Oct. 4, 1966 R. C. FALTER 3,276,524

DRIVE ADAPTER FOR TORQUE RESPONSIVE CONTROL

Filed March 16, 1964

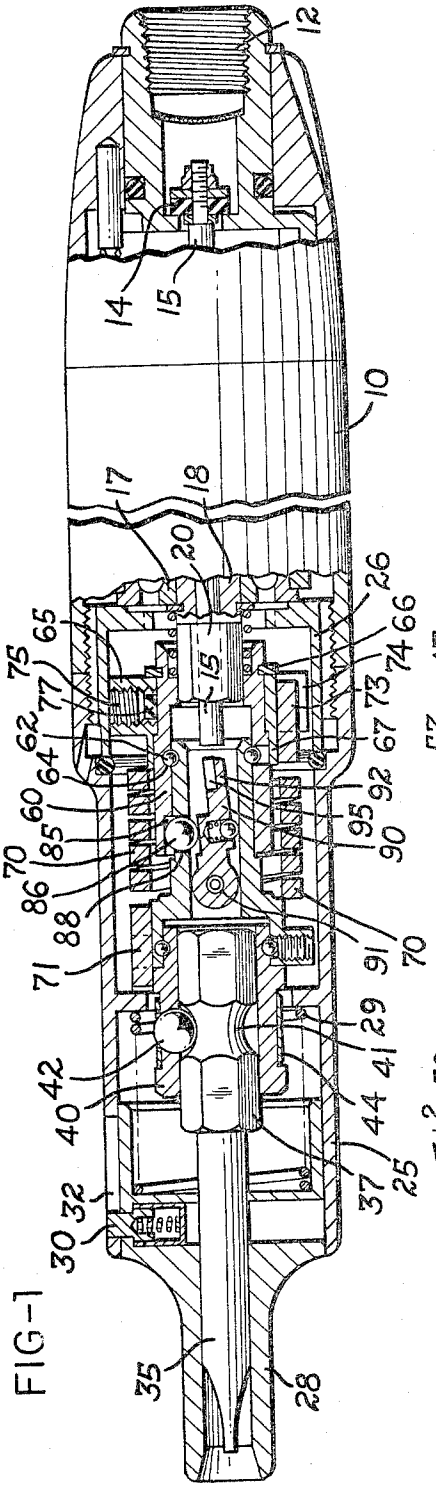


FIG-1

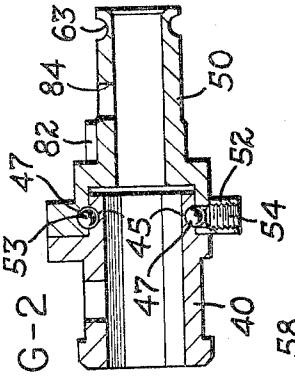


FIG-2

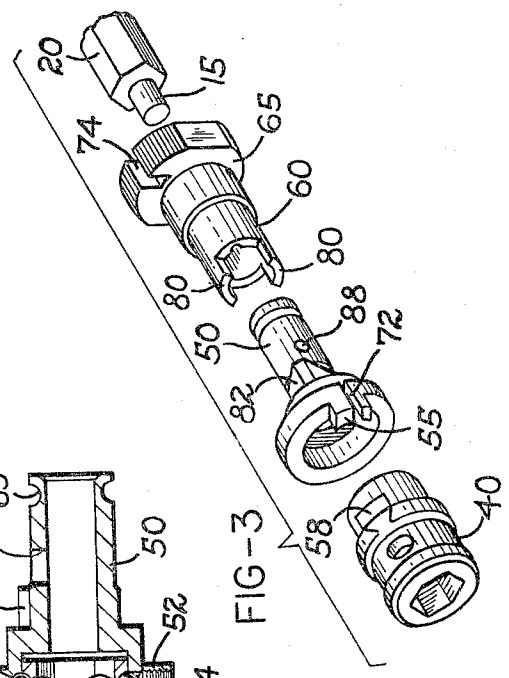


FIG-3

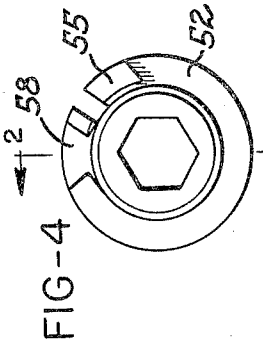


FIG-4

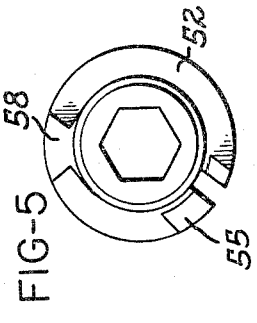


FIG-5

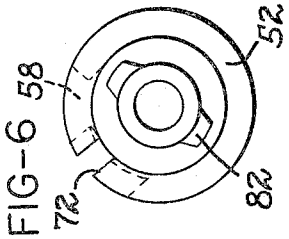


FIG-6

INVENTOR.

RONALD C. FALTER

BY

Marechal, Biebel, French & Bugg

ATTORNEY

United States Patent Office

3,276,524

Patented Oct. 4, 1966



3,276,524

# DRIVE ADAPTER FOR TORQUE RESPONSIVE CONTROL

Ronald C. Falter, Dayton, Ohio, assignor to Rockwell Manufacturing Company, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Mar. 16, 1964, Ser. No. 351,965
5 Claims. (Cl. 173—163)

This invention relates to an improvement in the driving mechanism of fastener driving tools, such as power screw drivers, having torque responsive mechanism which limits the amount of torque that can be applied by the tool to a fastener.

The type of tool to which the present invention is directed is normally known as a power screw driver or fastener driver. It applies the rotary power of a motor, for example a rotary pneumatic or electric motor, to a fastener driving bit or socket wrench, and includes mechanism between the driving motor and the bit which limits the amount of torque that can be applied to the fastener. Particularly, the present invention concerns an improvement in tools of this type as disclosed in application Serial No. 214,293, filed August 2, 1962, now U.S. Patent No. 3,195,704, in the name of Eugene Linsker, and assigned to the assignee of this application.

Briefly, such torque controlling mechanism incorporates a torsion spring which provides the effective driving connection between the motor and the bit as the bit is being driven. This spring has a predetermined resistance to deflection, and thus will act essentially as a solid driving member until the resistance of the fastener being driven increases to the point that the torque being transferred through the spring exceeds its ability to drive without deflection. Suitable mechanism is arranged at that time to sense the deflection of the spring and shut off the power to the motor.

Tools of this type are generally portable and held by hand, and thus the operator will grasp the casing or housing of the tool and hold it stationary while applying the bit to the fastener. When the motor stops, the operator, realizing that the fastener has been set, lifts the tool to release the bit from the fastener. However, there will inherently be a moment or two of reaction time before the operator accomplishes this release of the bit from the fastener, and in the meantime his natural reaction is to hold the tool stationary. It has been found that when small sizes of these tools are used to drive small fasteners, for example ⅛" to ⅜" hex screws, the energy "stored" in the torsion spring as it deflects to actuate the power shut-off mechanism will be released through the bit, tending to rotate the bit in a reverse direction and thus to loosen the fastener. As a practical matter, it appears this tendency need be considered only with small tools driving small fasteners, since in larger sizes the fastener has sufficient frictional resistance, due to its engagement in the work onto which it has been set, to withstand this momentary reverse action of the tool.

The present invention, therefore, is concerned primarily with power screw drivers and the like which are used to set small fasteners, and incorporating the torque responsive control as above described.

The primary object of this invention is to provide an improved drive adapter or mechanism for such power screw drivers and the like, wherein energy stored in the torque responsive control mechanism of the tool can be dissipated without transferring such energy to the fastener driving bit with a tendency to loosen the fastener being set.

Another object of the invention is to provide such a drive mechanism or adapter in which a positive drive



connection is provided during the application of driving force to the bit or wrench of the power tool, and in which the drive connection to the bit from the torque responsive control will temporarily be released to avoid reverse driving of a fastener before the tool can be withdrawn from the work.

A further object of the invention is to provide such a drive adapter for small power operated screw drivers and the like, wherein a predetermined and limited amount of rotary motion is permitted between the bit holding driven member and the member which applies driving torque thereto.

Another object of the invention is to provide such a drive adapter in a tool having a torsion spring drive which can be prestressed to control the torque at which it will deflect.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawing, and the appended claims.

In the drawing—

FIG. 1 is a shortened view, with the housing broken away and essential parts of the mechanism shown in section, illustrating a preferred embodiment of the invention;

FIG. 2 is a detail sectional view of the intermediate driving member and the driven member which are the essential parts of the drive adapter provided by the invention;

FIG. 3 is an exploded perspective view of the parts shown in FIG. 2, together with the primary drive member and its input shaft;

FIG. 4 is an end view of the parts shown in FIG. 2, with the section along which FIG. 2 is indicated thereon by the section line 2—2;

FIG. 5 is a view similar to FIG. 4, but with the parts in a moved position illustrating the manner in which the driving and driven lugs can separate; and

FIG. 6 is an end view of the parts shown in FIGS. 2 and 3, as seen from the right side thereof.

Referring to the drawing, which illustrates a preferred embodiment of the invention, a power screw driver is shown incorporating a housing **10** within which a suitable rotary drive motor, in this case a pneumatic motor, is mounted together with suitable reduction gearing (not shown). The rear portion of the housing is provided with an inlet fitting **12** through which pressure fluid can be supplied, and the flow of this fluid to the pneumatic motor is controlled by an automatic shut-off valve **14** carried on the rear of a control rod **15**. The forward bearing **17** of the gear reduction unit is shown, mounting the drive shaft **18** which includes a hex head or spline **20**, and as shown, the control rod **15** extends through these parts and forwardly toward the nose of the tool beyond the end of the spline **20**.

The housing **10** preferably has a separate nose portion **25** mounted thereon, for example being threaded to an intermediate fitting **26**, as shown. The forward end of this nose piece includes a finder member **28** which is slidably mounted therein, being urged to extend as shown by the spring **29**, and being guided in and prevented from leaving the forward end of the nose piece by the retractable spring-loaded pin **30** which can slide in the slot **32** formed in the nose piece. This pin also limits the axial movement of the finder.

A fastener driving tool, in this case shown as an ordinary chisel-blade screw driver bit **35**, can be mounted to extend through the finder portion **28**, as shown, and the bit includes an enlarged shank **37** of non-circular cross-section, ordinarily of hex shape, as shown. This shank of the bit is received and mounted within the driven or output member **40** of the adapter provided by the inventor. The shank of the bit includes a conventional

undercut section 41 into which a retaining ball 42 is pressed by a band spring 44 mounted to surround the driven member 40. At its rearward end the driven member 40 is provided with a race 45 for receiving a number of ball bearings 47.

Behind the driven member 40 is the intermediate driving member 50, of tubular shape, and including an enlarged forward end 52 surrounding the race 45 on the driven member and providing an outer race 53. The threaded plug 54 serves to hold the ball bearings 47 in place, and when these parts are assembled this bearing arrangement provides for rotation between the members 40 and 50, while preventing relative axial movement between these parts. Extending forwardly from the enlarged part 52 of the intermediate drive member there is a driving lug 55, and extending outwardly from the driven member 40 there is a driven lug 58. These lugs are arranged such that they are in the same circular path, and thus when the member is rotated lug 55 will impart a rotary driving force through the lug 58 to the driven member 40.

Mounted around the rearward end of the intermediate driven member 50 is the primary drive member 60, as shown in FIG. 1, and these parts are held against relative axial movement, while being free to rotate relative to each other, by the ball bearings 62 which are received in the inner race 63, formed on member 50, and the outer race 64 formed on member 60. These bearings are retained in the races by the forwardly extending portion of a spring anchor ring 65 which mounts around the rear of member 60, being positioned axially by the split ring 66. The forward extending portion of member 65 is indicated at 67 in FIG. 1.

The main torsion control spring 70 extends around the telescoped drive members 50 and 60, and is anchored to them at opposite ends tending to prevent relative rotation between them. The forward end 71 of this spring is received in a slot 72 formed through the intermediate drive member 50 and its lug 55. The rearward end 73 of the spring is received in a slot 74 which is formed in the anchored ring 65. This ring in turn is fixed to the primary drive member 60 by the clamping force of a set screw 75 acting against the surface of member 60 through a plastic pressure block 77.

As shown particularly in FIG. 3, the primary driving member 60 is formed with a pair of forwardly extending jaws 80, which extend around the intermediate drive member 50, and around the outwardly extending lugs or jaw member 82 formed thereon. The spring 70 acts to rotate the intermediate member 50 in a clockwise direction (when viewed from the direction of the input spline 20) thus tending to advance the lugs 82 forwardly, as in a direction to drive a righthand threaded fastener, until that lug engages a jaw 80. By appropriately rotating the ring 65 with the parts in this position, e.g., with the lugs 82 advanced to contact the jaws 80, the spring 70 can be "preset" to a predetermined torque, and the system will tend to continue to drive until that torque is exceeded, whereupon the jaws 80 will rotate forwardly away from the lugs 82. This construction has a further advantage in that a torque reverse direction drive can be obtained from the jaws 80 through the reverse lugs 82.

Within the forwardly extending part of the primary driving member 60 there is a cam or pocket 85 formed to receive a ball 86 which extends through a slot or hole 88 in the wall of the intermediate member 50. This ball is urged into the pocket 80 by a spring-loaded control finger 90 mounted to pivot within the intermediate member 50 around a pin 91. Normally, the position of the parts is such that the rearward end 92 of this member will engage the end of rod 15, but if member 60 is caused to rotate with respect to member 50, this will cause the ball 86 to push inward upon member 90 and align the pocket or cut-out 95 in the rearward end of member 90 with the end of the rod 15, permitting that rod to move forward and thus permitting closing of the power control valve 14. Details of the construction and operation of this are fully described in said Patent No. 3,195,704.

Considering, therefore, the condition that occurs as a fastener has been set by the tool, the jaws 80 on the primary driving member have advanced against the force of spring 70, away from the lugs 82 on the intermediate driving member. The lug 55 on that member is engaged with the lug 58 on the driven member, and from that member there is a direct connection through to the bit 35 and the fastener with which it is engaged. As the valve 14 closes, the motor will stop, and the spring 70 will release the energy stored therein by causing the primary driving member 60 to rotate in the opposite direction. At this time, of course, the intermediate driving member 50 and the driven member 40 are held stationary due to contact of the bit with the fastener. This reverse rotation of the primary driving member is carried back through the reduction gearing and the motor, tending to accelerate these parts in a reverse direction, and their inertia is coupled to the primary driving member as the jaws 80, now rotating backwards with respect to the original driving direction, contact the lugs 82. It has been found that this causes a tendency for the jaws 80 actually to strike a blow against the lugs 82, which in the case of working with small fasteners can tend to loosen them.

However, with the construction provided by the present invention, reverse rotation of the intermediate driving member due to this "resetting" of the jaws 80 against the lugs 82, merely causes the lug 55 to rotate away from the lug 58 on the driven member, and the force is dispelled without being transmitted to the bit. It has been observed in actual embodiments of tools incorporating the invention that the lug 55 may rotate as much as 180° or more in a reverse direction away from the output or driven lug 58, but once the jaws 80 contact the lugs 82, further rotation of the lug 55 ceases, before it can revolve completely around to strike the lug 58 from the other side.

While the method and form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise method and form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a power tool for driving fasteners and adapted to set the fasteners to a predetermined torque, the combination of a primary drive member and a motor connected to rotate said primary drive member, an intermediate drive member mounted coaxially with respect to primary drive member rotatable with respect thereto, a torsion spring connected at opposite ends to said primary and intermediate drive members and operative to prevent rotation therebetween up to a predetermined torque at which said spring will yield, a driven member rotatably mounted coaxially with respect to said intermediate driving member and including an adapter for receiving a fastener driving tool to deliver torque to such tool, said driven member being mounted for free rotation with respect to said intermediate drive member and being axially fixed with respect to said intermediate drive member, a driving lug extending from said intermediate drive member, and a driven lug on said driven member positioned to be engaged by said driving lug such that a driving torque can be applied to said driven member in one direction of rotation with said lugs engaged and reverse motion of said intermediate driven member resulting from release of energy stored in said spring after a fastener has been set will be dissipated by separating movement of said lugs in the other direction of rotation to avoid the transmission of a reverse torque to the driven member.

2. In a power tool for driving fasteners and adapted to set the fasteners to a predetermined torque, the combination of a primary drive member and a motor connected to rotate said primary drive member, an intermediate drive member mounted coaxially with respect to primary drive member rotatable with respect thereto, a torsion spring connected at opposite ends to said primary and intermediate drive members and operative to prevent rotation therebetween up to a predetermined torque at which said spring will yield, a power control responsive to relative rotation of said primary and intermediate drive members to stop the application of power by said motor to said primary drive member, a driven member rotatably mounted coaxially with respect to said intermediate driving member and including an adapter for receiving a fastener driving tool to deliver torque to such tool, said driven member being mounted for free rotation with respect to said intermediate drive member and being axially fixed with respect to said intermediate drive member, a driven lug extending from said driven member to move in a circular path, a driving lug extending from said intermediate drive member into said circular path for engaging said driven lug to transmit a driving torque to said driven member in one direction of rotation and providing for separating movement of said lugs in the other direction of rotation to prevent the transmission of a reverse torque to the driven member for a portion of one complete rotation of said intermediate member in said other direction.

3. In a power tool for driving fasteners and adapted to set the fasteners to a predetermined torque, the combination of a primary drive member and a motor connected to rotate said primary drive member, an intermediate drive member mounted coaxially with respect to primary drive member rotatable with respect thereto, a torque control device connected bewteen said primary and intermediate drive members and operative to prevent rotation therebetween up to a predetermined torque and to yield and permit rotation therebetween while storing energy due to the excess in torque, driven member rotatably mounted in an axially fixed position with respect to said intermediate driving member and including an adapter for holding a fastener driving tool to deliver torque to such tool, a driving lug extending from said intermediate drive member to rotate in a circular path, and a driven lug on said driven member extending into said circular path such that a driving torque can be applied to said driven member with said lugs engaged and reverse motion of said intermediate driven member resulting from release of energy stored in said torque control device after a fastener has been set will be dissipated by separating movement of said lugs along said circular path to avoid the transmission of a reverse torque to the driven member.

4. In a power tool for driving fasteners to a predetermined torque, a motor, a power control for said motor, a driving spline member connected for rotation by said motor in a direction to drive a threaded fastener, a primary drive member slidably mounted on said spline member, an intermediate drive member rotatably mounted on said primary drive member and fixed for sliding movement therewith, spaced jaw members on said respective primary and intermediate drive members extending into a common circular path, a torsion spring connected between said primary and intermediate drive members and



acting to urge said jaw members into engagement in a direction opposite to the normal rotation of said spline member, said spring being yieldable at a predetermined torque to permit separation of said jaw members and relative rotation between said intermediate and primary drive members, a driven member rotatably mounted and axially fixed on said intermediate drive member, an adapter on said driven member for receiving a fastener driving tool through which driving torque is delivered to a fastener, a driving lug on said intermediate drive member and a driven lug on said driven member extending in an overlapping arrangement into a common circular path providing a means for transmitting driving torque from the intermediate member to said driven member and providing for limited free rotation of said intermediate member as when the direction of rotation thereof is reversed, and control mechanism responsive to relative rotation between said primary drive member and said intermediate drive member due to yielding of said spring and operative to actuate said power control to cut off the power supply to said motor.

5. In a power tool for driving fasteners and adapted to set the fasteners to a predetermined torque, the combination of a primary drive member and a motor connected to rotate said primary drive member, a power control arranged to start and stop the application of power by said motor to said primary drive member, intermediate driving means mounted coaxially with respect to said primary drive member and rotatable with respect thereto, a driven member rotatably mounted coaxially with respect to said intermediate driving means and including an adapter for receiving a fastener driving tool to deliver torque to such tool, a torsion spring connected at opposite ends to said intermediate driving means and to one of said members and operative to prevent rotation therebetween up to a predetermined torque at which said spring will yield, means responsive to relative rotation of said intermediate driving means and said one member upon yielding of said spring and connected to actuate said power control to stop said motor, a first lug extending from said other member to move in a circular path, a second lug extending from said intermediate driving means into said circular path for engaging said first lug to transmit a driving torque, said lugs being of sufficiently small extent along said circular path to permit substantial relative rotation therebetween whereby energy stored in said spring upon yielding thereof can be dissipated without applying a reverse torque to said driven member.


**References Cited by the Examiner**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,184,394 | 12/1939 | Moutti | 173—93.5 |
| 2,250,736 | 7/1941 | Torresen | 81—52.4 |
| 2,760,391 | 8/1956 | Knutson | 81—52.4 |
| 2,764,272 | 9/1956 | Reynolds | 192—150 |
| 3,000,244 | 9/1961 | Sturrock | 173—93.5 |
| 3,150,725 | 9/1964 | Hornschuck et al. | 173—93.5 |
| 3,195,704 | 7/1965 | Linsker | 173—15 |



FRED C. MATTERN, JR., *Primary Examiner.*

MILTON KAUFMAN, *Examiner.*

L. P. KESSLER, *Assistant Examiner.*