United States Patent

[11] 3,595,105

[72] Inventor **Theodore R. Wagner**
257 Lansing St., Aurora, Colo. 80010

[21] Appl. No. **781,396**
[22] Filed **Dec. 5, 1968**
[45] Patented **July 27, 1971**

[54] **TORQUE MEASURING TOOL UNIT**
12 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **81/52.4**
[51] **Int. Cl.** **B25b**
[50] **Field of Search** ..... 81/524; 64/29; 192/50; 206/52 F; 220/31 SR, 55 K, 55 I, 55 M

[56] **References Cited**

UNITED STATES PATENTS

2,508,820	5/1950	Fraley	206/42 X

FOREIGN PATENTS

256,607	3/1949	Switzerland	64/29

Primary Examiner—James L. Jones, Jr.
Attorney—Andrew F. Wintercorn

ABSTRACT: In this torque measuring tool unit, a plurality of drive transmitting balls are spaced circumferentially in coplanar relationship around the common axis of two driving and driven housing sections, the balls being in one of said housing sections and pressed by individual coiled compression springs releasably into registering recesses of uniform size and depth provided in the other of said housing sections. A screw element threaded in one of the housing sections relative to the other provides an adjustable backing for the springs, and when this screw is tightened it enables the balls to transmit higher torque, and vice versa. A detent and pointer turn with the screw relative to graduations on the housing to hold the screw in a set position and indicate the torque setting. The torque measuring tool unit is connected between a driving unit and a tool such as a screw driver or wrench to protect the work against overtightening of a screw of nut and prevent stripping of threads.

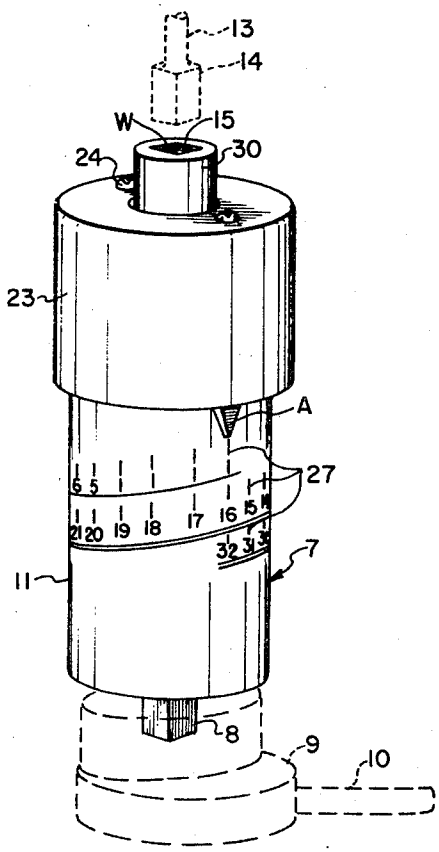


FIG. 2

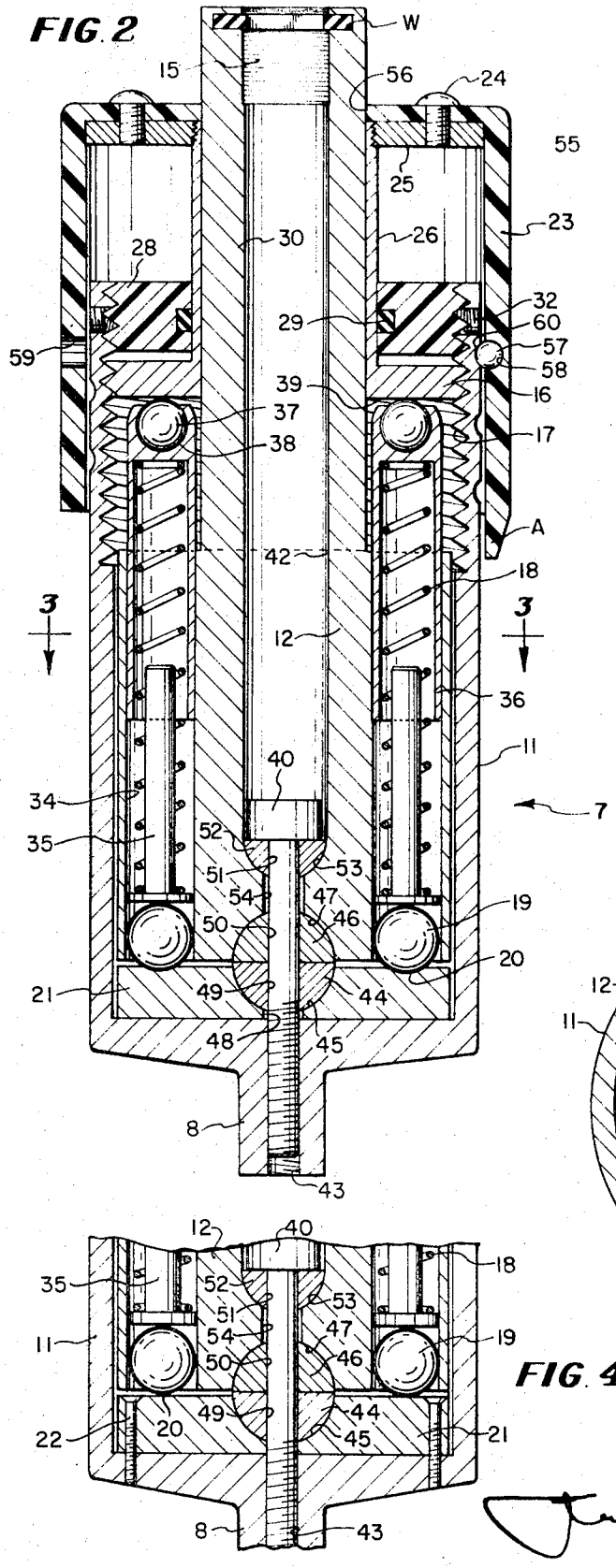


FIG. 1

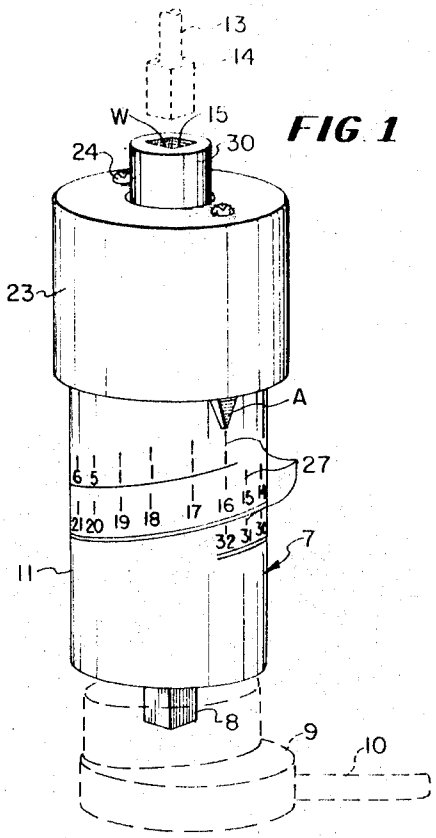


FIG. 3

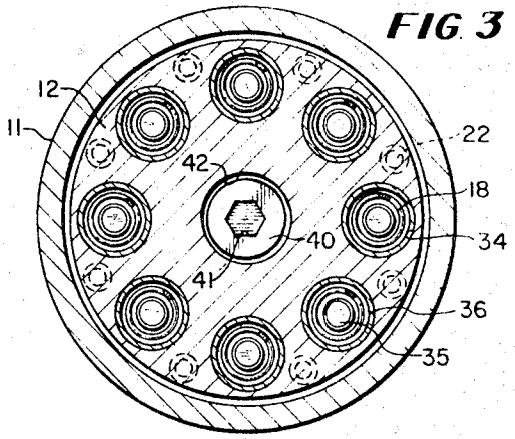


FIG. 4

INVENTOR:
THEADORE R. WAGNER

Attorney

TORQUE MEASURING TOOL UNIT

This invention relates to a new and improved torque measuring tool unit, the same being designed to be connected at one end with a torque applying tool device, like that shown, for example, in my U.S. Pat. No. 3,356,117, and have a tool such as a wrench or screwdriver inserted in a tool holder on the other end.

The principal object of my invention is to provide a simple, compact, and economical, as well as highly practical torque measuring tool unit designed to be easily adjusted manually by the turning of a cap on one end of the device to set it to obtain precisely the kickout adjustment desired within close limits and thus assure the desired tightening of a nut or screw without, at any time, incurring the danger of overtightening and possibly stripping threads.

A salient feature of the present construction is that variable loading of a plurality of circumferentially spaced compression springs caged in one housing section behind a similar number of drive transmitting balls normally engaging in a plurality of circumferentially spaced spherical depressions provided in a relatively rotatable coaxially disposed housing section, hollow pistons being provided to enclose and support the other ends of the springs remote from the balls and carrying other balls on their outer ends for antifriction bearing engagement on the smooth face of a threadedly adjustable pressure plate that is turned by means of the cap. In that way, the farther the pressure plate is adjusted in the one direction the more torque can be transmitted through the springs and spring-pressed balls from a driving to a driven shank, and the screw-threaded adjustment of the pressure plate accurately predetermines the torque at which the torque measuring balls kick out.

Another important feature is the detent means for releasably securing the cap in adjusted relationship to the housing despite kicking-out of the torque gauging balls in the event of overload, the detent means being of a concealed type enclosed between the housing and the cap and a pointer being provided on the cap and moving relative to graduations a on the housing to indicate the torque setting.

Still another important feature is the novel construction of the swivel joint between the relatively rotatable inner and outer parts of the housing utilizing two half-balls, one half fitting universally in a semispherical socket in the center of the one housing part and the other half fitting universally in a semispherical socket in the adjacent end of the other housing part, while still another half-ball is entered universally in a semispherical socket in the inner end of the axial bore in the one housing part, and a bolt is extended through center holes in the three half-balls and threaded in the other housing part at the center of the end thereof, this construction allowing for the tightening of the bolt enough to define the swivel connection between the housing parts leaving limited operating clearance between the parts involved without danger of introducing any errors in the torque adjustments mentioned above.

The invention is illustrated in the accompanying drawing, in which:

FIG. 1 is a perspective view of my improved torque measuring tool unit indicating in dotted lines how it is adapted to be assembled between a torque applying device at one end and a screwdriver or wrench or other tool applied to the other end;

FIG. 2 is a longitudinal section through the unit on an enlarged scale to better enable a clear understanding of its operation;

FIG. 3 is a cross section on the line 3–3 of FIG. 2, and

FIG. 4 is a fragmentary sectional detail showing parts in moved positions, as when a kickout occurs due to overload.

The same reference numerals are applied to corresponding parts throughout the views.

Referring to the drawing, the reference numeral 7 designates the torque measuring tool unit of my invention generally having an axial square drive shank 8 on its one end

adapted to be entered in the tool holder of a torque applying device indicated in dotted lines at 9 which has a radial torque arm 10 in radially freely slidable relation thereto to turn the unit 7 by ratchet action selectively in either direction, depending on the setting of the pawl thereof, as more fully disclosed in my U.S. Pat. No. 3,356,117. The outer housing part 11 of the unit 7 turns with the driving shank 8 and so does also the inner relatively rotatable housing part 12 until the drive transmitting balls of the torque measuring unit kick out, as hereinafter described, but up to that point the wrench or screwdriver or other tool, the driven shank end of which is indicated in dotted lines at 13 has drive transmitted thereto. This shank has a square drive end portion 14 dimensioned for snug-fitting engagement in the square drive socket 15, and suitably yieldably retained by a rubber washer W, as in the above patent, whereby the unit 7 transmits drive to the tool in either direction within the drive capacity for which the unit 7 has been set, thereby safeguarding the work against over tightening of a nut or screw and avoiding stripping threads.

The amount of torque that can be applied to the inner housing part 12 is determined by the threaded adjustment of the screw-threaded pressure plate 16 in the threaded bore 17 of the outer housing part 11 to compress a plurality of coiled compression springs 18 to apply spring loading to a plurality of drive transmitting balls 19, which, by their normal engagement in shallow spherical recesses 20 provided in the hardened end plate 21 fixed in the end of the outer housing part 11, as by screws 22 (see FIG. 4), serve to keep the inner housing part 12 turning with the outer housing part 11 until the balls 19 kick out, as illustrated in FIG. 4, due to load imposed by the tool 13 beyond that for which the pressure plate 16 has been set. The nylon cap 23 that encloses the open end of the outer housing part 11 has the pressure plate 16 suitably secured thereto by screws 24 entered in holes in the cap registering with threaded holes in a ring 25 threadedly secured on the end of the axial sleeve portion 26 of the pressure plate. A pointer or arrow A on the edge of the skirt portion of the cap serves to indicate the torque setting for unit 7 in relation to the circumferentially spaced graduations 27 provided around the middle portion of the outer housing part 11, which as seen in FIG. 1 are numbered suitably 1 to 32 for that number of inch/pounds for which unit 7 may be calibrated. The next higher unit with heavier springs would be calibrated higher. A ring-shaped plug 28 of plastic material serves with its seal ring 29 both as a dirt shield around the reduced axial sleeve portion 26 of the pressure plate 16 and as a friction or dampening means to hold the parts releasably in adjusted position, while still allowing easy turning of the pressure plate 16 with the cap 23 whenever the torque setting of the unit 7 is to be changed. Setscrews 32 threaded in radial holes in the inner end portion of the inner housing part 11 serve to secure the plug 28 in place. The reduced axial sleeve portion 30 of the inner housing part 12 has a free working fit inside the axial sleeve portion 26 of the pressure plate 16. Each of the springs 18 works with its ball 19 in a bore 34 provided in the inner housing part 12 parallel to the axis thereof and has a flatheaded pin 35 resting on one end with the flat outer face thereof in supporting abutment with a ball 19 while the other end is housed in a hollow piston 36 slidable in the bore 34 like the head end of the pin 35 and having the other end of the spring resting therein, next to a ball 37 set into a bearing socket 38 provided in the end of the piston while the ball provides point rolling contact on the flat end face 39 of the pressure plate 16.

It is important to keep the inner end of the inner housing part 12 accurately parallel to the end plate 21 and still permit the relative rotation necessary upon kickout of the balls 19 from the recesses 20 and also permit anchoring the swiveled end of the inner housing part 12 centrally with respect to the neighboring end of the outer housing part 11. This is accomplished with a bolt 40, the head end of which has an Allen wrench socket 41, as seen in FIG. 3, so that an Allen wrench can be entered through the axial bore 42 of the inner housing

part 12 to tighten the bolt 40, which threads in an axial hole 43 provided in the center of the outer housing part 11. A half-ball 44 fits universally in a semispherical socket 45 provided in the center of the end plate 21, as shown, and another half-ball 46 fits universally in a similar semispherical socket 47 provided in the lower end of the inner housing part 12, the bolt 40 passing through aligned center holes 48, 49, and 50 in the end plate 20 and ball halves 44 and 46, respectively, and also passing through another center hole 51 in still another half-ball 52 having a universal fit in a semispherical socket 53 provided in the inner end of the bore 42. There is a restriction 54 in the inner end of the bore 42 between the sockets 47 and 53. With this construction, the bolt 40 can be tightened enough to leave limited operating clearance between all of the parts involved, without any danger of introducing any error in the torque adjustment made with the pressure plate 16.

It is also important to note that the ring 25 has a press fit around its periphery 55 inside the cap 23 to center the pressure plate 16 and its sleeve portion 26 accurately with respect to the cap, this being important because the center hole 56 in the end of the cap 23 has a close bearing fit on the reduced axial sleeve portion 30 of the inner housing part 12. Sleeve portion 30, as previously mentioned, has a free working fit inside the axial sleeve portion 26 of the pressure plate. Hence, here again, I am providing close bearing support in the right places. I have insured the necessary freedom of relative rotation between the outer and inner housing parts 11 and 12, so that the actual torque measurement to within an infinitesimal value depends upon the setting of the pressure plate 16 and nothing else. That is why not even the slight friction drag exerted by the plastic ring 28 and its seal ring 29 is permitted to introduce any error at any given torque setting of the unit 7.

In some units 7, the cap 23 may be set at the factory with a setscrew or the like against turning with respect to the outer housing part 11 to have the unit 7 serve as a torque measuring unit for whatever inch-pounds the unit may be labeled. However, where the unit 7 is to be manually adjustable for setting at various settings shown by the graduations 27 from 1 inch-pound on up to 30 or 32 inch-pounds in two complete turns of the cap 23, accordingly as the unit has been calibrated, a steel detent ball 57 of small diameter is provided inside the cap 23, set in a semispherical depression 58 provided on the inside of the cap, in diametrically opposed relation to a hole 59 drilled in the opposite side, and this ball is arranged to snap into shallower semispherical recesses 60 provided in the outside of the outer housing part 11 in aligned relation to the graduation marks 27, previously mentioned, whereby to lock the cap 23 detachably in any given setting, the ball 57 by virtue of the springiness of the nylon cap 23 being adapted to ride out of one depression 60 and snap into the next as the cap 23 is turned in resetting the unit for a different torque setting, the recesses 60 being substantially shallower than the recess 58 to make this operation possible.

In operation, the torque measuring unit 7 cooperating with the torque applying tool device 9 and the driven tool 13 to drive the latter in either direction, as desired, makes certain that no greater torque is transmitted to the tool 13 than the unit has been adjusted for, thereby protecting the work against overtightening a nut or screw and accordingly reducing likelihood of stripping threads. As previously indicated, some of these units may be permanently set for a given torque setting at the factory and labeled accordingly, a setscrew or the like serving to fasten the cap 23 in its fixed position. On the other hand, where, as in the present unit shown in FIG. 1, there are graduations 27 reading from 1 inch-pound on up to say 32 inch-pounds in two turns of the cap 23, the detent ball 57 snaps into place in one after another of the depressions 60 as the pointer A moves from one to another, and in that way the user can quickly determine the torque setting and change it to a higher or lower setting, as the work requires, and in each new setting the detent ball 57 holds the cap securely in that new setting until it is to be changed.

It is believed the foregoing description conveys a good understanding of the objects and advantages of my invention. The appended claims have been drawn to cover all legitimate modifications and adaptations.

I claim:

1. A torque responsive device of the character described comprising two coaxial relatively rotatable housing sections, a plurality of drive transmitting balls disposed in circumferentially spaced relation in one of said housing sections normally drivingly engaging in circumferentially spaced recesses provided in the other of said housing sections, the balls and recesses being concentric with and in a plane substantially normal to the axis of said housing sections, compressible spring means holding each of said balls engaged in its recess, and a single screw-threadedly adjustable pressure plate in one of said housing sections rotatable relative to the other housing section to simultaneously vary alike the spring loading on said balls for kickout of said balls at a higher or lower torque level depending upon the direction of screw adjustment, said compressible spring means comprising compression springs and hollow pistons of elongated form in which said compression springs are supported, said pistons being closed at one end for support of the springs and bearing support on said pressure plate at circumferentially spaced points, the pistons being guided for reciprocation in circumferentially spaced bores provided in one of said housing sections parallel to the axis thereof and in which said springs are received, said pistons carrying balls with freedom to turn in bearing sockets provided in the closed ends of said pistons, said balls having antifriction rolling contact on a flat surface on said pressure plate.

2. A torque responsive device of the character described comprising two coaxial relatively rotatable cylindrical telescoping housing sections, a plurality of drive transmitting balls disposed in circumferentially spaced relation in one of said housing sections normally drivingly engaging in circumferentially spaced recesses provided in the other of said housing sections, the balls and recesses being disposed concentric with and in a plane substantially normal to the axis of said housing sections, compressible spring means holding each of said balls engaged in its recess, and a single screw-threadedly adjustable pressure plate in one of said housing sections rotatable relative to the other housing section to simultaneously vary alike the spring loading on said balls for kickout of said balls at a higher or lower torque level depending upon the direction of screw adjustment, said balls and springs being in the inner one of said housing sections, which has a reduced axial end portion with a square socket in its outer end adapted to receive a drive member, the socket being in one end of an axial bore extending inwardly from said socket to near the inner end of said inner housing section where means is provided for an axial swivel connection between the two housing sections, the outer housing section having an axial drive extension coaxial with but extending in the opposite direction than the axial end portion of the inner housing section, the other end of said outer housing section being open, a closure for said open end having a center opening provided therein through which the reduced axial end portion of the inner housing section extends, said pressure plate also having a reduced axial extension swiveled on the aforesaid axial end portion and extending through the center opening in said closure, and a cylindrical cap fixed to the axial extension of said pressure plate for rotary adjustment thereof and disposed in telescoping relation to the outer end of the outer housing section.

3. A torque responsive device as set forth in claim 2 including a friction washer in the center hole in said closure surrounding and resisting turning of the axial extension on said pressure plate to resist turning of said cap while still permitting manual adjustment of the pressure plate with said cap.

4. A torque responsive device as set forth in claim 2 including detent means on the inside of said cap engageable in depressions provided on the outside of the outer housing section in a predetermined circumferentially and axially spaced

relation for releaseably securing said cap and pressure plate in its adjusted position.

5. A torque responsive device as set forth in claim 2 including detent means on the inside of said cap engageable in depressions provided on the outside of the outer housing section in a predetermined circumferentially and axially spaced relation for releaseably securing said cap and pressure plate in its adjusted position, there being a pointer on the inner end of said cap turning with said pressure plate in its adjustment, and graduation means relative to which said pointer moves in a circle in making the pressure plate adjustments, whereby to give a definite reading for each torque setting of the device.

6. A torque responsive device as set forth in claim 2 including universally adjustable ball and socket means forming parts of a swivel connection between the housing sections preventing axial movement of one section endwise relative to the other.

7. A torque responsive device of the character described comprising two coaxial relatively rotatable cylindrical telescoping housing sections, a plurality of drive transmitting balls disposed in circumferentially spaced relation in one of said housing sections normally driving engaging in circumferentially spaced recesses provided in the other of said housing sections, the balls and recesses being disposed concentric with and in a plane substantially normal to the axis of said housing sections, compressible spring means holding each of said balls engaged in its recess, and a single screw-threadedly adjustable pressure plate in one of said housing sections rotatable relative to the other housing section to simultaneously vary alike the spring loading on said balls for kickout of said balls at a higher or lower torque level depending upon the direction of screw adjustment, said balls and springs being in the inner one of said housing sections, which has a reduced axial end portion on which said pressure plate is swiveled for rotation, a cylindrical cap fixed to said pressure plate for rotary adjustment thereof and disposed in telescoping relation to the outer one of said housing sections, and means providing an axial swivel connection between the housing sections preventing axial movement of one section endwise relative to the other, the inner one of said housing sections having an axial bore, and said swivel connection comprising an axial bolt extending from said bore through a center hole in the end of the inner housing section and threaded in a center hole in the outer housing section, and bearing ball means receiving said bolt in center holes therein, said ball means being split through the center normal to the bolt, one ball half being universally received in a semispherical bearing provided in the end of the inner housing section and the other ball half being universally received in a semispherical bearing provided in the outer housing section.

8. A torque responsive device as set forth in claim 7 including another half-ball with a center hole therethrough receiving the head end of said bolt, said half-ball being universally received in a semispherical bearing provided at the inner end of said bore.

9. A torque responsive device of the character described comprising two coaxial relatively rotatable cylindrical telescoping housing sections, a plurality of drive transmitting balls disposed in circumferentially spaced relation in one of said housing sections normally drivingly engaging in circumferentially spaced recesses provided in the other of said housing sections, the balls and recesses being disposed concentric with and in a plane substantially normal to the axis of said housing sections, compressible spring means holding each of said balls engaged in its recess, and a single screw-threadedly adjustable pressure plate in one of said housing sections rotatable relative to the other housing section to simultaneously vary alike the spring loading on said balls for kickout of said balls at a higher or lower torque level depending upon the direction of screw adjustment, said balls and springs being in the inner one of said housing sections, which has a reduced axial end portion on which said pressure plate is swiveled for rotation, a cylindrical cap fixed to said pressure plate for rotary adjustment thereof and disposed in telescoping relation to the outer one of said housing sections, the skirt portion of the cap that telescopes in relation to the outer one of said housing sections being radially flexible and resilient, and a detent projection provided on the inner side of the latter portion of said cap and arranged to engage under spring action releasably in depressions provided in the outside of the outer housing section in a predetermined circumferentially and axially spaced relation.

10. A torque responsive device as set forth in claim 9 including a pointer on the inner end of said cap turning with said pressure plate in its adjustment, and graduation means on the outside of the outer housing section relative to which said pointer moves in a circle in making the pressure plate adjustments, whereby to give a definite reading for each torque setting of the device.

11. A torque responsive device as set forth in claim 9 wherein said cap is of plastic material and has a radially springable peripheral wall, and the detent projection is defined by a metallic detent ball set in a recess provided in the inner side of said wall and is arranged in the turning of said cap to ride into and out of shallower recesses provided in circumferentially spaced relation in the periphery of said housing in a predetermined relationship to said graduation means and pointer to maintain a selected torque setting of said device.

12. A torque responsive device as set forth in claim 9 wherein said pressure plate is restrained frictionally against turning relative to said housing, whereby to hold the same against turning from adjusted position while still permitting manual adjustment of the pressure plate with said cap.