United States Patent

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[72] Inventor **Otmar M. Ulbing**
Lisle, N.Y.

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[73] Assignee **Ingersoll-Rand Company**
New York, N.Y.
a corporation of New Jersey

[54] **ROTARY IMPACT WRENCH MECHANISM**
11 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **173/93.5**
[51] **Int. Cl.** **B25b 21/02**
[50] **Field of Search** 173/93.5

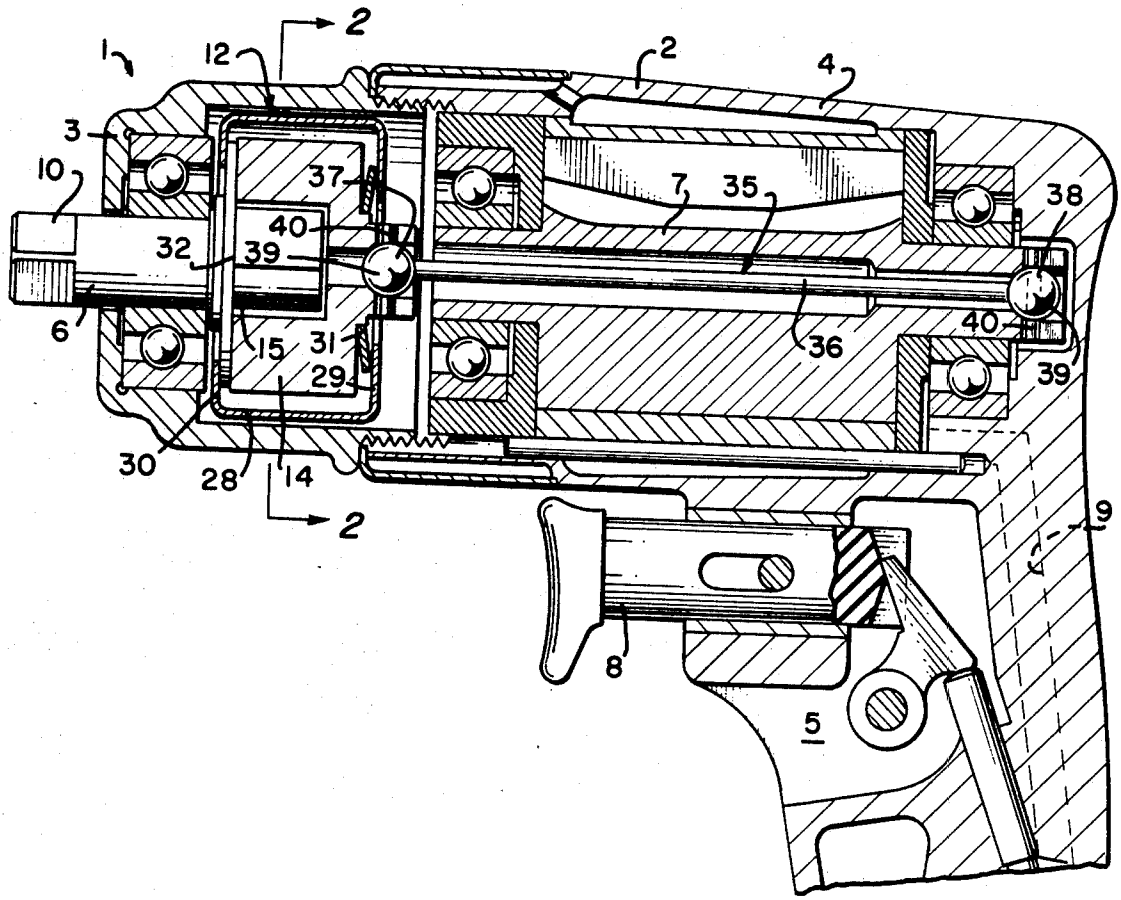
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Primary Examiner—Ernest R. Purser
Attorneys—Carl R. Horten and David W. Tibbott

ABSTRACT: A rotary impact wrench mechanism including a hammer rotating around an anvil with both having cooperating cam surfaces for periodically engaging shoulders on the hammer and anvil to cause impacts. The hammer is connected to the wrench motor by a joint that allows the hammer to move transversely following impact to cause the hammer to automatically disengage itself from the anvil and to start further rotary movement.



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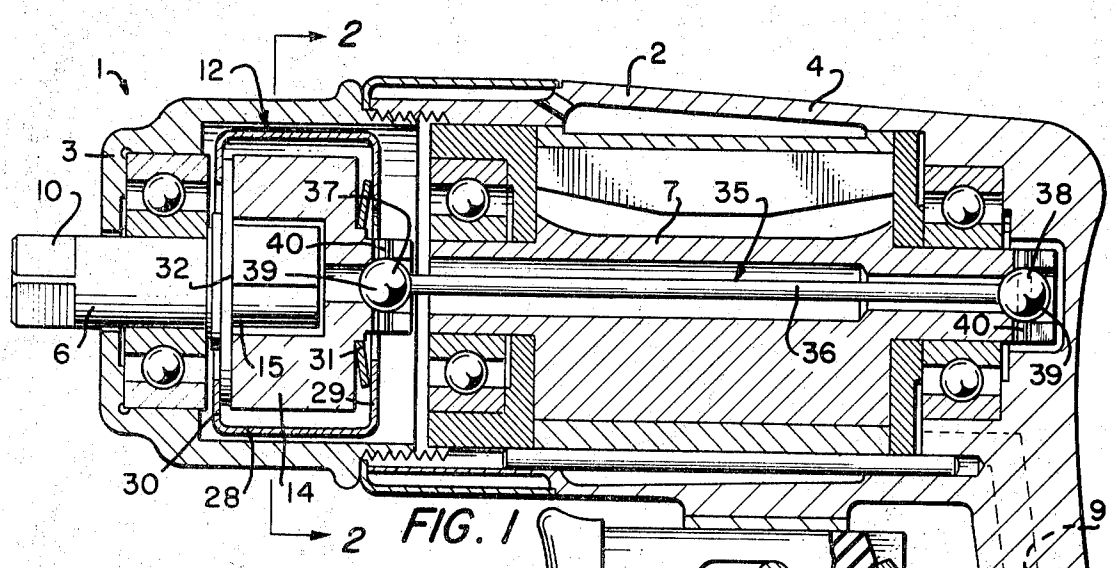


FIG. 1

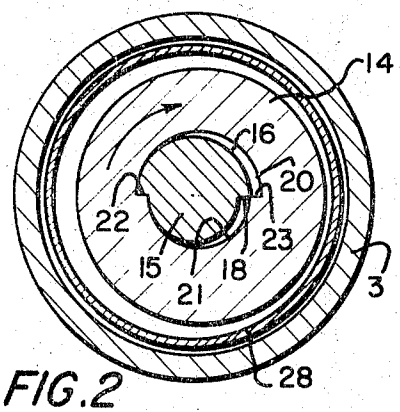


FIG. 2

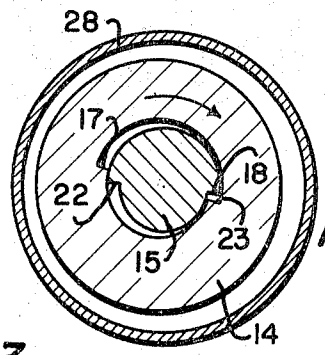


FIG. 4

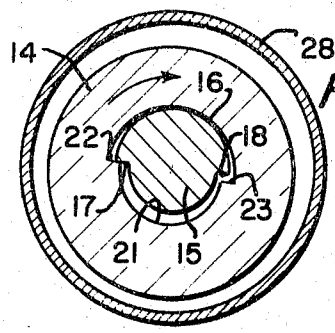


FIG. 3

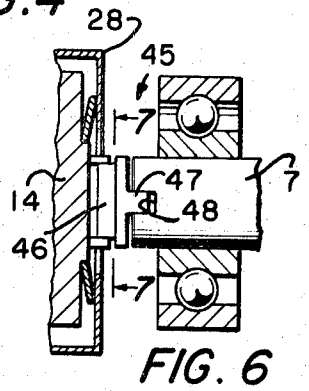


FIG. 6

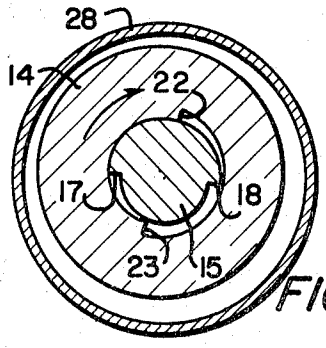


FIG. 5

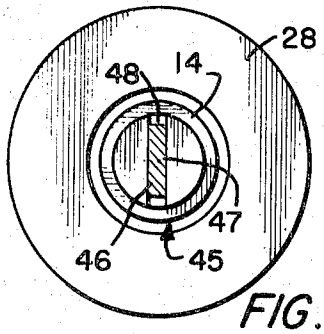


FIG. 7

INVENTOR
OTMAR M. ULBING

BY

David W. Tibbott

ATTORNEY

ROTARY IMPACT WRENCH MECHANISM

BACKGROUND OF INVENTION

This invention relates to a power-operated rotary impact wrench for applying rotary or angular impacts to fasteners such as threaded nuts, bolts, etc. In particular, this invention relates to a rotary impact wrench mechanism for changing the rotating torque of a rotary motor, such as an air-driven motor, to a series of rapid rotary impacts which can be applied to a threaded nut for either driving it tight or for removing it.

Most rotary impact mechanisms in use today contain an anvil adapted to be connected to a wrench socket and a hammer rotated by a motor. The hammer is alternately engaged and disengaged from the anvil, being engaged to impact the anvil, thereafter being disengaged from the anvil to gather rotary speed again, prior to striking another impact to the anvil. Various means are used for accomplishing this alternate engagement and disengagement between the anvil and hammer.

One well known rotary impact wrench mechanism used to day is known as the "swinging weight" mechanism and is disclosed in the U.S. Pat. No. 2,285,638 to Amtsberg. This mechanism uses a pair of diametrically opposed tilting hammer dogs which rotate around a lobed anvil and are cammed into an impact position with the lobes or jaws on the anvil by engagement with the anvil. The hammer dogs are released by the cams on the anvil immediately before impact and means is provided for applying a drive torque to the dogs to cause them to rotate to a disengaging position following an impact.

Conventional "swinging weight" mechanisms require a separate cam system utilizing motor torque to declutch the impact jaws following impact. This requirement complicates these mechanisms and increases their manufacturing costs. The prior art has attempted to eliminate the cam system for declutching by using springs but springs wear out quickly and are limited to low speeds for satisfactory operation, thereby making it necessary to reduce the speed of the tool motor by using gearing.

Another disadvantage of the conventional "swinging weight" mechanism is that it often rebounds after impact and strikes a blow on its reverse stroke, which is very undesirable because not only is it inefficient, but it is acting in the reverse direction.

SUMMARY OF INVENTION

The principal object of this invention is to provide a rotary impact wrench mechanism which eliminates the need for a separate cam system or springs for declutching the impact jaws following impact.

Other important objects are: to provide an extremely simple rotary impact wrench mechanism which comprises very few elements thereby rendering it relatively economical to manufacture and increasing its reliability; to provide a simple impact mechanism which has a substantially reduced amount of rebound following impact; to provide a rotary impact wrench mechanism which eliminates the impacting of blows in the reverse direction on rebound; and to provide a rotary impact wrench mechanism which does not contain a separate cam system or springs for declutching and which can be rotated at conventional motor speeds.

In general, the foregoing objects are attained in a rotary impact mechanism including a driving member driving a hammer element, a driven member driven by an anvil element, cam means to relatively position the hammer and anvil impact surfaces or shoulders to cause said surfaces or shoulders to periodically engage and means interconnecting one of the hammer and anvil elements to its member by a yieldable joint allowing the one element to move transversely relative to the other element to cause the two impact shoulders to automatically disengage following each impact.

BRIEF DESCRIPTION OF DRAWINGS

The invention is described in connection with the accompanying drawings wherein:

FIG. 1 is an axial section of an impact wrench containing an impact mechanism embodiment of this invention;

FIGS. 2 to 5 are sequential sections taken on the line 2–2 in FIG. 1 and showing the impact mechanism in various positions at and following the striking of an impact blow;

FIG. 6 is a fragmentary axial section showing a second embodiment; and

FIG. 7 is a section taken on line 7–7 in FIG. 6.

DESCRIPTION OF PREFERRED EMBODIMENT

The rotary impact wrench 1 shown in FIG. 1 conventionally includes a casing 2 including a nose portion 3, a motor portion 4 and a handle portion 5. The nose portion 3 carries a spindle 6 projecting from its front end, the motor portion 4 houses an air motor having a drive shaft 7 and the handle portion 5 carries an operating trigger 8 and an inlet passage 9 for feeding air to the motor. The spindle 6 carries flats 10 adapting it to be attached to a conventional wrench socket (not shown). All of the foregoing structure is conventional in the rotary impact wrench art.

The motor shaft 7 is connected to the wrench spindle by a novel rotary impact clutch 12 which is the subject of this invention. In general, the clutch 12 includes a hammer 14 rotating around an anvil 15. The hammer 14 is driven by the motor shaft 7 and the anvil 15 is integrally fixed to the spindle 6.

The anvil 15 includes a semicircular enlargement or cam lobe 16 forming a pair of diametrically located and extending anvil impact surfaces or shoulders 17 and 18. The hammer has a bore 20 that has a cross section similar to that of the anvil 15, except that it is somewhat larger. The bore 20 includes an internal cam lobe 21 of reduced radius which is joined to the remainder of the bore 20 by a pair of diametrically located and radially extending hammer impact surfaces or shoulders 22 and 23. The bore 20 and internal cam lobe 21 are sized sufficiently larger than the anvil 15 so that when one set of anvil and hammer impact shoulders 17 and 22 approach each other, the other set of impact shoulders 18 and 23 can rotate past each other with a slight clearance.

The foregoing structure is self-camming. That is, it cams the impact shoulders into impact position once during each rotation of the hammer 14 about the anvil 15. This can be seen in FIG. 2 wherein the hammer 14 is rotating in a clockwise direction and the internal cam lobe 21 of the hammer bore 20 has just completed riding on the external cam lobe 16 on the anvil 15. The engagement between the cam lobes 16 and 21 forces the hammer impact shoulder 22 into a position to impact the anvil impact shoulder 17.

The anvil 15 and hammer 14 are surrounded by a cup-shaped case 28 that normally rotates with the hammer 15. The case 28 includes a rear annular flange 29 that projects inwardly in back of the hammer 14 and a annular flange 30 that projects inwardly in front of the hammer. A belleville spring 31 is disposed between the hammer 14 and the rear flange 29 and a large washer 32 is positioned between the anvil 15, hammer 14 and the front flange 30. The case 28 is deformed to form the flanges 29 and 30 while the surrounded elements, 14, 15, 31 and 32 are located within the case 28. The case 28 locks the hammer 14 and anvil 15 in parallel positions at all times (the axes of the hammer 14 and anvil 15 remain parallel) while allowing the hammer 14 to slide or move transversely relative to the anvil 15.

The hammer 14 is driven by the motor shaft 7 through a yieldable connection 35 that allows the hammer 14 to move transversely in any radial direction relative to the anvil 15. In FIG. 1, this yieldable connection 35 takes the form of a drive bar 36 loosely located in the hollow drive shaft 7 and having a universal joint connection at both ends, one universal joint 37 being at the rear end of the hammer 14 and the other universal joint 38 being at the rear end of the drive shaft 7. Each univer-

sal joint 36 and 37 includes a ball 39 fixed on the end of the drive bar 36 and a diametrical located pin 40 projecting from both sides of the ball 39 and seating in notches provided respectively in the drive shaft 7 and the hammer 14.

OPERATION

In describing the operation of the impact wrench 1, it is assumed that the operator has placed a socket on the spindle 6 and has positioned the socket on a fastener to be driven. When the motor is first started, the fastener is continuously rotated during its rundown, without impacting due to the frictional engagement between the hammer 14 and anvil 15 caused by the belleville spring 31. As soon as the fastener begins tightening, the torque load on the spindle 6 will rise and cause the wrench to begin impacting. Impacting begins as soon as the hammer 14 begins rotating relative to the anvil 15.

Looking at FIG. 2, the hammer 14 is rotating in a clockwise direction and the hammer impact shoulder 22 has impacted the anvil impact shoulder 17. The hammer 14 was forced to move transversely into the impact position by the internal hammer cam lobe 21 riding on the anvil cam lobe 16. The two cam lobes 16 and 21 drop off each other at substantially the instant of impact.

Looking at FIG. 3, following impact, the torque applied to the hammer 14 causes the hammer impact shoulder 22 to pivot on the anvil impact shoulder 17, swinging the hammer transversely generally downward as shown in FIG. 3. This swinging of the hammer 14 about the anvil will result in two actions both of which act to disengage the hammer from the anvil. In one case, as the hammer 14 moves transversely downward, relative to the anvil 15, the hammer impact shoulder 22 is tilted or inclined relative to the anvil impact shoulder 17, causing the hammer shoulder 22 to act as a cam and to force the hammer 14 transversely to the left as shown in FIG. 3 whereby the hammer 14 tends to slide off of the anvil impact shoulder 17. In addition, the engagement point between the hammer bore surface 20 and the anvil surface 16 will travel clockwise, looking at FIGS. 2 to 4, providing a leverage force tending to lift the hammer shoulder 22 to the left off of the anvil impact shoulder 17. The result of these two actions is to disengage the hammer from the anvil whereby it begins rotating again until striking another impact.

FIGS. 4 and 5 show further positions of the hammer 14 as it accelerates. The internal hammer cam lobe 21 is riding on the anvil cam lobe 16 and begins to progressively move the hammer 14 transversely into the impact position shown in FIG. 2. This mechanism impacts once each full revolution.

It can be seen that the yieldable connection 35 between the motor drive shaft 7 and the hammer 14 allows the hammer 14 to move transversely in any direction that it may be urged by the self-camming impact clutch mechanism 12.

When the motor is reversed and the hammer 14 rotates in the counterclockwise direction, looking at FIGS. 2 to 5, the impact shoulders 18 and 23 will periodically engage to deliver impacts to the anvil. Otherwise, the impact clutch mechanism 12 will operate in the same manner as above-described.

The fact that the impact clutch 12 automatically cams the clutch into disengagement following impact reduces the amount of rebound of the hammer 14, reducing the possibility of a reverse impact occurring on rebound.

FIGS. 2 to 5 illustrate the hammer 14 as having a cam lobe 21 that is concentric with the hammer bore 20. This is not always true as applicant has found that the lobe 21 can be nonconcentric to the bore 20. In addition, the anvil lobe 16 can be nonconcentric with the remainder of the anvil surface.

SECOND EMBODIMENT - FIGS. 6 AND 7

The second embodiment differs from the first embodiment by having a different type of yieldable joint 45 between the hammer 14 and motor drive shaft 7. The yieldable joint includes an intermediate coupling disc 46 having diametrically extending keys 47 on its opposite faces extending at right angles to each other and fitting in corresponding notches or kerfs 48 provided in the hammer 14 and the front end of the drive shaft 7. This joint 45 allows the hammer to move in any transverse direction relative to the hammer 14.

Although plural embodiments of the invention are illustrated and described, it should be understood that the invention is not limited thereto and that various changes may be made in the design and arrangement of the parts without departing from the spirit and scope of the invention as set forth in the claims.

I claim:

1. A rotary impact wrench mechanism comprising:
a rotary driving member;
a rotary driven member;
an anvil element having an anvil impact surface and connected to said rotary driven member;
a hammer element mounted to rotate adjacent said anvil and having a hammer impact surface adapted to engage said anvil impact surface periodically as said hammer element rotates, said hammer element being connected to said rotary driving member;
said members being connected to their respective elements by a means which prevents relative rotary movement therebetween;
cam means operative to relatively position said anvil and hammer impact surfaces to cause said surfaces to periodically engage; and
one of said anvil and hammer elements being connected to its member by a yieldable joint allowing said one element to move transversely relative to the other element to cause the two impact surfaces to automatically disengage each other following each impact.

2. The mechanism of claim 1 wherein:
said hammer element includes an axial bore surrounding said anvil element;
said hammer impact surface being a radially extending shoulder projecting inwardly from the wall of said bore; and
said anvil impact surface being a radially extending shoulder projecting outwardly from said anvil element.

3. The mechanism of claim 2 including:
means resiliently holding said hammer and anvil elements in substantially parallel planes while allowing them to move transversely relative to each other.

4. The mechanism of claim 3 wherein:
said means resiliently holding said hammer and anvil elements in substantially parallel planes is a hollow case substantially surrounding said hammer and anvil and containing a spring disposed between one of said elements and said case and positioned substantially coaxially with said elements.

5. A rotary impact wrench comprising:
motor driving a rotary driving member;
a rotary spindle member adapted to drive fasteners;
an anvil element having an anvil impact surface and connected to said rotary spindle member;
a hammer element connected to said rotary driving member and mounted to rotate adjacent said anvil, said hammer element having a hammer impact surface adapted to engage said anvil impact surface periodically as said hammer rotates;
said members being connected to their respective elements by a means which prevents relative rotary movement therebetween;
cam means operative to relatively position said anvil and hammer impact surfaces to cause said surfaces to periodically engage to deliver an impact to said anvil; and
one of said anvil and hammer elements being connected to its member by a yieldable joint allowing said one element to move transversely relative to the other element to cause the two impact surfaces to automatically cam each other apart under the application of torque from said motor following each impact.

6. A rotary impact wrench comprising:

a motor;
a rotary driving member connected to said motor;
a rotary driven member adapted to drive a fastener;
an anvil element connected to said rotary driven member and having an anvil impact surface;
a hammer element mounted to rotate adjacent said anvil connected to said rotary driving member, said hammer element having a hammer impact surface adapted to engage said anvil impact surface periodically as said hammer element rotates;
said members being connected to their respective elements by a means which prevents relative rotary movement therebetween;
means holding said anvil and hammer elements together to maintain them in parallel planes while they rotate;
cam means operative to relatively position said anvil and hammer impact surface to cause said surfaces to periodically engage; and
one of said anvil and hammer elements being connected to its member by a joint allowing said one element to move transversely relative to the other element to cause the two impact surfaces to automatically disengage each other following each impact.

7. A rotary impact wrench mechanism comprising:
a hammer element connected to a rotary driving member;
an anvil element connected to a rotary driven member;
said members being connected to their respective elements by a means which prevents relative rotary movement therebetween;
one of said elements having a bore that receives and rotates around the other element;
said one element including a pair of radially extending steps or shoulders located within said bore, spaced substantially diametrically from each other and facing in opposite rotary directions; and
said other element including a pair of radially extending steps or shoulders spaced substantially diametrically from each other and facing in opposite rotary directions.

8. The mechanism of claim **7** wherein:
said pair of shoulders on said one element are interconnected by a cam lobe surface projecting radially inwardly into the bore; and
said pair of shoulders on said other element are interconnected by a cam lobe surface projecting radially outward from said other element;
said cam lobe surfaces being adapted to interengage to move said elements periodically into impact position as said hammer element rotates relative to said anvil element.

9. The mechanism of claim **8** wherein:
said cam lobe surfaces are arcuate surfaces.

10. The mechanism of claim **9** wherein:
one of said members is connected to its element by a joint allowing that element to move transversely relative to the opposite element.

11. The mechanism of claim **8** including:
means resiliently holding said elements in substantially parallel planes and holding their axes parallel to each other while allowing them to move transversely relative to each other.