United States Patent [19]

Obligado

[11] **3,712,032**

[45] **Jan. 23, 1973**

[54] **HIGH SPEED CENTRIFUGAL AIR-OIL SEPARATOR**

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[73] Assignee: **Arco Corp.**, Stratford, Conn.

[22] Filed: **Nov. 19, 1970**

[21] Appl. No.: **91,118**

[52] **U.S. Cl.** **55/409**

[51] **Int. Cl.** **B01d 45/12**

[58] **Field of Search** 55/409

[56] **References Cited**

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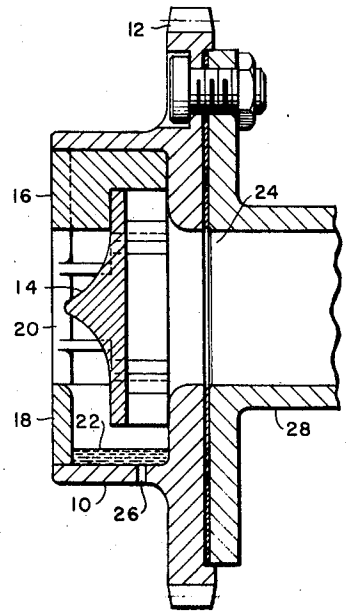
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[57] **ABSTRACT**

An air-oil separator is constructed as an integral part of a gear box and it includes a rotating cylindrical housing in which are mounted an axially positioned radial deflector and a plurality of radial vanes for centrifuging the oil-air mixture. The heavier oil displaces the lighter air creating a pool of oil on the inner surface of the cylinder. The pool of oil is permitted to flow through radially disposed holes in the housing but is maintained at a sufficient depth to provide a seal against the escape of air which is vented axially overboard.

6 Claims, 2 Drawing Figures



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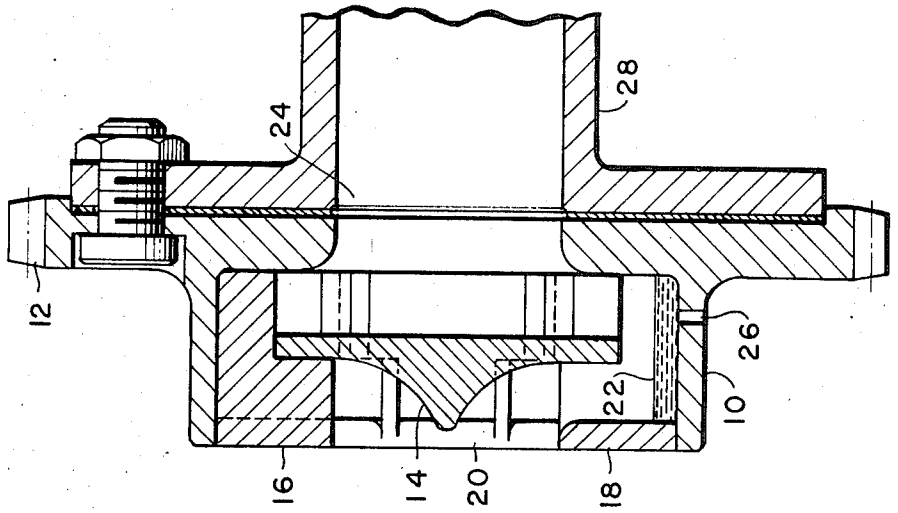


Fig. 2

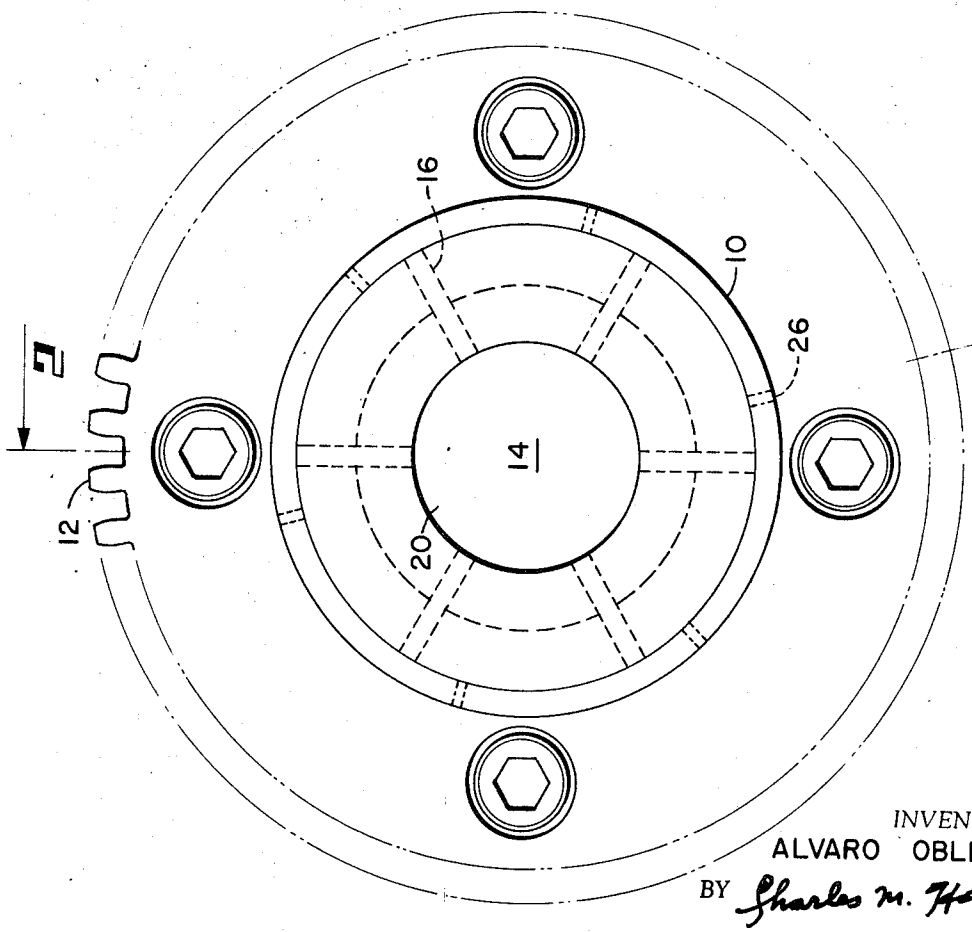


Fig. 1

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HIGH SPEED CENTRIFUGAL AIR-OIL SEPARATOR

Background of the Invention

The present invention is designed for use in connection with the gear box of a gas turbine engine or other rotating machinery. In such applications it is well known that the pressurizing air for such systems must be vented, that is to say, the air entrapped in the lubricating oil must be separated from the oil and discharged overboard without the significant loss of oil from the gear box. While many systems of this type are known to the prior art, the present invention accomplishes the air-oil separation in a self-contained compact gear arrangement which operates with essentially 100 percent efficiency, i.e., the air removed without significant loss of oil.

THE DRAWINGS

FIG. 1 is an end view of an illustrative embodiment of this invention; and

FIG. 2 is a cross section taken through the line 2—2 of FIG. 1.

Brief Summary of the Invention

The disclosed air-oil separator is intended for use in a gear box and is incorporated as an integral part of one of the gear shafts. It allows venting of large quantities of air directly overboard without significant loss of oil. The design concept of the separator is based on the centrifugal pump. Its advantages are its positive separation mechanism, its compact size and its ability to operate under a gear box environment with large quantities of air and oil. The invention utilizes an axially positioned radial deflector in combination with a plurality of radially disposed vanes which serve to impart a centrifugal force to the oil and air. The oil is discharged from the separator through radially disposed passages. The air exits axially downstream from the incoming air-oil mixture.

Description of the Illustrated Embodiment

The disclosed air-oil separator is incorporated as an integral part of a hollow cylindrical shaft **10** of a conventional gear **12**. The gear **12** is incorporated in a gear box (not shown).

The hollow shaft **10** provides a cylindrical housing into which the centrifuge elements are press fitted. The centrifuge elements include an axially positioned radial deflector **14** supported by a plurality of radially disposed vanes **16**. The vanes **16** are in turn supported by a centrally apertured disk **18** and are made integral with the disk **18**. The centrally located aperture in the disk **18** provides an inlet port **20** in axial alignment with the radial deflector **14**.

A slightly positive gear box pressure forces the mixture of air and oil into the shaft **10** through the axial inlet port **20**. The radial deflector **14** is provided with a curved surface of revolution having a **90** degree arc with its apex facing the inlet port **20**. Thus, the air-oil mixture intercepted by the deflector **14** is radially deflected outwardly towards the radial vanes **16** which then centrifuge the mixture and impels it radially against the inner surface of the hollow shaft **10**. The heavier oil displaces the lighter air creating a pool of oil

22 on the inner surface of the cylinder. The pool of oil **22** is maintained at a depth from zero to an allowable maximum which is determined by the dimensions of the inlet port **20** and an exit port **24** as compared with the inner diameter of the hollow shaft **10** and the diameter of the deflector **14**, and by the size of the orifices **26** through which the oil is permitted to escape in a controlled manner back into the gear box. The orifices **26** are sized on the basis of expected oil flow rates and developed centrifugal oil pressure. With the apertures **26** sealed to the flow of air, the separated air is forced to exit through the exit port **24** and is exhausted through a second shaft **28** to the atmosphere.

The efficiency of the separator increases with rotational velocity and decreases with increasing air flow. The pressure drop across the unit is mainly a function of the air flow rate and separator efficiency and size. Rotational velocity has only a slight effect on pressure drop.

It is noted that the vanes **16** axially extend the entire length of the separator housing. However, the vane is radially longer at the inlet side of the housing than it is at the outlet side. This has some effect on reducing the impedance to the radial inward flow of air, but a symmetrically shaped vane would also provide satisfactory operation of the separator.

It is also noted that the separating efficiency will not suffer should the oil pool **22** be of zero level since the developed centrifugal air pressure will, in general, be far too low to force an appreciable quantity of air through the orifices **26**.

The advantages of this separator are its compact size and its ability to operate under most any turbulent gear box environment with large quantities of air and oil and without significant loss of energy and efficiency. It allows the venting of large quantities of air overboard without any loss of oil.

I claim:

1. An air-oil separator comprising:

a hollow rotating cylinder;

an axial opening in one end of said cylinder, said opening providing an inlet admitting a mixture of air and oil thereto;

an axial opening in the opposite end of said cylinder, said opening providing an air outlet from said cylinder;

a plurality of passages in the periphery of said cylinder, said passages providing radial oil outlets through said cylinder, said passages being sized to maintain a pool of oil on the inner cylindrical surface of said cylinder to provide a seal for preventing the flow of air through said passages;

an axially positioned radial deflector fixed to said cylinder, said deflector intercepting said air-oil mixture and radially deflecting said mixture to the inner surface of said cylinder;

and a plurality of axially and radially extending vanes fixed to the inner cylindrical surface of said cylinder, said vanes imparting a centrifugal force to said mixture.

2. The invention as defined in claim **1** wherein said radial deflector has a curved surface of revolution having a 90° arc with its apex positioned on the axis of said cylinder and facing said inlet.

3. An air-oil separator comprising in combination:

a rotating gear affixed to a hollow cylindrical rotating shaft, said shaft being partially closed at both ends;

an axial inlet in one end of said shaft for admitting an air-oil mixture;

an axial outlet in the other end of said shaft for exhausting air therefrom;

a plurality of oil outlet passages radially extending through the cylindrical surface of said shaft, said passages being sized to maintain a pool of oil on the inner cylindrical surface of said cylinder to provide a seal for preventing the flow of air through said passages;

a radial deflector fixed within said shaft adjacent said inlet, said deflector intercepting and deflecting said air-oil mixture radially toward the inner cylindrical surface of said shaft;

and a plurality of axially and radially extending vanes affixed to the inner cylindrical surface of said shaft for imparting a centrifugal force to said air-oil mixture, whereby said air and oil are separated and said oil exits through said plurality of oil outlet passages, and whereby said air is exhausted through said air outlet.

4. The invention as defined in claim **3** wherein said vanes extend radially from said inner surface to the surface of said deflector.

5. The invention as defined in claim **4** wherein said vanes extend axially the entire distance between said inlet and said outlet.

6. The invention as defined in claim **5** wherein said radial deflector has a curved surface of revolution having a **90** degree arc with its apex positioned on the axis of said shaft and facing said inlet.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,712,032 Dated January 23, 1973

Inventor(s) Alvaro Obligado

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Line reading "Assignee: Arco Corp., Stratford, Conn."

should read --- Assignee: Avco Corp., Stratford, Conn. ---.

Signed and sealed this 29th day of May 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents