US 20070059188A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2007/0059188 A1**

Fraser et al. (43) **Pub. Date: Mar. 15, 2007**

(54) **AERODYNAMICALLY ENHANCED BEARING HOUSING POCKET GEOMETRY**

(75) Inventors: **Brock Fraser**, Asheville, NC (US); **Adam Reinke**, Arden, NC (US); **Neal Narron**, Asheville, NC (US)

Correspondence Address:
Patent Docket Administrator
BorgWarner Inc.
3850 Hamlin Road
Auburn Hills, MI 48326 (US)

(73) Assignee: **BorgWarner Inc.**, Auburn Hills, MI

(21) Appl. No.: **11/242,344**

(22) Filed: **Oct. 3, 2005**

Related U.S. Application Data

(60) Provisional application No. 60/716,016, filed on Sep. 9, 2005.

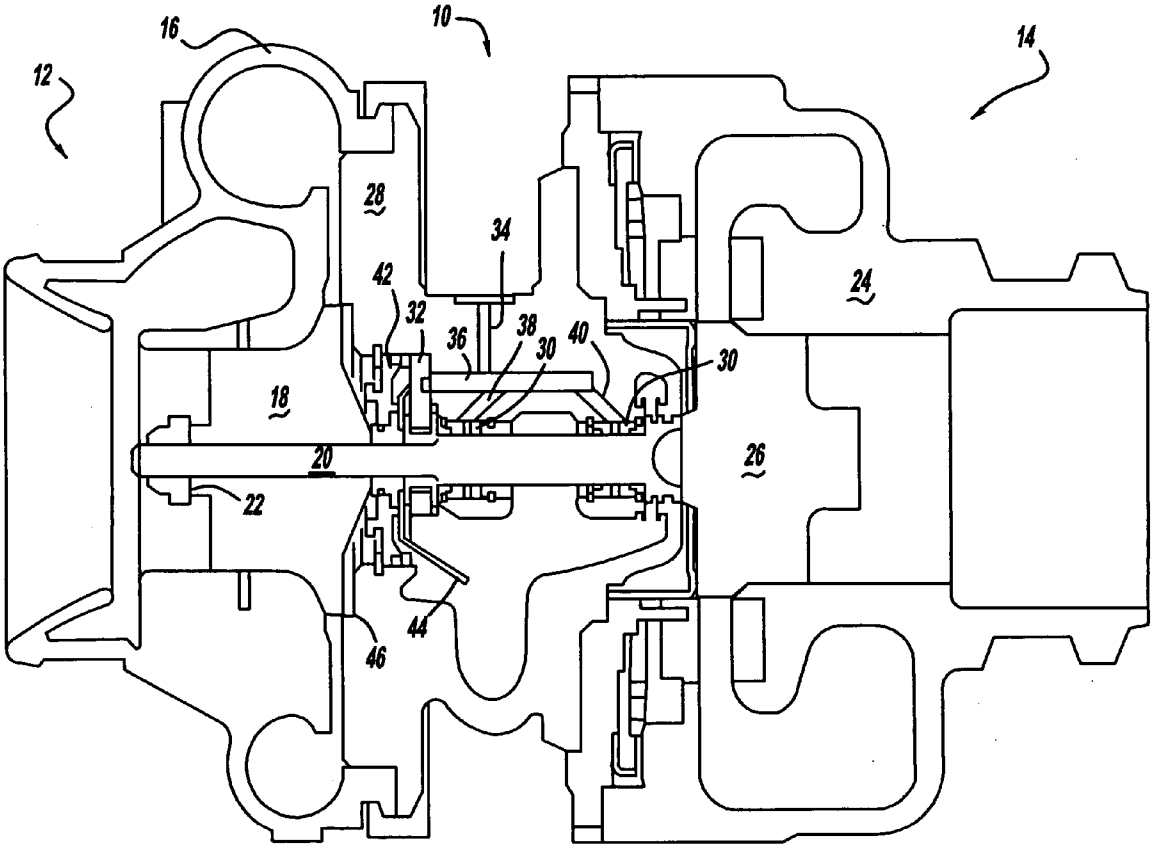
Publication Classification

(51) **Int. Cl.**
F04B 17/00 (2006.01)

(52) **U.S. Cl.** **417/407**

(57) **ABSTRACT**

A turbocharger unit having an aerodynamically enhanced pocket, comprising a turbine having a turbine housing and a turbine wheel connected to a shaft along with a compressor having a compressor housing and a compressor wheel mounted on the same shaft. There is an intermediate housing disposed between the turbine housing and the compressor housing, circumscribing the shaft, and having a compressor wheel pocket. There is a series of bearings located in the intermediate housing for supporting the shaft. There is also a series of fluid passages located in the intermediate housing which provide fluid to lubricate the bearings. A seal is used for the prevention of oil from entering the compressor wheel pocket. The compressor wheel pocket has an aerodynamically enhanced pocket for the improvement of pressure balance behind the compressor wheel, preventing the oil in the intermediate housing from entering the compressor housing.



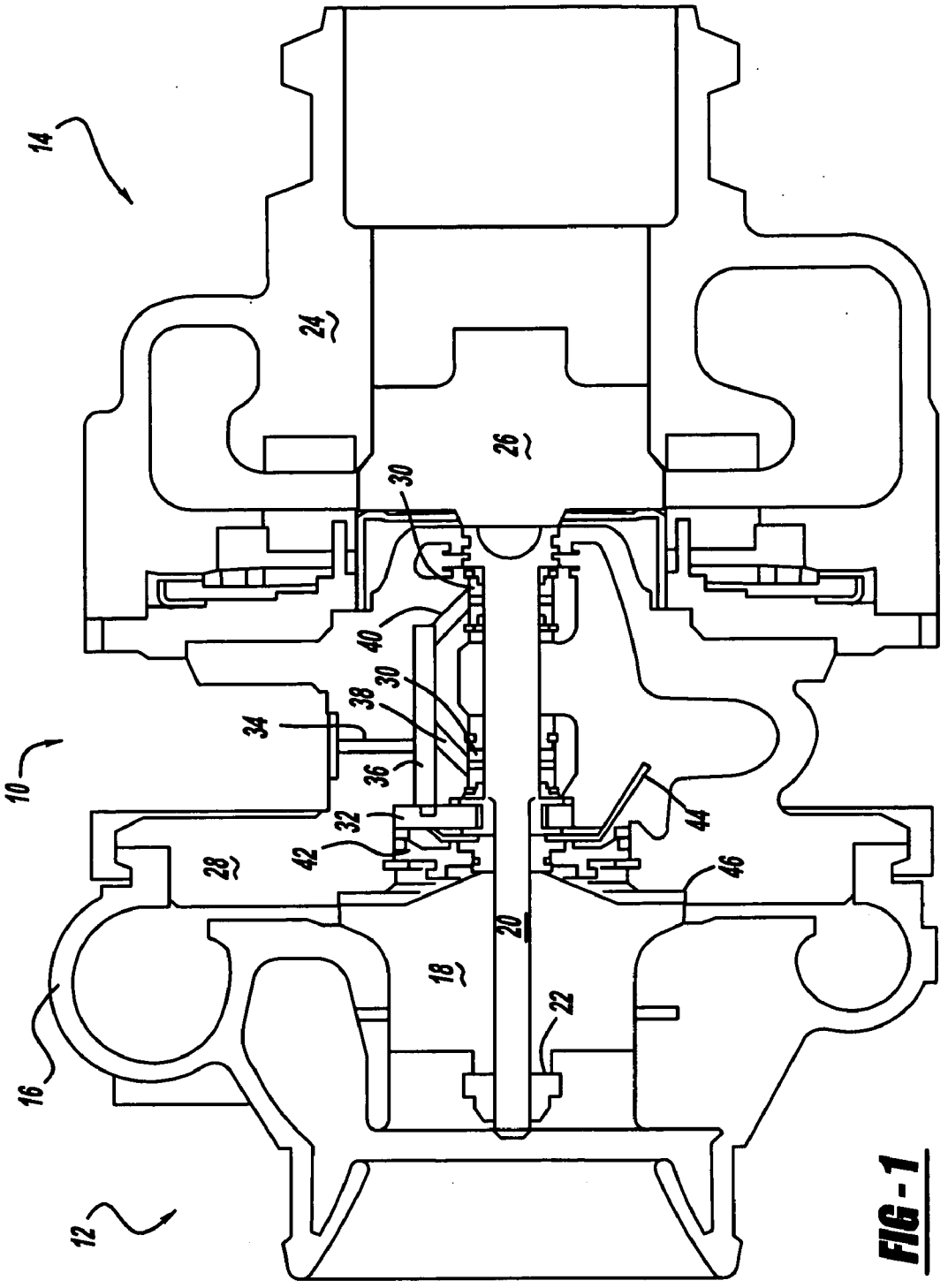


FIG-1

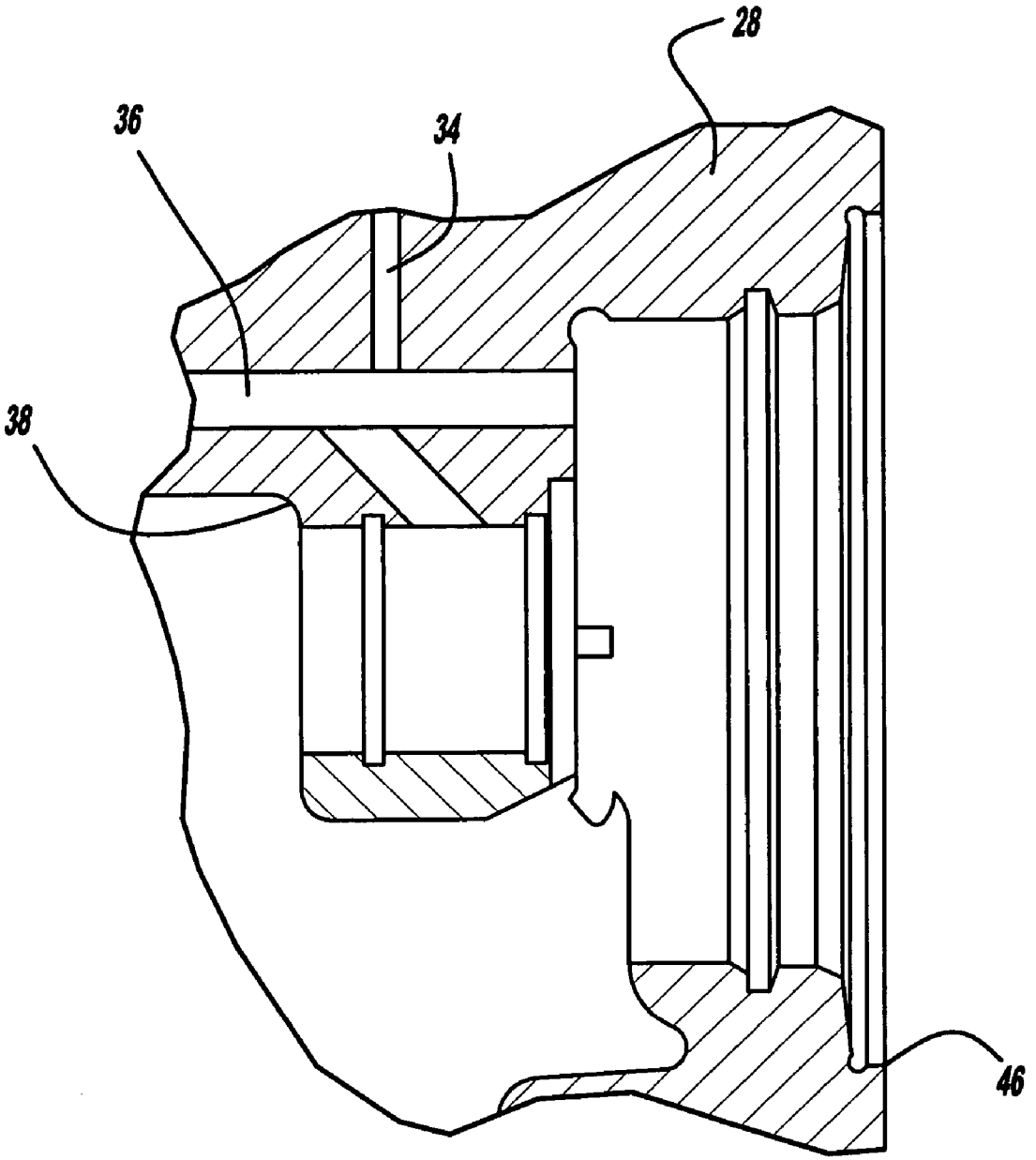


FIG - 2

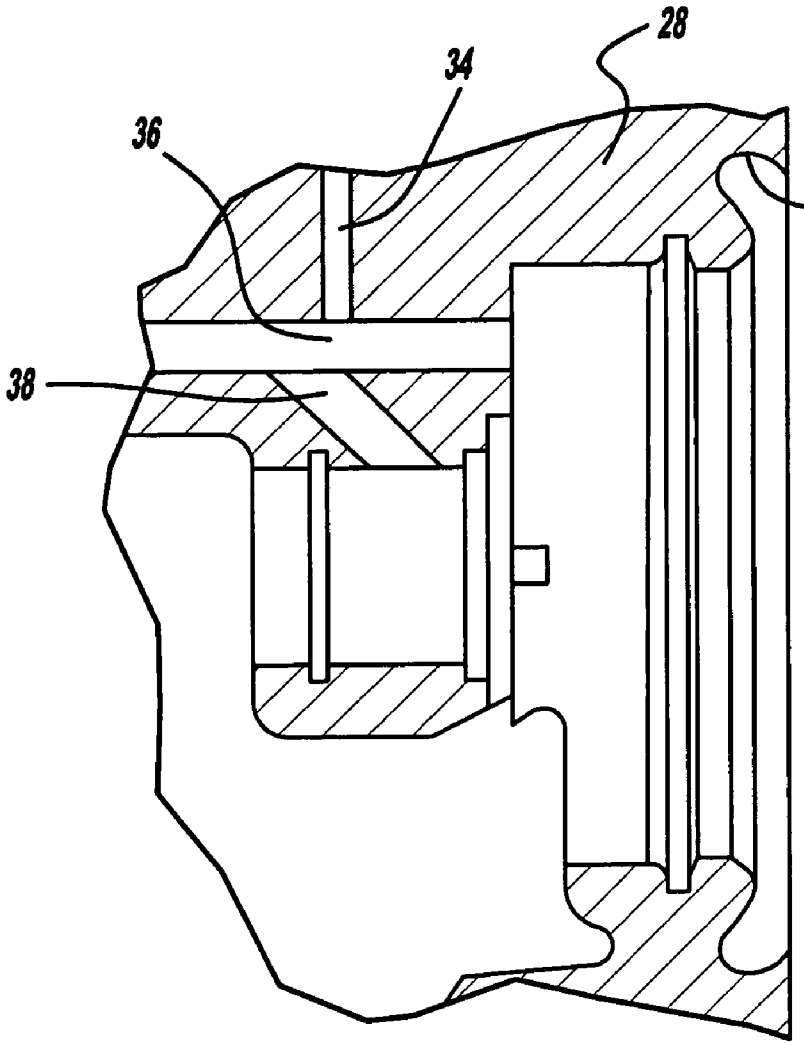


FIG - 3

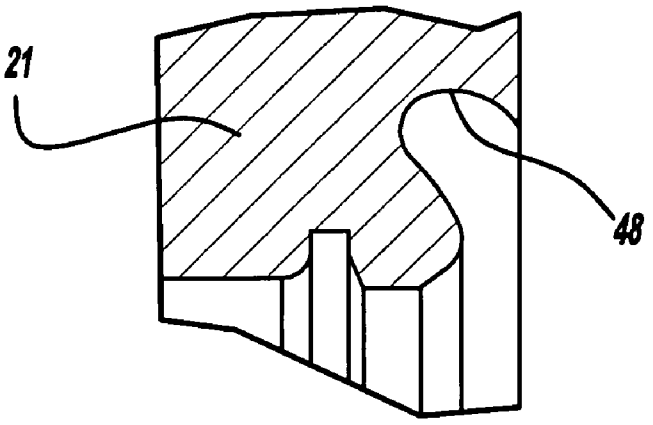


FIG - 4

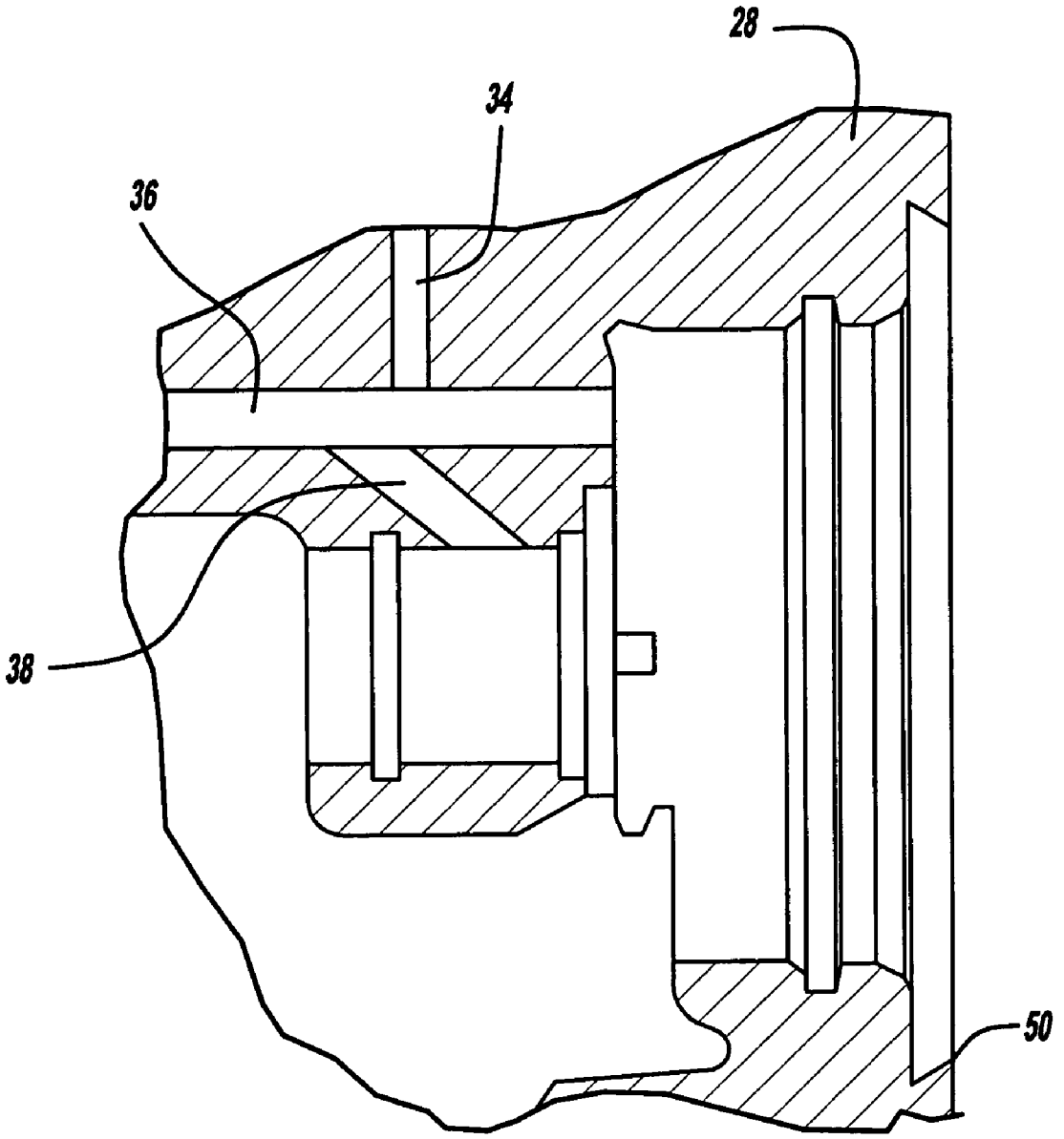


FIG - 5

AERODYNAMICALLY ENHANCED BEARING HOUSING POCKET GEOMETRY

FIELD OF THE INVENTION

[0001] The present invention relates to turbochargers and the prevention of oil leakage due to insufficient pressure balance across the compressor oil seal.

BACKGROUND OF THE INVENTION

[0002] Turbochargers are a commonly used apparatus for increasing power density in engines. Turbochargers are comprised of a turbine and a compressor. The turbine has a housing and a turbine wheel; the compressor has a compressor housing and a compressor wheel. The compressor wheel and turbine wheel are both mounted on a common shaft. Located between the turbine housing and the compressor housing is an intermediate housing, which both the turbine housing and the compressor housing are connected to. The intermediate housing has a compressor wheel pocket; the compressor wheel resides partially in the compressor wheel pocket, and partially in the compressor housing.

[0003] The turbine wheel rotates from the flow of exhaust gas from the engine through the exhaust manifold and into the turbine housing. As the turbine wheel spins, the compressor wheel spins as well. As the compressor wheel spins, fresh air is compressed and forced into the engine's intake manifold. As air flows through the compressor housing, under certain operating conditions, the compressor wheel is spinning at a high rotational speed, but the boost pressure is low. This can occur when the vehicle engine is running at high idle speed and can cause a pressure imbalance to occur on the side of the compressor wheel where the intermediate housing is located. This pressure imbalance occurs in the area between the compressor wheel and the intermediate housing.

[0004] The pressure imbalance is a lack of pressure against the labyrinth seal and the oil it retains, which can to leak into the compressor wheel pocket and into the compressor housing. Oil leaking onto the compressor wheel and compressor housing can cause fouling and problems with the air intake components leading to the engine.

SUMMARY OF THE INVENTION

[0005] Accordingly, the present invention is directed to the prevention of a pressure imbalance between the compressor wheel and the intermediate housing. The present invention is a turbocharger unit having an aerodynamically enhanced pocket, comprising a turbine having a turbine housing and a turbine wheel connected to a shaft along with a compressor having a compressor housing and a compressor wheel mounted on the same shaft. There is an intermediate housing disposed between the turbine housing and the compressor housing, circumscribing the shaft, and having a compressor wheel pocket. There is a series of bearings located in the intermediate housing for supporting the shaft. There is also a series of fluid passages located in the intermediate housing which provide fluid to lubricate the bearings. A seal is used for the prevention of oil from entering the compressor wheel pocket. The compressor wheel pocket has an aerodynamically enhanced pocket for the improvement of pressure balance behind the compressor wheel, preventing the oil in the intermediate housing from entering the compressor housing.

[0006] In a first embodiment, the aerodynamically enhanced pocket is a spoon edge comprised of a rounded indentation under a sharp edge at the end of said compressor wheel pocket.

[0007] In a second embodiment, the aerodynamically enhanced pocket is a knife edge comprised of an acute angle at the edge of said compressor wheel pocket.

[0008] Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0010] FIG. **1** is a sectional side view of a conventional turbocharger unit;

[0011] FIG. **2** is an enlarged sectional side view of an intermediate housing used in a conventional turbocharger unit;

[0012] FIG. **3** is an enlarged sectional side view of an intermediate housing, partially broken away, having an aerodynamically enhanced pocket according to a first embodiment of the present invention;

[0013] FIG. **4** is a greatly enlarged sectional side view of an intermediate housing having an aerodynamically enhanced pocket according to a first embodiment of the present invention; and

[0014] FIG. **5** is an enlarged sectional side view of an intermediate housing, partially broken away, having an aerodynamically enhanced pocket according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] The following description of the preferred embodiment(s) is merely exemplary in nature and is in no way intended to limit the invention, its application, or uses.

[0016] Referring to FIGS. **1** and **2**, a turbocharger unit is generally shown at **10**. The turbocharger unit **10** is comprised of a compressor **12** and a turbine **14**. The compressor **12** is comprised of a compressor housing **16**, and a compressor wheel **18** held onto a shaft **20** by a retaining nut **22**. Turbine **14** is comprised of a turbine housing **24** and a turbine wheel **26** welded onto shaft **22**. In between and connected to the turbine housing **24** and the compressor housing **16** is intermediate housing **28**. Located inside the intermediate housing is a set of bearings **30** and a thrust bearing **32**. The bearings **30** and thrust bearing **32** receive oil from an oil feed passage **34**. The oil feed passage **34** feeds oil into a main oil passageway **36**; the main oil passageway **36** delivers oil directly to the thrust bearing **32**, and to a first angled passageway **38** as well as a second angled passage-

way **40**. The first angled passageway **38** and the second angled passageway **40** deliver oil to bearings **30**. Oil is prevented from coming in contact with the compressor wheel **18** through the use of labyrinth seal **42**.

[**0017**] The various embodiments of the present invention will now be described. During normal operation, the exhaust gas from the vehicle engine flows through the turbine **14**, and spins the turbine wheel **26** at a high rotational speed. Spinning the turbine wheel **26** at high rotational speed causes the shaft **20** and the compressor wheel **18** to spin at the same speed as the turbine wheel **26**. The compressor wheel **18** compresses air in the compressor housing **16**, and forces the compressed air into the intake manifold of the engine (not shown). The bearings **30** are lubricated through oil flowing through the first angled passageway **38** and the second angled passageway **40**. In FIG. **2**, the standard recess **46** is shown formed as part of the intermediate housing **28**. The standard recess **46** defines a sharp edge of the intermediate housing **28**, which then recesses straight into the intermediate housing **28**. The shape of the standard recess **46** allows the compressor wheel **18** to extend partially into the intermediate housing **28**. During conditions of low boost and high air flow through the compressor housing **16** (such as high idle speed, no load), the shape of the recess **46** creates an adverse air pressure balance, which in turn creates a lack of pressure against the labyrinth oil seal **42** which can cause oil to leak into the compressor housing **16**.

[**0018**] Referring now to FIGS. **3** and **4**, a first embodiment of the present invention is shown as a spoon-shaped recess **48**. The spoon-shaped recess **48** defines the same sharp edge in the intermediate housing **28** as the standard recess **46**, but recesses in a round, spoon-shaped manner. The spoon-shaped recess **48** reduces the pressure imbalance caused by the compressor wheel **18** when the turbocharger **10** is running at high oil flow conditions, for example, high engine speed, low engine load operating conditions. The spoon-shaped recess **48** may be comprised of various radii to compensate for various ranges of pressure imbalance due the size of the intermediate housing **28**, the size of the compressor wheel **18**, and the volume of air flow through the compressor **12**.

[**0019**] A second embodiment of the present invention is shown in FIG. **5**. The intermediate housing **28** has a knife-shaped recess **50** defined by the same sharp edge as the standard recess **46** of the intermediate housing **28**, but then recesses into the housing to form an angle. The knife-shaped recess **50** shown in FIG. **5** reduces the pressure imbalance caused by the compressor wheel **18** when the turbocharger **10** is running at high oil flow conditions, for example, high engine speed, low engine load operating conditions. The knife-shaped recess **50** may be comprised of various angles to compensate for various ranges of pressure imbalance due the size of the intermediate housing **28**, the size of the compressor wheel **18**, and the volume of air flow through the compressor **12**.

[**0020**] It should be noted that both the spoon-shaped recess **48** and knife-shaped recess **50** define a sharp edge in the intermediate housing **28** which is the same diameter as the sharp edge defined by the standard recess **46**.

[**0021**] Reducing the adverse pressure balance between the intermediate housing **28** and the compressor wheel **18** increases the capability of the labyrinth seal **42** to retain oil within the intermediate housing **28** by eliminating any suction force created by compressor wheel **18** spinning at a high rotational speed, while the turbocharger **10** is not under load.

[**0022**] The description of the invention is merely exemplary in nature and, thus, variations that do not depart from the gist of the invention are intended to be within the scope of the invention. Such variations are not to be regarded as a departure from the spirit and scope of the invention.

What is claimed is:

1. A turbocharger unit having an aerodynamically enhanced pocket, comprising:

a turbine having a turbine housing and a turbine wheel connected to a shaft;

a compressor having a compressor housing and a compressor wheel mounted on said shaft;

an intermediate housing disposed between said turbine housing and said compressor housing, circumscribing said shaft, having a compressor wheel pocket, said compressor wheel extending at least partially into said compressor wheel pocket;

one or more bearings located in said intermediate housing, for supporting said shaft;

a series of fluid passages located in said intermediate housing for allowing oil to lubricate said bearings;

a seal for the prevention of said oil from entering said compressor housing; and

wherein said compressor wheel pocket has an aerodynamically enhanced pocket for the prevention of air pressure imbalance around said compressor wheel, and preventing said oil from entering said compressor housing.

2. The turbocharger unit of claim 1, wherein said aerodynamically enhanced pocket is a spoon-shaped recess.

3. The turbocharger unit of claim 2, wherein said spoon-shaped recess is comprised of a sharp edge and a rounded recess at the end of said compressor wheel pocket.

4. The turbocharger unit of claim 1, wherein said aerodynamically enhanced pocket is a knife-shaped recess.

5. The turbocharger unit of claim 4, wherein said knife-shaped recess is comprised of a sharp edge having an angled recess at the edge of said compressor wheel pocket.

* * * * *