April 21, 1959 | G. S. WING | 2,882,773

BOLT HOLDING WRENCH

Filed June 10, 1957 | 2 Sheets-Sheet 1

FIG. 1

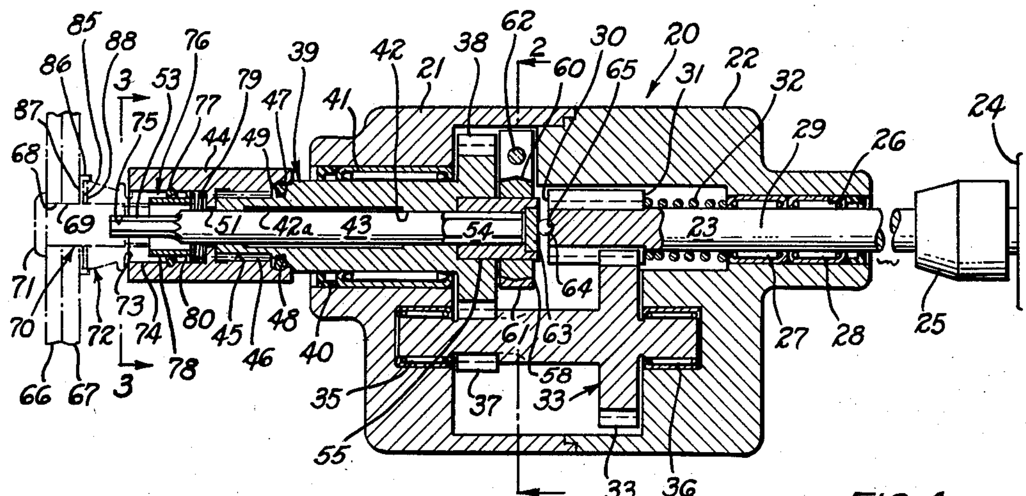


FIG. 2

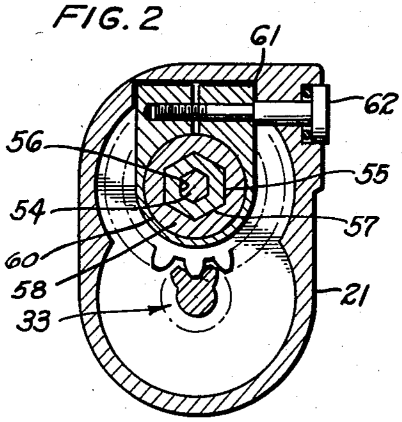


FIG. 4

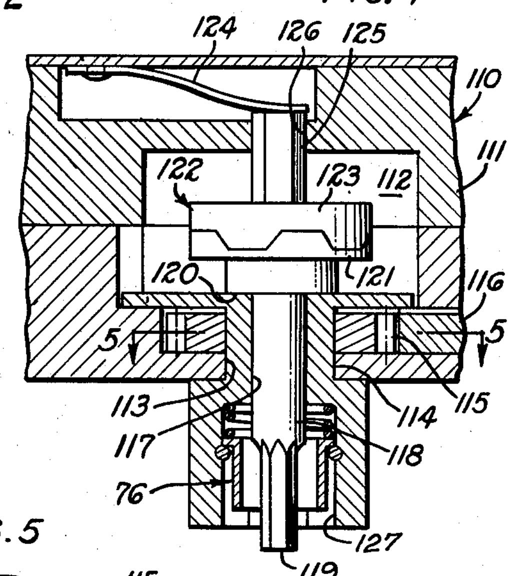


FIG. 5

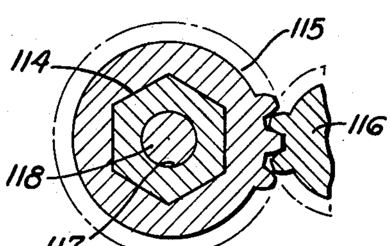
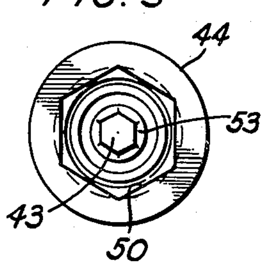


FIG. 3



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BOLT HOLDING WRENCH

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FIG. 6

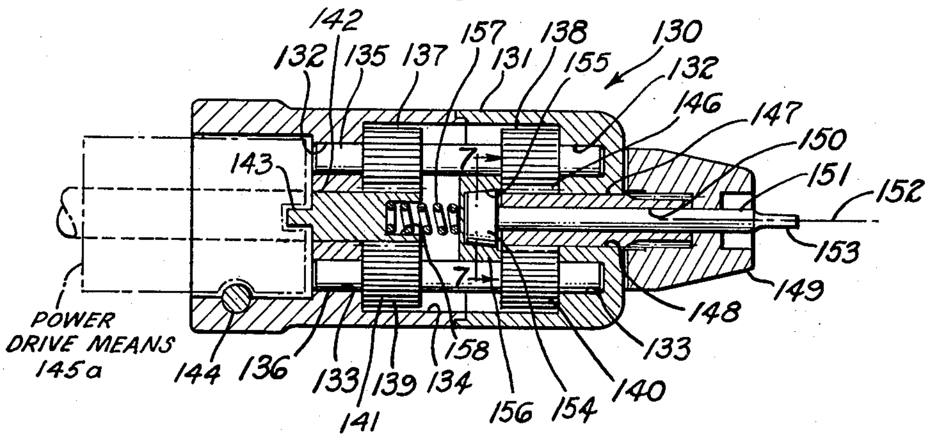


FIG. 7

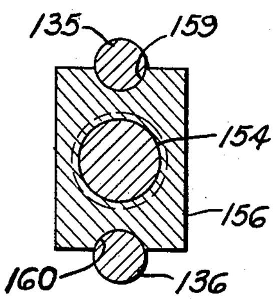


FIG. 8

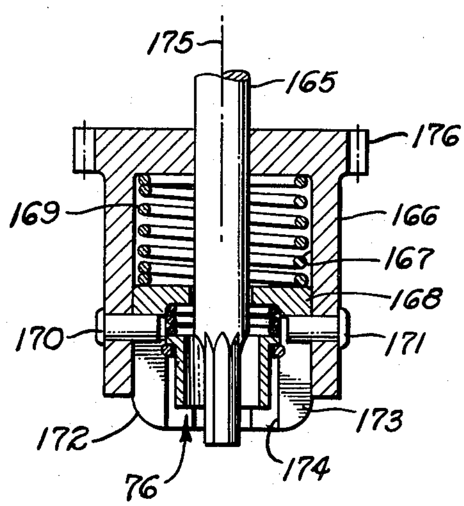


FIG. 9

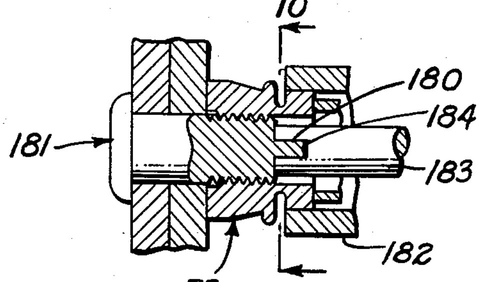
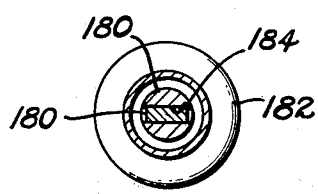


FIG. 10



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BOLT HOLDING WRENCH

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Application June 10, 1957, Serial No. 664,634

3 Claims. (Cl. 81—56)

This invention relates to a tool for tightening a threaded collar onto a threaded pin.

An object of this invention is to provide a tool for tightening a fastener of the above type from a single end of said fastener.

A further object is to provide means for protecting the tool from damage which might occur as the result of excessive torque loads on some of the tool elements.

This invention is carried out by providing a coaxial wrench and socket adapted for rotation relative to each other. By this means, the wrench can engage the pin of the fastener, and the socket can engage the collar so as to tighten the collar onto the pin. In the preferred embodiment of the invention, the socket rotates, and the wrench does not.

According to a preferred but optional feature of the invention, the wrench is held by frictional clutching means so that it will be turned by excessive torques which otherwise might damage it.

According to still another preferred but optional form of the invention, either the wrench or the socket is adapted to retract so as to permit the tool to advance onto the fastener as the fastener is tightened.

The above and other features of this invention will be fully understood from the following detailed description and the accompanying drawings, of which:

Fig. 1 is a side view, partly in cross-section, of the presently preferred embodiment of this invention, showing a fastener being tightened thereby;

Fig. 2 is a cross-section taken at line 2—2 of Fig. 1;

Fig. 3 is an end view taken at line 3—3 of Fig. 1;

Fig. 4 is a side view, partly in cross-section, of still another embodiment of the invention;

Fig. 5 is a fragmentary cross-section, taken at line 5—5 of Fig. 4;

Fig. 6 is a side view, partly in cross-section, of still another embodiment of the invention;

Fig. 7 is a partial cross-section taken at line 7—7 of Fig. 6;

Fig. 8 is a fragmentary side view, partly in cross-section, showing another means for providing relative axial movement between the wrench and the socket;

Fig. 9 is a fragmentary side view, partly in cross-section, showing the use of a modified wrench for tightening a fastener of a somewhat different configuration from that shown in Fig. 1; and

Fig. 10 is a cross-section taken at line 10—10 of Fig. 9.

The preferred embodiment of this invention is shown in Fig. 1 wherein a tool **20** has a frame which may conveniently be made from two parts **21** and **22**, the parts being joined together when the tool is assembled. A tool drive shaft **23**, which may be driven by a drill motor **24** that is connected thereto by chuck **25**, enters the frame through a passage **26**. This passage has a pair of needle bearings **27**, **28**, for rotatably mounting the tool drive shaft. The tool drive shaft **23** has a central axis **29** and is axially slidable in the passage **26**. The drive shaft terminates within a drive gear **30**. The drive gear provides

a shoulder **31** facing toward the passage **26**. A coil spring **32** biases the drive gear away from the passage **26**.

The drive gear **30** meshes with a pinion gear **33** which is journaled in needle bearings **36** in part **22** of the frame and needle bearings **35** in part **21** of the frame. The pinion gear has teeth **34** and **37** which are axially spaced from each other. The teeth **34** mesh with the teeth on the drive gear **30**, while the teeth **37** mesh with teeth **38** on a socket drive shaft **39**.

The socket drive shaft **39** is journaled in a passage **40** through part **21** of the frame in needle bearings **41** so as to be rotatable therein. The socket drive shaft has a wrench passage **42** therethrough which is generally circular. It has a bearing relief **42*a*** at its midsection to reduce frictional drag in the passage. A wrench **43** passes through the socket drive shaft, and the socket drive shaft rotates free of the wrench. A socket **44** has splines **45** which engage splines **46** on the end of the socket drive shaft, which hold the socket with the socket drive shaft for rotation therewith. The socket is provided with a groove **47**, and the socket drive shaft is provided with a groove **48**. These grooves accommodate a retainer spring **49** between them which holds the socket axially on to the socket drive shaft.

The socket has internal collar engaging surfaces **50** which have the general configuration of a collar to be turned on to a pin. These surfaces form a hexagon as shown in Fig. 3.

The socket has a central port **51** which passes the wrench **43** therethrough. The socket and the wrench have central axes which coincide with axis **29**.

The protruding end of the wrench has pin-engaging surfaces **53** which may conveniently be of the Allen-head type, that is, hexagonal, although any other configuration might also be used which will engage the surfaces of a recess in the pin of a fastener to be tightened. The central portion of the wrench is round. As best shown in Fig. 2, the wrench is provided with splines or some other type of interrupted surface such as the hexagonal surfaces **54**. These surfaces **54** fit in a clutch socket **55** which clutch socket has a hexagonal opening **56** for receiving the hexagonal end of the wrench. The outer surface **57** of the clutch socket may also conveniently be hexagonal for engaging a clutch band **58**. This clutch band is provided with a circular peripheral surface **60** which may preferably have an outwardly convex V shape in cross-section (see Fig. 1). This peripheral surface is gripped by a brake **61** of the Prony type, which can be tightened on to the clutch band by a brake-adjustment screw **62** (see Fig. 2). The brake restrains the wrench and, of course, the degree of restraint, from restraint which for all practical purposes is total, to relatively easily yielding restraint, is adjustable by the clutch band. The terms "restraint" and "restrained" as used in this specification and in the claims cover all such degrees of restraint of rotation against the wrench relative to the frame.

The right hand end of the clutch socket **55** has a hardened insert **63** against which a thrust bearing **64** bears. This bearing, which may be a ball as shown, is carried in a recess **65** in the drive shaft **23**. It will be seen that the action of the coil spring **32** in moving the drive shaft to the left in Fig. 1 tends to keep the thrust bearing ball firmly between and against the drive shaft and the insert **63** of the clutch assembly. This biases the wrench to the left in Fig. 1.

The clutch socket **57** is axially movable in opposition to the coil spring **32** so that the wrench can be moved axially. The clutch assembly and the frame hold the socket drive shaft **39** against making any appreciable axial movement.

In Fig. 1 there is also shown a fastener for which tool **20** is particularly suited. A fastener of this nature is generally used for joining a pair of bodies **66** and **67** together. These bodies have registering holes **68**, **69** respectively, through which an externally threaded shank of a pin **70** is passed. The pin has a head **71** which bears against one of the bodies while the threaded end of the pin projects through and beyond the bodies. A collar **72** having a shear section **73** and a hexagonal socket engaging section **74** is threaded onto the pin.

This fastener may be provided with a washer **85** having an annular flange **86**, and two flat sides. One flat side bears against body **67**, and the other against the collar **72**. The washer has a layer **87**, **88** of substantially dry lubricant on both of said flat sides, although the layer **87** adjacent body **67** is optional. A suitable lubricant for this purpose is sold by S. C. Johnson & Son, Inc., located in Racine, Wisconsin, under the name #153 Wax Lubricant "Tube Draw." This lubricant is provided in an evaporable liquid base. The base evaporates before the lubricant is used as described below, leaving the dry wax. This is a polar wax which dries to a thin film. The purpose of this film is to reduce or eliminate the variability of the reaction forces between the collar and the work. When this reaction is constant, then the pre-load on the pin can be accurately controlled by adjusting the torque applied to the collar.

In setting this fastener, the wrench **43** is inserted into a recess **75** in the end of the pin, and the socket **44** engages the hexagonal socket engaging section **74**. As can be seen from the drawings, holding the wrench **43** stationary and turning the socket will cause the collar to tighten on to the bolt until sufficient torque is exerted on the hexagonal socket engaging section **74** that the shear section **73** fails and the hexagonal section comes free. A more complete description of a fastener of this type and its operation is given in my co-pending patent applicant Serial No. 643,183, filed February 28, 1957, entitled "Fastener."

In order to expel the sheared-off hexagonal section from its socket, an ejector means **76** is provided which comprises a retainer ring **77**, within the socket, a flanged tubular member **78** surrounding the wrench **43** and a coil spring **79** opposed between the socket and the flange **80** of the member **78**. The hexagonal section will force the tubular member **78** back into the socket while the fastener is being tightened. After the shear section has failed and the tool withdrawn, the spring **79** will force the tubular member **78** to the left in Fig. 1 so as to eject the hexagonal section from the socket.

Another embodiment of the invention, utilizing a different type of clutch means, is shown in Fig. 4. A tool **110** has a frame **111** having a clutch cavity **112** and a shaft passage **113** therein. A socket drive shaft **114** is journaled in the shaft passage **113** and has a ring gear **115** (see Fig. 5) keyed thereto so that rotation of the ring gear as caused by a drive gear **116** will turn the socket drive shaft.

The socket drive shaft **114** has a wrench passage **117** therethrough which accommodates a wrench **118** having a central circular cylindrical portion terminating at the lower end with pin engaging surfaces **119** which are preferably hexagonal in the shape of the well known Allen-head wrench. The wrench has a shoulder **120** which rests upon the socket drive shaft to limit the downward movement of the wrench. At the upper end of the wrench there is integrally attached the lower contact plate **121** of an over-riding clutch **122**. A matching upper contact plate **123** is held against the contact plate **121** by pressure exerted from a leaf spring **124** against a shaft **125** to which the upper plate is attached. Shaft **125** is hexagonal, and thereby keyed into a hexagonal passage **126** so that it is held against rotation but is axially movable against the force of the spring **124**. An ejector means **76** is provided in the socket in the same manner as in the tool of Fig. 1, and like reference numerals are used.

Fig. 6 shows a tool **130** which is particularly suitable for use with a drill motor, inasmuch as it is an entirely in-line tool. This tool has a frame **131** which frame is provided with shaft passages **132** and **133**. A gear cavity **134** is provided between the shaft passages to accommodate a pair of spur gear pinion shafts **135**, **136** which are journaled at their two ends in passages **132** and **133** respectively. These spur gear pinion shafts each have a pair of spur gears incorporated in their length, spur gears **137**, **138** being included on pinion shaft **135** and spur gears **139** and **140** being incorporated on pinion shaft **136**.

A spur gear **141** is journaled in a bearing **142** in the frame and has a lug **143** for engagement with a shaft of a drill motor (power drive means **145*a***). A screw **144** provides for retention of the drill motor in the proper location in the neck **145** of the frame. Spur gear **141** makes meshing and driving contact with spur gears **137** and **139**.

Another spur gear **146** is mounted coaxially with spur gear **141** and meshes with spur gears **138** and **140**. Spur gear **146** is integral with a socket drive shaft **147** which drive shaft extends through a bearing **148** in the frame and receives a socket **149** on its projecting end. The socket drive shaft **147** has a wrench passage **150** extending axially therethrough so as to receive a wrench **151**. The wrench and the socket have a common central axis **152**.

The wrench is provided with pin engaging surfaces **153** on its end which may form a hexagonal prism so as to form an Allen-head wrench if desired. At its other end the wrench is provided with a tapered head **154** which is tapered so as to fit into a circular tapered recess **155** in a clutch disc **156**. The thickness of the head is less than the depth of the recess **155**. A coil spring **157** is opposed between the spur gear **141** and the clutch disc **156**. The coil spring is seated in a recess **158** in spur gear **141**, and bears against that gear and against the clutch disc so as to force the clutch disc toward the socket.

As can best be seen from Fig. 7, the clutch disc is generally rectangular and has two arcuate (preferably circular) cut-outs **159**, **160** which bear against the spur gear pinion shafts **135** and **136**, respectively. These cut-outs prevent the clutch disc from rotating in the frame.

An ejector means **76** (not shown) can be provided in the socket in the same manner as in the device of Fig. 1.

In all of the aforesaid embodiments, provisions have been made for the wrenches to be axially movable while the socket is held substantially axially immovable. In general when installing the fastener of the type shown in Fig. 1, such an arrangement is to be preferred both for the most effective tightening of the fastener and for simplicity of tool construction. However, sometimes it may occur that a retractable socket and a non-retractable wrench is to be preferred. In Fig. 8, such a device is shown. A wrench **165** may be substituted for the wrench in any of the above tools, and be keyed so that it cannot move axially, although it can be turned. A socket drive shaft **166** may also be substituted for the corresponding part in the above tools. The socket drive shaft is provided with a tubular portion **167** within which a socket **168** is slidably disposed. A coil spring **169** is opposed between the tubular portion **167** and the socket **168** so as to force the socket away from the frame. A pair of pins **170**, **171** projects into the tubular portion and also into axial slots **172**, **173** respectively in the socket. The socket will thereby turn with its drive shaft, and can slide axially therein.

Collar engaging surfaces **174** are provided inside the socket, and these surfaces may be provided in an hexagonal pattern if desired. The socket and the wrench have a common central axis **175**.

A spur gear **176** is made integral with the socket drive shaft **166** so that when this gear is driven by any desired means, the socket will rotate relative to the wrench. The wrench may include any of the clutch devices shown in the above described embodiment.

If desired, an ejector means such as means **76** may be provided in this socket as shown. These are identical with the means shown with Fig. 1, like parts bearing identical numerals.

Occasionally, it may be desired to form the fastener with a protrusion on the pin for being gripped instead of a recess. Such a modification of the pin is shown in Figs. 9 and 10, wherein the protrusion comprises a tongue **180** having a rectangular cross section protruding from the end of a pin **181**. In all other respects the pin can be the same as the pin **70** shown in Fig. 1, of course omitting the recess at the end thereof. A collar **72** identical with that shown in Fig. 1 is to be threaded on to the pin by a socket **182**. A wrench **183** has its end modified with a straight slot **184** for receiving the tongue **180**. The socket and the rest of the wrench may be made according to any of the above described embodiments. This device illustrates the fact that the hexagonal shapes provided on the nut and in the socket and also the Allen-head type end on the wrench are not limitations on this invention. Rather, any desired pin and collar engaging surfaces may be provided as appropriate to the fastener being tightened.

The operation of these devices will now be described. With respect of the device of Fig. 1, the pin will first be inserted in the registering holes **68** and **69** in the plates **66** and **67**. The collar will then be started upon the pin. The wrench **43** is inserted into the recess in the end of the pin and the socket **44** is pushed over the hexagonal portion of the collar. This action retracts ejector means **76**.

Thereafter, the drill motor **24** or other means for turning the drive shaft **23**, is powered so as to rotate the same. This rotation is transmitted by the gear frame from the drive shaft through the pinion **33** to the socket drive shaft **39**. The wrench **43** does not initially rotate because it is held by the clutch, and the collar will therefore be turned onto the pin by the socket, because the wrench holds the pin against rotation. After the collar has been seated against the body **67**, the motor will exert a torque on the hexagonal section until a sufficient torque is exerted that the fastener fails at the shear section **73** at which time the load is relieved from the socket **44**. The tool can then be pulled off of the fastener leaving the remainder of the collar (to the left of the shear section in Fig. 1) torqued to a value determined by the yield strength of the shear section. In normal cases this is all that occurs. However, it sometimes may occur that the shear section might no fail at a torque limit below that which would damage the wrench **43**. In fact, wrenches have been destroyed by this means in wrenches not involving yieldable means for protecting the same. As the tool advances toward the body **69** when the collar advances on the pin, the wrench will be forced inwardly against spring **32**.

In the tools shown, the clutch is adjusted so as not to yield, but instead, to restrain the wrench up to torque values needed to set the fastener, and below values which would harm the tool. In the tool of Fig. 1, the clutch band begins to shift in the brake **61** at a torque value which is determined by the setting of the brake adjustment screw **62**. The torque exerted on the wrench can therefore never exceed a safe value, and the wrench is protected against distortion.

The operation of tool **110** shown in Fig. 4 is as follows. The socket **127** is placed over the collar, and the wrench **118** is inserted into the recess in the pin. Thereafter the drive gear **116** is turned by power applied in any desired manner so as to rotate the socket drive shaft **114** and thereby the socket **127**, tightened the collar on the pin.

As the socket advances onto the pin the wrench **118** will be forced in an axial direction upward as shown in Fig. 4. This force is exerted against the force of spring **124**. This tends both to retract the wrench **118** and keep the over-riding clutch **122** engaged by forcing the contact plates **121** and **123** together. If an overload on the wrench occurs, then the over-riding clutch will slip by virtue of the lands on the contact plate **121** and **123** climbing each other in a well understood manner. It will be recognized that contact plate **123** is held against rotation because of the hexagonal shape of its shaft **125**.

The operation of tool **130** (Figure 6) will now be described. A drill motor (not shown) can be fitted on to the lug **143** and held in place by screw **144**, whereupon turning the gear train starting with spur gear **141**, and ending with the spur gear **146** on the socket drive shaft **147** drives the socket **149** to turn a collar on to a pin in the manner as heretofore described.

The coil spring **157** presses the clutch disc **156** toward the socket drive shaft. As can best be seen from Fig. 7, the cut-outs **159** and **160** fit around the shafts of the spur gear pinions so that the clutch disc is not rotatable. It will also be appreciated that the thickness of the head **154** of the wrench is less than the gap of the circular tapered recess **155**. Therefore when the spring moves the clutch disc to the right as shown in Fig. 6 and pressure of the tool against the pin moves the wrench **151** to the left a contact is made between the wrench and the clutch disc which prevents the wrench from rotating at torques less than some predetermined value.

As the socket moves along the pin while threading on the collar, the wrench **151** retracts into the tool, pushing te clutch disc along with it. If a torque overload is exerted on the tool in excess of the torque which can be held by the disc, then the wrench simply slips in the clutch and thereby is protected against the damage due to overloads on the tool.

Occasionally it may be desired to have the socket retract, instead of the wrench. This is not ordinarily the situation, but in the event that it is, any of the above described wrenches may be given a collar or some other type of key to hold it against axial movement while still permitting the same slipping rotational movement in the clutch. Then the socket drive shaft **166** of Fig. 8 may be substituted for the other socket drive shaft, and be driven by the spur gear **176** attached thereto, from means such as spur gear **116** in Fig. 4. The socket **168** will engage the collar in the usual manner, while the wrench **165** is inserted into the recess in the pin.

The socket drive shaft does not appreciably move axially, and neither does the wrench in this device, and they do not move appreciably axially relative to each other. However, the socket **168** does move axially within the socket drive shaft in opposition to the coil spring **169**. The pins **170** and **171** in slots **172** and **173** respectively keep the socket from turning relative to the drive shaft and cause the socket to be restrained to only axial movement relative to the said drive shaft.

It also may occur that instead of having a projecting end on the wrench such as the aforesaid Allen-head ends for the purpose of extending into a recess in the fastener, the fastener may instead be provided with means such as the tongue **180** shown in Fig. 9, and the wrench will therefore be given a matching slot **184** for receiving the same. This simply comprises a modification of the pin engaging surfaces on the end of the wrench and no other alterations need be made in the aforesaid tool for this purpose.

All of the above tools provide a means for tightening down a threaded fastener particularly a fastener of which a portion is to be torqued off so as to limit the torque applied thereto. In addition these tools are protected against damage due to torque overloads which otherwise might twist the wrench, thereby rendering the wrench useless and perhaps also damaging other parts of the tool structure.

This invention is not to be limited by the embodiments shown in the drawings and described in the description, but only in accordance with the scope of the appended claims.

I claim:

1. A tool for tightening a threaded fastener in which a collar is threaded onto a threaded pin comprising: a

frame; a socket drive shaft journaled in the frame and supported by the frame for rotation relative thereto; a gear on said socket drive shaft; a socket member on said socket drive shaft, said socket member being adapted to engage the collar to turn the same onto the pin; a wrench member adapted to engage the pin to restrain it from rotation, said wrench member passing through the socket member, the wrench member being axially movable relative to the frame and restrained against rotation relative thereto; a tool drive shaft journaled to the frame and axially shiftable relative thereto; bias means pressing said tool drive shaft toward the wrench member; a gear on said tool drive shaft, said tool drive shaft, socket member and wrench member having coincident central axes; a pinion gear laterally spaced from the aforesaid axes and interconnecting the gear on the tool drive shaft with the gear on the socket drive shaft, the gears on the tool drive shaft and the pinion gear being of sufficient axial length to permit relative sliding between them while the said gears remain enmeshed; and bearing means disposed between the tool drive shaft and the wrench member enabling the tool drive shaft to rotate independently of the wrench member, the bearing means being operative to transmit bias force from the tool drive shaft to the wrench member to axially shift the wrench member toward a fastener to be engaged by the tool.

2. A tool for tightening a threaded fastener in which a collar is threaded onto a threaded pin comprising: a frame; a socket drive shaft journaled in the frame and supported by the frame for rotation relative thereto; a gear on said socket shaft; a socket member on said socket drive shaft, said socket member being adapted to engage the collar and turn the same onto the pin; a wrench member adapted to engage the pin to restrain it from rotation, said wrench member passing through the socket member, the wrench member being axially movable relative to the frame and restrained against rotation relative thereto; a tool drive shaft journaled to the frame and axially shiftable relative thereto; a gear on said tool drive shaft, said tool drive shaft, socket member, and wrench member having coincident central axes; a pinion gear having an axis of rotation laterally spaced from the said axes and interconnecting the gear on the tool drive shaft with the gear on the socket drive shaft, the gear on the tool drive shaft and the pinion gear being of sufficient axial length to permit relative sliding between them while they remain enmeshed; bias means operable on the tool drive shaft and effective to press said wrench member toward a fastener engaged by the tool; whereby the tool drive shaft is adapted to rotate independently of the wrench member but is operative with the bias means to axially shift the wrench member toward the fastener to be engaged.

3. A tool according to claim 2 in which the bias means comprise compressible springing means disposed between and bearing against the tool drive shaft and the wrench member which press said wrench member axially toward a fastener engaged by the tool, and react between the tool drive shaft and the wrench member as a bearing enabling the tool drive shaft to rotate independently of the wrench member while exerting an axial force thereon.

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