SHUT-DOWN MECHANISM FOR PNEUMATIC TOOLS

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This invention relates to a shut-down mechanism for a pneumatic tool and more particularly to an automatically operated valve which is adapted to stop the flow of a pressurized fluid to the tool motor upon reaching a predetermined condition in its operation.

One object of the invention is to provide a shut-down mechanism of this general character which is adapted to cut off the supply of motor fluid to the motor and to be automatically restored to resume operation.

Another object of the invention is to provide a shut-down mechanism which is not wasteful of motor fluid.

Further objects of the invention will become obvious from the following description and from the drawings in which:

Fig. 1 shows a preferred embodiment of the invention as applied to an impact wrench. The view is a side elevation partly in longitudinal section.

Fig. 2 is an enlarged view in longitudinal section of the valve shown in Fig. 1 which constitutes the principal part of the shut-down mechanism, and

Fig. 3 is a cross-section of the impact wrench taken along the lines 3—3 of Fig. 1 looking in the direction of the arrows.

The impact wrench 10 is of the general type referred to in the copending U. S. application of Harrison et al., Serial No. 405,708, filed January 25, 1954, and comprises a casing 12, the rear end of which houses a motor 14 which through suitable planetary gearing 18 drives a spindle 16 upon which is rotatably mounted a rotary hammer 18.

As described in the above said application the hammer 18 is adapted to deliver hammer blows to a suitable anvil 20 rotatably mounted in the sleeve bearing 22 set in the forward end 24 of the tool casing which is suitably attached to the rear portion 12 of the casing by means of suitable screws 26.

As is also described in the application the means by which the hammer blows are caused to be delivered to the anvil by hammer 18 includes V-shaped cam grooves 28 formed on the interior of the hammer 18 and corresponding V-shaped cam grooves 30 formed in the spindle 16, there being also provided balls 32 cooperating with the cams 28 and 30 to produce endwise motion of the hammer 18 against the force of a spring 34 tending to thrust the hammer forward. The spring 34 is contained within a chamber 36 in the hammer 18 and presses against a thrust bearing 38 mounted at the rear of the spindle 16.

Motive fluid for operating the tool is provided through a suitable handle 40 of the well-known pistol grip type. Motive fluid enters by way of an inlet 42 communicating with the hose coupling 44 and is adapted to pass by way of an inlet passage 46 to the inlet port 48 leading to motor 14. The flow of fluid from the inlet chamber 42 to the inlet passage 46 is controlled by a throttle valve 50 of any suitable form, in this instance being of the poppet type having a stem 52 extending through an interior wall of the handle 40 and adapted to be actuated by a finger operated trigger 54, the motion of the latter being transmitted to the stem 52 by a pivoted link member 56.

Impact wrenches of this general type are adapted to transmit driving force to wrench sockets and the like (not shown) adapted to be mounted on a tool receiving spindle such as shown at 58. As described in the above application spindle 58 is adapted to be turned when low resistance is encountered and at the speed of the spindle 16 until a predetermined resistance is encountered, whereupon the cam mechanism which includes the cam grooves 28 and 30 and the balls 32 causes the hammer 18 to rise against the pressure of spring 34 and without rotation. When the hammer 18 rises to a position where it disengages the anvil 20, the cam mechanism rotates the hammer at high speed to re-engage the anvil 20 thereby delivering a blow thereto and expending the energy accumulated in the spring 34 while the hammer 18 remained stationary. The force applied to the anvil 20 from the hammer element 18 is delivered to spindle 58, the inner end of member 58 being square as shown at 60 to engage the squared internal hole 62 of the anvil 20.

For purposes hereinafter described, the spindle 58 is a spring which is adapted to be prestoned by a coupling member 64 which engages the splined end 66 of the anvil member 20 and the spindle 58, more particularly, as described in copending application of Harold C. Reynolds of even filing date herewith, Serial No. 555,666. As described in both said patent applications, the spring spindle 58 is prestoned to a predetermined degree corresponding to a desired maximum force to be produced by the impact blows of the hammer 18 to the spindle 58. Being thus prestoned the hammer blows acts upon the spindle 58 without springing action of the spindle until blows of such predetermined adjustment are reached. Until this condition exists the rebound of the hammer 18 is negligible. Beyond that condition the member 58 is capable of acting as a spring and the excess energy provided above that required to produce torque of the predetermined maximum above referred to is returned to the hammer 18 as recoil. Consequently the hammer at these higher energy values rebounds, which action is utilized to actuate the shut-down mechanism of this invention.

To this end there is provided an axially movable valve 70 in a valve chamber 72 formed in the casing 12 preferably near the junction of that casing with the handle portion 40. At one end of the valve chamber 72 is provided a port 74 at which the inlet passage 46 terminates. Adjacent the port 74 is provided an inwardly extending flange 76 forming a seating for the head of the valve 70.

The chamber 72 is also provided with a discharge port 78 communicating with the passage 48 leading to the motor 14. The head of the valve 70 is formed with a seating washer 80 held on the head of the valve 70 by a suitable nut 82. At the other end of the valve chamber 72 is inserted a cup shaped member or bushing 84 with its open end toward the flange 76. Bushing 84 contains the cylindrical guide portion 86 of valve 70 and permits sliding movement of the valve longitudinally.

The cross sectional area of the interior of the bushing 84 is less than the seating area of the washer 80 upon its seat 76. Thus, with equal pressures on opposite ends of the valve there is normally a tendency of the valve 70 to remain pressed upon its seat 76.

At the end of the cup shaped member 84 is a tapered exhaust seat 88 leading to atmosphere by way of exhaust port 90 and the clearance space 92 provided at the end of the bushing 84. A ball valve 94 is adapted to rest upon the seat 88, there being a spring 96 pro-
vided bearing at one end against the ball 94 within the guide portion 86 of valve 70.

For the purpose of unscrewing ball 94 a plunger 98 is provided slidingly extendable in a bore 100 in the end of the bushing 84 to contact the ball 94 at the seat 88. At its outer end the plunger 98 is operatively situated with respect to a lever 102 pivotally mounted as at 104 on the casing 12. Arm 102 is biased to contact the end of plunger 98 by means of a light spring 106. Preferably arm 102 is situated in the end of the housing 24 so that it will be struck by the rear end of hammer 18 as it recoils as above described and is thus adapted to unscrew the exhaust valve 94 to vent the pocket formed by the guide portion 86 of valve 70 and the interior of the cup shaped bushing 84.

For the purpose of normally introducing pressure within said pocket to partly counterbalance that in the supply chamber at port 46 there is provided a restrictive passage 108 leading preferably longitudinally of the valve 70 from one end of the chamber 72 to the other.

Due to the larger sectional area of the washer 80 as compared with the opposed sectional area of the guide portion 86 and the slight pressure of springs 96 and 106, normal line pressure acting on the various areas of the valve 70 biases it to its seat 76, cutting off the flow of pressure fluid to the motor 14. However, upon closure of the throttle valve 50 a slight leakage is permitted through a port 110 transversely extending from the restrictive passage 108 to the vicinity of the port 78 which permits bleeding of the line pressure fluid from the supply passage 46. Thereupon spring 96 permits the valve 70 to move to its open position.

Subsequent operation of the trigger 54 to unscrew the throttle valve 50 to supply the motor 14 with motive fluid under line pressure does not affect the valve 70 because when washer 80 is unscrewed the valve 70 is completely balanced so far as motive fluid pressure is concerned and is biased to its open position by the springs 96 and 106. Actuation of the motor 14 causes rotation of the spindle 58 as above described and the subsequent hammering of the hammer 18 on anvil 20. Upon reaching the predetermined maximum torque at the spindle 58, hammer 18 will recoil as above explained to strike the arm 102. Consequently thrust of the plunger 98 unscrews the exhaust valve 94 to evacuate the air under pressure within the pocket in bushing 84. Because of the restrictive size of the passage 108 motive fluid cannot fill the pocket within bushing 84 to build up pressure therein and accordingly valve 70 is actuated to its closed position shutting off the supply of motive fluid to the port 78 and accordingly motor 14 stops.

Valve 70 will remain in its closed position until throttle valve 50 is permitted to close by release of the trigger 54. This permits the evacuation of air under pressure from the supply passage 46 and in fact from all parts of the tool beyond the throttle valve 50 through the bleeder port 110 leading to motor 14.

Reactuation of the tool is effected by operation of the throttle valve 50 through the manually controlled trigger 54. This cycle is repeated as desired.

To provide access to the outer end of the valve chamber 72 a plug 120 is threaded and sealed in the adjacent outer wall of casing 12.

Thus by the above construction are accomplished the objects hereinafter referred to.

I claim:

1. A shut-down mechanism for a pneumatic tool including a valve chamber member, said chamber member having a pressure fluid supply port, an atmospheric exhaust port, and a discharge port, a valve member in the chamber for controlling the flow of pressure fluid to said discharge port, a guide portion on said valve member forming with said chamber member a pocket communicating with said exhaust port, a second valve controlling the flow of fluid from said pocket to said exhaust port, resilient means to bias said valve member to a position to permit flow of pressure fluid from the supply port to the discharge port, and to bias the second valve to its closed position, means including a restrictive passage constantly communicating said pocket with said supply port to conduct pressure fluid to said pocket to assist the biasing action of said resilient means, and means operatively by said pneumatic tool to unscrew said exhaust valve.

2. The shut-down mechanism as set forth in claim 1 in which is provided a manually operable throttle valve associated with the fluid supply port and means for bleeding down the pressure fluid in the valve chamber when said throttle valve is in its closed position.

3. The shut-down mechanism as set forth in claim 1 in which the restrictive passage is in the valve member.

4. The shut-down mechanism as set forth in claim 3 in which the restrictive passage extends longitudinally of the valve member and is continuously open to conduct a limited flow of pressure fluid from the supply port to said pocket and the exhaust port is substantially larger than said passage to prevent the building up of pressure in said pocket when said exhaust port is open.

5. The shut-down mechanism as set forth in claim 1 including a plunger extending to said second valve from outside the chamber member, and a mechanically operated arm to actuate the plunger.

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