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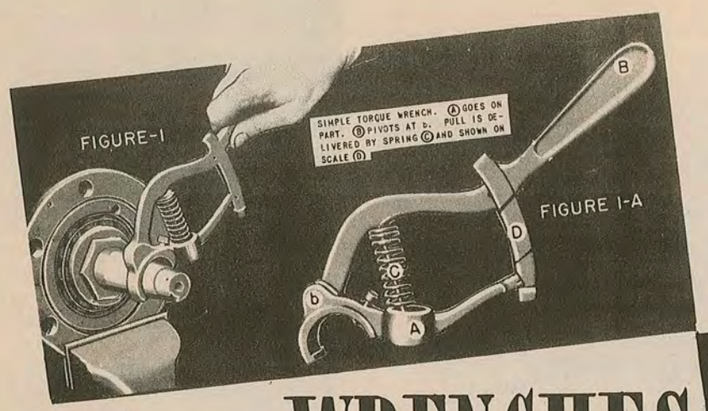

Torque WRENCHES

a left-handed Monkey Wrench

From TIMKEN AXLE NEWS

Something new has been added to the well-known family of monkey wrenches, Stillson wrenches, end wrenches, socket wrenches, etc. Here's a nut-shell education on the what, why, and how of this new wrench.

The name *torque wrench* is not a good one and it doesn't really describe the tool. It's like asking for a 'hammering hammer'. Torque and wrench mean the same thing - to twist.

Torque wrench is the commonly used name for a wrench that 'clocks' the resistance offered by the nut, bolt, or part under the wrench. It takes the guesswork out and keeps you from applying more pressure than the part was meant to have.

In this way, it prevents the musclemen among us from tearing nuts apart or stripping threads. And, of course, it allows the clumsiest mechanic to make an adjustment worthy of the most precise surgeon.

The torque wrench is made in many forms. The simplest form is shown in Figure 1. It consists of three main parts. (A) is the wrench which is applied to the part to be turned. In this case, the wrench is the spanner type, with a tongue to fit into the keyway of a shaft. (B) is the wrench handle which is pivoted on the wrench at b. Any pull on the wrench handle is delivered downward to the wrench by means of spring (C) and is shown on the scale (D). In other words, you push down on the spring and it pushes down on (A) which turns the part to be turned. The scale travels past the pointer and 'clocks' the power exerted.

The size of the spring determines the torque capacity - the pulling power - of the wrench. Naturally, a light spring will permit only a relatively light pull - the spring closes easily. The various stages of the spring compression (as you apply power to the handle) are indicated by the pointer as the scale on the wrench handle moves by. See *Figure 1-a.* A heavier spring allows you to apply more force to the handle.

Two other forms of the torque wrench are shown in *Figure 2.* These are the snap-on type, for use with standard sockets. One has a circular indicator and the other a linear indicator. All torque wrenches work on the basic principle of the simple wrench shown in Figure 1, regardless of the type of spring used.

Well, why do we use torque wrenches? Answer: To provide uniform tightness of such parts as studs, nuts and capscrews. It is the answer to the age-old question, 'how tight is tight'. We all know

Figure 2
Torque wrenches come in many types. These are snap-ons for standard sockets.

that, with a long enough wrench handle and enough pull, the head of a capscrew can be twisted off and a stud can be pulled in two. This is the result of exceeding the strength of the material.

Take steel for an example. All steel gives with impact, it stretches when pulled, it compresses under load, and it bends under load. And if not pulled beyond its tensile limit, it snaps back to its original shape like a rubber band. The degree of *temporary* change in shape depends upon the quality of the steel and its heat treatment which result in definite physical properties.

A bar of steel under pull, or tension, will resist stretching up to a certain point. Over this point it will take a 'set' and remain permanently stretched and a further increase in load will result in failure. You can throw it away. See test specimens in *Figure 3.*

This explains the experience every mechanic has had at least once. Capscrews or stud nuts are pulled home very tight in the afternoon. The next morning it is discovered that the screws or nuts can be turned very slightly for additional tightening. What happens is that the elastic limit of the steel is exceeded and it takes a permanent set - elongating, stretching out overnight. This explains loose cylinder-head nuts, loose axle-shaft, drive-stud nuts, loose carrier-flange capscrews, leaking gaskets after the job has been tightened with an ordinary wrench and a lot of 'beef'. A more scientific tool for 'tightening nuts', the torque wrench, is used by the automotive industry and should be used in all maintenance shops.

Torque wrenches are available with scales reading in pounds-inches or pounds-feet depending upon the job to be done.

A measurement of 25 pounds-feet means a pull of 25 pounds at a 1 foot lever length - or 50 pounds at a 1/2 foot lever length.

In other words, the 'lever length' or length of the wrench handle determines the amount of force your fist at the end of the handle will have to exert to do a particular piece of work. For instance, if you have a nut that requires a force of 25 pounds to turn it, using a 1 foot lever (handle) - then with a 2½ foot lever, it'll only require a force of 10 pounds; with a 5 foot lever, 5 pounds, etc. The longer the handle, the less force you have to exert.

Whether the mechanic uses a piece of pipe to increase the length of the wrench for easy pull is of no importance as long as he stops at the correct reading on the indicator scale.

The correct reading for each job, of course, has to be determined before-hand. The thread fit must be taken into consideration. A very tight thread-fit will require more pounds-feet pull than a loose fitting thread to get the same degree of tightness of the nut or head against the part.

In Timken axles for example, the majority of capscrews and studs used are in the range of sizes as follows and this chart may be used as an approximate guide in using torque wrenches.

Diameter	Pounds-Feet
3/8"	20-22
7/16"	45-55
1/2"	55-65
9/16"	65-75
5/8"	75-85

The above applies to standard threads only. For fine pitch threads, less wrench pull is required for the same tightness of nut or screw.

A few simple rules will guide you to more accurate and faster use of the torque wrench.

1. Know what pull is correct to use.
2. Be sure indicator (dial or pointer) is properly set before starting pull.
3. Work on clean, dry threads.
4. If threads are cleaned and oiled, reduce torque applied by approximately 10 per cent.
5. Use the torque wrench for tightening only. Always loosen or remove studs or nuts with a standard wrench.
6. Pull smoothly up to the torque desired. Don't stop, then start again - more torque is required to start up once you have stopped, and you'll be misled by the reading.

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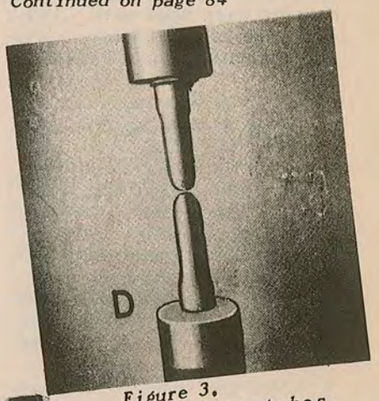


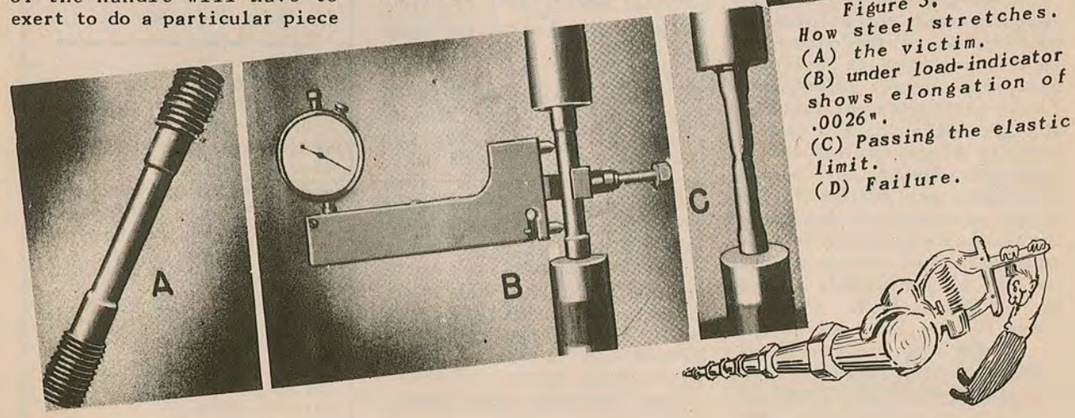


Figure 3.
How steel stretches.
(A) the victim.
(B) under load-indicator shows elongation of .0026".
(C) Passing the elastic limit.
(D) Failure.

A few examples of parts on Timken axles absolutely demanding correct and uniform tightness of nuts and screws are:

A. Differential bearing - cap stud-nuts and capscrews. *Improper tightening at these points may alter the differential bearing adjustment.*

B. Differential-case capscrews attaching the case halves. *It is important that the halves be in perfect alinement to insure proper differential-gear tooth-contact.*

C. Bevel-gear to spur-pinion cross-shaft-mounting capscrews on double-reduction type differential-carrier units. *Improper capscrew tightening at these points may cause gear run-out, or may cause premature capscrew failure and gear damage.*

D. Bevel and spur-pinion bearing-cage stud-nuts. *Uniform tightening at these points is important because bearing adjustment is controlled by shims. Bearing-case to shim pressure should therefore be uniform.*

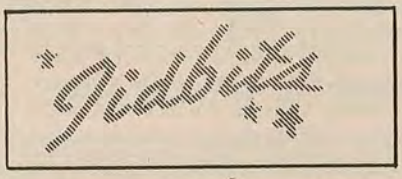
E. Bearing retainer-washer capscrews on spur-pinion cross-shaft of double-reduction carriers. *The retaining washer controls the spur-pinion-bearing adjustment. Capscrew tightening should be uniform to provide full bearing of washer against the bearing-cone.*

The use of a suitable torque wrench for adjustment of bearings is the only satisfactory method of obtaining uniformly correct adjustment.

It eliminates entirely the the human element of 'feel', etc. The Timken tapered roller bearings on Timken bevel pinion mountings are adjusted to a slight pre-load. In this case the bearing adjustment is made to result in a torque wrench pull of 6 to 8 pounds-inches on the pinion shaft. Figure 2 shows the checking operation.

These are only a few of the situations where the use of a torque wrench is essential for correct adjustment - see your maintenance manual for those that apply to the particular cases you run across. You'll discover that nearly all tightening operations include a specification on torque. Don't try to see what happens when they are changed a little. Too-tight strains bolts - not-enough is worse.

Warning to the beginner: A torque wrench has nothing to do with engine torque, so don't let a wise guy fool you. However, we now have a 'left-handed monkey wrench,' because a torque wrench will pull one way only.



Your maintenance manual isn't all deadwood and dry reading, in many cases it's bright, fresh, and lively - full of interesting news and juicy tips. Read it once in a while. Here's a couple of samples....

From the Chevrolet 1½ ton TM 10-1127:

The transfer case drain-plug is a magnetic plug which attracts any small metal particles, such as a small chip off a gear, and thereby prevents metal particles from being circulated through the gears with the lubricant. *(Page 7-103)*

When it is necessary to interchange tires, always place the tire showing the most wear on the inside dual, and the tire with the least wear on the front wheels. The reason for this is simply that the inside dual tire is the hottest running tire on a truck, the outside dual next, and the front tire is the coolest. The less rubber on a tire, the cooler it will run. *(Page 10-1)*

In replacing brake lining, satisfactory performance can be obtained by replacing only the forward shoes when the reverse linings do not show excessive wear. Tests have shown that in most cases the reverse lining will outlast two sets of forward linings. This is true of both front and rear wheel brakes.

Shoes should be changed in sets; that is, both forward shoes on front wheels or both forward and reverse shoes on front wheels. The same is true on the rear wheels. *(Page 5-5)*

Should water be lost from the cooling system and the engine overheats, do not add water immediately - allow the engine to cool down while running at idling speed. Then add water slowly while the engine is still running.

If water is poured into the radiator while the engine is hot, there is danger of cracking the cylinder head. *(Page 6 - 201)*

FLEXIBLE LINES

(Continued from page 45 of the May ARMY MOTORS)

One of our make-up men - the one with the slack jaw and conspicuous fangs - saw no reason why we should run the last 3 inches of our story on 'Flexible Lines' last month - so he just left them off. We, however, are firmly determined to see the thing through. Here they are: The last 3 inches.

One of the advantages of the fittings used, is the fact that they can be used over again since the assembly doesn't distort either the nut or the body of the fitting. However, a new sleeve must be used as this portion of the fitting does not have the re-usable feature.

Anyhow, mark our words, this kit should prove one of the handiest things you can have around the Maintenance Shop.