

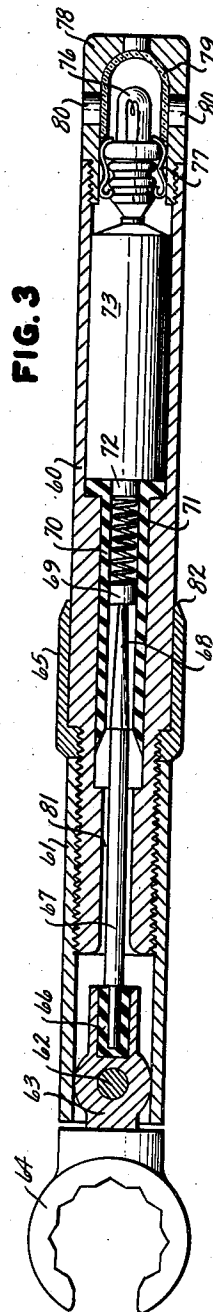
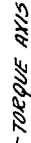
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SIGNAL TYPE TORQUE INDICATING WRENCH

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SIGNAL TYPE TORQUE INDICATING
WRENCH

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The invention described herein may be manufactured and used by or for Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to improvements in torque indicating wrenches and particularly that class of wrenches wherein an indicating or signal means is incorporated responsive to flexure of an element of the wrench under torque load and effective to indicate the application of a predetermined torque to a wrench work head.

Torque indicating wrenches are per se old in the art and in one form of construction of which I am aware, the point at which the indicating mechanism becomes operative to indicate the applied torque is adjusted by varying the effective length of a flexure or beam member which transmits the torque from a handle to a work head. This form of construction is satisfactory where the torque range is small but requires an excessive length of wrench where the torque range is large, such as is encountered in the aircraft field. A further disadvantage in prior constructions is lack of means for altering the type of work head without requiring recalibration of the wrench and the indications given by the optical type of indicating means of prior wrench constructions are difficult to detect in strong lighting conditions.

In accordance with the present invention the point of indication of the applied torque may be predetermined within a large torque range with little or no increase of wrench length primarily by adjusting the relative spacing of electrical contacts in the indicator mechanism rather than by changing the length of the flexure or beam member.

In accordance with the present invention various types of wrench work heads may be applied to the wrench to adapt it to various working requirements and by maintaining the axis of torque applied to the work head constant the wrench calibration remains unchanged. The present invention also provides means for shading the signal illuminating means from the effects of strong external light so that the torque indications are visible even in strong daylight.

Another feature of the present invention comprises the providing of a wrench structure having a substantially smooth cylindrical exterior free of protruding parts to facilitate handling and eliminate catching or snagging of the wrench on surrounding parts of the mechanism being worked on.

Other structural features comprise providing

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a completely closed wrench for housing the working parts thereof and protecting them from mechanical injury and deterioration due to dirt and moisture, and the provision of a compact, rugged mechanism capable of withstanding severe shock and hard usage without impairing the torque indicating accuracy of the device.

A further feature of my invention comprises a battery holding tube wherein the dry cells which form the energy source are inserted, whereby the tube is intermediate the dry cells and the internal walls of the wrench for the purpose of protection against swelling of the battery or corrosion caused by rupture of the casing of one or more of the dry cells with use.

With the above features and objects of the invention in mind, other features will become apparent from the detailed description taken in conjunction with the appended drawings in which:

Figure 1 is a longitudinal cross section of one form of my invention;

Figure 1a is a detail showing a work head in place on the wrench illustrated in Figure 1;

Figure 1b is an enlarged detail of one element of the form shown in Figure 1;

Figure 2 is an exterior view of the form shown in Figure 1; and

Figure 3 is a longitudinal cross section of another form of my invention.

Referring to Figures 1 and 2, a wrench handle member is shown having a hollow cylindrical wrench body 1 secured to a hollow cylindrical handle 2 as by threading 3. Within body 1 is a generally tubular flexure element 4 having an end protruding therefrom adapted for attachment to a work head 5 (Figure 1a). Flexure element 4 is pivotally secured at 6 to body 1 whereby relative angular movement is provided between the free end 4a of flexure element 4 and a sleeve-like taper member 8 slidably disposed within body 1 and adapted to transmit torque stress from handle 2 to flexure element 4. The tapered surface 9 of taper member 8 is concentrically spaced from the free end 4a of flexure element 4, the concentric spacing being variable by reciprocating taper member 8 relative to said free end 4a. Reciprocal movement of taper member 8 is obtained by means of a sleeve 10 (Figure 1b) rotatably mounted on body 1 and provided with an internal spiral groove 11 coacting with spherical bearings 12 which are maintained in diametrically opposed relationship by longitudinal slots 13 cut through the walls of body 1, the spherical bearings 12 being retained in a peripheral groove

14 provided externally on the taper member 8. The rotatable sleeve 10 is restrained against axial movement on body 1 by a shoulder 16 thereon and by a sleeve 17 secured in any suitable manner on body 1, such as by a shrink fit. The rotatable sleeve 10 is externally knurled as indicated at 18 and is provided with a scale 19 calibrated in torque units and adapted to cooperate with a fixed index mark 19a provided on body 1 to indicate the torque setting of the wrench. Rotation of the sleeve 10 will, by virtue of the spiral groove 11, exert a longitudinal thrust on the spherical bearings 12 in a direction depending upon the direction of rotation of the sleeve 10, the longitudinal thrust on spherical bearings 12 being transmitted to taper member 8 by reason of the retention of the spherical bearings 12 in the peripheral groove 14 on taper member 8. Accordingly, the concentric spacing between the tapered surface 9 and the free end 4a of flexure element 4 may be predetermined by the operator by rotary adjustment of the sleeve 10 to effect reciprocal motion of the taper member 8 relative to said free end 4a. It will now be apparent that owing to the pivotal relationship provided at 6 between body 1 and flexure element 4, a movement of handle 2 in a torque applying direction will not transmit any torque force to the work head until taper member 8 has moved angularly with body member 1 relative to the free end 4a of flexure element 4 to the point where the tapered surface 9 abuts free end 4a. The extent of this no-load or lost motion movement of handle 2 depends on the amount of initial concentric spacing provided between the tapered surface 9 and the free end 4a by the adjusted position of taper member 8 relative thereto, the purpose of the lost motion movement being to provide a predetermined spacing between electrical contact elements as will presently appear.

Integrally supported at 20 within flexure element 4 and concentrically spaced from the inner walls thereof is a contact rod 21 having a contact element comprising a free end 21a adapted to electrically contact either of a pair of contact screws 23, depending on the direction of torque movement of handle 2. Screws 23 are adjustably secured in a member 24 movable in a torque applying direction with the handle 2. Relative angular movement of the electrical contacts is obviously effected during the no-load movement of handle 2 whereby an initial spacing between the contacts predetermined by the extent of said no-load movement is realized. The torque stress transmitted from handle 2 to flexure element 4 through abutment of the free end 4a thereof with tapered surface 9 subsequent to no-load movement serves to flex the tubular portion of flexure element 4 and simultaneously decrease the initial spacing between the contact elements to the point where electrical contact is obtained, it being noted that said contact rod 21 remains substantially straight and unaffected by the flexure of flexure element 4. The function of the contact rod 21 is to provide for coaction of the contact elements at a point substantially removed from pivot 6 whereby the arc of relative movement of the contacting elements is enlarged for structural convenience.

Member 24 is electrically insulated from ground by means of insulating washers 26 and 27 and insulating collar 28. Suitable ports are provided in insulating collar 28 in alignment with ports 29 in body member 1 whereby access to contact screws 23 may be had for adjustment thereof.

Member 24 abuts the center terminal of a signal lamp 30 supported within and in electrical contact peripherally with a collar 33, slidably retained and insulated from ground in a translucent, colored plastic sleeve 34 disposed within the handle 2. A spacer tube 35 is slidably disposed within the translucent sleeve 34 and abuts collar 33 whereby biasing action of a spring 36 is transmitted through a series of cells 37 to the outer end of spacer tube 35 for the purpose of maintaining electrical contact between extremity 24a of member 24 and the center terminal of signal lamp 30. An end cap 39 is provided for retaining the spring 36 in compression against the negative casing electrode of the outermost cell thereby establishing a series connection of the cells 37 to form a battery disposed within a battery holding sleeve 40 which is provided for protection of the inner surface of handle 2 in the event of one or more of the cells swelling or bursting its casing and loosing a corrosive electrolyte. Although three cells are shown, it will be appreciated that the device is not limited to any specific number. The peripheral casing terminal of signal lamp 30 is electrically connected through spaced tube 35 to the positive center terminal of the battery, the negative terminal thereof being grounded through spring 36. The center terminal of signal lamp 30 in electrical contact with the extremity 24a of member 24 is insulated from ground. Accordingly, any movement of handle 2 in a torque applying direction sufficient to bring either of the contact screws 23 into contact with the free end 21a of contact rod 21 will complete a circuit through ground from the negative casing terminal of the battery to the center terminal of the signal lamp 30 whereby the signal lamp will be lit, the illumination thereof being visible exteriorly of handle 2 via ports 41 and 42 in spacer tube 35 and handle 2, respectively, the intermediate translucent, colored plastic sleeve 34 imparting its characteristic color to the light rays to enhance noticeability.

In operation, the sleeve 10 is manually rotated to bring a desired torque indicium of scale 19 opposite the fixed index mark 19a on body member 1. The rotation of sleeve 10 serves to fix the position of taper member 8 in relation to the free end 4a of flexure member 4 whereby the concentric spacing between free end 4a and the tapered surface 9 of taper member 8 is determined. Since flexure member 4 is pivotally related to handle member 2, a definite degree of lost motion is provided between free end 4a and the tapered surface 9, as heretofore described. When handle 2 is operated to apply working torque, the initial movement thereof takes up the lost motion, and one or the other of contact screws 23, depending upon the direction of torque rotation of handle member 2, is brought proportionally closer to the free end 21a of contact rod 21. This initial motion transmits no torque stress to flexure member 4 until the lost motion has been entirely taken up, i. e., at the end of the no-load movement when some portion of the tapered surface 9 will abut free end 4a. Continued motion of handle member 2 will cause a deflection of the tubular portion of flexure member 4, said deflection increasing proportionally with the torque stress applied to handle member 2 until a contact screw 23 approaching the free end 21a of contact rod 21 closes contact therewith. At that instant a circuit through the battery and signal lamp 30 is completed, thereby

lighting the lamp, the light thereof being visible to the operator as heretofore described.

In the event of an overload being applied beyond the stress for which flexure element 4 is designed, the shoulder 44 thereon abuts the portion 45 of body 1 to take the excess stress, thereby protecting flexure member 4 from being stressed beyond its proportional limit.

As will be apparent from the structure, when taper member 3 is set at the right as viewed in Figure 1, the lost motion is greatest, whereby one contact screw 23 is relatively close to the free end 21a of contact rod 21 at the end of the no-load movement; accordingly, only a small deflection of flexure member 4 will take place as handle 2 moves said contact screw 23 into contact with said free end 21a during the subsequent torque load movement. Conversely, when taper member 3 is set at the extreme left, the no-load movement is least; consequently, a greater deflection of flexure member 4 will take place in the ensuing motion of handle member 2. Accordingly, the degree of torque exerted before the signal lamp 30 lights is determined by the degree of lost motion taken up during initial no-load movement of handle 2, which is dependent upon the adjusted axial position of taper member 3 relative to the free end 4a of flexure member 4.

Adjustability of contact screws 23 is provided as a manufacturing convenience so that a zero setting may be obtained; and also from time to time as usage of the wrench causes wear and tear on the parts and affects the elasticity of the flexure member 4, resetting to zero may be desirable. This feature is a refinement and not essential to the usefulness of the wrench for general conditions. In adjusting the zero setting, the wrench is held with the axis of the screws 23 vertical and the upper screw adjusted so that the signal lamp 30 just lights with the scale 19 set to zero and the wrench supported to the handle with no torque load other than the weight of the other end. Each screw 23 is adjusted in the upper position, since that is the position wherein contact is made with the free end 21a of contact rod 21 when the weight of one end of the wrench is used to produce a torque stress.

The work head 5 is affixed to an adapter head 47 by means of stud 48 and reciprocating spring biased ball detent 49. Various types of work heads may be utilized since adapter head 47 is detachable from flexure element 4 by reason of the spring biased ball detent 50. Keying pin 51 extends through flexure element 4 and engages the sides of open ended slots 52 cut into the rim of adapter 47 for the purpose of preventing relative rotary motion therebetween.

The calibration of torque scale 19 is calculated for a torque axis extending axially through the work head carrying stud 48, as illustrated on Figure 2. The torque axis lies outside the physical confines of the wrench body, an important aspect, since such a construction permits the design and attachment of various types of work heads, e. g., a tubing nut type, as illustrated in Figure 3, directly to flexure member 4, provided that such other type is designed to have its torque axis identical with that shown for the adapter 47. Accordingly, a single calibrated scale is operable in conjunction with a variety of work heads. Work heads of various types may be attached to flexure element 4 in the manner shown for the adapter 47 by being constructed to coact with ball detent 50 and keying pin 51. Likewise, special adapters to hold various types of work heads may

be constructed, e. g., the specific adapter 47 shown is intended for socket type of work heads.

A further feature of the invention resides in the use of the translucent, colored plastic sleeve 34, both as an insulating means and as a means for enhancing visibility of the light rays. It has been found in practice that a red colored sleeve produces a quality of light which is very distinguishable. The sleeve 34 is used in conjunction with frosted plastic inserts 55 in ports 42. The purpose of inserts 55 is to weaken the incident and reflected rays of outside light whereby contrast with the direct rays from the signal lamp 32 is increased promoting visibility to the operator when working in strong light. Also, the depth of the ports 42 in relation to their diameter has a shading effect against outside light, the frosted plastic inserts 55 preventing ports 42 from filling up with oil and grease.

In the modification shown in Figure 3, 60 is a handle threadedly secured to a body 61 and axially adjustable relative thereto. A lock nut 65 is provided to secure handle member 60 in adjusted position. Pivotaly supported at 62 within body 61 is a work head holding member 63 adapted for attachment to a work head 64. Axially supported within member 63 and electrically insulated therefrom by a plastic cup 66 is a flexure member 67 having a tapered end 68 abutting the button 69 slidably disposed within an insulating plastic sleeve 70. A spring 71 is in compression between button 69 and a slidable button 72 for electrical contact with the negative casing electrode of dry cell 73 housed within the handle 60. A signal lamp 76 is held in a clip 77 supported within a cap 78 threadedly secured at the extremity of handle 60. A colored, translucent plastic cap 79 abuts the peripheral edge of clip 77 and is held in position in the cap 78 adjacent ports 80 by the biasing action of spring 71 transmitted through button 72, dry cell 73, signal lamp 76 and clip 77. The positive center electrode of dry cell 73 abuts the center terminal of signal lamp 76. Consideration of the structure will make it apparent that the negative side of the dry cell 73 is electrically connected to flexure member 67 through button 69, spring 71 and button 72, all aforementioned elements being electrically insulated from ground by sleeve 70 and plastic cup 66. The peripheral casing terminal of signal lamp 76 is grounded.

In view of the pivotal relationship provided at 62 between the sleeve 70 and the tapered end 68 of flexure member 67 when handle 60 is adjusted relative axially to the body member 61, a specific degree of lost angular motion is provided between the sleeve 70 and the tapered end 68 by virtue of the taper provided thereon. As the handle member is adjusted axially outwardly, the lost angular motion between sleeve 70 and the tapered end 68 of flexure member 67 may be seen to increase, whereby initial motion of the handle member 60 in a torque applying direction will have a corresponding no-load movement. Conversely, as the handle member is adjusted axially inwardly, the lost angular motion between sleeve 70 and tapered end 68 of flexure member 67 is decreased, whereby the corresponding no-load movement of handle member 60 is lessened. Subsequent to a no-load movement of either high or low degree, an abutting action between the inner peripheral edge of the sleeve 70 and some adjacent portion of the tapered end 68 of flexure member 67 will result and the ensuing bowing effect on flexure member 67 will cause the center portion thereof to contact the surface of the surrounding bore

81 in handle 60. Accordingly, the negative casing electrode of the dry cell 73 will be grounded whereby a circuit will be completed through the signal lamp 76, the illumination thereof being visible to the operator through the colored, translucent plastic cap 79 and the ports 80. In the specific illustration of Figure 3, the handle member 60 is shown as screwed to the inward limit of its motion relative to the body member 61, the tapered end 62 of the flexure member 67 then protruding as far into sleeve 70 as it is possible for it to go whereby a small degree of lost motion is provided in relative angular movement therebetween. The lock nut 65 is shown tightened against the outer end of the body member 61 to secure the handle member 60 in position. In this specific illustration, the wrench is set for the uppermost limit of the torque range inasmuch as movement of the handle 60 in torque applying direction will involve the least possible no-load movement prior to transmission of torque stress to the flexure member 67, whereby the spacing between the central portion thereof and the internal surface of the bore 81 within the body member 61 will be relatively large at the end of the no-load movement, thus necessitating a relatively large flexure of the flexure member 67 to produce a contact, corresponding to a large torque stress.

Calibration in torque units of a wrench of the type shown in Figure 3 has been provided in practice by means of a simple longitudinal scale on the exterior of handle 60 whereby distances relative to the edge 82 of locknut 65 are readable in torque units for convenience in setting the wrench to operate the signal lamp when a desired degree of torque is reached. Inasmuch as the change in bending resistance of the flexure member 67 at various settings along the tapered end 62 introduces factors which complicate calibrating this type of wrench by a purely mathematical process, it has been found feasible to provide a scale calibrated empirically rather than by calculation.

It will be understood that my invention is not limited to the specific structure herein disclosed, but is capable of modification without departing from the spirit thereof and I seek protection of United States Letters Patent for the novel features and structure set forth in the appended claims.

I claim:

1. A signal type torque indicating wrench including a tubular handle member, a beam member pivotally supported by said handle member and having a projecting portion adapted to be connected to a work head, said beam member serving to transmit torque from the handle to the work head, said beam member extending into said handle member and having a tapered end portion, a sleeve concentrically mounted within said handle member and surrounding the tapered portion of the beam with a spacing therefrom dependent upon the axial position of said sleeve with respect to the tapered portion of the beam, means for axially adjusting said sleeve with respect to said beam to adjustably vary an initial no-load movement of the handle with respect to the beam member, a signal circuit electrical contact positioned within the handle, said beam member forming a second electrical contact, axial adjustment of said sleeve member varying the point of contact to thereby vary the amount of torque load applied to said beam member to cause engagement of said contacts.

2. In a signal type torque indicating wrench mechanism, a handle member having a relatively movable work head mounted thereon, a beam-like flexure member secured at one end to said work head, said handle member being operative to transmit torque stress to said flexure member, a hollow tapered member carried by said handle member and adjustable longitudinally relative to said flexure member, said tapered member having spaced internal taper surfaces with the free end portion of said flexure member being adjacent to and between said taper surfaces, transmission of torque stress from said handle member to said flexure member being through said tapered member whereby adjustment of said tapered member is operative to determine the point of torque transmission therethrough and the extent of no-load movement of said work head relative to said handle member, and indicating means operative to give a signal upon a predetermined amount of bending of said flexure member after completion of said no-load movement.

3. In a signal type torque indicating wrench, a handle, a work head pivotally connected to said handle for relative angular movement with respect thereto, a yielding beam member secured to the work head for yieldingly transmitting torque from the handle to the work head, an abutment member associated with the handle and having a portion adapted to engage a portion of the beam member to transmit torque load to the beam member, one of said portions being inclined so that adjustment thereof relative to the other portion in a direction longitudinally of the beam member varies the point of engagement between said portions and the extent of no-load movement of said handle relative to said work head, and said portions being adapted to engage after a predetermined initial no-load movement of the handle to transmit torque load to the beam member, means for adjusting said inclined portion in a direction longitudinally of the beam member, signal means adapted to indicate the application of a selected torque to said work head, means for actuating said torque indicating signal means upon completion of a definite and predetermined movement of said work head relative to said handle, and said latter movement consisting of said no-load movement as determined by the adjustment of said inclined portion plus a torque applying movement sufficient to complete said latter movement.

4. A signal type torque indicating wrench mechanism comprising, a hollow handle member having a work head mounted thereon for limited rotary movement relative to the handle member, a flexure member secured at one end to said work head and extending axially through a portion of said hollow handle member, torque transmitting means carried within said handle member for engagement with means on the other end of said flexure member, one of said means being of tapered form so that adjustment thereof relative to the other means in a direction longitudinally of said flexure member varies the point of engagement between said means and the extent of no-load movement of said handle member relative to said work head, signal means adapted to indicate the application of a selected torque to said work head, means for actuating said torque indicating signal means upon completion of a definite and predetermined movement of said work head relative to said handle member, and said latter movement consisting of said no-load movement as determined by the adjustment of

said means of tapered form plus a torque applying movement sufficient to complete said latter movement.

5. In a signal type torque indicating wrench, a handle member having a work head mounted thereon for limited rotary movement relative to the handle member, a beam-like flexure member secured to said work head, torque transmitting means carried by said handle member and adapted for engagement with a portion of said flexure member spaced from said work head, said means being of tapered form and being adjustable with respect to said portion of the flexure member in a direction longitudinally of the latter member to vary the point of engagement between said means and said portion of the flexure member and to vary the extent of no-load movement of said handle member relative to said work head, signal means adapted to indicate the application of a selected torque to said work head, means for actuating said torque indicating signal means upon completion of a definite and predetermined movement of said work head relative to said handle member, and said latter movement consisting of said no-load movement as determined by the adjustment of said means of tapered form plus a torque applying movement sufficient to complete said latter movement.

6. In a signal type torque indicating wrench, a handle, a work head pivotally connected to said handle for relative angular movement with respect thereto, a yielding beam member secured to the work head for yieldingly transmitting torque from the handle to the work head, abutment means associated with the handle and having a portion inclined with respect to the length of the beam member, said inclined portion being adapted to engage the beam member after a predetermined initial no-load movement of the handle relative to said work head to transmit torque load to the beam member, means for adjusting the abutment means in a direction parallel with the beam member to vary the extent of no-load movement of the handle, and torque indicating signal means responsive to a definite and predetermined extent of relative movement between said work head and said handle for indicating the application of any selected torque to the wrench handle.

7. In a signal type torque indicating wrench, a handle member for applying a torque load, a work head pivotally connected to said handle member for relative angular movement with respect thereto, a flexure means through which said torque load is applied to said work head, an adjusting means associated with said handle member and said flexure means including a tapered member selectively positionable relative to said flexure

means and adapted to transmit the torque load from said handle member to said flexure means at a selected position on the tapered member whereby a no-load condition is provided for the initial movement of said handle member in a torque applying direction, the extent of said no-load movement being determined by the selected position of said tapered member relative to said flexure means, and torque indicating signal means responsive to a definite and predetermined extent of relative movement between said work head and said handle member for indicating the application of any selected torque to the handle member.

8. A signal type torque indicating wrench comprising, a hollow handle member having a relatively movable work head rotatably mounted thereon and having a yielding means within the handle member for transmission of torque from said handle member to said work head, means to provide a lost motion movement of said handle member relative to said yielding means in applying torque to said work head, means for adjusting the extent of said lost motion movement, signal means adapted to indicate the application of a predetermined torque to said work head, means for actuating said torque indicating signal means upon completion of a definite and predetermined movement of said work head relative to said handle member, and said latter movement consisting of said lost motion movement as determined by the adjustment of the second named means plus a torque applying movement sufficient to complete said latter movement.

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