

[72] Inventor **Ronald Frederick States**  
**London, England**  
 [21] Appl. No. **861,898**  
 [22] Filed **Sept. 29, 1969**  
 [45] Patented **May 11, 1971**  
 [73] Assignee **Desoutter Brothers Limited**  
**Hendon, London, England**  
 [32] Priority **Nov. 29, 1968**  
 [33] **Great Britain**  
 [31] **56653/68**

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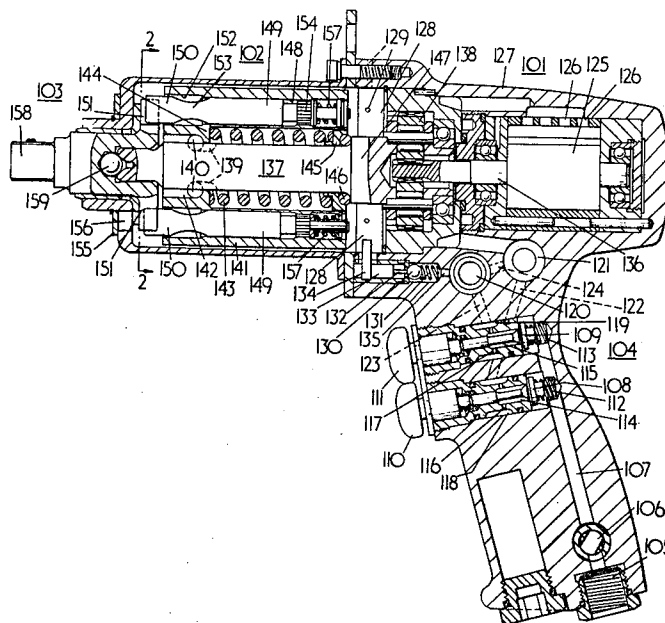
*Primary Examiner*—Ernest R. Purser  
*Attorney*—Irving M. Weiner

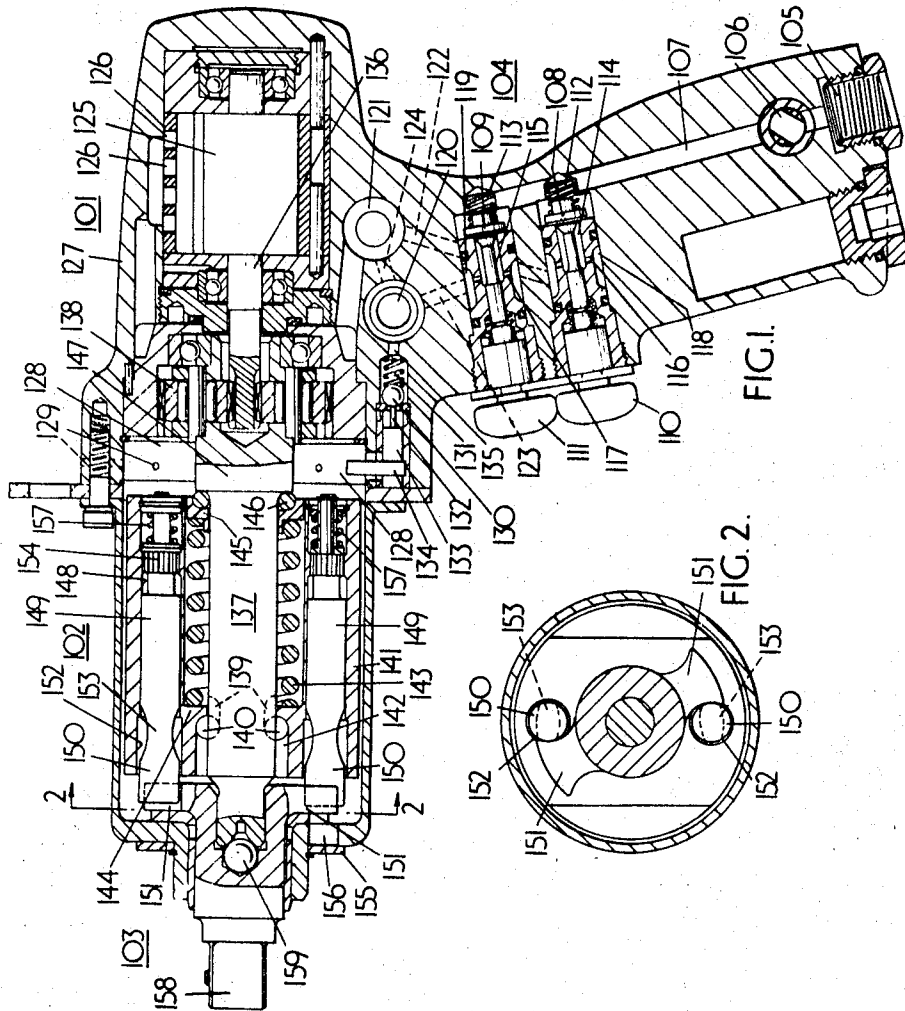
[54] **POWER-OPERATED IMPACT WRENCH OR  
 SCREWDRIVER**  
**10 Claims, 6 Drawing Figs.**

[52] U.S. Cl. .... **173/12,**  
**173/93.5, 192/150**  
 [51] Int. Cl. .... **B25b 23/14**  
 [50] Field of Search ..... **173/12;**  
**192/150**

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**ABSTRACT:** A power-operated impact wrench, screwdriver or like rotary tool with relatively movable hammer and anvil members and means for automatically causing them to become engaged and disengaged cyclically in which there is means for causing disengagement of the hammer members from the anvil members at a value of torque above a predetermined value comprising an inertia means which is coupled to the hammer member by resilient means the values of which are so chosen that values of torque below the predetermined cutoff value the inertia means is constrained by the resilient means from moving relative to the hammer means and the tool operates in a normal manner while at a value of torque above the predetermined value inertia means move against the action of the resilient means thereby to allow the amount of disengagement movement of members to increase and operate control means to interrupt a supply of power to the tool.





INVENTOR  
RONALD FREDERICK STATES  
BY *Frederick M. States*  
ATTORNEYS

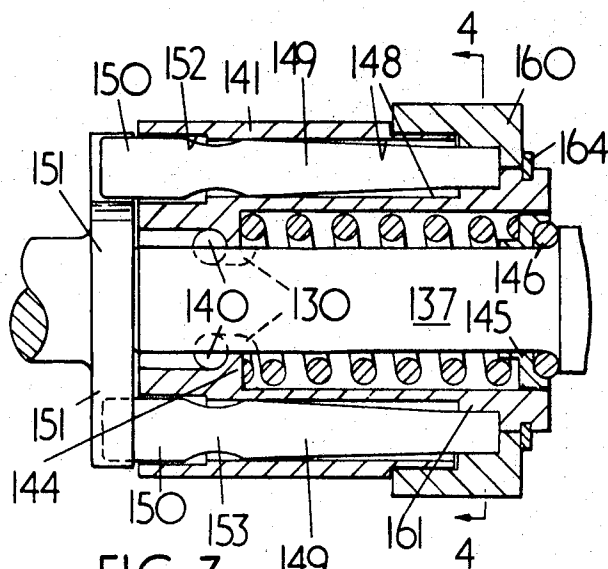


FIG. 3.

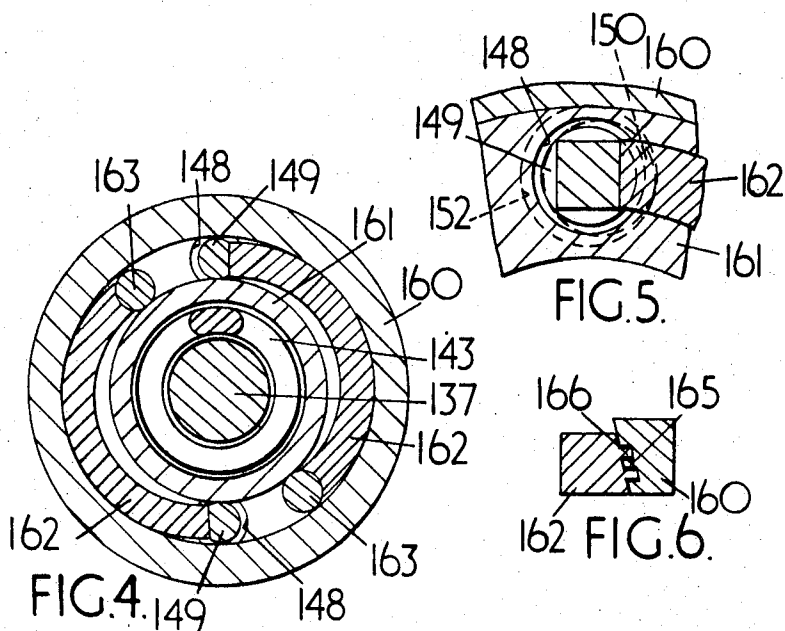


FIG. 4.

INVENTOR  
RONALD FREDERICK STATES  
BY *Frederick H. Wainer*  
ATTORNEYS

# POWER-OPERATED IMPACT WRENCH OR SCREWDRIVER

The invention relates to portable power-operated impact wrenches, screwdrivers and like rotary impact tools of the kind comprising relatively movable anvil and hammer members with means for automatically causing them to become engaged and disengaged as required in the operation of the tool, and is an improvement in or modification of the invention described and claimed in the specification of our Pat. application Ser. No. 743,100 which consists in a power-operated impact wrench, screwdriver or like rotary tool of the kind comprising relatively movable hammer and anvil members with means for automatically causing them to become engaged and disengaged cyclically, characterized in that there is provided inertia means coupled to the hammer member by resilient means in such manner that, at values of torque below a predetermined value, the inertia means is constrained by the resilient means from moving relative to the hammer means, while at the predetermined value of torque the inertia means move relative to the hammer means and thereby acts upon the said automatic means to increase the amount of disengagement movement of the members and operates control means to interrupt a supply of power to the tool.

The invention described and claimed in our application Ser. No. 743,100 consists in a power-operated impact tool as set forth in the preceding paragraph, in which the hammer and anvil members execute a rotary motion during the operation of the tool, the hammer member continuously and the anvil member intermittently when struck by the hammer member, while the inertia member is a rotary means associated with the hammer member and having abutment surfaces therebetween, between which pressure of a predetermined value is applied by resilient means, the abutment surfaces being capable of moving one from the other against the action of the resilient means a restricted amount, when the hammer member strikes the anvil member, and upon coming into contact again imparts a force to the hammer member which acts to increase the amplitude of disengagement movement of the hammer member from the anvil member.

In the embodiment described and illustrated in our copending application the spring means for applying pressure of a predetermined value to the abutment surfaces between the inertia member and the hammer member is a torsion cylinder with axial slots in the wall thereof.

It has been found that the torsion cylinder is difficult and expensive to manufacture, and it is therefore proposed to provide spring means of alternative forms as hereinafter described.

The present invention consists in a power-operated impact wrench, screwdriver or like tool as claimed in our application Ser. No. 743,100 in which the spring means comprises a pair of resilient levers one end of which acts upon or is formed integral with a hammer member, and each of which means is supported within a bore in the inertia means.

The invention further consists in a power-operated impact wrench, screwdriver or like rotary tool in which each resilient lever presents a different resistance to bending in different radial directions, and is rotatable around its longitudinal axis to change the effective resistance to bending to change the predetermined maximum value of torsion delivered by the tool.

The invention still further consists in a power-operated impact wrench, screwdriver or like rotary tool as set forth above, in which the ends of the resilient levers remote from the hammers are acted upon by a cam-operated lever mechanism which prestresses the lever against an abutment surface upon the inertia means positioned in advance of the hammer members when rotated in the normal direction of operation of the tool.

The accompanying drawings show, by way of example only, two embodiments of the invention in which, FIG. 1 is a longitudinal section of the tool, FIG. 2 is a cross section on the line 2-2 of FIG. 1,

FIG. 3 is a longitudinal section of part of the tool of FIG. 1 showing an alternative arrangement,

FIG. 4 is a cross section on the line 4-4 of FIG. 3,

FIG. 5 is a part cross section on the line 4-4 showing an alternative mode of constructing the spring means, while

FIG. 6 is a radial section through the adjusting ring showing a conical construction instead of the cam construction of FIG. 4.

The tool illustrated is of the pistol-grip type and comprises a motor and gear portion 101, a torque control and hammer and anvil portion 102, a head portion 103 and a pistol-grip portion 104.

The tool illustrated is of the kind in which the maximum torque which can be delivered is controlled in one direction of rotation, but is not so controlled in the reverse direction of rotation. There is no reason why a tool constructed in accordance with the invention should not be designed to be controlled in both directions of rotation. In the tool illustrated the torque control operates only when the output shaft is rotating in a clockwise direction.

Air passes to the tool by way of a flexible tube connected to the connector 105 at the bottom of the pistol-grip portion 104, and passes by way of the adjustable flow constriction valve 106, into the passageway 107, by which it reaches the heads 108 and 109 of the pushbutton valves 110 and 111. Valve 110 when pressed causes the motor to rotate in the anticlockwise direction and valve 111 in the clockwise direction.

By operation of the knobs of the valves 110 and 111 the stems of the valves are shifted longitudinally and the heads 108 and 109 respectively are lifted off their seatings, against the action of the springs 112 and 113 respectively. The air passing under the head of the valve enters the cavity 114 or 115, as the case may be, and passes through the radial ports 116 and 117 and enters the circumferential grooves 118 or 119.

Above the valves 110 and 111 are two piston valves 120 and 121, arranged transversely of the tool, the air from the circumferential groove 118 of the pushbutton valve 110 passing directly to the piston valve 121, by way of the passage 122, and from the circumferential groove 119 to the valve 121 by way of the valve 120, via passages 123 and 124.

Piston valve 121 is a conventional two-position valve which directs the air from the change direction pushbutton valves 110 and 111 to one or other of alternative sets of inlet ports entering the bottom of the cylinder of the vane-type motor 125, depending from which of the channels 122 and 124 the air is received. This valve also connects the other set of inlet ports to atmosphere, to relieve the pressure in front of the vanes, while the main exhaust from the cylinder is by way of the ports 126, by channels not shown in the inner surface of the casing 127, the cavity 128 and radial ports 129 in the casing.

The piston valve 120 is an on/off valve in which the piston is moved against the action of a spring by air from the passage 123 to open a port to the passage 124. The ball valve 130 is held closed by the spring 131, and is opened by the rod 132 in extension of plunger 133, which latter has a trigger 134 which projects into the cavity 128, and is moved by the hammer mechanism as hereinafter described, when a predetermined maximum value of torque is applied by the tool.

When the ball valve 130 is opened, air from in front of the piston of the valve 120 is allowed to leak away by way of the passage 135 and the valve is forced to close by the spring above referred to, and the motor stops. No such action takes place in the tool illustrated when the reverse pushbutton valve is operated.

Shaft 136 of the motor 125 is extended, and drives the enlarged shaft 137 by way of the gear 138. The enlarged shaft 137 is positioned in the torque control and hammer and anvil portion 102, and is provided with grooves 139 of arcuate cross section, in the form of a Vee with its apex towards the head of the tool, and an opposite sides of the shaft, each containing a ball 140.

Around the shaft 137 and concentric therewith is positioned a cylindrical inertia member 141, which has a pair of straight grooves 142 of arcuate cross section, parallel to the axis of the shaft 137, and on the inner surface of a projection 144 on the member 141 into which the ball 140 projects. Upon rotation of the shaft 137 and the inertia member 141 relative to one another, the balls are constrained to follow either the one or the other of the sides of the Vee formed by the grooves in the shaft, and inertia member is urged to move longitudinally of the shaft in the direction of the motor 125. This longitudinal movement acts to compress the helical spring 143, which abuts one end of the inward projection 144 from the inertia member 141, and at the other end the thrust ring 145, and the balls 146 against the enlarged portion 147 of the shaft 137.

The use of balls running in grooves forming a Vee in a shaft to provide longitudinal movement of a cylindrical member to produce against the action of a spring, cyclic engagement and disengagement of hammer and anvil members is similar to that used in the construction disclosed in our copending application, but whereas in this prior proposal the hammer members are positively driven by the balls, and the inertia member is coupled to the hammer members by a torsion cylinder action as resilient means, in the constructions disclosed in this specification the inertia member is positively driven by the balls, and the hammer members are coupled to the inertia member by spring levers acting as the resilient means.

The construction shown in FIGS. 1 and 2, and in FIGS. 3 and 4 are similar, inasmuch as the cylindrical inertia member is provided with diametrically opposite longitudinal bores 148, which contain spring levers 149, but differ as to the way in which the resistance to bending of the spring levers is changeable to change the value of the maximum torque which the tool will deliver.

In both constructions the spring levers 149 make a close fit in the bore 148 intermediate their ends, and the sides of the bore form a fulcrum. The end of each lever adjacent the nose of the tool is formed as a hammer 150, which is circular in cross section, and they each engage the side of an anvil member 151, cyclically, as the inertia cylinder 141 rotates, disengagement after contact and withdrawal of the hammer longitudinally being carried out by the balls as previously described, after which, under the action of the spring 143 the hammers reenter the spaces between the anvil members and carry out the next hammer stroke. This cyclic action continues as the motor 125 is in operation.

An abutment surface is provided in continuation of the bore 148 on that side of the bore in advance of the hammer, when the tool is rotating in a clockwise direction. This abutment surface is provided by an eccentric bore 152 of larger diameter, displaced by the difference in radius, so that the surfaces at the side in advance of the hammer become coextensive. The diameter of the hammer, in the construction shown in FIGS. 1 and 2 is such that a close fit of the hammer with the abutment surface is made, while there is freedom for the hammer to move away from this surface when the spring lever is deflected.

In the construction of FIGS. 1 and 2 the spring levers 149 are of varying cross-sectional width about their waist 153, and therefore have different resistances to bending in different radial directions. So that the resistance to bending may be changed, to change the value of maximum torque which the tool can deliver, each spring lever is rotatable about its longitudinal axis in relation to the bore 148.

The end of each spring lever 149 is provided with splines 154, which are disengageable from splines in the bore, by turning the cover plate 155 on the nose of the tool to expose the bore 156, and by inserting a tool which engages the end of the hammer 150, and by pressing against the action of the spring 157, the spring lever can be turned and then released to occupy another position.

The pair of spring levers are matched as to their resistance to bending in the various alternative positions, with the result that when both are in the same position a balanced structure is provided.

The anvil members 151 are formed integral with the toolholder 158, which is centered with the shaft 137 by the end thrust ball 159.

When the tool is used as a stud runner, for example, the tool used is a nutlike member with a threaded bore, and the stud is drawn into the nutlike member by pressing momentarily the clockwise rotation button on the tool. The stud is then inserted in the bore in the workpiece, and the clockwise rotation button is again pressed. When there is no resistance or very little resistance to the rotation of the toolholder 158, the hammers press against the anvils and the inertia member and the toolholder rotate together. When, however, resistance to rotation takes place as the stud enters the bore, the balls roll along to grooves in the shaft 137 and the hammers are withdrawn cyclically and returned to the positions shown in FIGS. 1 and 2, where they each deliver a blow to the anvil members 151.

When the resistance to rotation is moderate and the torque required to rotate the stud is less than the maximum predetermined torque required to be applied to the stud, the hammers remain in contact with the abutment surface and the hammers 150 and the inertia cylinder 141 move as one. When the resistance reaches a value which requires the application of the maximum predetermined torque to be applied, the inertia cylinder begins to rotate further than the hammers at each blow, and a gap is momentarily produced between the hammers and the abutment surfaces in the larger bores 152. Seeing that the inertia cylinder is firmly secured to the spring levers 149 at their ends remote from the hammers, these levers are flexed, and the inertia cylinder is decelerated and then moves in an anticlockwise direction relative to the hammers to close the gap. The extent of movement depends upon the resistance to bending of the spring levers, and the force imparted to the inertia means in an anticlockwise sense after the hammers have struck the anvils, depends upon the effective mass of the inertia member and the resilience of the spring means.

This reverse motion results in relative rotational movement between the inertia cylinder and the shaft 137, whereby the balls run further up the grooves and additional longitudinal movement is given to the inertia cylinder. As the torque approaches the maximum predetermined value, the inertia cylinder strikes the trigger 134 and opens valve 130 and the motor stops.

The piston valve 120 is provided with a bleed hole for the passage of air between opposite sides of the piston to equalize the pressure each side, so that when the valve is closed by the opening of the valve 130 it cannot return to the open position until the air supply to the valve 130 is cut off by the release of the pushbutton valve 111. Consequently, the motor remains stopped until the pushbutton valve is again operated.

When the stud has thus been set the anticlockwise rotation button 110 is pressed and the tool is removed from the stud. An automatic maximum torque control is not required for the anticlockwise direction of rotation in this application of the tool, and it is therefore not provided in this arrangement.

In the construction shown in FIGS. 3 and 4, the spring levers 149 are circular in cross section, and therefore have a uniform resistance to bending in all radial directions, and the adjustment of the resilience is carried out in a different manner from that shown in FIGS. 1 and 2. The levers are tapered towards one end to provide a fulcrum within bore 148, and the ends opposite to the hammers are positioned between a rotatable cam-faced ring 160 and a projecting ring 161 on the inertia cylinder 141.

Each spring lever 149 is provided with a flat-bottomed transverse groove into which is fitted one end of an arcuate lever 162, while the other end rests against a pin 163. The levers engage the inner cam surface of the ring 160, so that as the latter is rotated the amount of pressure imparted to the end of each spring lever is variable, thereby pressing the hammer against the abutment surface in the bore 152 to different degrees, and thus changing the prestressing of the spring levers. The cam ring 160 is held in position by the retaining ring 164.

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It can be easily understood that the greater the prestressing of the spring levers 149, the greater is the reluctance of the inertia member to leave the hammers at each blow, and the greater the torque required to bring the automatic shutoff valve 130 into action.

In the construction shown in FIG. 5 the spring levers are made of different diameters in different radial directions at right angles to one another so that by rotation into alternative positions, the arcuate levers 162 may engage alternative flats in a circumferential groove and thus provide two alternative ranges within which the prestressing can be effected by rotation of the cam ring 160.

The cam ring can be formed alternatively as a nut having conically arranged teeth 165 as shown in FIG. 6, with corresponding teeth 166 on the arcuate lever 162. As the nut is screwed down, the levers 162 are moved inwardly and vice versa.

Spring levers do not have to be precisely matched as to resilient characteristics in the construction shown in FIGS. 3 to 6, seeing that the cam ring or nut can be given sufficient lateral freedom of movement for the pressure applied by the arcuate levers to become equal, and in consequence the prestressing against the abutment surfaces in each large bore 152 become equalized.

It is to be understood that the above description is by way of example only, and that details for carrying the invention into effect may be varied without departing from the scope of the invention.

I claim:

1. In a power-operated impact wrench, screwdriver or like rotary tool of the kind comprising relatively movable hammer and anvil members with means for automatically causing them to become engaged and disengaged cyclically, and in which there is provided inertia means coupled to the hammer member by resilient means in such manner that, at values of torque below a predetermined value, the inertia means is constrained by the resilient means from moving relative to the hammer means, while at the predetermined value of torque the inertia means moves relative to the hammer means and thereby acts upon the said automatic means to increase the amount of disengagement movement of the members and operates control means to interrupt a supply of power to the tool, the improvement comprising forming the resilient means as a pair of resilient levers one end of each of which acts upon or is formed integral with a hammer member, and each of which is supported within a bore in the inertia means.

2. A power-operated impact wrench, screwdriver or like rotary tool as claimed in claim 1, in which the ends of the resilient levers remote from the hammers are acted upon by a cam-operated lever mechanism which prestresses the lever against an abutment surface upon the inertia means positioned

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in advance of the hammer members when rotated in the normal direction of operation of the tool.

3. A power-operated impact wrench, screwdriver or like rotary tool as claimed in claim 1 in which each resilient lever presents a different resistance to bending in different radial directions, and is rotatable around its longitudinal axis to change the effective resistance to bending to change the predetermined maximum value of torsion delivered by the tool.

4. A power-operated impact wrench, screwdriver or like rotary tool as claimed in claim 3, in which each resilient lever is provided with splines at the end opposite to the hammer, which engage corresponding splines in the wall of the bore, and has means for securing the splines in each of its alternative circumferential positions to determine the effective resilience thereof.

5. A power-operated impact wrench, screwdriver or like rotary tool as claimed in claim 1, in which the inertia member is a hollow cylindrical member which is provided with diametrically opposite longitudinal bores in the wall thereof which house the resilient levers.

6. A power-operated impact wrench, screwdriver or like rotary tool as claimed in claim 5, in which one end of each resilient lever is circular in cross section and is formed as a hammer.

7. A power-operated impact wrench, screwdriver or like rotary tool as claimed in claim 4 in which the resilient levers make a close fit in their bores intermediate their ends at the sides of the bore form a fulcrum.

8. A power-operated impact wrench, screwdriver or like rotary tool all as claimed in claim 7, in which each resilient lever is of different diameter in different radial directions at right angles to one another intermediate their ends, and is provided with two longitudinal flats at right angles to one another at the end opposite the hammer against which rests an adjustable prestressing member, thereby to provide two ranges within which the predetermined pressure can be effected by positioning the resilient lever so as to be engaged at either of the said two longitudinal flats.

9. A power-operated impact wrench, screwdriver or like rotary tool as claimed in claim 7, in which each resilient lever is tapered and is provided with a longitudinal flat at the end opposite to the hammer against which rests an adjustable prestressing member.

10. A power-operated impact wrench, screwdriver or like rotary tool as claimed in claim 9, in which the prestressing member is an arcuate lever lying in a plane which is at right angles to the axis of rotation of the inertia member, and situated within a cam ring which is rotatable about an axis to change the value of prestressing.

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