REGENERATIVE COMPRESSORS WITH INTEGRAL MUFFLERS

Filed Dec. 29, 1965

INVENTORS

DWIGHT E. HARRIS &
GUNther ZOHFELD

BY

Bumbaugh, tree, gross & Dornehe

their

ATTORNEYS
ABSTRACT OF THE DISCLOSURE

A regenerative compressor of the type including a motor and a housing providing a toroidal compressor chamber cooperating with an impeller driven by the motor, and an annular chamber surrounding the motor through which a fluid is introduced and extracted through inlet and outlet ports between the compressor chamber and annular chamber. The annular chamber is divided into separate inlet and outlet portions communicating with respective ports, and has opposed faces adjacent which sound absorbing material is disposed, partially filling the annular chamber. Perforated retaining plates secure the sound absorbing material in place within the annular chamber and effectively provide a series of sound absorbing cavities between the plate and opposing face of each chamber.

This invention relates to noise suppressors for regenerative compressors, and, more specifically to an improved regenerative compressor and sound muffler assembly which attenuates compressor noise without adding to the overall dimensions of the compressor.

Many regenerative compressors, particularly of the type described herein, inherently generate noise due to the pressure pulsations created by the expansion and/or compression of the fluid trapped between impeller blades as it passes the baffle separating the inlet and outlet ports of the compressor chamber. In this respect, the compressor acts much like a siren. In many compressor applications,roy the noise level of a compressor may be critical. For this reason, it is essential that the compressor operate with minimum noise.

Of the regenerative compressor using noise suppressing devices, many employ mufflers or other sound absorbing apparatus which are either poor sound attenuators or, although effective, increase the overall dimensions of the compressor. The latter, however, are undesirable, since they add weight to the compressor and render it unsatisfactory for use in equipment in which the space or volume occupied by the compressor must be minimized.

It is therefore an object of the invention to provide an improved regenerative compressor assembly which efficiently and effectively reduces the noise generated in the compressor.

A further object of the invention is to provide a noise attenuation design for regenerative compressors which does not increase the overall dimensions of the compressor.

The invention attains these and other objects by suppressing compressor noise by means integral with the compressor. Specifically, this is accomplished by providing a compressor housing formed with a generally annular chamber surrounding the compressor motor and locating within this chamber sound absorbing material or structure. In a preferred embodiment, this chamber is divided into inlet and outlet portions which communicate with the respective inlet and outlet ports of the compressor chamber.

For a better understanding of the invention, reference may be made to the following detailed description, taken in conjunction with the accompanying drawings, in which:

FIGURE 1 is a cross-section of a compressor in accordance with the invention, taken generally along the line 1—1 of FIGURE 2; and

FIGURE 2 is a cross-section of the compressor, taken along the line 2—2 in FIGURE 1. Turning now to FIGURES 1 and 2, a representative compressor includes a housing 10 having an annular compressor chamber 12 containing a stripper section 14 located between inlet port 30 and outlet port 32. Pressure is built up in the compressor by the rotation of the impeller 16 which is segmented by a plurality of spaced radial blades 19. The impeller 16 is driven by a motor 20 whose axis of rotation is coaxial with the impeller. The motor 20, shown schematically, comprises a stator 21 and a rotor 22 mounted on a shaft 23. The shaft 23, which is attached to the impeller 16, is mounted in bearings 24 and 25 in the stator housing 10. An end bell 26 is suitably fastened to the main part of the housing, as by the cap screws 26a, and may be removed for assembly and replacement or repair of the motor 20 or motor bearings 24, 25. An end cover 27 at the other end of the housing 10 protects the impeller 16 from direct forces or blows which could cause an imbalance or misalignment of the impeller on the shaft 23 and confines the working fluid within the machine.

Referring to FIGURE 2, the fluid (e.g., air) is introduced into the toroidal stator chamber 12 through the inlet port 30 and extracted at an increased pressure from the outlet port 32, as indicated by the arrows. These ports 30, 32 communicate with a generally annular chamber divided by the two baffle plates 35 and 36 into an inlet chamber 34a and an outlet chamber 34b (FIGURE 1). External connections to the compressor are made through inlet and outlet connectors portal to the respective chamber sections 34a and 34b, the inlet connector 38 being shown in FIGURE 1.

The inlet chamber 34a, in accordance with the invention, has two functions. First, it acts as an annular chamber for fluid supplied to the compressor and therefore reduces the turbulence of the fluid entering the stator compression chamber 12 through the inlet port 30. Second, it is a sonic attenuation cavity for sound pressure waves inherent in this type of regenerative compressor. Similarly, the outlet chamber 34b serves to dampen the sound wave pulsations generated by the passage of the impeller blades 19 past the stripper adjacent the outlet port 32. It is also a sound attenuating cavity for the outlet side of the compressor.

At each of the faces 40a of the inlet chamber 34a is a muffler 41 consisting of sound absorptive material 42 and a rigid plate 43 retaining the sound absorptive material and having perforations 43a to effectively create a multitude of sound absorptive cavities in the material 42. In the same manner, the outlet chamber 34b is provided with a pair of sound absorptive mufflers 45 at the faces 40b comprising a sound absorptive material 46 and perforated retainers 48. It should be noted that since the chambers 34a and 34b surround the motor 20, the mufflers also attenuate motor noise which is transmitted through the housing 10. Alternatively, the inlet and outlet chambers 34a, 34b can be separated into several intercommunicating resonant cells dimensionally proportioned to attenuate compressor noise by reflection and cancellation of the predominant frequency sound waves.

Thus, in accordance with the invention, the compressor noise is quenched at its immediate source by means integral with the compressor. Moreover, since no devices
3,360,193

external to the compressor itself are required, such suppression is effected without an increase in the overall dimension of the compressor, and the uncomplex construction and assembly of the mufflers and the compressor housing facilitates economic production.

The embodiments of the invention described herein are illustrative only, and many modifications and variations may be made therein within skill of the art. Accordingly, all such modifications and variations are intended to be included within the scope of the appended claims.

We claim:

1. In a regenerative fluid compressor of the type having a rotary impeller and an integral motor coaxial with the impeller, the combination of a housing member having a compressor chamber and a second chamber surrounding the motor, the housing providing inlet and outlet ports between the compressor and second chambers, and sound absorbent means in said second chamber to attenuate sound generated by variations in the pressure of the fluid passing therethrough.

2. In a regenerative compressor of the type having a motor integral therewith, the combination of a housing member having a toroidal chamber with inlet and outlet ports therein and a generally annular chamber surrounding the motor divided into semi-annular inlet and outlet portions communicating with said respective inlet and outlet ports, and sound absorbent means partially filling said inlet and outlet portions of said annular chamber.

3. In a regenerative compressor of the type having an integral motor and a rotary impeller driven by and coaxial with the motor, the combination of a housing member having a generally annular chamber surrounding the motor and including inlet and outlet ports for introducing and extracting fluid from the compressor through the chamber, said chamber having opposed faces, and a pair of spaced-apart segments of sound absorbent material adjacent said faces and partially filling said chamber to provide at least one cavity for attenuating sound generated in connection with the passage of fluid through both the inlet and outlet ports.

4. The combination in accordance with claim 3 further comprising opposed perforated retaining means butting said sound absorbent segments in said chamber.

5. In a regenerative compressor of the type having a rotary impeller and an integral motor coaxial with the impeller, the combination of a housing member having a toroidal stator chamber and an annular chamber surrounding the motor and divided into inlet and outlet portions for communication with the stator chamber, said annular chamber having opposed annular faces, and a semicircular muffler of sound absorbent material in each of said inlet and outlet portions and partially filling said chamber.

6. In a regenerative compressor of the type having a motor integral therewith and a rotary impeller driven by and coaxial with the motor, the combination of a housing member having an annular chamber surrounding the motor and including inlet and outlet ports for the compressor, and means within said annular chamber forming a plurality of resonant sound cavities at least one of which communicates with the inlet port and at least another of which communicates with the outlet port.

7. A regenerative compressor according to claim 6, in which the annular chamber includes opposed faces and the resonant sound cavities are formed adjacent the opposed faces.

References Cited

UNITED STATES PATENTS

1,320,224 10/1919 Garman ------- 230—232 X
2,396,319 3/1946 Edwards et al. ------ 103—111
2,731,194 1/1956 Kent ---------- 230—232 X

ROBERT M. WALKER, Primary Examiner.