# United States Patent [19]

**Anderson**

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[54] **INERTIAL AIR CLEANER FOR GAS TURBINE**


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[52] **U.S. Cl.** ..... **60/39.09 P,** 415/121 G, 55/396

[51] **Int. Cl.** ..... **F02g 3/00,** B01d 45/12

[58] **Field of Search** ..... 60/39.09 P, 39.09 R; 415/121 G; 55/306, 396



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[57] **ABSTRACT**

The air intake to a gas turbine comprises a plurality of stationary, spiralled blades mounted therein for centrifugally discharging dirt ladened air radially outwardly to a restricted passageway which communicates with a collector. Clean air enters a larger, circumferentially disposed passageway positioned inwardly of the restricted passageway to communicate substantially clean air to the compressor stage of the turbine.


**12 Claims, 7 Drawing Figures**

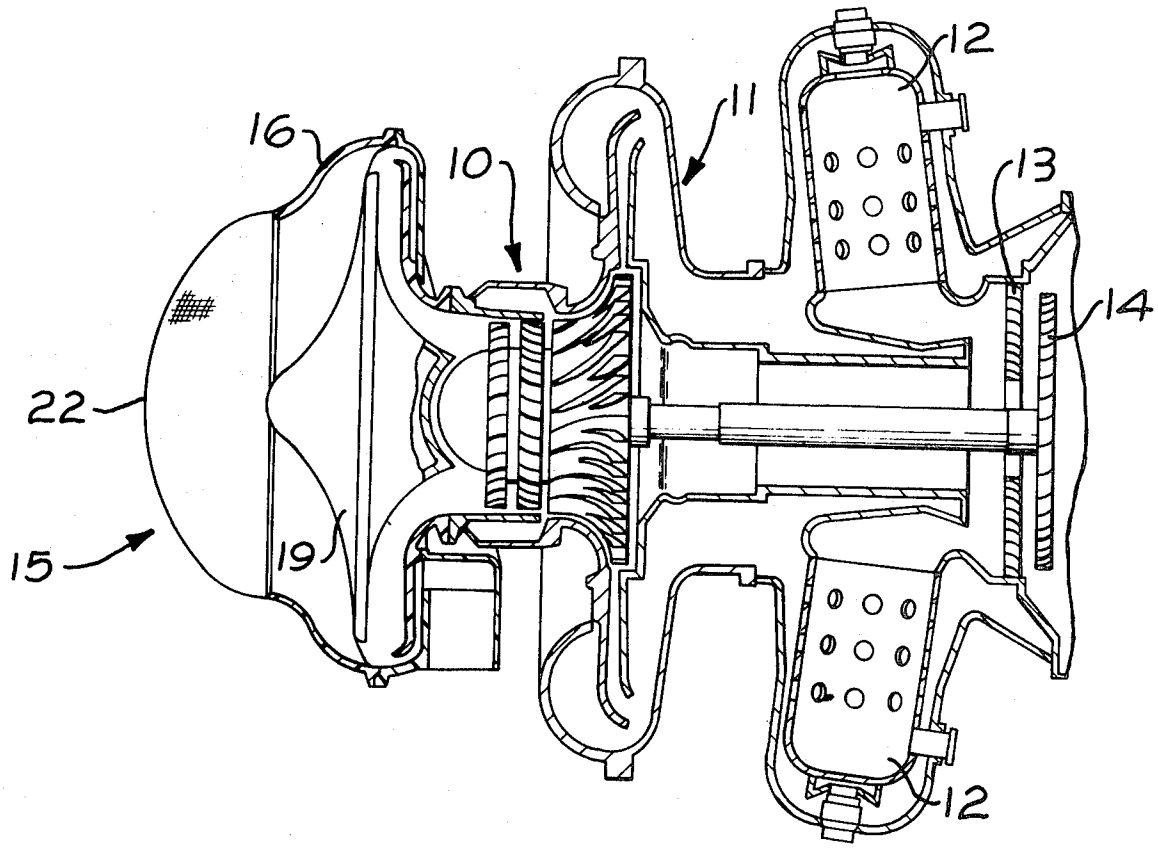
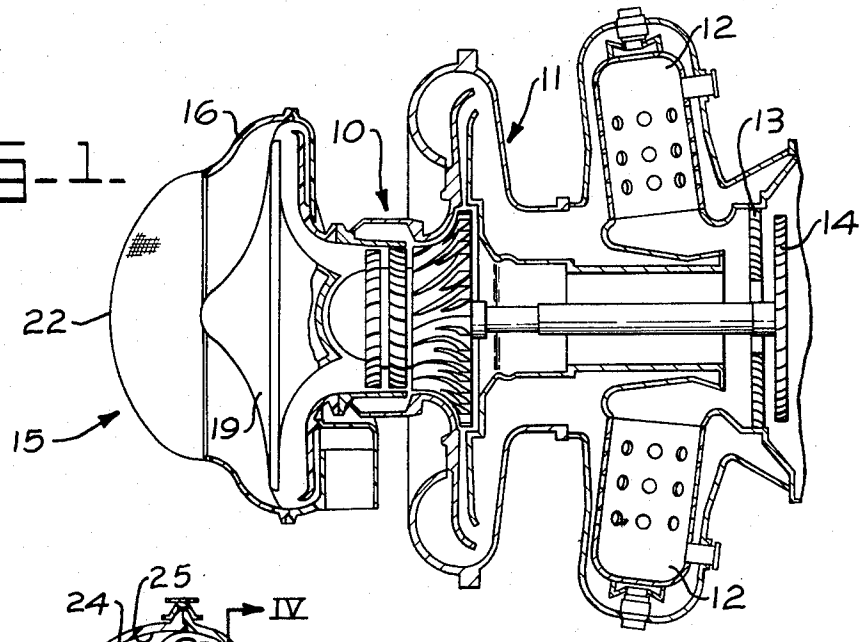


Fig. 1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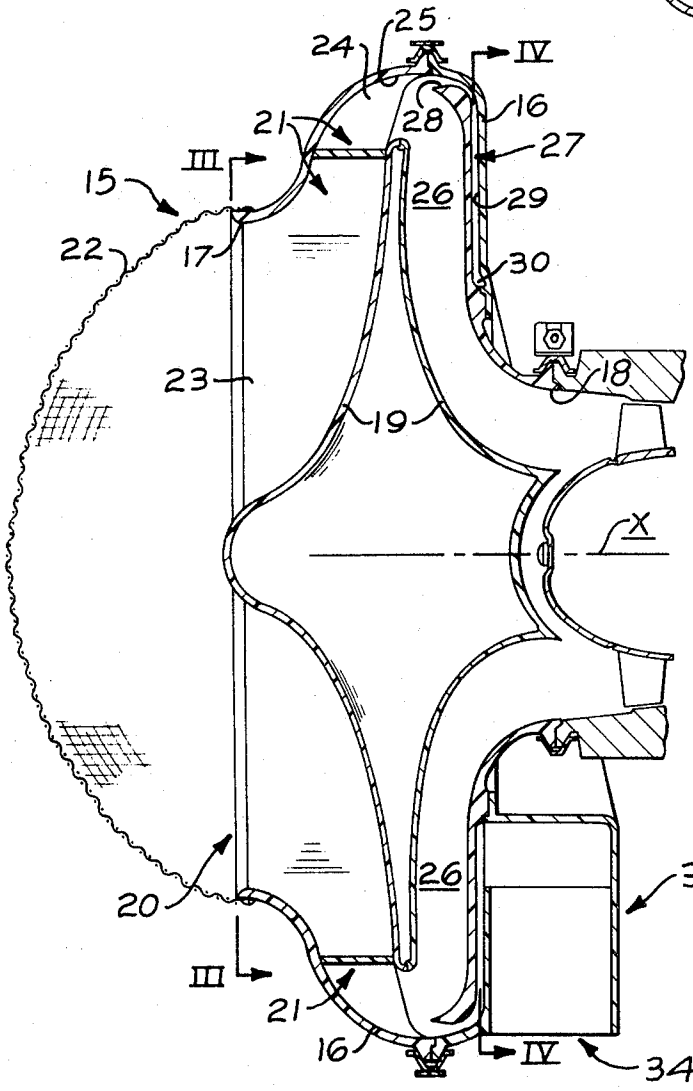
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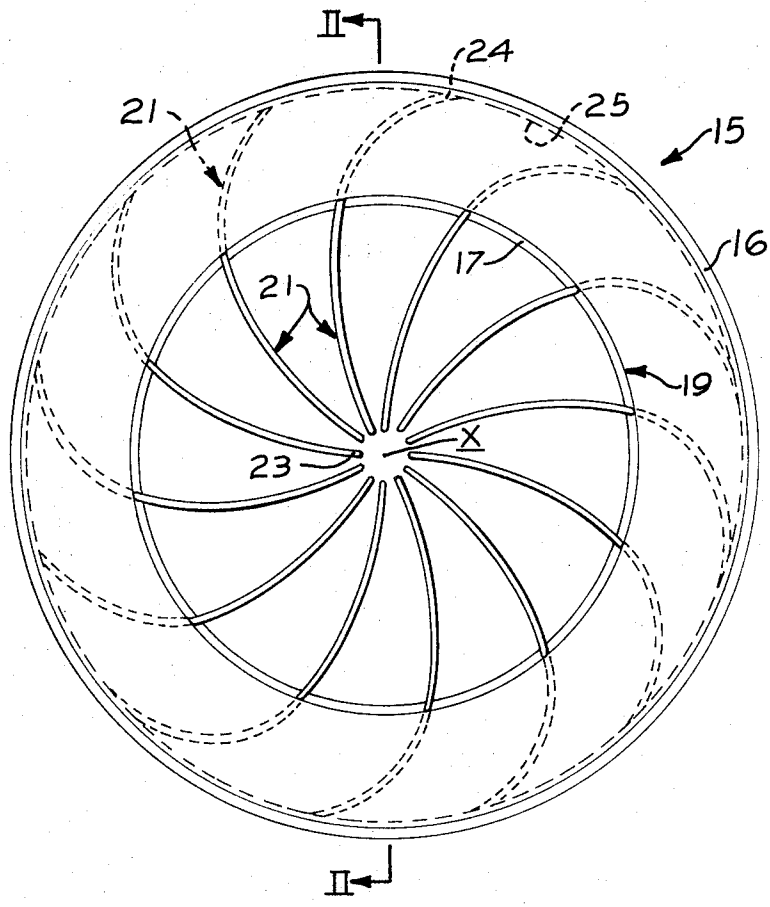
Fig. 2

Fig. 3



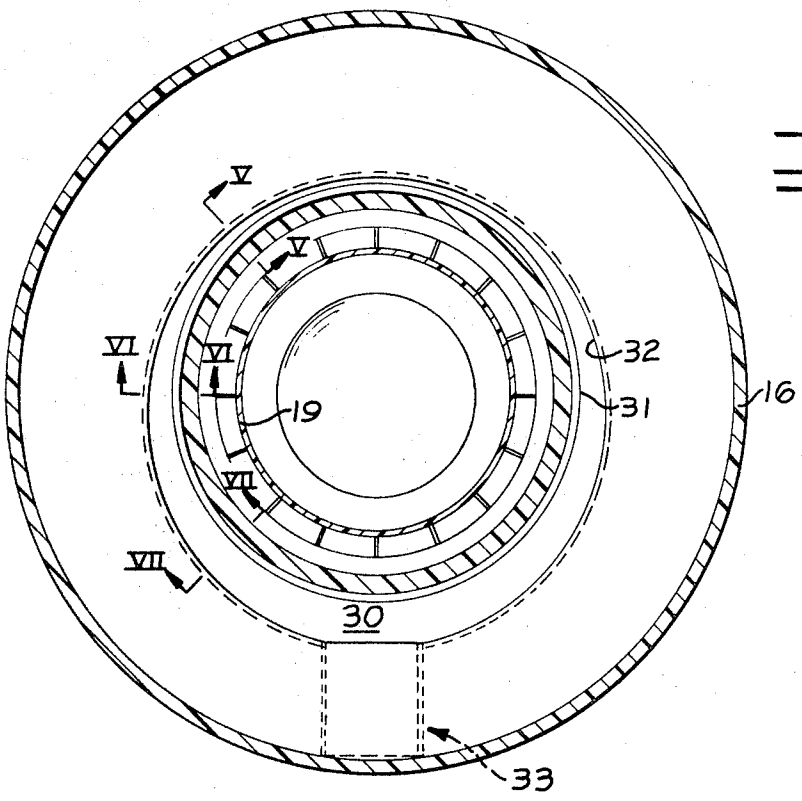
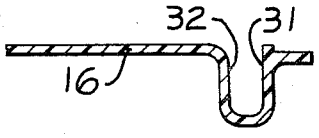



Fig-4-

Fig-5-



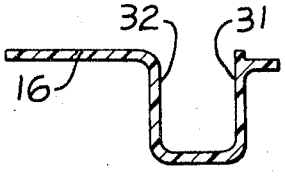




Fig-6-

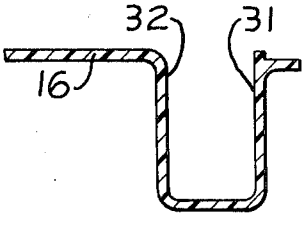



Fig-7-

# INERTIAL AIR CLEANER FOR GAS TURBINE

## BACKGROUND OF THE INVENTION

This invention relates to an inertia-type separator, particularly adapted to supply clean air to the compressor stage of a gas turbine.

Internal combustion engines, such as diesels and gas turbines, require substantial amounts of clean air to operate efficiently. Such engines normally utilize filter-type air cleaners to clean ambient, dirt ladened air prior to its discharge into the engine. In addition to the air cleaners, many engines further utilize a fan for aiding in the removal of dirt. Such conventional air cleaning systems are oftentimes costly, bulky and tend to induce pressure and velocity fluctuations which induce an inefficient discharge of the air into the engine.

## SUMMARY OF THE INVENTION

An object of this invention is to overcome the above, briefly described problems by providing a non-complex and economical inertia type air cleaner which assures an efficient discharge of clean air into an engine and which requires minimal servicing.

The air cleaner comprises an annular housing defining an inlet and an outlet and an annular member attached within the housing. A plurality of circumferentially spaced vanes are secured to the member, adjacent to the housing's inlet, to extend radially outwardly to define a plurality of first passages for centrifugally expelling incoming ambient air therefrom. A second passage, defined between the member and the housing, extends radially inwardly to communicate clean air to the compressor stage of a gas turbine, for example. A third, restricted passage is positioned radially outwardly from the second passage to communicate with the first passage to receive contaminants, such as dirt, centrifugally discharged therein.

## BRIEF DESCRIPTION OF THE DRAWINGS

Further objects of this invention will become apparent from the following description and accompanying drawings wherein:

FIG. 1 is a longitudinal cross sectional view of a portion of a gas turbine having the inertial-type air cleaner of this invention attached to the compressor stage thereof;

FIG. 2 is an enlarged view of the air cleaner, taken in the direction of arrows II—II in FIG. 3;

FIG. 3 is an end elevational view of the air cleaner, taken in the direction of arrows III—III in FIG. 2;

FIG. 4 is a cross sectional view taken in the direction of arrows IV—IV in FIG. 2; and

FIGS. 5–7 are enlarged sectional views respectively taken in the direction of arrows V—V, VI—VI and VII—VII in FIG. 4.

## DETAILED DESCRIPTION

The conventional turbine, partially illustrated in FIG. 1, has an axial-centrifugal compressor 10 adapted to discharge air into diffuser ducts 11 and combustion chambers 12. The turbine functions in a conventional manner to discharge heated and expanded gases through nozzle vanes 13 and against the blades of a gas producer turbine wheel 14. Such gases further drive a power turbine (not shown) which in turn drives a power output shaft.



This invention is drawn to an inertial-type air cleaner 15 adapted to have an annular, plastic housing 16 thereof attached to the turbine's compressor stage to supply substantially clean air to a co-axially aligned inlet thereof. Referring to FIGS. 2 and 3, the air cleaner is disposed on a longitudinal axis X thereof and further comprises an annular inlet 17 and an axially spaced annular outlet 18 communicating with the compressor'inlet. An annular plastic member 19, having aerodynamically shaped front and rear cones, is attached within the housing between inlet 17 and outlet 18 by plastic vane means 20.

The vane means comprises a plurality of circumferentially and equally spaced vanes 21 positioned adjacent to inlet 17 to define a plurality of first passage means between each adjacent pair of vanes for centrifugally expelling air radially outwardly therefrom. A semi-spherically shaped screen 22 (FIG. 2) is attached at the inlet to housing 16 to prevent the ingress of large particles of dirt and the like therethrough. As shown in FIG. 3, the vanes are preferably equally spaced about axis X and are disposed in parallel relationship therewith.

When viewed in such transverse cross section (FIG. 3), each vane has compound radii of curvatures which gradually decrease in magnitude, substantially along the full length thereof, from axis X radially outwardly towards housing 16. In addition, a radial inner portion 23 of each vane is disposed in approximate tangential relationship and closely adjacent to the axis, whereas a radial outer portion 24 thereof is disposed in approximate tangential relationship relative to circular inner wall portions 25 of housing 16. Also, each pair of circumferentially adjacent vanes generally diverge radially outwardly from the axis.

As viewed in cross section along axis X in FIG. 2, the first end of each first passage means, positioned at inlet 17, has a substantially larger cross sectional area than a second end thereof, positioned at a communicating second passage means 26. The first passage means are designed to provide a substantially uniform air velocity therethrough. The annular second passage means, defined between member 19 and housing 16, extends radially inwardly towards axis X to communicate substantially clean air from the first passage means to outlet 18.

A third passage means 27, defined in the housing, has an annular inlet 28 disposed in approximate parallel relationship with respect to axis X and positioned radially outwardly from second passage means 26. Inlet 28 preferably has a cross sectional area which is substantially less than that of each of the first and second passage means. The third passage means further comprises a radially inwardly extending portion 29 communicating with a contaminant collecting means comprising a collecting chamber 30.

Referring to FIGS. 4–7, eccentrically disposed inner and outer wall portions 31 and 32, respectively, are formed on the housing to define the generally annular collecting chamber. When revolved about axis X, the chamber has a gradually enlarged cross sectional area from an upper portion to a diametrically opposed lower portion thereof. The collecting means further comprises a collecting box 33 (FIG. 2) secured to housing 16 to have a chamber thereof communicate with the lower portion of the annular collecting chamber.

The above described air cleaner is designed to remove approximately 95 percent of the incoming dirt particles and other contaminants, down to a 3 to 5 micron size. During a typical air-cleaning operation: Approximately 110 percent of the air required for efficient turbine operation flows through inlet **17** at approximately 60fps; the air increases to a velocity approximating 85fps in the first passage means defined by vanes **21**; air entering second passage means **26** attains a velocity approximating 140fps which increases to about 360fps at outlet **18**; approximately 10 percent of the total air inflow enters inlet **28** of the third passage means and carries the inertially separated dirt particles to collecting box **33** whereat a compressor discharge pressure or exhaust gas driven jet pump (not shown) functions to pick them up at an outlet **34** and discharges them to ambient.

What is claimed is:

**1.** An inertial type air cleaner adapted for attachment to the inlet of an inertial combustion engine comprising

an annular housing disposed on a longitudinal axis thereof,

means defining an inlet and an outlet disposed in axially spaced apart relationship in said housing,

an annular member attached within said housing between said inlet and outlet,

vane means attached in circumferentially spaced relationship on said member, adjacent to said inlet, to extend radially outwardly from said axis to define first passage means for centrifugally expelling air radially outwardly therefrom,

second passage means defined between said member and said housing to extend radially inwardly towards said axis to communicate said first passage means with said outlet, and

means defining third passage means, having an inlet positioned radially outwardly from said second passage means, and at the intersection of said first and second passage means, communicating with said first passage means for receiving centrifugally expelled air therefrom.

**2.** The invention of claim **1** wherein said vane means comprises a plurality of vanes circumferentially spaced about said axis.

**3.** The invention of claim **2** wherein each of said vanes is disposed in parallel relationship with respect to said axis.

**4.** The invention of claim **2** wherein each of said vanes, when viewed in cross section transverse to said axis, has a radius of curvature which gradually decreases in magnitude, substantially along the full length thereof, from said axis radially outwardly towards said housing.

**5.** The invention of claim **4** wherein each of said vanes, when viewed in cross section transverse to said axis, has a radial inner portion disposed in approximate tangential relationship and closely adjacent to said axis and a radial outer portion disposed in approximate tangential relationship to circular inner wall portions of said housing.

**6.** The invention of claim **4** wherein each pair of circumferentially adjacent vanes define a passage of said first passage means therebetween, said pair of vanes generally diverging radially outwardly from said axis.

**7.** The invention of claim **6** wherein a first end of each of said passages of said first passage means, positioned at said inlet, has a substantially larger cross sectional area than a second end thereof, positioned at said second passage means, when each of said passages is viewed in cross section longitudinally along said axis.

**8.** The invention of claim **1** wherein said housing, said member and said vane means are each composed of a non-metallic plastic material.

**9.** The invention of claim **1** wherein the inlet to said third passage means is annular, has a cross sectional area substantially less than that of each of said first and second passage means and is disposed in approximate parallel relationship with respect to said axis, said third passage means further comprising a radially inwardly extending portion communicating with a contaminant collecting means.

**10.** The invention of claim **9** wherein said collecting means comprises eccentrically disposed inner and outer wall portions formed on said housing to define a generally annular collecting chamber about said axis having a gradually enlarged cross sectional area from an upper portion to a diametrically opposed lower portion thereof.

**11.** The invention of claim **10** wherein said collecting means further comprises a collecting box secured to said housing to have a chamber thereof communicate with the lower portion of said collecting chamber.

**12.** The invention of claim **1** further comprising a turbine having a compressor stage, said housing attached to said compressor stage at the outlet of said housing.

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