

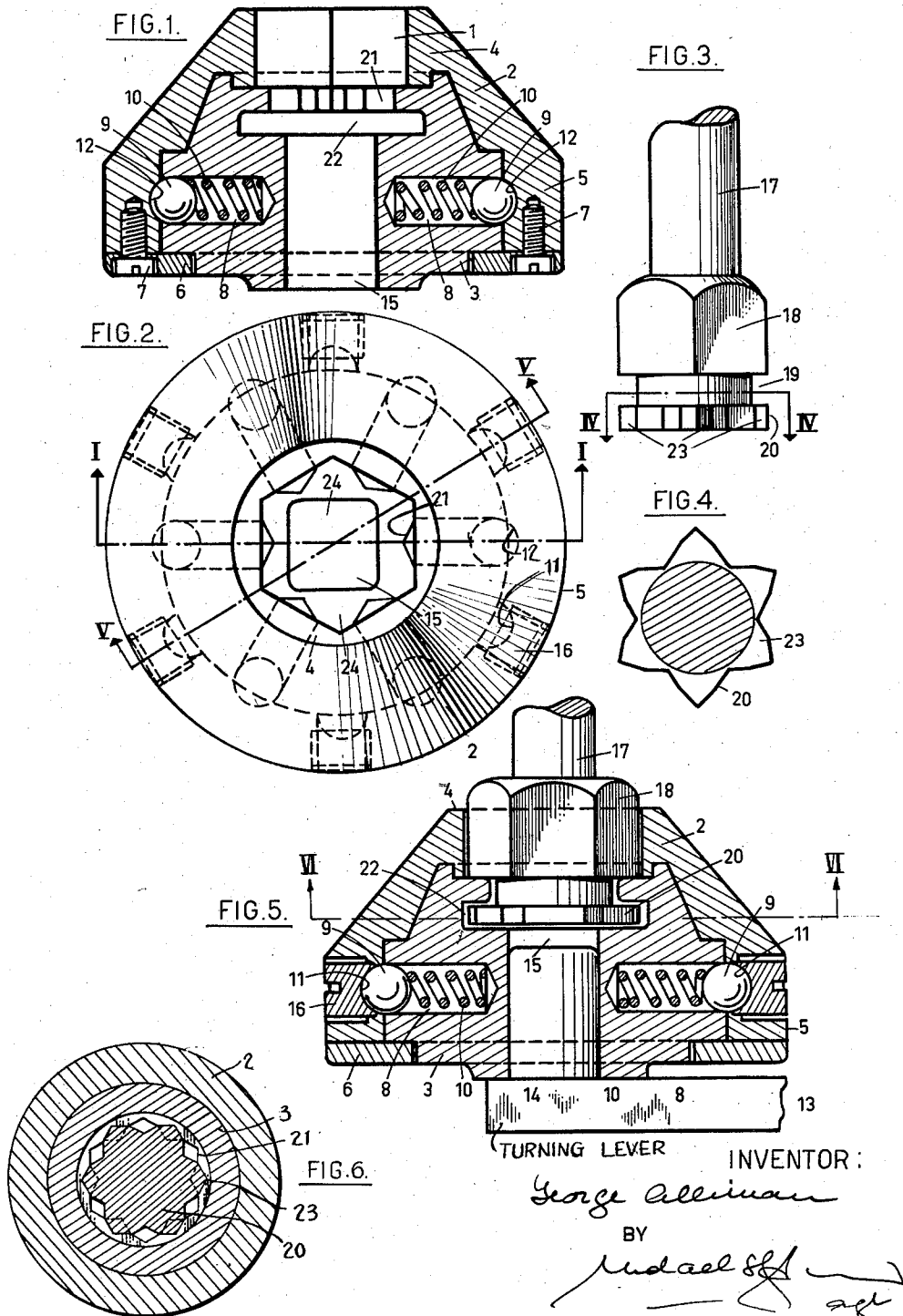
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PREDETERMINED TORQUE RELEASE WRENCH

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PREDETERMINED TORQUE RELEASE WRENCH

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This invention relates to a socket wrench for engaging a screw head, and more particularly to the kind of wrench whereby a torque not in excess of a predetermined value may be applied to the screw head or the like.

When screws are being tightened the degree of torque exerted on the screw head depends to a large degree on the sense of feel of the operator. It is true that the length of the spanners or the lever arms of the wrenches to be used for this purpose can be given dimensions such that it is possible to provide a certain degree of security against the screws in question being over-tightened, so that the material from which the screw is made will not be over-stressed at the threaded portion. On the other hand, however, it is of great importance in many cases that the screws are actually tightened with a specified maximum torque so that they are equal to the demands placed on them. This is the case, for example, with regard to anchoring rods for fixing plates used to support roofs and walls in mines, tunnel construction or quarries or for general anchoring purposes, such as form the subject, for example of Swiss specification No. 292,333.

For such purposes this invention provides a predetermined torque release wrench constructed to engage a specially shaped bolt head or the like in such a manner that the socket of the wrench will first slip over the bolt head to a fitting-on position, and then by rotation of the wrench handle about the bolt arm to a predetermined torque position will enter into bayonet connection with the specially constructed head of the bolt.

This bayonet connection will remain closed and thereby lock the bolt head and the wrench axially to each other, until excess torque applied to the wrench will open the bayonet connection permitting the wrench to be detached leaving the bolt tightened to the extent desired corresponding to the predetermined torque value at which the bayonet connection opened.

According to the invention such a wrench engages the polygonal head of a screw bolt which is formed with one half of the bayonet connection. This wrench comprises an outer annular wrench member formed at one end with a polygonal opening mating with and adapted to receive the polygonal head of the screw, and an inner wrench member turnable within the outer wrench member coaxial therewith and formed with the complementary half of the bayonet connection. The inner wrench member is turnable within the outer wrench member from an unlocked angular position where the bayonet connection is unlocked so that the bolt head may enter the receiving opening in the outer wrench member, to a locked angular position where the bayonet connection is in locked position preventing removal of the wrench from the screw, and from this locked angular position again on to an unlocked angular position where the bayonet connection is unlocked permitting the wrench to be detached from the screw. Interposed between the inner and the outer wrench members are yieldable resilient torque responsive coupling means such as a ball de-

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tent type of coupling engaging both these members in such a manner as to prevent the inner wrench member from being turned within the outer wrench member from the locked to the unlocked angular position except when a torque of predetermined magnitude applied to the inner wrench member has been reached. With the resiliently yieldable coupling means functioning in this manner the wrench cannot be separated from the head of the screw until the required predetermined tightening force has been applied thereto. This arrangement ensures that once the wrench has been properly positioned on the screw head and the operator has begun to turn the wrench to tighten the screw, the screw must then be positively tightened to the prescribed extent before it is possible for the wrench to be removed from the screw head again.

The accompanying drawings illustrate one embodiment of the predetermined torque release socket wrench provided by the invention and also show a screw head with a suitable bayonet fitting. In the drawings:

Figure 1 is a longitudinal section on the line I—I of Figure 2, which is a top plan view of the predetermined torque release wrench with the driving member disposed in the fitting-on position;

Figure 3 is an elevation showing the head portion of a screw or bolt shaped for bayonet connection with the wrench;

Figure 4 is a cross-section on the line IV—IV of Figure 3;

Figure 5 is a longitudinal section on the line V—V of Figure 2, with the predetermined torque release socket wrench fitted on the screw head shown in Figure 3 and with the driving member of the wrench in the driving position;

Figure 6 is a cross-sectional view taken on line VI—VI of Figure 5, showing the bayonet connection locked between the screw head and the wrench.

As will be seen from Figures 1, 2 and 5, the wrench comprises a hexagonal opening 1 in an outer socket member 2, and also an inner driving member 3 coaxial with the outer socket member and rotatable about the axis of the opening and coupled to the outer socket member 2 by an interposed resiliently yieldable coupling means. The outer socket member 2 forms a casing embracing the driving member 3, and has a base end portion 4 defining the central hexagonal opening 1. The socket member 2 also comprises a cylindrical opposite end portion 5 and an intermediate frusto-conical portion merging with the base end portion 4.

The driving member 3 is secured against axial displacement in the outer socket member 2 by a retainer ring 6 which is mounted on the free end of the cylindrical portion 5 of the socket wall and is fixed to the portion 5 by means of screws 7.

The driving member 3 has six radial bores 8 open at the outer end and arranged with uniform angular spacing. A steel ball 9 is displaceably guided in each bore 8 under the influence of a spring 10 urging it in the outward direction. Twelve seats or recesses for receiving the balls 9 are formed on the inside of the wall section 5 and are also uniformly spaced, these seats comprising six relatively deep seats or recesses 11 (Figure 5) and six seats or recesses 12 (Figure 1) of shallower depth, these deeper and shallower seats being arranged alternately along the periphery of the wall portion 5. The radial planes containing the axes of the ball seats 11 extend in line with respective diagonals of the hexagonal opening 1. The depth of each of the ball seats 11 is such that the balls 9 are seated in these seats when the driving member 3 is in the driving position or predetermined torque position as shown in Figure 5 and are just sufficient to allow the balls to transmit the prescribed maxi-

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imum tightening moment to the screw or bolt from the driving member 3 to the socket member 2 before the force of the springs 10 is overcome and the balls are forced out of their seats 11. The driving member 3 is rotated by means of a turning lever or hand lever 13 (Figure 5), which has a square pin 14 inserted for this purpose into a central square hole 15 of the driving member 3 for rotating the same.

The depth of the shallower seats 12, on the other hand, is such that the balls 9 are seated in them when the driving member 3 is in the fitting-on position shown in Figures 1 and 2, and that the balls are only able to maintain this position but are not able to transmit the torque from the driving member 3 to the socket member 2 which is needed for tightening the screw or bolt.

The shallow seats 12 are milled directly into the wall section 5, while the deeper seats 11, on the other hand, are each formed in the end of a screw 16, as will be seen more clearly from Figure 5, each of the said screws 16 being screwed from outside into a radial threaded bore of the wall section 5.

As shown by Figures 3 to 5, the free end of the head of a screw or bolt 17 is formed with a profiled disc 20 which is spaced from the main head portion 18 by an annular groove 19. It will be seen from Figures 1 and 5 that the driving member 3 has a recess adjoining the opening 1 of the socket member 2, the said recess forming a collar 21 which has an axial length less than the width of the annular groove 19 and is complementary in shape to, and able to slide over, the profiled disc 20. Adjacent to the collar 21 there is formed in the socket member 2 an enlarged recess portion or annular groove 22 of an axial dimension exceeding the thickness of the profiled disc 20. The hexagonal opening 1 is so formed as to receive the hexagonal portion 18 of the head of the screw or bolt 17. Furthermore, as will be seen from Figure 4, the profiled disc 20 is provided with six radial projections 23 the free ends of which substantially coincide with the corresponding corner portions of the hexagonal portion 18 of the screw head. Consequently, when the driving member 3 is in the fitting-on position shown in Figures 1 and 2, the predetermined torque release wrench can easily be fitted on to the hexagonal portion or head 18 of the screw 17 without any obstruction; in the driving position shown in Figure 5, however, the collar 21 of the driving member 3 projects into the annular groove 19 of the screw head and analogously the profiled disc 20 of the head projects into the enlarged recess portion 22 of the driving member 3. The hexagonal portion 18 of the screw head is then non-rotatably positioned in the opening 1 of the socket member 2.

Therefore, with the driving member 3 in the fitting-on position shown in Figures 1 and 2, the radial projections 23 of the screw head disc 20 can pass through corresponding indentations 24 in the collar 21 of the driving member 3, to be disposed in the enlarged recess portion 22 completely clear these indentations 24 as in the position shown in Figure 5. If a torque for tightening the screw 17 is applied to the driving member 3 by means of the hand lever 13 after the lever has been applied, the driving member 3 initially is rotated freely through a small angle relative to the socket member 2 owing to the resistance of the screw 17 and because the balls 9 engaging in the shallower seats 12 are not able to transmit to the socket member 2 any torque sufficient for rotating the screw 17. Consequently, with such initial rotation of the driving member 3 the indentations 24 in the collar 21 thereof move to a position situated above the projections 23 of the disc 20 of the screw head which has remained stationary, whereby a bayonet connection is formed between the profiled disc 20 of the screw and the collar 21 of the driving member 3 for preventing withdrawal of the wrench. The free turning movement of the driving member 3 in relation to the socket member 2 and the screw head can continue until the balls 9 have

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snapped into the deeper seats 11. In this position, the balls 9 transmit the torque to be applied to the screw bolt 17 for tightening the latter, so that the screw or bolt can be tightened with the bayonet connection closed.

The tightening operation is completed as soon as the torque transmitted to the screw head has reached the prescribed or predetermined maximum. When this is reached, the balls 9 are forced out of their seats 11 by continued torque application. Thereupon, the driving member 3 can rotate freely in relation to the socket member 2 and the screw head until the balls 9 again engage in respective shallower seats 12. In this position the bayonet connection is open again, since the driving member 3 again has a position relative to the socket member 2 similar to the fitting on position which is shown in Figures 1 and 2, i.e. to the starting position. Owing to the symmetry and the equal spacing of the bores 8 and of the seats 11 and 12, a fitting on position and a driving position of the driving member 3 relative to the socket member 2 is always reached alternately after each $\frac{1}{12}$ of a rotation between opening and closing of the bayonet connection.

Instead of using six driving positions and as many fitting on positions, it is also possible to use a smaller or larger number thereof. It is sufficient that the driving member cooperates with the free end of the screw head by means of at least one radial indentation in one of the parts cooperating with a mating projection of the other part, so that the driving member 3 can be moved relative to the socket member 2 into at least one fitting on position and at least one driving position between opening and closing of the bayonet connection. Thus it is only in the fitting on position that the bayonet connection is released and it is only in the driving position that the driving member and the socket member are connected with a coupling force sufficient to effect the tightening of the screw.

Where the screw is shaped for bayonet engagement and intended for the use of a predetermined torque release wrench of the kind herein described, a marking means may be embodied in the wrench whereby a suitable mark is automatically made on the screw head indicating that the screw has been tightened to the extent desired by the use of such a wrench. In this way it is possible to avoid the danger that the screw head although shaped for bayonet engagement, might be tightened by ordinary wrenches or tools whereby the extent of tightening is not predeterminedly controllable. But with the marking means built into the wrench arrangement may be such that a circular track or arcuate track or mark is produced upon the end face of the screw head by the angular movement of the inner wrench member within the outer wrench member between unlocked and locked positions. Therefore, after the work of tightening the screws has been done by the use of such a wrench, a checker need only check the end faces of the screw heads to see whether they show the arcuate or circular track or mark produced by the marking means.

What I claim is:

1. A wrench for tightening a screw having a polygonal head at the end of its shank and having one half of a bayonet connection means at the end of said screw head distant from said shank, said wrench comprising, in combination, an outer annular wrench member formed at one end with a polygonal opening mating with and adapted to receive the polygonal head of the screw and an inner wrench member turnable within said outer wrench member and having next to said opening of said outer wrench member the other half of the bayonet connection means, said inner wrench member being turnable with respect to the axis of said outer wrench member from an unlocked angular position with respect to said outer wrench member where the bayonet connection means is in an unlocked position permitting the screw head to be received in said opening of said outer wrench member, to a locked angular position with respect to said outer wrench member

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where the bayonet connection means is in an unlocked position permitting the screw head to be received in said opening of said outer wrench member, to a locked angular position with respect to said outer wrench member where the bayonet connection means is in a locked position preventing removal of the wrench from the screw, and from the locked angular position again to an unlocked angular position where the bayonet means is again in an unlocked position permitting the screw and wrench to be separated from each other; and yieldable resilient means cooperating with said inner and outer wrench members for preventing said inner wrench member from being again turned to said unlocked angular position until a torque of predetermined magnitude has been applied to said inner wrench member, so that the wrench cannot be removed until a given tightening force has been applied to the screw.

2. In a wrench for tightening a screw having a polygonal head at the end of its shank, an outer end portion spaced from said head on the side thereof distant from said shank and having a plurality of outwardly directed radial projections distributed about the axis of the screw, the latter being formed with an annular groove between said end portion and said head thereof, said wrench comprising, in combination, an annular outer wrench member formed at one end with a polygonal opening mating with and adapted to receive the polygonal head of the screw and an inner wrench member turnable within said outer wrench member, said inner wrench member having next to said opening of said outer wrench member an annular portion provided with a plurality of inwardly directed radial projections equal to the number of screw projections and distributed about the axis of said opening, said inner wrench member having with respect to said outer wrench member a first angular position where the projections of said inner wrench member are adapted to pass axially between the projections of said end portion of said screw during said movement of the head of the latter into said opening of said outer wrench member so that said projections of said inner wrench member become located in the groove of said screw, said inner wrench member being formed next to said annular portion thereof at the side of said annular portion opposite from said opening of said outer wrench member with an annular groove which receives the projections of said end portion of said screw member, so that when said inner wrench member is thereafter turned with respect to said outer wrench member through an angle less than the angular distance between said projections of the end portion of the screw, the inner wrench member and screw cooperate with each other to provide a bayonet connection between the wrench and the screw; and yieldable resilient means cooperating with said inner and outer wrench members to prevent said inner wrench member from being turned with respect to said outer wrench member to a second position where the projections of said inner wrench member are again aligned with the spaces between the projections at the end portion of the screw until a torque of predetermined magnitude is applied to said inner wrench member, whereby a predetermined tightening force must be applied to the screw before the wrench can be removed therefrom.

3. A wrench for tightening a screw having a polygonal head at the end of its shank and having one half of a bayonet connection means at the end of said screw head distant from said shank, said wrench comprising, in combination, an outer annular wrench member formed at one end with a polygonal opening mating with and adapted to receive the polygonal head of the screw and an inner wrench member turnable within said outer wrench member and having next to said opening of said outer wrench member the other half of the bayonet connection means, said inner wrench member being turnable with respect to the axis of said outer wrench member from an unlocked angular position with respect to said outer wrench mem-

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ber where the bayonet connection means is in an unlocked position permitting the screw head to be received in said opening of said outer wrench member, to a locked angular position with respect to said outer wrench member where the bayonet connection means is in a locked position preventing removal of the wrench from the screw, and from the locked angular position again to an unlocked position where the bayonet means is again in an unlocked position permitting the screw and wrench to be separated from each other; yieldable resilient means cooperating with said inner and outer wrench members for preventing said inner wrench member from being again turned to said unlocked angular position until a torque of predetermined magnitude has been applied to said inner wrench member, so that the wrench cannot be removed until a given tightening force has been applied to the screw; and adjusting means operatively cooperating with said yieldable means to determine the magnitude of the torque required to turn said inner wrench member from said locked position with respect to said outer wrench member.

4. A wrench for tightening a screw having a polygonal head at the end of its shank and having one half of a bayonet connection means at the end of said screw head distant from said shank, said wrench comprising, in combination, an outer annular wrench member formed at one end with a polygonal opening mating with and adapted to receive the polygonal head of the screw and an inner wrench member turnable within said outer wrench member and having next to said opening of said outer wrench member the other half of the bayonet connection means, said inner wrench member being turnable with respect to the axis of said outer wrench member from an unlocked angular position with respect to said outer wrench member where the bayonet connection means is in an unlocked position permitting the screw head to be received in said opening of said outer wrench member, to a locked angular position with respect to said outer wrench member where the bayonet connection means is in a locked position preventing removal of the wrench from the screw, and from the locked angular position again to an unlocked angular position where the bayonet means is again in an unlocked position permitting the screw and wrench to be separated from each other, said outer wrench member having an inner annular surface directed toward an outer annular surface of said inner wrench member; a plurality of spring pressed ball members carried by one of said wrench members and projecting beyond said surface thereof, the other of said wrench members being formed in said surface thereof with at least a pair of recesses angularly spaced about the common axis of said wrench members, one of said recesses being deeper than the other and said spring pressed ball member being located in said deeper recess when said inner wrench member is in said locked angular position thereof, a greater force being required to angularly displace said spring pressed ball member and deeper recess with respect to each other than to angularly displace said spring pressed ball member and the other of said recesses, so that said inner wrench member cannot be moved from said locked position thereof until said greater force is applied thereto.

5. A wrench for tightening a screw having a polygonal head at the end of its shank and having one half of a bayonet connection means at the end of said screw head distant from said shank, said wrench comprising, in combination, an outer annular wrench member formed at one end with a polygonal opening mating with and adapted to receive the polygonal head of the screw and an inner wrench member turnable within said outer wrench member and having next to said opening of said outer wrench member the other half of the bayonet connection means, said inner wrench member being turnable with respect to the axis of said outer wrench member from an unlocked angular position with respect to said

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outer wrench member where the bayonet connection means is in an unlocked position permitting the screw head to be received in said opening of said outer wrench member, to a locked angular position with respect to said outer wrench member where the bayonet connection means is in a locked position preventing removal of the wrench from the screw, and from the locked angular position again to an unlocked angular position where the bayonet means is again in an unlocked position permitting the screw and wrench to be separated from each other, said outer wrench member having an inner annular surface directed toward an outer annular surface of said inner wrench member; a plurality of spring pressed ball members carried by one of said wrench members and projecting beyond said surface thereof, the other of said wrench members being formed in said surface thereof with at least a pair of recesses angularly spaced about the common axis of said wrench members, one of said recesses being deeper than the other and said spring pressed ball member being located in said deeper recess when said inner wrench member is in said locked angular position thereof, a greater force being required to angularly displace said spring pressed ball member and deeper

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recess with respect to each other than to angularly displace said spring pressed ball member and the other of said recesses, so that said inner wrench member cannot be moved from said locked position thereof until said greater force is applied thereto; and adjusting means cooperating with said other wrench member to vary the depth of said deeper recess, whereby the force required to move the wrench from said locked position can be adjusted.

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