Jan. 16, 1945. A. J. LARRECQ 2,367,223

COMBINED CENTRIFUGAL COMPRESSOR AND COOLER

Filed April 7, 1942

Fig. 1.

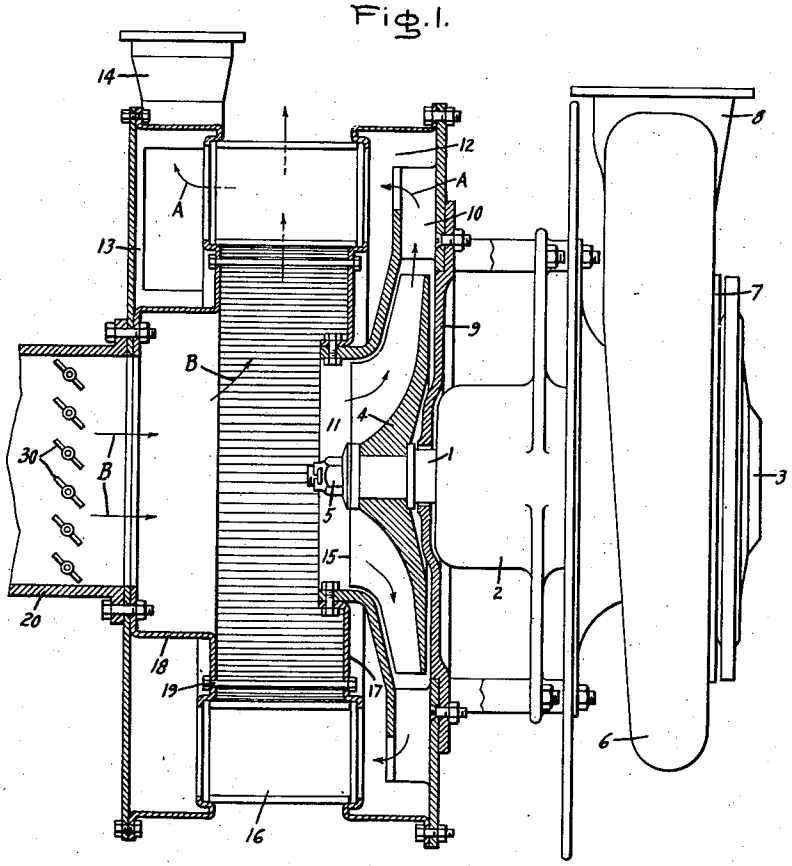


Fig. 2.

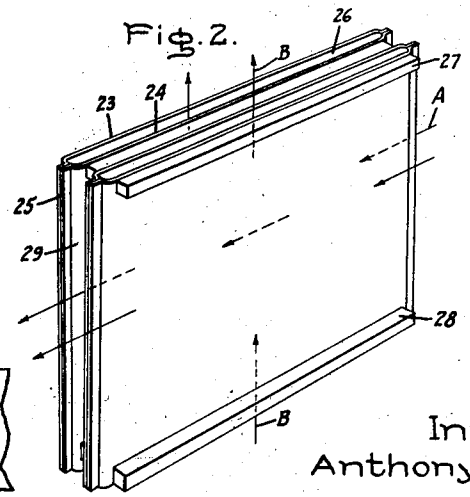
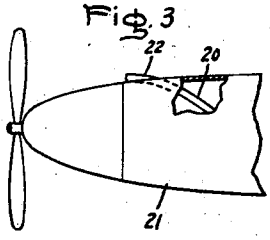


Fig. 3



Inventor:
Anthony J. Larrecq,
by Harry E. Dunham
His Attorney.

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COMBINED CENTRIFUGAL COMPRESSOR AND COOLER

Anthony J. Larrecq, Indianapolis, Ind., assignor to General Electric Company, a corporation of New York

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10 Claims. (Cl. 62—135)

The present invention relates to centrifugal compressors and especially to centrifugal compressors such as are used on aircraft as superchargers, although its use is not limited thereto necessarily.

In connection with such centrifugal compressors, there is required usually a cooler or heat exchanger, for cooling the air discharged from the compressor, and the object of my invention is to provide an improved construction and arrangement of centrifugal compressor and cooler wherein the cooler is built into and forms a unitary part of the compressor.

For a consideration of what I believe to be novel and my invention, attention is directed to the following specification and the claims appended thereto.

In the drawing, Fig. 1 is a side elevation, partly in section, of a supercharger embodying my invention, a supercharger of the gas turbine driven type being illustrated in the present instance; Fig. 2 is a detailed perspective view of a part of the cooler or heat exchanger; and Fig. 3 shows the structure mounted on an aircraft.

Referring to the drawing, 1 indicates a shaft mounted in a bearing 2 and having on one end a turbine wheel 3 and on the other end a compressor impeller 4, the impeller being held in position by a nut 5 on the end of shaft 1. Adjacent to the turbine wheel is an annular nozzle box 6 having a ring of nozzles 7 which serve to direct gases to the buckets of the turbine wheel. The nozzle box inlet 8 may be connected with the exhaust manifold of an aircraft engine whereby it receives exhaust gases from the engine. This is a known type of gas driven turbine and requires no further explanation. Its specific construction forms no part of the present invention.

Impeller 4 is located in a compressor casing 9 and surrounding the impeller is a ring of circumferentially spaced curved diffuser vanes 10 which define diffuser passages through which air discharged from the periphery of the impeller flows and which function to convert the velocity of the air into pressure in a well understood manner. From the diffuser passages air flows to the radial outer portion 12 of the compressor casing and thence axially to an annular discharge chamber or scroll 13 from which it flows outwardly through a discharge conduit 14 which may connect with a point of consumption for the air, for example, the intake manifold on an aircraft engine. The eye of the impeller is indicated at 15. It stands in line with the inlet 11 to the compressor casing.

Located between the radially outer portion 12 of the compressor casing and the discharge scroll 13 is an annular air cooler or heat exchanger 16 supported at one edge from the compressor inlet by a wall 17 and at the other edge by a wall 18 which forms a part of discharge scroll 13. The parts may be held in assembled relation by suitable tie bolts 19 or by other suitable means. At 20 is an admission conduit for supplying air to both the cooler or heat exchanger and to the compressor. Conduit 20 may take air from any suitable source. In the case of an aircraft, it ordinarily receives air from a ram facing into the slip stream whereby air is forced through the conduit to the cooler and the eye of the impeller, building up a positive pressure in front of the eye of the impeller. This is shown in Fig. 3 wherein 21 indicates in outline an aircraft and 22 indicates a ram connected to conduit 20 and facing into the slip stream.

Cooler or heat exchanger 16 may be of any suitable construction, the essential thing being that it has passages for the flow of the air from the compressor (the air to be cooled) axially to the diffuser 13 and interspersed passages for the flow of cooling air radially outward. In both Figures 1 and 2, the arrows A indicate the direction of flow of the air to be cooled and arrows B indicate the direction of flow of the cooling air. Referring particularly to Fig. 2, the cooler is shown in the present instance as comprising a plurality of cells each comprising two spaced plates 23 and 24 connected along opposed edges as is indicated at 25 to define radially extending passages 26 for the cooling air. A plurality of cells are spaced circumferentially relatively to each other and are structurally united to define an annular cooler. The cells are spaced by means of spacer strips 27 and 28 which space apart the cells to define axially extending passages 29 for flow of the air to be cooled. The radially outer spacers 28 are somewhat wider in a circumferential direction than are the spacers 27 to take care of the difference in diameters between the radially outer and radially inner sides of the cooler.

If desired, adjustable louvers 30 may be arranged in conduit 20 to control the flow of air to the compressor and to the cooler.

In operation, air enters through conduit 20 and divides, a part of it entering the eye of the impeller and the remainder flowing radially outward through the cooling air passages 26. The air which enters the eye of the impeller is discharged radially from the impeller to the diffuser from which it travels axially through the passages 29 of the cooler to discharge scroll 13 and thence out through conduit 14 to the point of consumption.

The air which effects the cooling flows radially outward through passages 26 and is discharged to atmosphere. In flowing along the walls 23 and 24 the cooling air absorbs heat from the air flowing through passages 29.

Owing to the ram effect, i. e., the forced flow of air through conduit 20 by reason of the ram 22 facing into the slip stream, a positive pressure is built up inside the cooler and in front of the eye of the impeller sufficient to effect flow of cooling air through the cooler.

By my invention, I provide an improved construction which is relatively light in weight (a thing of great importance in the case of aircraft), compact, and efficient in operation. By utilizing a single air inlet for both the compressor and the cooler, there is required only a single conduit and ram for conveying air to both. This, I regard as an important feature of my invention.

From another viewpoint, my invention comprises a centrifugal type compressor which has a casing with a central inlet for medium to be compressed and an outlet for compressed medium together with a cooler for compressed medium. The cooler has two axially spaced annular headers of which one is connected to and partly formed by the compressor casing. These two headers are connected by a plurality of circumferentially spaced, axial channel members forming cooling passages between them and concentrically surrounding the inlet of the compressor casing. One of the headers has a wall which forms a channel in alignment with and axially spaced from the compressor inlet for conducting operating medium such as air to the compressor and to the cooling passages formed between the channel members.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof, but I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A combined centrifugal compressor and cooler comprising a compressor casing having an admission opening, a discharge scroll, a cooler located between said casing and scroll and forming a common conduit for conveying fluid to both the compressor and the cooler.

2. In combination, a compressor having an inlet and an annular discharge area concentrically surrounding the inlet, an annular discharge chamber spaced axially from said discharge area, and an annular row of spaced cooling tubes connected between said discharge area and said discharge chamber.

3. A compressor having a casing with a central inlet and a structure surrounding the inlet and attached to the casing comprising a cooler and a discharge chamber, and a common inlet for the cooler and central inlet formed by a wall of the discharge chamber.

4. A compressor having a casing with a central inlet and walls defining a discharge area, an annular cooler attached to said walls through which medium to be cooled flows axially from said discharge area and cooling medium flows radially, and walls forming a discharge chamber attached to said cooler and forming a conduit for conducting cooling medium to the cooler and medium to be compressed to the compressor.

5. In combination, a centrifugal impeller, a casing for the impeller having an inlet and walls forming a discharge area surrounding the impeller, an annular cooler surrounding said inlet and attached to said walls, said cooler having axially extending passages for flow of medium from said discharge area and radially extending passages for flow of cooling medium, and walls attached to said cooler to form a discharge chamber and a conduit connected to said walls for conducting medium to both the cooler and the compressor.

6. In combination, a centrifugal impeller, a casing for the impeller having an inlet and walls forming a discharge area surrounding the impeller, an annular cooler surrounding said inlet and attached to said walls, said cooler having axially extending passages for flow of medium from said discharge area and radially extending passages for flow of cooling medium, walls attached to said cooler to form a discharge chamber, and a common supply inlet for said impeller and cooler formed at least partly by said last mentioned walls.

7. For use on an aircraft, a supercharger comprising a centrifugal impeller, a casing member having walls forming a discharge area surrounding the impeller, an annular cooling member attached to said casing member and having passages for the flow of cooling air and passages for the flow of air to be cooled, and a common inlet formed by one of said members for supplying air to said impeller and cooler.

8. In combination, a centrifugal compressor having a casing forming an inlet, and an annular discharge area on the same side as and concentrically spaced from the inlet, a discharge scroll axially spaced from the annular discharge area, a plurality of circumferentially spaced channel members for conducting compressed medium from the discharge area to the scroll, said channel members forming substantially radial passages between them with inlet openings for directly receiving a part of the medium flowing towards the inlet of the casing.

9. In combination, a compressor having a casing with a central inlet for conducting medium to be compressed to an impeller chamber formed by the casing, said casing having walls forming an annular row of discharge openings concentrically spaced from and located on the same side of the casing as said inlet, and means for conducting medium to be compressed to the compressor and for cooling compressed medium discharged therefrom, said means comprising an annular row of circumferentially spaced axial channel members having inlets connected to said discharge openings and a discharge scroll connected to the outlets of said channel members, said scroll having an inner wall forming a conduit for medium to be conducted to the inlet of the compressor and to cooling passages formed between said channel members.

10. In combination, a centrifugal compressor having a central inlet for medium to be compressed and a cooler for cooling compressed medium discharged from the compressor, said cooler having two axially spaced annular headers of which one is in part formed by the compressor casing and a plurality of axial circumferentially spaced channel members connected between the headers and forming cooling passages between them, the inlets to said passages surrounding concentrically the inlet to the compressor casing, and one of said headers forming a channel for conducting operating medium to the inlet of the compressor and to said cooling passages.

ANTHONY J. LARRECQ.