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R. F. STATES
 ROTARY IMPACT TOOL HAVING TORQUE RESPONSIVE
 DISENGAGEMENT AND POWER CONTROL

3,515,225

Filed July 8, 1968

3 Sheets-Sheet 1

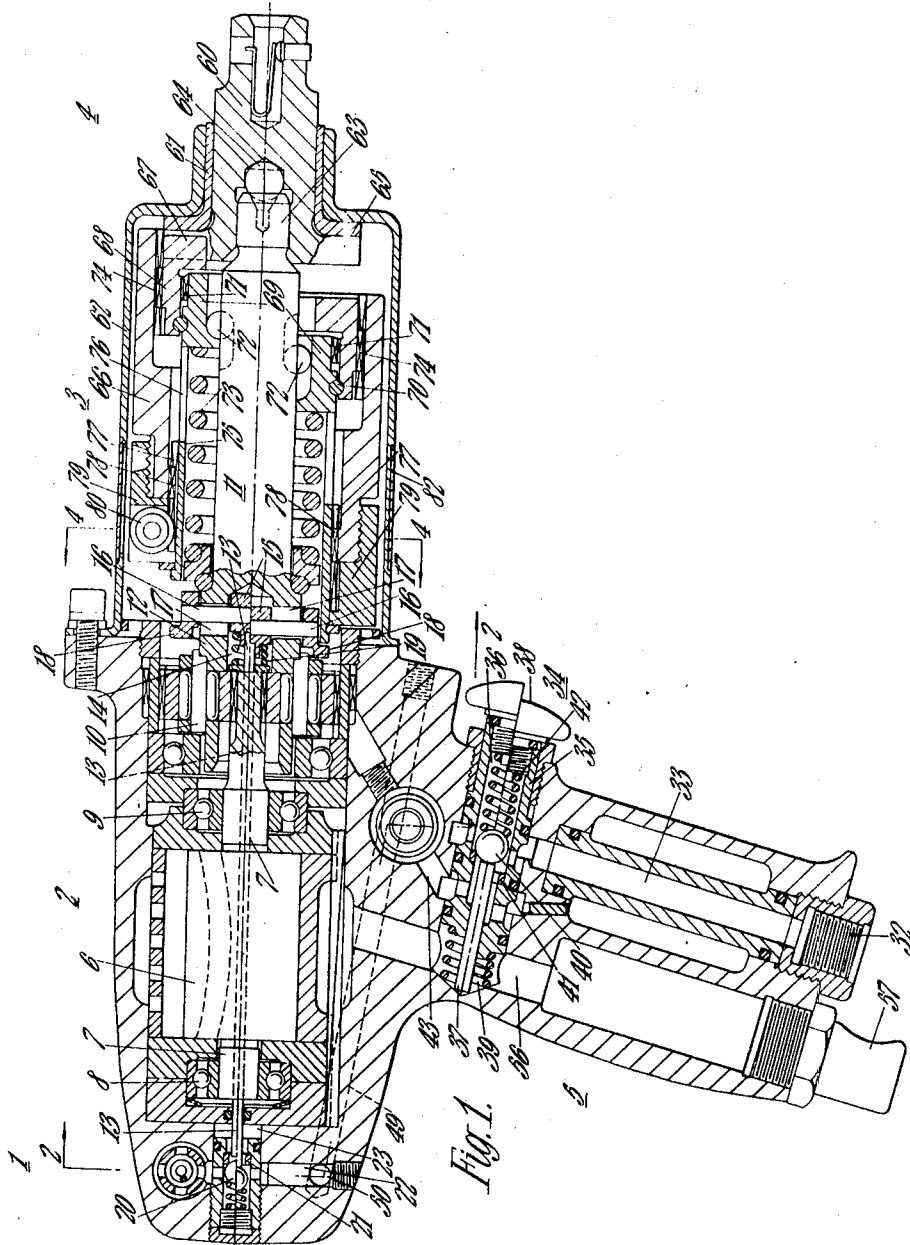


Fig. 1.

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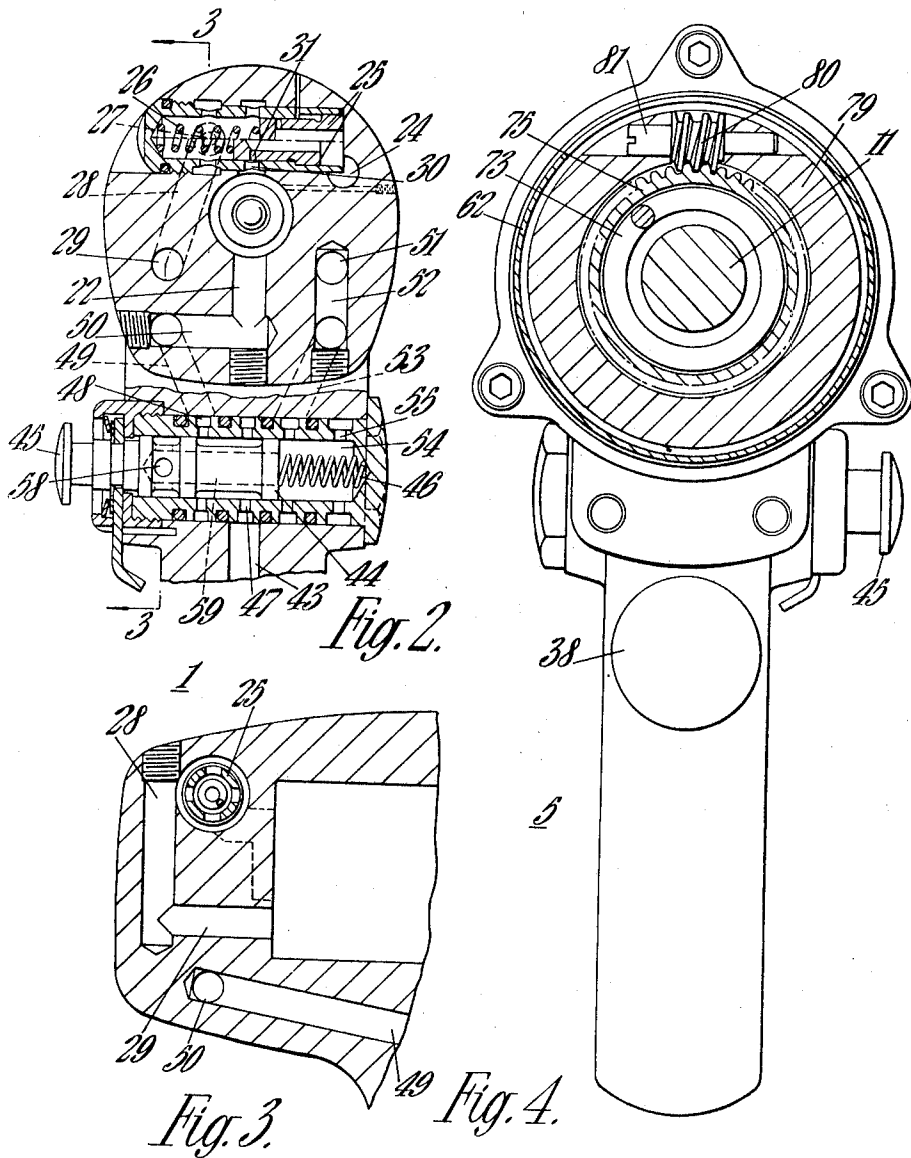
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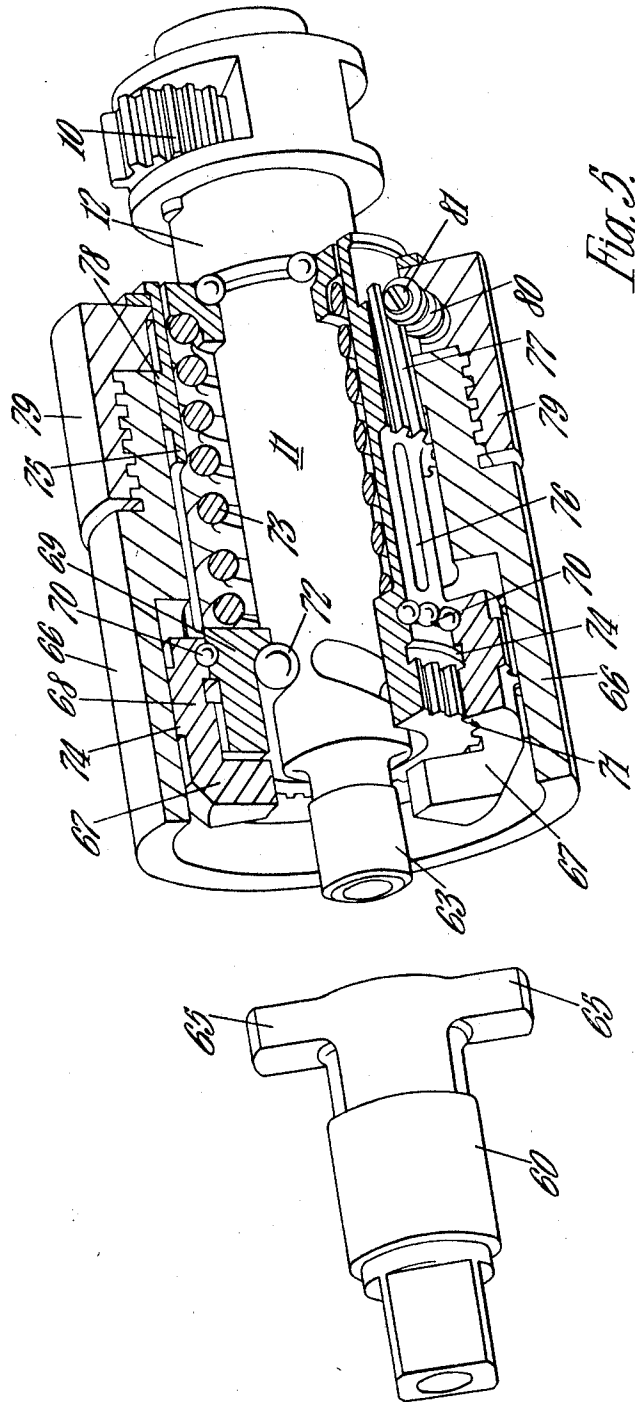
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1

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ROTARY IMPACT TOOL HAVING TORQUE RESPONSIVE DISENGAGEMENT AND POWER CONTROL

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4 Claims

ABSTRACT OF THE DISCLOSURE

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 in which there is provided a rotary mass coupled to the hammer member by spring means in such manner that at values of torque below a predetermined value the rotary mass is constrained by the spring from moving relative to the hammer means, while at a predetermined value of torque the rotary mass 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 operate control means to interrupt the supply of power to the tool.

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 provided with means for automatically causing them to become engaged and disengaged as required in the operation of the tool.

The object of the present invention is to provide a compact, readily portable and easily manipulatable tool of the kind above referred to comprising relatively few parts, and in which the torque which can be applied by the tool is governed, and is readily adjustable as to its maximum value.

The invention pertains to a power-operated impact wrench, screwdriver or like rotary tool of the kind comprising relatively movable hammer and anvil members provided 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 moves relative to the hammer means and thereby acts upon the automatic means to increase the amount of disengagement movement of the members and operates control means to interrupt the supply of power to the tool.

The invention further pertains to 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 in a continuous manner 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 spring means, the abutment surfaces being capable of moving one from the other against the action of the spring 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

2

which acts to increase the amplitude of disengagement movement of the hammer member from the anvil member.

The invention still further relates to a power-operated impact tool as set forth in the preceding paragraph, in which the disengagement movement of the hammer from the anvil is caused by the relative rotational movement of the hammer member and a driving shaft upon which it is mounted by means of balls located in ramp like grooves within each.

The invention still further relates to a power-operated impact tool as set forth above driven by a pneumatic motor and having control valve means which acts to interrupt the supply of air to the tool by the increased amplitude of disengagement movement of the hammer member from the anvil member at the predetermined value of torque developed by the tool.

The accompanying drawings show, by way of example only, one embodiment 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 part longitudinal section on the line 3—3 of FIG. 2;

FIG. 4 is a part elevation and part section on the line 4—4 of FIG. 1 while,

FIG. 5 is a perspective view of the hammer and anvil means and the torque control means.

The tool illustrated is of the pistol grip type and comprises a torque control valve portion 1, a motor and gear portion 2, a torque control and hammer and anvil portion 3, a head portion 4 and a pistol grip portion 5.

A motor 6 is of the pneumatic vane type and is of conventional design, and shaft 7 thereof is supported in bearings 8 and 9. The shaft 7 drives planetary gears 10, the output of which drives a shaft 11 at a reduced speed by way of an enlarged part 12 of the shaft 11. The motor shaft 7 has an axial bore which contains a slidable rod 13, one end of which engages with the torque control valve portion 1, while the other end of which projects into a bore 14 in the enlarged part 12 of the shaft 11.

The drawing showing those portions of the tool which slide axially during use of the tool are split about the longitudinal axis and are shown in their two alternative extreme axial positions, as will hereafter be explained.

The end of the rod 13 within the bore 14 is provided with a head member 15 having a cross bore in which is located a transverse rod 16, which passes through diametrically opposed holes 17, in the enlarged part 12 of the shaft 11, and is fastened at its ends within bores in a ring 18.

The ring 18 is urged in the direction of the head portion 4 of the tool by a helical spring 19 housed in the bore 14. In consequence, when the ring 18 is moved towards the torque control valve portion 1, the rod 13 pushes a ball 20 from its seating 21 and allows air in a passage 22 to pass into a cavity 23, where it passes by way of a bore, not shown, to a longitudinal bore 24, (see FIG. 2) and thence to the end of a piston valve 25, to move it from the position shown in its upper half to the position shown in its lower half, against the action of a helical spring 26.

The valve 25 is between the supply of air from passage 22 and the inlet to the motor for the driving direction of running, by way of a port 27, passage 28 and passage 29, and thus, when the valve 25 is moved to the left of FIG. 2, a port 30 is closed and the flow of air to the motor is interrupted. Even if the rod 13 is now released, the valve 25 is maintained closed by the pressure produced by air passing through a small bore 31, and the valve will not open until the supply of air to the tool is interrupted.

The supply of air to the motor is by flexible tubing connected to a connector 32, from which it enters a

bore 33. A press-button control valve 34 comprises a plunger 35 having a large bore 36 at the knob end, and a small bore at the other end into which is slide fitted a rod 37. The plunger is urged in the direction of knob 38 by a spring 39, while a ball 40 is urged towards a seating 41 by a helical spring 42. When the knob 38 is pressed, the ball 40 is held back by the rod 37 and the valve opens and air passes through the valve from the bore 33 to the bore 43. See also FIG. 2.

A piston valve 44 is a reversing valve, which is operated by pressure of the thumb upon a knob 45 against the action of a spring 46. The valve may be held in this position by means of a sliding catch provided. With the valve in the position as shown in FIG. 2 the air from the passage 43 enters by way of port 47, and leaves for the motor by way of port 48, passage 49, passage 50 and passage 22, and the valve portion 1 previously mentioned. The exhaust from the motor leaves by way of passages 51, 52 and 53 to arrive at a cavity 54 behind the valve 44 and leaves by a port 55, and thence by a bore (not shown), to an exhaust passage 56, and leaves by an orifice 57.

When the knob 45 is pressed, the air passes to the motor by way of passages 53, 52, and 51 to rotate the motor in the opposite direction, while the exhaust from the motor leaves by the passage 49 and passing through a radial bore 58 passes through an axial bore 59 in the piston 44, enters the cavity 54 and leaves by the port 55 as before.

Seeing that the air is passing through the valve portion 1 in the opposite direction, this valve does not work when the motor is reversed, and the exhaust passes through without interruption.

A tool holder 60 in the head portion 4 of the tool, is adapted to receive a wrench, screwdriver or other rotary tool, and is held for rotation in a bearing 61 in an outer casing 62, and is provided with an axial bore which receives end 63 of the shaft 11, and is provided with a thrust ball 64.

The tool holder 60 has a pair of anvils 65 (see also FIG. 5) formed integral therewith, which are rotatable intermittently within a cylindrical inertia member 66 when struck by continually rotatable hammers 67. The hammer members are, for the convenience of manufacture, constructed in two parts, with outer ring 68 carrying the hammers 67 located longitudinally in an inner ring 69 by balls 70, and located circumferentially by splines 71 upon each, and in consequence move together.

The inner surface of the inner ring 69 is provided with spiral ramped surfaces which are engaged by a pair of balls 72, which also engages in grooves in the surface of the shaft 11, so that, when the hammers 67 are retarded by the anvil 65, the shaft 11, which is continually rotating, urges the balls to roll up the ramps upon the inner rings 69 and urge the latter in an axial direction of the shaft 11, to compress helical spring 73 thereby allowing the hammers 67 to become disengaged from the anvils 65, pass over them and then re-enter between the anvils to repeat the cycle of operation.

The ramps on the inner ring 69 and the grooves in the shaft 11 are of V-shape in elevation, and therefore symmetrical about a plane passing through the axis of rotation, and the hammering cycle therefore takes place in a similar manner for either direction of rotation of the tool.

In order that the torque control valve portion 1 shall be operated when the torque applied by the tool to a nut or screw and the motor stopped, an inertia cylinder 66 is loosely splined by splines 74 to the outer ring 68 carrying the hammers 67, with the looseness amounting to the capability of rotation the one in relation to the other of a degree of two.

The inner ring 69 previously mentioned, forms part of a torsion cylinder 75 provided with longitudinal slits 76,

which give the cylinder the required resilience in the circumferential direction. The outer end of the torsion cylinder away from the inner ring 69 is provided with spiral splines 77, into which splines 78 on the interior of the inertia cylinder 66 fit. When the inertia cylinder 66 is moved longitudinally of the torsion cylinder 75, firstly the slack in the splines 74 is taken up, and after that a degree of stressing is applied to the torsion cylinder.

In order that the adjustment of the degree of stressing easily variable, part 79 is screw threaded upon the inertia cylinder 66, and in a recess therein is mounted a worm 80, which engages the helical splines 77, and upon rotation of the part 79 by the operation of the worm 80, the splines 78 move along the splines 77 to change the stress.

Access to axle 81 upon which the worm 80 is mounted, may be obtained through a removable cover 82 covering a window in an outer casing 62.

When the structure comprising the hammer member 67, the rings 68 and 69, the torsion cylinder 75 and the inertia cylinder 66, move longitudinally to free the hammers from the anvils, the inner end of the torsion cylinder moves towards the ring 18, but does not contact or move it until the resistance to the movement of the anvils by the impact of the hammers reaches a predetermined value. This value is determined by the degree of stressing applied to the splines 74. During low values of torque the splines of the inertia cylinder 66 are held in contact with the splines of the outer ring 68 by the stress applied by the torsion cylinder, when the hammers meet the anvils. However, when the torque rises to the predetermined value the inertia cylinder continues to move when the hammers hit the anvils, and on returning to the previous position with the splines in contact, the energy contained in the inertia cylinder is delivered to the outer ring 74, and a kick is given to the latter which in conjunction with the balls 72 and the ramp surfaces, moves the whole structure a further distance towards the ring 18, and thus operates the valve portion 1 by way of the rod 13.

The torque control means only operates in the one direction of rotation, for example when tightening up a nut, or screw, and is not necessary when the tool rotates in the opposite direction to release a nut or remove a screw.

It can be appreciated from the above description that the tool is relatively simple in form and has few moving parts, which renders it robust, and that the degree of torque applied by the tool is readily adjustable as to its maximum value.

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. A power-operated impact wrench, screwdriver or like rotary tool of the kind comprising relatively movable hammer and anvil members provided with means for automatically causing the to become engaged and disengaged cyclically, the improvement including resilient means and inertia means coupled to the hammer member by the 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 a predetermined value of torque, the inertia means moves relative to the hammer member and thereby acts upon the 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.

2. The rotary tool as claimed in claim 1, in which the hammer and anvil members execute a rotary motion during the operation of the tool, the hammer member in a continuous manner and the anvil member intermittently when struck by the hammer member, while the inertia means is a rotary means associated with the hammer

5

member and having abutment surfaces therebetween, between which pressure of a predetermined value is applied by spring means, the abutment surfaces being capable of moving one from the other against the action of the spring 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.

3. The rotary tool as claimed in claim 2, in which the disengagement movement of the hammer member from the anvil member is caused by the relative rotational movement of the hammer member and a driving shaft upon which it is mounted by means of balls located in ramp like grooves within each.

4. The rotary tool as claimed in claim 1 driven by a

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pneumatic motor and having control valve means which acts to interrupt the supply of air to the tool by the increased amplitude of disengagement movement of the hammer member from the anvil member at said predetermined value of torque developed by the tool.

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U.S. Cl. X.R.

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