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PRESSURE FLUID ACTUATED TOOL

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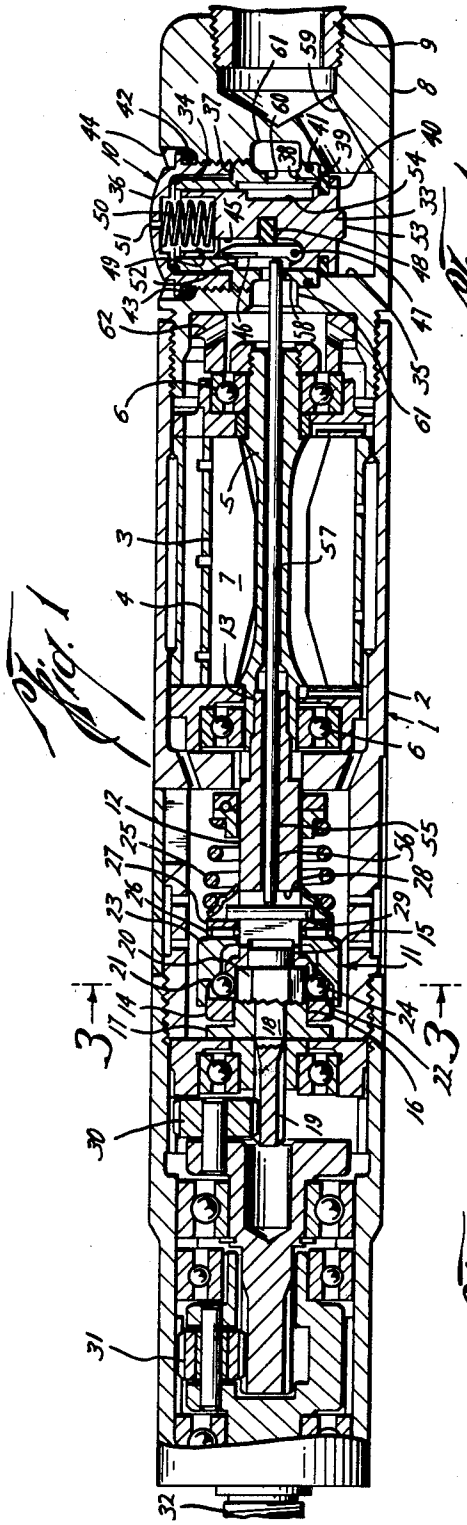


Fig. 1

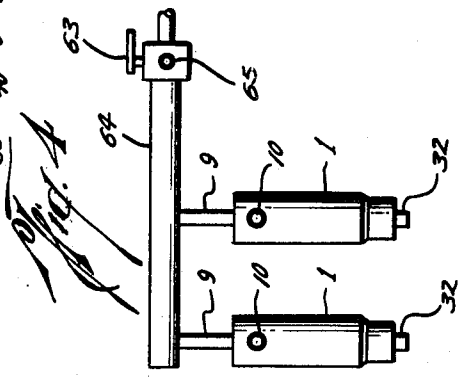


Fig. 4

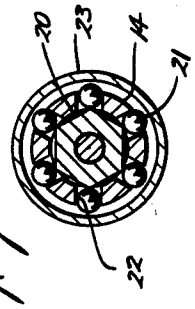


Fig. 3

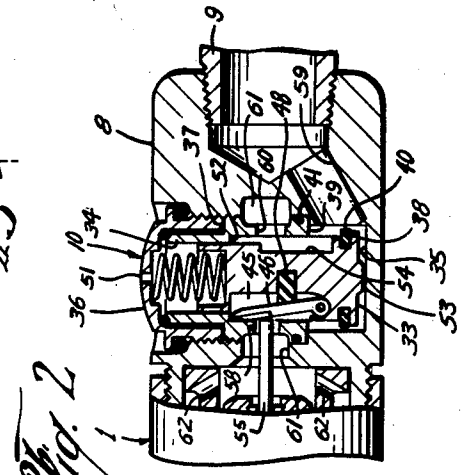


Fig. 2

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# PRESSURE FLUID ACTUATED TOOL

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This invention relates generally to a torque responsive pressure fluid actuated tool for running up and setting threaded elements such as screws, nuts, bolts and the like, and more particularly to fluid valving means therefor.

In the running up and setting of a plurality of screws or bolts for engine cover plates, pans or the like, a plurality, or gang, of pressure fluid, torque responsive tools may be used, which tools may be supplied with compressed air from a common source in order to supply motive power to the tool motors. As is well known, similar threaded parts are not exact in size, and may have slight irregularities such as burrs and dents, or dirt, or the like. Also similar torque tools are not precisely exact in size, adjustment and operation. Thus in operation, similar torque tools of a gang, operating simultaneously on a plurality of similar threaded parts, may reach predetermined torque levels at slightly different times with the result that a torque clutch on one tool may be slipping, with a consequent air waste and wear of the clutch parts, whereas another tool of the gang might still be turning its threaded part.

A nobject of this invention is to provide a new and improved pressure fluid tool for running and setting threaded elements, which is especially useful in applications where a plurality of such tools is employed simultaneously to work pieces.

Another object is to provide a pressure fluid operated tool useful in multiple spindle operations wherein the tools may be supplied with pressure fluid from a common supply source.

Another object is to provide a new and improved valving means for a pressure fluid tool whereby an operator may be remote from the tool.

Another object is to provide an automatic valving means for a pressure fluid operated tool wherein the valve will reset itself for a subsequent operation when the pressure of the fluid falls below a predetermined level.

Another object is to provide a pressure fluid operated tool which is especially useful in multiple spindle applications, wherein each of the tools may independently arrive at a predetermined torque level and be shut off, irrespective of the torque demands of the other tools in the gang.

Another object is to provide a new and improved valve which will automatically shut off pressure fluid to a tool when a predetermined torque is reached, and which valve will automatically reopen when the pressure of the fluid falls below a predetermined level.

Other objects will become apparent from the following description and the accompanying drawings, in which:

FIG. 1 is a longitudinal sectional view of a pneumatic tool embodying the invention.

FIG. 2 is a sectional view of the valve portion of the tool showing the valve in an open position.

FIG. 3 is a sectional view taken on line 3—3 in FIG. 1.

FIG. 4 is a diagrammatic view of a multiple air tool arrangement.

Referring to the drawings, a pressure fluid tool is shown generally at 1, having a case 2 within which is rotatably mounted a vane motor 3, which motor includes a stator 4, a rotor 5 journalled within bearings 6, and having the usual radially movable vanes 7. Threadedly secured to the right end of the case 2 is a coaxial head 8 having a pressure fluid connector 9 and a valve assembly 10.



Within the left end of the case 2 is a torque responsive clutch assembly 11 having a driving clutch member 12 extending coaxially from the rotor 5 and being rotationally locked thereto by means of a polygonal shank 13, or other suitable means. The driving clutch member 12 has its left end enlarged to form a head 14 which has internal bores to provide a running fit on cylindrical bearing portions 15 and 16 of a cam member 17 which is fitted on a polygonal shank 18 of a driven spindle 19. The cam member 17 is provided with a polygonal cam section 20. The head 14 has a plurality of radial bores 22 in which the balls 21 are disposed to engage the sides of the cam section 20.

A ball retainer 23 having an inclined wall 24 is urged axially against the balls 21 by an adjustable compression spring 25. An anti-friction bearing 26 is provided between a spring follower 27 and the ball retainer 23. The driving clutch member 12 has a slot 28 transversally therethrough, and mounted therein is a cross piece 29 which engages the spring follower 27 for axial movement therewith.

From the driven spindle 19, rotation is transmitted through a system of planetary gears 30 and 31 to a suitable work driving tip 32 which may be of any desired shape.

The head 8 has a bore 35 in which the valve assembly 10 is disposed. The valve assembly 10 comprises a valve member 33 closely fitted into a valve sleeve 34 which is threaded into the bore 35. A valve retaining plug 36 is also threaded into the bore 35, and engages a shoulder 37 of the valve sleeve 34 to position and lock the same in place. The valve member 33 has an annular shoulder 38 which underlies the lower portion 39 of the valve sleeve 34. An annular seal 40 is provided on the shoulder 38. An annular seal 41 is provided between the lower cylindrical portion of the sleeve 34 and the wall of the bore 35. Suitable sealing means 42 is provided between a shoulder 43 on the sleeve 34 and a counterbore 44 in the head 8.

The valve member 33 has a recess 45 intermediate the ends thereof and a pawl, or sear, 46 is disposed within the recess 45 and is pivotally mounted on pin 47. A spring 48, or other suitable resilient means, is disposed between the pawl 46 and the member 33 to urge the pawl 46 out of the recess 45. The upper end of the member 33 has a counterbore 49. A spring 50 is disposed in the counterbore 49 and is arranged to urge the member 33 to an open position downwardly from the retaining plug 36. A vent hole 51 is provided in the plug 36.

An internal annular shoulder 52 is provided in the sleeve 34 intermediate the ends thereof. The valve member 33 has a boss 53 on its lower end, and an intermediate portion of the member 33 is contoured as at 54.

A trip rod 55 extends axially from the cross piece 29 through a bore 56 in the driving clutch member 12 and through bore 57 in the rotor 5 and through an opening 58 in the sleeve 34 to a position in alignment with and confronting the pawl 46.

Referring to FIG. 2, the spring 50 urges the valve member 33 downwardly to open the same. When the member 33 moves downwardly a sufficient amount, the spring 48 moves the pawl 46 in a counter-clockwise direction whereupon the free end of the pawl engages under the shoulder 52 of the sleeve 34 to prevent upward movement of the member 33. As the member 33 moves downwardly, the annular shoulder 38 and seal 40 move away from the lower portion 39 of the sleeve 34. The boss 53 provides a positive downward stop for the member 33 whereby most of the lower surface of the member does not contact the bottom of the bore 35.

Pressure fluid supplied through the connector 9 is admitted through port 59 into bore 35, into the sleeve 34,

and around the valve member 33 and is admitted through port 60 into an annular chamber 61, thence to the motor 3 through ports 62.

The fluid exerts pressure on all portions of the member 33 except on the top portion thereof which is closely fitted within sleeve 34. Thus the member 33 acts as a differential piston, so that the pressure fluid constantly urges the member 33 upwardly into the sleeve 34 because of the difference in axially effective areas exposed to the pressure fluid. The free end of the pawl 46 engaging the shoulder 52 prevents such upward movement of the member 33.

In operation, when free running of the work, such as a bolt, is completed, seating resistance gradually increases until the work ceases to rotate, thereby causing spindle 19 to remain stationary, even though the motor 3 is still turning, whereupon the rotation of the head 14 of the driving clutch member 12 will cause the balls 21 to pass over the points of the polygonal cam section 20, as is shown in FIG. 3, thereby imparting radially outward movement to the balls 21 and a consequent axial movement to the ball retainer 23, the bearing 26 and the spring follower 27 against the spring 25. This axial movement causes the cross piece 29, which is engaging the spring follower 27, to drive the trip rod 55 toward the pawl 46 to swing the free end thereof in a clockwise direction away from the shoulder 52. As the pawl 46 is thus moved, the spring 48 is compressed to permit the pawl 46 to move out of engagement with the shoulder 52, whereupon the fluid pressure acting on the differential areas will move the member 33 and pawl 46 upwardly into sleeve 34, and cause seal 40 to seat against the lower portion 39 of the valve sleeve 34, thereby preventing further supply of pressure fluid to the motor 3, as shown in FIG. 1. The valve 10 thus will remain closed so long as a sufficient fluid pressure is exerted on the bottom of the valve member 33.

When the pressure fluid supply is shut off, the air in the head 8 and connector 9 may be exhausted to the atmosphere whereupon the spring 50 will automatically reopen the valve member 33 to the position shown in FIG. 2.

In multiple tool applications, because of the normally open, resetting feature of the valve 10, the pressure fluid may be supplied to and controlled from a central remote position. As shown diagrammatically in FIG. 4, pressure fluid may be supplied from a central supply, through master valve 63, into a manifold 64, thence into connectors 9, each leading to a tool 1. When a tool reaches a predetermined torque, that tool will shut off automatically and independently of any other tool in the group. When all of the tools have reached the predetermined torque, and have shut off, the master valve 63 can then be turned to shut off the pressure fluid supply, and to exhaust the air from the tools, the connectors 9 and the manifold 64 as, for example, through exhaust port 65 in the master valve 63, or in any other suitable manner, whereupon the valve assembly 10 of each tool 1 will automatically reset to the open position shown in FIG. 2, as preveiously described, whereupon the operation may be repeated on successive similar work.

This invention is not limited to the embodiment shown. Various changes, within the scope of the following claims, will occur to those skilled in the art.

I claim:

1. In a pressure fluid actuated tool for running and setting a threaded element, a fluid motor, a spindle, rotation transmitting clutch means between said motor and spindle automatically releasable upon a predetermined resistance to rotation of said spindle, a normally locked open valve means controlling the supply of pressure fluid to said motor, means automatically unlocking said valve means to interrupt said supply upon release of said clutch means, and means automatically reopening said valve means when the pressure of the fluid falls below a predetermined level.

2. In a pressure fluid actuated tool for running and setting a threaded element, a fluid motor, a spindle, rotation transmitting clutch means between said motor and spindle automatically releasable upon a predetermined resistance to rotation of said spindle, normally locked open valve means to supply pressure fluid to said motor, means automatically releasing said valve means to interrupt said supply upon release of said clutch means, and means automatically returning said valve means to the locked open position when the pressure of the fluid falls below a predetermined level.

3. In a pressure fluid actuated tool for running and setting a threaded element, a fluid motor, a spindle, rotation transmitting clutch means between said motor and spindle automatically releasable upon a predetermined resistance to rotation of said spindle, a normally locked open valve means controlling the supply of pressure fluid to said motor, means automatically releasing said valve means to close said supply upon release of said clutch means, and spring means automatically reopening said valve means when the pressure of the fluid falls below a predetermined level.

4. In a pressure fluid actuated tool for running and setting a threaded element, a fluid motor, a spindle, rotation transmitting clutch means between said motor and spindle automatically releasable upon a predetermined resistance to rotation of said spindle, a normally locked open valve means controlling the supply of pressure fluid to said motor, means to unlock said valve upon release of said clutch means, pneumatic means automatically closing said valve means to interrupt said supply when said valve is unlocked, and means automatically opening said valve means when the pressure of the fluid falls below a predetermined level.

5. In a pressure fluid actuated tool for running and setting a threaded element, a motor, a spindle, rotation transmitting clutch means between said motor and spindle automatically releasable upon a predetermined resistance to rotation of the said spindle, means forming a passageway conveying motive fluid to said motor, a valve in said passageway, a pawl pivotally connected to the said valve and adapted to lock the said valve in an open position, means associated with said clutch means adapted to unlock the said pawl upon the said predetermined resistance to rotation of the said spindle, the said valve being adapted to be closed by the pressure fluid when said pawl is in the said unlocked position, means to release said pressure fluid from said tool, means to automatically reopen said valve when the said pressure fluid is released.

6. In a pressure fluid actuated tool for running and setting a threaded element, a motor, a spindle, rotation transmitting clutch means between said motor and spindle automatically releasable upon a predetermined resistance to rotation of the said spindle, means forming a passageway conveying motive fluid to said motor, a normally open valve in said passageway, a pawl pivotally connected to the said valve and adapted to lock the said valve in an open position, means associated with said clutch means adapted to unlock the said pawl upon the said predetermined resistance to rotation of the said spindle, the said valve being adapted to be closed by the pressure fluid when said pawl is in the said unlocked position, means to release said pressure fluid from said tool, means to automatically reopen said valve when the said pressure fluid is released.

7. In a pressure fluid actuated tool for running and setting a threaded element, a motor, a spindle, rotation transmitting clutch means between said motor and spindle automatically releasable upon a predetermined resistance to rotation of the said spindle, means forming a passageway conveying motive fluid to said motor, a normally open valve in said passageway, a pawl pivotally connected to the said valve and adapated to lock the said

valve in an open position, a trip rod associated with said clutch means adapted to move axially to unlock the said pawl upon the said predetermined resistance to rotation of the said spindle, the said valve being adapted to be closed by the pressure fluid when said pawl is in the said unlocked position, means to release said pressure fluid from said tool, means to automatically reopen said valve when the said pressure fluid is released.

8. In a pressure fluid actuated tool for running and setting a threaded element, a motor, a spindle, rotation transmitting clutch means between said motor and spindle automatically releasable upon a predetermined resistance to rotation of the said spindle, means forming a passageway conveying motive fluid to said motor, a valve in said passageway, a pawl pivotally connected to the said valve and adapted to lock the said valve in an open position, means associated with said clutch means adapted to unlock the said pawl upon the said predetermined resistance to rotation of the said spindle, the said valve being adapted to be closed by the pressure fluid when said pawl is in the said unlocked position, means to exhaust said pressure fluid from said tool, means to automatically reopen said valve when the said pressure fluid is exhausted.

9. In a pressure fluid actuated tool, a housing, a rotary motor within said housing, a passageway adapted to supply motive fluid to said motor, a spring biased valve normally open relative to said passageway, clutch means drivingly connected to said motor, trip means associated with said clutch means, a pawl locking the said valve means in the said open position, the said trip means adapted to be moved axially by the said clutch means under certain conditions of operation to unlock the said pawl, pressure fluid means adapted to close the said valve to shut off the motive fluid to the said motor when the said pawl means is in the said unlocked position, and means to reopen the said valve means when the pressure of the said fluid falls below a predetermined level.

10. In a pressure fluid actuated tool, a housing, a rotary motor within said housing, a passageway adapted to supply motive fluid to said motor, a valve normally open relative to said passageway, clutch means drivingly connected to said motor, trip means associated with said clutch means, a pawl locking the said valve means in the said open position, the said trip means adapted to be moved axially by the said clutch means under certain conditions of operation to unlock the said pawl, pressure fluid means adapted to close the said valve to shut off the motive fluid to the said motor when the said pawl means is in the said unlocked position, and means to reopen the said valve means when the pressure of the said fluid falls below a predetermined level.

11. In a pressure fluid actuated tool, a housing, a rotary motor within said housing, a passageway adapted to supply motive fluid to said motor, a valve in and normally open relative to said passageway, clutch means drivingly connected to said motor, trip means associated with said clutch means, a pawl locking the said valve means in the said open position, the said trip means adapted to be moved axially by the said clutch means under certain conditions of operation to unlock the said pawl, pressure fluid means adapted to close the said valve to shut off the motive fluid to the said motor when the said pawl means is in the said unlocked position, and spring means to reopen the said valve means when the pressure of the said fluid falls below a predetermined level.

12. In a pressure fluid actuated tool, a housing, a rotary motor within said housing, a passageway adapted to supply motive fluid to said motor, a normally open valve in said passageway, clutch means drivingly connected to said motor, trip means associated with said clutch means, a pawl locking the said valve means in the said open position, the said trip means adapted to be moved axially by the said clutch means under certain conditions of operation to unlock the said pawl, the said valve being adapted to shut off the motive fluid to the said motor when the said pawl means is in the said unlocked positon, and means to reopen the said valve means when the pressure of the said fluid falls below a predetermined level.



13. In a pressure fluid operated torque tool, a normally open fluid valve, means mounted on and carried by said valve for retaining said valve in a locked open position, means responsive to a predetermined torque to unlock the said valve, pneumatic means adapted to close the unlocked valve, means to automatically open the said valve when the fluid pressure falls below a predetermined level.

14. In a pressure fluid operated torque tool, a motor, a normally open fluid valve to supply fluid to said motor, means mounted on and carried by said valve for retaining said valve in a locked open position, means responsive to a predetermined torque to unlock the said valve, the said valve being adapted to shut off the pressure fluid upon said unlocking, means to automatically open the said valve when the fluid pressure falls below a predetermined level.

15. In a pressure fluid actuated tool for running and setting a threaded element, a motor, a spindle, rotation transmitting clutch means between said motor and spindle automatically releasable upon a predetermined resistance to rotation of the said spindle, means forming a passageway conveying motive fluid to said motor, a normally open valve in said passageway, a pawl pivotally connected to the said valve and adapted to lock the said valve in an open position, a trip rod associated with said clutch means adapted to move axially to unlock the said pawl upon the said predetermined resistance to rotation of the said spindle, the said valve being adapted to be closed by the pressure fluid when said pawl is in the said unlocked position.

16. In a pressure fluid actuated tool for running and setting a threaded element, a motor, a spindle, rotation transmitting clutch means between said motor and spindle automatically releasable upon a predetermined resistance to rotation of said spindle, means forming a passageway to supply motive fluid to said motor, a normally open valve in said passageway, means adapted to lock the valve in said open position, means effective in response to said clutch release to unlock said valve, the valve being adapted to be closed by the pressure fluid when in said unlocked position.


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## Notice of Adverse Decision in Interference

In Interference No. 94,618 involving Patent No. 3,059,620, R. E. Eckman, PRESSURE FLUID ACTUATED TOOL, final judgment adverse to the patentee was rendered May 2, 1966, as to claims 1, 2, 3 and 4.

[*Official Gazette June 28, 1966.*]