

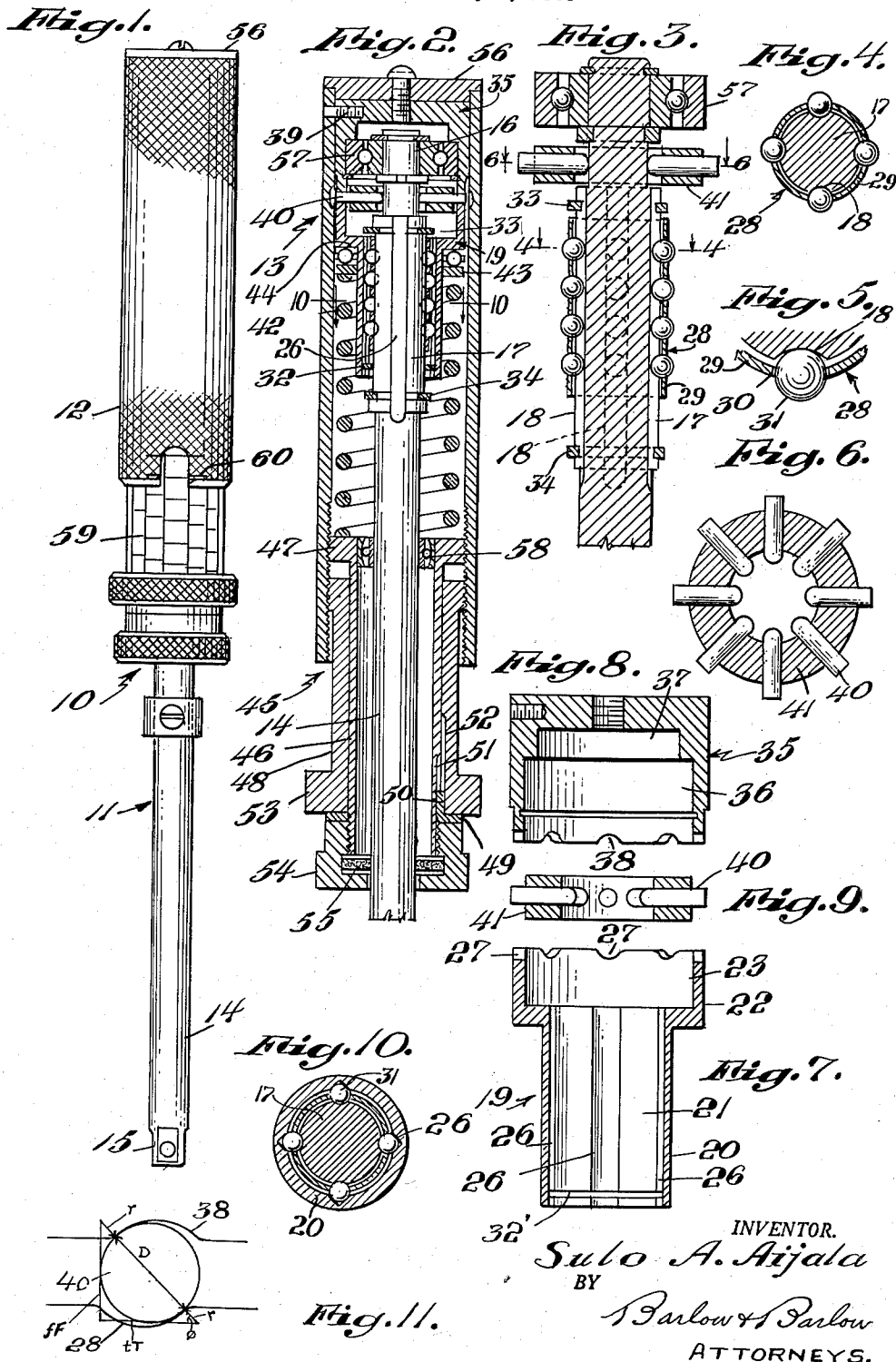
Jan. 24, 1961

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2,968,979

PREDETERMINED TORQUE RELEASE HAND TOOL

Filed May 5, 1959



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**PREDETERMINED TORQUE RELEASE  
HAND TOOL**

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Filed May 5, 1959, Ser. No. 811,208

11 Claims. (Cl. 81—52.4)

This invention relates to improvements in a torque applying tool and has for an object to provide a tool of the above type so constructed as to allow for close tolerance in setting to yield at a predetermined torque.

Another object of the present invention is to provide a tool of the above character in which the friction between relatively moving surfaces will be reduced to areas defined by line and point contact.

Another object of the present invention is to provide a tool of the above character so constructed that calibration of the tool may be predetermined prior to assembling of the parts of the tool.

Another object of the invention is to provide a tool of the above character which will retain its accuracy of setting even when subjected to severe usage.

Another object of the invention is to provide a tool of the above character so constructed as to resist the influence of end thrust or radial load on the handle during the tightening of screws and bolts.

Another object of the invention is to provide a tool of the above character in which the inner working parts are protected from foreign matter.

Another object of the invention is to provide a tool of the above character in which the torque controlling mechanism allows either left or right hand operation thereof.

Another object of the present invention is to provide a tool of the above type in which an audible signal will be had upon the application of predetermined torque on the work.

With these and other objects in view, the invention consists of certain novel features of construction as will be more fully described and particularly pointed out in the appended claims.

In the accompanying drawings:

Figure 1 is an elevational view of predetermined torque applying tool embodying my invention;

Figure 2 is an enlarged longitudinal sectional view of the tool of Figure 1 showing the inner parts of the tool;

Figure 3 is an enlarged sectional view of certain parts of the inner mechanism shown in Figure 2;

Figure 4 is a sectional view taken substantially along line 4—4 of Figure 3;

Figure 5 is a sectional view of a fragmentary portion of the view of Figure 4 shown on an enlarged scale;

Figure 6 is a sectional view taken substantially along line 6—6 of Figure 3;

Figure 7 is a sectional view of one of the parts of the clutch mechanism of the tool;

Figure 8 is a sectional view of a second part of said clutch mechanism;

Figure 9 is a sectional view of a third part of said clutch mechanism;

Figure 10 is a sectional view taken substantially along line 10—10 of Figure 2 with certain parts of the tool appearing on line 10—10; and

Figure 11 is a force diagram.

Referring to the drawing in more detail, 10 designates a tool for applying a predetermined torque to work and

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comprises a shaft or shank 11, a tubular handle 12, and a mechanism 13 herein referred to broadly as a clutch, to connect the handle and shank for rotation of said shank and operable to be disengaged upon said predetermined torque being applied to the work, as for example, turning screws, turning nuts and the like. In the present instance the shank is shown as being a round shaft having a reduced portion 14 which has a square stud 15 at the outer end thereof for receiving various forms of work engaging adapter elements, as for example, screw driver blades, socket wrenches and the like. The other end of the shaft is reduced as at 16 which provides an intermediate portion 17 of larger diameter. This portion 17 has a plurality of axially extending grooves 18 which in the present instance are four in number and equally spaced angularly from each other. The grooves 18 are arcuate in cross-section for reasons which will hereinafter appear.

The clutch mechanism 13 comprises a first torque sensitive member or sleeve 19 (see Figure 7) which has a stem 20 with a bore 21 therethrough and an enlarged head 22 which is provided with a bore 23 of much larger diameter than bore 21 and extends in axial continuation thereof. The wall of bore 21 is provided with a plurality of axial extending generally V-shaped grooves 26 (see Figure 10) which are equal in number to the number of grooves 18 and are similarly angularly spaced from each other. The outer end edge of the head 22 has a plurality of radially extending grooves 27 which are arcuate in cross-section as best seen in Figure 7. The bore 21 is much larger in diameter than the shaft portion 17 which is received in said bore 21 and is connected thereto by a ball bearing spline device designated generally 28 (see Figures 3, 4 and 5).

The device 28 comprises a ball retaining sleeve 29 having a plurality of axially extending rows of openings 30 therethrough in which are received ball bearings 31. The rows of openings 30 are equal in number to the number of grooves 18 and are similarly angularly disposed. The device is received on the shaft portion 17 in the space between said portion 17 and bore 21, and with the balls 31 engaged in the grooves 18 and 26, thus connecting shaft 11 to sleeve 19 to extend co-axially with each other. The device 28 is axially slidable relative to said shaft and sleeve and is held within the sleeve by a shoulder 32 formed by a snap ring lodged in groove 32' and projecting from the wall of bore 21 at the lower end portion thereof. Snap ring 33 secured to the upper end of shaft portion 17 projects therefrom to form a stop for retaining the sleeve 19 and ball spline from riding off shaft portion 17. The grooves 18 are arcuate in cross-section, as previously mentioned and are generated on a radius greater than the radius of the balls 31 so that the balls 31 have a point contact in the grooves 18 and thus friction is reduced between the said grooves and balls.

It may be here mentioned that the snap ring abutment 33 and a similar abutment 34 are provided merely for retaining the sleeve 19 and ball retainer 28 in position during the assembly of the tool.

A second torque sensitive member in the form of an inverted cup-like member 35 (see Figure 8) has an axial bore 36 which is reduced inwardly as at 37. A plurality of radial extending semi-circular grooves 38 extend inwardly at the outer end edge of member 35 and these are in number equal to the number of grooves 27 and are similarly angularly spaced. Member 35 is received within the upper portion of handle 12 in line with sleeve 19 and with the grooves 38 thereof positioned opposite grooves 27 and adapted to be placed in registry therewith. A screw 39 extends through the handle 12 into screw

threaded engagement with the member 35 to secure the same to turn with handle 12. The sleeve 19 and member 35 are connected together for relative rotation one from the other by rollers 40 which are engaged in said grooves when in registry with each other. The rollers 40 are held spaced from each other by an annulus 41 which surrounds the portion 16 and is lodged within the bores 23 and 36. The annulus 41 has radial openings therethrough through which the rollers 40 project to engage in said grooves 27, 38. The grooves 27 and 38 have substantially the same radii. The radius of rollers 40 is smaller so that they will have a line contact with the grooves, which assures load distribution to prevent breaking of materials, all as hereafter mentioned. A compression spring 42 is arranged within the hollow of handle 12 and has one end thereof extending into engagement against a thrust bearing 43 which is engaged in turn against an annular shoulder 44 formed at the junction of head 22 and the stem 20 of sleeve 19. The other end of the spring engages against a spring pressure adjusting sleeve 45 which threadably engages the lower portion of the bore of handle 12. Thus it will be apparent that sleeve 19, rollers 40, and member 35 are held in yielding engagement by the pressure of spring 42.

The spring pressure adjusting sleeve 45 is made in two parts, an inner sleeve 46 which has an enlarged inner head 47 which threadably engages the bore of the handle 12 and a second or outer sleeve 48 which surrounds sleeve 46 and likewise threadably engages the bore of the handle 12. The inner end of the sleeve 48 is spaced from the head 47 and is connected to the sleeve 46 by means of a lock washer 49 which is provided with a lip 50 which functions as a spline to enter in aligned grooves 51 and 52 in sleeves 46 and 48. A knob 53 is provided on sleeve 48 for rotating said sleeves to advance or withdraw the same from said handle in accordance with the direction in which said sleeves are rotated. Thus the spring pressure may be adjusted to the spring force desired on the clutch. A lock nut 54 bearing against washer 49 threadably engages the sleeve 46 and axially moves the same so as to bind the screw thread engagement between sleeve 46 and handle 12 in the known manner. A dust seal 55 is positioned between lock nut 54 and the end of sleeve 46. A cap 56 closes the other end of the handle.

The shank 11 is mounted for rotation relative to the handle 12 by a ball bearing 57 at the upper end of the shaft and a radial bearing 58 at a lower position on said shaft. The inner raceway of bearing 57 is frictionally received at the upper end of reduced portion 16 of the shaft, and the outer raceway of the bearing 57 is frictionally received in the bore 37 of member 35. The inner raceway of bearing 58 is received on the reduced portion 14 of the shaft and the outer raceway thereof is frictionally received in the bore of sleeve 45 and held to move axially therewith. The inner raceway of bearing 58, while held sufficiently snug on shaft 11 so as to turn therewith, may be moved axially so as to allow axial movement of sleeve 45 relative to shaft 11.

From the foregoing it will be apparent that rotation of handle 12 will rotate shank 11 in unison therewith through clutch connection 13. Upon the resistance encountered by shank 11 to the torque applied to the handle 12 overcoming the pressure of spring 42 which forces the cam surfaces of notches 27, 38 against rollers 40, the same will yield and rollers 40 will be carried about the shank 11, riding in and out of grooves 27 and will indicate an unmistakable audible signal to indicate the predetermined torque having been reached. The grooves 27 and 38 provide cams which are arranged to have line contact with the rollers 40; thus it will be apparent the area of surface engaged between the clutch parts is reduced to a considerable degree and will provide for greater accuracy in release of the clutch parts and accurate restoration thereof to clutch relation. It will also be noted the ball bearing spline connection between the

shaft and sleeve 19 has point engagement in the spline grooves which likewise reduces friction. In other words, it will be particularly noted that friction has been reduced at all locations wherein surfaces are moved relative to each other. Thus, the shaft 11 rotates relative to the handle 12 on ball bearings 57, 58 while axial movement of the shaft relative to the adjacent surface is on ball bearings 31. The sleeve 19 rotates relative to the spring 42 on a ball thrust bearing 43. All this makes for greater accuracy in a tool of the above character.

In the use of the tool the spring force is adjusted to yield at a predetermined torque to be applied to the work. The resistance of the work to the torque applied thereto will cause relative angular movement between the rollers and the surface of the grooves in a direction for the rollers to ride out of said grooves and break the drive connection between the sleeve 19 and member 35. The said relative angular movement of the rollers along the surfaces of the grooves is on an arcuate inclined as seen in Figure 11 and the contact of the rollers on said surfaces is a line contact at all times. During this relative movement of the rollers along the surfaces of the grooves there is an increase of spring force in response to the additional compression of the spring 42 due to the axial movement of the sleeve 19. This increased spring force resists rotation of sleeve 19 but the cam surfaces of the grooves is such that the output torque begins to and continues to decrease to nearly zero, the instant the rollers ride out of the grooves 27 in sleeve 19 and until the rollers have been restored into a next in line groove 27. Both release and restoration create an unmistakable signal to indicate the predetermined torque has been attained.

In adjusting the spring pressure for a predetermined torque, the lock nut 54 is loosened which allows the sleeve 48, and 46 to be turned in unison in or out of the handle as the setting may require. The outer surface of sleeve 48 is graduated as at 59 which in conjunction with datum line 60 indicates the torque setting. Upon the adjustment having been made, the lock nut may be tightened to preserve the said adjustment.

It may be here mentioned that said spring force resists rotation of the sleeve 19 as a function of the angle of contact of the rollers between said sleeve 19 and member 35. Thus the pressure angle may be calculated to dislodge the rollers at a predetermined torque throughout the entire range of the tool. The ability of the release mechanism to operate throughout the entire range of the tool is dependent on the condition  $\Delta f < \Delta F$ ;  $\Delta f$  being the increment of increased spring force due to additional compression by the releasing process and  $\Delta F$  being the increment of increased axial component of the torque applied at the handle. The output torque begins to decrease and continues to decrease to nearly zero, the instant the rolls start to climb the arcuate surfaces of the notches. Where  $K$  is the spring factor:

$$\Delta F = K(2r + D) \sin \Delta \theta$$

$$\Delta F = T \tan \Delta \theta$$

I claim:

1. In a predetermined torque applying tool having a shaft, a handle, a clutch for connecting said handle to said shaft for rotating the same, said clutch having a first part connected to said handle for rotation therewith, a second part connected to said shaft for rotation therewith, anti-friction means for axially slidably mounting one of said parts, said parts each having a plurality of grooves therein with the grooves on the said first part being adapted to be moved into axial registry with the grooves on the said second part, a third part between the first and second parts and engaged in said grooves, said slidable part being spring biased toward the other part to cause engagement of said grooves with the third part for providing a driving connection for transmitting torque applied to said handle to said shaft.

2. In a predetermined torque applying tool as set forth in claim 1 wherein said third part comprises rollers.

3. In a predetermined torque applying tool as set forth in claim 1 wherein said third part comprises rollers and an annular cage for retaining said rollers spaced from each other.

4. In a predetermined torque applying tool as set forth in claim 1 wherein said grooves are concave and said third part comprises rollers with a radius less than the radius of the concavity of said grooves to have a line contact in said grooves.

5. In a predetermined torque applying tool having a shaft, a handle, and a clutch for connecting said handle to said shaft for rotating the same, said clutch having a first part carried by said handle for rotation therewith, a second part carried by said shaft for rotation therewith, one of said parts being axially movable relative to the other of said parts, antifriction means for mounting said movable part, said parts extending axially in line with each other and spring urged for movement toward each other, the ends of said parts opposite each other, each having radially extending concave grooves, and a plurality of rollers positioned in the space between said adjacent ends and each engaged in a groove in one of said parts and in a groove in the other of said parts for connecting said parts to each other for rotation one from the other.

6. In a predetermined torque applying tool as set forth in claim 3 wherein said rollers have a radius less than the radius of said grooves to provide line engagement in said grooves.

7. In a predetermined torque applying tool as set forth in claim 5 wherein said rollers are radially disposed relative to said shaft and carried in a sleeve surrounding said shaft.

8. In a predetermined torque applying tool having a shaft, a handle, a clutch for connecting said handle to said shaft for rotating the same, said clutch having a first part connected to said handle for rotation therewith, a second part connected to said shaft for rotation therewith, said parts each having a plurality of grooves therein with the grooves on the said first part being adapted to be moved into axial registry with the grooves on the said second part, a third part between the first and second parts and engaged in said grooves, said slidable part being spring biased toward the first part to cause engagement of said grooves with the third part for providing a driving connection for transmitting torque applied to said handle to said shaft, wherein said grooves are concave and said third part comprises rollers with a radius less than the radius of the concavity of said grooves to have a line contact in said grooves.

9. In a predetermined torque applying tool having a shaft, a handle, and a clutch for connecting said handle to said shaft for rotating the same, said clutch having a first part carried by said handle for rotation therewith, a second part carried by said shaft for rotation therewith, one of said parts being axially movable relative to the other of said parts, said parts extending axially in line with each other and spring urged for movement toward each other, the ends of said parts opposite each other, each having radially extending concave grooves, and a plurality of rollers positioned in the space between said adjacent ends and each engaged in a groove in one of said parts and in a groove in the other of said parts for connecting said parts to each other for rotation one from the other, wherein said rollers have a radius less than the radius of said grooves to provide line engagement in said grooves.

10. In a predetermined torque applying tool having a shaft with axial grooves therein, a handle, and a yieldable clutch for connecting said handle to said shaft for rotating the same, said clutch having a part surrounding said shaft with axial grooves therein, and a ball spline connecting said part to said shaft for rotation therewith and for axial movement relative thereto, said balls being of a radius less than the radius of the grooves in said shaft to have point contact with the surface of said shaft grooves.

11. In a predetermined torque applying tool having a shaft with axial grooves therein, a handle, and a yieldable clutch for connecting said handle to said shaft for rotating the same, said clutch having a part surrounding said shaft with axial grooves therein, and a ball spline connecting said part to said shaft for rotation therewith and for axial movement relative thereto, said balls being of a radius less than the radius of said grooves to have a point contact with the surface thereof.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

|           |               |                |
|-----------|---------------|----------------|
| 1,913,046 | Callan        | June 6, 1933   |
| 2,396,040 | Darling       | Mar. 5, 1946   |
| 2,441,038 | Siesel        | May 4, 1948    |
| 2,732,746 | Livermont     | Jan. 31, 1956  |
| 2,771,804 | Better et al. | Nov. 27, 1956  |
| 2,819,635 | Better et al. | Jan. 14, 1958  |
| 2,852,972 | Larson        | Sept. 23, 1958 |
| 2,884,103 | Connell       | Apr. 28, 1959  |

##### FOREIGN PATENTS

|         |        |              |
|---------|--------|--------------|
| 846,203 | France | May 27, 1939 |
|---------|--------|--------------|