United States Patent

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[54] **COMPACT FLUID COMPRESSOR**
7 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **417/354,** 310/67
[51] **Int. Cl.** **F04b 17/00,** H02k 7/00
[50] **Field of Search** 417/354, 423; 310/67

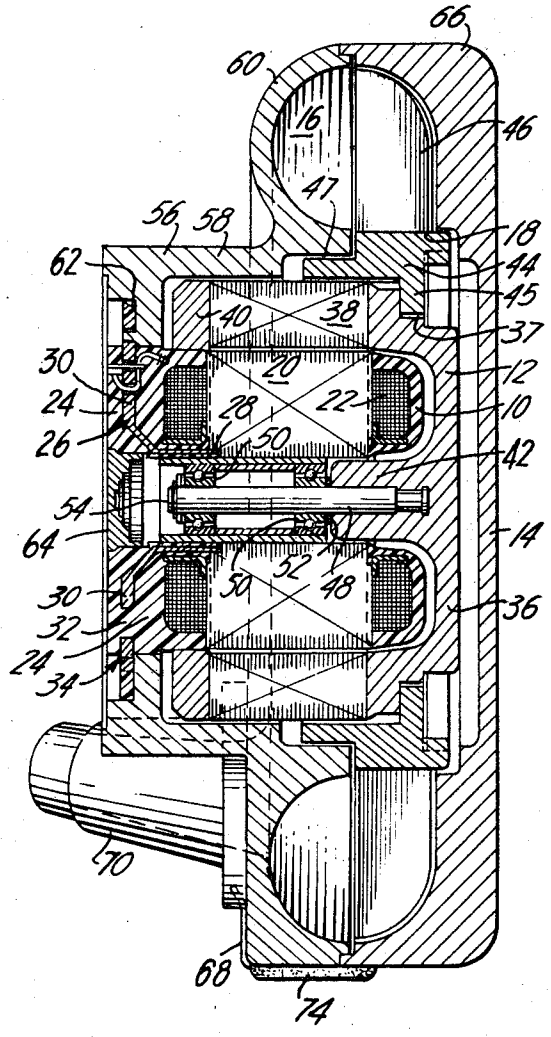
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ABSTRACT: A regenerative compressor in accordance with the invention described herein comprises a stator and a rotor coaxial therewith to form a motor. Concentric to the motor and between its ends is a compressor chamber having inlet and exhaust openings. A compressor wheel is mounted on the rotor and projects into the compressor chamber for providing a high compression output in a limited space.



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FIG. 2

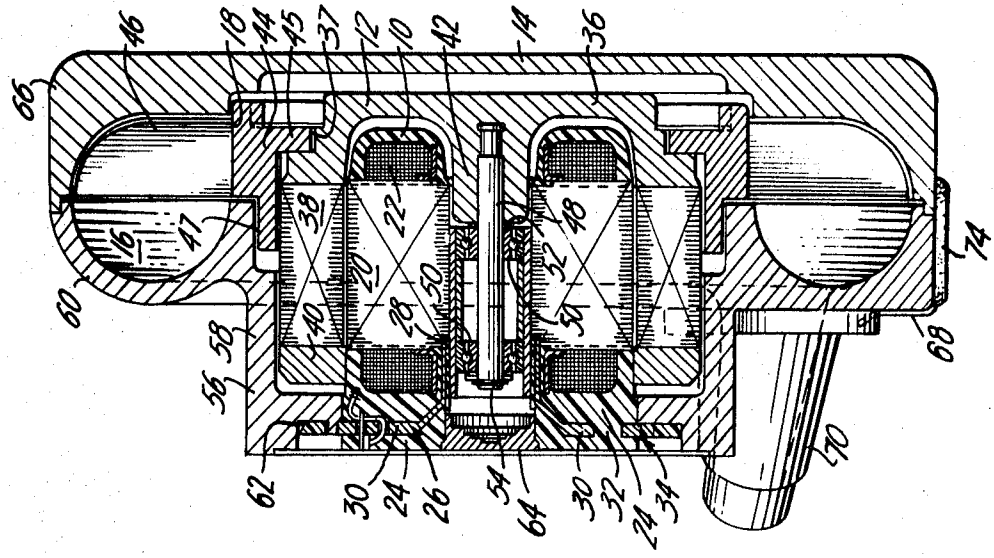
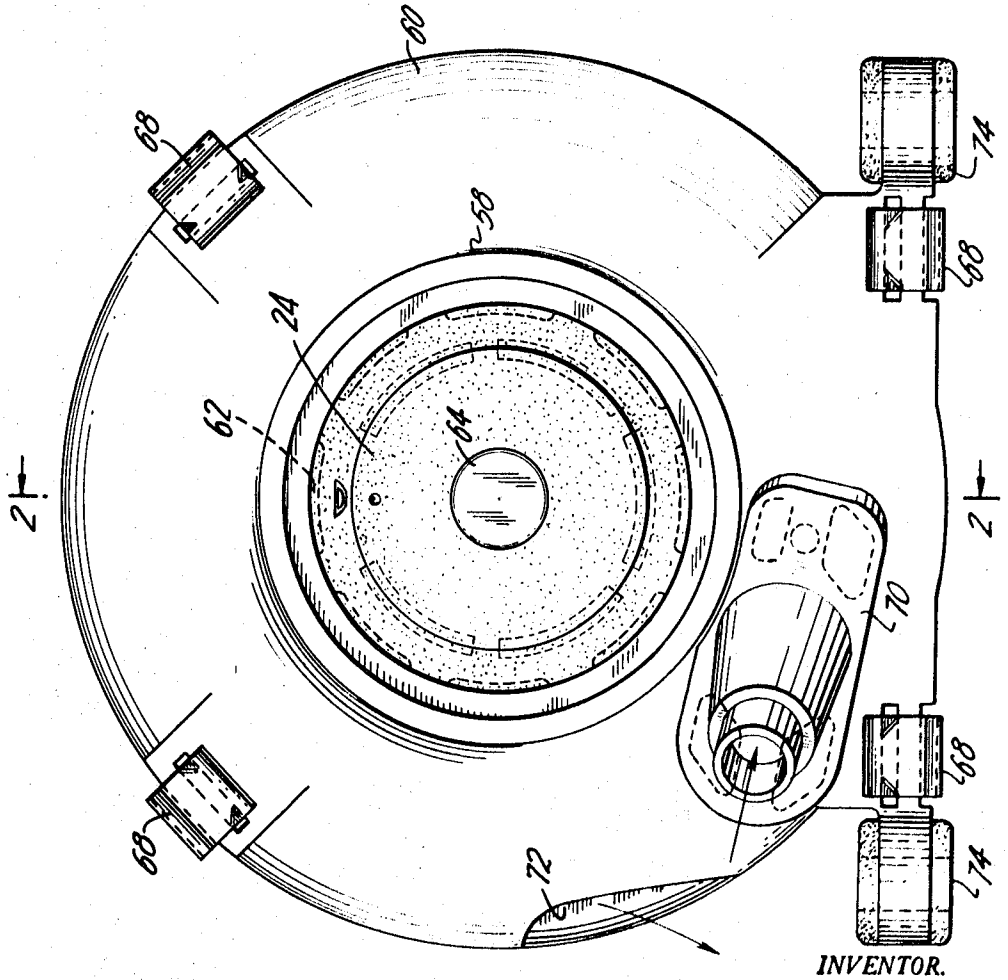


FIG. 1



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COMPACT FLUID COMPRESSOR

In many applications involving the use of electric motors or electronic components, it is necessary to remove the heat generated in order to maintain the operating life or characteristics of the unit. To accomplish this, it is usual to provide an electric fan that will remove the heat generated and provide the above-described advantages. Generally, however, space is at a premium and the size of the fan must be kept to a minimum in order to be compatible with the installation.

Another application requiring compact exhaust fans is the removal of wet or corrosive vapors, such as given off by the chemical solutions employed in certain types of duplicating or printing machines. In addition to the space problem, it is a necessity in the design of fans for this type of application, that the motor and blower structure be protected from the harmful effects of the vapors.

In all of the above-described applications still another factor must be considered, i.e., the fan must provide a high compression in order to remove as much of the heat and vapors as possible. Compact tube axial fans and centrifugal compressors are available, but these units do not provide a high enough output for many requirements nor are such units resistant to the harmful effects of excessive moisture or corrosive vapors.

Where high outputs are required, designers have frequently employed regenerative compressors. However, presently available regenerative compressors are too large for many environments, conventionally consisting of a shaft extending axially from an electric motor and carrying an impeller that projects into a compressor chamber spaced from the motor. The overall dimensions, particularly in the axial direction, are thus often too large to be satisfactorily utilized in the environments described above. These devices also present some structural difficulties that add to their complexity and cost.

It is an object of this invention, therefore, to provide a fan capable of a high compression and having a relatively small axial length so as to be usable where space is at a premium and a high output is required.

It is another object of this invention to provide a fan that is capable of exhausting corrosive or wet vapors while preventing detrimental effect to the motor.

It is still another object of this invention to provide a regenerative compressor of the type described above wherein the problems associated with mounting the impeller to the shaft are alleviated and wherein the heat of the motor is dissipated in the airstream driven by the impeller.

Briefly described, this invention comprises a cup-shaped rotor assembly mounted for rotation about a stator assembly and wherein the impeller wheel is mounted directly to the rotor assembly and projects radially therefrom at a point located between the ends of the motor. An annular compressor chamber is also located between the ends of the motor and is coaxial therewith, so as to receive the impeller wheel. By this arrangement, the size of the fan is significantly reduced and motor heat is dissipated into the airstream exhausted by the compressor.

If the motor is to be used to exhaust corrosive or wet vapors, the motor assembly may be encapsulated in a suitable plastic that prevents the detrimental effect of these vapors on the motor.

For a better understanding of the present invention, reference is made to the following specification and the accompanying drawings, in which:

FIG. 1 is an elevation view of a regenerative compressor in accordance with the invention; and

FIG. 2 is a cross-sectional view of the compressor shown in FIG. 1, taken along the line 2—2.

Referring to the drawings, there is disclosed (FIG. 2) a centrally disposed stator assembly **10** surrounded by a cup-shaped rotor assembly **12** to form a motor carried in a housing **56, 58**. Located coaxially with the motor is an annular substantially closed compressor chamber **16** of generally toroidal configuration that receives a suitable impeller assembly **18** secured directly to the rotor assembly **12**.

The stator assembly **10** is annular and comprises a laminated core or stack **20** surrounded by suitable windings **22** connected to an alternating current source in any conventional fashion to provide the revolving magnetic field. A flanged member **26** includes a collar portion **28** received in the aperture of the stator assembly **10** and a flange **30** projecting radially from the collar portion adjacent one end of the stator assembly. At the outer edge of the flange **30**, a plurality of slots **32** are formed for a purpose to be fully explained hereinafter.

Molded about the stator assembly **10** is a plastic material **24** that may, if the fan is to be utilized to exhaust wet or corrosive vapors, completely encapsulate the stator and provide a protective coating for the core **20**. Otherwise, the plastic **24** need not encapsulate the outside diameter of the core **20**. During the molding operation, plastic will flow through the openings **32** to establish an interlock for the member **26**. Along the faces of the flange **30** the plastic stops a distance from the end to leave a projecting rim **34** around the circumference of the stator assembly. The purpose of this rim will be fully explained hereinafter.

The rotor assembly **12** is a generally cup-shaped arrangement including a flat base portion **36** supporting the annular laminations **38** and an end ring **40**. Laminations **38** project axially from the outer periphery of the base portion **36** so as to cooperate with the core **20** and provide an electric motor. Also projecting axially from the inner face of the base portion **36** is a central boss member **42**, the purpose of which will be explained hereinafter.

As mentioned previously, the impeller assembly **18** is carried on the rotor assembly **12** and comprises an annular mounting ring **44** that is fixedly secured to the outer periphery of the rotor assembly at a point intermediate the ends thereof. As shown in FIG. **2**, the ring **44** defines a fractional part of the innermost surface of the compressor chamber **16**. Thus the ring **44** completes the chamber **16** defined by the housing. A plurality of regenerative compressor blades **46**, which may be curved or planar, project radially from the outer surface of the ring member **44** and extend into the compressor chamber **16**. The blades **46** serve to compress gases which enter the chamber **16** as they are forced to move in a generally circulatory manner through a substantial portion of the chamber **16**. The blades **46** extend to the outermost surface that defines the chamber **16** as shown in FIG. **2**. It should be apparent that this arrangement reduces the axial length of the compressor to that of the electric motor and also eliminates the problems of attaching the impeller to a narrow cylindrical shaft. Motor heat is readily dissipated since the fan blades **46** and ring member **44** are made of a metal or plastic having good thermal conductivity, and thus provide a good heat conducting path from the motor to the chamber **16** where the heat is exhausted with the air.

Preferably, the impeller assembly **18** should be secured to the rotor assembly **12** in a very rigid manner due to the high forces acting thereon. The accomplishment of such a joint is difficult when the fan is to be extremely small because of the lightweight materials being utilized However, the joint described herein provides the desired rigidity while allowing use of the materials desired. The end of the rotor base **36** is cut to form a step **37** extending around its periphery so that two surfaces are provided. Depending inwardly from the ring **44** is a lip portion **45** that is adapted to butt against the two surfaces provided by the step **37**. Since the ring **44** extends along the laminations **38**, three distinct areas of contact between the ring and rotor assembly are provided and a rigid joint is achieved. The left-hand portion of the ring may be extended, as at **47**, under the chamber **16** to provide a greater contact area between the ring and the rotor assembly and an improved fluid seal.

When assembled in their operative relationship, the boss member **42** projects into the central aperture of the stator assembly **10**. Rotatably supporting the rotor assembly **12** is a shaft **48** fixedly carried by the boss member **32** and extending through the remaining portion of the central aperture. A suita-

ble radial bearing **50** and thrust bearing arrangement **52** is provided around the shaft **48** in a manner that is well known in the art. To prevent axial movement of the rotor assembly, a retaining washer **54** is snapped over the end of the shaft **48** also in a manner that is well known in the art.

A preferred form of housing includes a first housing portion **56** adapted to be secured to the stator assembly and has a cup-shaped portion **58** that may be integrally molded with a semicircular wall portion **60** forming a portion of the toroidal chamber **16**. The end face of the cup-shaped portion **58** includes an annular opening therethrough having an undercut lip portion **62** projecting inwardly around the periphery of the opening. When assembled, the rim **34** on the stator assembly **10** will be received in the lip **62** and adhesively secured thereto. A removable end cap **64** may be placed in the open end of the central opening through the stator assembly to seal the motor.

Also included as part of the housing is a back wall portion **66** that is generally cup-shaped and complementary to the chamber wall **60**. When assembled, e.g., by suitable clips **68**, the housing and the compressor chamber **16** are formed. The housing thus defines at least three sides of an annular compression chamber. As shown by FIG. **1**, this chamber is of substantially constant cross-sectional area.

The compressor chamber includes an inlet **70** and an outlet **72**, between which is located a stripper (not shown) projecting inwardly from the chamber wall **60** at a point between the inlet and exhaust opening so as to guide the air through the exhaust opening. Any convenient shape of inlet and outlet may be employed, to suit the particular application and environment. In the illustrated embodiment, the inlet includes a generally tubular coupling element for connection to a conduit, and the outlet comprises simply an opening in the wall **60** of the compressor chamber. Mounting lugs **74** may also be provided to secure the fan to a support member.

It should be apparent from the preceding description that a narrow fan capable of a high delivery is provided wherein the heat dissipation and impeller mounting problems are solved. Additionally, it should be noted that if the stator windings **20** are completely encapsulated in plastic, the fan may be used to exhaust wet or corrosive vapor.

While in the foregoing there has been disclosed an illustrative embodiment of this invention, various modifications will occur to those skilled in the art to which this invention pertains. Accordingly, it is not desired to limit the invention to the exact features disclosed, but to encompass all such modifications.

I claim:

1. A regenerative compressor comprising a centrally disposed stator assembly, a rotor assembly surrounding said stator assembly and operatively associated therewith to form an electric motor, a housing secured to said stator, said housing partially defining an annular and substantially closed compression chamber surrounding said rotor assembly and disposed substantially between the ends thereof, said chamber being concentric with said stator assembly and said rotor assembly, a ring rigidly secured to said rotor defining at least a part of the innermost surface of said chamber, a plurality of regenerative compressor blades depending from said ring and extending into said chamber whereby gases which enter said chamber are compressed as they are forced to move through a substantial portion thereof in a circulatory manner.

2. A regenerative compressor according to claim **1** wherein said ring is fixedly secured to said rotor assembly at a point intermediate the ends thereof.

3. A regenerative compressor according to claim **1** wherein said housing defines at least three sides of said chamber.

4. A regenerative compressor according to claim **1** wherein said ring defines a fractional part of the innermost surface of said chamber and the remainder of said chamber is defined by said housing.

5. A regenerative compressor according to claim **4** wherein said chamber is generally toroidal in shape.

6. A regenerative compressor according to claim **1** wherein said chamber is of substantially constant cross-sectional area and said regenerative compressor blades extend to the outermost surface that defines said chamber.

7. A regenerative compressor according to claim **1** wherein said rotor assembly includes a cup-shaped member surrounding the stator assembly, a portion of which forms a step around its periphery, and said ring includes a lip which butts against two surfaces of said step to provide a rigid joint between said ring and said rotor assembly.