

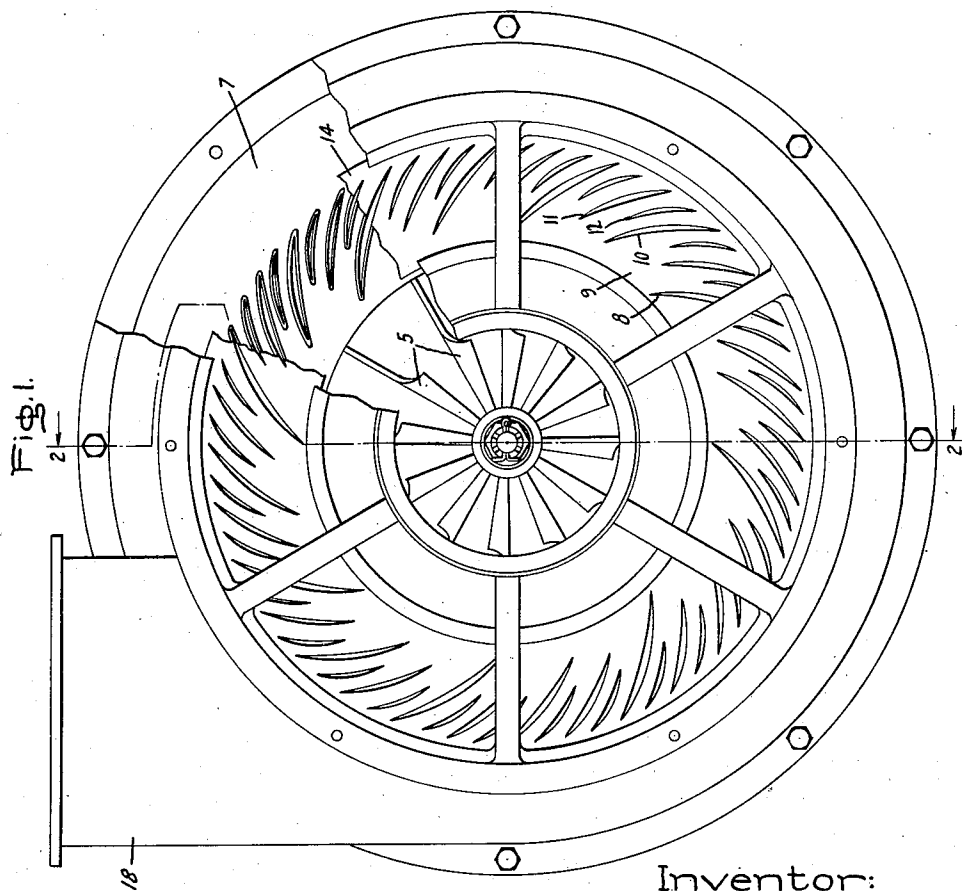
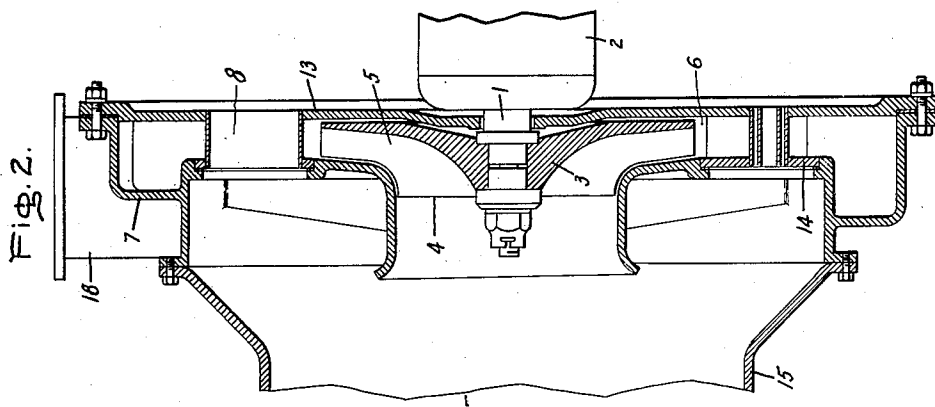
April 17, 1945.

D. R. SHOULTS
CENTRIFUGAL COMPRESSOR

2,373,713

Filed May 20, 1942

2 Sheets-Sheet 1



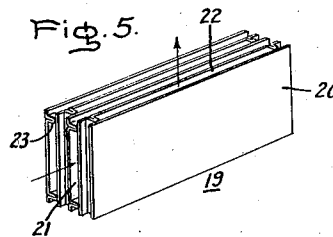
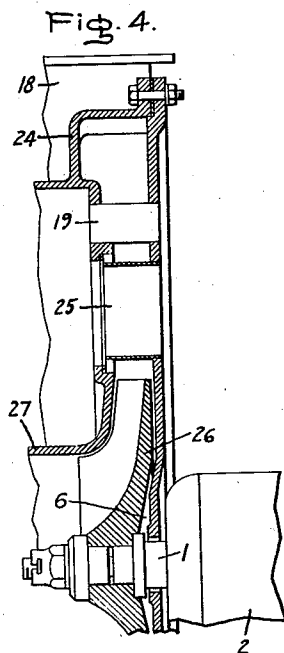
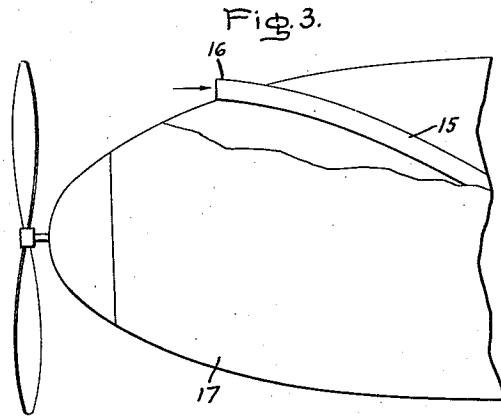
Inventor:
David R. Shoults,
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His Attorney.

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2 Sheets-Sheet 2



Inventor:
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UNITED STATES PATENT OFFICE

2,373,713

CENTRIFUGAL COMPRESSOR

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New York

Application May 20, 1942, Serial No. 443,747

2 Claims. (Cl. 230—209)

The present invention relates to centrifugal compressors and especially to centrifugal compressors such as are used on aircraft to provide air at a desired pressure for supercharging an aircraft engine, a cabin, or the like.

In the operation with such compressors the air is heated to a considerable extent by the action of the compressor, making it desirable in many instances to provide a cooler or heat exchanger to cool the air on its way from the impeller of the compressor to the point of consumption.

The object of my invention is to provide an improved construction and arrangement wherein the cooler or heat exchanger is built directly into the compressor, forming in substance a unitary part thereof, and for a consideration of what I believe to be novel and my invention attention is directed to the following specification and to the claims appended thereto.

In the drawings, Fig. 1 is a face view, with parts broken away, of a structure embodying my invention; Fig. 2 is a sectional view taken on line 2—2, Fig. 1; Fig. 3 is a detail view showing the structure mounted on an aircraft; Fig. 4 is a detail view of a modification; and Fig. 5 is a perspective view of a part of a cooler shown in Fig. 4.

Referring to the drawings, 1 indicates a shaft carried in a suitable bearing 2 and having mounted thereon an impeller 3 of known construction. The eye or inlet of the impeller is indicated at 4 and the impeller blades are indicated at 5. The compressor casing is indicated at 6 and the discharge scroll at 7. Shaft 1 may be driven by any suitable means. In the case of an aircraft supercharger, for example, it may be driven by a turbine wheel operated by exhaust gases from an aircraft internal combustion engine.

Located between the discharge ends of the impeller vanes and the discharge scroll 7 is a diffuser having vanes which define passages for converting velocity of the medium being compressed into pressure, and according to my invention I provide a diffuser which functions also as a cooler or heat exchanger to effect cooling of the medium being compressed as it passes through the diffuser. To this end, I provide the diffuser with hollow vanes through which cooling medium flows, and in addition to the usual or what may be termed the primary set of vanes, I provide preferably an additional set or sets of hollow vanes interspersed with the primary set, each additional interspersed set being shorter in a radial direction than the preceding set. In addition, I may provide, if found desirable, an annular cooler or heat exchange unit which surrounds directly the

diffuser and is in series therewith as regards the flow of medium to be cooled and in parallel therewith as regards the flow of cooling medium.

The primary set of cooling vanes is indicated at 8. These vanes define curved diffuser passages 9 shaped to convert velocity of medium flowing through them into pressure. Interspersed between vanes 8 are a plurality of sets of hollow vanes 10, 11 and 12, the sets being successively shorter as shown clearly in Fig. 1. The several sets of vanes are supported on one side in suitable openings in casing wall 13 and on the other side in openings in an annular side plate 14 fixed in and forming a part of the other side wall of the casing. In the present instance, I have shown three additional sets of vanes arranged between the vanes 8. However, more than this number may be used, the arrangement being such preferably that at the radially outer portion of the diffuser the vanes are quite close together so that all the air comes into intimate contact with a cooling surface to multiply the cooling effect. By correctly shaping the passages between the vanes and by gradually increasing the number of vanes from the radially inner end of the diffuser to the radially outer end, the functioning of the diffuser as a device for converting velocity into pressure is not adversely affected and at the same time it is made to function efficiently as a cooler or heat exchanger.

Medium to be compressed and cooling medium may be conveyed to the impeller inlet and to the cooler respectively by suitable conduits. In the case of an aircraft supercharger where the medium to be compressed and the cooling medium is air I may provide a single conduit 15 for both. Conduit 15 may be connected with a suitable ram 16 facing into the slip stream of the aircraft 17, as shown in Fig. 3. This serves to set up a positive pressure for effecting flow of air through the cooler passages and to the eye of the impeller. Cooling air flowing through the cooler passages may discharge directly to atmosphere or to other suitable point.

The scroll is provided with a discharge pipe 18 for conveying air from the scroll to the point of consumption.

In operation, the medium being compressed is discharged by the impeller through the diffuser passages defined by the sets of vanes 8, 10, 11 and 12 to the discharge scroll and in flowing through such passages is cooled by cooling medium flowing through the hollow vanes.

If desired, I may provide, in addition to the sets of hollow vanes, an annular cooler or heat

exchanger 19 which directly surrounds the diffuser and is located in the discharge scroll. Such an arrangement is shown in Figs. 4 and 5 wherein spaced plates 20 define passages 21 for the cooling medium and passages 22 for the medium to be cooled. Plates 20 are held in spaced relation by spacers 23, the plates and spacers being suitably joined together by suitable means such as by brazing or the like or by being made integral with each other. The structure is supported in the side walls of the discharged scroll 24. The diffuser is indicated at 25, the impeller at 26, and the air supply conduit at 27. They may be the same in structure and arrangement as are the corresponding parts of Figs. 1 and 2.

My invention has the advantages that it is relatively simple in structure, compact and light in weight; the two latter are especially important in the case of an aircraft supercharger since space and weight are important factors in aircraft design.

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 centrifugal air compressor for use on an aircraft comprising a bearing, a shaft in the bearing, an impeller on said shaft, a casing for the impeller comprising a wall which defines an axially facing inlet through which air is supplied to the impeller, a diffuser surrounding the impeller comprising axially extending curved vanes, said vanes being hollow for flow of cooling air through them, a wall which surrounds said first-named wall in spaced relation thereto to define an annular passage for directing cooling air to said hollow vanes, and a conduit for directing air to said inlet and said annular passage.

2. A centrifugal air compressor for use on an aircraft comprising a bearing, a shaft in the bearing, an impeller on said shaft, a casing for the impeller comprising a wall which defines an axially facing inlet through which air is supplied to the impeller, a diffuser surrounding the impeller comprising a plurality of sets of interspersed vanes, successive sets being shorter in radial extent, and said vanes being hollow for flow of cooling air through them, a wall which surrounds said first-named wall in spaced relation thereto to define an annular passage for directing cooling air to said hollow vanes, and a conduit for directing air to said inlet and said annular passage.

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