

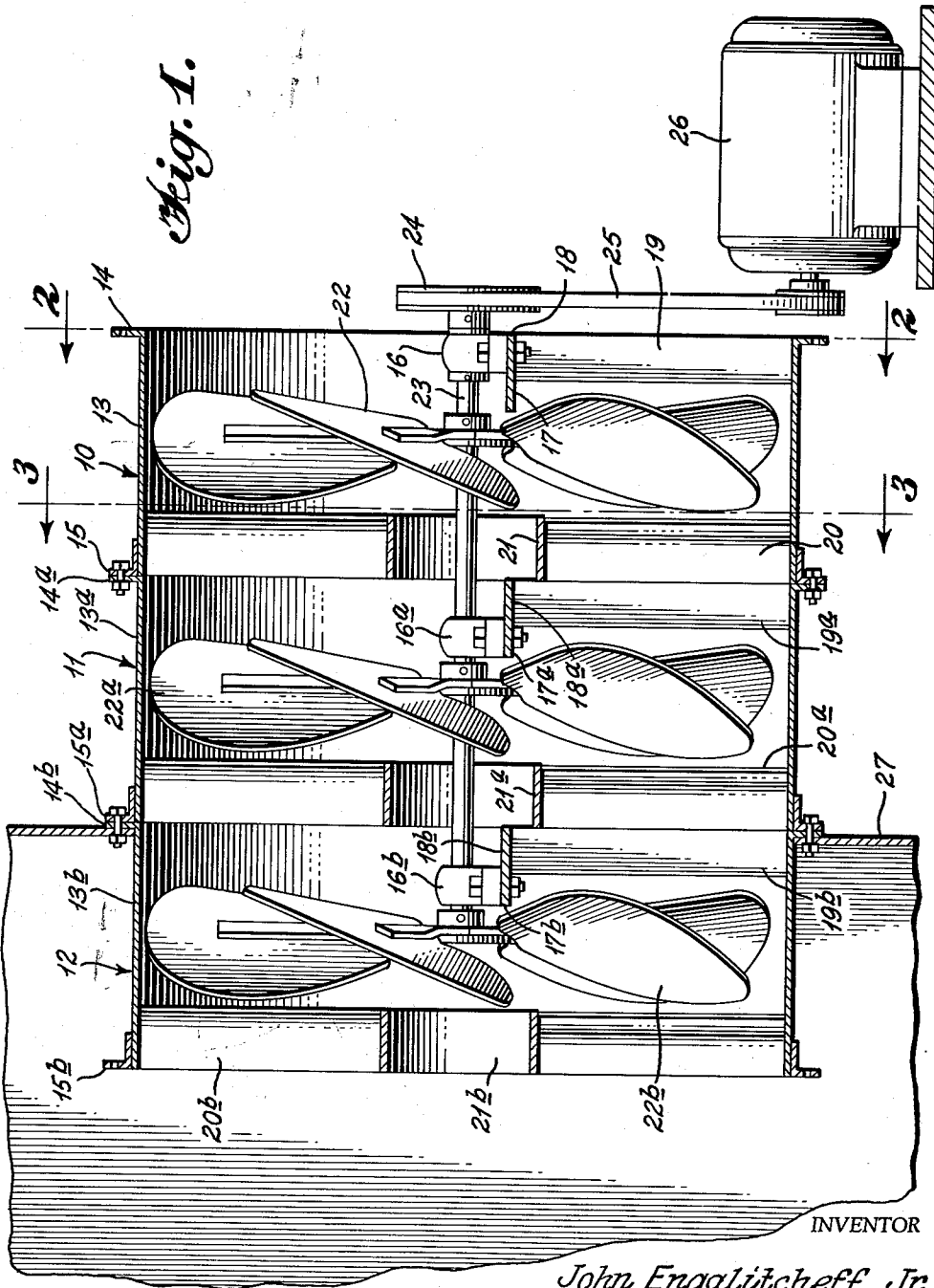
April 9, 1963

J. ENGALITCHEFF, JR  
MULTISTAGE AIR MOVING DEVICE

3,084,850

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3 Sheets-Sheet 1



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*Fig. 2.*

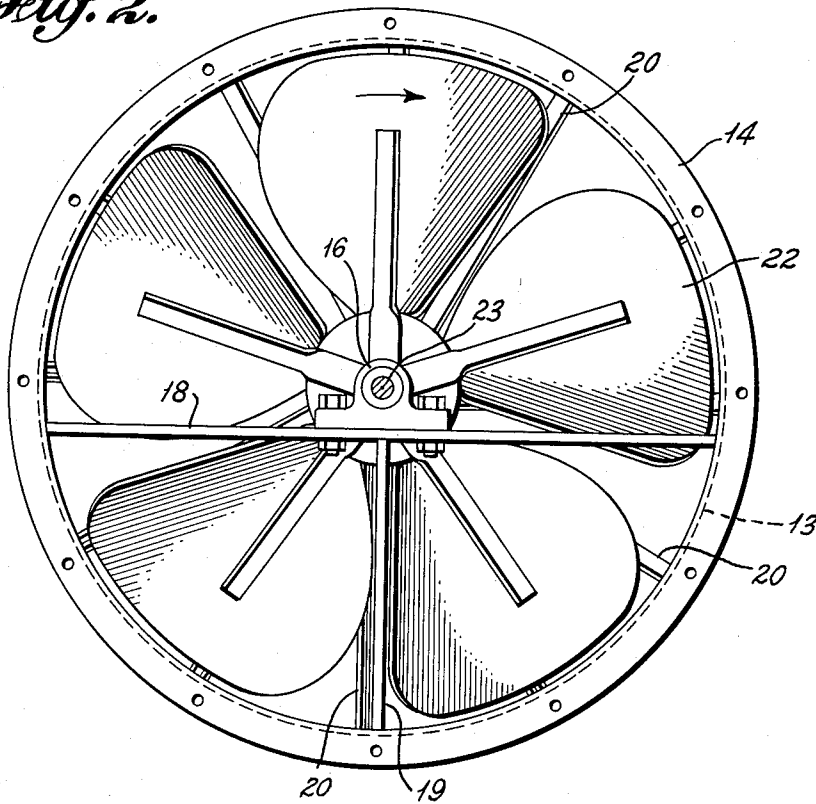
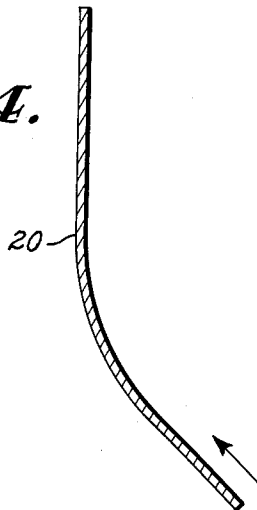


*Fig. 4.*



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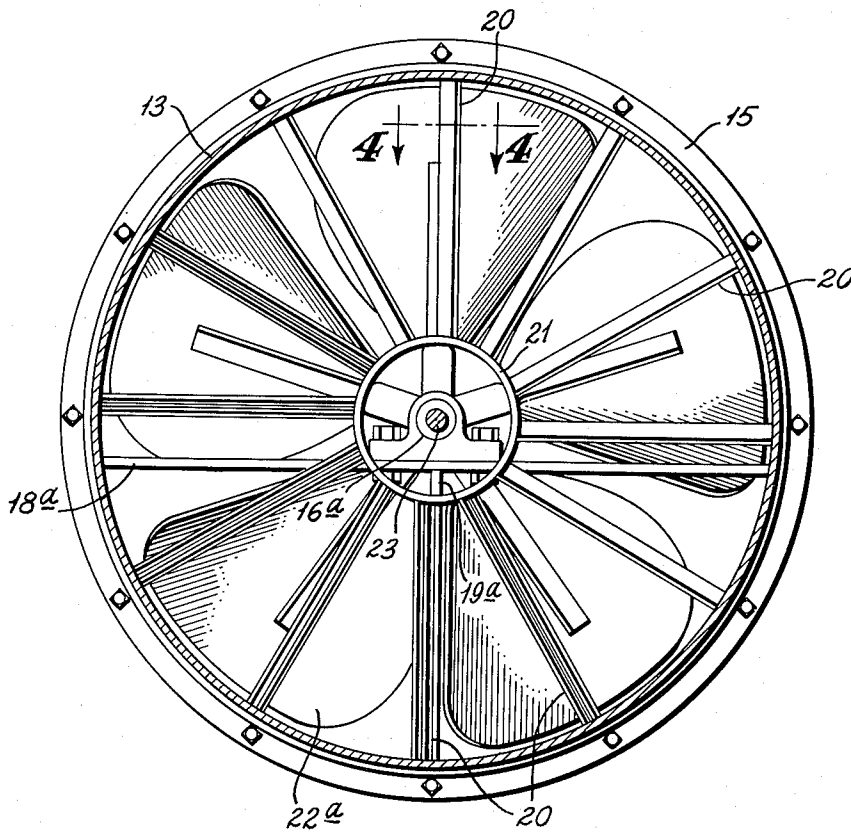
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*Fig. 3.*



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## MULTISTAGE AIR MOVING DEVICE

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1 Claim. (Cl. 230-122)

This invention relates to air moving devices and more particularly relates to fans of the type used in conjunction with evaporative condensers, cooling towers, and the like.

Air conditioning, refrigeration, as well as apparatus for performing a variety of chemical processes, include condensers, cooling towers, and the like. These pieces of equipment require fans capable of maintaining the movement of large volumes of air over long periods of time. The degree of compression required is, however, quite small, usually from one to four inches of water pressure rise above atmospheric pressure.

The art prior to the present invention has attempted to meet these requirements by the use of air screw type, axial flow propellers and centrifugal fans. The axial flow propeller enjoys an economic advantage over the centrifugal fan in that the horsepower requirements of its driving motor are lower for per unit volume of air moved with the maintenance of a design pressure rise across the fan. On the other hand, the centrifugal air moving fan, while much more costly to operate than its axial flow counterpart, does enjoy the advantage of being much quieter than air axial flow fan of like capacity. Thus, the prior art in designing an air moving system for industrial purposes or for residential apartment air conditioning was always confronted on the one hand with a cost problem and on the other with a noise problem. Whatever the choice, neither solution was satisfactory.

It is an object of this invention to overcome the foregoing difficulties of the prior art and to provide air moving apparatus quieter than a centrifugal fan of equal capacity and yet less costly to operate than a single stage axial flow fan of the like capacity.

According to the present invention the noise and operating cost reductions discussed above are achieved by apparatus which is simple and economical to build and which is readily adaptable to the specific requirements of various pieces of equipment with which it may be used.

Other objects and advantages of this invention will be apparent from a consideration of the following detailed description of a preferred embodiment thereof in conjunction with the annexed drawings wherein:

FIGURE 1 is a view in longitudinal section of a multistage air moving device constructed in accordance with the principles of the present invention;

FIGURE 2 is an end view of the device of FIGURE 1 showing the details of the fan of the first stage;

FIGURE 3 is a view in section taken on the line 3-3 of FIGURE 1; and

FIGURE 4 is a view in section taken on the line 4-4 of FIGURE 3.

It will be noted that the air moving device shown in the drawings is made up of three identical units 10, 11, and 12 connected in series. The unit 10 is comprised of a cylindrical housing, or ducting, 13 of sheet metal having annular flanges 14 and 15 at its opposite ends. Within the housing 13 there is located a fan shaft bearing 16 supported on a shelf 17 formed integral with a strut 18 which extends chordwise across the housing 13 below and parallel to the horizontal diameter thereof. Strut 18 is reinforced by a vertical support 19 (see FIGURE 2).

At the opposite end of the housing 13 from the bearing 16 there are provided a series of stator blades 20 ex-

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tending radially of the housing 13 in an annular zone defined by the inner wall of the housing 13 and an annular wall 21. Annulus 21 and the bearing 16 are both coaxial with housing 13. The wall of the cylinder 13 is reinforced in the region of the stator blades 20 by the girding portion of an L section annulus, the radial portion of which constitutes the flange 15.

Units 11 and 12 are identical to unit 10 and their component parts are illustrated with the same reference numerals as are used in relation to unit 10 except for the suffix "a" as to the unit 11 and the suffix "b" as to the unit 12.

Once the desired number of units are coaxially connected by bolting together adjacent flanges 15 to 14a and 15a to 14b, axial flow air screw type fans 22, 22a, and 22b are located in housings 10, 11, and 12 respectively, and their common axle or drive shaft 23 is located in bearings 16, 16a and 16b. Each of the fans 22, 22a and 22b is keyed to the shaft 23. A portion of the shaft 23 projects beyond the intake end of unit 10, and a sheave 24 is keyed to this projecting portion. The sheave 24 is connected by a V-belt 25 to an electric motor 26.

The fans 22, 22a and 22b are of the same blade configuration, size, and pitch, and being keyed to the common drive shaft 23, they run at the same speed and direction. Since the air leaving the fan 22 is no longer axially oriented, the load could not be shared between fans 22, 22a, and 22b were it not for the stator blades 20. However, as can be seen by reference to FIGURE 4, these blades are so contoured as to reorient the air between fans 22 and 22a to an axial direction so that fan 22a attacks the air issuing from the stator blades 20 at the same angle at which fan 22 attacks the air entering the system. The stator blades 20a perform the same function between fans 22a and 22b. The stator blades 20b are not necessary to align the air for a subsequent fan and may be omitted. However, in some instances the stator blades 20b are useful in directing the air into an evaporator or cooler for superior heat exchange, a portion of the evaporator or cooler being indicated by the numeral 27 in FIGURE 1.

Since units 10, 11, and 12 are identical, various numbers of such units may be connected in series to perform a given function. Since each fan accomplishes only its proportional fraction of the total pressure rise developed across the system, fan blade tip speeds may be low with resultant noise reduction. Because the stator units reorient the air to an axial direction, the fans of successive stages do not have to be designed to accommodate different angles of air flow, thereby allowing for the economy inherent in standardization on a single design.

Although the present invention has been shown and described with reference to a particular embodiment, changes and modifications obvious to one skilled in the art are deemed to be within the spirit, scope, and contemplation of the invention.

What I claim is:

A multistage air moving device comprising a plurality of axially arranged interchangeable units, each comprising a length of sheet metal ducting, an air screw shaft bearing in each unit, means supporting said bearing from one end of the respective length of ducting, means to interconnect said units end to end with the bearings in axially aligned position, a common shaft mounted on said bearings, a propeller-type air screw in each unit mounted on said shaft and located to suck air into one end of each of said lengths of ducting and to discharge air through the other end thereof, and a series of stator blades adjacent said other end of each of said lengths of ducting to reorient the flowing air to an axial direction, said blades being wholly supported in fixed position from the respective length of ducting at an end thereof opposite

to the end at which the shaft bearing supporting means is located, whereby the strength of each length of ducting is reinforced at its opposite ends by said bearing supporting means and said series of stator blades respectively.

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