POWER TOOL HAVING STALL TORQUE CALIBRATING UNIT

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References Cited
UNITED STATES PATENTS
2,808,916 11/1957 Johnson

ABSTRACT

A rotary output locating and locking device operable for positively locking a rotary output of an air motor operated power tool in a predetermined angular relation to the tool housing and for positioning a torque indicator carried on a motor operated rotary drive, which is interconnected to the rotary output via a torsional spring drive, in a corresponding starting position to condition the tool to be energized for calibrating and setting stall torque under simulated running load conditions.

12 Claims, 1 Drawing Figure
POWER TOOL HAVING STALL TORQUE CALIBRATING UNIT

FIELD OF THE INVENTION

This invention generally relates to the power fastening art and particularly concerns a stall torque calibrating unit for a power tool of a general type described in my co-pending United States patent application Serial No. 036,951 filed May 13, 1970, now U.S. Pat. No. 3,666,021 entitled "Power Tool Having Proportioning Transmission" and assigned to the assignee of this invention.

BACKGROUND OF THE INVENTION

Need exists for compact portable power tools capable of being set to close torque tolerance limits for a variety of fastener setting jobs such as in assembly plants of setting automotive trim screws and the like. In addition, reliable inspection and verification of the torque setting of the tool on the job is desirable and may be required in certain instances to meet rigid quality control standards. While tools are available to control applied torque within precise tolerance limits and provide a reading of the instantaneous peak applied torque delivered to a job under running load conditions such as the tool disclosed in my referenced patent application, nonetheless, it would be desirable in certain instances to quickly and easily check the preadjusted torque setting of such tools under hand-held simulated conditions before actually using the tool on a fastener under running load conditions.

OBJECTS OF THE INVENTION

A primary object of this invention accordingly is to provide an improved stall type power tool capable of providing a quick and easy read-out of the stall torque setting of the tool under hand held simulated running conditions and which may be effectively utilized not only to verify the torque setting of the tool but also to rectify or change the torque setting from job to job for specified fastener setting applications.

Another object of this invention is to provide a power tool of the type described incorporating a torsional drive quick and easy to manufacture and assemble in a compact rugged construction of mechanical simplicity for extended service usage with minimum maintenance requirements.

Other objects will be in part obvious and in part pointed out in more detail hereinafter.

SUMMARY OF THE INVENTION

Briefly stated, the power tool of my invention is provided with a torsional spring drive coupled within a transmission housing between a rotary drive of a stall type air motor and a rotary output of the tool. A rotary output locating and locking device is operable to selectively lock the rotary output to the transmission housing in a predetermined position relative to the rotary drive such that energization of the motor will cause the rotary drive to actuate a torque indicator which reflects the torque applied by the torsional spring drive to the locked rotary output for checking the calibration of the stall torque setting of the tool.

A better understanding of the objects, advantages, features, properties and relationships of the invention will be obtained from the following detailed description and accompanying drawing which sets forth an illustrative embodiment and is indicative of the way in which the principle of the invention is employed.

BRIEF DESCRIPTION OF THE DRAWING

The drawing shows a side view, partly in section and partly broken away, showing a part of a power tool incorporating this invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring in detail to the drawing wherein a preferred embodiment of this invention is incorporated, a power tool 10 is shown having a stall type air motor 12 suitably connected to a source of compressed air, not shown, for rotating vanes 14 of a rotor 16 drivenly connected with conventional gearing, not shown, within gear case 18 wherein bearings 20 are mounted for supporting a drive shaft or spindle 22 for rotation.

Spindle 22 is splined to a maximum diameter end portion of a tubular driving member 24 rotatably supported within an elongated transmission housing 26 threadably secured in coaxial relation to the gear case 18. The tubular driving member 24 receives, in co-axial telescoping fashion, a reduced shank 28 of an output spindle 30. A forward reduced end of the tubular driving member 24 surrounds the shank 28 and abuts a shoulder 32 of the output spindle 30 the shank 28 of which is received in a close rotating fit within the tubular driving member 24.

At the front of the tool 10, as viewed at the left hand side of the drawing, a quick-change hex chuck 34 is mounted within housing 26 for holding hex drive power screwdriver bits or other suitable driver accessories in a central hex opening 36 formed in the end of the output spindle 30. It is also to be understood that the speed characteristics of the motor 12 are of a type which are in inverse relation to its load characteristics and particularly suited for tightening different types of fasteners, typically threaded fasteners onto a workpiece.

To minimize inertial torque transfer to a fastener and to match the fastener force applied to a predetermined torque desired, typically within stringent tolerance limits, as described in my above referenced patent application, a torsion spring 40 is connected between the tubular driving member 24 and the output spindle 30 with the torsion spring 40 co-axially received within transmission housing 26 in surrounding concentric relation to members 24, 30. The spring 40 may be suitably connected in any desired manner between members 24 and 30, but for illustrative purposes, opposite ends of the spring 40 are shown with aligned tungs 42 and 44 extending in opposite axial directions for receipt within radial slots 46 and 48 in the maximum diameter portions of the tubular driving member 24 and the output spindle 30.

In the specifically illustrated embodiment of this invention, a pin and slot arrangement is provided such that when tool 10 is run in reverse to rotate the output spindle 30 counterclockwise to loosen a fastener, e.g., the wall surrounding an end 50A of a circumferentially extending slot 50 formed in the tubular driving member 24 directly drives the output spindle 30 via pin 52 integrally formed on output spindle 30 to project radially outwardly from its shank 28 into the slot 50 in captured relation thereto. Rotation of output spindle 30 in the clockwise direction for setting a fastener, e.g., is intentionally permitted relative to the tubular drive member.
24 from free-running no-load speed to stall to ensure that the drive is through the spring 40 so as to reduce the inertial torque applied to a fastener under running conditions.

At stall, however, the spring 40 must be wound less than the total angular freedom of relative rotation between the tubular driving member 24 and output spindle 30 to ensure a continuously active spring drive. In the illustrated embodiment, such relative rotation is limited to about 90° maximum displacement of the pin 52 within its slot 50. Depending on the selected motor running speed, the gear reduction from the rotor 16 to the spindle 22, and the torsion spring rate selected, the motor 12 may be set to stall within a desired limited number of motor revolutions while continuing to maintain an active torsional spring drive to the output spindle 30 so as to effectively reduce kinetic energy transmission to a fastener well within acceptable limits.

To measure torque which will be transmitted to a fastener under actual running conditions but before the tool 10 is applied to actually rundown a fastener on a job, a suitable torque indicator or scale 54 is shown mounted in fixed relation on the maximum diameter portion of the tubular driving member 24. An opening 56 is formed in the housing 26 to ensure that the torque scale 54 is clearly visible to provide a direct readout which may be marked by appropriate indicia 58, in inch pounds torque, e.g., reflecting loading of the spring 40 due to its windup in a clockwise direction.

To check the torque setting, rectify or preadjust torque setting at stall under such simulated conditions, the output spindle 30 is fixed to housing 26 and located in a predetermined position relative to the rotary drive such that the visible readout of the torque scale 54 through opening 56 will establish a starting position for measuring stall torque. While this starting point may vary depending on the condition of the spring 40 at the beginning of a fastener setting operation, the spring 40 in the preferred embodiment is unloaded with the motor 12 in a de-energized state, and the mounting of the assembled torsional drive by the spring tangs 42 and 44 in the slots 46 and 48 serve to position the pin 52 at the end 50A of its slot 50 as illustrated in the drawing.

To locate the scale 54 at its starting position, a pair of locking apertures 60 and 62 are formed at predetermined radial positions respectively in the housing 26 and in the maximum diameter portion of output spindle 30 such that upon manually orienting the output spindle to register its aperture 62 with the housing aperture 60, the torque scale 54 on the driving member 24 will be at a zero torque setting with the spring 40 relaxed. Upon inserting an appropriate locking member such as the illustrated rod 64 through the registered apertures 60, 62 the rod 64 and its cooperating locking apertures 60, 62 serve as a rotary output locating and locking device to positively lock the output spindle 30 to the housing 26 while the spring 40 acts to automatically position the torque scale 54 in its starting position aligned with the readout opening 56 in the housing 26.

Thereupon, the motor 12 may be energized with the output spindle 30 locked, and the spring 40 will twist to windup in proportion to the applied torque of the rotating mass and deaccelerate the motor 12 to stall while the angular deflection of the spring 40 is reflected in the torque read-out from the scale 54.

If desired, other arrangements may be provided such as a push button mounted in the housing 26 and spring loaded toward a normally inoperative position, e.g., to be manually actuated into engagement with a locking shoulder suitably formed on the output spindle 30, upon momentarily energizing the motor 12, to register the output spindle 30 in locked relation to the housing 26 with the scale 54 set in starting position.

In the actual fastener rundown, the motor 12 would gain somewhat more kinetic energy than when the tool 10 is driven with its output spindle 30 held rigid under simulated conditions. However, since all practical fastening jobs inherently provide some energy absorption, spring windup with the output spindle 30 locked to the housing 26 provides a simulated rundown very close to actual conditions obtained in driving fasteners over their practical torque rate ranges.

The tool 10 may be readily calibrated for accurate torque readout, and the above described construction permits quick and easy preadjustment to selected stall torque settings. Such preadjustment may be effected by suitable orifice regulation in the tool or by pressure regulation in the air supply line upstream of the motor. In this respect, my co-pending patent application Ser. No. 240,715 filed Apr. 3, 1972 entitled "Stall Torque Regulator Valve for Fluid Operated Power Tool" and assigned to the assignee of this invention is particularly effective in desirably maintaining a high level of motor running speed despite reduction in the preadjusted stall torque setting. A power tool having a torsional drive for applying fastener torque with a stall torque calibrating unit of the type disclosed will be seen not only to provide a compact portable tool for hand held applications but will also be particularly suited for applications wherein a relatively lightweight tool is required for specified fastener setting operations while additionally providing desired readout of the spring windup for use in simplified calibration and preadjustment of the torque setting.

As will be apparent to persons skilled in the art, various modifications, adaptations and variations of the foregoing specific disclosure can be made without departing from the teachings of the present invention.

I claim:

1. A power tool having a stall type air motor for setting fasteners to a specified torque at stall and comprising a rotary drive drivingly connected to the motor, a rotary output rotatable in one angular direction for setting fasteners, a housing, torsion spring means in the housing connecting the rotary drive and rotary output for driving the rotary output, the torsion spring means having resistance to torsional deflection which increases with deflection and being operable to be angularly deflected in proportion to torque applied by the torsion spring means to the rotary output upon rotation of the rotary drive in said one angular direction relative to the rotary output, a torque indicator movably mounted relative to the housing for actuation by the rotary drive, the torque indicator being movable from a starting position to a second position to provide an indication of said torque applied by the torsion spring means to the rotary output, and a rotary output locating and locking device operable to positively lock the rotary output in a predetermined angular position relative to the housing and position the torque indicator in its starting position for calibrating said torque ap-
plied by the torsion spring means at stall as indicated by the torque indicator upon energizing the motor.

2. The power tool of claim 1 wherein the rotary output locating and locking device comprises first and second apertures respectively formed in the housing and the rotary output, the apertures being registrable to positively lock the rotary output in said predetermined angular position relative to the housing with the torque indicator located in its starting position.

3. The power tool of claim 2 wherein the rotary output locating and locking device further includes a locking member selectively insertable into the first and second apertures upon their being brought into registration to engage and interconnect the housing and rotary output in positively locked relation.

4. The power tool of claim 1 wherein the torque indicator is fixed to the rotary drive for rotation therewith, the torque indicator being positioned in its starting position by the torsion spring means upon locating the rotary output in said predetermined angular position relative to the housing.

5. The power tool of claim 4 wherein the torque indicator comprises a scale with indicia marked thereon, and wherein the housing has a readout opening formed therein for visual observation of the scale.

6. The power tool of claim 4 wherein the torsion spring means is unloaded when the rotary output is located in said predetermined angular position relative to the housing with the torque indicator positioned in its starting position in condition to calibrate the stall torque setting upon energizing the motor.

7. The power tool of claim 1 further including a slot circumferentially formed in one of the rotary drive and rotary output members, and a pin fixed to the other of the rotary drive and rotary output members and received in the slot, the pin and slot permitting angular movement of the rotary drive in said one angular direction relative to the rotary output.

8. The power tool of claim 7 wherein the torsion spring means has a spring rate sufficient to decelerate the motor in a predetermined number of motor revolutions at a given motor running speed, and wherein the slot is of sufficient length to effect an active torsional spring drive under such running load conditions to stall.

9. The power tool of claim 7 wherein the pin is normally positioned at the end of the slot in engagement with said one member when the rotary output is in said predetermined angular position relative to the housing with the torque indicator located in its starting position.

10. The power tool of claim 9 wherein the pin and said one member provide a direct driving connection between the rotary drive and rotary output upon energizing the motor to rotate the rotary drive in a direction opposite said one angular direction.

11. The power tool of claim 1 wherein the torsion spring means is a helical torsion spring having opposite ends drivingly connected to the rotary drive and the rotary output, the torsion spring having its coils positioned between the rotary drive and the rotary output with freedom of movement for unrestricted axial deflection and radial contraction responsive to loading.

12. The power tool of claim 11 wherein one of the rotary drive and rotary output members is a tubular member with the other of said members being received in co-axial telescoping relation to said one tubular member, and wherein the helical torsion spring is received within the housing in concentric surrounding relation to the rotary drive and rotary output members with freedom of movement within the housing for unrestricted radial contraction and axial extension responsive to loading.

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