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TORQUE RELEASE MEANS FOR ROTARY PNEUMATIC TOOLS

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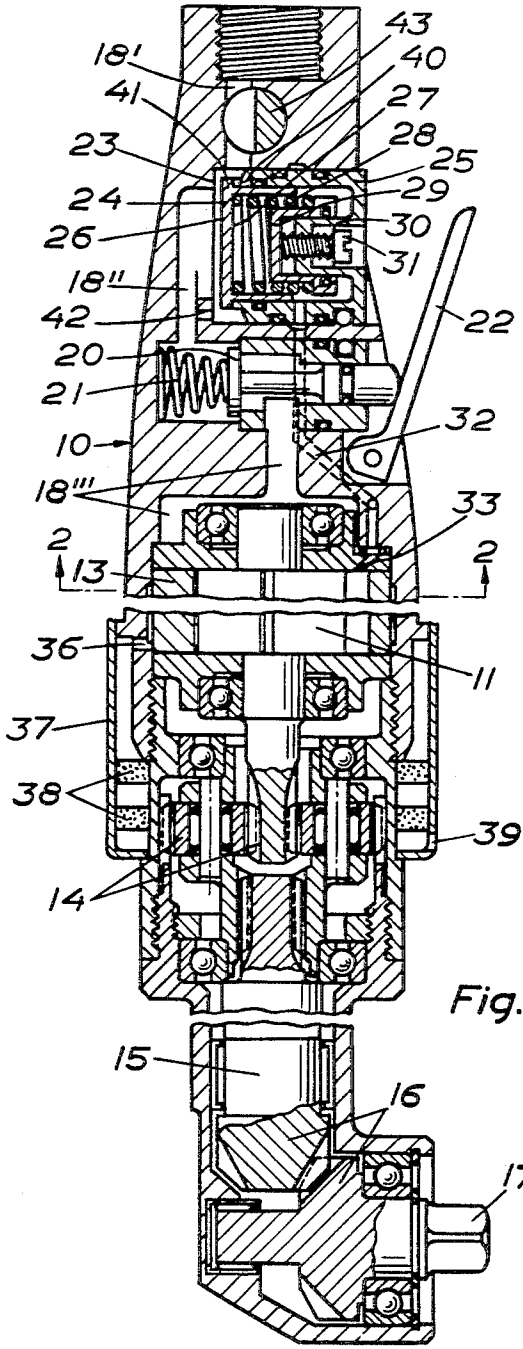


Fig. 1

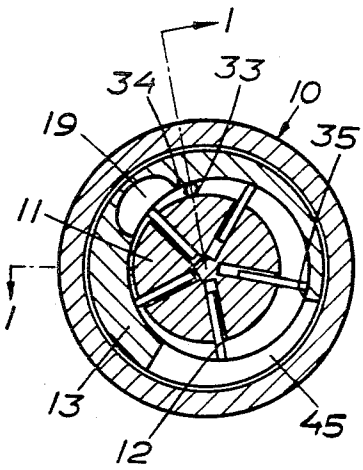


Fig. 2

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TORQUE RELEASE MEANS FOR ROTARY PNEUMATIC TOOLS

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ABSTRACT OF THE DISCLOSURE

The invention provides a rotary pneumatic torque release tool having a vane motor in which a control mechanism is triggered by the development of a predetermined torque in the motor cylinder and acts to effect the operation of the tool. The tool comprises a housing and a working cylinder in said housing containing a vane motor rotatably mounted between inlet and outlet ports in said working cylinder. The motor drives the tool. The housing contains an air supply connection for connecting said inlet port to a source of compressed air. The housing also contains a control mechanism which is effected by an adjustable pressure-sensing means operatively connected to said control mechanism which acts to release said control mechanism in response to a predetermined raise in the pressure sensed by said sensing means. Said pressure-sensing means is connected by a passage means in said housing separate from said connection with an orifice in said cylinder and thereby subjected to the driving pressure acting directly on the vanes for rotating said motor. An increase in said driving pressure is sensed by said pressure-sensing means which triggers said control mechanism when a predetermined rise is determined.

In a torque release means for rotary pneumatic tools including a compressed air driven vane motor and a normally open shut-off valve for closing the air supply connection to the motor, a piston element on the shut-off valve is connected to an orifice in the working cylinder of the vane motor for sensing the drive pressure therein acting directly on the vanes thereby to shut off the valve against the pressure in the air connection when a predetermined raise in pressure is reached in the working cylinder.

This invention relates to torque release means for rotary pneumatic tools. More particularly the invention is concerned with rotary pneumatic torque release tools such as nut setters, screw drivers and the like, of the type incorporating a control mechanism therein which upon the development of a predetermined drive torque in the tool is releasable to perform a control movement affecting the operation of the tool. The operation of the tool is normally affected in a manner to enable control of the torque output of the tool in order to protect the work against being overloaded or to run the work to the desired degree of tightness. It has been suggested (U.S. Patent 2,923,306 to W. G. Mitchell) to base the operation of the control mechanism on sensing of the pressure in the air supply connection to the tool and to release movement of the control mechanism when a predetermined pressure raise is reached therein. However, if one compares the pressure in the air inlet during idle rotation of for example a nut setting tool and during transmission of nearly maximal torque thereby, there is normally noted a pressure raise in the connection in the order of magnitude of half an atmosphere or less. It is therefore difficult during the rough operation to which nut setting tools are subjected

in practice, to release the control mechanism with sufficient quickness and accuracy in order to assure protection against overloading or to receive, during tightening of series of nuts, sufficiently small variations from case to case in the final torque reached.

It is the main object of the invention to increase, in torque release control mechanism of the type in question, the magnitude of the pressure differential acting to release the mechanism and to adapt the construction thereof to this increased pressure differential so that overload protection and control of the final torque can be had with substantially increase dependability. For these and other purposes there is according to the invention provided a rotary pneumatic torque release tool comprising a housing, a working cylinder in said housing, a vane motor rotatably mounted between inlet and outlet ports in said cylinder for driving said tool, an air supply connection for connecting said inlet port to a source of compressed air, a control mechanism in said housing to be released for performing a control movement affecting the operation of said tool upon the development of a predetermined torque therein, adjustable pressure sensing means operatively connected to said control mechanism for releasing said control movement thereof in response to a predetermined raise in the pressure sensed by said sensing means, and passage means in said housing separate from said connection, said passage means communicating said sensing means with an orifice in said working cylinder subjected to the drive pressure therein acting directly on the vanes for rotating said motor.

Because of flow losses and expansion in the air motor the active pressure at the orifice of the disclosed torque release tool may fall below the incoming line pressure in the connection by several atmospheres. At increased torque transmission the air flow through the motor is successively diminished. By reason thereof the flow losses are also reduced and expansion in the motor is counteracted due to leakage past the motor vanes and thus the pressure raises and approaches the line pressure. The pressure differential which may be used for releasing the control mechanism is thus doubled many times over whereby a more accurate release may be attained.

The above and other objects of the invention will become obvious from the following description and from the accompanying drawing in which a preferred embodiment of the invention is illustrated by way of example. It should be understood that this embodiment is only illustrative of the invention and various modifications may be made within the scope of the claims.

In the drawing FIG. 1 shows a longitudinal section through a rotary torque release tool embodying the invention. The longitudinal section is taken along the line 1—1 in FIG. 2. FIG. 2 is a cross section on the line 2—2 in FIG. 1.

In the figures there is shown a nut setting tool **10** provided with a compressed air driven vane motor **11**. The motor **11** carries radial driving vanes **12** which rotate in a working cylinder **13**. The motor **11** is coupled via planetory gearing **14** to an axle **15** which via angle gearing **16** drives a square driving boss **17**.

Compressed air is supplied via a hose, not shown, to the rear end of the nut setting tool from which an air supply connection 18^{I}–18^{III} extends forwardly within the nut setting tool **10** to the air inlet **19**, FIG. 2, in the working cylinder **13** of the vane motor **11**. In the air supply connection portion 18^{II} is arranged a throttle valve **20** which is kept in closed position by a spring **21** and may be opened manually by depression of a trigger **22**.

Upstream of the throttle valve **20** there is arranged between the air supply connection portions 18^{I} and 18^{II} a

valve seat 23 and a control mechanism provided by a shut-off valve 24 cooperating with the seat for affecting operation of the tool by a control movement shutting off the air supply. The shut-off valve 24 consists of a piston element 26, 27 which is slidably and sealingly guided in a valve housing 25. When the shut-off valve 24 is open, its forward piston face 26 is subjected to the pressure in the air suppy connection 18^1 adjacent to the valve seat 23. The opposed piston face 27 of the shut-off valve 24 faces an interior chamber in the valve housing 25 and is actuated by a helical spring 28. The rear end of the latter is supported by a flange on a shell 29 which is sealingly slidable on a cylindrical part 30 in the valve housing 25. A set screw 31 is threaded into the part 30 and bears aagins the bottom of the shell 29. By axial adjustment of the set screw 31 one thus can pre-load the spring 28 to the desired extent.

A passage 32 connects the chamber of the valve housing 25 with an orifice 33 in the working cylinder 13. The orifice 33 is preferably disposed in the sector of the working cylinder 13 which is bounded by the closing edge 34 of the air inlet 19 and half the angular distance to the opening edge 35 in the air outlet 45, FIG. 2, of the vane motor 11. Via the orifice 33 and passages 32 the pressure in the working cylinder 13 is thus transmitted to the chamber of valve housing 25 and acts against the piston face 27 therein.

From the air outlet 45 the air is directed via a peripheral groove and radial bores 36 to a sound muffler 37 containing sound damping sintered rings 38 whereupon the air via openings 39 is let out into the open air.

During tightening of a nut the operator holds the nut setting tool 10 and inserts the square boss 17 into a wrench sleeve, not shown, which has been placed around the nut. The shut-off valve 24 is in the position shown in FIG. 1. Accordingly the piston face 26 is actuated by the pressure in the air supply connection portion 18^1 and keeps the shut-off valve 24 open against the action of the spring 28. The opening position is defined by an annular abutment 40 in the valve housing 25 against which a radial flange 41 on the shut-off valve 24 bears.

When the trigger 22 is actuated compressed air will flow via the air supply connection 18^1–18^{111} to the vane motor 11 expanding in the working cylinder 13 while driving the vanes 12 so that the motor 11 and thus the square boss 17 are rotated. At the beginning of the tightening the rotational resistance is small, the vane motor 11 rotates rapidly and the pressure around the orifice 33, which is disposed within the expansion zone of the working air, will be relatively low. With increasing resistance to rotation the number of revolutions and the air consumption successively decrease so that a raise in pressure takes place in the air inlet 19. A corresponding raise in pressure takes place at the orifice 33, in the passage 32, in the chamber of valve housing 25, and at the piston face 27, and this pressure raise is amplified by the expansion being counteracted by air leaking past the vanes 12 to an increased extent with decreasing number of revolutions and by a reduction of the pressure loss at the inlet 19. By adjustment of the set screw 31 the spring tension in the spring 28 is chosen such as to cause the pressure raise at the piston face 27 to close the shut-off valve 24 when the desired final torque has been reached. The shut-off valve 24 in the open position thereof is disposed at a relatively short distance from the seat 23. The air flow passing the valve 24 therefore builds up a pressure differential at opposite sides of the valve flange 41. This pressure differential increases strongly during the shut-off movement and causes the shut-off valve to rapidly snap to closed position when the desired shut-off pressure has been built up in the valve housing 25.

Since the air supply connection portions 18^{11}, 18^{111} downstream of the valve seat 23, upon closing the valve 24, are exhausted via the vane motor 11, the shut-off valve 24 will remain closed by the spring 28 as long as the trigger 28 is depressed. A bore 42 passes through the seat 23 and allows the passage of bleed air in parallel with the closed shut-off valve 24. As soon as the trigger 22 is released and the throttle valve 20 closes, the bore 42 consequently causes pressure equalization in the air supply connection portions 18^1, 18^{11} at opposite sides of the valve seat 23. As a result herewith the pressure acting on the piston face 26 will open the shut-off valve 24 and the nut setting tool 10 will be ready for a new tightening operation.

In cases when the tightened nut joint is capable of elastic rebound, the kinetic energy of the rotating parts will be absorbed during closing of the shut-off valve by the joint without annoying increase of the reaction force taken up by the operator. In case of a rigid joint one can counteract the appearance of too large a reaction force by a reduction of the incoming pressure in the air supply connection portion 18^1 causing a reduction of the number of revolutions. This is accomplished by angular adjustment of a throttling valve 43 or a throttling screw inserted in the air supply connection portion 18^1 in which portion the pressure of the incoming air can be reduced to the desired extent by throttling.

What I claim is:

1. A rotary pneumatic torque release tool comprising a housing, a working cylinder in said housing, a vane motor rotatably mounted between inlet and outlet ports in said cylinder for driving said tool, an air supply connection for connecting said inlet port to a source of compressed air, a control mechanism in said housing to be released for performing a control movement affecting the operation of said tool upon the development of a predetermined torque therein, adjustable pressure sensing means operatively connected to said control mechanism for releasing said control movement thereof in response to a predetermined raise in the pressure sensed by said sensing means, and passage means in said housing separate from said connection, said passage means communicating said sensing means with an orifice in said working cylinder subjected to the drive pressure therein acting directly on the vanes for rotating said motor.

2. A torque release tool according to claim 1 in which said orifice is disposed within a sector of said cylinder bounded by the closing edge of said inlet port and half the angular distance to the opening edge of said outlet port.

3. A rotary pneumatic torque release tool comprising a housing, a working cylinder in said housing, a vane motor rotatably mounted between inlet and outlet ports in said working cylinder for driving said tool, an air supply connection for connecting said inlet port to a source of compressed air, a shut-off valve in said connection movable to open and shut positions relative thereto, means for normally maintaining said valve in open position, adjustable pressure sensing means operatively connected to said valve for causing movement thereof to shut position in response to a predetermined raise in the pressure sensed by said sensing means, and passage means in said housing separate from said connection, said passage means communicating said sensing means with an orifice in said working cylinder subjected to the drive pressure therein acting directly on the vanes for rotating said motor.

4. A rotary pneumatic torque release tool comprising a housing, a working cylinder in said housing, a vane motor rotatably mounted between inlet and outlet ports in said cylinder for driving said tool, an air supply connection for connecting said inlet port to a source of compressed air, a shut-off valve in said connection movable to open and shut positions relative thereto, a first surface on said valve subjected to pressure in said connection for normally maintaining said valve in open position, a chamber adjacent said valve, a second surface on said valve connected to said chamber and adapted to move said valve to shut position in response to a predetermined rise in pressure in said chamber, and passage means in said housing separate from said connection, said passage

means communicating said chamber with an orifice in said cylinder subjected to the drive pressure therein acting directly on the vanes for rotating said motor.

5. A torque release tool according to claim 4, in which said shut-off valve is biased by spring means to shut position, and means for adjusting the bias of said spring means to adjust the magnitude of the pressure in said chamber causing said valve to shut.

6. A torque release tool according to claim 4 in which said valve is a seat valve with one face thereof exposed to pressure in said connection and the other to pressure in said chamber.

7. A torque release tool according to claim 4 in which there is provided a manually actuatable throttle valve in said connection downstream of said shut-off valve and a bleed passage in parallel with said shut-off valve for producing pressure equalization in said connection at opposite sides of said shut-off valve in the shut position of said throttle and shut-off valves to enable said first surface to open said shut-off valve under the action of pressure in said connection between said valves.

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