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(54) DUAL INLET ROTARY TOOL

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(57) **ABSTRACT**

A rotary device having a housing that has a first fluid inlet and second fluid inlet. A rotor is rotatably mounted in the housing and is in communication with the first and second fluid inlets.

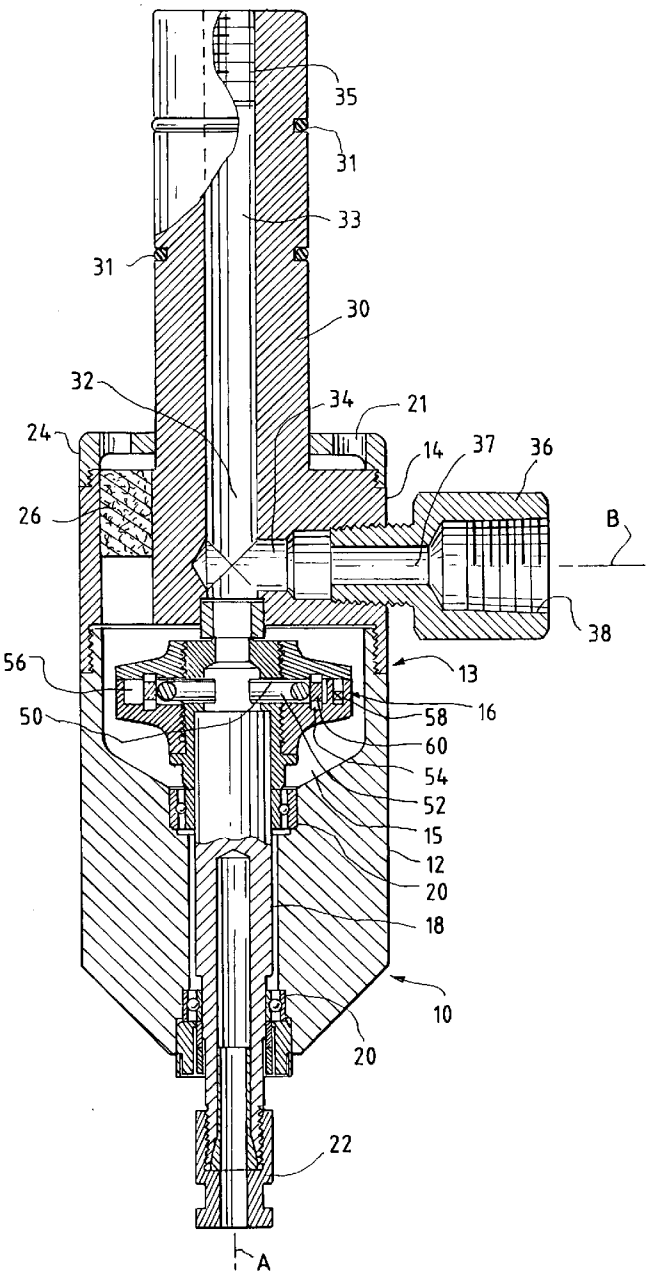

FIG. 1

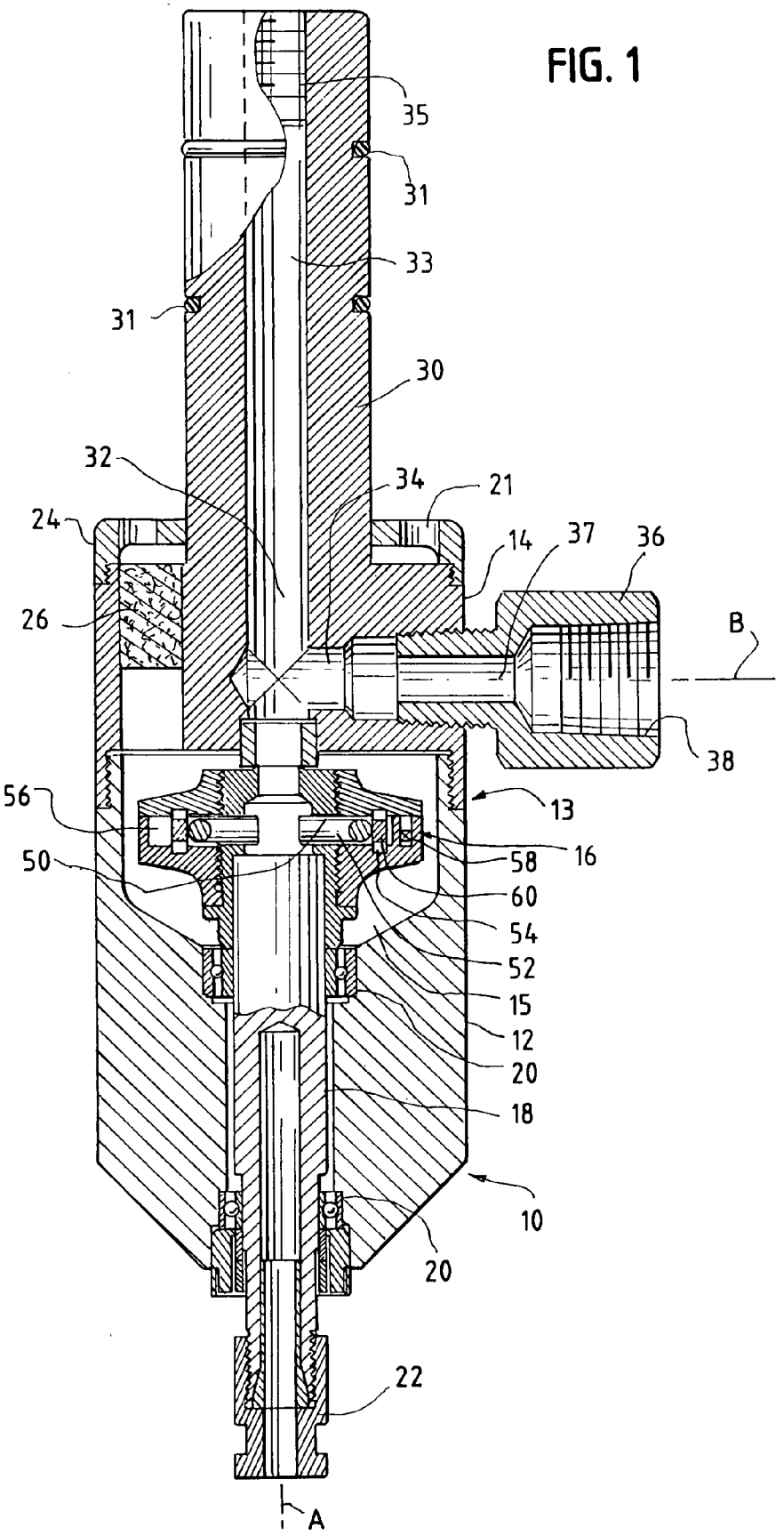
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FIG. 2A

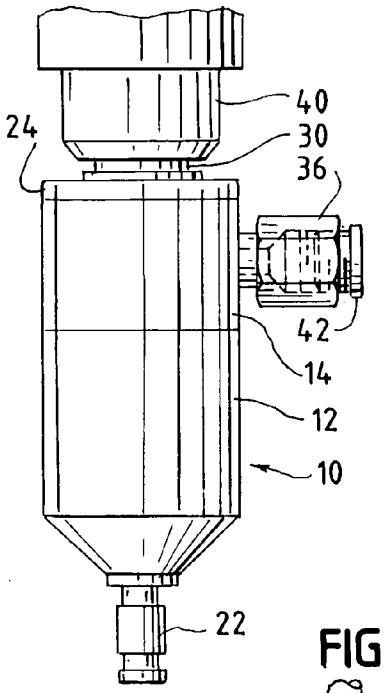


FIG. 2B

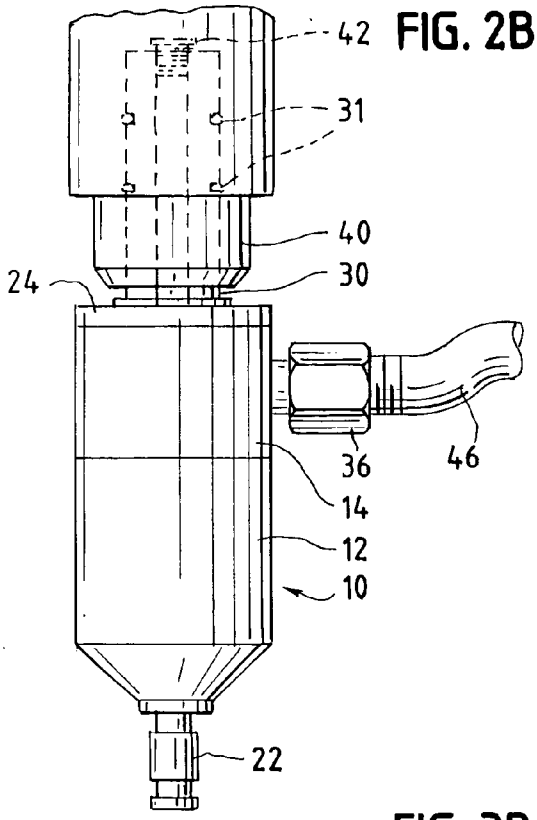


FIG. 3A

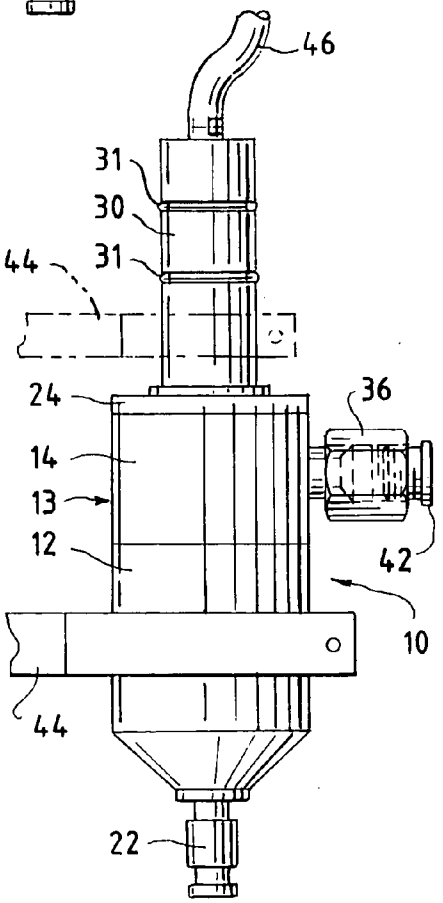
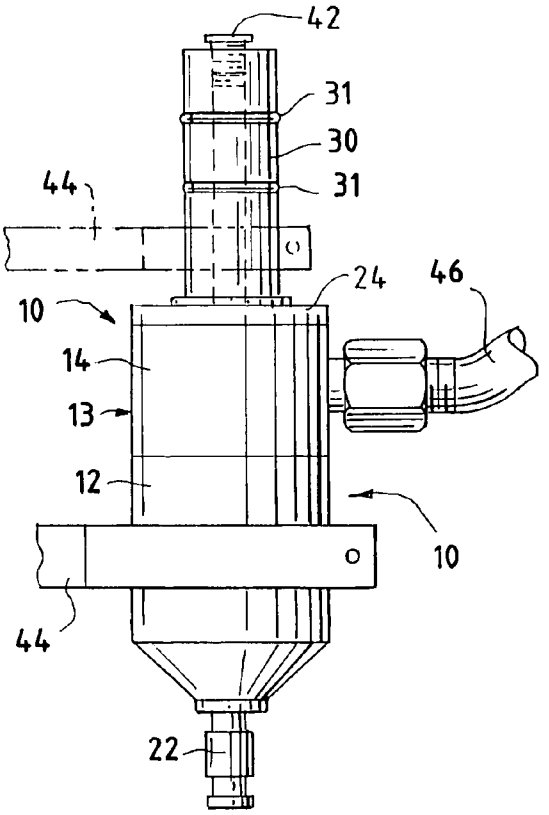


FIG. 3B



DUAL INLET ROTARY TOOL

FIELD OF THE INVENTION

[0001] This invention relates generally to rotary tools. In particular, this invention relates to machine mounted pressurized fluid driven rotary tools.

SUMMARY OF THE INVENTION

[0002] In one embodiment, the present invention relates to a rotary device having a housing that has a first fluid inlet and a second fluid inlet. A rotor is rotatably mounted in the housing and is in communication with the first and second fluid inlets.

[0003] The present invention also relates to a method for connecting a rotary tool to a fluid source by providing a housing and a rotor mounting in the housing. First and second fluid inlets are provided in the housing, which are each in communication with the rotor. A plug is inserted into the first fluid inlet and the second fluid inlet is connected to a high pressure fluid source.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] **FIG. 1** is a cross-sectional view of a rotary tool according to the present invention.

[0005] **FIGS. 2A and 2B** are side views of the rotary tool according to the present invention as mounted to a CNC machine.

[0006] **FIGS. 3A and 3B** are side views of the rotary tool according to the present invention as mounted to a machine fixture.

DETAILED DESCRIPTION

[0007] Referring to **FIG. 1**, an exemplary rotary device according to the present invention is shown generally at **10**. The exemplary device described herein is a pneumatic tool having a turbine rotor powered by oil-free high pressure air, however, it will be understood that the concepts of the current invention could be used or adapted for use for any rotary tool having any type of fluid driven motor, such as a vane motor, and powered by any type of compressed fluid.

[0008] As shown in **FIG. 1**, the rotary tool **10** generally has a housing **13** formed by a front section **12**, a back section **14** threaded to the front section **12**, and an end cap **24** threaded to the back section **14**. The front section **12** includes a portion having a relatively large diameter to which a fixture can be attached, as described in more detail below. The portion of the front section **12** having the relatively large diameter includes a motor chamber **15** formed on an inside portion thereof and a rotor **16** mounted within the motor chamber **15**.

[0009] The back section **14** of the housing **13** includes a first fluid inlet **34** that has a longitudinal axis B that is generally perpendicular to an axis of rotation A of the rotor **16**. The first fluid inlet **34** is in communication with the rotor **16** and is adapted to receive a pressurized fluid and transmit the pressurized fluid to the rotor **16**. The first fluid inlet **34** is formed by a bore extending through the sidewall of the back section **14** of the housing **13** and is adapted to receive a hose from a high pressure air source, an inlet adapter, or a plug, as described in more detail below, for example by having threads formed on at least a portion of the bore. An inlet adapter **36** is threaded into the first fluid inlet **34** and has a bore **37** therethrough that is in communication with the first fluid inlet **34**. The inlet adapter **36** is adapted to receive a hose from a high pressure air source or a plug, as described in more detail below, for example by having threads **38** formed on at least a portion of the bore.

[0010] The back section **14** of the housing **13** also includes a second fluid inlet **32** that has a longitudinal axis that is generally parallel to the axis of rotation A of the rotor **16**. The second fluid inlet **32** is in communication with the rotor **16** and is adapted to receive a pressurized fluid and transmit the pressurized fluid to the rotor **16**. The second fluid inlet **32** is formed by a bore extending through the end of the back section **14** of the housing **13**. A generally cylindrical shank **30** having a longitudinal axis that is generally parallel to the axis of rotation A of the rotor **16** is integrally formed to the back section **14** of the housing **13**, extends from the end of the back section **14**, and can be used as a mount to connect the rotary tool **10** to a machine, as is described in more detail below. The shank **30** has a bore **33** extending therethrough, which is in communication with the second fluid inlet **32**, to allow the shank **30** to receive a pressurized fluid and transmit the pressurized fluid to the second fluid inlet **32**, as described in more detail below. The shank **30** is adapted to receive a hose from high pressure air source or a plug, as described in more detail below, for example by having threads **35** formed on at least a portion of the bore. A pair of o-rings **31** sit within indentations in the outer wall of the shank **30**.

[0011] Inside of the back section **14** is a muffler **26**, which may be composed of a felt-like material and is adapted for muffling the noise caused by exhausted fluids. In addition, the end cap **24** includes one or more holes **21** each having a predetermined diameter which are adapted to allow the pressurized fluid to escape from the motor chamber **15**.

[0012] A rotor **16**, having an axis of rotation A, is mounted within the motor chamber **15** such that the rotor **16** can rotate therein. As described herein, the rotor **16** is a reaction turbine-type rotor, such as that described in U.S. Pat. No. 4,776,752 to Davis, which has a common assignee with the present invention, and the disclosure of which is hereby incorporated by reference. However, the present invention is not so limited and may be applied to rotary devices having other types of motors. In operation, pressurized air is directed to the rotor **16** from the first fluid inlet **34** and/or the second fluid inlet **32**. As the air enters the rotor **16** it enters a first annular chamber **50**, flows around a resilient valve ring **52** through radial holes **54** in annular wall **60** into a second annular chamber **56**, where it is directed through nozzles **58**, thereby imparting rotation to the rotor **16** and therefore the rotatable shaft **18**. The pressurized fluid is expelled from the rotor **16** through the nozzles **58** and passes into the motor chamber **15**, through the muffler **26**, and exits the rotary tool **10** through the holes **21** in the end cap **24** to atmosphere. As the pressurized fluid is directed into the rotor **16**, rotation increases to a pre-selected maximum. Centrifugal forces acting on resilient valve ring **52** tend to cause radial expansion of the ring **52**, however, the inner surface of the annular wall **60** supports the valve ring **60**, except at radial holes **54**. This enables the radial expansion of the valve ring **52** to be directed into the holes **54** so as to cause a controlled elastic deformation of valve ring **52**. In operation, as the resilient valve ring **52** deforms, it approaches the

ends of radial holes **54**. As the distance narrows sufficiently, fluid flow through the radial holes **54** is restricted and rotating forces reduced. As drag forces acting on the system and rotating forces reach equilibrium, the forces acting on the resilient valve ring **52** will also be in equilibrium. This results in a constant rotary speed. If drag forces increase, the equilibrium would be disrupted, and the forces on the resilient valve ring **52** will retract the valve ring **52** from its closest proximity to radial holes **54**, allowing additional fluid flow until another equilibrium is established. If for any reason the turbine should exceed the desired governed speed, the resilient valve ring **52** will move to restrict pressure fluid flow even further until sufficient overspeed will cause all flow to stop, thereby incorporating an overspeed safety.

[**0013**] A rotatable shaft **18** is attached at one end to the rotor **16** and at the other end to a collet **22**, which is used to hold a tool (not shown), such as a grinding-type tool. The shaft **18** is rotatably supported by bearings **20** which, in turn, are respectively secured to the front section **12** of the housing **13**.

[**0014**] As shown in **FIG. 2A**, to mount the rotary tool **10** to a CNC machine, or other machine having a chuck for mounting the tool, the tool **10** is secured to the machine by inserting the shank **30** into the chuck **40** of the machine (not shown) and securing it thereto. If the machine provides high pressure air through the chuck **40**, the bore **33** in the shank **30** (see **FIG. 1**) is left open and the high pressure air is supplied to the rotor **16** through the second fluid inlet **32** (see **FIG. 1**). When secured in the chuck **40**, the o-rings **31** (see **FIG. 1**) prevent the high pressure air from escaping around the outside of the shank **30**. The first fluid inlet **34** (see **FIG. 1**) is blocked by threading a plug **42** into the inlet adapter **36**. Alternatively, if an inlet adapter **36** is not used, the first fluid inlet **34** can be blocked by threading a plug **42** directly into the first fluid inlet **34**. As can best be seen in **FIG. 1**, when connected in this way, air from the high pressure air source enters the tool **10** through the shank **30**, passes through the bore **33** in the shank **30** to the second fluid inlet **32**, and from the second fluid inlet **32** to the rotor **16**, where the high pressure air drives the rotor **16**. The high pressure air that is expelled from the rotor **16** enters the motor chamber **15**, passes through the muffler **26**, and is expelled from the tool **10** through the holes **21** in the end cap **24**.

[**0015**] Alternatively, as shown in **FIG. 2B**, the second fluid inlet **32** (see **FIG. 1**) could be blocked by threading a plug **42** into the shank **30** and the hose **46** of a high pressure air source (not shown) could be connected to the inlet adapter **36** to provide high pressure air to the rotor **16** through the first fluid inlet **34** (see **FIG. 1**). Alternatively, if an inlet adapter **36** is not used, the hose **46** could be connected directly into the first fluid inlet **34**. As can best be seen in **FIG. 1**, when connected in this way, air from the high pressure air source enters the tool **10** through the inlet adapter **36**, passes through the bore **37** in the inlet adapter **36** to the first fluid inlet **34**, and from the first fluid inlet **34** to the rotor **16**, where the high pressure air drives the rotor **16**. The high pressure air that is expelled from the rotor **16** enters the housing **13**, passes through the muffler **26**, and is expelled from the tool **10** through the holes **21** in the end cap **24**.

[**0016**] As shown in **FIG. 3A**, to mount the rotary tool **10** to a machine having a fixture **44**, such as a robotic arm, the tool **10** is secured to the fixture **44** by clamping the housing **13** within the fixture **44**. Alternatively, depending on the machine and the desired usage, the tool **10** can also be secured to the fixture **44** by clamping the shank **30**, rather than the housing **13**, within the fixture **44**, as shown in phantom. The shank **30** is connected to the hose **46** of a high pressure air source (not shown) to provide high pressure air to the rotor **16** through the second fluid inlet **32** (see **FIG. 1**). The first fluid inlet **34** (see **FIG. 1**) is blocked by threading a plug **42** into the inlet adapter **36**. Alternatively, if an inlet adapter **36** is not used, the first fluid inlet **34** can be blocked by threading a plug **42** directly into the first fluid inlet **34**. As can best be seen in **FIG. 1**, when connected in this way, air from the hose **46** enters the tool **10** through the shank **30**, passes through the bore **33** in the shank **30** to the second fluid inlet **32**, and from the second fluid inlet **32** to the rotor **16**, where the high pressure air drives the rotor **16**. The high pressure air that is expelled from the rotor **16** enters the housing **13**, passes through the muffler **26**, and is expelled from the tool **10** through the holes **21** in the end cap **24**.

[**0017**] Alternatively, as shown in **FIG. 3B**, the inlet adapter **36** could be attached to the hose **46** of the high pressure air source (not shown) to provide high pressure air to the rotor **16** (see **FIG. 1**) through the first fluid inlet **34** (see **FIG. 1**). Alternatively, if an inlet adapter **36** is not used, the hose **46** could be attached directly to the first fluid inlet **34**. The second fluid inlet **32** (see **FIG. 1**) is then blocked by threading a plug **42** into the end of the shank **30**. As can best be seen in **FIG. 1**, when connected in this way, air from the high pressure air source enters the tool **10** through the inlet adapter **36**, passes through the bore **37** in the inlet adapter **36** to the first fluid inlet **34**, and from the first fluid inlet **34** to the rotor **16**, where the high pressure air drives the rotor **16**. The high pressure air that is expelled from the rotor **16** enters the housing **13**, passes through the muffler **26**, and is expelled from the tool **10** through the holes **21** in the end cap **24**.

[**0018**] As can be seen from the above description, the current invention allows a single rotary tool to be used with almost any machine, any mounting configuration, and any fluid inlet configuration desired, rather than having different tools for each.

[**0019**] The foregoing description of the preferred embodiment of the invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or to limit the invention to the precise form disclosed. The descriptions were selected to best explain the principles of the invention and their practical application to enable other skills in the art to best utilize the invention in various embodiments and various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention not be limited by the specification, but be defined by the claims set forth below.

What is claimed is:

1. A rotary device, comprising:

a housing having a first fluid inlet and a second fluid inlet;

a rotor rotatably mounted in the housing and in communication with the first and second fluid inlets.

2. A rotary device, as recited in claim 1, wherein the first fluid inlet has a longitudinal axis transverse to an axis of

rotation of the rotor and is adapted to receive a pressurized fluid and transmit the pressurized fluid to the rotor.

3. A rotary device, as recited in claim 2, wherein the first fluid inlet comprises a bore extending through a side of the housing.

4. A rotary device, as recited in claim 1, wherein the second fluid inlet has a longitudinal axis parallel to an axis of rotation of the rotor and is adapted to receive a pressurized fluid and transmit the pressurized fluid to the rotor.

5. A rotary device, as recited in claim 4, wherein the second fluid inlet comprises a bore extending through an end of the housing.

6. A rotary device, as recited in claim 1, further comprising a mount connected to an end of the housing for connecting the rotary device to a machine.

7. A rotary device, as recited in claim 6, wherein the mount is adapted to receive a pressurized fluid and transmit the pressurized fluid to the second fluid inlet.

8. A rotary device, as recited in claim 6, wherein the mount comprises a bore therethrough, the bore being in communication with the second fluid inlet.

9. A rotary device, as recited in claim 6, wherein the mount is integral with the housing.

10. A rotary device, as recited in claim 6, wherein the mount comprises a shank connected to and extending from the end of the housing.

11. A rotary device, as recited in claim 10, wherein the shank is adapted to receive a pressurized fluid and transmit the pressurized fluid to the second fluid inlet.

12. A rotary device, as recited in claim 10, wherein the shank comprises a bore therethrough, the bore being in communication with the second fluid inlet.

13. A rotary device, as recited in claim 10, wherein the shank is integral with the housing.

14. A rotary device, as recited in claim 1, further comprising an inlet adapter, removably connected to the housing and in communication with the first fluid inlet, for connecting the housing to a high pressure fluid source.

15. A rotary device, as recited in claim 14, further comprising a plug adapted to prevent the flow of fluid through the inlet adapter.

16. A rotary device, as recited in claim 1, further comprising a plug adapted to prevent the flow of fluid through the first or second fluid inlet.

17. A method for connecting a rotary tool to a fluid source, comprising the steps of:

providing a housing and a rotor mounted in the housing;

providing a first fluid inlet in the housing in communication with the rotor;

providing a second fluid inlet in the housing in communication with the rotor;

inserting a plug into the first fluid inlet; and

connecting the second fluid inlet to a high pressure fluid source.

18. A method for connecting a rotary tool to a fluid source, as recited in claim 17, further comprising the step of providing a mount connected to an end of the housing for connecting the housing to a machine.

19. A method for connecting a rotary tool to a fluid source, as recited in claim 17, further comprising the step of providing a shank connected to and extending from an end of the housing for connecting the housing to a machine.

20. A method for connecting a rotary tool to a fluid source, as recited in claim 19, further comprising the step of providing a bore through the shank adapted to receive a pressurized fluid and transmit the pressurized fluid to the first or second fluid inlet.

21. A method for connecting a rotary tool to a fluid source, as recited in claim 17, further comprising the step of providing an inlet adapter for connection to the first or second fluid inlet for connecting the fluid inlet to a high pressure fluid source.

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