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(54) **TOOL FOR ADJUSTING VALVES AND SETTING INJECTOR PRELOAD AND METHODS USING THIS TOOL**

WERKZEUG ZUM EINSTELLEN VON VENTILEN UND ZUM HERSTELLEN DER VORSPANNUNG EINER EINSPRIZTDÜSE UND VERFAHREN MIT EINEM SOLCHEN WERKZEUG

OUTIL POUR LE REGLAGE DE SOUPAPES ET LA MISE EN PLACE DE LA PRECHARGE D'UN INJECTEUR ET METHODES UTILISANT CET OUTIL

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Description

[0001] This invention relates to torque tools and, in particular, to dual or combination torque tools according to the preamble of claim 1 (see, for example, US-A-4 474 059), for setting valve clearances on internal combustion engines or other components where feeler gauges are normally used.

[0002] Internal combustion engines typically require a specified clearance between the valves and the valve opening mechanisms. Rocker arms are used on many engines to open the valves. One end of each rocker arm engages a camshaft directly, in the case of overhead camshafts, or a push rod in the case of push rod engines. The opposite end of the rocker arm operatively contacts the valve. More specifically, this end of the rocker arm usually has an adjustment screw or bolt. The lower end of the screw or bolt contacts the valve, a cross head for multiple valve engines or other such components associated with the valve. There is usually a lock nut on the top of the screw or bolt above the rocker arm which is tightened to keep the screw or bolt in a desired position. The clearance is set by loosening the lock nut and inserting a feeler gauge between the bottom of the screw or bolt and the valve. The screw or bolt is then tightened or loosened until the mechanic senses the correct amount of drag on the feeler gauge as it is pulled between the screw or bolt and the valve.

[0003] After the correct amount of gap is set, the lock nut is tightened. This should be done to a specified torque. However the screw or nut must be held at the rotational position where the gap was set. Accordingly a normal socket-type torque wrench cannot be used since it would interfere with the screwdriver or wrench or the screw or nut. A special crow foot torque wrench is usually used to enable the mechanic to hold the screw or bolt while the lock nut is tightened.

[0004] The disadvantage of this technique is not only the requirement for multiple tools. There are also problems in setting the valve clearance within acceptable tolerances. The drag of the feeler gauge may be an acceptable way of measuring the gap for an experienced mechanic when the parts are new. However the task is not as easy for inexperienced personnel, particularly as the parts become worn. They may be pitted or otherwise distorted such that a feeler gauge tends to ride on the rough surfaces instead of measuring the actual gap.

[0005] US-A-4,474,059, which could be considered to represent the most relevant state of the art, discloses an adjusting tool for use on a valve stem pusher structure to enable gap indication and adjustment. In particular, a socket grips a nut associated with the valve stem pusher structure, and an indicator on the gripper indicates the gap dimension as the gripper is moved toward and away from the valve stem structure with the socket locked on the nut.

[0006] DE A 195 14 882 merely describes a torque wrench with a clutch mechanism.

[0007] It is therefore an object of the invention to provide an improved apparatus and method for adjusting valves which overcomes deficiencies in the prior art.

[0008] It is also an object of the invention to provide an improved apparatus and method for adjusting internal combustion engine valves which does not depend upon the use of feeler gauges or the like.

[0009] It is a further object of the invention to provide an improved apparatus and method for adjusting internal combustion engine valves where the bolt or screw on the rocker arm can be rotated with a tool to the required position to set the specified clearance, and the lock nut and can be tightened with the same tool while the bolt or screw is held in the required position.

SUMMARY OF THE INVENTION

[0010] There is provided, according to one aspect of the invention, a tool for adjusting a value or setting injector preload in an internal combustion engine having a valve or fuel injector opening member with a male threaded member operatively and adjustably contacting the valve according to claim 1. The tool includes a first member engagable with the threaded member for rotating the threaded member towards or away from the valve. There is means for rotating the first member in a first rotational direction so the male threaded member moves towards the valve and for rotating the first member in a second rotational direction so the male threaded member moves away from the valve. There is means for stopping movement of the first member, as the first member moves towards the valve, when the male threaded member operatively contacts the valve and thereby takes up play between said valve opening member and the valve. There is means for measuring a predetermined amount of rotation of the threaded member, as the threaded member is rotated in the second rotational direction away from the valve, after having operatively contacted the valve, and thereby setting a specified amount of play between said valve opening member and the valve.

[0011] There is provided a method of setting a valve clearance on an internal combustion engine having a rocker arm with a male threaded member operatively contacting a valve using the tool according to claim 1. The method includes the steps of loosening any lock nut on the threaded member and rotating the male threaded member in a first rotational direction towards the valve until the male threaded member operatively contacts the valve. The male threaded member is then rotated in a second rotational direction, opposite the first direction, for a specified angle of rotation related to the pitch of the male threaded member, such that a specified clearance is set between the male threaded member and the valve.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] In the drawings:

Figure 1 is an isometric view of a valve adjusting tool, according to an embodiment of the invention;

Figure 2 is an enlarged, fragmentary end view, partly in section, of the tool of Figure 1a;

Figure 3 is a sectional view taken a long line 3-3 of Figure 2;

Figure 4 is an exploded isometric view of the screwdriver, clutch, cam device, setting knob and dial thereof;

Figure 5 is an exploded isometric view of the torque wrench portion thereof and the screwdriver; and

Figure 6 is an exploded isometric view of the display apparatus of Figure 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] Referring first to Figure 1, this shows a tool 20 according to an embodiment of the invention, for setting valve clearances on internal combustion engines. It may also be used for related tasks such as setting injector preload to rocker arm actuated fuel injectors. It includes a handle 22 which is generally similar in configuration to a standard torque wrench. There is a socket 24 which is interchangeable on this embodiment to fit different sized lock nuts on the rocker arms of different engines. The tool includes a setting knob 30 which, as described in more detail below, is used to set the required clearance between the typical screw or nut on the rocker arm and the valve or other component connected to the valve such as a cross head. There is a scale 78 and a needle 82 which are utilized in setting the clearance. Figure 1 shows an electronic display apparatus 32 which is connected to the tool 20 by a cable 34, to display a reading on LED display panel 36 thereof.

[0014] In this example the display apparatus 32 has an internal microprocessor and other electronic components as well described below. As seen in Figure 6 the display apparatus includes a top cover 160 and a bottom cover 162 connected together by screws 163. There is a power on LED 164 and a power on/off switch 166. The unit is powered by batteries 168 in battery case 170. There is an external power connector 172 and a keypad 150. An electronic board 174 includes a processor 176. Connector 178 is provided for a sensor cable 34.

[0015] As seen best in Figures 2 and 5, there is a screwdriver bit 40 located coaxially within the socket 24 and rotatable relative to the socket 24. The screwdriver bit is received non-rotatably in a socket 42. A set screw 44, shown in Figure 4, is used to secure the bit in the socket. A coil spring 46 extends about the socket to take up any free play. The bit has a replaceable tip 41 secured in place by a c-clip 43.1. Although in this example a screwdriver tip is employed, an Allen wrench, a smaller socket or other such tool may be substituted depending upon the nature of the male threaded member used for adjustment purposes on the rocker arm.

[0016] In this embodiment the socket 42 is integral with an annular member 48 shown in Figures 2, 3 and 4. There is a cylindrical member 50 located on bottom end 52 of the knob 30 and radially spaced-apart from its outer rim 54. The annular member 48 is rotatably received in annular gap 56 between the rim 54 and the cylindrical member 50.

[0017] There is a one-way cam mechanism 60, best shown in Figure 3, operatively disposed between the cylindrical member 50 and the annular member 48. The annular member has a plurality of pockets or recesses 62, three in number in this example. They are 120 degrees apart in this embodiment although the number and spacing of recesses could vary. Each recess is provided with a roller 66 biased to one end of the recess by a coil spring 68. It may be seen that one end 70 of the recess is deeper than the opposite end 72 where the roller is located. In addition each coil spring 68 is acutely angled towards a tangent with the cylindrical member. The result is that when the knob 30, with its cylindrical member 50, are rotated clockwise, with reference to Figure 3, relative rotational movement of the cylinder 50, and attached knob 30, is permitted relative to annular member 48 which is non-rotatably connected to the screwdriver bit 40. However, when the knob 30 is turned in the opposite direction, namely counter clockwise, annular member 48 and cylindrical member 50 lock, insuring that the screwdriver bit rotates exactly the same amount as the knob without any slippage.

[0018] There is a replaceable ring 76 near the top of the knob which is calibrated with the scale 78 appropriate for a particular engine. There is a transparent housing 80 within the ring. The magnetic needle 82 is freely, rotatably mounted in the transparent housing 80. It is kept at a fixed rotational position relative to the tool, as illustrated in Figure 1, by a magnet 86 mounted on handle 22.

[0019] There is a clutch assembly 90 within the annular gap 56 of the knob 30 which is operatively disposed between the knob and annular member 48, particularly top 92 thereof. The clutch, as seen best in Figure 4, includes a pair of Bellville washers 94 and three flat washers 96 in this example. The washers are fitted between the top 92 of the annular member 48 and inner end 98 of annular gap 56 in the knob shown in Figure 2.

[0020] There is a mechanism, shown generally at 100, for adjusting friction in the clutch assembly. This includes a crown gear 102 with a male threaded member 104 extending downwardly and centrally therefrom as seen in Figure 4. The threads in the member 104 are

received in a female threaded aperture 106 in the cylindrical member 42 connected to the annular member 48 as shown in Figure 4. There is a worm gear 110 with an Allen head 112 extending rotatably through an aperture 114 in the knob 30. The crown gear is rotatably supported on an annular bearing member 120 within the knob. Rotation of the worm gear, via the Allen head 112 in one direction, rotates the crown gear 102 clockwise and thus compresses the annular bearing member 120 towards the top 92 of the annular member, with the washers 94 and 96 therebetween. This increases friction in the clutch and thus the maximum amount of torque which can be applied to the screwdriver bit 40 by the knob 30 before the clutch slips. Rotation of the Allen head in the opposite direction decreases friction in the clutch and thus decreases the maximum torque.

[0021] Handle 22, as best seen in Figure 5, has a housing 43 with a top 132 secured in place by up a plurality of bolts 134. There is an optical encoder 140 mounted in the housing. In this example a U.S. digital E2-256-375 encoder is used although other rotational sensors could be substituted. The digital encoder used in this example produces 1024 pulses per revolution. It is an incremental shaft encoder and a noncontacting rotary to digital position feedback device. It has an internal monolithic electronic module which converts the real-time shaft angle, speed and direction into TTL-compatible outputs. The encoder has a sensor head 141, shown in Figure 4, fixedly mounted in housing 43. A disk 143 is non-rotatably mounted on bit 40 by a set screw 151. Washers 149 and clip 153 extend about the bit on either side of the disk.

[0022] In order to calculate the direction and distance traveled, the encoder pulses and phase must be counted and decoded. This is accomplished in this example by HTCL2016 decoding chip 176 which is located within display apparatus 32. This chip checks the phase and number of pulses to determine the count up or down and adjusts the output counter value accordingly. The output counter value is two bytes long and is read by the microprocessor one byte at a time.

[0023] Keypad 150 is a Grayhill 88BA2 4x4 sealed keypad in this example. It is modified to permit the last row of keys to be interpreted as a system reset. To interface the keypad to the micro-processor, a National Semiconductor MM74C922 16-key encoder is employed.

[0024] A XiCOR X250640 serial EEPROM memory is employed in this example to store the various engine manufacturer's clearance data. The serial memory is programmed externally by connecting a programming board to the parallel port of a personal computer. The data to be programmed must be in a specific format for this particular embodiment. One example follows:

Cat Type,0001,0012,0123
Next ,0180,0360,0270

[0025] The clearance values are decimal number values and are the number of degrees of rotation required to achieve the desired valve clearance. The first eight characters are the engine identification, entered as they will appear on the LCD panel. These eight character locations are then followed by a comma and then the clearances (in degrees) for the inlet valve, the exhaust valve and the compression release brake. Each clearance value in this example must be four digits in length and separated by a comma. The last value has no comma but is followed by a carriage return.

[0026] The display panel 36 in this example is an Optrex DMC-16433 backlit LCD panel which displays the menus and clearance information. The microprocessor sends an eight-bit word for each character to be displayed. A NEL-D32-46 inverter is used to supply the backlight for the panel.

[0027] In this example power is supplied by four AA batteries 168 which can deliver 7.5-14 V DC.

Operation

[0028] It should be understood that the mechanical components of tool 20 are capable of operating independently of the electronic components. Thus, the tool could be built without the electronic components and operate simply by using magnetic needle 82 and scale 78 on the knob. The lock nut on the rocker arm is loosened, using socket 24 and handle 22. Screwdriver bit 40 is fitted on the rocker arm screw and the knob 30 is rotated clockwise until the clutch assembly 90 slips, indicating that the screw has bottomed out against the valve. As discussed above, the amount of torque applied to the screw can be adjusted by rotating Allen head 112 connected to worm gear 110. Disk-type clutch 90 slips smoothly and cam device 60 allows easy relative rotation between cylindrical member 50 connected to the knob and annular member 48 connected to the screwdriver bit. No backlash is encountered as with ratchet-type one-way devices.

[0029] After the screw bottoms out against the valve, the mechanic continues to rotate the housing 80 clockwise until the end of needle 82 is aligned with a zero point marked on the scale 78. The mechanic then rotates knob 30 counter clockwise. The cam mechanism 60 causes the annular member 48, connected to the screwdriver bit, to lock relative to cylindrical member 50 connected to the knob. Thus the screwdriver bit is rotated exactly the same amount as the knob. The mechanic aligns the end ofthe needle with the marking on the scale 78 corresponding to the required amount of rotation. The scale 78 can be calibrated in, for example, thousands of an inch, according to the particular pitch of the thread of the rocker arm screw. For example, if the adjusting screw has a pitch of 24 T.P.I.(threads per inch), the screw would move nearly 1/24 inches or 0.04166" per 360 degrees of rotation. Thus, by determining the thread pitch, whether SAE or metric, it becomes quite simple to compute how many degrees the screw must be rotated in order to obtain a linear move-

ment of, for example, 0.254 or 0.508 mm (0.010 or 0.020 inches).

[0030] Handle 22 of the illustrated electronic version has a zero button 160 shown in Figure 1. The LCD displays the rotation of the screwdriver bit relative to handle 22. In the sample, the LCD displays this value in degrees from the zero point. The operation occurs with the tool in place on the adjustment screw of the rocker arm. The power button on the display apparatus 32 is pushed. The LED panel begins to flash. Any button in the last row of the panel is pressed to reset the system. The mechanic then presses 1. The lock nut is loosened using handle 22. The adjustment screw is then screwed in using knob 30 until the clutch slips, indicating that the screw has bottomed. The user then presses the zero button 160 on handle 22.

[0031] The LCD will then display:

ROTATED= ±0000°

[0032] Any movement of the screwdriver shaft relative to the handle will be displayed in degrees on the LCD. A "+" indicates the rotation is counter clockwise from the zero point and a "-" indicates rotation is counter clockwise.

[0033] It is also possible to operate the device in an Engine Type mode where the engine type and clearance type will automatically display the desired and actual clearances for the particular model of engine. With the tool in place on the adjustment screw, the procedure is as follows:

1. Press the power button. The LED will begin to flash.
2. Press any button on the last row to reset the system.
3. Press 2.
4. Select the desired engine manufacturer.
5. Scroll through the available models by pressing the ^ key.
6. Press the B key to accept the displayed model.
7. Select the desired clearance to be set (Inlet, Exhaust, Compression Relief Brake).
8. Loosen the lock nut.
9. Using the slip clutch knob 30, screw in the adjustment screw until it just bottoms.
10. Press the zero button 160 on the tool handle. The LCD will now display:

    MODEL (type of adjustment)
    ACTUAL = ±0000°
    DESIRED = (spec. value)
    x.xx mm x.xx"

Any movement of the screwdriver shaft relative to the handle will be displayed in degrees on the LCD. A "+" indicates the rotation is counter clockwise from the zero point and a "-" indicates rotation is clockwise.

11. Rotate the slip clutch knob 30 until the desired value and actual values are the same.
12. Hold the knob still and tighten the lock nut.

[0034] As discussed above, the handle 22 is generally similar to a standard torque wrench and includes a rotatable grip 201 for adjusting the torque. The lock nut can be tightened to the required torque using the handle until it clicks in the standard way.

[0035] It will be understood by someone skilled in the art that many of the details provided above are by way of example only and can be altered or deleted without departing from the scope of the invention as set out in the following claims.

Claims

1. A tool for adjusting a valve or setting injector preload in an internal combustion engine having respectively a valve or fuel injector opening member with a male threaded member operatively and adjustably contacting the valve or fuel injector respectively and a locking nut threadably mounted on the male threaded member, wherein the tool includes:

a socket (24) having a socket cavity for fitting onto said locking nut, a handle (22) mounted to said socket (24) for rotating said socket (24) so as to loosen or tighten said locking nut along said male threaded member and

means (78, 82, 86 and 140, 141, 143, 176) co-operating with an elongate screwdriver bit (40) for measuring a predetermined amount of rotation of said screwdriver bit (40) when engaged with the male threaded member, as the male threaded member is rotated in the second rotational direction away from the valve or fuel injector, after having operatively contacted the valve or fuel injector, and thereby setting a specified amount of play between said valve or fuel injector opening member and the valve or fuel injector, **characterized in that** the tool further comprises:

said screwdriver bit (40) rotatably mounted in, and co-axially with, said socket (24) and said socket cavity for free rotation relative to said socket (24), said screwdriver bit (40) extending through an aperture in an end of said socket (24) opposite an open end of said socket (24) so as to dispose a tip (41) of said bit (40) into said socket cavity for engaging an end of said male threaded member when said socket (24) is fitted onto said locking nut,

a knob (30) mounted to an end of said

screwdriver bit (40) opposite said tip (41),
a clutch (90) mounted between said knob (30) and said screwdriver bit (40),
said screwdriver bit (40) engagable with the threaded member for rotating the threaded member towards or away from the valve or fuel injector;
the knob (30) and clutch (90) for rotating said screwdriver bit (40) in a first rotational direction so the male threaded member moves towards the valve or fuel injector and for rotating said screwdriver bit (40) in a second rotational direction so the male threaded member moves away from the valve or fuel injector;
said clutch (90) adapted so as to slip when the male threaded member operatively contacts the valve or fuel injector and takes up play between said valve or fuel injector opening member and the valve or fuel injector.

2. A tool as claimed in claim 1, wherein the male threaded member is a screw.

3. A tool as claimed in claim 1 or 2, wherein the clutch includes a torque sensor which releases said screwdriver bit when tightening torque applied to the male threaded member reaches a preset amount.

4. A tool as claimed in any preceding claim, including means for locking the clutch when the threaded member is rotated in the second rotational direction to prevent slippage between said screwdriver bit and the knob and clutch.

5. A tool as claimed in claim 4, wherein the means for locking includes a cam device.

6. A tool as claimed in claim 5, wherein the cam device includes an outer annular member, an inner cylindrical member within the annular member, rollers and means for resiliently biasing the rollers between the members.

7. A tool as claimed in claim 6, wherein the annular member has a plurality of recesses adjacent to the cylindrical member, the rollers being within the recesses.

8. A tool as claimed in claim 6 or 7, wherein the means for biasing includes a coil spring in each said recess.

9. A tool as claimed in claim 8, wherein each coil spring is angled acutely towards the cylindrical member with respect to a tangent of the cylindrical member.

10. A tool as claimed in any one of claims 7 - 9, wherein the recesses are equally spaced-apart about the cylindrical member.

11. A tool as claimed in any preceding claim, wherein the clutch includes a plurality of friction plates.

12. A tool as claimed in claim 11, wherein the friction plates are annular.

13. A tool as claimed in claim 6, wherein the outer annular member is operatively connected to said screwdriver bit and the inner cylindrical member is operatively connected to the knob and clutch.

14. A tool as claimed in claim 13, wherein the clutch includes a plurality of friction plates between the annular member and the means for rotating the screwdriver bit.

15. A tool as claimed in any preceding claim, wherein said socket and said handle form part of a torque wrench.

16. A tool as claimed in any one of claims 1-14, wherein said socket is rotatably mounted on the handle, and wherein the means for measuring the predetermined amount of rotation includes a magnetic needle rotatably mounted on the means for rotating, a magnet on the handle for maintaining the needle at a fixed rotational position with respect to the handle and a dial on the means for rotating to indicate rotation of the means for rotating relative to the needle.

17. A tool as claimed in any preceding claim, wherein the means for measuring the predetermined amount of rotation includes an electronic sensor.

18. A tool as claimed in claim 17, wherein the sensor includes an optical encoder, a microprocessor and an electronic readout.

19. A method of setting a valve clearance on an internal combustion engine having a rocker arm with a male threaded member operatively contacting a valve and a locking nut threadably mounted on the male threaded member comprising the steps of:

a) providing a tool according to any one of claims 1-18;

b) turning socket (24) and handle (22) so as to loosen any lock nut on the male threaded member;

c) turning screwdriver bit (40), knob (30) and clutch (90) so as to rotate the male threaded member in a first rotational direction towards the valve until the male threaded member operatively contacts the valve and the clutch (90) slips; and

d) turning screwdriver bit (40), knob (30) and clutch (90) so as to rotate the male threaded member in a second rotational direction, opposite the first direction, for a specified angle of rotation related to the pitch of the male threaded member as indicated on, and read from, said means for measuring a predetermined amount of rotation such that a specified clearance is set between the male threaded member and the valve.

20. A method as claimed in claim 19 including the step of calculating the specified angle of rotation from the specified clearance and the pitch of the male threaded member.

21. A method of setting injector preload on an internal combustion engine having a rocker arm with a male threaded member operatively contacting a fuel injector, and a locking nut threadably mounted on the male threaded member comprising the steps of:

a) supplying a tool according to one of the claims 1 to 18;

b) turning socket (24) and handle (22) so as to loosen any lock nut on the male threaded member;

c) turning screwdriver bit (40), knob (30) and clutch (90) so as to rotate the male threaded member in a first rotational direction towards the injector until the male threaded member operatively contacts the injector; and

d) turning screwdriver bit (40), knob (30) and clutch (90) so as to rotate the male threaded member in a second rotational direction, opposite the first direction, for a specified angle of rotation related to the pitch of the male threaded member as indicated on, and read from, said means for measuring a predetermined amount of rotation such that a specified clearance is set between the male threaded member and the injector.

22. A method as claimed in claim 21 including the step of calculating the specified angle of rotation from the specified clearance and the pitch of the male threaded member.

Patentansprüche

1. Werkzeug zum Justieren eines Ventils oder Einstellen einer Einspritzdüsenvorlast in einem Verbrennungsmotor, der mit einem Ventil- bzw. Kraftstoffeinspritzdüsenöffnungsteil mit einem betriebsfähig und justierbar das Ventil bzw. die Kraftstoffeinspritzdüse kontaktierenden Außengewindeteil und einer auf dem Außengewindeteil schraubbar montierten Klemmmutter ausgestattet ist, wobei das Werkzeug umfasst:

eine Aufnahme (24) mit einem Aufnahmehohlraum zum Aufstecken auf die Klemmmutter, einen an der Aufnahme (24) montierten Handgriff (22) zum Drehen der Aufnahme (24) zwecks Lösens oder Klemmens der Klemmmutter entlang dem Außengewindeteil und

mit einem langgestreckten Schraubendreherbit (40) zusammenwirkende Elemente (78, 82, 86 und 140, 141, 143, 176) für die Messung eines vorher festgelegten Drehwinkels des im Eingriff mit dem Außengewindeteil befindlichen Schraubendreherbits (40), wenn das Außengewindeteil, nachdem es beim Betriebenwerden das Ventil oder die Kraftstoffeinspritzdüse kontaktiert hat, durch Drehung in die zweite Drehrichtung vom Ventil oder der Einspritzeinrichtung weg bewegt wird und dadurch ein vorgeschriebenes Maß eines Spiels zwischen dem Ventil- oder Kraftstoffeinspritzdüsenöffnungsteil und dem Ventil oder der Kraftstoffeinspritzdüse eingestellt wird, **dadurch gekennzeichnet, dass**

das Schraubendreherbit (40) zur Aufnahme (24) und zum Aufnahmehohlraum koaxial ausgerichtet und darin zwecks freier Drehung relativ zur Aufnahme (24) drehbar montiert ist, wobei das Schraubendreherbit (40) durch eine Öffnung in einem Ende der Aufnahme (24) ragt, das einem offenen Ende der Aufnahme (24) gegenüberliegt, so dass sich eine Spitze (41) des Bits (40) innerhalb des Aufnahmehohlraums in Eingriff mit einem Ende des Außengewindeteils befindet, wenn die Aufnahme (24) auf die Klemmmutter gesteckt wird,

dass das Werkzeug außerdem umfasst:

einen an einem der Spitze (41) entgegengesetzten Ende des Schraubendreherbits (40) montierten Drehknopf (30),

eine zwischen dem Drehknopf (30) und dem Schraubendreherbit (40) montierte Kupplung (90),

wobei das Schraubendreherbit (40) zwecks Drehung des Gewindeteils hin zu oder weg von dem Ventil oder der Kraftstoffeinspritzdüse in das Gewindeteil eingreifen kann;

wobei sich das Außengewindeteil bei Drehung des Schraubendreherbits (40) durch den Drehknopf (30) und die Kupplung (90) in eine erste Drehrichtung zum Ventil oder der Kraftstoffeinspritzdüse hin bewegt und sich bei Drehung des Schraubendreherbits (40) in eine zweite Drehrichtung vom Ventil oder der Kraftstoffeinspritzdüse weg bewegt;

wobei die Kupplung (90) so ausgelegt ist, dass sie rutscht, wenn das Außengewindeteil beim Betriebenwerden das Ventil oder die Kraftstoffeinspritzdüse kontaktiert und das Spiel zwischen dem Ventil- oder Kraftstoffeinspritzdüsenöffnungsteil und dem Ventil oder der Kraftstoffeinspritzdüse beseitigt.

2. Werkzeug nach Anspruch 1, wobei das Außengewindeteil eine Schraube ist.

3. Werkzeug nach Anspruch 1 oder 2, wobei die Kupplung einen Drehmomentsensor enthält, der das Schraubendreherbit entriegelt, wenn das auf das Außengewindeteil aufgebrachte Anzugsmoment einen festgelegten Wert erreicht.

4. Werkzeug nach jedem der voranstehenden Ansprüche, Elemente zum Sperren der Kupplung enthaltend, um ein Rutschen zwischen dem Schraubendreherbit und dem Drehknopf und der Kupplung zu verhindern, wenn das Außengewindeteil in die zweite Drehrichtung gedreht wird.

5. Werkzeug nach Anspruch 4, wobei das Element zum Sperren eine Nockeneinrichtung enthält.

6. Werkzeug nach Anspruch 5, wobei die Nockeneinrichtung ein Außenringteil, ein Innenzylinderteil innerhalb des Außenringteils, Rollen und Elemente zum federnden Vorspannen der Rollen zwischen den Teilen enthält.

7. Werkzeug nach Anspruch 6, wobei das Ringteil mit einer Vielzahl von an das Innenteil angrenzenden Vertiefungen ausgestattet ist, wobei sich in den Vertiefungen die Rollen befinden.

8. Werkzeug nach Anspruch 6 oder 7, wobei das Element zum Vorspannen eine Spiralfeder in jeder Vertiefung enthält.

9. Werkzeug nach Anspruch 8, wobei sich jede Spiralfeder im spitzen Winkel zum Zylinderteil bezogen auf eine Tangente des Zylinderteils befindet.

10. Werkzeug nach einem der Ansprüche 7 bis 9, wobei die Vertiefungen äquidistant über dem Zylinderteil verteilt sind.

11. Werkzeug nach jedem voranstehenden Anspruch, wobei die Kupplung eine Vielzahl von Reibscheiben enthält.

12. Werkzeug nach Anspruch 11, wobei die Reibscheiben ringförmig sind.

13. Werkzeug nach Anspruch 6, wobei das Außenringteil mit dem Schraubendreherbit betriebsfähig verbunden ist und das Innenzylinderteil mit dem Drehknopf und der Kupplung betriebsfähig verbunden ist.

14. Werkzeug nach Anspruch 13, wobei die Kupplung eine Vielzahl von Reibscheiben zwischen dem Ringteil und dem Drehelement des Schraubendreherbits enthält.

15. Werkzeug nach jedem der voranstehenden Ansprüche, wobei die Aufnahme und der Handgriff einen Teil eines Drehmomentschlüssels bilden.

16. Werkzeug nach jedem der Ansprüche 1 bis 14, wobei die Aufnahme drehbar am Handgriff montiert ist und wobei das Element zur Messung des vorher festgelegten Drehwinkels eine am Drehelement drehbar montierte Magnetnadel, ein Magnet am Handgriff zum Halten der Nadel in einer festen Drehstellung in Bezug auf den Handgriff und eine Skala auf dem Drehelement zum Anzeigen der zur Nadel relativen Drehung des Drehelements enthält.

17. Werkzeug nach jedem der voranstehenden Ansprüche, wobei das Element für die Messung eines vorher festgelegten Drehwinkels einen elektronischen Sensor enthält.

18. Werkzeug nach Anspruch 17, wobei der Sensor einen optischen Kodierer, einen Mikroprozessor und eine elektronische Ausgabeeinrichtung enthält.

19. Verfahren zum Einstellen eines Ventilspiels an einem Verbrennungsmotor, der einen Kipphebel mit einem ein Ventil betriebsfähig kontaktierenden Außengewindeteil und eine auf dem Außengewindeteil schraubbar montierte Klemmmutter besitzt, die Schritte umfassend:

a) Bereitstellen eines Werkzeugs entsprechend jedem der Ansprüche 1 bis 18;

b) Drehen von Aufnahme (24) und Handgriff (22) zum Lösen jeder Klemmmutter auf dem Außengewindeteil;
c) Drehen von Schraubendreherbit (40), Drehknopf (30) und Kupplung (90) zwecks Drehung des Außengewindeteils in eine erste Drehrichtung hin zum Ventil, bis das Außengewindeteil das Ventil betriebsfähig kontaktiert und die Kupplung (90) rutscht; und
d) Drehen von Schraubendreherbit (40), Drehknopf (30) und Kupplung (90) zwecks Drehung des Außengewindeteils in eine zur ersten Richtung entgegengesetzte zweite Drehrichtung um einen vorgeschriebenen, auf die Gewindesteigung des Außengewindeteils bezogenen Drehwinkel, der auf dem Element zur Messung des vorher festgelegten Drehwinkels angezeigt und von dort ausgegeben wird, so dass ein vorgeschriebenes Spiel zwischen dem Außengewindeteil und dem Ventil eingestellt wird.

20. Verfahren nach Anspruch 19, umfassend den Schritt der Berechnung des vorgeschriebenen Drehwinkels aus dem vorgeschriebenen Spiel und der Gewindesteigung des Außengewindeteils.

21. Verfahren zum Einstellen einer Einspritzdüsenvorlast an einem Verbrennungsmotor, der einen Kipphebel mit einem eine Kraftstoffeinspritzdüse betriebsfähig kontaktierenden Außengewindeteil und eine auf dem Außengewindeteil aufgeschraubte Klemmmutter besitzt, die Schritte umfassend:.

a) Bereitstellen eines Werkzeugs entsprechend jedem der Ansprüche 1 bis 18;
b) Drehen von Aufnahme (24) und Handgriff (22) zum Lösen jeder Klemmmutter auf dem Außengewindeteil;
c) Drehen von Schraubendreherbit (40), Drehknopf (30) und Kupplung (90) zwecks Drehung des Außengewindeteils in eine erste Drehrichtung hin zur Kraftstoffeinspritzdüse, bis das Außengewindeteil die Kraftstoffeinspritzdüse betriebsfähig kontaktiert; und
d) Drehen von Schraubendreherbit (40), Drehknopf (30) und Kupplung (90) zwecks Drehung des Außengewindeteils in eine zur ersten Richtung entgegengesetzte zweite Drehrichtung um einen vorgeschriebenen, auf die Gewindesteigung des Außengewindeteils bezogenen Drehwinkel, der auf dem Element zur Messung des vorher festgelegten Drehwinkels angezeigt und von dort ausgegeben wird, so dass ein vorgeschriebenes Spiel zwischen dem Außengewindeteil und der Kraftstoffeinspritzdüse eingestellt wird.

22. Verfahren nach Anspruch 21, umfassend den Schritt der Berechnung des vorgeschriebenen Drehwinkels aus dem vorgeschriebenen Spiel und der Gewindesteigung des Außengewindeteils.

Revendications

1. Outil pour ajuster une soupape ou pour régler la précharge d'un injecteur d'un moteur à combustion interne, comprenant un élément d'ouverture, respectivement pour une soupape ou un injecteur de carburant, ayant un élément mâle fileté, en contact de manière ajuatable et fonctionnelle avec respectivement la soupape ou l'injecteur de carburant, et un écrou de blocage monté par vissage sur l'élément mâle fileté, cet outil comprenant :

- une douille (24) ayant une cavité de douille pour s'ajuster sur ledit écrou de blocage, une poignée (22) montée sur ladite douille (24) pour faire tourner ladite douille (24) de façon à desserrer ou serrer ledit écrou de blocage le long dudit élément mâle fileté,
- et des moyens (78, 82, 86 et 140, 141, 143, 176) coopérant avec un embout allongé de tournevis (40), pour mesurer une valeur d'angle de rotation dudit embout de tournevis (40) lorsqu'il est en prise avec l'élément mâle fileté, lorsque l'on fait tourner l'élément mâle fileté selon un deuxième sens de rotation, éloignant de la soupape ou de l'injecteur, après avoir été en contact fonctionnel avec la soupape ou l'injecteur de carburant, en établissant ainsi un certain jeu entre ledit élément d'ouverture de la soupape ou injecteur de carburant, et la soupape ou l'injecteur de carburant, **caractérisé en ce que** cet outil comprend en outre :

  - ledit embout de tournevis (40) est monté rotatif à l'intérieur de, et coaxialement avec, ladite douille (24) et ladite cavité de douille pour une rotation libre relativement à ladite douille (24), ledit embout de tournevis (40) s'étendant au travers d'un orifice dans une extrémité de ladite douille (24), opposée à une extrémité ouverte de ladite douille (24) de sorte qu'une pointe (41) dudit embout (40) soit positionnée dans ladite cavité de la douille pour être en prise avec une extrémité dudit élément mâle fileté lorsque ladite douille (24) est positionnée sur ledit écrou de blocage,
  - un bouton (30) monté sur une extrémité dudit embout (40) opposée à ladite pointe (41),
  - un embrayage (90) monté entre ledit bouton (30) et ledit embout de tournevis (40),
  - ledit embout de tournevis (40) pouvant ve-

nir en prise avec l'élément mâle fileté pour faire tourner l'élément fileté en le rapprochant ou l'éloignant de ladite soupape ou dudit injecteur de carburant ;

- le bouton (30) et l'embrayage (90) permettant de faire tourner l'embout de tournevis (40) dans un premier sens de rotation de sorte que l'élément mâle fileté se rapproche de la soupape ou de l'injecteur de carburant, et permettant de faire tourner ledit embout de tournevis (40) dans un deuxième sens de rotation de sorte que l'élément mâle fileté s'éloigne de la soupape ou de l'injecteur de carburant ;
- ledit embrayage (90) étant conçu pour glisser lorsque l'élément mâle fileté est en contact fonctionnel avec la soupape ou l'injecteur de carburant, et rattraper le jeu entre ledit élément d'ouverture de la soupape ou de l'injecteur de contact, et ladite soupape ou ledit injecteur de carburant.

2. Outil selon la revendication 1, dans lequel l'élément mâle fileté est une vis.

3. Outil selon la revendication 1 ou 2, dans lequel l'embrayage comprend un capteur de couple qui libère ledit embout de tournevis lorsque le couple de serrage appliqué à l'élément mâle fileté atteint une valeur prédéterminée.

4. Outil selon l'une quelconque des précédentes revendications, comprenant des moyens pour bloquer l'embrayage lorsque l'on fait tourner l'élément fileté dans le deuxième sens de rotation pour empêcher un glissement entre l'embout de tournevis et le bouton et l'embrayage.

5. Outil selon la revendication 4, dans lequel les moyens de blocage comprennent un dispositif à came.

6. Outil selon la revendication 5, dans lequel le dispositif à came comprend un élément annulaire extérieur, un élément cylindrique intérieur à l'intérieur de l'élément annulaire, des galets et des moyens pour contraindre élastiquement les galets entre les éléments.

7. Outil selon la revendication 6, dans lequel l'élément annulaire comprend plusieurs logements, adjacents à l'élément cylindrique, les galets étant logés dans les logements.

8. Outil selon la revendication 6 ou 7, dans lequel les moyens pour contraindre comprennent un ressort hélicoïdal dans chacun desdits logements.

9. Outil selon la revendication 8, dans lequel chaque ressort hélicoïdal est incliné vers l'élément cylindrique suivant un angle aigu relativement à une tangente à l'élément cylindrique.

10. Outil selon l'une quelconque des revendications 7 à 9, dans lequel les logements sont régulièrement répartis autour de l'élément cylindrique.

11. Outil selon l'une quelconque des revendications précédentes, dans lequel l'embrayage comprend plusieurs plaques de friction.

12. Outil selon la revendication 11, dans lequel les plaques de friction sont annulaires.

13. Outil selon la revendication 6, dans lequel l'élément annulaire extérieur est relié fonctionnellement audit embout de tournevis et l'élément cylindrique intérieur est relié fonctionnellement au bouton et à l'embrayage.

14. Outil selon la revendication 13, dans lequel l'embrayage comprend plusieurs plaques de friction entre l'élément annulaire et les moyens pour faire tourner l'embout de tournevis.

15. Outil selon l'une quelconque les revendications précédentes, dans lequel ladite douille et ladite poignée forment une partie d'une clef dynamométrique.

16. Outil selon l'une quelconque des revendications 1 à 14, dans lequel ladite douille est montée en rotation sur la poignée, outil dans lequel les moyens pour mesurer la valeur prédéterminée de l'angle de rotation, comprennent une aiguille magnétique montée en rotation sur les moyens de rotation, un aimant sur la poignée pour maintenir l'aiguille dans une position angulaire fixe relativement à la poignée et un cadran sur les moyens de rotation pour indiquer l'angle de rotation des moyens de rotation relativement à l'aiguille.

17. Outil selon l'une quelconque des revendications précédentes, dans lequel les moyens pour mesurer la valeur d'angle de rotation prédéterminée comprennent un capteur électronique.

18. Outil selon la revendication 17, dans lequel le capteur comprend un encodeur optique, un microprocesseur et un système de lecture électronique.

19. Procédé pour régler le jeu d'une soupape sur un moteur à combustion interne ayant un culbuteur comprenant un élément mâle fileté en contact fonctionnel avec une soupape et un écrou de blocage monté par vissage sur l'élément mâle fileté, com-

prenant les étapes suivantes :

a) disposer d'un outil selon l'une quelconque des revendications 1 à 18 ;
b) faire tourner la douille (24) et la poignée (22) de façon à desserrer tout écrou de blocage sur l'élément mâle fileté ;
c) faire tourner l'embout de tournevis (40), le bouton (30) et l'embrayage (90) de façon à faire tourner l'élément mâle fileté dans un premier sens de rotation, en direction de la soupape, jusqu'à ce que l'élément mâle fileté soit en contact fonctionnel avec la soupape et que l'embrayage (90) glisse ; et,
d) faire tourner l'embout de tournevis (40), le bouton (30) et l'embrayage (90) de façon à faire tourner l'élément mâle fileté dans un deuxième sens de rotation, opposé au premier sens, d'un angle de rotation spécifié, fonction du pas de l'élément mâle fileté, ledit angle étant indiqué sur les et lu à partir des, moyens pour mesurer une valeur d'angle de rotation, de sorte qu'un jeu spécifique est ménagé entre l'élément fileté et la soupape.

20. Procédé selon la revendication 19, comprenant une étape pour calculer l'angle de rotation spécifié en fonction du jeu spécifié et du pas de l'élément mâle fileté.

21. Procédé pour régler la précharge d'un injecteur sur un moteur à combustion interne ayant un culbuteur avec un élément mâle fileté en contact fonctionnel avec un injecteur de carburant, et un écrou de blocage monté par vissage sur l'élément mâle fileté, comprenant les étapes suivantes :

a) disposer d'un outil selon l'une des revendications 1 à 18 ;
b) faire tourner la douille (24) et la poignée (22) de façon à desserrer tout écrou de blocage sur l'élément mâle fileté ;
c) faire tourner l'embout de tournevis (40), le bouton (30) et l'embrayage (90) de façon à faire tourner l'élément mâle fileté selon un premier sens de rotation, vers l'injecteur, jusqu'à ce que l'élément mâle fileté soit en contact fonctionnel avec l'injecteur ; et,
d) faire tourner l'embout de tournevis (40), le bouton (30) et l'embrayage (90) de façon à faire tourner l'élément mâle fileté selon un deuxième sens de rotation, opposé au premier sens, d'un angle de rotation spécifié, fonction du pas de l'élément mâle fileté, ledit angle étant indiqué sur les, et lu à partir des, moyens pour mesurer une valeur d'angle de rotation prédéterminé de sorte qu'un jeu spécifié est ménagé entre l'élément mâle fileté et l'injecteur.

22. Procédé selon la revendication 21, comprenant une étape pour calculer l'angle spécifié de rotation en fonction du jeu spécifié et du pas de l'élément mâle fileté.

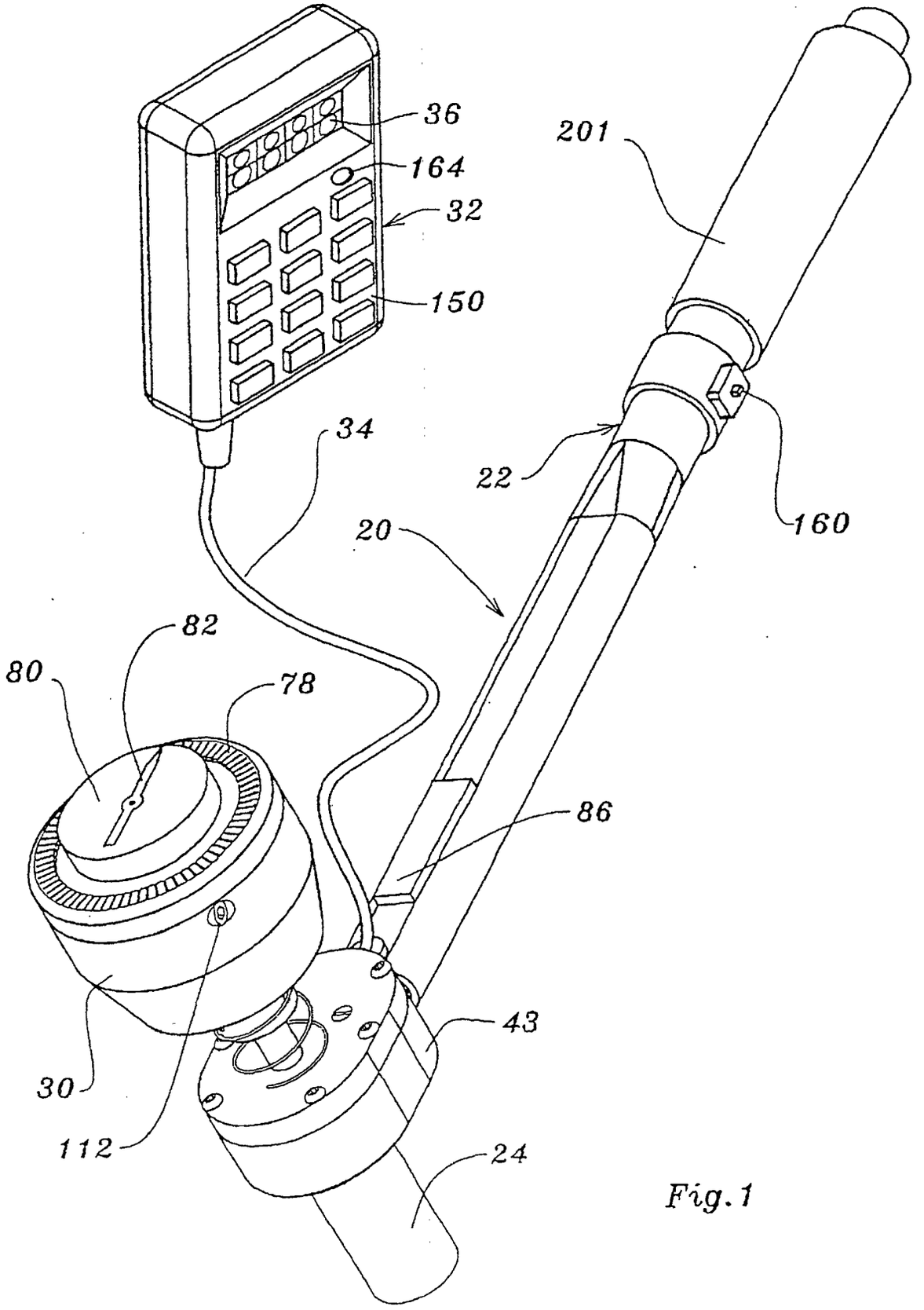

Fig. 1

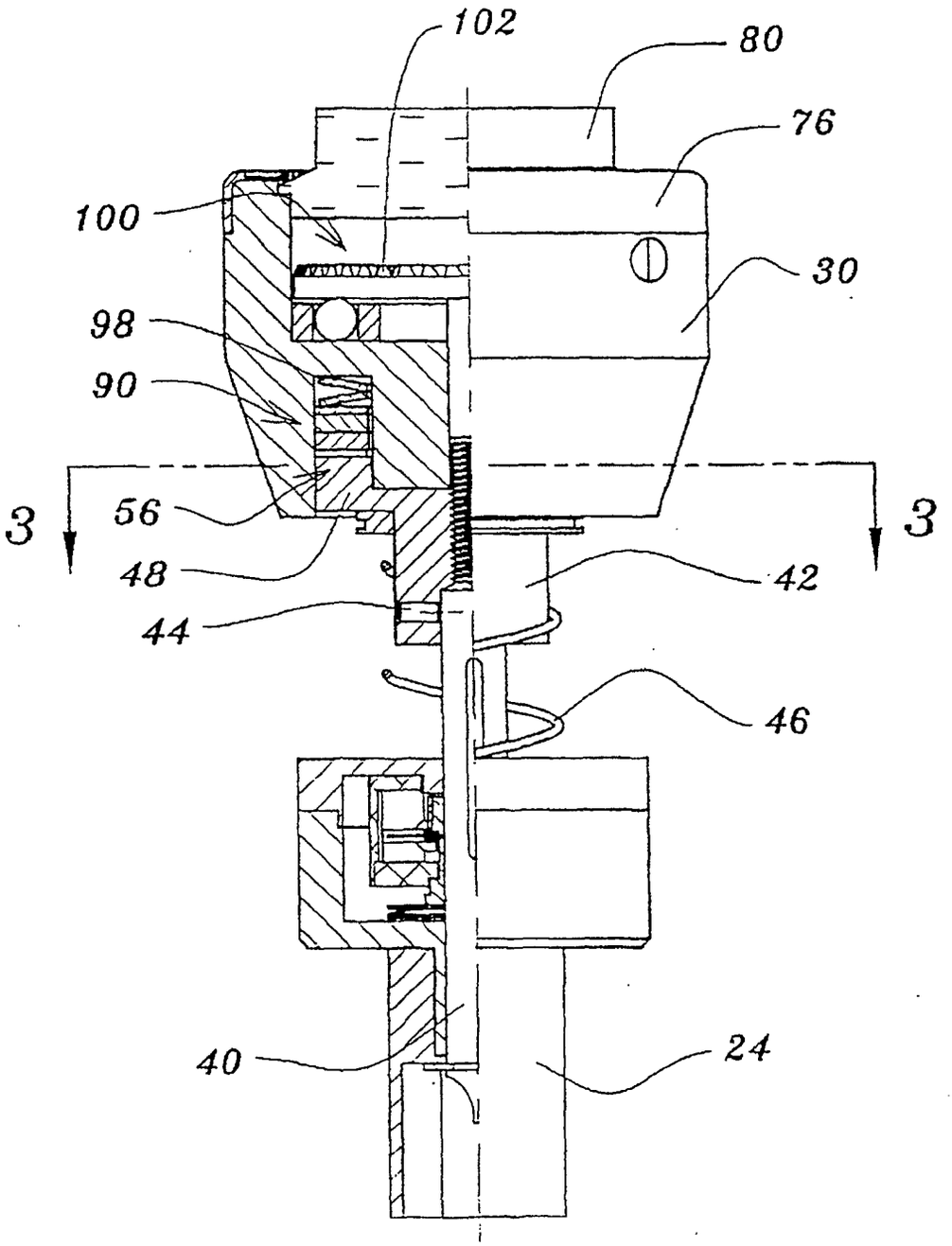

Fig. 2

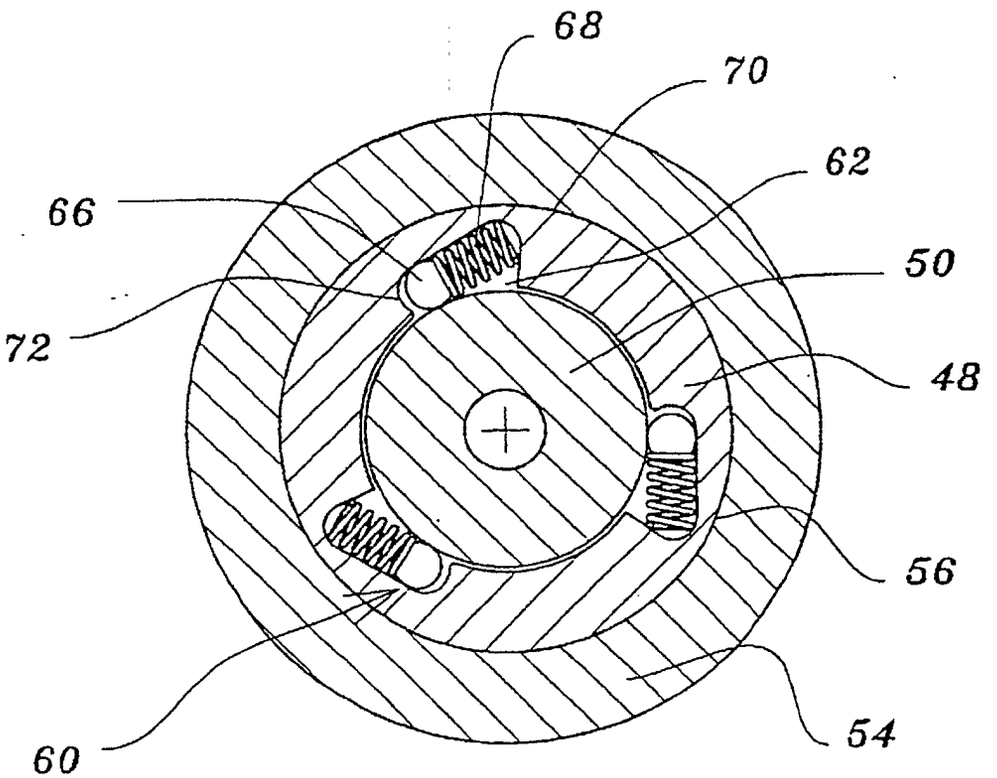

Fig. 3

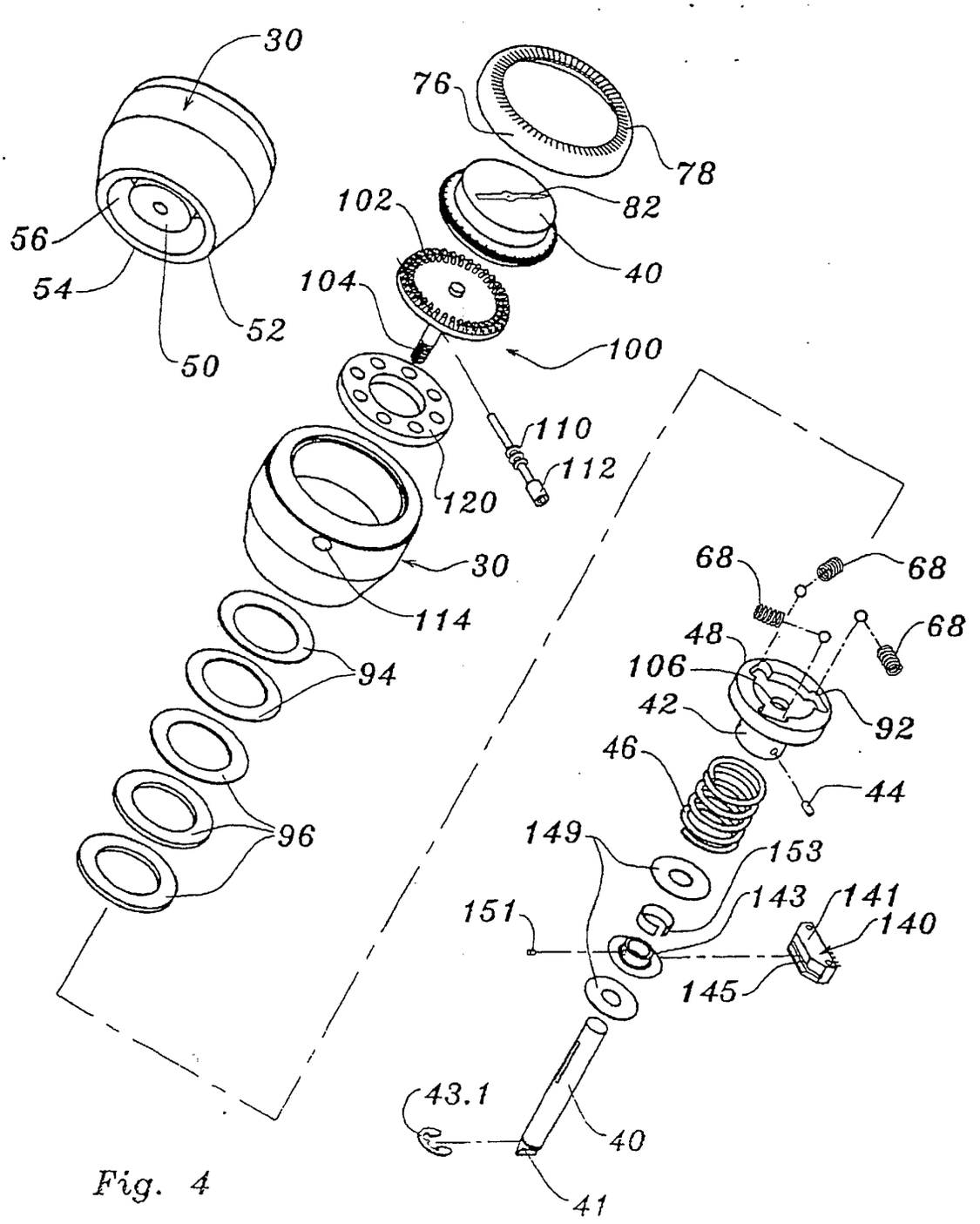
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Fig. 4

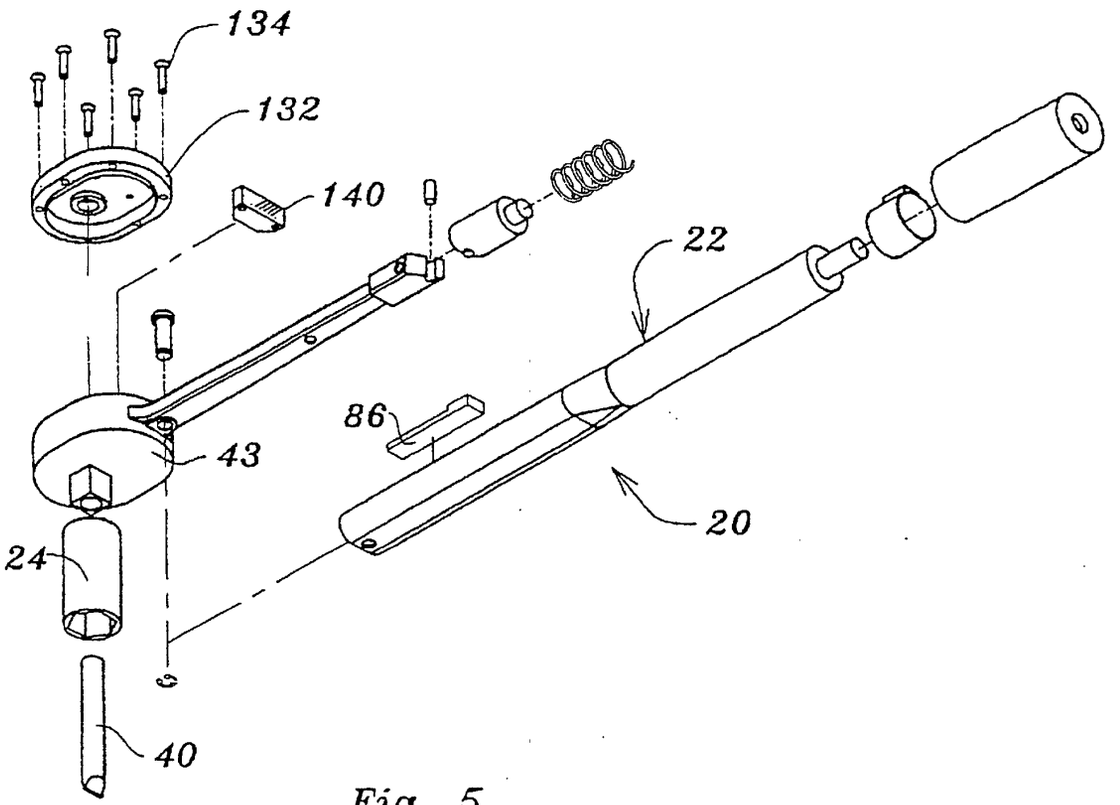

Fig. 5

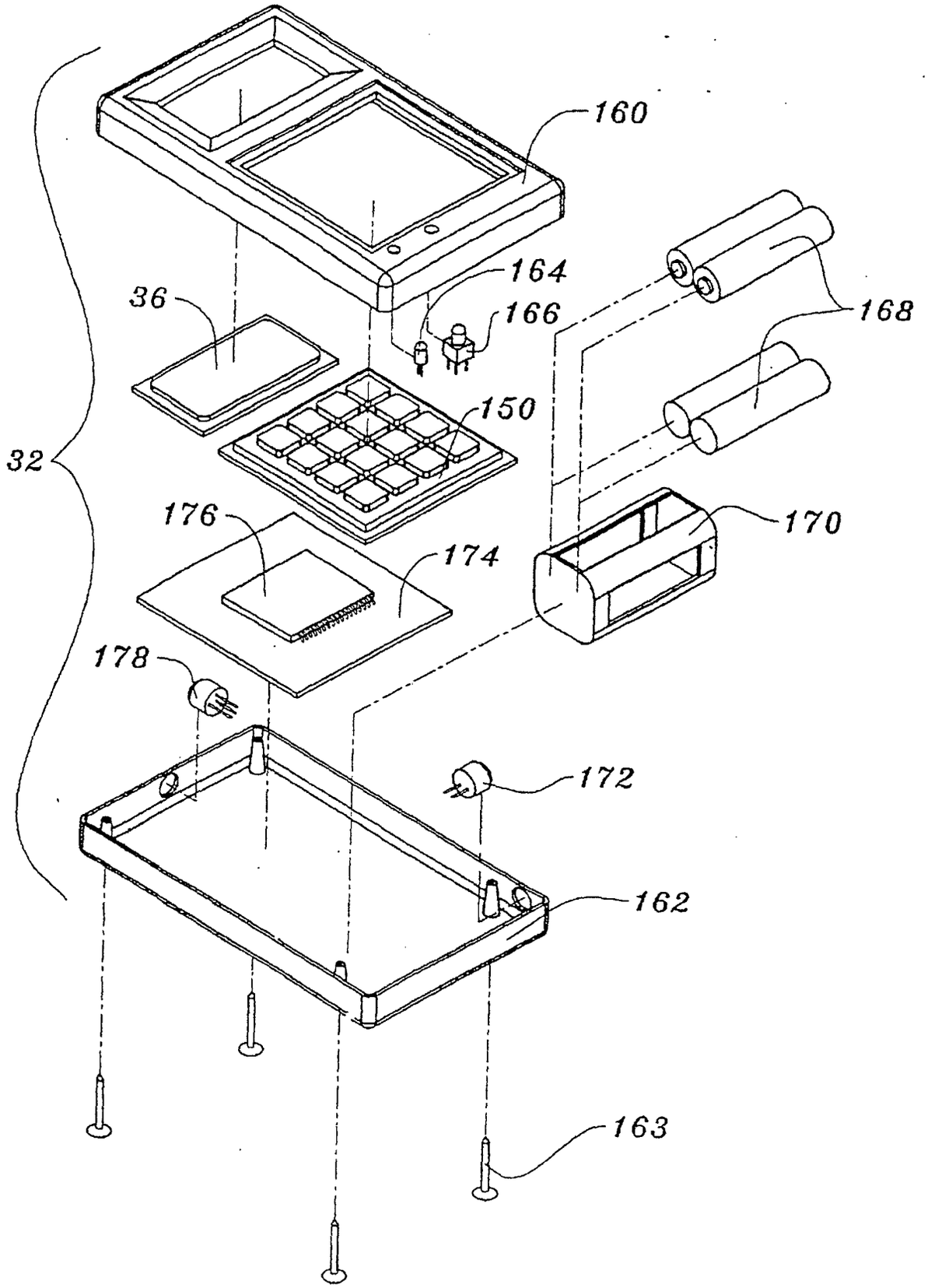

Fig. 6