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Stalker

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[54] **AXIAL FLOW COMPRESSOR**

[75] Inventor: **Edward A. Stalker,** Bay City, Mich.

[73] Assignee: **The Stalker Corporation,** Essexville, Mich.

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[52] **U.S. Cl.**..... **415/206,** 415/209, 415/210
[51] **Int. Cl.**..... **F01d 9/00,** F03b 3/16
[58] **Field of Search** 415/181, 206, 209, 210, 415/216

[56] **References Cited**

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Primary Examiner—Carlton R. Croyle
Assistant Examiner—Louis J. Casaregola
Attorney, Agent, or Firm—Biebel, French & Bugg

[57] **ABSTRACT**

A supersonic axial flow compressor is formed with an annular compartment downstream of the rotor. The compartment is provided with axially extending dividers or partitions which divide the compartment into sub-chambers. The walls of the partitions form curved surfaces which are inclined to the direction of flow from the rotor to induce a succession of shock waves for increasing the static pressure. A collector is axially positioned with respect to the compartment and shares with the compartment a common dividing wall within which are formed a plurality of inclined passages which receive the flow and direct it into the collector. The passages are inclined both to the radius and the axis to accommodate the high speed flow without generating shock waves, and are formed with throats which converge and diverge in the direction of flow.

7 Claims, 5 Drawing Figures

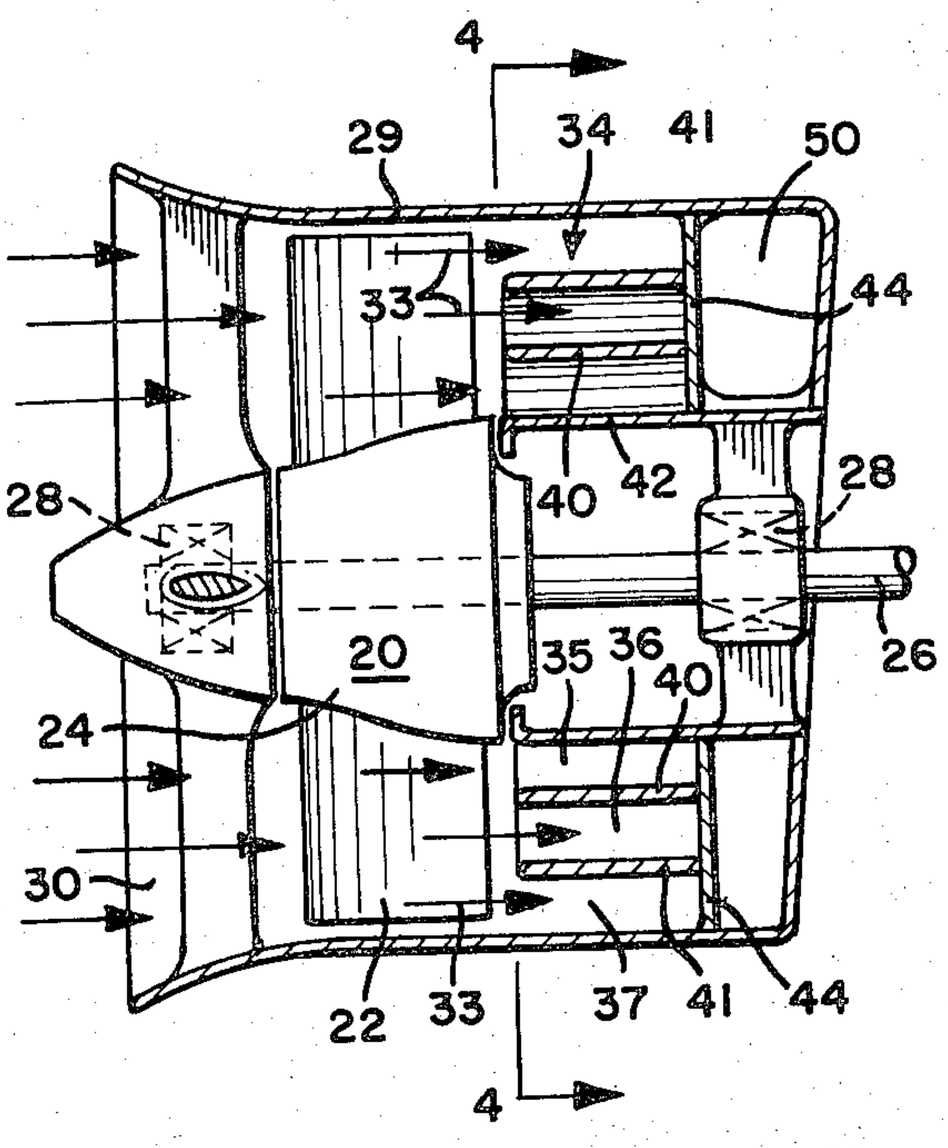


FIG-1

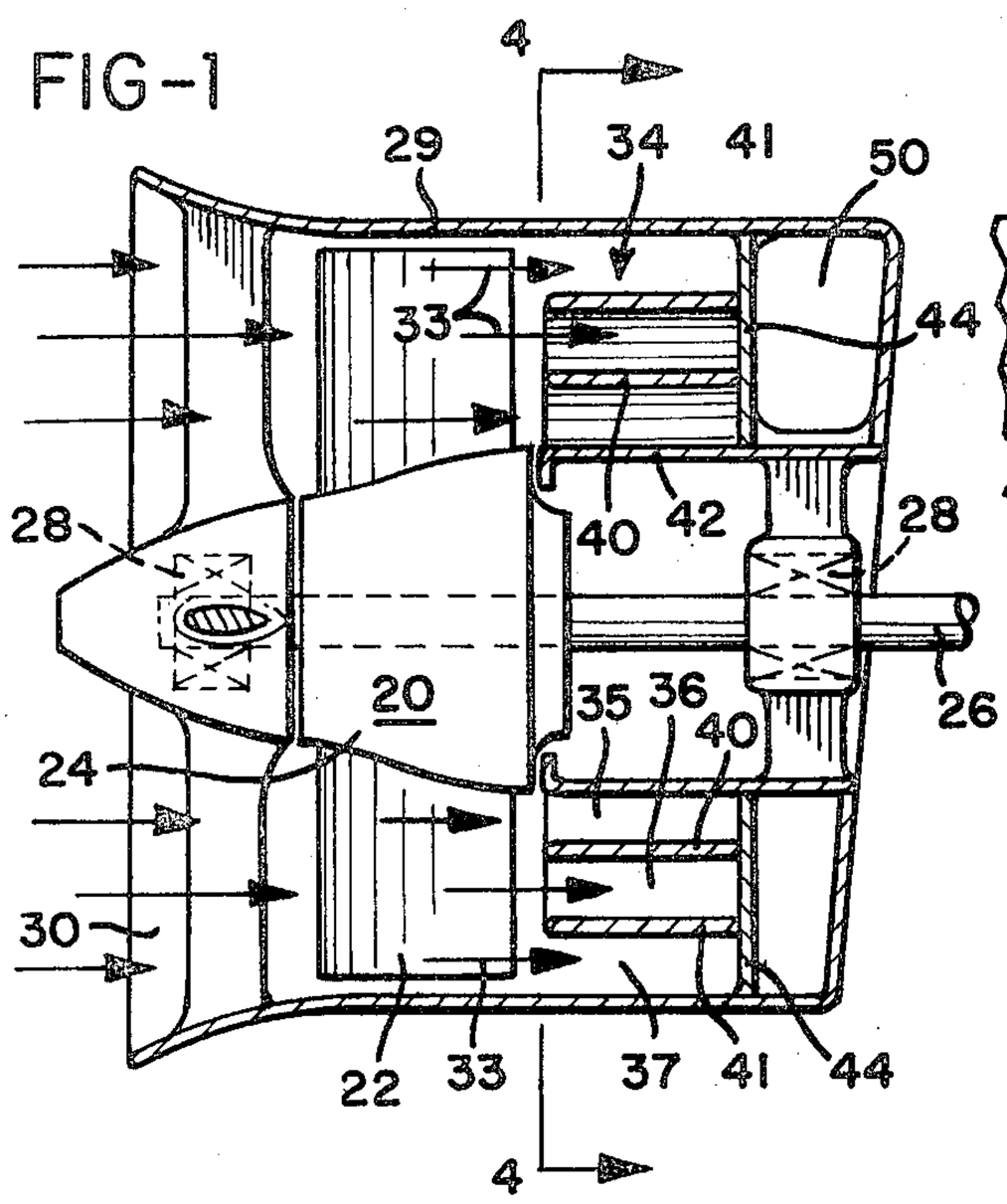


FIG-4

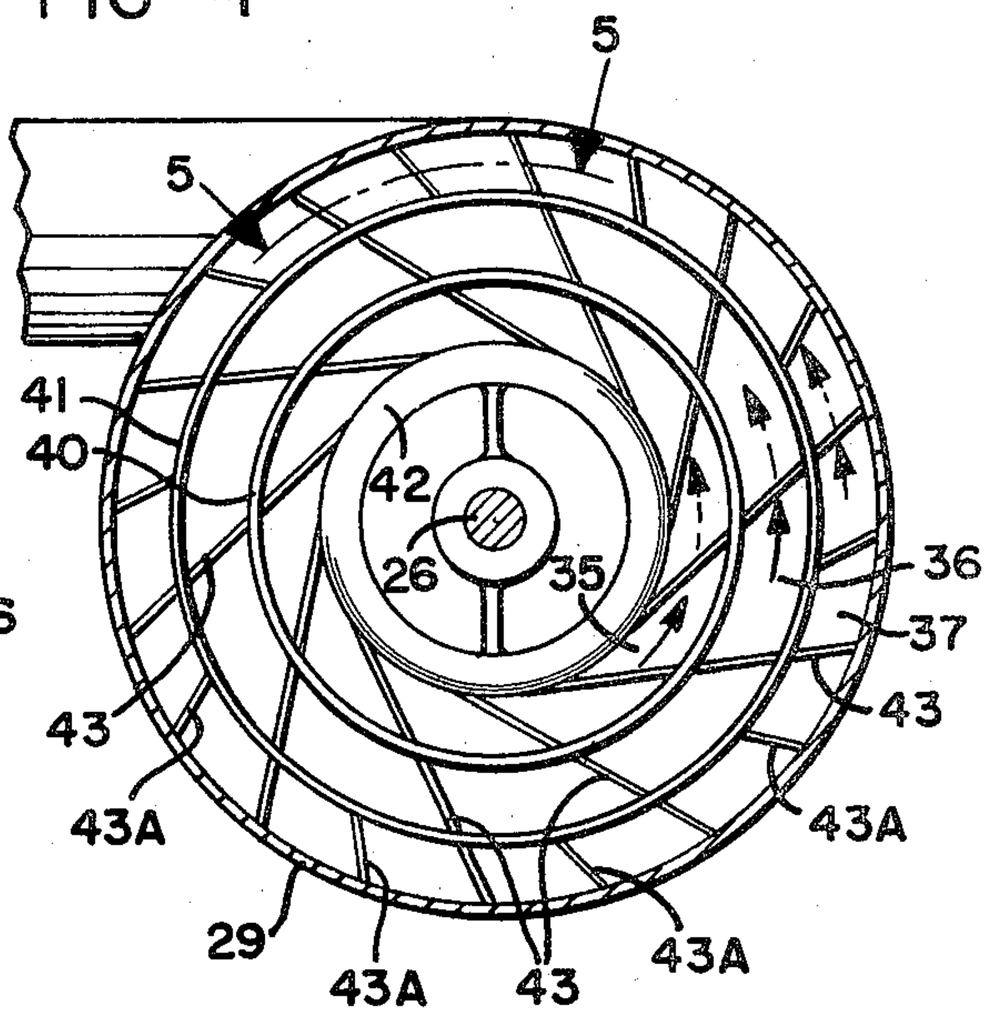


FIG-2

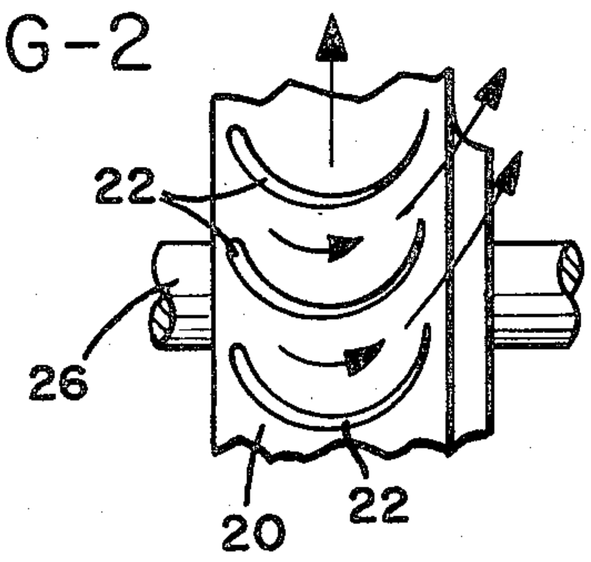


FIG-5

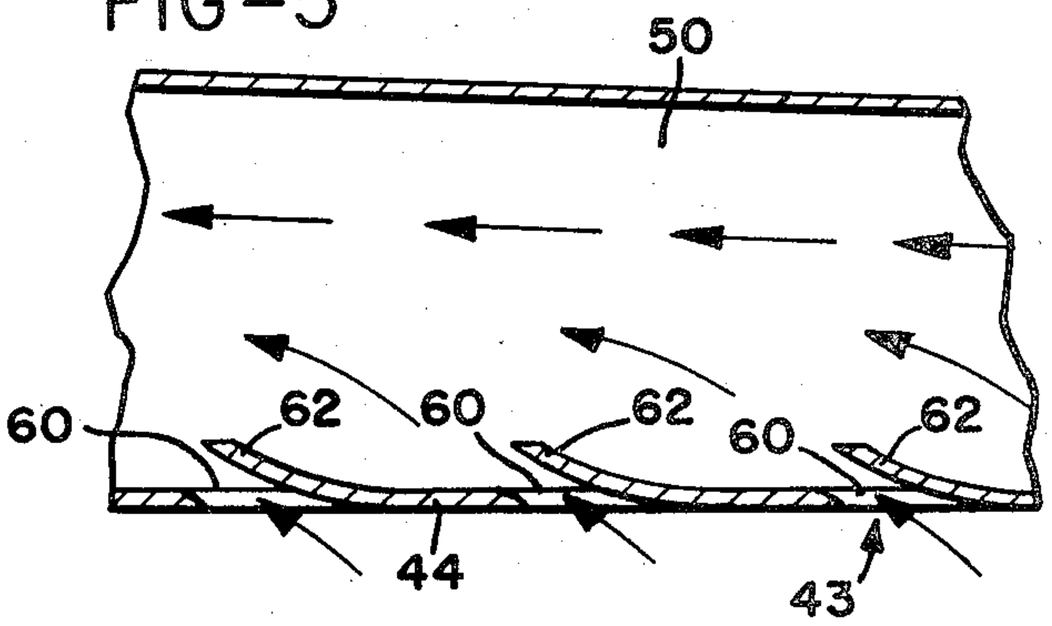
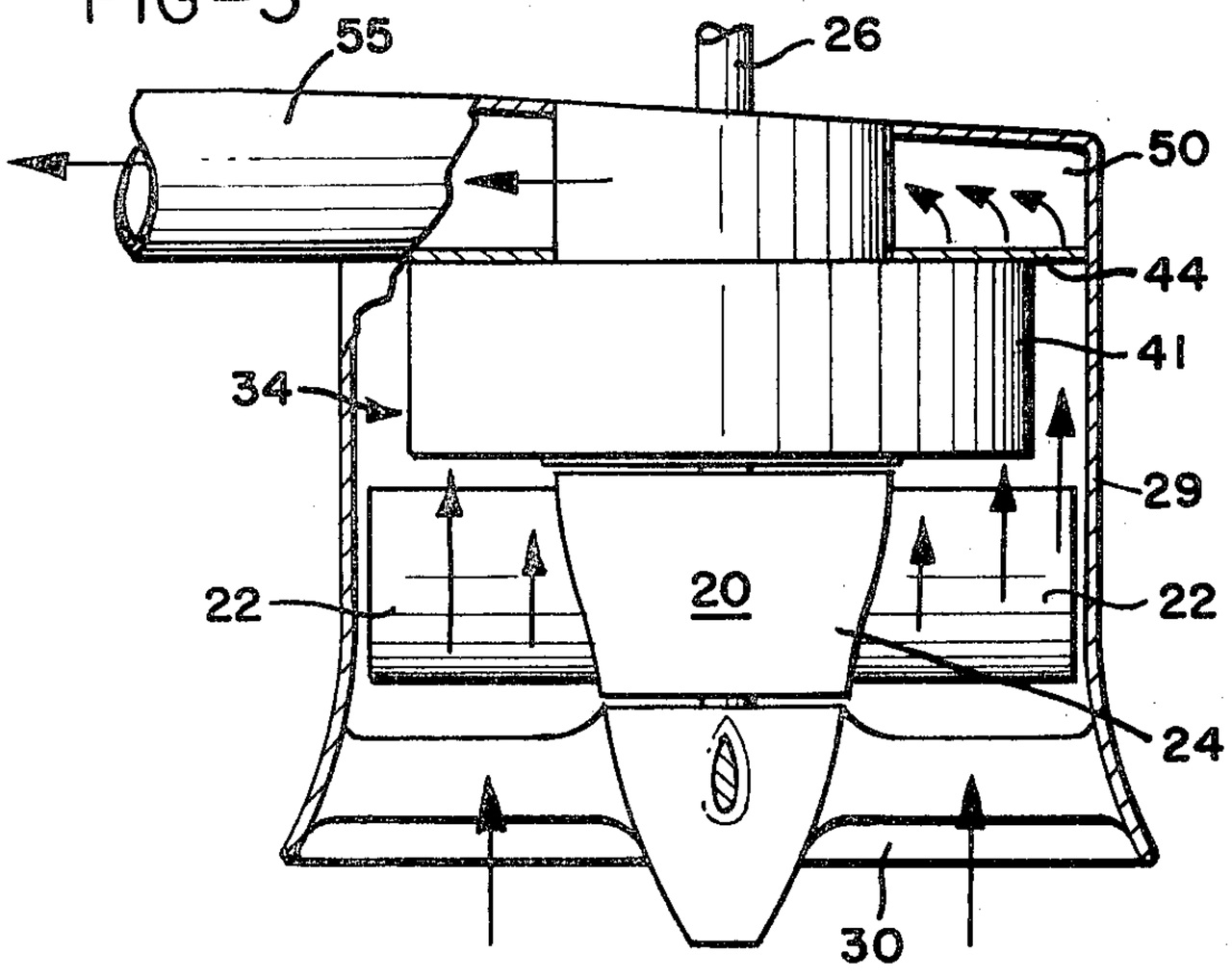


FIG-3



AXIAL FLOW COMPRESSOR

BACKGROUND OF THE INVENTION

This invention relates to elastic fluid compressors and more particularly axial flow compressors in which the flow of fluid from the compressor rotor is supersonic. Supersonic axial flow compressors can produce high compression ratios but they often present problems in diffusing the flow to increase the static pressure, and problems in turning the flow to a desired direction.

SUMMARY OF THE INVENTION

In the present invention, means are disclosed for increasing the static pressure in an axial flow compressor by first passing the flow from the compressor blades along a curved surface. It is known that supersonic flow of about Mach 1.7 when turned by a 12° wedge will have a shock wave that drops the Mach number down to about 0.92. This invention utilizes curved surfaces to create successive inclined shock waves for effectively increasing the static pressure, in combination with inclined inlets or passages leading from a compartment defined by curved walls, into a collector.

The flow from the rotor of an axial flow compressor is directed mainly in the peripheral direction. This flow is reduced in velocity by passing the supersonic flow along curved surfaces which take the form of axially extending walls or dividers defining generally annular sub-compartments. A common wall separates the sub-compartments from a collector, and passages or collector inlets are formed in this wall to direct the flow into the collector. The inlets are inclined both to the radius and to the axis and direct the flow substantially along the surface of the wall in the collector.

It is an accordingly important object of this invention to provide an axial flow compressor in which curved wall means are employed to reduce the velocity of the supersonic flow.

A further object of this invention is the provision of an axial flow compressor in which the output of the compressor is received within a compartment defined by a radial series of axially extending curved wall means, and in which a collector receives the flow from the compartment through inclined inlet passages.

Another important object of the invention is the provision of a collector compartment in an axial flow compressor which has at least one axially extending divider which is curved in the direction of fluid flow, to induce a series of shock waves. The divider also reduces the intensity and magnitude of turbulence which would otherwise arise from the fact that there are different fluid velocities in the portions of the flow from different radial portions of the compressor blades.

These and other objects and advantages of the invention will be apparent from the following description, the accompanying drawings, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** discloses a compressor according to this invention, in axial section;

FIG. **2** shows a fragmentary development of the rotor;

FIG. **3** is a plan view of the compressor of FIG. **1** with the case being partially broken away;

FIG. **4** is a section on line **4—4** in FIG. **3**; and

FIG. **5** is an enlarged development of a fragment of the collector particularly to show the passages leading into the collector.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to the figures in the drawings, a supersonic axial flow compressor constructed according to the teachings of this invention is shown in and as including a rotor **20.** The rotor **20** has blades **22** mounted on a hub **24** which is, in turn, mounted on a shaft **26** and supported for rotation on bearings **28** in a case **29.** Fluid enters at the entrance **30** and flows between the blades **22** in the direction of the arrows **33** and into an annular compartment **34.**

The compartment **34** is subdivided into generally concentric sub-compartments including an inner sub-compartment **35,** a middle sub-compartment **36,** and an outer sub-compartment **37,** by a pair of wall means or divider **40** and **41** and an inside wall **42.** The dividers **40** and **41** are extended generally axially in the direction of the rotor **20** and from the sub-compartment which receive flow from corresponding axial regions of the blades **22.** The divider surfaces together with the walls of the case **29** present curved surfaces to the flow from the compressor blades **22.**

As seen in FIG. **2,** the flow from the blades **22** has a large peripheral component of velocity and a relatively smaller axial velocity component. Since the dividers **40** and **41** are curved in the direction of flow they precipitate a succession of inclined shock waves which reduce the supersonic flow velocity. While a pair of dividers **40** and **41** is disclosed forming three sub-compartments, it is within the scope of the invention to use more or less said dividers or to employ a single spirally formed divider to assure the benefits of this invention.

The fluid is extracted from the compartment **34** into a collector **50** by preferably inclined inlets **43** which are formed in the rear wall **44** of the compartment **34.** The rear wall **44** is also the front wall of the collector **50.** The inlets **43,** as shown in FIGS. **4** and **5,** are inclined both at an angle to the radius and at an angle to the axis to accommodate the high speed flow without generating shock waves. The inlets **43** may extend entirely across the compartment **34** or may extend only across one of the sub-compartments as shown by the inlets **43A** extending across the outermost compartment **37** in FIG. **4.** The collector **50** has one or more conduits **55** leading out of the collector for the discharge of flow therefrom.

The inlets **43** direct the flow from the compartment **34** substantially along the wall **44** within the collector **50.** The inlets thus define passages which may be formed with throats **60** as defined by the wall **44** and inwardly extending fingers **62** which converge somewhat and then expand in the direction of flow to diffuse the flow and to increase the static pressure.

It is accordingly seen that this invention provides an axial flow compressor in which high compression ratios may be formed in a more efficient manner. Not only do the curved surfaces presented by the dividers produce successive shock waves, the divider has the secondary benefit of reducing the intensity and magnitude of turbulence which may otherwise arise from the different fluid velocities existing in the portions of the flow from corresponding radial portions of the blades **22.**

It is preferred that the slots defined in the inlets **43** be placed as close together as 12° of arc. As this may

not be practical this spacing may be greater. However, the spacing of the inlets leading to the collector from the outer sub-compartments **37** may be greater in number, as shown by the inlets **43A** of FIG. **4.**

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention.

What is claimed is:

1. In an axial flow compressor having a bladed rotor, the improvement comprising an annular compartment positioned in downstream relation to the rotor and adapted to receive the flow from the compressor blades, said compartment being defined by a back wall and axial wall means extending from said back wall toward the compressor blades dividing said compartment effectively into a plurality of radially spaced subcompartments, a collector positioned, axially downstream from said compartment, said compartment back wall forming a partition between said compartment and said collector, and means in said back wall defining a plurality of angularaly spaced inlets leading from said compartment into said collector, said inlets being inclined to direct the flow from said compartment into the collector substantially along the surface of said back wall.

2. The compressor of claim **1** in which said inlets are formed with walls which converge and then expand in the direction of flow to diffuse the flow and increase static pressure.

3. The compressor of claim **1** in which said inlets extend along straight lines in said back wall at an angle to a radius.

4. The compressor of claim **1** in which there are a plurality of said axially extending wall means arranged in concentric relation.

5. In an axial flow supersonic compressor the improvement comprising an annular compartment positioned to receive flow from the compressor blades and having a back wall means, means in said compartment defining a generally axially extending partition effectively dividing said compartment into radial inner and outer sub-compartments, said partitions curving arcuately in the direction of rotational flow from said blades thereby reducing the velocity of supersonic flow by the generation of shock waves along the surfaces thereof, a collector positioned in axial relation to said sub-compartments and separated therefrom by said wall means, and a plurality of inlet passages formed in said wall means leading from said compartment into said collector, said passages receiving the flows from said compartment, and being inclined at an angle to the axis so that the exit flow from said compartment is in the same rotational direction as the flow in said sub-compartments.

6. The compressor of claim **5** in which there is provided a pair of said paritions dividing said compartment into radially outer, middle, and inner sub-compartments.

7. The compressor of claim **5** in which said inlets are formed with throats which converge and then expand in the direction of fluid flow to diffuse the flow.

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