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TORQUE WRENCH

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This invention relates to wrenches for applying a measured torque to nuts and the like, and has as a broad object to simplify, increase the accuracy and reliability, and increase the service life of such wrenches.

Another object is to provide a torque measuring wrench of rugged construction that gives a positive and easily recognized signal when the desired torque is reached.

Another object is to provide a torque measuring wrench the accuracy of which is substantially unimpaired by lubrication or lack of lubrication of the parts.

The present invention relates particularly to torque measuring wrenches of the snap action type which produce a distinctive signal and momentarily release when a predetermined torque is applied.

An objectionable feature of prior known wrenches of this type is that they employed cam mechanisms having sliding bearing surfaces of such a nature that the torque necessary to "trip" the wrench varied greatly with a change in the friction at the bearing surfaces. The friction could vary as a result of insufficient lubrication, excessive lubrication, accumulations of dirt, and wear, so that frequent calibration was essential.

Wrenches in accordance with the present invention differ essentially from prior wrenches of the snap action type in that the snap action is obtained by means of a spring element that reverses its shape when stressed beyond a predetermined point. The use of such a spring element makes it possible to substantially eliminate sliding friction from the wrench mechanism and thereby eliminate the inaccuracies inherent in wrenches having substantial sliding friction.

Several different types of reversible spring elements may be employed in accordance with the invention, some examples of which will now be described with reference to the drawing, in which:

Fig. 1 is a longitudinal sectional view showing what I now regard as my preferred construction of wrench;

Fig. 2 is a section taken along the line II—II of Figure 1, showing the shape of the spring element employed;

Fig. 3 is a view similar to Figure 1 but showing the wrench in a different position of operation;

Fig. 4 is a view similar to Figure 1 but showing a modified construction;

Fig. 5 is a cross section taken in the plane V—V of Figure 4;

Fig. 6 is a view similar to Figure 1 but showing still another modification of the invention;

Figs. 7 and 8 are cross sections taken in the planes VII—VII and VIII—VIII, respectively, of Figure 6;

Fig. 9 is a detail section showing a modification of the structure of Fig. 1; and

Fig. 10 is a section in the plane X—X of Fig. 9.

Referring first to Fig. 1, the wrench therein disclosed comprises a head 10 adapted to engage the nut or other object to be turned, which head projects from one end of a hollow handle 11 in which it is pivotally mounted. Thus the inner portion of the head 10, which is positioned within the end of the handle 11, is apertured to receive a pivot sleeve 12, which pivot sleeve also extends into and is supported by apertures in the opposite side walls of the handle 11. The head 10 has limited rotation in a counterclockwise direction with respect to the handle 11 but is held against clockwise rotation. Thus, an arm 13 on the head 10 extends into the handle and has an outer face 14 which normally lies against one edge wall 15 of the handle to prevent clockwise rotation of the head 10. However, other portions of the head within the handle are rounded as indicated at 16 and 17 to permit limited counterclockwise rotation of the head without interference, while at the same time maintaining more or less of a seal between the head and the edge walls 15 and 18 of the handle.

Counterclockwise rotation of the head with respect to the handle is yieldably resisted by a stiff bar spring 19 which is anchored at one end in an anchor block 20 mounted in the rear end of the handle and extends forwardly therefrom through the handle, the extreme front end of the spring resting against a rounded surface 21 on the arm 13 of the wrench head. It will be apparent, therefore, that when the handle 11 is rotated clockwise with respect to the head 10, the bar spring 19 yieldably resists the rotation to a greater and greater extent as it is bent away from the edge wall 15 of the wrench toward the edge wall 18.

I provide an indication of the torque applied from the handle 11 to the head 10 by a mechanism which responds to a predetermined deflection of the bar spring 19. This mechanism includes a strip spring member 23, lying approximately alongside the bar spring 19, and a pin 24 attached to a leaf spring 25 which is secured by a rivet 26 to the edge wall 18 of the handle.

The strip spring 23 has its opposite ends notched as shown in Fig. 2, and these notched

ends are engaged by a notched supporting member 29 on the free end of the bar spring 19 and a notched pin 30 adjustably supported in an aperture provided therefor in the block 20. The notched block 29 and the notched pin 30 act as knife edge supports for the opposite ends of the strip spring 23 so as not to interfere with free flexing or buckling of the strip. The pin 30 can be moved inwardly by an adjusting screw 32 and locked in desired position of adjustment by a lock screw 33.

The free end of the leaf spring 25 normally bears against one face of the strip spring 23 adjacent the right end of the latter as shown in Fig. 1. The strip spring 23 is also normally engaged by a fulcrum 34 on the bar spring and is adapted to be engaged by an adjustable fulcrum screw 35, mounted in the edge wall 18, during operation of the wrench. This operation will be apparent from an inspection of Fig. 3, which shows the handle 11 deflected clockwise with respect to the wrench head 10 just sufficient to apply a torque barely less than that for which the wrench is adjusted. It will be observed that the strip spring 23 has been carried into engagement with the end of the fulcrum screw 35 and strongly deflected between the support 29 and the fulcrum 34 so that the upper side of the strip spring is concave between the support 29 and the fulcrum 34, convex for a short distance to the right of fulcrum 34 and then concave from that point on to the right end of the strip. At the same time, the strip is compressed longitudinally between the support 29 and the pin 30, this longitudinal compression resisting movement of the right end portion of the strip upwardly. However, as the torque is increased beyond a certain point, the bending of the left end of the spring between the support 29 and the fulcrum 34 by the fulcrum screw 35 causes the right portion of the spring to suddenly snap from the solid line position shown in Fig. 3 upwardly into the dotted line position. This movement carries the leaf spring 25 upwardly to suddenly project the pin 24 through a window 36 in the handle, as also indicated in dotted lines in Fig. 3. The pin 24 and window 36 are so located longitudinally of the handle that they are covered by a finger of the workman using the wrench so that the workman is apprized of the snapping of the strip spring by the impingement of the pin 24 against his finger. The snapping of the spring is also attended by a readily audible click so that an audible indication is also provided. Normally the fulcrum 34 engages the outwardly flexed side of the snap spring 23.

As soon as the force applied to the handle is released, the bar spring 19 and the head 10 return to normal position and the strip spring 23 snaps back into its normal position shown in Fig. 1. Although the restraining force resisting clockwise rotation of the handle 11 relative to the head 10 is supplied chiefly by the relatively stiff bar spring 19, the strip spring 23 supplies appreciable resistance during the final movement of the handle relative to the head, this resistance increasing rapidly as the strip spring moves into the solid line position shown in Fig. 3 but suddenly decreasing as the spring snaps over into the dotted line position. The reduction in the resistance to turning movement afforded by the snapping over of the strip spring is sufficient to be felt by the workman and in ordinary practice it prevents the application of torque to the nut being tightened in excess of that for which

the wrench is adjusted. This is an important advantage as it permits rapid operation without danger of excessively tightening the nuts.

The wrench described can be adjusted to trip at different applied torques by varying the positions of the fulcrum screw 35 and the pin 30. In general, retraction (upward movement) of the fulcrum screw 35 increases the torque at which the strip spring snaps over because it permits the bar spring 19 to be deflected farther before the strip spring 23 is engaged with the fulcrum screw 35. Furthermore it is ordinarily necessary to retract the pin 30 as the fulcrum screw 35 is retracted because as the bar spring 19 is deflected upwardly it carries the supporting block 29 toward the pin 30, thereby longitudinally compressing the strip spring 23 to a greater and greater extent. When the wrench is adjusted to snap at a relatively light torque, the strip spring 23 may be slightly compressed between the block 29 and the pin 30 when the wrench is in normal condition as shown in Fig. 1. On the other hand, if the fulcrum screw 35 is retracted a substantial distance to adjust the wrench for the application of a relatively heavy torque, the pin 30 may have to be retracted so far that the strip spring 23 is not longitudinally compressed at all when the wrench is in the normal position shown in Fig. 1. However, the notched ends of the block 29 and the pin 30 and the notched ends of the strip spring maintain the latter in engagement with the block 29 and the pin 30 at all times.

In all positions of adjustment, the leaf spring 25 bears against the upper face of the strip spring 23, thereby biasing it to bow downwardly as shown in Fig. 1.

The fulcrum screw 35 may be of the headless type and a lock nut 37 may be provided to hold it in a position of adjustment. It is also preferable to reinforce the edge wall 18 of the handle with a strip 38 adjacent the fulcrum screw 35. The anchor block 20 is inserted longitudinally into the handle 11 during assembly and retained in position by screws 39.

There is shown in Fig. 4 a simpler construction of wrench. In this instance the handle 11a, wrench head 10a, anchor block 20a, and bar spring 19a correspond to the elements in Fig. 1 but the strip spring 23a, instead of being floatingly supported at both ends, is rigidly secured at its left end to the bar spring 19a by a screw 40. The opposite or right end of the strip spring 23a is square cut and engages in slots 41 in the block 20a on opposite sides of the end of the pin 30a. However, the longitudinal compression of the strip spring is adjusted as before by varying the position of the pin 30a. The construction shown in Fig. 4 functions the same as the structure shown in Fig. 1, as illustrated in Fig. 3. Thus, when the bar spring 19a has been deflected sufficiently, the pressure of the fulcrum screw 35a against the strip 23a at a point to the left of the fulcrum 34a, causes the curvature of the right end of the strip to reverse and carry the pin 24a through the window 36a. It will be noted that the pin 24a is mounted directly on the strip spring 23a instead of on a separate leaf spring as in Fig. 1.

In the third modification of the invention, shown in Fig. 6, the strip spring 23b is similar to that in Fig. 4 except that it is dished as indicated at 42 at its point of contact with the adjustable fulcrum screw 35b. It is well known that a dished disc has a very pronounced snap action and this feature is utilized in the model shown

in Fig. 6 to accentuate the movement of the right end of the strip carrying the indicating pin 24b. In the construction of Fig. 6, it is not necessary to compress the strip spring 23b longitudinally and hence the right end of the spring is unsupported, the snap action with this construction being dependent entirely upon the use of the dished portion 42 of the strip.

It is possible with all of the constructions described to increase the range of adjustability of the wrench by varying the coupling between the head 10, 10a or 10b, and the bar spring 19, 19a or 19b, and a suitable construction whereby this can be effected is shown in Fig. 6. Thus, the underside of the left end portion of the bar 19b is provided with a longitudinal groove 43 and the arm 13b of the head is extended and likewise provided with a longitudinal groove 44 having upper edges 45 which engage a ball 46 interposed between the arm 13b and the bar spring 19b. The ball 46 is secured to the end of a small rod 47 which extends rearwardly through the handle alongside the bar 19b and through a hole 48 provided therefor in the block 20b. The free end of the rod 47 is threaded and screwed into a knurled nut 49 mounted in a notch or slot 50 provided in the block 20b. It will be observed that by rotating the nut 49, the ball 46 can be moved longitudinally to vary the effective length of the arm 13b. Thus, when the ball 46 is positioned near the left end of the bar 19b, as shown in Fig. 6, a relatively slight torque between the head and the handle is sufficient to produce a large deflection of the bar spring 19b. On the other hand, if the ball 46 is moved to the right near the end of the arm 13b, a relatively large torque must be applied between the handle and the wrench head to produce the same deflection of the bar 19b.

It will be observed that the groove 44 in the arm 13b becomes progressively deeper toward the end of the bar. This is to prevent interference between the arm 13b and the rod 47 when the arm rotates upwardly.

As best shown in Fig. 7, a spring click pawl 52 may be provided to retain the nut 49 in a position of adjustment but the nut may be turned against the resistance of the pawl 52 by inserting the end of a tool, such as a screwdriver, through a window 54 provided in the handle and prying the nut in one direction or the other.

In Fig. 1 the strip support 29 is nonadjustable and all adjustments of the longitudinal compression of the strip are made by the screws 32 and 33. However, an adjustable support can be substituted for the support 29, as shown in Figs. 9 and 10.

Thus, a rivet 60, having a head 61 containing an eccentric groove 62 is tightly fitted in an aperture provided therefor in the end of the bar spring 19, so that friction retains it in any position into which it may be turned. The end of the bar spring may be slotted as indicated at 63 to permit a spring grip on the rivet 60. The end of the spring strip 23 is arcuate and fits into the eccentric groove 62 as shown in Fig. 10. By rotating the rivet, a very fine adjustment of the longitudinal compression of the spring can be had. To facilitate adjusting rotation, the head 61 may be provided with a polygonal socket into which a wrench may be inserted through a window 64 in the wall 18. Considerable range of adjustment of the torque required to trip the wrenches of Figs. 1, 4 and 9, can be had by merely varying the longitudinal compression of

the spring strip 23. Thus, a 7 inch wrench has been adjusted to trip at any desired torque from about 65 inch pounds to about 165 inch pounds by varying the compression of the spring strip 23, without adjustment of the screw 35. By also adjusting the screw 35, the range was from about 30 to about 250 inch pounds.

Although for the purpose of explaining the invention certain specific embodiments thereof have been described in detail, it is to be understood that other variations and modifications will readily occur to those skilled in the art and the invention is to be limited only to the extent set forth in the appended claims.

I claim:

1. A torque wrench comprising a work engaging member, a handle member, means rockably interconnecting said two members, spring means interposed between said two members for yieldably resisting rocking movement therebetween, said spring means including a snap action element yieldable suddenly in response to distortion beyond a predetermined point and comprising: a strip of spring material, a pair of strip supporting elements adapted to bear against opposite ends of said strip, a pair of strip-distorting elements for contacting said strip on opposite sides thereof, one of said elements insuring curving of said strip in one direction when said members are in normal position, and means responsive to said rocking movement between said members for applying the other of said elements against said strip with sufficient force to reverse the curvature of at least a portion thereof, said reversal being resisted by longitudinal compression of said strip between said strip supporting elements.

2. A wrench as described in claim 1, in which said spring means also comprises a spring bar for resisting relative rocking motion between said two members, with one of said strip supporting elements fixed with respect to one end of said bar, and the other strip supporting element fixed with respect to the other end of said bar, one of said strip supporting elements being closer to said bar than the other whereby said elements are moved toward each other, in response to deflection of said bar, to longitudinally compress said strip.

3. A torque wrench comprising an elongated hollow handle, a work engaging member pivotally mounted within one end of said handle and projecting from the handle, said work engaging member having an arm within said handle, an anchor block rigidly secured in the other end of said handle, a spring bar anchored at one end in said block and extending through said handle into engagement with said arm for yieldably resisting rocking movement of said handle with respect to said work engaging member, said handle having an aperture in one side wall thereof, an indicating finger movable from an inner position within said handle to an outer position projecting through said aperture, means supporting said finger for movement between said two positions and yieldably urging it into said inner position, and means responsive to predetermined deflection of said bar for moving said finger into said outer position.

4. A wrench as described in claim 3, including adjustable means intercoupling said bar and said finger supporting means for varying the deflection of said bar required to project said finger.

5. A wrench as described in claim 3, including a strip spring extending longitudinally within said

handle, means supporting one end of said strip from the free end of said bar for lateral movement therewith, stop means anchored to said handle for engagement with the side of said strip adjacent said one end for deflecting said strip in response to deflection of said bar, means on said block engaging the other end of said strip and functioning with said first mentioned strip supporting means to compress the strip longitudinally and thereby bow it, fulcrum means on said bar engageable with the side of said strip between said stop means and said other end of said strip, said fulcrum means contacting the side of said strip which is outwardly flexed and functioning together with said stop means to reverse the curvature of said strip between said fulcrum and said other end in response to a predetermined deflection of said bar.

6. A wrench as described in claim 3, including a strip spring extending longitudinally within said handle, first means supporting one end of said strip from the free end of said bar for lateral movement therewith, stop means anchored to said handle for engagement with one face of said strip adjacent said one end for deflecting said strip in response to deflection of said bar, second means supporting the other end of said strip from said handle and functioning with said first strip supporting means to compress the strip longitudinally and thereby bow it, fulcrum means on said bar engageable with the other face of said strip between said stop means and said other end of said strip, said fulcrum means contacting the outwardly flexed side of said strip and functioning together with said stop means to reverse the curvature of said strip between said fulcrum and said other end in response to a predetermined deflection of said bar, said stop means and second supporting means being adjustable to vary the degree of deflection of said bar required to reverse the curvature of said strip.

7. A torque wrench comprising an elongated hollow handle, a work engaging member pivotally mounted within one end of said handle and projecting from that end of the handle, said work engaging member having an arm projecting substantially longitudinally within said handle, a bar spring within said handle and rigidly secured to the other end thereof, said bar spring having its free end adjacent and normally substantially parallel to said arm, a coupling member interposed between said arm and said bar spring and movable longitudinally therebetween for deflecting said bar in response to rotation of said work engaging member in one direction, means for effecting longitudinal adjustment of said coupling member, and means responsive to

predetermined deflection of said bar for producing a signal.

8. A wrench as described in claim 7, in which said means for adjusting the longitudinal position of said coupling member comprises a flexible rod connected to said coupling member at one end and extending longitudinally therefrom through said handle, means for laterally supporting the free end of said rod from said handle, and means for adjustably supporting said rod longitudinally in any one of a plurality of longitudinal positions.

9. A wrench as described in claim 1 in which one of said strip-supporting elements comprises an anchor member having a gripping aperture therein, a pin frictionally engaged in said aperture and projecting therefrom, the projecting portion having an annular groove therein eccentric with respect to the axis of the pin for receiving one end of said spring.

10. In a torque wrench, the combination of a work-engaging member, a handle member, means rockably connecting said members, a spring means resisting rocking movement between said members, a normally curved snap spring, and means operably associated with said normally curved snap spring for reversing the curvature of the snap spring when a force is applied to the handle member of sufficient magnitude to rock the same relative to the work member.

11. In a torque wrench, the combination of a work-engaging member, a handle member, means for rockably connecting said members, a spring for yieldably resisting rocking movement therebetween, said spring being mounted at one end between the handle member and having its other end engaged by a shoulder on the work-engaging member, an auxiliary member mounted within the handle, an indicating pin operatively associated with the auxiliary member, and means operatively connected with the auxiliary member, spring and the handle whereby the auxiliary member is actuated when the spring is flexed beyond a predetermined limit to thereby thrust the indicating pin through a hole in the handle.

12. In a torque wrench, the combination of a work-engaging member, a handle member, means rockably connecting the said members, a bar spring having one end anchored within the handle member and having its other end engaged with a shoulder formed on the work-engaging member, a snap spring mounted within the handle and connected between the handle and the bar spring whereby when the bar spring is flexed beyond a predetermined limit, the snap spring is snapped.

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