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3,368,631

TORQUE CONTROL APPARATUS FOR IMPULSE TOOLS

Filed Oct. 14, 1965

2 Sheets-Sheet 1

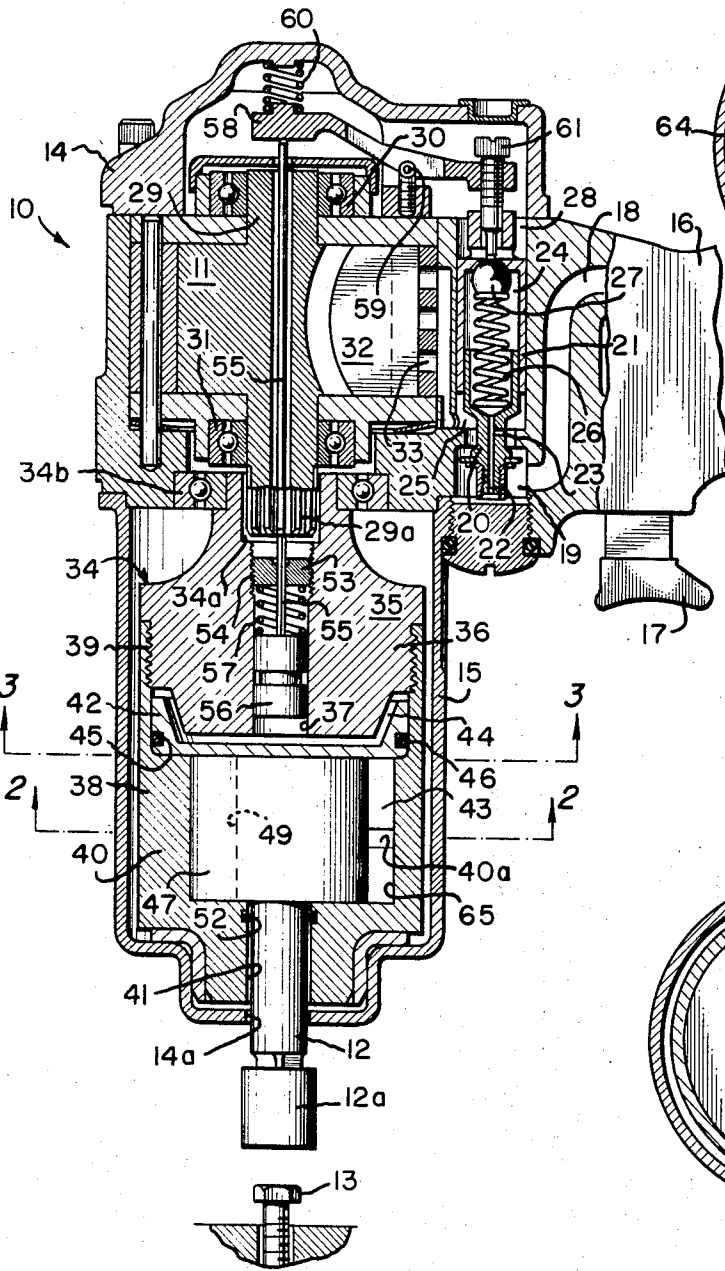


FIG. 1

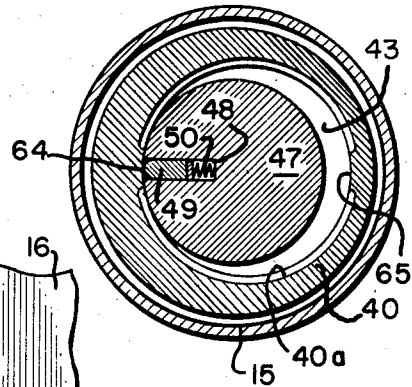


FIG. 2

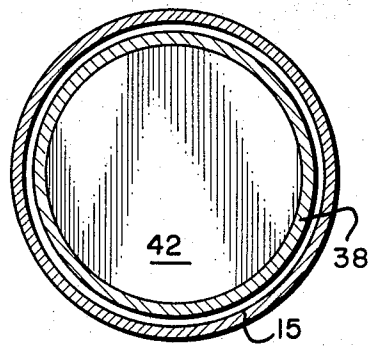


FIG. 3

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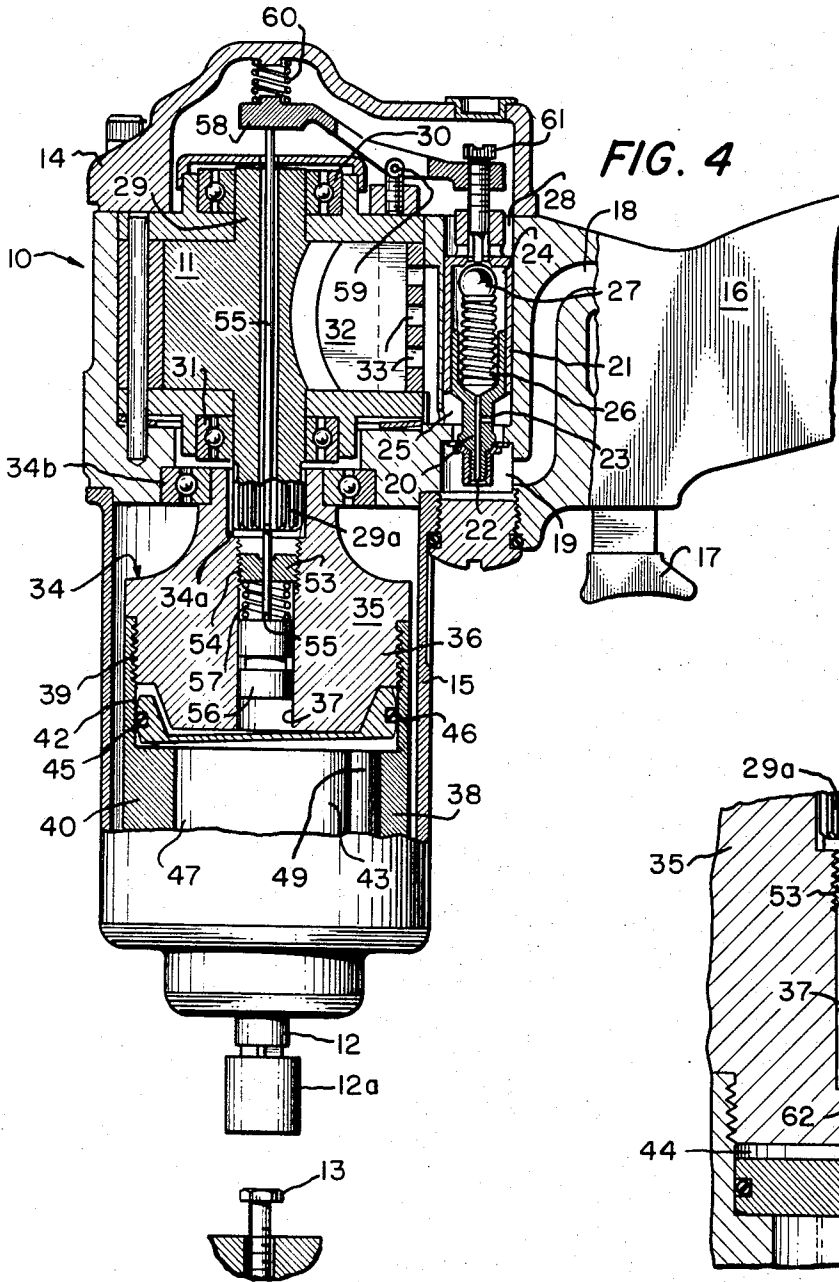
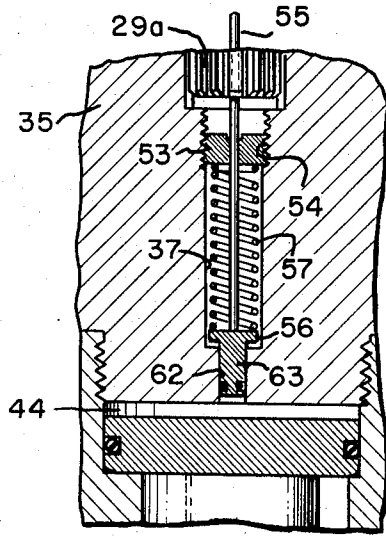


FIG. 5



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**TORQUE CONTROL APPARATUS FOR
 IMPULSE TOOLS**

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ABSTRACT OF THE DISCLOSURE

An impulse tool comprising a rotatably driven housing including a cavity containing a fluid, a rotor disposed within the housing cavity and in the fluid therein, and sealing means operable during relative rotation of the housing and rotor to cause a rotary impulse of the rotor. A wall defining the cavity is movable, in response to the pressure of fluid in the cavity, to bypass fluid around the rotor and cause the tool to be shut off.

The disclosure

This invention relates to power tools and has more particular reference to the provision of a new and improved apparatus for controlling the torque transmitted from an impulse tool to a member such as a fastener or a retainer which is driven thereby.

An object of the present invention is to provide a new and improved apparatus for controlling the torque transmitted from an impulse tool to a member such as a fastener or a retainer which is driven by the impulse tool.

Another object of the invention is to provide a new and improved control apparatus of the type set forth which limits the maximum torque supplied by the impulse tool to the driven member to prevent torque in excess of the desired maximum driving torque from being supplied to the driven member.

Another object is to provide a new and improved control apparatus of the type set forth which is easily and simply adjustable to vary the maximum torque transmittable from the impulse tool to the driven member.

Another object is to provide a new and improved control apparatus of the type set forth which is adapted to control the operation of the motor or driving means powering the impulse tool.

Another object is to provide a new and improved control apparatus of the type set forth which is accurate and efficient in operation while being relatively simple and economical in construction.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings. It will be understood that changes may be made in the details of construction and arrangement of parts shown and described as the preferred forms of the invention have been given by way of illustration only.

Referring to the drawings:

FIG. 1 is an elevational sectional view of an impulse wrench including an embodiment of the present invention;

FIG. 2 is a sectional view taken on line 2-2 of FIG. 1, looking in the direction of the arrows;

FIG. 3 is a sectional view taken on line 3-3 of FIG. 1, looking in the direction of the arrows;

FIG. 4 is an elevational sectional view generally similar to FIG. 1, but showing the impulse wrench after it has developed torque in excess of that to be transmitted to the driven member; and

FIG. 5 is a fragmentary, elevational sectional view of an alternate embodiment of the invention.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout the several views, FIGS. 1 through 4 illustrate an impulse wrench designated generally at 10. The impulse wrench 10 includes a spindle 12 driven by a pneumatic motor or driving means 11 to supply torque through a socket 12a to a driven member 13 which may be a fastener, retainer or the like.

More specifically, the impulse wrench 10 comprises a tool casing or housing 14 which is formed to include a barrel 15 and a handle 16. The handle 16 carries the actuating means or trigger 17 of the impulse wrench 10 and includes therein a fluid passage 18 through which fluid under pressure enters the impulse wrench 10. The fluid passage 18 communicates with a fluid chamber 19 and supplies fluid under pressure thereto upon actuation of the trigger 17.

A trip valve 20 is slidably mounted within a valve housing 21 and includes a longitudinal bore 22 which communicates the fluid chamber 19 with a valve chamber 24 and, also, a transverse bore 23 which communicates the longitudinal bore 22 with a fluid chamber 25. A coil spring 26 is disposed within the valve housing 21 with one of its ends bearing against the trip valve 20 and the other of its ends engaging a ball member 27. The trip valve 20 is adapted to be maintained in an open position with the impulse wrench 10 delivering less than the maximum torque to be transmitted to the driven member 13, but to be automatically closed in a manner to be herein later described when the torque of the impulse wrench 10 exceeds the maximum torque to be delivered to the driven member 13. An exhaust passage 28 is provided to exhaust the trip valve 20 to atmosphere when the trip valve 20 is in its closed position and is normally closed by the ball member 27 when the trip valve 20 is in an open position.

As illustrated, the pneumatic motor or driving means 11 of the impulse wrench 10 is of the vane type, one of the vanes thereof being shown at 32, and receives fluid under pressure through the ports 33 which communicate with the fluid chamber 25. The motor 11 includes a shaft-like portion 29 which is rotatably journaled adjacent its longitudinally opposing ends in the bearings 30 and 31 and carries splines 29a at its forward end.

The impulse mechanism of the impulse wrench 10 is disposed within an inner housing designated generally at 34 which is located within the barrel 15 of the housing 14. The inner housing 34 is rotatably journaled in the bearings 34b and is connected by splines 34a to the splines 29a of the shaft-like portion 29 of the motor 11 for rotation with the motor 11.

The inner housing 34 is formed from a first housing member 35 and a second housing member 38 which is threaded at 39 to the first housing member 35. The first housing member 35 includes a body 36 and a bore 37 which extends longitudinally through the body 36. The second housing member 38 includes an eccentric or first fluid chamber 43 which is circumferentially bounded by an annular tapering wall 40. The second housing member 38 comprises a bore 41 which communicates with the eccentric fluid chamber 43 and cooperates with an opening 14a in the housing 14 to allow projection of the spindle 12 from the impulse wrench 10.

A disc-shaped wall or plate member 42 is transversely disposed within the second housing member 38 for slidable movement intermediate an end of the annular tapering wall 40 and the body 36 of the first housing member 35. The wall member 42, as illustrated in FIG. 1, cooperates with the body 36 of the first housing member 35 to define a second fluid chamber 44 which is substantially filled with hydraulic fluid. The second fluid chamber 44 communicates with the bore 37 in the first housing mem-

ber 35 to transmit hydraulic fluid thereto, but is sealed from the eccentric fluid chamber 43 by a sealing ring 46 disposed in an annular groove 45 located circumferentially around the wall member 42.

The impulse mechanism of the impulse wrench 10 is of the type disclosed in U.S. Patent No. 3,116,617, which was issued Jan. 7, 1964, to Donald K. Skoog. The impulse mechanism comprises a rotor or spindle actuator 47 which is disposed within the eccentric fluid chamber 43 to abut the wall member 42 when the latter is in abutting relationship with the annular tapering wall 40 of the eccentric fluid chamber 43, as shown in FIG. 1. The spindle actuator 47 includes a radially extending slot 48 within which there is disposed a vane 49 biased by a spring 50 towards the annular tapering wall 40. The surface of the annular tapering wall 40 engaged by the vane 49 includes an arcuate undercut or groove 40a which is interrupted at diametrically opposing sides of the annular tapering wall 40 by the projections 64 and 65 of the annular tapering wall 40. The eccentric fluid chamber 43 is substantially filled with hydraulic fluid around the spindle actuator 47 such that the spindle actuator 47 will be impelled by the differential in fluid pressure on the opposing sides of the vane 49 during the rotation of the inner housing 34.

As illustrated in FIG. 1, the spindle 12 of the impulse wrench 10 is secured to the spindle actuator 47 for rotation therewith and projects from the inner housing 34 through the bore 41 in the second housing member 38. A sealing ring 52 surrounds the spindle 12 to prevent leakage of the hydraulic fluid contained in the eccentric fluid chamber 43 through the bore 41. Alternatively, as disclosed in U.S. Patent No. 3,116,617, the spindle 12 could be carried by the inner housing 34 for rotation therewith providing that the motor 11 is suitably connected to rotate the spindle actuator 47.

The bore 37 in the first housing member 35 includes therein means for resisting movement of the wall member 42 towards the body 36 of the first housing member 35. More specifically, the illustrated resisting means comprises a nut or fixed member 53 which is threaded at 54 to the bore 37, a connecting rod 55 which extends through the fixed member 53 and carries a slidable piston 56 relative thereto, and a spring or similar resilient member 57 which urges the piston 56 from the fixed member 53. As the fixed member 53 is threaded at 54 to the bore 37 it will be seen that the loading on the spring 57 may be adjusted and, hence, the resisting force of the resisting means may be preset as desired.

Furthermore, as will be seen from FIGS. 1 and 4, the connecting rod 55 extends through the motor 11 and engages a lever 58 which is pivotable about a fixed pivot 59. One end of the lever 58 is secured by a coil spring 60 to the barrel 15. The other end of the lever 58 carries a screw member 61 relative to the ball member 27 such that engagement of the lever 58 by the connecting rod 55 closes the trip valve 20 and shuts off the supply of fluid to the motor 11. Alternatively, however, the connecting rod 55 may actuate pneumatic, hydraulic, or electric means to control the operation of the motor 11 or may be employed to effect other desired action.

FIG. 5 illustrates an alternative embodiment of the resisting means. As illustrated in FIG. 5, the forward end of the bore 37 in the first housing member 35 includes a neck portion 62 adjacent its communication with the rear fluid chamber 44; and the piston 56 includes a portion 63 slidable within the neck portion 62.

The operation of the illustrated impulse wrench 10 is as follows. The fixed member 53 of the means for resisting movement of the slidable wall member 42 is adjusted to load the spring 57 with the resisting force necessary to permit transmittal of the desired maximum torque to the spindle 12. Then the trigger 17 is actuated to supply fluid under pressure to the motor 11 through the

fluid passage 18, the fluid chamber 19, the trip valve 20, the fluid chamber 25, and the ports 33.

The fluid thus supplied to the motor 11 effects conjoined rotation of the motor 11 and the inner housing 34 which is splined to the shaft-like portion 29 thereof. The rotation of the inner housing 34 is transmitted into an impulse of the spindle actuator 47 due to the differential in pressure of the hydraulic fluid upon the opposing sides of the vane 49. This impulse pulses the spindle actuator 47 to drive the driven member 13 to the maximum desired torque. After the maximum desired torque has been delivered to the driven member 13, the pressure of the fluid on the high pressure side of the vane 49 forces the wall member 42 to rock towards the body 37 of the first housing member 35.

The rocking movement of the wall member 42 increases the pressure of the hydraulic fluid in the second fluid chamber 44 to overcome the loading on the spring 57. Thus, hydraulic fluid from the second fluid chamber 44 flows into the bore 37 and, through the connecting rod 55 and its engagement with the lever 48 and the screw member 61, closes the trip valve 20 to prevent the passage of fluid to the motor 11, as shown in FIG. 4.

Thus, rotation of the motor 11 and the inner housing 34 is stopped while hydraulic fluid from the high pressure side of the vane 49 flows to the low pressure side thereof through the bypass formed by the rocking movement of the wall member 42. After sufficient hydraulic fluid has passed to the low pressure side of the vane 49 such that the pressure of the hydraulic fluid remaining on the high pressure side thereof is below that pressure necessary to overcome the force of the spring 57, the spring 57 returns the wall member to the position shown in FIG. 1. This return of the spring 57 is accompanied by an opening of the trip valve 20 and the resultant passage of fluid to the motor 11. The impulse wrench 10 is then ready to drive the succeeding driven member 13 to torque.

From the foregoing, it will be seen that I have provided new and improved means for accomplishing all of the objects and advantages of my invention.

Having thus described my invention, I claim:

1. In an impulse tool comprising a rotatable housing including a cavity containing a fluid, a rotor in said cavity and in said fluid, driving means connected to one of said housing and said rotor for rotating said one relative to the other thereof, a tool member connected to the other of said housing and rotor adapted for rotatably driving a driven member, and sealing means sealing said cavity into a high pressure portion and a low pressure portion during a relatively small part of each revolution of said relative rotary movement, an apparatus for limiting the torque transmitted to said driven member, comprising:
 - a wall of said cavity being movable between a first position wherein it prevents fluid from bypassing said sealing means and a second position wherein it allows fluid to bypass said sealing means; and
 - means normally retaining said wall in said first position whereby, when the pressure of fluid in said high pressure portion of said cavity attains a predetermined pressure, such fluid overcomes said retaining means and moves said wall to said second position.
2. A torque limiting apparatus according to claim 1, further comprising:
 - means actuatable, in response to movement of said wall to said second position, for shutting off said driving means.
3. A torque limiting apparatus according to claim 2, further comprising:
 - said retaining means being adjustable to vary the fluid pressure required to move said wall to said second position.
4. In an impulse tool comprising a rotatable housing including a rotor cavity containing a fluid, a rotor in said rotor cavity and in said fluid, driving means connected

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to said housing for rotating said housing relative to said rotor, a tool member connected to said rotor and adapted for rotatably driving a driven member, and sealing means sealing said rotor cavity into a high pressure portion and a low pressure portion during a relatively small part of each revolution of said housing relative to said rotor, an apparatus for limiting the torque transmitted to said driven member, comprising:

said housing including a second cavity containing a fluid;

a wall interposed intermediate said rotor and second cavities, said wall being movable between a first position wherein it prevents the fluid in said rotor cavity from bypassing said sealing means and a second position wherein it allows such fluid to bypass said sealing means; and

means upon the opposing side of said wall from said rotor cavity cooperating with the fluid in said second cavity to normally retain said wall in said first position whereby, when the pressure of fluid in said high pressure portion of said rotor cavity attains a prede-

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termined pressure, the fluid in said high pressure portion urges said wall to said second position.

5. A torque limiting apparatus according to claim 4, further comprising:

said last mentioned means being connected to said driving means to shut off said driving means when said wall moves to said second position.

6. A torque limiting apparatus according to claim 5, further comprising:

said last mentioned means being adjustable to vary the fluid pressure required to move said wall to said second position.

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