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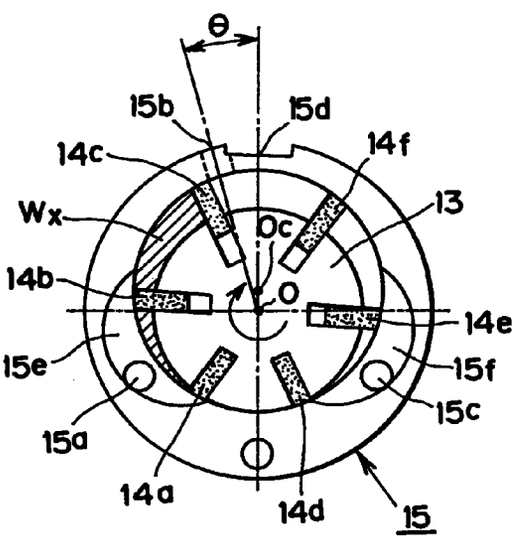
(54) Impact wrench

(57) An impact wrench includes a motor portion, a clutch hammer portion, and an anvil portion. The motor portion includes a rotor (13) which is supported within a cylinder (15) for rotation in forward and reverse directions, and a plurality of rotor blades (14a - 14f) which are radially arrayed so as to be movable in the radial direction. The clutch hammer portion is coupled with a drive shaft of the rotor. The anvil portion which receives a hitting force from the clutch hammer portion so as to rotate. The cylinder (15) is provided with an air inlet hole (15a) for forward rotation and another air inlet hole (15c) for reverse rotation. The air inlet holes (15a, 15c) penetrate the cylinder in the axial direction and are symmetrically arranged on both sides with respect to the center axis of the cylinder (15). The cylinder (15) is also provided with an air outlet hole (15b) which is formed at a location shifted from the top by an angle θ in a direction toward the air inlet hole (15a) for forward rotation. This structure makes it possible to loosen a threaded member easily through application of a loosening torque that is larger than tightening torque.

FIG.3



EP 0 832 721 A1

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to an impact wrench, and more particularly to an impact wrench that provides a larger torque when loosening a threaded member such as a bolt than it provides when tightening the threaded member.

2. Description of the Related Art:

Impact wrenches are air driven tools for tightening and loosening threaded members such as bolts and nuts. In a conventional impact wrench, the motor portion and clutch-hammer portion are designed such that tightening torque and loosening torque are equal to each other.

Such an impact wrench suffers no problems when used to tighten a threaded member. However, when the wrench is used to loosen the threaded member that has been tightened with the same wrench, loosening takes much time and is inefficient because the tightening torque and loosening torque are approximately equal.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an impact wrench which can loosen a threaded member easily through application of a loosening torque that is larger than the tightening torque.

To achieve the above object, the present invention provides an impact wrench which includes a motor portion, a clutch hammer portion, and an anvil portion. The motor portion includes a rotor which is supported within a cylinder for rotation in forward and reverse directions, and a plurality of rotor blades which are radially arrayed so as to be movable in the radial direction. The clutch hammer portion is coupled with a drive shaft of the rotor. The anvil portion which receives a hitting force from the clutch hammer portion so as to rotate. The cylinder is provided with an air inlet hole for forward rotation and another air inlet hole for reverse rotation. These air inlet holes penetrate the cylinder in the axial direction and are symmetrically arranged on both sides with respect to the center axis of the cylinder. The cylinder is also provided with an air outlet hole which is formed at a location shifted from the top by an angle θ in a direction toward the air inlet hole for forward rotation. The angle θ is preferably in the range of 10° to 20°.

According to the impact wrench of the present invention, the loosening torque can become larger than the screw tightening torque through a mere shift in the location of the air outlet hole formed in the cylinder. Thus, an improved impact wrench which can easily loosen a tightened threaded member is provided by a minimum design change.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an impact wrench according to the present invention;
FIG. 2 is an exploded perspective view of the motor portion of the impact wrench shown in FIG. 1;
FIG. 3 is an explanatory view showing action of the motor portion during forward rotation; and
FIG. 4 is an explanatory view showing action of the motor portion during reverse rotation.

DESCRIPTION OF PREFERRED EMBODIMENT

An embodiment of the present invention will now be described with reference to the drawings. As shown in FIG. 1, compressed air is introduced into an impact wrench 1 through an air inlet 2a of a hose adapter 2 which is screwed into the bottom end of a handle portion 18. A trigger 3 is rotatably attached to the upper part of the handle portion 18. When the trigger 3 is rotated counterclockwise (the direction indicated by the arrow in the figure) about an axis 3a, the trigger 3 pushes down a trigger pin 19, which in turn pushes down a valve stem 4 which is continuously urged upward by a spring 17 and is in contact with a shoulder portion 18a. Through these actions, the valve stem 4 breaks contact with the shoulder portion 18a, such that compressed air is introduced into an air passage 18b. A cylindrical portion 5a of an air regulator 5, which is provided at the bottom of the handle portion 18, has a plurality of adjustment holes 5b of different diameters. Air pressure is adjusted through rotation of a knob 5c. Compressed air is introduced through the adjustment holes 5b into an air passage 18c.

A reverse valve 6 is supported in a bushing 21, and is slidable in the forward and reverse directions. The bushing 21 is inserted in the lower portion of a motor housing 20. In the bushing 21 is formed an air hole 21a which communicates with the air passage 18c formed in the handle portion 18. The reverse valve 6 has two smaller diameter portions 6a and 6b in its central region. When the reverse valve 6 is moved to the forward position, the smaller diameter portion 6a moves to the location of the hole 21a in the bushing 21, the compressed air flows, through a passage formed by the smaller diameter portion 6a, into an air passage (not shown) in the motor housing 20, so that the impact wrench is driven in the tightening direction (forward direction). When the reverse valve 6 is moved to the rear position, the other smaller diameter portion 6b moves to the location of the hole 21a in the bushing 21, the compressed air flows, through a passage formed by the smaller diameter portion 6b, into another air passage (not shown) in the motor housing 20, so that the impact wrench is driven in the loosening direction (reverse direction). The compressed air is introduced

through one of two passages 7a, which are symmetrically formed within an end cap 7, into the motor portion 8; and is then exhausted through outlet holes 15b which will be described later. Finally, the compressed air is exhausted out to the atmosphere through a deflector air outlet 9. The revolving torque generated in a motor portion 8 is transmitted to a clutch hammer portion 10, then an anvil portion 11 struck by the hammering mechanism of the clutch hammer portion 10 drives a main shaft 11a to rotate.

FIG. 2 is an exploded perspective view of the motor portion 8. The motor portion 8 is contained in the motor housing 20 and comprises a rear plate 12, a rotor 13, rotor blades 14a - 14f, a cylinder 15, and a front plate 16.

The rotor 13 is provided with a drive shaft 13a and radial grooves 13b which extend in the longitudinal direction of the cylinder 15. A plurality of (e.g. six) rotor blades 14a - 14f are inserted in the grooves 13b so as to be reciprocable in the radial direction of the rotor 13.

The front and rear ends of the cylinder 15 are covered by a front plate 16 and a rear plate 12, respectively. A bearing 12b is fixed to the rear plate 12, while another bearing (not shown) is fixed to the front plate 16. Those bearings rotatably support the drive shaft 13a of the rotor 13.

Spline teeth 13c are formed on the drive shaft 13a near its end, which faces the clutch hammer portion 10, so that the drive shaft 13a is coupled with a boss portion (not shown) of the clutch hammer portion 10 through fitting.

FIG. 3 shows action of the motor portion; specifically, action of the rotor 13, the rotor blades 14a - 14f and the cylinder 15 during forward rotation. When the reverse valve 6 is moved to the forward rotation position, compressed air is introduced into the motor portion 8 through a hole 12a formed at the left side of the rear plate 12. The compressed air is introduced into the interior of the cylinder 15 through a forward rotation air inlet hole 15a bored in a crescent-shaped depression 15e formed in the cylinder 15. The rotor 13 is driven forward around the center O indicated by the arrow in FIG. 3. The center O of the rotor 13 is eccentric with respect to the center Oc of the cylinder 15. The compressed air within the active area Wx (hatched area in the FIG. 3) related to the three rotor blades 14a - 14c that are exposed to the compressed air produces as a rotation driving force. The compressed air is exhausted through the outlet holes 15b which are formed in the cylinder 15 at locations shifted from the top 15d of the cylinder 15 by an angle θ. The outlet holes 15b are preferably arrayed in the axial direction of the cylinder 15, as shown in FIG. 2.

FIG. 4 shows action of the motor portion during reverse rotation. When the reverse valve 6 is moved to the rear position, compressed air is introduced into the motor portion 8 through the hole 12a formed at the right side of the rear plate 12. The compressed air is introduced into the cylinder 15 through a reverse rotation air inlet hole 15c bored in a crescent-shaped depression 15f formed in the cylinder 15. The position of the reverse rotation air inlet hole 15c is symmetrical with that of the forward rotation air inlet hole 15a. The rotor 13 is driven reverse around the center O as indicated by the allow in FIG. 4. The compressed air within the active area Wy (hatched area in FIG. 4) related to the two rotor blades 14d and 14e that are exposed to the compressed air produces a rotation driving force. The compressed air is exhausted through the outlet holes 15b.

As described above, according to the present invention, the outlet holes are formed in the cylinder at a location offset from the top of the cylinder by an angle θ in the direction toward the forward rotation air inlet hole. Therefore, the active area Wy for loosening (reverse) rotation is larger than the active area Wx for tightening (forward) rotation, so that the loosening (reverse) torque is larger than the tightening (forward) torque. The angle θ is preferably between 10° and 20°. If the angle θ is smaller than 10°, the active area Wy for reverse rotation may not be sufficiently larger than the active area Wx for forward rotation, and the tightened screw may not be easily loosened with the impact wrench. If the angle θ is larger than 20°, the active area Wx for tightening (forward) rotation may be too small and proper tightening torque may not be obtained.

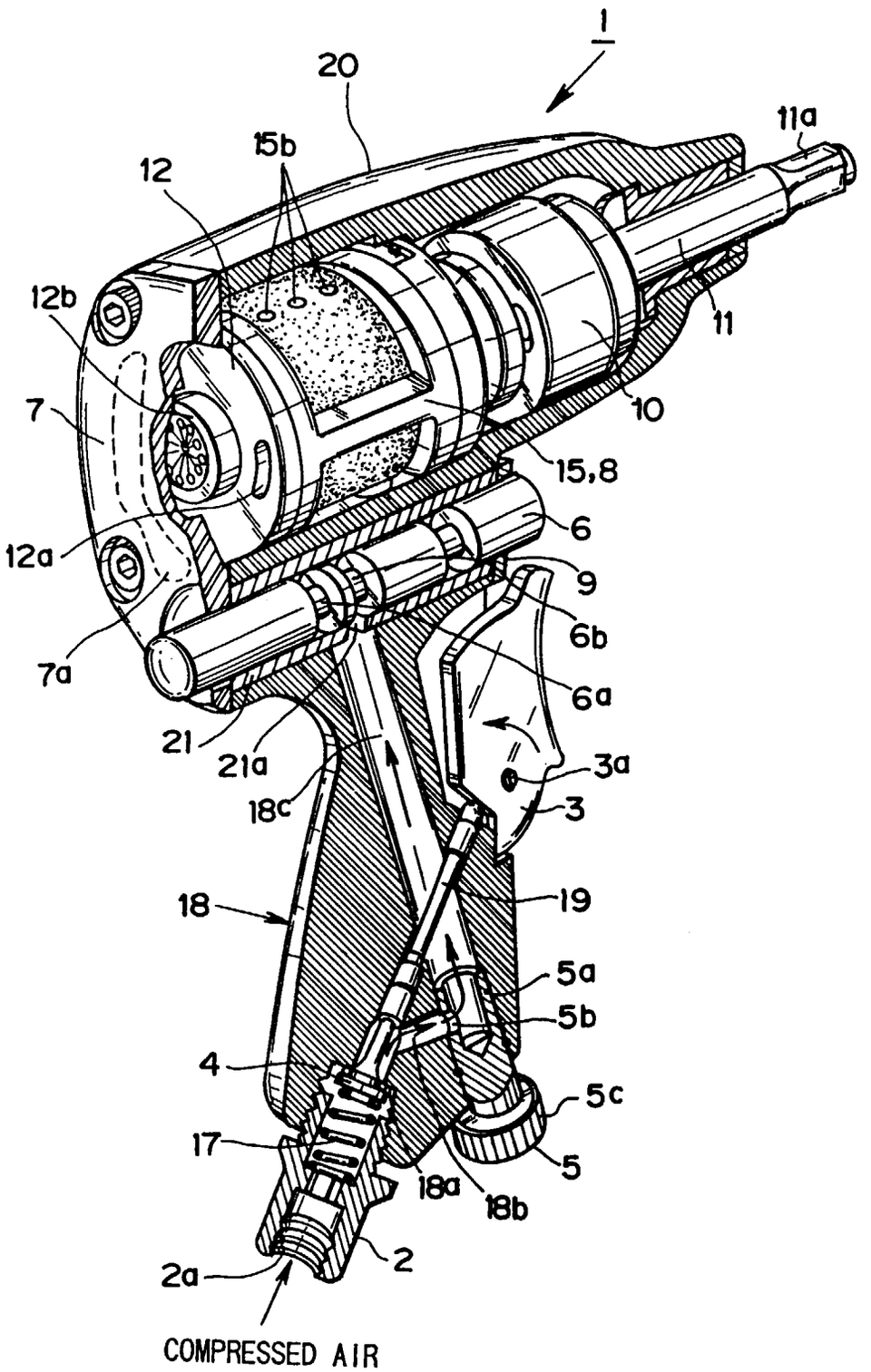
Claims

1. An impact wrench comprising:

a motor portion including a rotor which is supported within a cylinder for rotation in forward and reverse directions, and a plurality of rotor blades which are radially arrayed so as to be movable in the radial direction;
a clutch hammer portion coupled with a drive shaft of the rotor; and
an anvil portion which receives a hitting force from said clutch hammer portion so as to rotate,
characterized in that said cylinder is provided with an air inlet hole for forward rotation and another air inlet hole for reverse rotation, said air inlet holes penetrating said cylinder in the axial direction and being symmetrically arranged on both sides with respect to the center axis of said cylinder, and
said cylinder is provided with an air outlet hole which is formed at a location shifted from the top by an angle θ in a direction toward said air inlet hole for forward rotation.

2. An impact wrench according to Claim 1, characterized in that said angle θ is in the range of 10° to 20°.

FIG.1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20
11a
15b
12
12b
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9
6b
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6a
21
21a
3a
18c
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4
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17
5
18a
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2
2a
COMPRESSED AIR

FIG.2

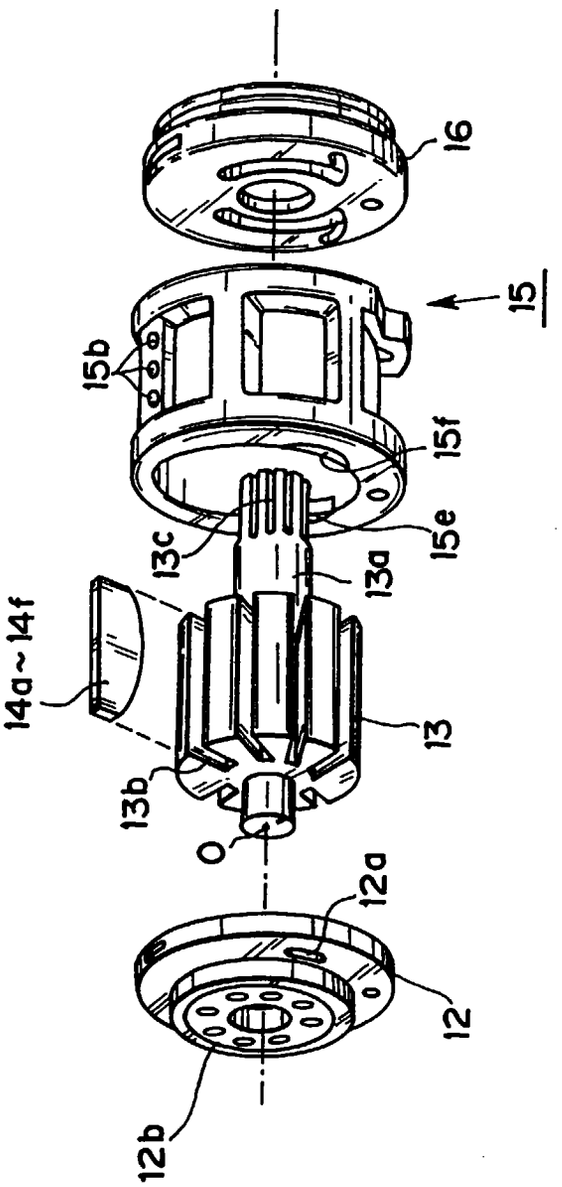

FIG.3

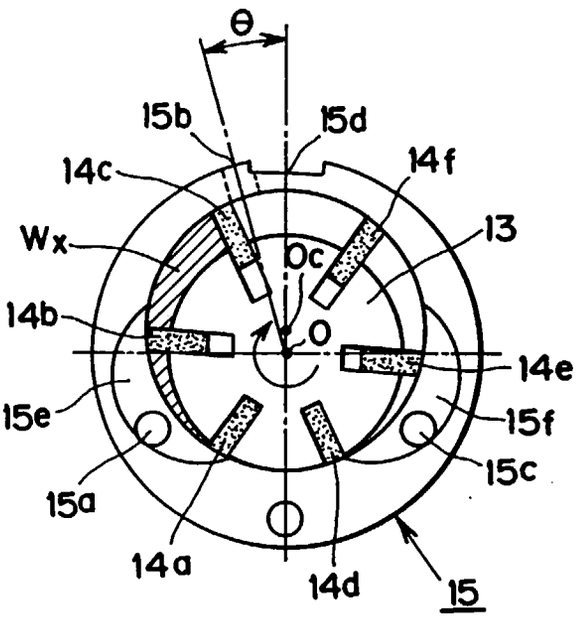
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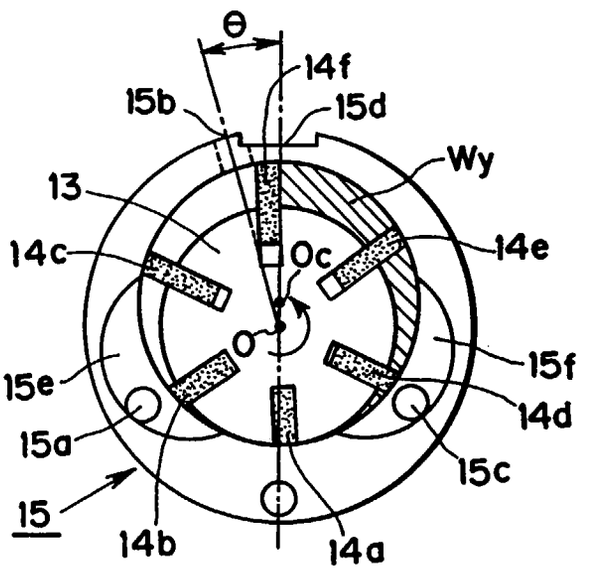
FIG.4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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 97 10 2332

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y A	EP 0 581 431 A (INGERSOLL-RAND COMPANY) * figure 9 *	1 2	B25B21/02 F01C21/16 F01C13/02
Y	US 3 951 217 A (WALLACE ET AL) * column 4, line 3 - line 16 *	1	
Y	US 4 740 144 A (BIEK) * column 1, line 35 - line 38 *	1	
A	US 4 418 764 A (MIZOBE) * figure 7 *	1	
A	DE 14 78 904 A (GARDNER-DENVER COMPANY) * figure 7 *	1	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B25B
F01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 March 1997	Carmichael, Guy

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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