United States Patent

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[54] TORQUE LIMITING WRENCH

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[52] **U.S. Cl.** **81/52.4**
[51] **Int. Cl.** **B25b**
[58] **Field of Search** 81/52.4, 52.5

[56] **References Cited**

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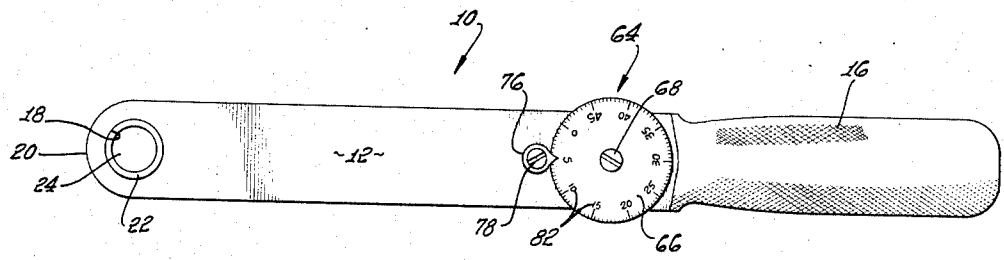
[57] **ABSTRACT**

A torque limiting wrench adapted to tighten a fastener with either a right- or left-hand thread, which wrench will physically register a predetermined torque requirement when said torque limit is reached upon the tightening of said fastener. The wrench includes a body portion having a longitudinal axis and carried on said body portion and aligned parallel with said longitudinal axis is a deflectable means pivotally connected with said body portion. Mounted on the deflectable means is a conventional wrench socket head adapter to receive a wrench socket head. Release connecting means associated with said body portion and said deflectable means provided remote from the pivotal connection is adapted to be overcome by torque created between the body and fastener as it is tightened to allow the deflectable means to pivot out of parallel alignment with said body portion signaling that the predetermined torque has been reached by said fastener as it is tightened.

14 Claims, 8 Drawing Figures



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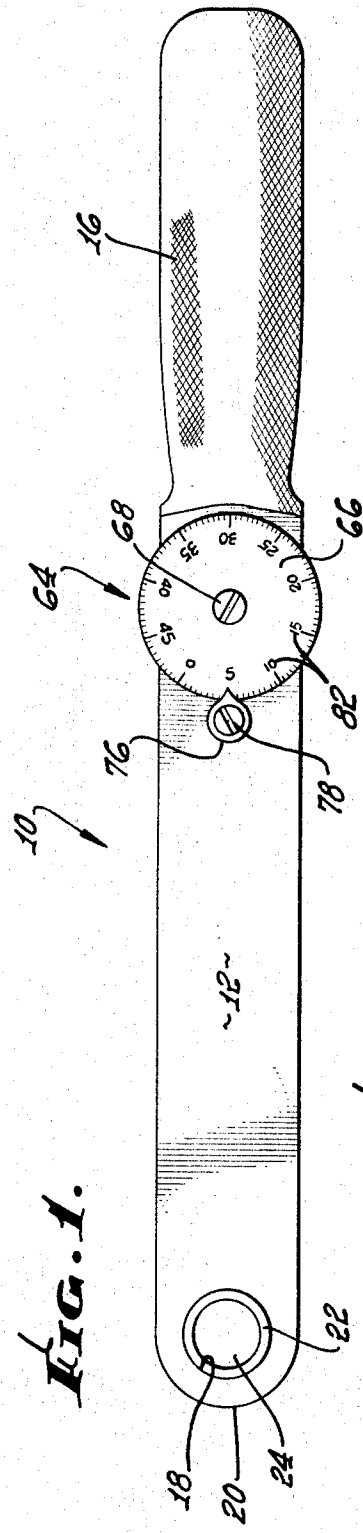

FIG. 1.

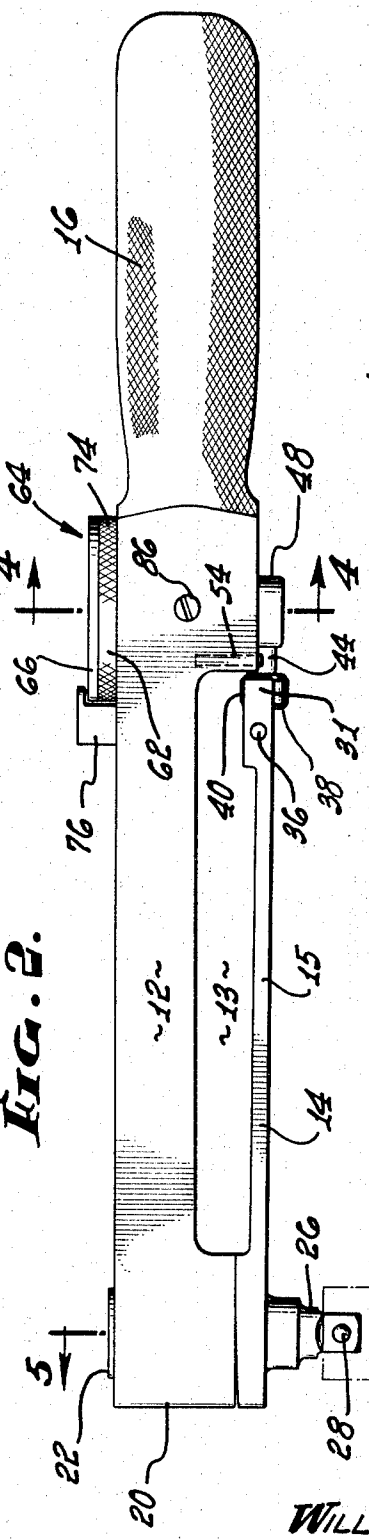

FIG. 2.

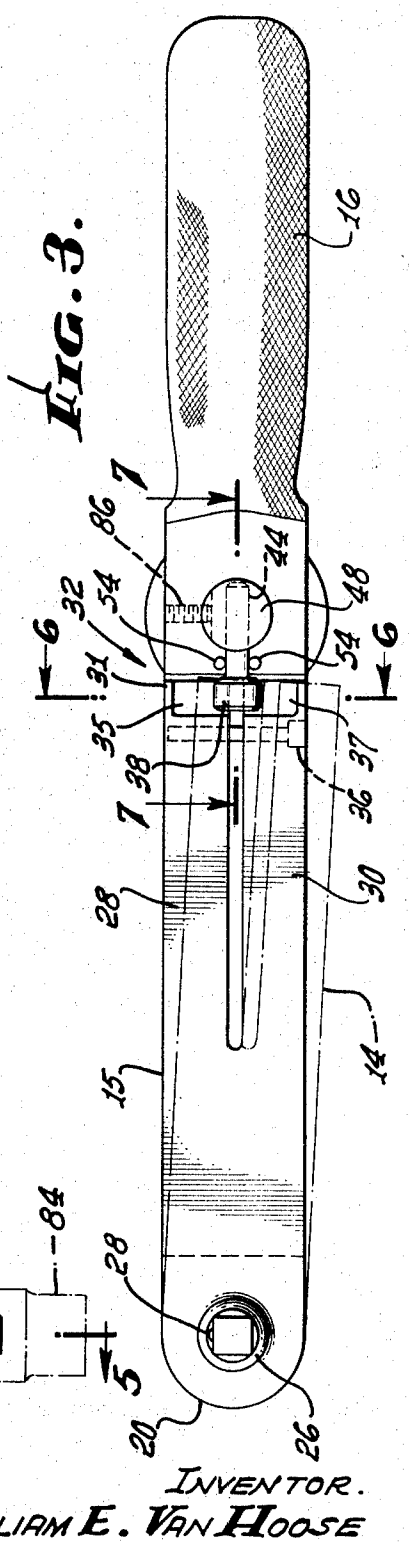

FIG. 3.

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FIG. 4.

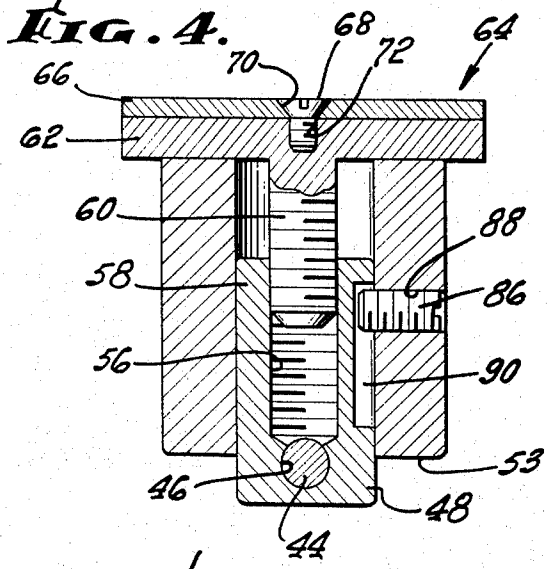


FIG. 5.

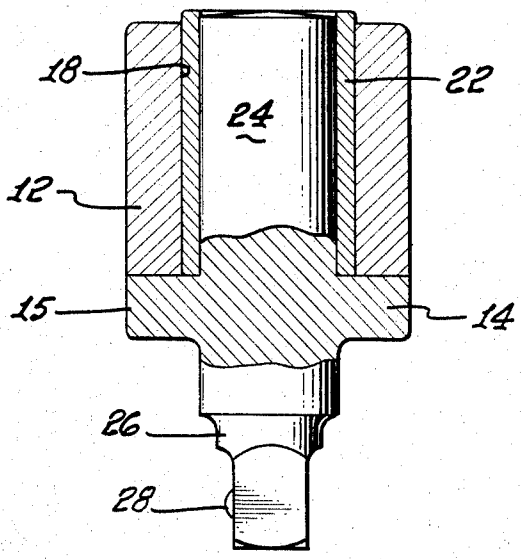


FIG. 6.

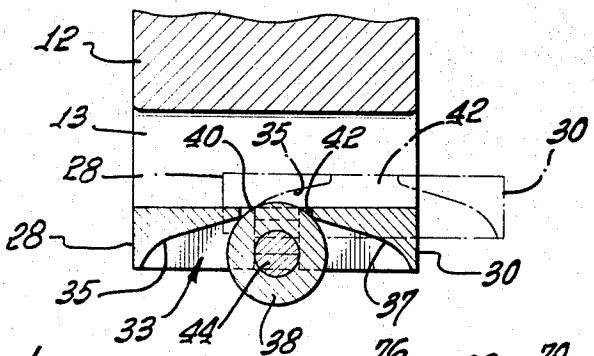


FIG. 8.

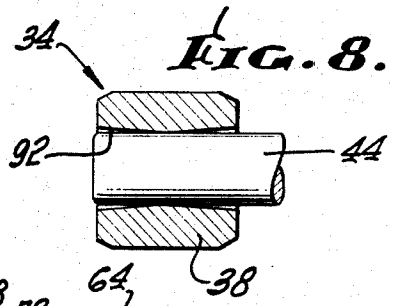
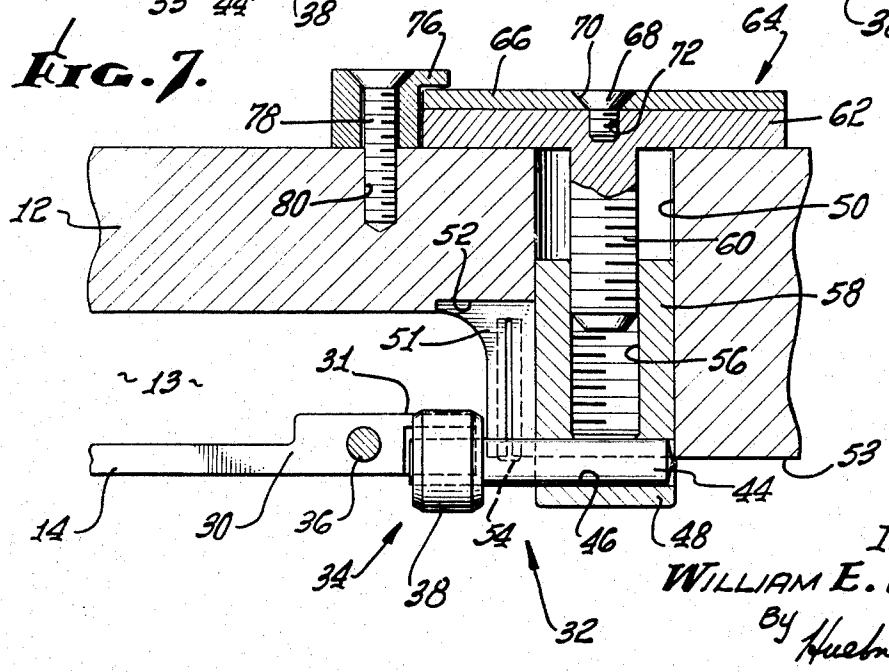


FIG. 7.



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TORQUE LIMITING WRENCH

BACKGROUND OF THE INVENTION

When threaded fasteners are used for joining parts together in a secured relationship, it has become common practice for the engineering profession to prescribe precisely defined torque limits to be applied to these threaded fasteners in order that the elastic limits of the fasteners and the joined parts will not be exceeded. Torque wrenches designed to indicate to the user when the desired torque threshold has been reached have been developed, but all of these wrenches have one or more drawbacks which the present invention is intended to alleviate or eliminate. Most torque wrenches prior to this invention included springs in their mechanisms and are referred to as the "click and sudden release type." In order for the wrenches to remain accurate over any length of time, it is necessary to readjust them, taking into consideration the fatigue factor of the springs. Additionally, there is the possibility of crystallization of the springs.

Most of the prior art torque wrenches use various linkage elements between the wrench gage and the point being gaged. The drag coefficients of these various linkage means must periodically be compensated for as the parts wear down. The relatively complex linkage mechanisms of prior art torque wrenches increase the cost of manufacture and multiply the number of potential defects in accuracy which may occur.

Finally, prior art torque wrenches cannot be used with both normal threaded and reverse threaded fasteners. Separate wrenches must be used depending upon the direction of the threads of the fasteners, while the present invention can be used with either type of fastener.

SUMMARY OF THE INVENTION

The primary purpose of this invention is to provide a torque limiting wrench which can be precisely calibrated to measure the amount of torque force required to set a fastener. Due to the fact that this invention preferably uses no springs, has a minimal number of moving parts, and includes fewer bearing surfaces than prior art torque wrenches, the wrench remains accurate over a longer period of time than the prior art devices.

The torque wrench is capable of measuring either clockwise or counterclockwise torque forces and can, therefore, be used with either normal or reverse threaded fasteners.

These purposes are accomplished through the use of a torque limiting wrench which comprises two major components, a body portion and a deflectable means or a beam portion. The deflectable means is pivotally connected to the body portion so that the longitudinal axis of the body portion and the deflecting beam are in spaced parallel alignment when the wrench is in its at rest position. A conventional socket wrench adapter is mounted on the deflectable means. Associated with the deflectable means or beam and body portion are release connecting means near the end thereof opposite the pivotal connection. This release connecting means includes adjustable cam means mounted on the body portion, and adjustable cam receiving means engageable with said adjustable cam means.

When the wrench is fitted to a threaded fastener and rotated around the axis of the pivotal connection, the engagement of the adjustable cam means with the cam receiving means of the deflectable means maintains said deflectable means in a spaced axially parallel relationship with the body portion until a predetermined torque threshold, as calibrated on adjusting means, is reached, at which time the deflectable means ceases to rotate around the central axis at is pivotal connection. This point is instantly evident to the user of the wrench because during the brief period of time when the relationship between the body portion and deflector means shifts out of longitudinal alignment the wrench becomes momentarily easier to rotate around the axis of the fastener being set, which feeling signals the user of the wrench that the maximum desirable torque force has been applied to the fastener being set.

These and other objects and advantages will become apparent from the following description and drawings, wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top elevational view of the torque limiting wrench;

FIG. **2** is a side elevational view of the torque limiting wrench;

FIG. **3** is a bottom elevational view of the torque limiting wrench, with phantom lines to indicate the configuration of the wrench when a predetermined torque threshold has been attained;

FIG. **4** is an enlarged, cross sectional view of the torque force calibrating means taken along line **4—4** of FIG. **2**;

FIG. **5** is an enlarged, cross sectional view of the head of the torque limiting wrench taken along line **5—5** of FIG. **2**;

FIG. **6** is an enlarged cross sectional view of the cam means taken along line **6—6** of FIG. **3**;

FIG. **7** is an enlarged partial cross sectional view of the torque force adjustment means and camming means of the torque limiting wrench taken along line **7—7** of FIG. **3**; and

FIG. **8** is an enlarged partial cross sectional view of the roller cam means of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The torque limiting wrench, generally designated **10**, comprises two major portions a body portion **12**, which is preferably of elongated and generally rectangular in cross section construction, and a deflectable means **14** or an elongated, bifurcated deflectable beam which is carried on and longitudinally axially aligned in a spaced, parallel relationship with the body portion **12** when the wrench **10** is assembled and in its at rest configuration. The body portion **12** is cut out on its underside, forming an elongated recess **13** between a head end **20** and an area intermediate the ends of portion **12**. The body portion **12** includes a rounded handle **16**, which may be knurled as shown in the drawings. A bore **18** extends through the body portion **12** at the head end **20** and is normal to the longitudinal axis of the body portion **12**. Both the body portion **12** and beam **14** are preferably fabricated from aluminum; however, it should be recognized that other metals may be used with equal efficiency.

Mounted within the bore **18** is a tubular bearing sleeve **22**. Deflectable beam **14** includes a pivot pin **24** adapted to fit within tubular bearing sleeve **22**. A socket adapter **26** of the conventional type and including a spring loaded detent **28** is mounted on the side **15** of the deflectable beam **14** opposite the pivot pin **24** and sharing a common central axis with the pivot pin **24**. Deflectable beam **14** preferably extends angularly downward from the pivot connection so that its two parallel resilient bifurcated positions **28** and **30** terminate slightly before the body portion **12** (see FIG. **2**).

A set screw **36** connects the bifurcated portions **28** and **30** adjacent ends **31**. By tightening or loosening this screw **36** the distance between the bifurcated portions **28** and **30** of deflectable beam **14** can be controlled, the purpose of which will be explained in detail in following paragraphs.

Release connecting means generally designated **32** are associated with the deflectable beam **14** and body portion **12**. These means **32** include cam receiving means **33** and cam means **34**. The cam receiving means **33** include concave camming surfaces **35** and **37** in ends **31**, which are formed in each bifurcated portion **28** and **30** respectively and extending inwardly from the side **15** of deflectable beam **14**.

The cam means **34** includes a roller cam **38** which contacts the bifurcated portions **28** and **30** at their camming surfaces **35** and **37** and is seated in an at rest position therebetween, and biased thereagainst flexing the deflectable beam **14** inwardly into recess **13**. The points of contact between cam roller **38** and cam surfaces **35** and **37** form a cord **40** of the cam roller **38**, with the cord **40** generally extending into a

channel 42 formed between bifurcated portions 28 and 30 of the deflectable beam 14. Roller 38 is mounted on and rotates freely about a pin 44. The longitudinal axis of roller pin 44 is parallel to the longitudinal axes of body portion 12 and deflectable beam 14.

Roller pin 44 is permanently fitted into a bore 46 of a piston member 48 extending normal to the axis of said bore 50 46. Piston member 48 is slidably mounted within a vertical bore 50 extending through the body portion 12. This vertical bore 50 is normal to the longitudinal axis of body portion 12 and is parallel to the axis of pivot pin bore 18. Communicating with the bore 50 is an elongated slot 51 extending between bore 50 and recess 13 formed in body portion 12. The slot 51 extends upward from surface 53 of portion 12 terminating in an upper end 52 and has a width generally complementary with the diameter of pin 44, and is aligned therewith so the pin 44 may move within the slot 51. With a positioning of the pin 44 in slot 51, rotation of piston 48 within bore 50 will be prevented. Wear pins 54 may be set in body portion 12 on both sides of slot 51. The wear pins 54 are comprised of a harder metal than the body portion 12, and therefore restrict wear of the slot 51.

A vertical threaded bore 56 is countersunk in the upper portion 58 of piston 48 and is adapted to receive a threaded central shank 60 of a lower disc 62 of calibrating means, generally designated 64. Calibrating means 64 also comprises an upper disc or calibrating plate 66. A short set screw 68 passes through a center bore 70 of plate 66 and threads into a bore 72 of lower disc 62. The knurled rim 74 of lower disc 62, best seen in FIG. 2, facilitates manual rotation of the calibrating means 64.

A calibrating indicator 76 is mounted on body portion 21 adjacent the calibrating means 64, preferably by means of a screw 78 which threads into a bore 80 in body portion 12.

The wrench may be calibrated to measure torque in pound-feet, ounce-inches, in the metric scale, or the like. Numbers 82 on upper calibrating plate 66 indicate one form of measuring increment which may be etched or otherwise applied on the plate 66.

In operation, a socket head 84, shown in shadow in FIG. 2, is chosen which fits the head of whatever fastener (not illustrated) is to be tightened by means of the wrench 10. The socket 84 is then snap fitted onto adapter 26. The maximum torque force to be used with the fastener being tightened is adjusted for by rotating calibrating means 64 until the desired rating, as indicated by numbers 82 on dial 66, is in alignment with indicator means 76. A clockwise rotation of calibrating means 64 so that the torque force setting aligned with indicator means 76 increases from "0" to "5" as shown in FIG. 1, will draw piston 48 upwardly into bore 50 and in turn flex the deflectable beam 14 inwardly through the association with cam roller 38 and camming surfaces 35 and 37.

In order to prevent the removal of the piston 48 from bore 50, a set screw 86 extends through a bore 88 in the body portion 12 into a longitudinal channel 90 formed in piston member 48.

As the calibrating discs 62 and 66 are rotated from a lower to a selected higher torque setting, and as piston 48 is drawn into piston bore 50, cam roller pin 44, is also drawn toward the top 52 of slot 51. Consequently, roller cam 38 is caused to bear against its seat between the cam surfaces 35 and 37 of the bifurcated portions 28 and 30, respectively, of deflectable beam 14, thereby causing the bifurcated portions 28 and 30 to flex into recess 13 of body portion 12. Therefore, with pivot pin 24 engaging the tubular bearing 22 and with cam surfaces 35 and 37 being engaged by cam roller 38, the deflectable beam 14 is maintained in a temporarily fixed at rest longitudinal alignment with body portion 12.

As a fastener is tightened the wrench 10 will function as a unitary tool until the maximum torque force as designated by the alignment of indicator 76 with a setting on dial 66 is reached. At that instant the deflectable beam 14 will cease to rotate around the axis of the fastener being tightened because the force holding roller 38 in channel 42 between cam surfaces 35 and 37 will have been exceeded by the torque created between the body portion and the fastener, at which point roller 38 will roll out of channel 42 and onto one or the other of cam surfaces 35 or 37 (see FIG. 6) as deflectable beam 14 moves out of its aligned registry with body portion 12 to a minor angle relative to the longitudinal axis of said body portion.

At this moment the wrench "gives" slightly as the contact between roller 38 and one of the cam areas is broken, this signals the user that the desired torque limit has been attained and further tightening of the fastener will exceed that torque limit.

The torque settings may be calibrated by means of two built-in devices of the wrench. One adjusting device is the two-part calibrating means formed by disc 62 and plate or dial 66. By loosening set screw 68, plate 66 may be turned independently of disc 62. In other words, plate 66 may be adjusted without changing the position of piston 48. A second adjusting means is the screw 36 which connects bifurcated portions 28 and 30 near cam surfaces 35 and 37. Loosening this screw increases the area or the size of the channel 42 between cam areas 32 and 34 so that a larger cord 40 of roller 38 will set in channel 42. The larger that cord 40 is, or the deeper roller 38 seats in channel 42, the greater will be the force required to cause roller 38 to roll out of channel 42 and onto one of the cam surfaces 35 and 37.

As can best be seen in FIG. 8, the internal bore 92 of roller cam 38 is preferably flared outwardly slightly at either end thereof forming a sloppy fit. This facilitates a smooth movement of cam roller 38 out of channel 42 and onto either cam surfaces 35 or 37 when the body portion 12 and the deflectable beam 14 move out of longitudinal axial alignment with each other, without a sudden disengagement. In other words, the lateral angular movement of beam 14 is always about the pivot 24 so it is an arcuate movement. Without a sloppy fit or play in the roller cam 38, there would be a binding and an increased friction drag which would distort a true torque reading. Thus, with such play the roller cam 38 can assume the arc of the cam surfaces 35 or 37 and perform smoothly with total surface contact against the cam surfaces.

While the deflectable beam 14 is preferably set as seen in FIG. 2, to taper outwardly from its pivotal connection so that the ends 31 of the bifurcated portions are below the body portion 12 and can be flexed inwardly by the release connecting means 32, a departure from this arrangement can be utilized with equal effect. The deflectable beam 14 instead of being flexible could be relatively stiff and the pivotal connection to the handle could be a sloppy pivot and a compression spring could be inserted between the beam 14 and the body portion 12 biasing the deflecting beam outwardly so that as the release connecting means 32 are tightened, they could overcome the compression spring whereby the appropriate torque setting requirement could be assumed.

It should be noted that by the presentation of two camming surfaces 35 and 37 and the seating of roller cam 38, the wrench 10 can be utilized with either right- or left-hand threaded fasteners with equal effect.

Although I have herein shown and described my invention in what I have conceived to be the most practical and preferred embodiments it is recognized that departures may be made therefrom within the scope of my invention.

I claim:

1. A torque limiting wrench adapted to tighten a fastener with either a right- or left-hand thread, said wrench physically registering a predetermined torque requirement when a torque limit is reached upon tightening said fastener comprising: a body portion having a longitudinal axis; a deflectable means carried on said body portion and aligned parallel with said longitudinal axis, when in an at rest position, said deflectable means pivotally connected with said body portion; a wrench socket head adapter mounted on said deflectable means to receive a wrench socket head; non-deflectable pressure adjustable release connecting means directly coupled to

said body portion and bearing against said deflectable means remote from said pivotal connection whereby said deflectable means may be overcome by torque created between said body and said fastener as it is tightened to allow said deflectable means to pivot out of parallel alignment with said body portion and signal that the torque limit of said fastener has been reached.

2. A torque limiting wrench as defined in claim 1 wherein said release connecting means includes a cam roller adjustable against said deflectable means to increase or decrease resistance of said deflectable means to pivotal movement out of parallel alignment with said body portion.

3. A torque limiting wrench as defined in claim 2 wherein calibration means are connected to said cam roller to control adjustment thereof.

4. A torque limiting wrench as defined in claim 2 wherein the deflectable means is a flexible elongated generally flat beam having bifurcated portions remote from said pivotal connection and an elongated open channel between said portions running along a longitudinal axis of said beam, said bifurcated portions terminating remote said pivot in spaced apart cam roller release receiving means and said bifurcated portions including adjustment means to vary the distance between said cam roller release receiving means.

5. A torque limiting wrench as defined in claim 4 wherein said cam roller release receiving means includes arcuate cam surfaces extending outwardly from said channel and normal to said longitudinal axis forming a roller race.

6. A torque limiting wrench adapted to tighten a fastener with either a right- or left-hand thread, said wrench physically registering a predetermined torque requirement when a torque limit is reached upon tightening said fastener comprising: a body portion having a longitudinal axis; a deflectable means carried on said body portion and aligned parallel with said longitudinal axis, when in an at rest position, said deflectable means pivotally connected with said body portion; a wrench socket head adapter mounted on said deflectable means to receive a wrench socket head; release connecting means associated with said body portion and said deflectable means and longitudinally spaced from said pivotal connection which may be overcome by torque created between said body and said fastener as it is tightened to allow said deflectable means to pivot out of parallel alignment with said body portion and signal that the torque limit of said fastener has been reached, the deflectable means being a flexible elongated generally flat beam having bifurcated portions remote from said pivotal connection and an elongated open channel between said portions running along a longitudinal axis of said beam, said bifurcated portions each including an arcuate cam surface extending outwardly from said channel and normal to said longitudinal axis forming a roller race, said release connecting means including a cam roller seated in said channel and engageable by one of said cam surfaces forming said roller race as said deflectable means pivots when said predetermined torque limit has been reached when tightening said fastener.

7. A torque wrench adapted to tighten a fastener with either a right- or left-hand thread, said wrench physically registering a predetermined torque requirement when a torque limit is reached upon tightening said fastener comprising: an elongated body having a longitudinal axis and including a handle, a deflectable member pivotally mounted on the handle and adapted to swing on the pivot transversely from a position generally parallel to the axis of the body to a position at a minor angle relative thereto, a wrench socket head adapter carried on said deflectable member and having an axis parallel to the axis of the pivot, coupling means remote from the adapter releasably coupling the deflectable member and body together for simultaneous rotation of handle and deflectable member transversely in either direction for corresponding rotation of said adapter and consequent tightening of said fastener, said coupling means in response to a predetermined torque limit force applied to the handle allowing deflection of the deflectable member from its parallel position to an angular position relative to the body to signal when the torque limit of said fastener has been reached; said coupling means remaining stationary relative to deflection of said deflection member.

8. A torque wrench as defined in claim 7 wherein said deflectable member includes an arcuate roller race having a seat intermediate the ends thereof and receiving said coupling means.

9. A torque wrench as defined in claim 8 wherein said coupling means includes a cam roller positioned within said seat and ; said seat releasably disengageable from said cam roller for movement of said roller race upon said cam roller when said predetermined torque limit is reached and said deflectable member pivots from its parallel position to an angular position relative to the body.

10. A torque wrench as defined in claim 9 wherein said cam roller is adjustable and capable of exerting controlled pressure against said deflectable member dependent upon the torque requirement desired.

11. A torque wrench as defined in claim 10 wherein said coupling means include visual calibration means to set the torque limit desired.

12. A torque wrench adapted to tighten a fastener with either a right- or left-hand thread, said wrench physically registering a predetermined torque requirement when a torque limit is reached upon tightening said fastener comprising: an elongated body having a longitudinal axis and including a handle, a deflectable flexible elongated generally flat beam having bifurcated portions and including concave cam surfaces interrupted by a seat therebetween, said beam pivotally mounted on the handle remote from said bifurcated portions and adapted to swing on the pivot transversely from a position generally parallel to the axis of the body to a position at a minor angle relative thereto, a wrench socket head adapter carried on said deflectable member and having an axis parallel to the axis of the pivot, coupling means remote from the adapter coupling the beam and the body together for simultaneous rotation of the handle and deflectable beam transversely in either direction for corresponding rotation of said adapter and consequent tightening of said fastener, said coupling means embodying a pressure adjustable cam roller resting in said seat between said cam surfaces; said wrench operable in response to a predetermined torque limit force applied to the handle disengaging the seat from said cam roller thus allowing deflection of the beam from its parallel position to an angular position relative to the body to signal when the torque limit of said fastener has been reached.

13. A torque wrench as defined in claim 12 wherein said coupling means includes a piston slidably mounted in said body coupled to said cam roller; and calibration adjustment means on said body engaging said piston to move in said body.

14. A torque wrench as defined in claim 12 wherein one of said cam surfaces is adapted to shift to a position bearing against said cam roller when said flat beam is deflected from its normal parallel position relative to said body.

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