Oct. 14, 1969 S. G. DUNLAP ET AL 3,472,102

BOLT HEAD MARKING DEVICE

Filed March 9, 1967 3 Sheets-Sheet 1

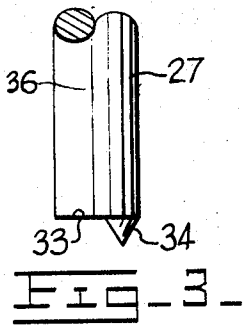


Fig-3-

3 Sheets-Sheet 1

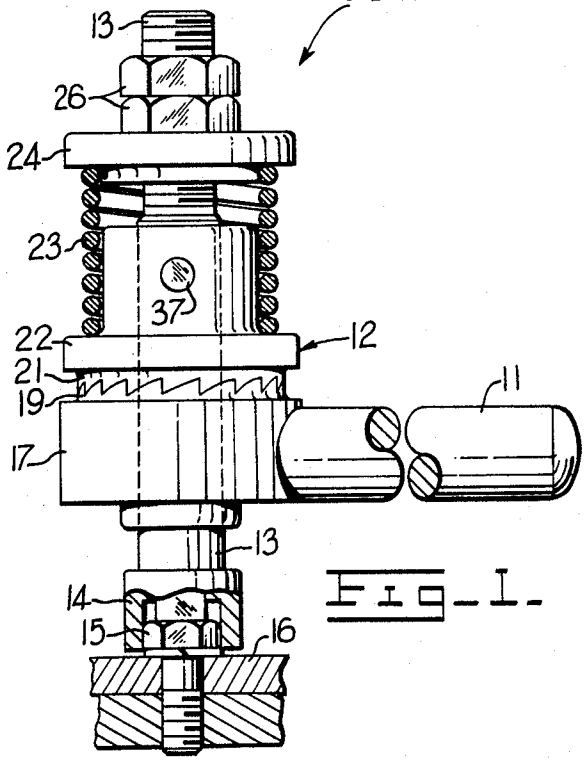


Fig-1-

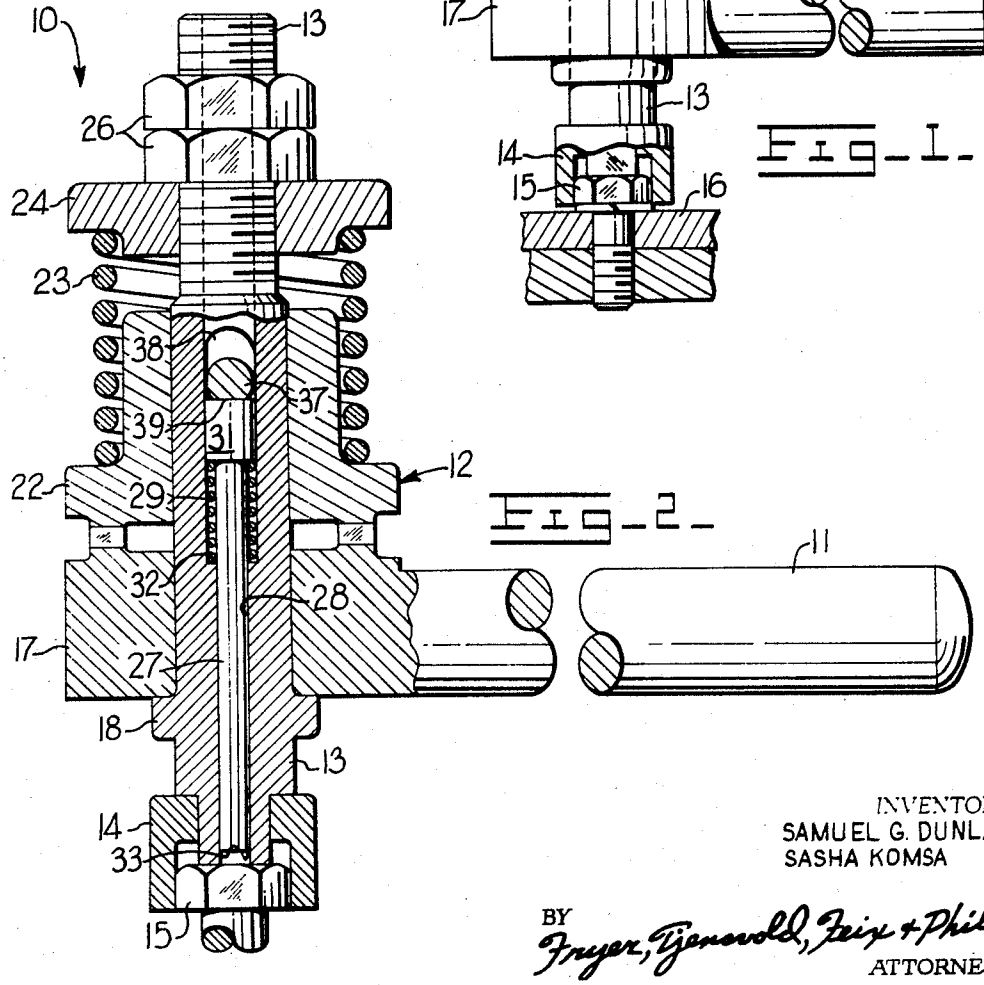


Fig-2-

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BOLT HEAD MARKING DEVICE

Filed March 9, 1967 3 Sheets-Sheet 2

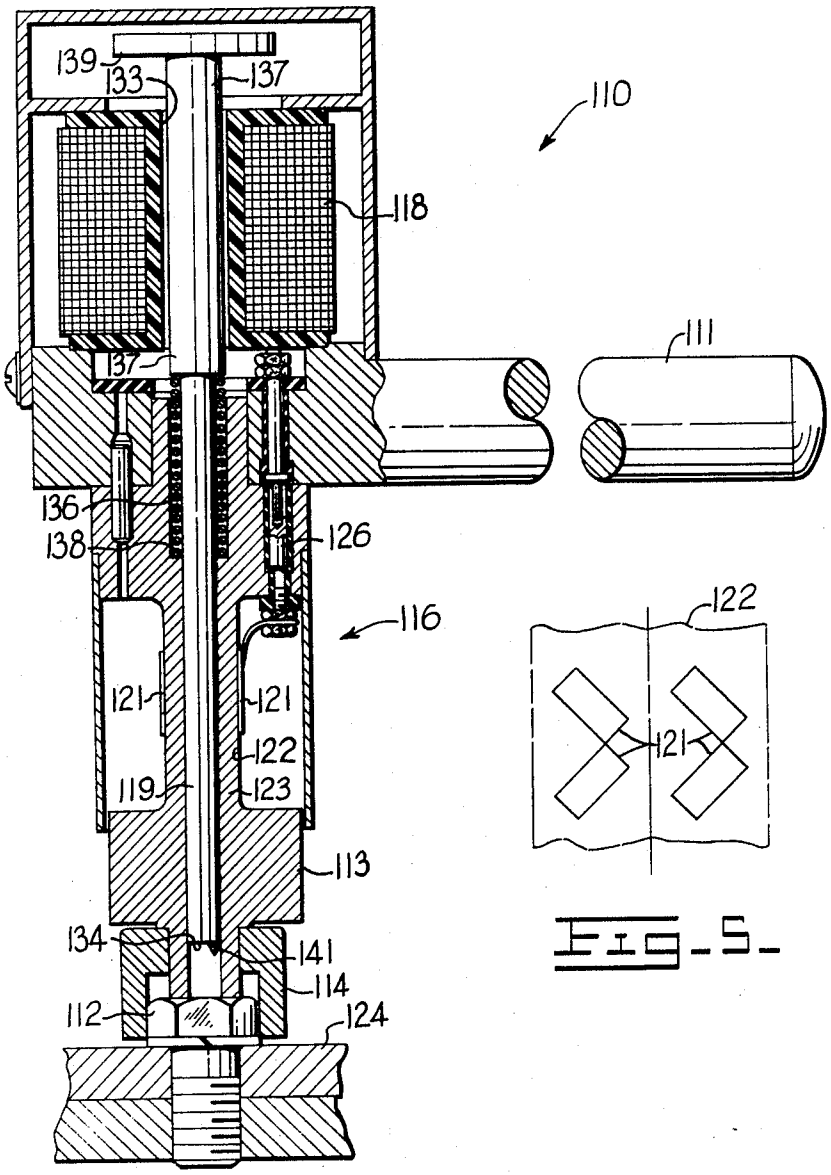


Fig-4-

Fig-5-

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BOLT HEAD MARKING DEVICE

Filed March 9, 1967 3 Sheets-Sheet 3

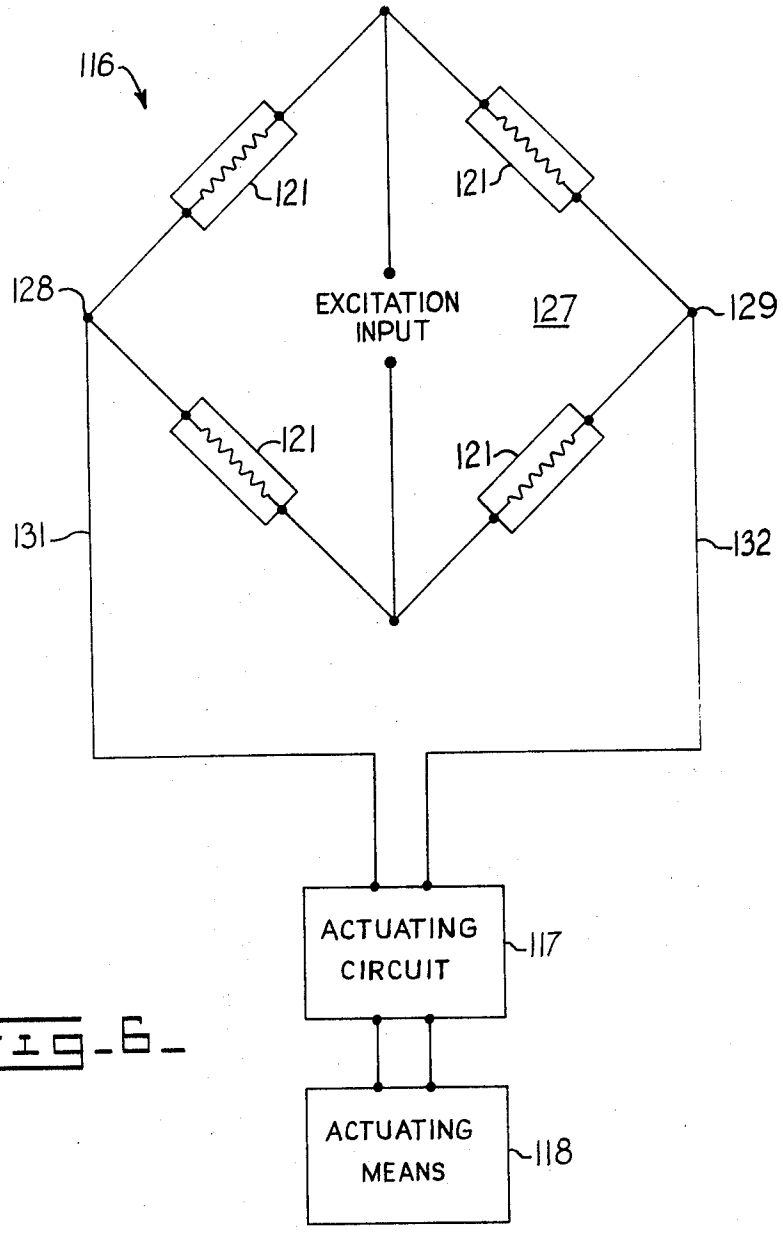


Fig-6-

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3,472,102

BOLT HEAD MARKING DEVICE

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U.S. Cl. 81—53 3 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for applying a predetermined torque force to a rotatable fastening member and marking the member to indicate completed application of the predetermined torque force. Driving means adaptable to apply a predetermined torque force to a rotatable fastening member and marking means operable from normally non-marking relation with the member to marking relation therewith upon application of the predetermined torque force to the rotatable fastening member.

Background of the invention

In the use of torque wrenches for applying preselected torques to bolts, nuts and the like in mechanical assemblies such as engine heads or connecting rods, it is desirable to apply a mark to each bolt which has been tightened. The assembler can thus ascertain whether any bolts have been missed and save time by eliminating retightening of any bolts.

Typical prior art torque wrenches applied a mark, e.g., of ink or paint, simultaneously with the engaging of the bolt or nut. By this technique, however, the bolt would be improperly marked if, e.g., the tightening operation were interrupted prior to application of full tightening torque. Further, an ink or paint mark is susceptible of being covered by subsequent painting and elimination of any indication of torque application.

Summary of the invention

The present invention provides a torque wrench for applying a predetermined torque force to a rotatable fastening member, such as a bolt or nut, and means for marking the member only upon complete application of the predetermined torque force to the rotatable member by the wrench.

Brief description of the drawing

FIGURE 1 is a view in elevation with parts in section of a preferred embodiment of the present invention.

FIGURE 2 is a central vertically sectioned view of the torque wrench of FIGURE 1.

FIGURE 3 is a fragmentary view of the marking end and projection of the marking member shown in FIGURE 2.

FIGURE 4 is a sectioned view in elevation of an alternate embodiment of the present torque wrench.

FIGURE 5 is a development illustration of a torque wrench shaft surface of the alternate embodiment showing a compensating arrangement of strain gauges disposed thereon.

FIGURE 6 is a schematic illustration of a Wheatstone bridge circuit with the strain gauges of FIGURE 5 as resistor legs therein, an actuating circuit and solenoid actuated thereby.

Description of the preferred embodiment

Referring to FIGURES 1 and 2, torque wrench **10** comprises a lever **11** by which torque force is applied

through variable slip clutch assembly **12**, torque wrench shaft **13** and female socket **14** to apply a clockwise torque force and thereby tighten rotatable fastening member **15**, e.g., a machine bolt disposed in structure **16**.

Slip clutch assembly **12**, includes a driving collar **17**, to which lever **11** is attached, and which is disposed to rotate freely on shaft **13** while resting on retaining means **18**. Sawtooth surface **19** of driving collar **17** meshes with sawtooth surface **21** of slip collar **22** in rotational driving relation thereto. Slip collar **22** is also in rotational driving relation with shaft **13** but is free to move longitudinally thereon. Slip collar **22** is further held in rotational driving relation with driving collar **17** by compression spring **23** which interacts between slip collar **22** and a longitudinally variable retaining means **24**. Adjusting nuts **26**, threadedly engaging shaft **13**, control the position of variable retaining means **24** and thus the amount of longitudinal force applied to slip collar **22** of clutch assembly **12** by spring **23**. Thus, slip clutch assembly **12** will permit application of a certain maximum torque force to bolt **15** whereupon sawtooth surface **21** of slip collar **22** rides over sawtooth surface **19** of driving collar **17** to terminate torque transmission. Further, the maximum applied torque force may be varied by changing the location of adjusting nuts **26** and, accordingly, the longitudinal force with which spring **23** acts against slip collar **22**.

To apply a mark on rotatable member **15** upon complete application of a preselected torque force thereto, marking means **27** is preferably a rod located in an axially disposed cylindrical chamber **28** defined by shaft **13**. Except upon complete application of a preselected torque force by wrench **10** to member **15**, marking rod **27** is held in spaced apart relation, i.e., non-marking relation, with member **15** by compression spring **29** disposed and interacting between head **31** of marking rod **27** and annular ledge **22** of chamber **28**.

With reference also to FIGURE 3, marking end **33** of marking rod **27** is communicable with bolt head **15**. To mark bolt head **15** with an identation which will not be subsequently obliterated, e.g., by paint, marking rod end **33** includes a conical marking projection **34** which makes an indentation on bolt head **15** when forced thereagainst. Preferably, marking projection **34** is offset with respect to the axis **36** of rod **27**, chamber **28** and thus bolt head **15**. Thus, if bolt head **15** is retorqued, as on disassembly and reassembly of structure **16**, the probability is high that marking projection **34** will leave a second mark, distinct from a first mark, as an indication that retorquing of bolt **15** is completed.

To operate marking means **27**, a pin **37** projects radially inward from slip collar **22** into chamber **28** through a shaft port **38** and has a flattened portion **39** resting atop marking rod head **31**.

In marking operation, bolt head **15** is rotated by lever **11** through slip clutch **12** and shaft **13**. Upon application of a preselected maximum torque, rotational resistance of bolt **15** causes sawtooth surface **21** of slip collar **22** to ride up on driving collar sawtooth surface **19**. Pin **37**, being connected to slip collar **22**, also rides up and spring **29** maintains marking rod head **31** in contact therewith. As slip collar teeth **21** ride over driving collar teeth **19** and snap down by the force of spring **23**, pin **37** acts against marking rod head **31** to drive marking rod **27** downward. The inertial energy of rod **27** continues its downward motion whereby projection **34** is caused to impinge and indent bolt head **15** and then return to its normal spaced apart relation to bolt head **15** by the action of spring **29**. By employing inertial energy of marking rod **27** rather than continued driving force of pin **37**, there is less tendency for wrench **10** to jump off bolt head **15** before a mark is applied.

Thus, the above embodiment provides a simple and reliable torque wrench suitable to apply a preselected torque force to a fastening member without overtorquing. Marking means apply a preferably permanent indentation in the fastening member only upon complete application thereto of a preselected torque force without external power being required for marking operation. Further, the torque wrench **10** is adaptable for electrically powered operation as an impact wrench as well as manual operation through lever **11**.

Referring to FIGURES 4, 5 and 6, torque wrench **110** comprises a lever **111** for applying rotational torque force to a rotatable fastening member **112** through a shaft **113** and female socket **114** thereon. Transducing means **116** associated with shaft **113** generates an electrical signal representative of the torque force applied to rotatable member **112**. Circuit means **117** receives the representative signal from transducing means **116** and generates an actuating signal when the representative signal corresponds to a preselected maximum torque. Actuating means **118** is disposed to receive said actuating signal and thereupon operate marking means **119** to mark rotatable fastening member **112**.

To detect the amount of torque applied to bolt head **112** through shaft **113**, transducer means **116** comprises resistive strain gauges **121** disposed upon the surface **122** of a portion **123** of shaft **113** having a uniform cylindrical configuration. Preferably, there are four strain gauges **121** disposed in usual compensating fashion upon shaft surface **122** to eliminate transduction effects in transducer **116** caused by temperature variations or bending of shaft portion **123**. Thus, the net resistive transducing effect of strain gauges **121** preferably varies only according to the torque force applied through shaft portion **123** to rotatable fastening member **112** disposed in structure **124**. Four terminals, e.g., **126**, are insulated with respect to shaft **113** and are electrically connected with strain gauges **121** to provide the Wheatstone bridge arrangement **127** of FIGURE 6. When torque force is applied through shaft portion **123**, an electrical signal proportional to the applied torque force is generated at terminals **128** and **129** of Wheatstone bridge **127** and fed to actuating circuit **117** by electrical connectors **131** and **132**. Actuating circuit means **117** may be a voltmeter having an adjustable needle contact point whereupon contact of the needle with the contact point generates an actuating signal. Preferably, circuit means **117** is an AC voltmeter, including a suitable holding circuit employed without a phase detector but with an AC base signal applied to Wheatstone bridge **127**, to permit generation of a temporary actuating signal when a preselected torque force is applied through shaft **113** is either clockwise or counterclockwise fashion. Alternatively, circuit **117** may be a comparator circuit wherein an actuating signal is generated when the proportional signal from Wheatstone bridge **127** exceeds an adjustable base signal.

Actuating means **118** preferably is a toroidal solenoid defining a cavity **133** disposed in axial alignment atop torque wrench shaft **113**. Solenoid **118** is connected to circuit **117** to receive and be actuated by the actuating signal thereon.

Marking means **119**, operated by solenoid **118** is preferably a rod with a marking end **134** similar to that shown in and described above with reference to FIGURE 3. Marking rod **119** is disposed in an axial cylindrical chamber defined by shaft **113**. Other than when solenoid **118** is actuated, rod **119** is spaced apart from bolt head **112** by a compression spring **136** acting against an enlarged head **137** of rod **119** and chamber ledge **138**. Marking rod head **137** extends upward through solenoid cavity **133** and has stop **139** capable of acting against solenoid **118** but not of interfering with marking impingement of marking projection **141** against bolt head **112**.

When torque wrench **110** is employed to torque a bolt **112** and apply a mark on completed application of a preselected maximum torque, torque force is applied to bolt **112** and apply a mark on completed application of a pre- of bolt **112** causes rotational strain in shaft **113**. Transducer **116** generates an electrical signal, proportional to shaft rotational strain and applied torque force at terminals **128** and **129** which is fed to circuit **117**. When the proportional signal represents a preselected maximum torque force applied to bolt **112**, circuit **117** transmits a temporary actuating signal to solenoid **118**. Actuation of solenoid **118** sets up a force field in cavity **133** which drives marking rod **119** downward, overcoming spring **136**, and causing marking projection to impinge and indent bolt head **112** as an indication of completed application of a preselected torque application thereto. When the temporary actuating signal from circuit **117** terminates and solenoid **118** is deactuated, spring **136** again moves marking means **119** into non-marking relation with bolt head **112**. Application of torque force to bolt head **112** may be terminated by a slip clutch assembly according to FIGURE 1 or by the operator on operation of marking means **119** or a separate alarm signal actuated by circuit **117**.

Thus, the above alternate embodiment provides a torque wrench with electrically actuated marking means to mark a rotatable fastening member only upon application of a preselected torque force thereto. Reliable and broad usage is assured since the wrench will function in either clockwise or counterclockwise fashion to a maximum torque force which may readily be varied. Further, the absence of moving parts in the transducer means **116** and the nature of strain gauges **12** permits a more accurate and consistent measurement of torque strain in the torque wrench shaft.

The present invention further provides a permanent mark on a rotatable fastening member to indicate completed application of a preselected maximum torque thereto. Thus, proper torquing of specific bolts, nuts, etc., can be ascertained by visual check with the possibility of eliminating the use of expensive castled nuts and cotter pins.

What is claimed is:

1. A torque wrench for applying a predetermined maximum torque force to a rotatable member and thereafter marking the member to indicate completed application of the predetermined torque force, comprising:

a shaft formed to receive the member in rotatable relation,

means associated with the shaft for rotating the shaft and member,

transducer means disposed upon the shaft between the member and rotating means to detect torque strain therein and generate a proportional electrical signal,

circuit means arranged to receive the proportional signal from the transducer means and generate an actuating signal when the proportional signal indicates torque strain in the shaft equivalent to the preselected torque force,

marking means disposed in the shaft adjacent the member, and

means responsive to the actuating signal from the circuit means for causing the marking means to act upon the rotatable member.

2. The invention of claim **1** wherein the transducer means comprises a compensating arrangement of strain gauges on a surface of the shaft, the strain gauges being electrically connected in a Wheatstone bridge arrangement.

3. The invention of claim **1** wherein the marking means is a rod reciprocably mounted in a bore axially formed through the shaft, an end of the rod adjacent the rotatable member forming a marking configuration, spring means tending to urge the rod out of marking rela-

tion with the member, and the signal responsive means is a solenoid disposed adjacent the marking rod.

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U.S. Cl. X.R.

73—139; 81—52.5; 173—12, 46