



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(11) **EP 1 213 096 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**12.06.2002 Bulletin 2002/24**

(51) Int Cl.7: **B25B 21/00**

(21) Application number: **01310168.8**

(22) Date of filing: **05.12.2001**

(84) Designated Contracting States:  
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU  
MC NL PT SE TR**  
Designated Extension States:  
**AL LT LV MK RO SI**

(72) Inventor: **Kusama, Masahiko**  
**Wentzville, Missouri 63385 (US)**

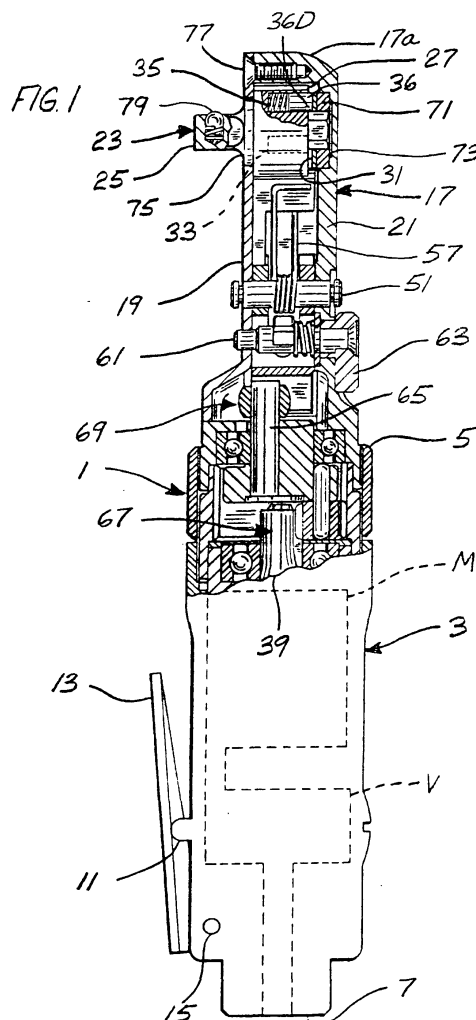
(74) Representative: **Smaggasgale, Gillian Helen**  
**W.P. Thompson & Co,**  
**Celcon House,**  
**289-293 High Holborn**  
**London WC1V 7HU (GB)**

(30) Priority: **06.12.2000 US 731400**  
**19.10.2001 US 52934**

(71) Applicant: **S.P. Air Kabusiki Kaisha**  
**Nagano Pref. 389-12 (JP)**

(54) **Power-driven ratchet**

(57) A hand-held power tool includes a housing having spaced front and back walls, and an output shaft mounted in the housing for rotation in one direction or the other on an axis extending transversely with respect to the walls. The shaft has an outer end portion projecting out from the front wall for reception of an attachment for the tool. A ratchet wheel on the shaft in the space between the walls is adapted to be driven in one direction or the other for rotating the shaft in the one direction or the other. The ratchet wheel has a side face facing a fixed surface on one of the walls and a plurality of recesses extending inward from the side face spaced at intervals around the axis. Cylindrical pins are each engaged by a corresponding one of a plurality of coil compression springs for biasing the pin outward from the recess against said fixed surface for holding the ratchet wheel against rotation in a direction opposite the driven direction of rotation. The outer ends of the pins functionally engage the fixed surface.



EP 1 213 096 A1

## Description

### Background of the Invention

[0001] This invention relates generally to hand-held power tools, more particularly to a hand-held pneumatically powered tool having an output shaft and a reversible ratchet wheel drive therefor.

[0002] The invention is especially concerned with a hand-held pneumatically powered tool primarily of the type disclosed in U.S. Patent No. 5,535,646 dated July 16, 1996 entitled Ratchet Drive, also of the type disclosed in the coassigned U.S. Patent No. 6,158,528 dated December 12, 2000, entitled Hand-Held Pneumatic Rotary Drive Device, and in the coassigned copending application of April 20, 2000, Serial No. 09/553,921, entitled Hand-Held Power Tool, all these being incorporated herein by reference.

[0003] Referring to said U.S. Patent No. 5,535,646 (briefly the '646 patent), the tool disclosed therein is shown to include an arrangement of washers including a friction washer (numbered 36) and one or preferably two Belleville spring washers (numbered 38) which combination, as stated in lines 58-60 of column 3 of the specification of the patent, "serves to pre-load the drive gear axially and prevent oscillation thereof." The primary purpose of this arrangement of washers is to inhibit uncalled-for rotation of the "drive gear" numbered 22 (the ratchet wheel), such as retrograde rotation thereof when the tool is set for driving the ratchet wheel in one or the other direction, as may be caused by back-drag of the pawl which has been selected for driving the ratchet wheel. Such retrograde rotation has the effect of detracting from the power of the tool. In this regard it may be observed that since in the use of the tool the ratchet wheel may be driven forward in one direction by the one pawl and forward in the other direction by the other pawl it is not possible to use means such as a back-check pawl for positively preventing retrogressive rotation of the ratchet wheel. While the '646 patent arrangement of washers has been generally satisfactory for the purpose, it has encountered the problem of relatively short life due to washer wear and the consequent necessity for shimming up the arrangement or replacing washers.

[0004] One attempt to solve the problem of rapid wear is shown in U.S. Patent No. 4,722,252. The Belleville washer is replaced by coil springs received in holes in the ratchet wheel which bias ball bearings against a wear washer. An advantage is that the ball bearings can be of a hardness similar to that of the wear washer. However because the ball bearings engage the wear washer substantially at a point, the ball bearings act like cutters as the tool operates, damaging the wear washer and reducing service life. Still another solution may be found in U.S. Patent No. 5,896,789, in which the ball bearings are eliminated at the springs directly engage a wear washer. To work, the ends of the springs must be machined flat, which adds cost to production. However, the

surface area of engagement between the springs and washer is still very small. Moreover, it is difficult to economically use springs which are sufficiently hard for wear purposes, but retain the needed resiliency.

### Brief Summary of the Invention

[0005] Accordingly, among the several objects of this invention may be noted the provision of a tool having the reversible ratchet type of drive with improved means for inhibiting uncalled-for rotation of the ratchet wheel and shaft; the provision of a tool with such means which is relatively self-compensating for wear, and which is relatively long-lived and does not require shimming or replacement often as the washer arrangement; and the provision of such means which is relatively readily and economically incorporated in the tool.

[0006] In general, a hand-held power tool of the invention comprises a housing having spaced front and back walls, with an output shaft mounted in the housing for rotation in one direction or the other on an axis extending transversely with respect to said walls. The shaft has an outer end portion projecting out from the front wall for reception of an attachment for the tool. A ratchet wheel on said shaft in the space between said walls is adapted to be driven in one direction or the other for rotating the shaft in the one direction or the other, said ratchet wheel having a side face facing a fixed surface on one of said walls and a plurality of recesses extending inward from said side face spaced at intervals around said axis, with a plurality of coil compression springs, one in each recess. A cylindrical pin is provided for each of said coil compression springs. Each cylindrical pin is engaged by a corresponding one of said coil compression springs for biasing the pin outward from the recess against said fixed surface for holding the ratchet wheel against rotation in a direction opposite the driven direction of rotation.

[0007] Other objects and features will be in part apparent and in part pointed out hereinafter.

### Brief Description of the Drawings

#### [0008]

Fig. 1 is a view in side elevation of a reversible-ratchet tool having means of this invention incorporated therein, broken away in part to show interior detail including said means;

Fig. 2 is an enlarged fragment of Fig. 1;

Fig. 3 is a view generally in section on line 3--3 of Fig. 2;

Fig. 4 is a view of the output shaft/ratchet wheel component per se;

Fig. 5 is a left side elevation of Fig. 4;

Fig. 6 is a right side elevation of Fig. 4; and

Fig. 7 is an enlarged side elevation of a cylindrical pin per se such as used in the tool.

**[0009]** Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

#### Detailed Description of the Preferred Embodiment

**[0010]** Referring to Fig. 1 of the drawings, a hand-held pneumatic power tool equipped with means of this invention for inhibiting uncalled-for rotation of the ratchet wheel (and output shaft) thereof, including the detrimental retrograde rotation above mentioned, is shown to comprise a generally elongate body sized and shaped to be held in the hand. The tool as a whole is designated **1**, the elongate body is designated **3**. The body has a forward end **5** and a rearward end **7** ("forward" and "rearward" as held in the hand). It is generally circular in transverse cross-section, having a motor chamber adjacent its forward end and a pneumatic motor **M** in the chamber, as is shown in said '646 patent and/or in said coassigned patent applications. The body is adapted at its rearward end **7** for connection of an air hose (not shown) for delivering air under pressure for operating the motor under control of a valve **V** in the body, the valve including stem **11** operable by lever **13** pivoted at **15**. This connection may be as shown in said '646 patent or said coassigned patent applications.

**[0011]** Extending forward from body **3** is a housing generally designated **17** having spaced walls **19** and **21**, the wall **19** being referred to as the front wall and the wall **21** being referred to as the back wall. At **23** is indicated an output shaft mounted in the housing adjacent the forward end **17a** thereof for rotation in one direction or the other on an axis extending transversely with respect to the walls **19**, **21**. The shaft has an outer end portion **25** projecting out from the front wall for reception of an attachment for the tool. A spur gear constituting a ratchet wheel **27** is provided on the shaft in the space between walls **19**, **21**. The ratchet wheel is adapted to be driven in one direction or the other for rotating the output shaft **23** in the one direction or the other by the motor in the body **3** acting through a bidirectional ratchet drive mechanism of the type shown in the aforesaid '646 patent and coassigned patent applications.

**[0012]** The ratchet wheel **27** is preferably made integral with the shaft **23**, having a side face **29** facing a fixed surface **31** on one of the walls **19**, **21**, namely the wall **21**. In accordance with this invention, the ratchet wheel has a plurality of recesses each designated **33** extending inward from its said side face **29** spaced at intervals around its axis. These recesses hold a plurality of a coil compression springs, each designated **35**, and partially contain a plurality of cylindrical pins **36**, one spring and one pin in each recess. Each spring **35** is compressed between the inner end **37** of the respective recess and a shoulder **36A** of the cylindrical pin **36**. The cylindrical pin comprises a friction portion **36B** and a locator portion **36C** having a smaller diameter than the friction portion. The shoulder **36A** is located at the inter-

section of the friction portion **36B** and the locator portion **36C** on a second end of the friction portion. The locator portion is received within the turns of the spring **35**, effectively locating the spring on the pin **36**. The friction portion **36B** (on a first end thereof) frictionally engages said fixed surface **31** thereby acting in effect as braking means for inhibiting uncalled-for rotation of the ratchet wheel **27** and shaft **23**, especially effective for inhibiting retrograde rotation thereof (in either direction). The cylindrical pins **36** each further include a detent **36D** received through the friction portion **36B** adjacent the periphery of the friction portion. The detent **36D** engages the ratchet wheel **27** adjacent the corresponding recess **33** receiving the pin **36** to prevent the pin from being pushed fully into the recess. Thus, pin **36** is held in constant engagement with the fixed surface **31**.

**[0013]** The ratchet wheel **27** has a side face **38** opposite its aforesaid face **29** facing and engaging the front wall **19**. Thus, the ratchet wheel **27** (and shaft **23**) are maintained against movement in the direction (toward the left as shown in Figs. 1 and 2) toward the front wall under the bias of springs **35** and the compression of the springs is thereby maintained. Frictional engagement of side face **38** of the ratchet wheel with the front wall adds a braking effect.

**[0014]** The bidirectional ratchet drive mechanism is powered by shaft **39** of the aforesaid pneumatic motor. This mechanism is generally of the same type as that disclosed in the aforesaid '646 U.S. patent and coassigned patent applications. For correlation therewith, there is shown herein pawl carrier **41** ("drive link" **16** of the '646 patent) having the pair of pawls **43** and **45** pivoted thereon at **47** and **49**, respectively, and itself pivoted on a pin **51** for oscillation in housing **17** adjacent the rearward end thereof on an axis extending transversely of the housing. The pawls **43**, **45** have the tails indicated at **53** and **55**, respectively. Indicated at **57** is the spring for biasing the pawls for engagement of the tails with cam **59** on camshaft **61** operable by lever **63** between the position wherein pawl **43** is engageable with the ratchet wheel for driving it one way as viewed in Fig. 3 and the position wherein pawl **45** is engageable with the ratchet wheel for driving it the other way as viewed in Fig. 3. At **65** is indicated the crank driven via gearing indicated at **67** which effects oscillating action of pawl carrier **41** via link **69**, oscillation of the pawl carrier effecting rotation of the ratchet wheel **27** and output shaft **23** in one direction or the other depending on the setting of lever **63**.

**[0015]** The output shaft **23** is journaled at its end opposite the end **25** in an annular bearing **71** lodged in a circular recess **73** in the inside of wall **21** of housing **17**. The ratchet wheel **27** has a disk formation **75** on its side opposite side **29** journaled in a circular opening in wall **19**. The side face **38** of the ratchet wheel surrounds this disk formation. The wall **19** is removably mounted by means of screws such as indicated at **77**. The outwardly projecting end **25** of shaft **23** (which is square) has a

recess (not numbered) holding spring-backed ball detent **79** for application of the attachment (e.g. socket wrench attachment) for the tool. Bearing **71** has a wear-resistant facing **81**, said surface **21** being the surface of this wear-resistant ring. Preferentially, three recess **33** and springs **35** are provided in the ratchet wheel **27**, spaced around the axis thereof at 120° intervals.

**[0016]** Details of the motor **M**, valve **V**, passaging in the body **3** for flow and exhaust of air, and the bidirectional ratchet drive mechanism may be ascertained from the aforesaid '646 patent and coassigned patent applications which, as above noted, are incorporated herein by reference.

**[0017]** Wear of the pins **36** and/or the facing **81** is automatically compensated for by expansion of the springs **35**, whereby the frictional braking effect of the springs is prolonged, without the shimming or washer replacement previously needed. The first ends of the pins **36** engaging the facing **81** are substantially flat so that the pins engage the facing over substantially the entire circular surface area of the first end, enhancing frictional braking. Moreover, the pins **36** may be made of a material and kind which is substantially the same hardness as the facing **81** to reduce wear of the pins. The relatively larger area of engagement of the first ends of the pins **36** with the facing **81** inhibits the pins cutting into the facing.

**[0018]** In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

**[0019]** As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

## Claims

1. A hand-held power tool comprising a housing having spaced front and back walls, an output shaft mounted in said housing for rotation in one direction or the other on an axis extending transversely with respect to said walls, said shaft having an outer end portion projecting out from the front wall for reception of an attachment for the tool, a ratchet wheel on said shaft in the space between said walls, said ratchet wheel being adapted to be driven in one direction or the other for rotating the shaft in the one direction or the other, said ratchet wheel having a side face facing a fixed surface on one of said walls and a plurality of recesses extending inward from said side face spaced at intervals around said axis, and a plurality of coil compression springs, one in each recess, a cylindrical pin for each of said coil compression springs, each cylindrical pin being engaged by a corresponding one of said coil compression

springs for biasing the pin outward from the recess against said fixed surface for holding the ratchet wheel against rotation in a direction opposite the driven direction of rotation.

2. A hand-held power tool as set forth in Claim 1 wherein each of said cylindrical pins is at least partially received in a corresponding one of said recesses in the ratchet wheel.
3. A hand-held power tool as set forth in Claim 1 or Claim 2 wherein each cylindrical pin comprises a friction portion having a first end engageable with the fixed surface and a locator stud disposed on a second end of the friction portion opposite the first end, the locator stud having a smaller transverse dimension than the friction portion and being received internally of said coil compression spring.
4. A hand-held power tool as set forth in any one of Claims 1 to 3 wherein the first end of the friction portion of the cylindrical pin is flat for engaging the fixed surface over substantially the entire circular surface area of the first end.
5. A hand-held power tool as set forth in any one of Claims 1 to 4 wherein each cylindrical pin comprises a friction portion having a first end engageable with the fixed surface and a locator stud disposed on a second end of the friction portion opposite the first end, the locator stud having a smaller transverse dimension than the friction portion and being received internally of said coil compression spring.
6. A hand-held power tool as set forth in any one of Claims 1 to 5 wherein the first end of the friction portion of the cylindrical pin is flat for engaging the fixed surface over substantially the entire circular surface area of the first end.

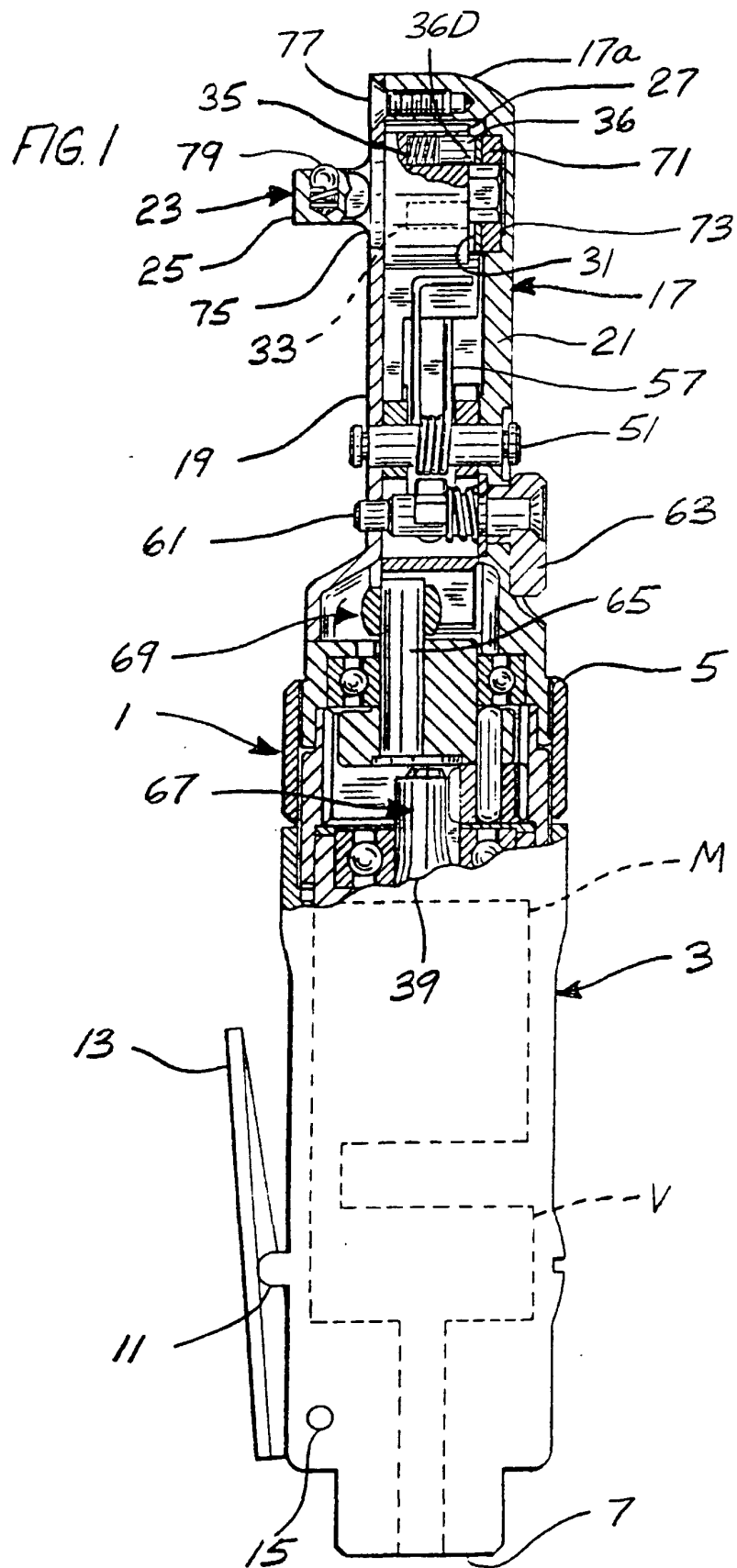


FIG. 2

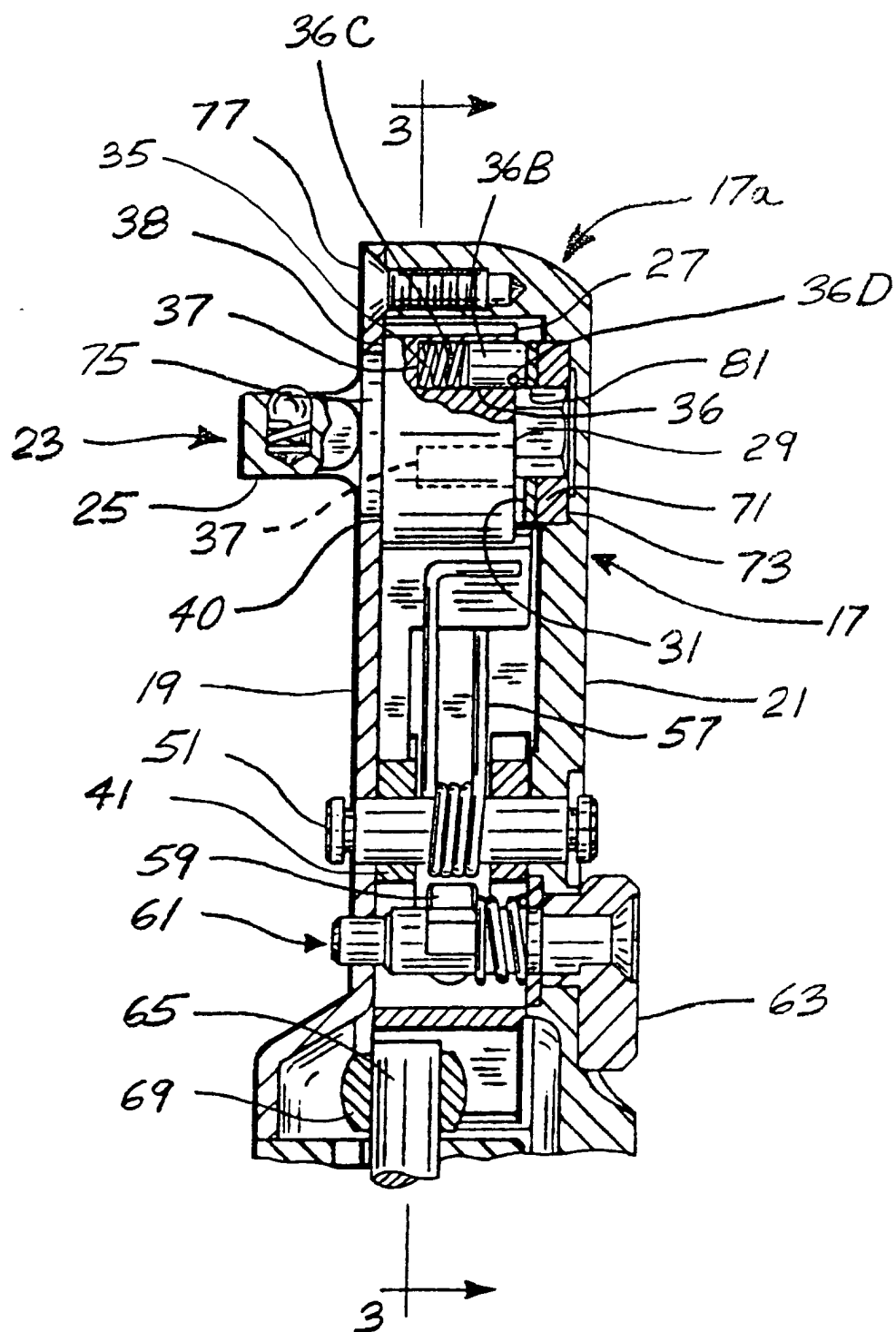


FIG. 3

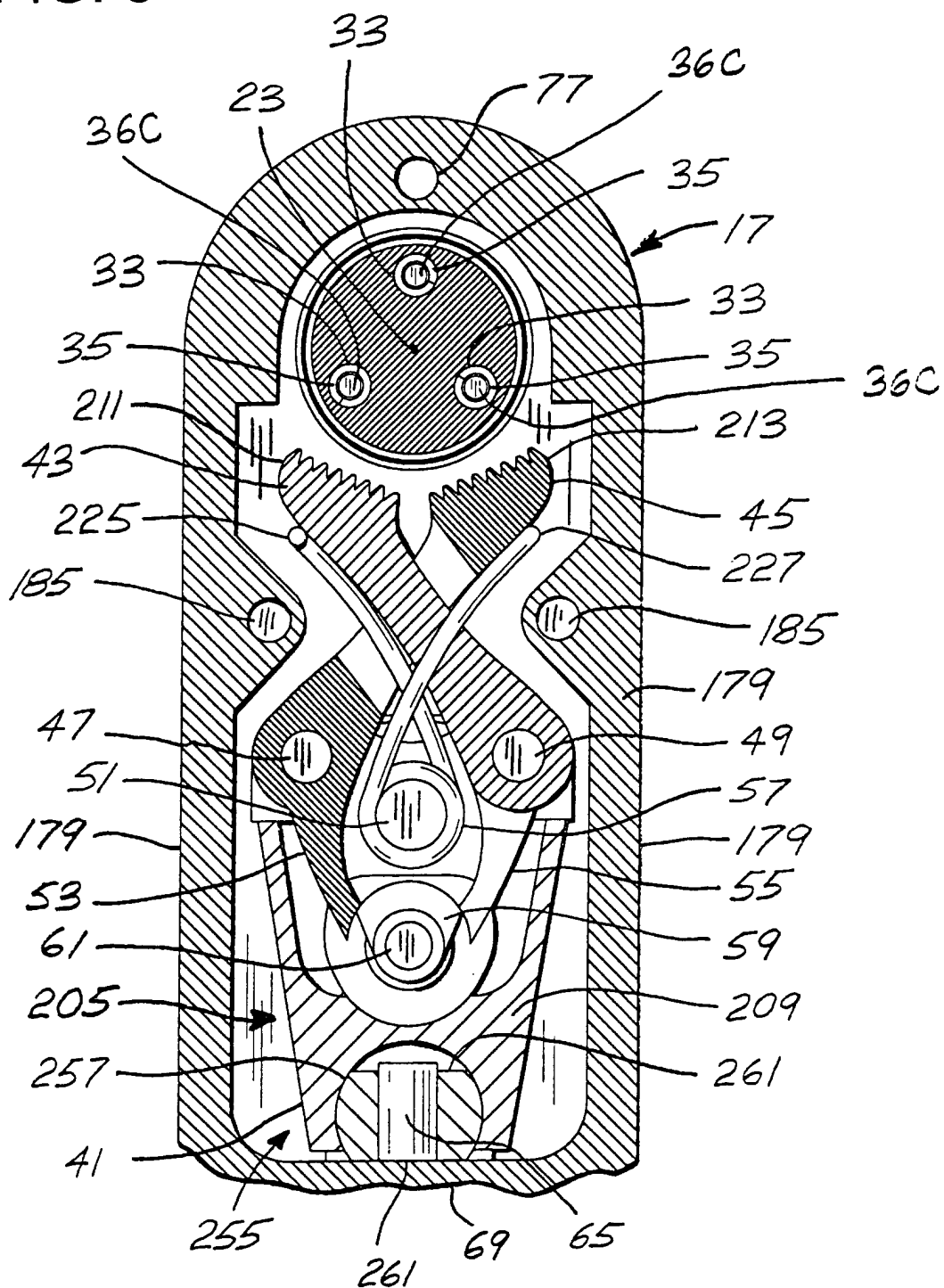


FIG. 4

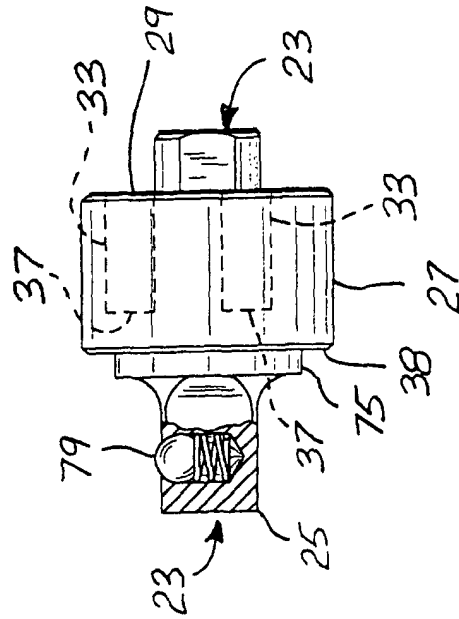


FIG. 5

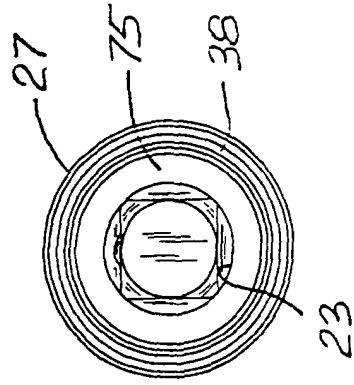


FIG. 6

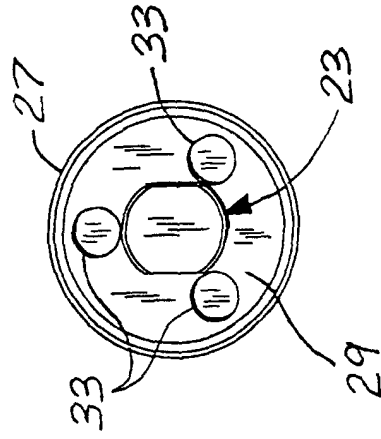
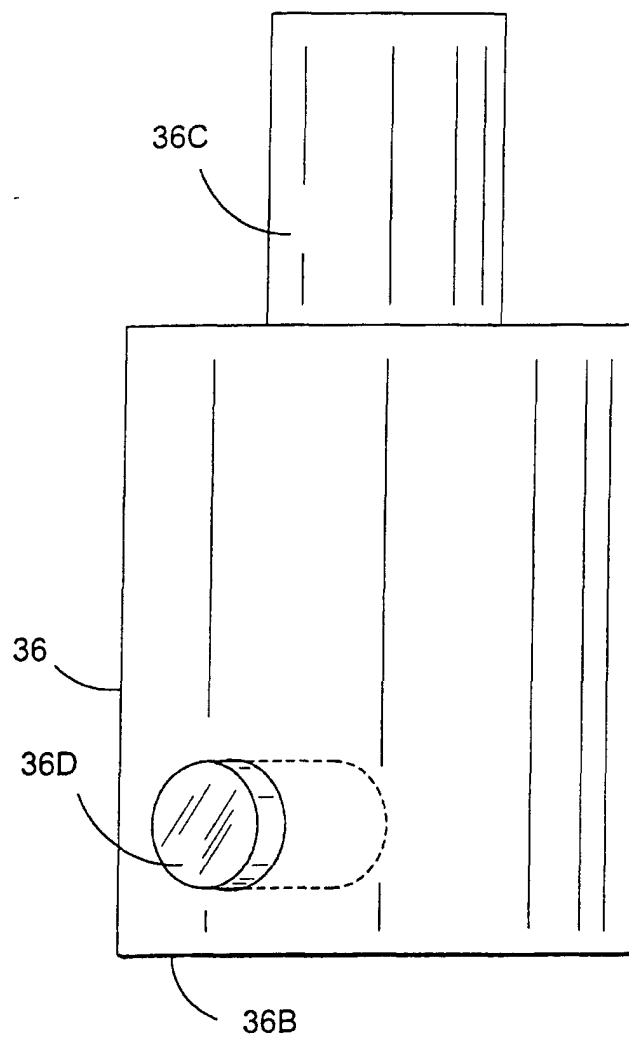




FIG. 7





European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number  
EP 01 31 0168

| 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.7) |
| D,Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | EP 0 908 273 A (CHICAGO PNEUMATIC TOOL CO)<br>14 April 1999 (1999-04-14)<br>* column 1, line 21 - line 42 *<br>* column 3, line 50 - column 4, line 22;<br>figures 3-7 * | 1,2                              | B25B21/00                                    |
| Y                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | US 5 237 885 A (PUTNEY GORDON A ET AL)<br>24 August 1993 (1993-08-24)<br>* column 1, line 40 - line 48 *                                                                 | 1,2                              |                                              |
| D,A                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | US 4 722 252 A (FULCHER WILLIAM A ET AL)<br>2 February 1988 (1988-02-02)<br>* column 5, line 6 - line 10; figure 5 *                                                     |                                  |                                              |
| The present search report has been drawn up for all claims                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                          |                                  | TECHNICAL FIELDS SEARCHED (Int.Cl.7)         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                          |                                  | B25B                                         |
| Place of search                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                          | Date of completion of the search | Examiner                                     |
| MUNICH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                                                                          | 21 March 2002                    | 01thoff, H                                   |
| <p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone<br/> Y : particularly relevant if combined with another document of the same category<br/> A : technological background<br/> O : non-written disclosure<br/> P : intermediate document</p> <p>T : theory or principle underlying the invention<br/> E : earlier patent document, but published on, or after the filing date<br/> D : document cited in the application<br/> L : document cited for other reasons<br/> &amp; : member of the same patent family, corresponding document</p> |                                                                                                                                                                          |                                  |                                              |

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 31 0168

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
The members are as contained in the European Patent Office EDP file on  
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-03-2002

| Patent document<br>cited in search report |   | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---|---------------------|----------------------------|---------------------|
| EP 0908273                                | A | 14-04-1999          | US 5896789 A               | 27-04-1999          |
|                                           |   |                     | BR 9803495 A               | 26-10-1999          |
|                                           |   |                     | CA 2248091 A1              | 09-04-1999          |
|                                           |   |                     | CN 1214292 A               | 21-04-1999          |
|                                           |   |                     | EP 0908273 A2              | 14-04-1999          |
|                                           |   |                     | JP 11188652 A              | 13-07-1999          |
|                                           |   |                     | TW 390828 B                | 21-05-2000          |
|                                           |   |                     | ZA 9808899 A               | 10-06-1999          |
| US 5237885                                | A | 24-08-1993          | US 5142952 A               | 01-09-1992          |
|                                           |   |                     | CA 2022966 A1              | 22-11-1991          |
|                                           |   |                     | CA 2142586 A1              | 22-11-1991          |
|                                           |   |                     | US 5309714 A               | 10-05-1994          |
|                                           |   |                     | US 5231901 A               | 03-08-1993          |
| US 4722252                                | A | 02-02-1988          | NONE                       |                     |