flow lines 21 and 22. Flow lines 21 and 22 are indicated as not going through the set of openings 19 and 20, but through a set of openings generally at right angles thereto.

Flow lines 21 and 22 pass through the spokes which are formed into a screw-type air-propeller, thence through the heating coil 15 and from there radially to a zone of the surface-of-revolution 16 from which they are deflected, as indicated by following the lines of flow out into free air. If the surface-of-revolution 16 is formed to be responsive to a focal point located generally about the center of the rotor 5, the direction of the lines of flow into free air will diverge in the general direction of the dotted lines 23, or the sadi lines of flow will form a path generally parallel in direction to the axis of the deflector, such as indicated by the flow lines 24, or the direction of flow may be caused to converge the general direction of the dotted lines 25, all according to the relative axial position of the rotor 5 with reference to the focal point of the solid of revolution 16.

It will be appreciated that the flow lines 23, 24 and 25 referred to, really lie within air-flow cones or cylinders, as the air-flow is a column of air symmetrical about the axis of the rotor and deflector.

Hollow cylinder 18, Fig. 1, is provided with an internally threaded end 26 which screws upon an externally threaded member 27, which said external threaded member forms a part of the motor frame 2.

If the threads of 27 are cut right-handed, then a counter-clockwise rotation of the deflector member 17 extends the said member in a westerly direction with reference to the center of rotator 5 and a clockwise rotation of member 17 moves the said member in an opposite direction, thus a rotary motion applied to member 17 functions to change the position of the deflector with reference to general location of the effective focal origin of the air-flow from the rotor 5, hence, changes the lines of air-flow to the general direction of 23, 24 or 25, as may be desired.

If warm air is desired instead of cool, the heating coils 15 may be turned on and the heat from the said coils focused into or diverged over the space under heating and ventilation. Having these heating coils in the path of air-flow permits a much larger wattage to be employed in these coils than would be permissible in still air with a simple reflector.

Such a construction has a high efficiency, low-moment of inertia, both functioning to reduce the size of motor 2, as well as the attendant cost of operation.

The focusing feature of the deflector serves to localize or spread out the air-flow, eliminating the necessity of costly oscillating accessories common to screw-type propeller-ventilators.

The rotor, being almost totally enclosed by solid material, makes it extremely difficult to get into difficulty with extraneous objects coming in contact with the rotor blades, such as so often takes place with a screw-type propeller in a wire guard.

An electrical heater employing a fan structure having a higher number of small impeller blades for a given number of revolutions per minute, than a fan employing a small number of large blades for the same revolutions per minute, operates more quietly than the latter. The experimental basis for this statement is found in an article by A. Fage in The Proceedings of the Royal Society of Great Britain for 1925 entitled, "An experimental study of the vibration in the blades and shaft of an airscrew" (air-propeller).

The terminology used in this description and in the claims hereunder is employed in conformity with standard practice turbine art.

Having described one embodiment of the invention, the scope thereof is covered in the claims hereunder.

What I claim is:

1. In an electric device for heating free-air space, a driving motor, an air-impeller rotor having a cup-shaped form mounted axially upon an extended shaft of said motor and rotatable therewith, said rotor being positioned to intake air through the end thereof adjacent said motor, a concave air-deflector radially surrounding said rotor, an intake port to admit air to said rotor from behind said deflector and in front of said motor, an electrical heating unit positioned in the cavity of said cup-shaped form, said deflector having its deflecting surface open directly to free-air space and formed to deflect heated exhaust air from said rotor into direct stream lines to remotely disposed parts of said space.

2. In an electric device for heating free-air space, a driving motor, an air-impeller rotor having a cup-shaped form mounted axially upon an extended shaft of said motor and rotatable therewith, said rotor being positioned to intake air through the end thereof adjacent said motor, said rotor being provided with a number of impeller vanes in combination with a peripheral velocity thereof causing low operating noise, a concave air-deflector radially surrounding said rotor, an intake port to admit air to said rotor from behind said deflector and in front of said motor, an electrical heating unit positioned in the cavity of said cup-shaped form, said deflector having its deflecting surface open directly to free-air space and formed to deflect heated exhaust air from said rotor into direct stream lines to remotely disposed parts of said space.

3. In an electric device for heating free-air space, a driving motor, an air-impeller rotor having a cup-shaped form mounted axially upon an extended shaft of said motor and rotatable therewith, said rotor being positioned to intake air through the end thereof adjacent said motor, said rotor being provided with a relatively high number of relatively small impeller vanes operating at a peripheral velocity causing relatively low operating noise, a concave air-deflector radially surrounding said rotor, an intake port to admit air to said rotor from behind said deflector and in front of said motor, an electrical heating unit positioned in the cavity of said cup-shaped

form, said deflector having its deflecting surface open directly to free-air space and formed to deflect heated exhaust air from said rotor into direct stream lines to remotely disposed parts of said space.

4. In an electric device for heating free-air space, a driving motor, a rotor having air-impeller vanes arranged along a surface of revolution and mounted axially upon an extended shaft of said motor and rotatable therewith, said rotor being formed to intake air through the end thereof adjacent said motor, a concave air-deflector radially surrounding said rotor, an intake air-port to admit air to said rotor from behind said deflector and in front of said motor, an electrical heating unit located in said surface of revolution, said deflector having its deflecting surface open to free-air space, and said vanes formed to exhaust heated air in a direction with respect to said surface to cause said air to assume direct stream lines to remotely disposed parts of said space.

5. In an electric device for heating free-air space, a driving motor, an air-impeller rotor having a cup-shaped form mounted axially upon an extended shaft of said motor with the open end of said cup-shaped form facing said motor, said rotor being rotatable with said shaft, an electrical heating unit located in the cavity of said cup-shaped form to heat the rotor intake air, a concave air-deflector radially surrounding said rotor and mounted in moveable axial relation thereto, said deflector having its deflecting surface open directly to free-air space and deflecting exhaust air from said rotor into direct stream lines to remotely disposed parts of said space, the direction of said stream-lines being fixed by said axial relation, and means adapted to change said axial relation to cause a change in the direction of said stream lines.

6. In an electric device for heating free-air space, a driving motor, an air-impeller rotor having a cup-shaped form mounted axially upon an extended shaft of said motor with the open end of said cup-shaped form facing said motor, said rotor being rotatable with said shaft, an electrical heating unit located in the cavity of said cup-shaped form to heat the rotor intake air, a concave air-deflector radially surrounding said rotor and mounted in moveable axial relation thereto, said deflector having its deflecting surface open directly to free-air space and formed to converge the directions of exhaust air from said rotor at locations in said space remotely disposed from said deflector, said locations being fixed by said axial relation, and means adapted to change said axial relation to cause a change in the location of the convergence of said directions.

7. In an electrically heated fan-heater, a driving motor, an air-impeller rotor mounted axially upon an extended shaft of said motor, said rotor having a coaxial free space internal of the impeller vanes of said rotor, an electrical heating unit disposed in said space, a concave air-deflector radially surrounding said rotor and formed to deflect radial exhaust air from said rotor away from said motor in a generally axial direction, and an intake air-port to admit air to said rotor from space between said rotor and said motor.

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