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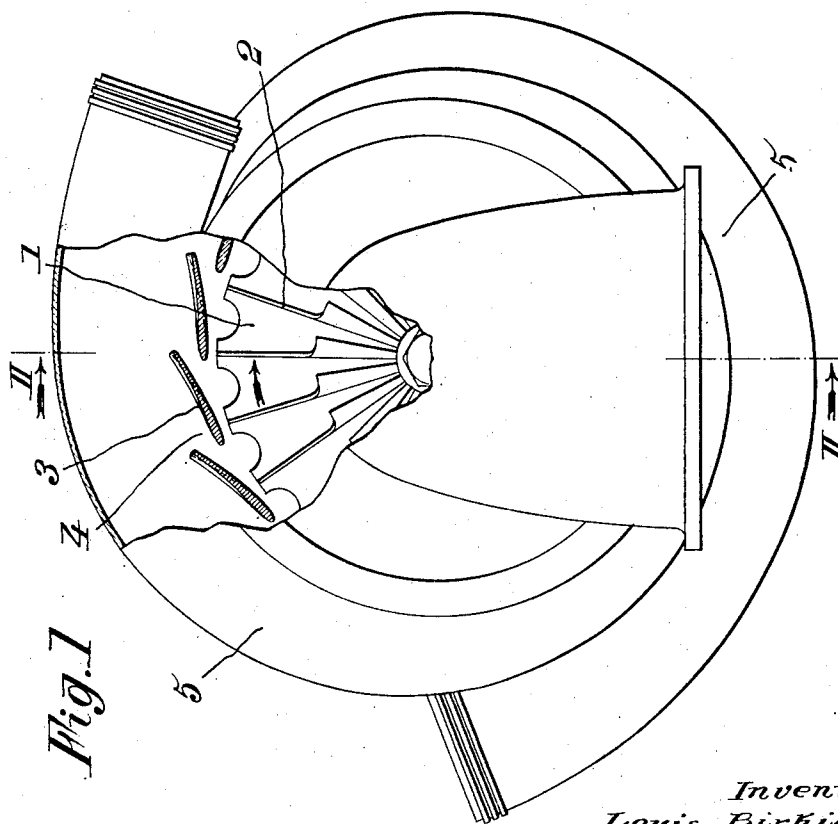
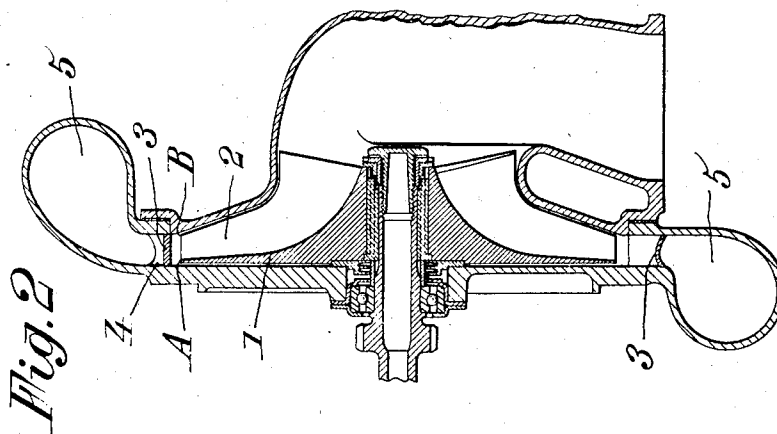
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2,228,194

CENTRIFUGAL COMPRESSOR

Filed Aug. 16, 1939

2 Sheets-Sheet 1



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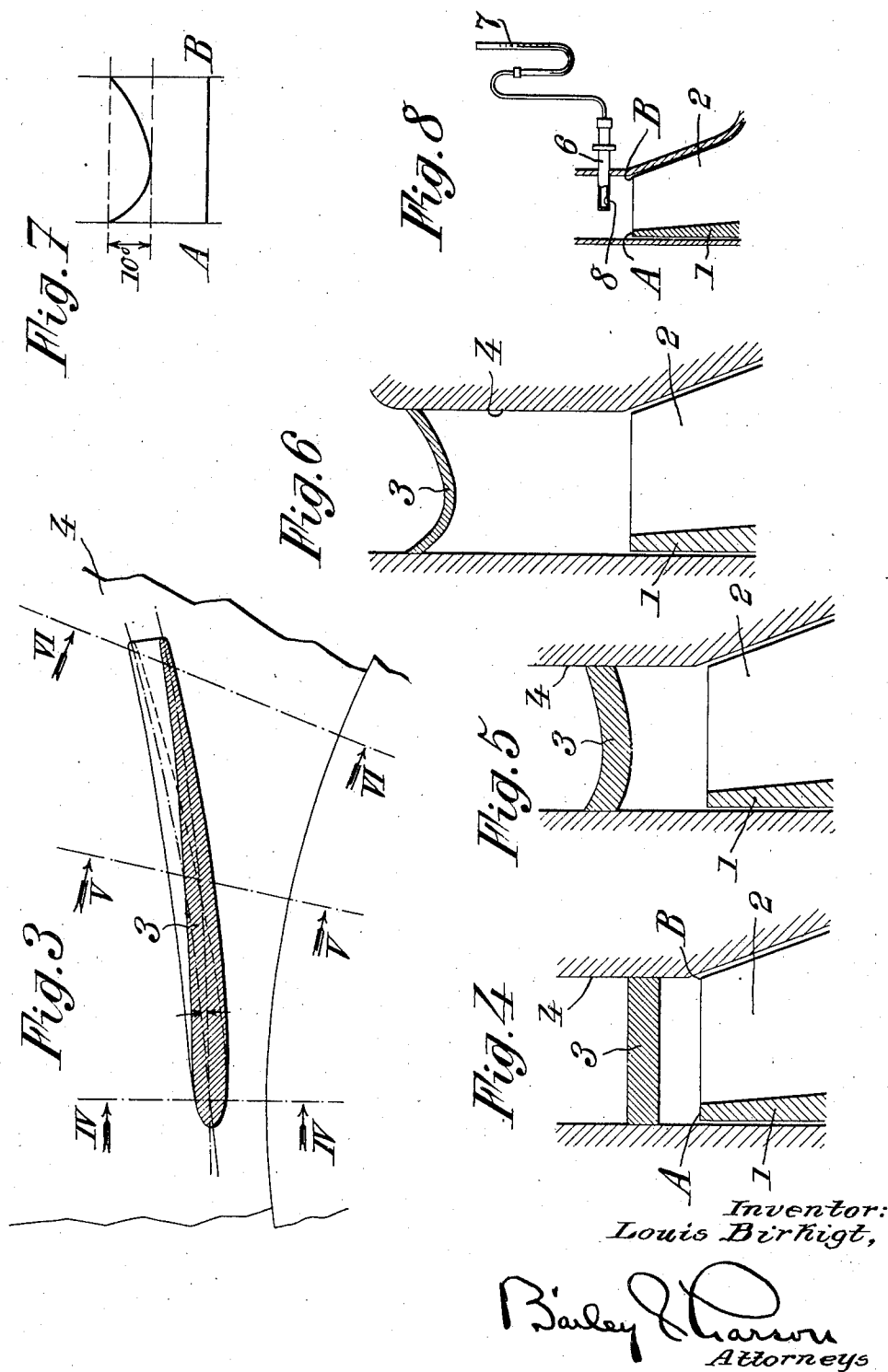
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UNITED STATES PATENT OFFICE

2,228,194

CENTRIFUGAL COMPRESSOR

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5 Claims. (Cl. 230-127)

This invention relates to centrifugal air and like compressors having at least one blade wheel or the like, compressing, by centrifugal effect, the air or other gaseous fluid between co-operating fixed blades which latter canalise the compressed fluid towards a discharge outlet, the said fixed blades generally being profiled and in each longitudinal section having a "median line," and concerns more particularly but not exclusively, amongst such compressors, those for internal combustion engines, particularly such engines for aircraft, and has for its main object not only to increase the efficiency of such compressors generally but to evolve such devices in which the gaseous fluid dealt with is heated to a lesser extent than hitherto.

The present invention takes account of the fact that in compressors of the kind concerned, the streams of gaseous fluid leave the blades of the rotor in directions the line of which varies along the trailing edge of each of the rotor blades, and generally in accordance with the invention the fixed co-operating blades are given such a form that the streams of fluid leaving the rotor attack the various longitudinal sections of each such fixed blade substantially according to the tangents to the part of the respective median lines of the said sections which come at or towards the leading edge of the said blade.

In addition, and preferably, such fixed blades have transverse sections in planes at right angles to their longitudinal sections, which are curved and the curvature of which increases from the leading edge thereof (where it is preferably straight) towards the rear trailing edge.

In order that the invention may be better understood, it will now be described with reference to the accompanying drawings, which are given by way of example only and in which:

Fig. 1 shows, part in elevation, part in section, a compressor constructed according to the invention.

Fig. 2 is a section along the line II--II, Fig. 1.

Fig. 3 shows, on a larger scale and in section, a detail of Fig. 1.

Figs. 4 to 6 are sections respectively along the lines IV--IV, V--V and VI--VI, Fig. 3.

Fig. 7 is a diagram to facilitate the understanding of the invention, and

Fig. 8 is a diagram illustrating a method of investigation for the study of gaseous currents or pressures in the interior of the compressor.

The drawings show a compressor for air or other gaseous fluid suitable for charging (for example) an aircraft engine and comprises, among-

other elements, a rotor 1 provided with a plurality of blades or vanes 2 adapted, when the said rotor is rotated, to distribute, by centrifugal effect, air or other gaseous fluid between fixed blades 3 regularly distributed on a stator 4 and set in such a manner as to canalise the fluid coming from the rotor 1 towards a discharge manifold 5.

Regarding this mechanism as a whole, with the exception of the fixed blades 3 comprised thereby, it can be constructed in any suitable usual manner and especially, as shown, so that the blades or vanes 2 of its rotor are formed by plane elements arranged radially.

It has been ascertained, experimentally, with such a mechanism the streams of air or other gaseous fluid leave the trailing edge AB of each blade or vane 2 in a direction (which is the resultant of a radial component and of a tangential component) forming with the plane of this blade or vane an angle the value of which is variable along the said trailing edge. In particular, in the neighbourhood of the middle region of the trailing edge AB, the said angle has a lower value than towards the extremities of the said trailing edge.

The method of investigation which will be more explicitly mentioned hereafter established that the extreme values of the angle in question can have a variation of the order of 10° , this variation being all the more considerable as the distance from the rotor is greater.

By way of example, there has been shown (Fig. 7) an experimental diagram of the variations of the said angle along the trailing edge AB. This curve is generally found to be asymmetric from the fact particularly that, towards the extremity A of the said trailing edge, the streams of air are subjected to the action of the wall of the rotor whereas towards the extremity B they are braked by the wall of the stator.

Now it is of advantage, in such a compressor, to reduce to the minimum the aerodynamic braking produced by the fixed blades 3 to improve the efficiency of the system as a whole.

For this purpose and to avoid the defect in such compressors as hitherto known that some of the streams coming from the blades or vanes 2 are not correctly guided by the fixed blades 3, the form of the said blades 3, according to the principal arrangement of the invention, is adapted to that of the gaseous stream issuing from the trailing edge AB of each blade or vane 2.

In other words, the blades 3 are given such a form that the streams of fluid distributed in different directions by the aforesaid trailing edge

attack the various longitudinal sections of the fixed blades 3 according to the tangents to the parts of the respective median lines of the said sections which come at or towards the leading edge of the said fixed blades.

For this purpose and for example, the embodiment illustrated by the drawings may be adopted, according to which a certain curvature is given to the median lines of each blade 3 (which curvature is variable from one median line to the other) the concavity of the said blade being, for example, turned towards the exterior, so that the said blade is given, in the general direction of its median lines, a somewhat streamlined shape similar in some respects to that given to the wings of aircraft, each median line being so directed as to be attacked tangentially by the streams of air opposite which it will come when in working position.

Further, the arrangement is such that the transverse sections of this blade, such as shown particularly by Fig. 5 and Fig. 6, are of curved shape and present an increasing curvature proceeding towards the trailing edge of the blade, the leading edge preferably being of substantially rectilinear shape as shown by Fig. 4.

It should be observed that these transverse sections, the shape of which is derived from the diagram of Fig. 7, will be generally asymmetric in a similar manner to the said diagram.

It is seen, from the foregoing, that it is necessary to take into account, for constructing the fixed blades 3, the direction according to which the gaseous fluid leaves each of the points of the trailing edge of the blades or vanes 2.

For determining these directions, any appropriate testing method may be adopted, particularly that more explicitly mentioned hereafter (by way of example).

According to this method, which is illustrated diagrammatically by Fig. 8 of the drawings, after having placed the rotor 1 provided with its blades or vanes 2 in its conditions of use and particularly having mounted it in a casing similar to the casing of the compressor but without fixed blades 3, there is brought successively opposite the trajectory of each of the points of the trailing edge AB of the blade or vane 2 (in the region where the leading edge of a fixed blade 3 will be located) a pressure gauge 6 branched on a manometer 7, the said gauge being formed, for example, by a hollow tube in the extremity of which is disposed a lateral aperture 8 the axis of which is perpendicular to that of the said tube.

For each axial position of the gauge 6, it is rotated around its axis to determine the setting of the orifice 8 for which the pressure is maximum, this setting defining the theoretical direction of the streams of fluid under pressure at the point concerned of the trailing edge AB.

By repeating this operation all along the said trailing edge, it will be possible to ascertain a large number of theoretical directions of the streams of fluid and, in consequence, to determine, with precision, the form to be given to the fixed blades 3.

By this method of investigation it will also be possible to determine, for each point of the trailing edge AB, the absolute value of the speed of the gaseous stream issuing from the said point.

The operation of the compressor constructed as described will be well understood without further description; it presents the advantage of having an efficiency superior to such compressors

with the usual fixed blades as hitherto constructed.

The invention is not limited to the precise forms or details of construction described, as these may be varied to suit particular cases.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is:

1. A centrifugal compressor for gaseous fluids of the type comprising a casing, a rotor mounted to turn in such casing, a plurality of impeller blades angularly spaced and carried by such rotor with their trailing edges towards the periphery thereof, inlet means for gaseous fluid in the casing leading to the rotor, outlet means from the casing for the gaseous fluid leaving the rotor around the periphery of the rotor, and a plurality of spaced fixed guiding blades for the gaseous fluid leaving the rotor, extending from side to side of the casing adjacent to and having their median lines intersecting at the leading edges of the guiding blades with radii of the rotor, to lead the issuing gaseous fluid therebetween to the outlet means, the median lines of the longitudinal sections in the fixed guiding blades adjacent the leading edges thereof having from side to side slightly variable angular positions in relation to the periphery of the rotor, the tangent to the median line at any longitudinal section adjacent said front edge lying in the line along which the gas streams strike the leading edges of the fixed guiding blades in the same longitudinal plane.

2. A centrifugal compressor for gaseous fluids of the type comprising a casing, a rotor mounted to turn in such casing, a plurality of impeller blades angularly spaced and carried by such rotor with their trailing edges towards the periphery thereof, inlet means for gaseous fluid in the casing leading to the rotor, outlet means from the casing for the gaseous fluid leaving the rotor around the periphery of the rotor, and a plurality of spaced fixed guiding blades of streamline shape in longitudinal section for the gaseous fluid leaving the rotor, extending from side to side of the casing adjacent to and having their median lines intersecting at the leading edges of the guiding blades with radii of the rotor, to lead the issuing gaseous fluid therebetween to the outlet means, the median lines of the longitudinal sections in the fixed guiding blades adjacent the leading edges thereof having from side to side slightly variable angular positions in relation to the periphery of the rotor, the tangent to the median line at any longitudinal section adjacent said front edge lying in the line along which the gas streams strike the leading edges of the fixed guiding blades in the same longitudinal plane.

3. A centrifugal compressor for gaseous fluids as claimed in claim 1 in which each fixed guiding blade from one side of the casing to the other side has a variable transverse cross section which at the leading edge is substantially straight and which is of increasing curvature proceeding towards its trailing edge.

4. A centrifugal compressor for gaseous fluids as claimed in claim 1 in which each fixed guiding blade from one side of the casing to the other side has a variable transverse cross section which at the leading edge is substantially straight and which is of increasing curvature towards its trailing edge, the curvature of the trailing edge corresponding with the different directions in which the streams of gaseous fluid strike the individual

points of the leading edges of the fixed guiding blades.

5. A centrifugal compressor for gaseous fluids as claimed in claim 1 in which each fixed guiding blade from one side of the casing to the other side has a variable transverse cross section which at the leading edge is substantially straight and

which is of increasing curvature towards the trailing edge, the curvature of the trailing edge being asymmetric from side to side and corresponding with the different directions in which the streams of gaseous fluid strike the individual points of the leading edges of the fixed guiding blades. 5

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