# United States Patent

**Sakamoto**

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[45] **May 30, 1972**


## [54] ROTATIONAL IMPACT TOOL


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[30] **Foreign Application Priority Data**

July 30, 1969 Japan.....44/60168

[52] **U.S. Cl.**.....**173/93.5**

[51] **Int. Cl.**.....**B25d 15/00**

[58] **Field of Search**.....173/93, 93.5, 93.6



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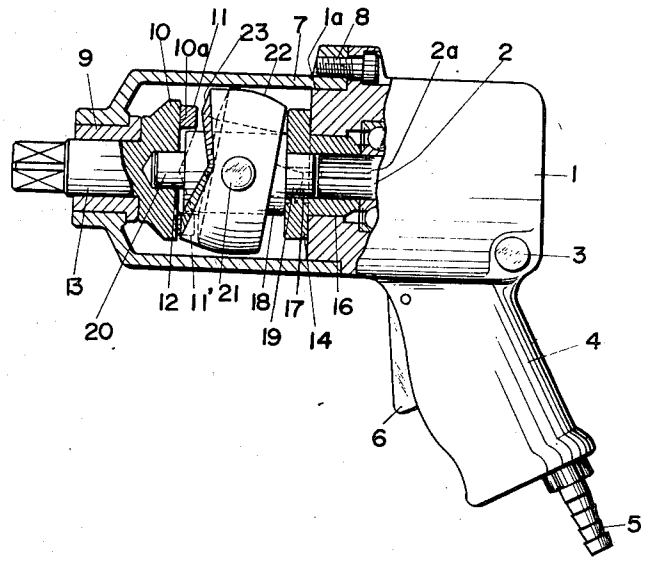
[57] **ABSTRACT**

A rotational impact tool having two oppositely facing hammers on a rotatable hammer body and two oppositely facing anvils on an output shaft, a motor for rotating the hammer body selectively in either direction through a driving connection which ensures tilting of the hammer body so that the advancing hammer is held back, and a camming arrangement which tilts the hammer body against the action of the driving connection to allow the advancing hammer to hit the corresponding anvil, thus producing a rotational impact on the output shaft.


**7 Claims, 5 Drawing Figures**



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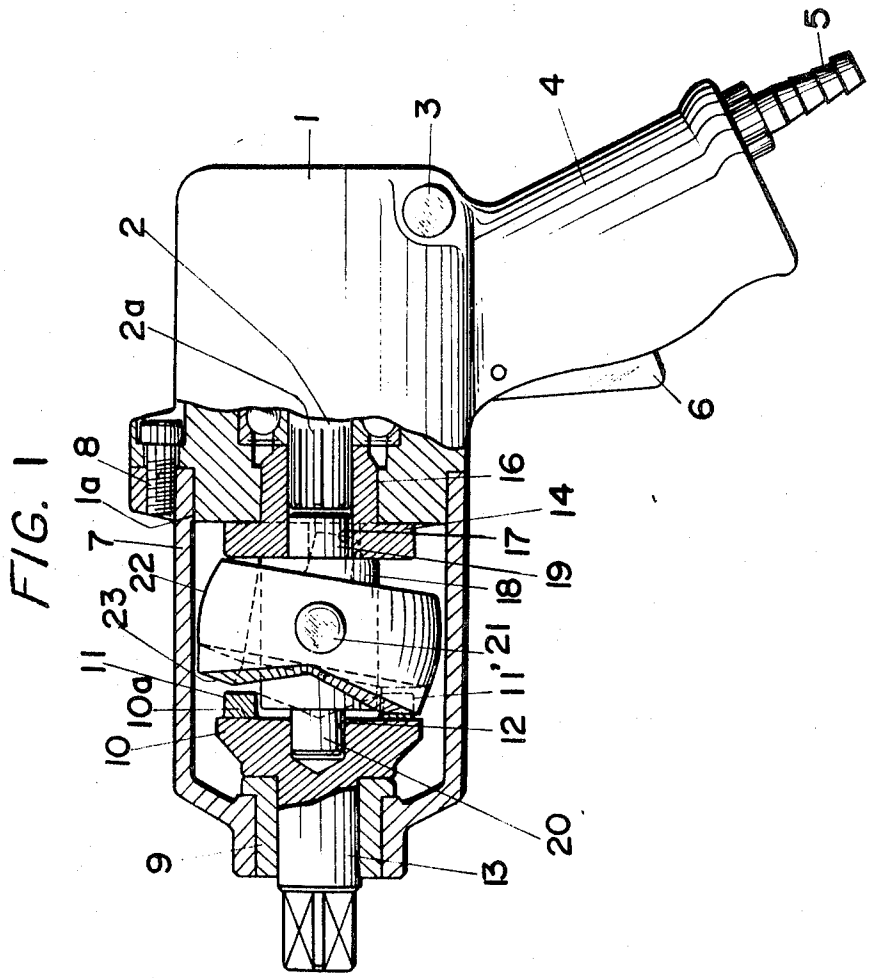


FIG. 1

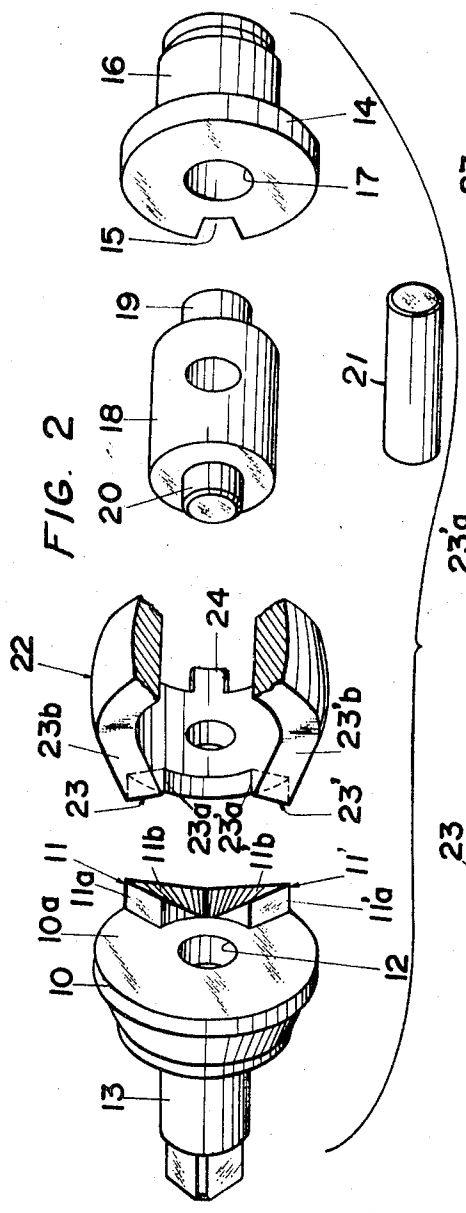


FIG. 2

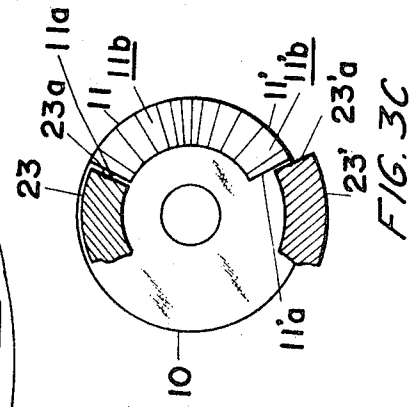


FIG. 3C

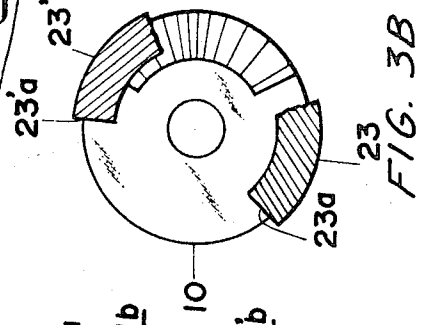


FIG. 3B

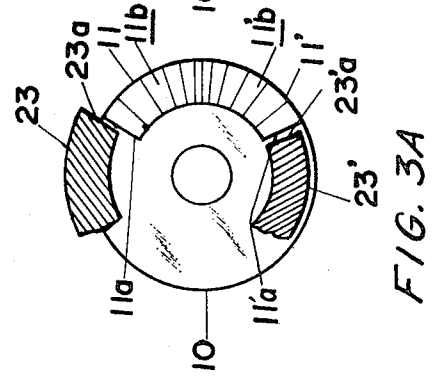


FIG. 3A

# ROTATIONAL IMPACT TOOL

## FIELD OF THE INVENTION

This invention relates to a rotational impact tool, and a preferred embodiment thereof is a tool for driving and loosening a screw by means of impact forces.

## BACKGROUND OF THE INVENTION

Screw drivers of such a kind usually comprise a tip to be engaged with a screw head, a driver shaft, anvils and hammers. A rotating hammer continuously hits one anvil fixed to the inner end of the screw driver shaft to provide rotational impact forces, thereby enabling a screw to be turned either clockwise or counterclockwise, depending on the direction of rotation. Automatic screw drivers of this kind desirably would have the following features:

a. rotation of hammer in both directions
b. high impact force from rotating hammer
c. high impact efficiency
d. conveniently small weight

An object of this invention is to provide an improved rotational impact tool.

## SUMMARY OF THE INVENTION

From a broad aspect, this invention provides a rotational impact tool comprising a motor, a hammer body rotatable by said motor, through a driving connection, about a first axis and tiltable about a second axis transverse to the first axis, a hammer face on said hammer body facing in one angular direction about said first axis, an output member rotatable about said first axis and provided with an anvil face facing in the opposite angular direction to said hammer face, the driving connection between the motor and the hammer body being adapted to cause tilting of the hammer body about the second axis so as to hold the hammer face clear of the anvil face upon rotation of the hammer body in said one angular direction, and a cam surface on said output member arranged to tilt the rotating hammer body about the second axis so as to bring the hammer face axially to a position where it will hit the anvil face, against the action of said driving connection and for a sufficient period for such hitting to occur, thereby delivering rotational impacts to the output member.

Preferably, in a rotational impact tool according to this invention and having the desirable feature of operation in both directions, the hammer body has two hammer faces facing in opposite angular directions about said first axis, the output member has two anvil faces each facing in the opposite angular direction relative to a corresponding hammer face, the hammer body is drivable selectively in both angular directions by the motor, the connection between the motor and the hammer body is adapted to cause tilting of the hammer body about the second axis so as to hold, upon rotation of the hammer body in a selected direction, the hammer face facing in said selected direction clear of the corresponding anvil face, and cam surfaces on said output member are arranged to tilt the hammer body about the second axis so as to bring the hammer face facing in said selected angular direction axially to a position where it will hit the corresponding anvil face, against the action of said driving connection and for a sufficient period for such hitting to occur, thereby delivering rotational impacts, selectively in either rotational direction, to the output member.

## BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment will now be described, by way of example, with reference to the accompanying drawings, in which

FIG. 1 is a longitudinal cross-sectional view of a preferred rotational impact tool according to the present invention,

FIG. 2 is an exploded perspective view of internal parts of the tool shown in FIG. 1, and

FIGS. 3A, B and C are explanatory diagrams of the angular positions of hammers and anvils during operation of the tool.



## DESCRIPTION OF PREFERRED EMBODIMENT

The preferred embodiment of this invention will be described hereinbelow with reference to the accompanying drawings. Referring now to FIG. 1 of the drawings, 1 denotes a body enclosing therein a pneumatic motor (not shown in the drawings) operable selectively in both angular directions and having an output shaft provided at the end thereof with a splined coupling 2*a*. 3 is a control for a valve controlling the direction of rotation, 4 is the hand grip, 5 the air supply connector adaptor, 6 the operation lever of an on/off and/or speed control valve (not shown) enclosed in said grip 4, and 7*a* the cover fixed to the front outer circumference 1*a* of said body 1 by means of a screw 8.

A bearing 9 mounted in the front cover 7 carries a rotatable screw driver output shaft 13 provided with an axial bore 12 (see FIG. 2) and provided with two projecting anvils 11 and 11′ on the face 10*a* of the radially extended portion 10 thereof. A driving member 16 is mounted on the spline coupling 2*a* of the motor shaft 2 and has a recess 15 eccentrically thereof. An intermediate shaft 18 is journalled at both ends 19 and 20 in bores 17 and 12 in said driving member 16 and said output shaft 13, respectively, on shaft 18 hammer body 22 is mounted by means of a bearing pin 21 (see FIG. 2) inserted through said shaft, the pin serving as a pivot axis about which the hammer body 22 can tilt. Said hammer body 22 is provided at the front end thereof with two hammers 23 and 23′ with respective hammer surfaces 23*a* and 23′*a* for hitting against the anvils 11 and 11′ of said output shaft 13 and at the rear end thereof with projections 24 engaging with the recess 15 in said driving member 16.

The anvil surfaces (i.e. those which are to be hit) 11*a* and 11*a*′ of the anvils are spaced apart by a relatively smaller angle (taken at the center of said shaft 13) than are the hammer surfaces 23*a* and 23*a*′ of the hammer body (taken at the shaft center of the hammer body 22) as shown in FIG. 3 A. The anvils 11 and 11′ have inclined back cam surfaces 11*b* and 11*b*′ respectively, whereas the hammers 23 and 23′ have inclined back surfaces 23*b* and 23*b*′ respectively.

When the pneumatic motor rotates clockwise (as seen in FIG. 3) to drive a right-handed screw, with the selective switch valve operated appropriately by means of the control 3, the hammer face 23*a* of one hammer 23 of the hammer body 22 will hit the corresponding anvil face 11*a* which is opposed to it (as regards angular directions) producing a rotational impact on the output shaft 13, as will now be explained.

The motor rotates the rotor shaft 2 and the driving cam or element 16 and thus the hammer body 22 and the intermediate shaft 18 are rotated together because of the engagement between the recess 15 on the flange 14 of said element 16 and the projection 24 at the back end of the hammer body 22. This engagement also causes tilting of the hammer body 22 as it rotates (see FIG. 1), so as to hold the hammer 23 and its face 23*a* axially clear of the anvils and particularly of the anvil 11 which it is intended to hit. On the contrary, the other hammer 23′ is, by this tilting, positioned so as to contact the back wall 10 of the output shaft 13 as the hammers rotate. This condition is shown in FIG. 3 A, where the eccentricity of hammers 23, 23′ as shown is due to the tilting.

As the hammer body 22 rotates clockwise from the FIG. 3 A position the hammer 23 passes over both anvils 11 and 11′ to the FIG. 3 B position by which time the inclined back 23′*b* of hammer 23′ is riding over and in contact with the anvil 11, so that the hammer body 22 becomes tilted back by means of the cam action of said anvil 11 against the opposite tilting action of the driving element 16 and the hammer body 22 becomes inclined in the reversed direction (to that of FIG. 1) when in the angular position of rotation shown in FIG. 3 B.

Next the inclined back surface 23*b*′ of the hammer 23′ rises over the inclined back surface 11*b*′ of the other anvil 11′ bringing the hammer surface 23*a* of the hammer 23 axially to a position where it will hit the anvil surface 11*a* of the other anvil 11, and this hitting occurs (see FIG. 3 C) just before the other hammer 23′ drops off the back surface of anvil 11′,

when the hammer body **22** is inclined in the contrary direction to that shown in FIG. **3** A. Accordingly, at the moment when the hammer **23'** drops off the back surface of said anvil **11'**, the hammer **23** hits the face **11***a* of anvil **11** producing a rotational impact force on output shaft **13** by virtue of the weight of the hammer body **22**. FIG. **3** C shows the moment of the above impact. After said impact the hammer body **22** is again tilted by means of the driving element **16** back to the original position shown in FIG. **3** A and in FIG. **1**.

In order to loosen a right-handed screw, the motor is driven counterclockwise, and the driving element **16** and the hammer body **22** will then be driven counterclockwise also, with the hammer **23'** now being normally held away from the anvils but brought forward to strike anvil **11'** at each revolution by the cam action of anvil **11** acting on the back surface of hammer **23**, thus producing counterclockwise rotational impacts on the output shaft **13**.

As is seen from the foregoing, the tool described comprises an intermediate shaft journalled between the driving element connected to the motor shaft and the screw drive output shaft, a hammer body capable of tilting about an axis transverse to its rotational axis, a driving member normally holding the advancing hammer face of the hammer body where it would not strike the corresponding anvil on the screw driver output shaft, whereas the other hammer is inclined in the specified direction taking the specified angle with the size of the hammers and the anvils taken into consideration to hit the anvil resisting against the action of the driving cam. One hammer rises over both the anvils and thus the advancing hammer face hits the corresponding anvil producing the impact force at the moment when the other hammer drops off the back surface of the other anvil.

In the tool described, the hammer body provides high impact efficiency with one impact per one rotation, repeatedly giving an impact at the maximum rotational torque because there is time to restore rotational momentum after each rotation. The rotational impact tool which has been described is of a simple construction, and enables a screw to be turned either clockwise or counterclockwise by means of the high impact force obtained. It provides all the desirable features (a) to (d) noted earlier herein.

I claim:

**1**. A rotational impact tool comprising:

a motor;

a hammer body reversibly rotatable by said motor about a first axis and tiltable about a second axis transverse to the first axis, said hammer body having two hammer faces thereon, said hammer faces facing in opposite angular directions with respect to said first axis;

an output member rotatable about said first axis, said output member having two anvil faces facing in opposite angular directions relative to a corresponding hammer face;

a driving connection between said motor and said hammer body for rotating said hammer body about said first axis, said driving connection tilting said hammer body about said second axis upon rotation of said hammer body in a selected angular direction by said motor, holding said hammer face facing in said selected direction clear of the corresponding anvil face; and

cam surfaces on said output member engaging said hammer body to tilt said hammer body about said second axis and bringing the hammer face facing in said selected angular direction axially to a position where it will hit the corresponding anvil face, against the action of said driving connection and for a sufficient period for such hitting to occur, thereby delivering rotational impacts, selectively in either rotational direction to said output member.

**2**. A rotational impact tool according to claim **1** wherein said hammer face facing in said selected angular direction hits the corresponding anvil face just when the other hammer becomes disengaged from said cam sufaces.

**3**. A rotational impact tool as claimed in claim **1**, in which said driving connection comprises a rotatable driving member co-axial with said hammer body and connecting the motor to the hammer body.

**4**. A rotational impact tool as claimed in claim **3**, comprising a coupling between said hammer body and said driving member, said coupling being eccentric to the first axis to tilt said hammer body about said first axis when said driving member is driven.

**5**. A rotational impact tool according to claim **4**, wherein said coupling comprises a projection on said hammer body, and a recess in said driving member, said projection engaging in said recess in the driving member.

**6**. A rotational impact tool according to claim **3**, comprising a shaft having two ends, said shaft being journalled at one end in said rotatable driving member and at the other end in said output member, said hammer body being tiltably mounted on said shaft.

**7**. A rotational impact tool according to claim **2**, wherein each anvil comprising a respective one of said cam surfaces and a respective one of said anvil faces.

* * * * *

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# UNITED STATES PATENT OFFICE
# CERTIFICATE OF CORRECTION

Patent No. 3,666,023 Dated May 30, 1972

Inventor(s) Yasuhisa SAKAMOTO

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

In the heading, please add the following Assignment data:

--[73] Assignee: NITTO KOHKI COMPANY LIMITED,

Signed and sealed this 10th day of April 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents