March 26, 1957 E. D. ETHINGTON ET AL 2,786,378

TORQUE TOOL AND RELEASE MECHANISM

Filed Aug. 31, 1954 2 Sheets-Sheet 1

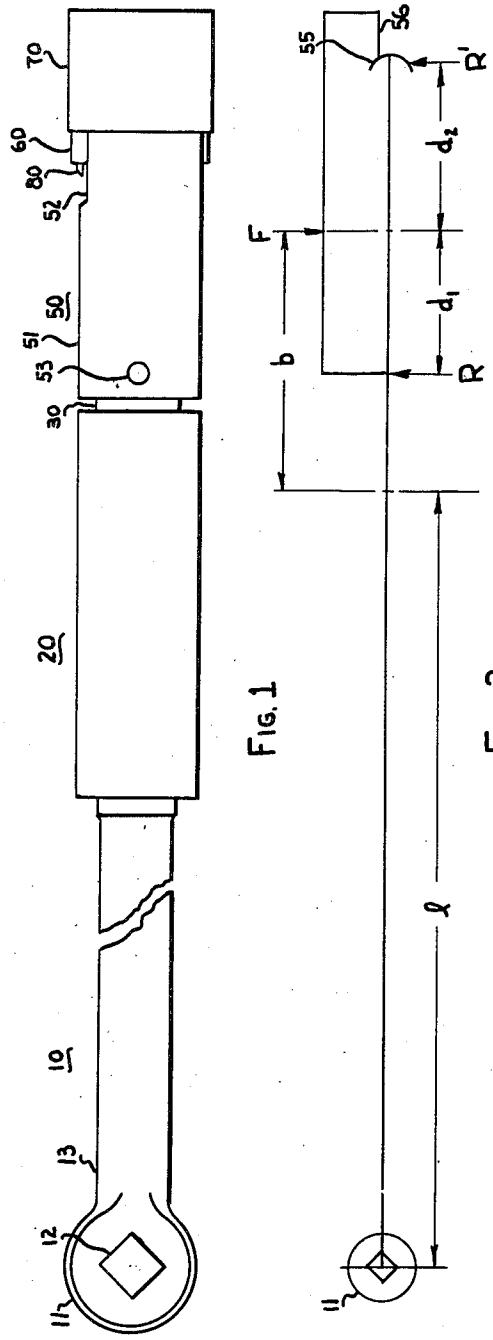


FIG. 1

FIG. 2

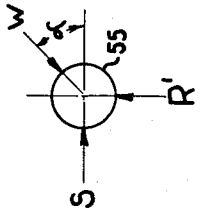


FIG. 3

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TORQUE TOOL AND RELEASE MECHANISM

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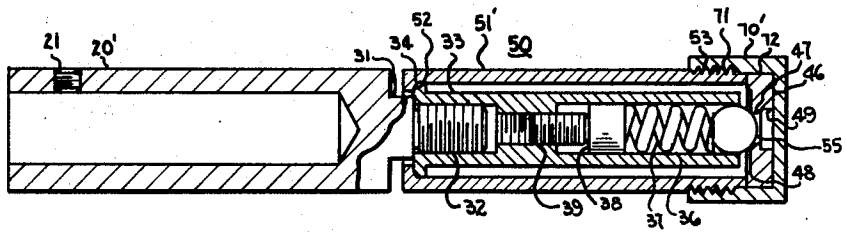


FIG. 4

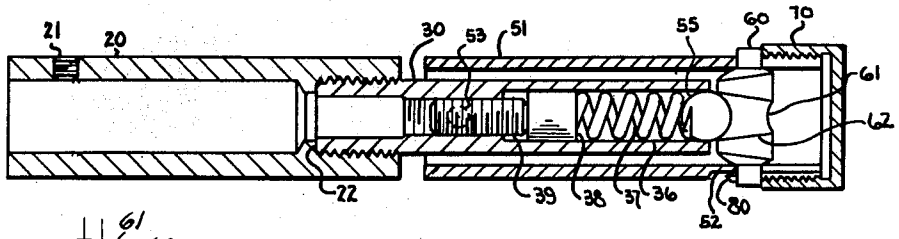


FIG. 5

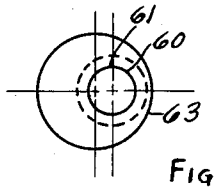


FIG. 7

FIG. 6

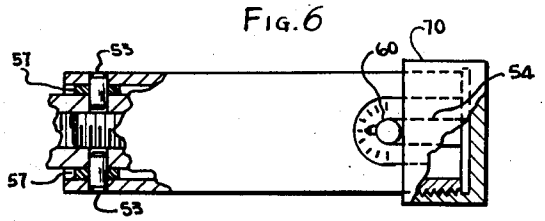


FIG. 4a

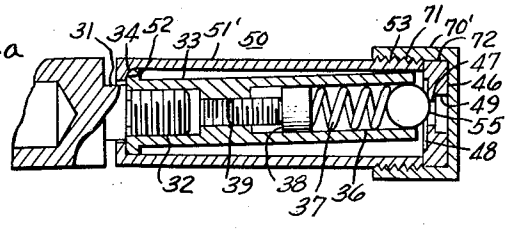


FIG. 8

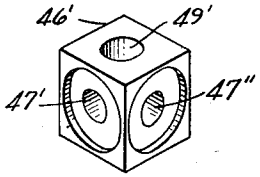
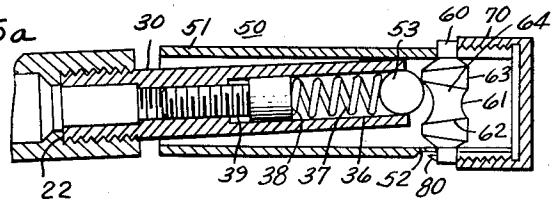


FIG. 5a



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TORQUE TOOL AND RELEASE MECHANISM

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Application August 31, 1954, Serial No. 453,380

15 Claims. (Cl. 81—52.4)

This invention relates to torque applying tools and to force release mechanisms for such tools and for general application. More particularly, in one aspect, the invention is applicable to a torque applying tool for indicating to an operator when a predetermined value of torque is applied. In another aspect, the invention relates to force release mechanisms especially suited to torque measuring tools although the invention is not limited thereto in its usefulness.

The torque tool has numerous applications in modern industry in the laboratory, in assembly, and in the shop. A most common application, for example, is the tightening of a screw threaded fastener to a given value of torque to produce a desired tension in the shank of the fastener.

Torque wrenches known in the prior art take a variety of forms and most all are classifiable generally either as the rigid lever arm type or the flexible lever arm type. Heretofore, so far as known, it has been the practice to construct both types of torque wrench as an integral combination of driving head, lever arm, and measuring mechanism. In this arrangement the torque lever arm is fixed and the associated measuring mechanism is designed and calibrated for the fixed lever arm length usually for operation over a single range of torque values. It is a common practice to use various accessories with either type of wrench. Such accessories serve as extensions from the driving head or extensions from the handle portion to permit access to the workpiece or to increase the effective lever arm of the tool. The prior art devices under such conditions require that a correction factor be applied to the measured value of torque to account for disturbance in the initial calibration occasioned by use of the accessory. This, of course, results in inconvenience and inefficiency in the use of the tool.

Both types of torque wrenches and tools, the rigid lever arm and the flexible lever arm, known heretofore incorporate some form of elastic or spring member for measurement of the applied torque. The relationship between spring deformation and applied force throughout the range of force must be known in order to produce accurate measurement. This relationship, expressed as the rate of change of force with respect to displacement or spring rate must be known for each tool. So long as torque measurement depends upon spring rate, a high degree of accuracy can be obtained only by individual calibration of the tools because of the lack of uniformity of spring rate in otherwise identical springs. This requirement in present practice militates against advantageous volume production techniques and leads to high cost of torque measuring tools.

It is the purpose of this invention to overcome these and other disadvantages of the prior art devices.

One object of this invention is to provide an attachment for torque applying tools which will indicate directly in units of torque the value of torque applied to a workpiece regardless of the lever arm length of the tool.

Another object is to provide a torque applying tool in which the torque setting may be established as a function of two independent variable quantities.

Another object is to provide a variable force release mechanism which will yield at a predetermined force value independently of the spring rate of the mechanism.

A further object is to provide a torque applying tool having an improved force release mechanism which produces a tactual and audible signal to the operator when a predetermined value of torque is applied.

It is an additional object to provide a variable force release mechanism in which the release force varies linearly with respect to shaft rotation.

A further object is to provide a torque wrench with a releasable coupling which automatically resets after each operation.

These and other objects and the advantages of this invention will become apparent from the description which follows in view of the accompanying drawings, in which:

Figure 1 is an elevational view of an illustrative embodiment of the invention as an attachment to a conventional wrench.

Figure 2 is a schematic representation of the assembly shown in Figure 1 for explanatory purposes.

Figure 3 is a schematic force diagram to aid in the description of the force release mechanism.

Figure 4 is a sectional view of one embodiment of the invention.

Figure 4*a* is a sectional view of the embodiment of Figure 4 with the parts in a different position.

Figure 5 is an elevation view in section of another embodiment of the invention.

Figure 5*a* is a sectional view of the embodiment of Figure 5 with the parts in a different position.

Figure 6 is a plan view in partial section of the embodiment shown in Figure 5.

Figure 7 is a plan view of one element of the force release mechanism of the embodiment shown in Figure 5.

Figure 8 is a perspective view of a modification of one of the parts.

The invention comprises a driving member and a driven member, the members being in pivotable or rotatable engagement at one point and connected through a releasable coupling at another point. The driven member is connectable to torque applying tools which may have different lengths of lever arms. The release force of the coupling is adjustable in accordance with two factors; the value of torque to be applied and the length of the lever arm. An indicator is provided which reads directly in terms of applied torque regardless of the nature or length of the tool.

The force release mechanism comprises two force transmitting elements one of which has a variable slope surface and the other of which has an engaging portion. The elements are relatively movable for the selection of the point of engagement at the desired slope. One element is yieldably urged by an elastic force or spring into engagement with the other. The release force of the mechanism is independent of spring rate and release occurs instantaneously.

Referring now to the drawings the various illustrative embodiments of the invention will be described in detail. Throughout the drawings like parts are designated by like reference numerals.

Figure 1 shows a torque applying tool **10** of a conventional type fitted with the inventive attachment through an adaptor **20**. The tool **10** comprises a drive head **11** provided with a drive square **12** for engaging the socket of a work engaging fitting (not shown) of any suitable kind. Connected with the drive head **11** is a lever arm **13** which may suitably be circular in cross section and of any appropriate length. The end portion of the lever

arm 13 which would normally be the handle portion extends into an axial bore in the adaptor 20. The adaptor bore is of such size as to accommodate the handle of the tool being used and the two members are preferably detachably secured together by any suitable means such as one or more set screws. As will appear more fully hereinafter the lever arm 13 and the adaptor 20 may, for certain applications of the invention, be made as a single integral part.

In the embodiment of Figure 1 the adaptor 20 is secured to a driven member 30 which in turn is connected to a driving member 50. The driving member includes an outer sleeve 51 preferably cylindrical and of suitable length to accommodate the hand of an operator. The outer surface of driving member 50 constitutes a grip portion adapted to receive a manually exerted force. The sleeve is provided with a flat or any other desired surface 52 for bearing scale divisions which may be calibrated in units of torque such as foot-pounds or inch-ounces. A pointer or index mark 80 is mounted on a rotatable shaft 60 for movement over the scale to select the desired value of torque. The driving member 50 also includes an end cap 70 secured to the sleeve by screw thread engagement.

The driving member 50 encases the driven member 30 and is in pivotal engagement therewith through the pivot pin 53 adjacent one end of the driving member. The driving member also houses a releasable coupling, to be described subsequently, which is interposed between the driving and driven members adjacent the other end of the driving member.

Obviously, in operation of this assembly, a manually exerted force on the driving member is transmitted through the pivotal engagement and releasable coupling to the driven member. In turn this force is transmitted from the driven member through the adaptor sleeve and wrench lever arm to the driving head and thence to the workpiece.

Referring now to Figure 2, there is shown a schematic line diagram to aid in explaining the force system in the illustrative embodiment of Figure 1 and the embodiments to be described subsequently. The parts corresponding to those of Figure 1 are designated by the same reference numerals.

A manual force F is applied to driving member 50 by the hand of the operator and is shown as a concentrated force. The assumption of a concentrated force is made to simplify the explanation although it will be well understood that the operator's hand applies a distributed force and the center of pressure may vary somewhat depending upon the configuration of the grip portion and the manner of gripping.

The torque tool has a lever arm length l which for a given wrench is fixed but varies among different wrenches. From the point of connection between the lever arm and adaptor, the force F is displaced a distance b. At the pivotal connection between the driving and driven member a portion of the force F is transmitted to the driven element and is represented as a reaction force R. The releasable coupling is represented schematically by two elements, one element having a surface of variable slope 55 and an engaging element 56. A portion of the force F is transmitted to the driven member through the releasable coupling and is represented as the reaction force R'. The point of force F is displaced a distance d_1 from the force R and a distance d_2 from the force R'.

The well known expression for torque which yields the value of torque applied to the workpiece is:

$$T=FL \tag{1}$$

where F is the force applied through a lever arm having an effective length L. By inspection it is seen that L is the sum of l and b and the general expression above becomes:

$$T=F(l+b) \tag{2}$$

The value of F can be expressed in terms of the reaction forces R and R' as follows:

$$F=\left(\frac{d_1+d_2}{d_1}\right)R' \tag{3}$$

Substitution of Equation 3 into Equation 2 yields:

$$T=\left(\frac{d_1+d_2}{d_1}\right)(l+b)R' \tag{4}$$

Equation 4 shows that the torque applied is a direct function of the lever arm length and the reaction force R' on the releasable coupling. Thus, the applied torque can be controlled by controlling the value of R'. Rearranging Equation 4;

$$R'=\frac{T}{\left(\frac{d_1+d_2}{d_1}\right)(l+b)} \tag{5}$$

shows that the value of R' must be set in accordance with the desired value of torque T to be applied and the length of the effective lever arm $l+b$. It thus becomes apparent that a desired value of torque may be applied with a wrench lever arm of any length if the force R' is predetermined in accordance with two factors, lever arm length and desired torque. This is accomplished by the provision of a coupling which will release at the predetermined value to interrupt the applied torque. Therefore, the release force of the coupling must be set in accordance with the two factors mentioned above.

The inventive coupling admirably suited to this requirement is disclosed in Figures 4, 5 and 7. The considerations in the operation of this coupling will be explained with reference to Figure 3. Consider the spherical element 55 acted upon by the force system shown. Force R' represents the reaction force of the support for the ball 55 and the perpendicular force S represents a force applied by a yieldable element such as a spring. The force W is applied through a force transmitting element 56. When the force W has a component which just slightly exceeds and is opposite to force S, the spring element will yield permitting minute displacement of the ball 55. This relation obtains when

$$W\cos\alpha=S \tag{6}$$

At this condition, the value of R' is:

$$R'=S\tan\alpha \tag{7}$$

From these considerations it now becomes apparent from Equations 5 and 7 that the torque transmitted to the workpiece is:

$$T=\left(\frac{d_1+d_2}{d_1}\right)(l+b)S\tan\alpha \tag{8}$$

For any given tool the values of d_1, d_2, l and b are constant. The first two factors of Equation 8 may be combined into a single constant value k. Equation 8 becomes:

$$T=kS\tan\alpha \tag{9}$$

Therefore, if one of the two factors S and tan α be set in accordance with the value of torque desired the other may be set in accordance with effective lever arm length.

This permits a single indicator scale to be calibrated in units of torque and the indicator will read directly the value of torque applied regardless of lever length. This follows because the variable lever length is accounted for by the setting of the force release mechanism itself.

The performance to be expected from an exemplary embodiment of the inventive device is indicated by the following tabular presentation. Note that the spring force S is constant for a given value of lever arm length

l. This data is based upon the following parameters: $d_1=d_2$ and $b=3$ inches.

Torque, foot-pounds	Angle α degrees	Spring Force, pounds		
		l=9 in.	l=12 in.	l=18 in.
5	14.1	10.0	8.0	6.7
10	26.5	10.0	8.0	6.7
20	45.0	10.0	8.0	6.7
30	56.3	10.0	8.0	6.7
40	63.5	10.0	8.0	6.7
50	68.2	10.0	8.0	6.7

Consider again the spherical element acted upon by the forces shown in Figure 3. The surface of the element in the plane of the force W may be characterized as having a variable slope as distinguished from a constant slope. For the spherical surface, the slope is equal to the tangent of the angle α and increases from zero value when α is 90 degrees to an infinite value when α is zero degrees. The slope of the surface of the element at the point of application of force W increases continuously as the point of application moves downwardly as shown in Figure 3. It will be appreciated that many surface configurations other than spherical have a variable slope and that the spherical element is given merely as an example.

With the application of force W at a point or in a limited area on the surface of the element **55**, the minute displacement of the element **55** permitted by yielding of the spring which applies force S causes the point of application of force W to move downwardly a small amount. At this new position the slope of the surface is greater and the component of force W which is opposite force S increases. This causes further yielding of the spring without any increase in the force W. Thus, the force F continues to move to a point of greater slope and the action is cumulative resulting in the instantaneous snap action of displacing the element **55** against the yielding spring until the force W no longer has a component directed oppositely to reaction force R'. Instantaneous release of the coupling is thus realized.

It is especially noteworthy that the release force of the coupling is independent of the spring rate. The displacement of the element **55** occurs at the instant the force W has a component equal and opposite to the spring force S. This spring force S may be applied by a spring having any rate or relation between force and displacement and it is only the initial value of spring force, not the spring rate, that determines at what value of force W the coupling will release. This is subject to one limitation in that the rate of change of spring force S with respect to displacement of element **55** must not exceed the rate of change of force due to the slope of the surface with respect to the displacement of element **55**. This condition is readily satisfied in practice.

The manner in which the foregoing principles are applied in the actual embodiments of the invention is set forth in Figures 4, 5, 6 and 7.

Referring to Figure 4 the adaptor **20'** which supports the driven member **33** is suitably a cylindrical sleeve for receiving the lever arm of a tool at one end. The lever arm is secured in place by a set screw **21**. At its other end, the adaptor has a reduced portion **31** and a threaded shank **32**. The threaded shank engages driven member **33** which is preferably cylindrical and axially aligned with the adaptor. Driven member **33** is provided with an annular shoulder **34**.

Coaxial with the driven member **33** is driving member **50** comprising a preferably cylindrical sleeve **51'** provided with an inwardly directed annular flange **52** providing pivotal engagement of sleeve **51'** with shoulder **34**. Adjacent the other end of the driving member, the sleeve **51'** is provided with a threaded portion **53** which engages the threaded sleeve portion of cylindrical end cap **70'**. The end of the sleeve **51'** abuts a detent element or insert **46** which is seated against the end wall of the cap **70'** to provide a positive stop which assures that the sleeve and cap have the same relative position each time the device is assembled.

The shoulder **34** together with the engaging portion of sleeve **51'** constitute a pivotal connection between the driving and driven members. The flange **52** limits the axial motion of the sleeve **51'** in one direction by engagement with the shoulder **34**. It is noted that pivotal motion of sleeve **51'** with respect to driven member **33** may occur in any plane since the members are cylindrical.

Interposed between the driving member **50** and driven member **33** to restrain pivotal motion until a predetermined force is applied is a releasable or yieldable coupling. The coupling comprises a detent element or insert **46** of any suitable cross-sectional configuration such as circular or rectangular. The insert **46** is supported by cap **70'** in a recess having a wall **72** with a fit sufficiently close to prevent relative movement of the parts yet permitting the insert to be readily removed.

The insert **46** constitutes a force transmitting element and defines on one of its axial faces a circular recess of one diameter having a peripheral edge **47**. On the opposite face is a recess of a different diameter having a peripheral edge **49**. The recesses are axially aligned with the center line of the driven member **33**. Note that the circular recess of larger diameter has its peripheral edge extending to the face of the insert, whereas the smaller recess having edge **47** is counterbored a certain amount leaving annular shoulder **48**. The reason for this construction will appear hereinafter.

Another force transmitting element having a variable slope surface is shown as a spherical member or ball **55**. The ball **55** is supported in an axial bore **36** and is yieldingly urged into the recess in the insert **46** by a resilient member shown as a coil spring **37**. The spring is seated against plunger **38** which is suitably limited in its axial motion by a shoulder on the wall of bore **36**. A set screw **39** engages one end of piston **38** and is accessible from the shouldered end of driven member **33**, with the adaptor removed, to adjust the force exerted by the spring on the ball.

The ball is urged into engagement with the peripheral edge **47** of the aligned recess and the point of engagement between the peripheral edge and the variable slope surface of the ball depends upon the diameter of the recess. The ball **55** has a reference position within the bore such that its center is slightly inside or in alignment with the axial face of the driven member. Thus, the ball is constrained against motion transversely of the driven member **33**. The counterbore **48** is of such depth that the edge **47** of the recess just engages, but does not displace the ball from its reference position when the end cap **70'** is screwed into seating engagement with sleeve **51'**.

The detent element **46** is removable from the recess **72** in the end cap and may be replaced in another position or orientation in the recess **72**. By rotating the detent element through 180 degrees the larger recess defined by peripheral edge **49** is presented to the surface of ball **55**. The axial length of the detent element including the shoulder **48** is such that the peripheral edge **49** just engages the ball surface without displacing the ball from its reference position. A set of inserts having recesses of different diameters may be provided.

The detent element **46** in the illustrative embodiment is constructed with only two recesses of different diameters and only two faces of detent element are used. It will now be apparent that the detent element may be constructed with different configurations such as a cube **46'**, as shown in Figure 8, with each of its six faces provided with recesses of different diameters. This will provide six different positions or orientations of the detent element for engaging the ball surface at a corresponding number of different positions. It will be understood that the face

with the largest diameter recess 49' need not be counterbored but that the remaining faces with smaller recesses 47' and 47'' should be counterbored to such depth that change of position of the detent element does not move the ball from the reference position. This prevents any disturbance of the spring force set by the position of the adjusting screw.

In operation of the embodiment of the invention of Figure 4 the detent element 46 is first positioned to provide the desired point of engagement between the surface of ball 55 and the peripheral edge of the recess in the detent element. This setting may be made in accordance with torque value desired to be transmitted by the tool. The spring force may then be adjusted by screw 39. This setting may be made in accordance with the effective lever arm length. Thus, first and second means are provided for predetermining the value of force on the driving member 50 at which the coupling will release. Obviously either means may be set in accordance with torque while the other means is then set in accordance with lever arm length. With a manually exerted force applied to the driving member forces will be transmitted to the driven member through the pivotal engagement and through the coupling. When the predetermined value of torque is reached the spring will yield slightly and the engaging portion of the detent element will encounter an ever increasing slope on the variable slope surface of the ball. Instantaneous pivotal motion of the driving member occurs, providing a tactual signal to the operator. The pivotal motion is limited by impact with the driven member providing an audible signal. The relative position of the parts in this condition is shown in Figure 4*a*. The motion is of such limited extent that the ball never completely leaves the recess on the detent element or, stated otherwise, the motion in the vicinity of the coupling engagement is less than the radius of the ball. Once the operator releases the force on the displaced driving member, the camming action of the ball under the influence of the spring resets the driving member for another operation.

The embodiment of the invention illustrated in Figures 5, 6, and 7 is, in many respects, similar to that of Figure 4. The adaptor 20 is provided with an internal shoulder 22 which serves to positively seat the tool lever arm. The driven member 30 is secured to the adaptor by screw thread engagement. Driving member 50 comprises a sleeve 51 pivotally connected at one end to the driven member 30 by aligned pivot pins 53. The pivot pins should have a close fit to prevent play in the pivotal connection. Washers 57 of suitable material such as fibre or plastic maintain the spacing between the members. The pivot pins permit pivotal motion of the driving member 50 about a single transverse axis.

The sleeve 51 is provided with a flat 52 and axially extending slots 54 in diametrically opposite portions of the sleeve wall. The end cap 70 is screw threaded onto sleeve 51.

A releasable coupling is interposed between the driving and driven members adjacent the end cap. The coupling comprises a detent element 63 having a shaft portion 69 rotatably journalled in the slots in the driving member. The shaft axis is perpendicular in direction to the axis of pins 53 and is fixed in position relative to the driven member 30 by locking engagement between the end cap and the end of the slots 54. The shaft at one of its ends carries an indicator arm 80 movable over the scale divisions on the surface of the flat 52. The scale may be suitably calibrated in units of torque.

As seen in Figures 5 and 7 the detent element is provided with a groove 64 which is circular in cross section and which extends circumferentially of the shaft axis. The depth of the groove varies continuously from a minimum value to a maximum value over an angular range of 180 degrees. As shown in Fig. 7, the root 61 of the groove is concentric with the shaft and the peripheral edge or surface 62 of the groove is eccentric with the shaft. This member is machined from standard stock by turning the groove on center and then offsetting the stock on the lathe centers a desired amount to turn the outer surface eccentrically.

The force transmitting element having a variable slope surface and shown as ball 55 is positioned in the axial bore 36 in driven member 30. Spring 37, seated against plunger 38 which is adjustably positioned by screw 39, urges ball 55 into mating engagement with the detent element. Since the root of the groove is concentric with the shaft the ball remains in its reference position for all rotative positions of the shaft. For this reason the spring force is determined only by the position of the adjusting screw.

The operation of this embodiment is similar to that of the embodiment shown in Figure 4 but a continuous variation in the torque is available. The shaft may be positioned in accordance with the value of torque desired to be applied and the spring force is then set in accordance with lever arm length. The force applied to the driving member is transmitted through the pivot pins and the releasable coupling. When the predetermined torque value is applied the coupling releases, producing a tactual and audible signal to the operator. The relative position of the parts in this condition is shown in Figure 5*a*. The driving member is automatically reset by operation of the spring and ball against the peripheral edge of the groove.

In this embodiment care should be taken to attach the adaptor to the tool such that the axis of shaft 60 lies in the plane of rotation of the workpiece to be engaged by the tool. Any lateral thrust applied by the operator will be ineffective to change the torque applied to the workpiece and will be likewise ineffective to release the coupling. Thus, greater accuracy is obtained.

Referring again to Figure 7 it will be seen that if the peripheral edge of the groove is tangent at a point to the root of the groove, the release force will be zero for one position of the detent element. If the maximum depth of the groove is equal to or slightly less than the ball radius, the coupling will be substantially rigid or non-releasable for one position of the detent element. It has been found that the concentric root and eccentric periphery of the groove yields a substantially linear relationship between release force (and therefore applied torque) and the angular displacement of the shaft. The advantages obtained in calibration are obvious.

The detent element and the ball are preferably made of hardened and polished steel or other metal to minimize surface indentation and friction.

This invention has been described with respect to particular embodiments but such embodiments are illustrative only and are not to be construed as limitations. Many modifications will now occur to those skilled in the art. For a definition of the invention, reference is made to the appended claims.

We claim:

1. A torque tool comprising a driving member and driven member interconnected by a releasable coupling, and first and second independently adjustable means on said members for varying the force required to release said coupling each of said means exerting constant influence on the coupling release force throughout adjustment of the other of said means.

2. A torque tool comprising a driving member and a driven member interconnected by a releasable coupling, said coupling including: first and second force transmitting elements being relatively movable in a direction away from each other and resisting means urging the elements toward engagement, the first force transmitting element having a variable slope surface and being supported by one of said members, the second force transmitting element engageable with said first element and being supported by the other of said members whereby

an angularly directed force having a component in said direction is transmitted between the elements, means for adjusting the resisting means to vary the magnitude of resistance, and means for adjusting said elements to select the slope of said surface, independently of said magnitude of resistance, at which said elements are engaged to vary the magnitude of said component and determine the value of torque transmitted between the members at which the relative movement occurs between said elements.

3. A torque applying tool comprising a driven member adapted to be connected to a workpiece, a driving member having one end pivotally engaging said driven member, a yieldable coupling interposed between said members, said coupling including first adjustable means for predetermining, in accordance with the torque desired to be transmitted by said tool, the force at which said coupling will yield, and second adjustable means for predetermining, in accordance with the length of the driven member, the value of force at which said coupling will yield, each of said means exerting constant influence on the coupling yield force throughout adjustment of the other of said means.

4. An attachment for a torque applying tool comprising a driven member defining an axis and adapted to be connected to said tool, a driving member coaxial with said driven member and having one end pivotally engaging said driven member, a force resolving releasable coupling interposed between the other end of said driving member and said driven member, settable force transmitting means on one member for predetermining, in accordance with the value of torque to be transmitted, the relative value of component forces which said coupling will produce, and settable reaction means on said driven member for predetermining, in accordance with a dimension of said tool, the reaction force opposing one of said components at which said coupling will release, the reaction means and the force transmitting means being effectively fixed relative to each other during setting thereof whereby the said component forces and reaction force may be established independently to determine the torque to be transmitted.

5. A torque tool for transmitting a predetermined value of torque comprising a driven member adapted to be connected to a workpiece, a driving member connected adjacent one end with said driven member, releasable coupling means interposed between the other end of said driving member and said driven member including first and second force transmitting elements, the first of said elements being guidably supported by one of said members and presenting a variable slope surface for engagement by the second of said elements, the second of said elements being supported by the other of said members and being relatively movable between first and second positions, said second element having a portion engaging said variable slope surface at a point in said first position and a portion engaging said variable slope surface at a different point in said second position, and yieldable means urging said elements into engagement with the same force in both said first and second positions of the second of said elements.

6. A torque tool comprising a driving member and a driven member interconnected by a releasable coupling including a first force transmitting element having a variable slope surface and supported by one of said members, a second force transmitting element engageable with said first element and supported by the other of said members, yieldable means urging said elements into engagement, one of said elements being movably mounted for positional adjustment to permit the selection of the slope of said surface at which said elements are engaged, and a reaction portion on one of said elements fixed relative to and engaging said yieldable means during said adjustment whereby the force exerted by the yieldable means is independent of said adjustment.

7. In a torque applying tool of the type including a driving member and a driven member interconnected by a yieldable coupling, the improvement in said coupling comprising a first force transmitting element supported by one of said members and having a variable slope surface, a second force transmitting element supported by the other of said members for engagement with a selectable portion of the variable slope surface of said first element, and mutually independent means for predetermining the value of force at which said coupling will yield including elastic force exerting means adjacent one of said elements urging said elements into engagement, and including rotatable adjusting means on the other of said elements for relatively displacing said elements to permit selection of the portion of the variable slope surface at which engagement is effective.

8. A torque applying tool comprising a driven member defining an axis and adapted to be connected to a workpiece, a driving member including means for transmitting a force and being coaxial with said driven member, means rotatably connecting said driven member to said driving member to prevent transverse movement thereof, a releasable coupling interposed between the driving member and driven member, said coupling including a first force transmitting element and a second force transmitting element, the first element having a variable slope surface and being supported by one of said members for translational movement, the second element being supported by the other of said members and engaging said surface, adjustable elastic means urging said elements into engagement, and independently adjustable movable means on the second element for varying the point of engagement of said first and second elements in accordance with the value of torque to be applied.

9. A torque tool comprising a driving member and a driven member interconnected by a releasable coupling, said coupling including first and second force transmitting elements being relatively movable in a direction away from each other and resisting means urging the elements toward engagement, the first element having a surface with a variable slope which increases with displacement in said direction and being supported on one of said members, the second element being supported on the other of said members whereby an angularly directed force having a component in said direction is transmitted between the elements, means for adjusting the resisting means to vary the magnitude of resistance, and means for adjusting the relative position of the elements to vary the magnitude of said component and thereby determine the value of torque at which relative movement is produced between the elements, the rate of change of said component due to said slope exceeding the rate of change of said resistance due to said movement.

10. An attachment for a torque applying tool comprising a driven member defining an axial bore and adapted to be connected to a lever of said tool, an exterior driving member coaxial with and having one end pivotally engaging said driven member, a releasable coupling between the other end of said driving member and said driven member, said coupling including a first element removably supported on said driving member and having a body portion defining plural circular openings of different diameters, said first element being supported with one of said openings in alignment with the said bore, a second element slidably supported in the bore of said driven member and having a variable slope surface engaging the periphery of one of said openings, and a spring in said bore urging said elements together, said body portion being positionable to selectably align said openings with said bore, each said periphery engaging a point of different slope on said second element to maintain the same position thereof for each selected opening whereby the torque transmitted is determined without disturbing the force of said spring.

11. A torque applying tool comprising a driven member adapted to be connected to a workpiece at one end,

a driving member connected to said driven member for pivotal motion about a single transverse axis, a releasable coupling comprising a first force transmitting element slidably supported within a recess in one of said members and having a variable slope surface, a second force transmitting element supported on the other of said members in opposed relation to said surface of said first element, resilient means in said recess urging said elements into engagement, said second element including a rotatable shaft portion extending at a right angle to said single transverse axis and having a shouldered portion of varying radius engaging said surface, whereby the release force of said coupling is a function of the rotative position of said shaft.

12. A coupling for interconnecting a driving member and a driven member providing an adjustable coupling release force comprising a first element having a shaft portion journalled in one of said members for rotation about the shaft axis and a detent portion defining a groove extending circumferentially of said shaft portion, said groove being circular in cross section, the root of said groove being concentric with said shaft axis and the peripheral edge of said groove being eccentric with said shaft axis, a second element slidably supported by the other of said members for motion toward and away from said first element and having a hemispherical surface in mating alignment with said groove, a spring urging said elements into engagement whereby the second element is at a fixed distance from said shaft axis for all rotative positions of said shaft and the release force of said coupling for all of said rotative positions is independent of the spring rate.

13. A coupling as defined in claim 12 wherein the peripheral edge of said groove is tangent at a single point to the root of said groove and the maximum depth of said groove is equal to the radius of curvature of said hemispherical surface whereby said coupling will release at substantially zero force value in one position and is effectively non-releasable in another position.

14. An attachment for a torque applying tool comprising a driven member adapted to be connected at one end to a lever of said tool, said member defining an axially extending recess at the other end, a driving member adapted to receive a manually exerted force pivotally connected adjacent one of its ends to said driven member, a releasable coupling interposed between the other end of said driven member and said driving member including: a ball slidably supported in said recess, a detent part having a shaft rotatably journalled in said driving member, said detent part defining a groove circular in cross section and extending circumferentially of said shaft and having a depth varying with circumferential position, a spring in said recess urging said ball into engagement with the wall of said groove, means for adjusting the force exerted by said spring, and means for rotatably positioning said shaft.

15. A torque applying tool comprising a driven member adapted to be connected to a workpiece at one end, said driven member defining an axially extending recess at the other end, an exterior driving member connected to said driven member for pivotal motion about a single transverse axis, a releasable coupling interposed between the other end of said driven member and said driving member including; a first spherical force transmitting element slidably supported in said recess by said driven member, a second force transmitting element having a shaft rotatably journalled in said driving member for rotation about an axis perpendicular to said single axis, said second element defining a groove circular in cross section and extending circumferentially of said shaft, a spring in said recess urging said first element into said groove, the root of said groove being coaxial with said shaft and the peripheral edge of said groove being eccentric of said shaft, whereby the position of said first element and the deflection of said spring is independent of the rotative position of said shaft, means for adjusting the force of said spring in accordance with the effective lever arm of said tool, and means for rotatively positioning said shaft in accordance with the torque desired to be applied by said tool.

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