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**"SETTING DEVICE FOR A THREADED FASTENER"**

The present invention relates to a device for setting a threaded fastener to a prescribed torque and more particularly, but not exclusively, to a device for setting to a prescribed  
5 torque an expansion bolt or nut of a masonry anchor.

One well known form of masonry anchor comprises a sleeve which is expanded into engagement with the wall of a hole drilled into masonry by drawing an expansion element into the sleeve upon tightening of a bolt or nut of the anchor. When an anchor of this type  
10 is used in certain high stress fixing applications it is necessary that the bolt or nut is tightened to a specified torque. Although this can be achieved by using a torque wrench, these are not always readily available on a building site and, furthermore, even if a torque wrench has been used, it cannot be ascertained on subsequent inspection that the fastener has been tightened to the required torque.

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There has been proposed in U.S. patent 4,144,796 a masonry anchor of the type described above, in which the bolt head carries a hexagonal tightening cap which is connected to the head by shear pins which shear at a predetermined torque applied between the cap and the head. The assembly of the cap to the bolt head by means of the shear pins significantly  
20 increases the cost of the masonry anchor and also a different bolt and shear pin combination (and hence a different anchor) needs to be provided for each different required torque setting.

We have determined that with a torque setting arrangement such as may be provided by a shear pin connection as described above and in certain other torque limiting devices  
25 which operate by shearing of a driving connection between a driving wrench and a bolt head or nut, shearing may take place relatively suddenly, without any significant advance warning being given to the operator. In the environment of a building site where certain masonry anchors may require setting to a high torque, the relatively sudden shearing of a driving connection between the wrench and anchor might cause injury to the hands or body from an  
30 uncontrolled follow-through of movement as the resistance to effort is suddenly removed and

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may also put the operator off-balance which may be dangerous if the operator is working from a ladder or from scaffolding.

According to the present invention, there is provided a setting device for setting a  
5 threaded fastener to a predetermined torque, comprising a body having a portion for  
engagement with the threaded fastener, and a driving portion for engagement with a torque-  
applying tool, means defining a first torque-transmitting connection between the portions so  
as to transmit torque from the driving portion to the fastener, said first torque-transmitting  
connection being adapted to break when a predetermined torque is attained, and means  
10 defining a further torque-transmitting connection between the portions, said further torque-  
transmitting connection being adapted to break the driving connection provided thereby at a  
torque less than said prescribed torque after the first torque-transmitting connection has  
broken, said further torque- transmitting connection being such that breakage of the driving  
connection takes place after substantial deformation of the further torque-transmitting  
15 connection which will be detectable by an operator.

Further according to the invention, there is provided a setting device for setting a  
threaded fastener to a predetermined torque, comprising a body having a portion for  
engagement with the threaded fastener, a driving portion for engagement with a torque-  
20 applying tool, and first torque-transmitting means between the portions so as to transmit  
torque from the driving portion to the fastener, said first torque-transmitting means being  
adapted to shear when a predetermined torque is attained, and further torque-transmitting  
means between the portions, said further torque-transmitting means being adapted to break  
the driving connection provided thereby at a torque less than the prescribed torque after the  
25 first torque-transmitting means has sheared, wherein the first torque-transmitting means shears  
relatively rapidly upon application of the required torque without substantial movement  
occurring of the driving portion relative to the engaging portion and the further torque-  
transmitting means then acts to transmit torque between the portions, the further torque-  
transmitting means permitting the driving portion to rotate relative to the engaging portion  
30 against resistance provided by deformation of the further torque-transmitting means until the

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driving connection provided thereby breaks after a progressive deformation which will be sensed by an operator.

Advantageously, the further torque-transmitting means is composed of a non-brittle  
5 plastics or alloy which is capable of substantial plastic deformation before breakage of the further drive transmitting connection.

Advantageously, the body of the device is of integral cast or moulded construction, preferably from a suitable alloy, with the first torque-transmitting means being defined by a  
10 thin-walled zone of the body, preferably a thin-walled annular zone. The engaging portion of the body preferably defines a socket for receiving a bolt head or nut.

Advantageously, the further torque-transmitting means comprises a pin or other coupling mounted on the axis of the body and in driving relationship with the driving portion  
15 and engaging portion of the body.

In one advantageous form, the setting device in accordance with the invention is particularly applicable to the setting of a masonry anchor into a hole drilled into the masonry with the head of an anchor bolt being engaged to the engaging portion of the body of the  
20 setting device. In this form, the pin which constitutes the further torque-transmitting means advantageously also acts as means for transmitting hammer blows directly to the head of the anchor to drive the anchor into the masonry prior to setting. In this configuration the torque transmitting means of the body itself will not be degraded by transmitted hammer blows during installation of the anchor.

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Advantageously, the driving portion is completely removable from the engaging portion after setting has taken place, and indicator means are preferably provided to provide a clear visual indication of setting at the required torque upon removal of the driving portion. Advantageously, the engaging portion is of a configuration to permit application of further  
30 torque directly to the portion after setting, with indication being provided that such further

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torque application has taken place. Such indication may consist of the absence of indicating means which is removed by the application of torque to the portion by a suitable tool and/or the presence of visible markings which may appear on the portion if torque is applied. As an example of the latter, the engaging portion of the body may be coated with a paint  
5 incorporating micro-capsules of another colour which are shattered upon application of torque directed to that portion of the body

According to a further aspect of the invention, there is provided a setting device for setting a threaded fastener to a predetermined torque, comprising a torque-transmitting body  
10 interposed between a tool and the threaded fastener, said body shearing in a predetermined zone at application of the predetermined torque, and coupling means within the body to maintain a secondary torque-transmitting connection after shearing of said zone, said coupling means being subject to substantial plastic deformation after shearing of said zone to provide a cushioning effect which prevents sudden release of the setting device.

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An embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:-

Figure 1 is an axial section of a setting device in accordance with a preferred embodiment of the invention; and

20 Figure 2 is an exploded view of the device shown in Figure 1.

In accordance with the preferred embodiment of the invention, there is provided a torque limiting setting device comprising a main body 2 of one-piece construction and comprising a socket portion 4 for engaging, by fitting over, a bolt head 6 of a masonry  
25 anchor of expansion type as described earlier. Outwardly of the socket portion 4, the body 2 has a driving portion 8 configured for engagement by a torque applying tool. As shown, the outer surface of the driving portion 8 is configured with a so-called double hexagon (12-point) configuration for driving connection with a ring spanner, socket wrench, or electric driving tool; however the configuration of the driving portion 8 can be different from that  
30 shown and other configurations compatible for use with suitable spanners, wrenches, or other

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tools may alternatively be adopted. The driving portion 8 is connected to the socket portion 4 via a part of the body which forms a relatively thin-walled annular zone 10 which shears on application of a predetermined torque in order to break the driving connection when the required torque setting has been reached. The body 2 is produced as a one-piece casting in 5 a suitable alloy which exhibits the strength characteristics necessary for transmission of the required torque and which also has predictable shearing characteristics in its thin-walled annular zone 10 upon application of a predetermined torque. The torque at which shearing occurs is determined by the thickness of the thin-walled annular zone 10 and this can be varied during manufacture by altering the thickness of the annular zone by incorporation of 10 different inserts into the mould so as to permit a range of setting devices to be produced with different torque characteristics at which shearing takes place.

In addition to the torque-transmitting connection provided by the thin-walled annular zone 10 between the driving portion 8 and socket portion 4, the driving portion 8 and socket 15 portion 4 are also interconnected by means of a central pin 12 composed of a non-brittle plastics material with a degree of inherent resilience or, alternatively, an alloy having similar characteristics. However, plastics is the preferred material for the pin 12 and a suitable grade of nylon can be used for this purpose. The driving portion 8 of the body is shaped with an internal socket 14 and the base 4a of the socket portion 4 of the body is formed with a shaped 20 central aperture 16. The shank of the pin 12 is so shaped that the distal end portion 18 of the shank mates with the correspondingly-shaped central aperture 16 in the base 4a of the socket portion 4 and the proximate end portion 20 of the shank is shaped to mate with the socket 14 within the driving portion 8. The cross-sections of the distal and proximate end portions of the shank of the pin 12 and the mating cross-sections of the socket 14 and aperture 16 in the 25 base of the socket portion 4 are such that a torque-transmitting driving connection is established. Although the particular cross-sectional configurations as illustrated will achieve an effective driving connection, it will be apparent that other cross-sectional configurations can achieve the same purpose. The pin 12 terminates at its end in a head 22 which overlies the outer end face 8a of the driving portion 8 and the distal end of the shank projects through 30 the aperture 16 in the base 4a of the socket portion 4 so as to engage the head 6 of the

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masonry anchor engaged within the socket portion 4.

Although a significant function of the pin 12 is to improve the operation of the setting device when the required torque is attained and as will be described subsequently, another  
5 important function of the pin 12 is to transmit hammer blows applied to the head 22 of the pin 12 directly to the masonry anchor as may occur when a masonry anchor with the setting device pre-installed thereon is being initially driven into a hole drilled in masonry prior to setting of the anchor within the hole. The use of the pin 12 as the means for transmitting hammer blows within the setting device avoids the hammer blows being transmitted through  
10 the relatively thin-walled shear zone 10 of the body 2 and which could, in some circumstances, result in damage to the thin-walled zone whereby subsequent shearing could occur at a torque setting lower than the design setting. Although for many applications it is particularly advantageous for the pin 12 to perform both of the described functions, in applications where the anchor is not likely to be hammered into the hole prior to setting it  
15 would, in principle, be feasible for the pin 12 to perform only the single function of improving the torque setting characteristics of the device, although as a matter of practical reality a pin which performs both functions will usually be provided.

As described, the pin 12, and in particular the shank of the pin 12, provides a  
20 secondary torque-transmitting connection between the driving portion 8 and socket portion 4 of the body 2 of the setting device. The pin 12 is designed to shear at a torque less than that required to shear the thin-walled zone 10 of the body 2, the shank of the pin having a shearing zone of reduced diameter defined by an annular groove 26 located immediately outwardly of its distal end portion 18 and also in substantial axial alignment with the thin-  
25 walled zone 10. The diameter of the shearing zone of the pin shank will determine the torque at which the shank shears and that can be controlled by varying the depth of the groove 26 during manufacture of the pin. Although the shearing zone of the pin 12 is designed to shear at a torque less than that of the thin-walled zone 10 of the body, it will be appreciated that until the thin-walled zone 10 of the body has actually sheared and rotational movement takes  
30 place between the driving portion 8 and socket portion 4 of the setting device, the shank of

the pin 12 will not actually be loaded with a torque which is able to engender its shearing.

In operation, when the prescribed torque limit for the body 2 is reached, the annular torque-transmitting zone 10 will shear; due to the nature of the material from which the body 2 is formed, although shearing will take place at an accurately determinable torque, it will occur relatively suddenly. Upon shearing the driving portion 8 will start to rotate relative to the socket portion 4 and to the head 6 of the masonry anchor therein, but that movement will immediately be resisted by the torque loading which is then applied to the shank of the pin 12. The characteristics of the material of the pin 12 are such that it will not suddenly shear under the applied torque, but rather it will firstly undergo some elastic deformation and then plastic deformation and, eventually the plastic deformation will occur over a sufficient angular extent that the shank of the pin 12 will shear in the zone defined by the groove 26. However unlike the action which occurs when the thin-walled annular zone 10 of the body 2 shears, the pin 12 will not suddenly shear. Instead, the operator will experience a distinct "feel" when the pin is under torque and is being deformed prior to shearing so that the operator is able to prepare himself for complete shearing of the pin at which point the driving portion 8 and the part of the pin attached thereto will be fully released from any constraint by the remainder of the device. In other words, after shearing of the main torque-transmitting zone 10 of the body has occurred at the prescribed torque for setting the anchor, the operator will experience a relatively gentle and progressive let-down prior to final detachment of the driving portion. As will be apparent, as the torque at which the pin shears is less than the design torque setting of the body of the device, the presence of the pin and its subsequent action will not increase the setting torque which is applied to the anchor.

Advantageously, the setting device is so constructed that it remains permanently attached to the anchor head 6 after setting so as to permit visual inspection, for example by building inspectors, for verification that setting to the required torque has taken place; the absence of the driving portion 8 will demonstrate that correct setting has taken place, although, preferably a prominent visual indicator is also provided as will be described below. The socket portion of the device may be permanently attached to the anchor head 6 for

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example by means of a suitable adhesive or by swaging the end of the socket portion over the end of the anchor head.

In practice, in situations where the setting device is intended to remain permanently  
5 attached to the head of the anchor to provide an indication of correct setting for inspection purposes, it is also necessary for there to be provision for the anchor to be released and/or reset at a later date although in this event it is necessary that the setting device should exhibit evidence that resetting has taken place. In the present embodiment this is achieved by providing the outer surface of the socket portion 4 with a double hexagonal configuration (a  
10 12-point configuration) whereby subsequent tightening or loosening of the anchor requires the use of a ring spanner or socket placed over the socket portion 4. The body of the socket portion 4 carries at its outer end a ring 30 of a relatively brittle plastics material. The ring 30 is fixed relative to the socket portion 4, for example in the manner described below, and is likewise provided around its outer periphery with a double-hexagonal configuration.  
15 Although the ring 30 does not inhibit the application of a ring spanner or socket to the socket portion, when torque is applied to the socket portion by the ring spanner or socket, the applied torque will cause breakage of the brittle ring; this effect can be achieved either by slightly angularly offsetting the double-hexagonal formation on the ring relative to that on the socket portion, or by making the double-hexagonal configuration on the ring to a closer  
20 tolerance than that on the socket portion. The ring 30 in effect provides an indicator of whether or not the socket portion has been tampered with after setting by application of a ring spanner or socket. For this purpose, the indicator ring 30 is in a prominent colour which contrasts with that of the socket portion 4 of the setting device so that its presence will readily be observable; and, conversely, its absence will also be apparent.

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The ring 30 also is used to facilitate remote observation of the correct setting of the anchor after removal of the driving portion when the correct torque has been attained. For this purpose, the ring 30 is located within the annular groove of the body 2 which defines the thin-walled shear zone 10 so that in the original state of the setting device prior to application  
30 of the torque, the indicator ring 30 will be partially concealed by the driving portion 8 and

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not readily be visible. Preferably, the ring 30 is assembled from two identical parts snap-fitted together and having projections 32 engaged in corresponding recesses 34 in the socket portion 4 to retain the ring 30 to the socket portion 4. When the required torque has been attained and the driving portion 8 has been removed from the socket portion, the ring 30 will  
5 be easily visible for the purposes of inspection from a remote position. Likewise, if the ring 30 is subsequently broken and removed as a result of torque application by a ring spanner or socket to the socket portion of the setting device retained on the head of the anchor, the absence of the indicator ring 30 will also be readily apparent to an observer even on inspection from a remote position. Although the indicator ring 30 provides a ready means  
10 of providing an indication of the correct setting and also an indication of subsequent disturbance of the setting, there are other ways in which this could be achieved as discussed previously.

In the embodiment described above, the pin 12 provides a secondary driving  
15 connection between the driving portion 8 and socket portion 4 and this secondary driving connection is broken by shearing of the pin at the weakened zone provided by the annular groove 26. When the pin 12 shears, the driving portion 8 together with the part of the pin outwardly of the shear zone can be removed. Shearing of the pin 12 occurs as a result of continuing rotation of the driving portion 8, and shearing of the pin 12 does not take place  
20 as a sudden action but, rather, as a progressive action which occurs with the continuing rotation. It has been determined that while the driving portion 8 is being rotated during the shearing of the pin, the progressive shearing of the pin can cause the effective axis of rotation of the driving portion 8 and part of the pin coupled thereto to shift laterally, in other words eccentrically, with respect to the axis of the socket portion 4 and bolt head 6 and in some  
25 circumstances this might result in some damage occurring during this phase to the indicator ring 30.

To avoid the effect just described, in a modified embodiment of the invention instead of shearing the pin 12 in order to break the secondary driving connection between the driving  
30 portion 8 and socket portion 4 as established by the pin 12, the distal end portion 18 of the

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pin progressively deforms under the applied torque after shearing of the primary driving connection between the driving portion 8 and socket portion 4 of the main body 2 so that, in effect, the driving teeth provided by the configuration of the distal end portion 18 are deformed or "stripped" whereby the driving connection with the central aperture 16 in the base 4a of the socket portion 4 is broken and the distal end portion 18 of the pin 12 will then simply rotate within the central aperture 16 without transmitting torque. It will be appreciated that during this action, the driving portion 8 will be constrained by the pin for rotation about the central axis of the device and will not be liable to eccentric rotation as may occur with the preceding embodiment. As the driving teeth provided by the distal end portion 18 of the pin 12 have stripped, the driving portion 8 together with the complete pin 12 can then be removed simply by withdrawing the distal end portion 18 of the pin from the central aperture 16. When breakage of the secondary torque transmitting connection is to be achieved in this manner, the distal end portion 18 of the pin may be shaped differently from that illustrated in Figure 2, for example with a reduced number of driving teeth to that illustrated or in any other way which leads to a reduction in the effective surface area through which torque is transmitted between the distal end portion 18 and central aperture 16 of the socket portion 4 so as to cause greater localised loading which will result in breakage of the driving connection under the effect of the applied torque. In general, the drive-transmitting connection between the distal end portion 18 of the pin and the central aperture 16 of the socket portion 4a can be of any non-circular shape which will deform under the applied torque such as to break the secondary driving connection.

Although the embodiments described are designed in particular for application to a bolt head of an anchor bolt, with appropriate modifications it could be used with an exposed nut of an anchor bolt. It may also be used with other forms of anchor or threaded fastener which require setting to a required torque.

The embodiment has been described by way of example only and modifications are possible in the scope of the invention.

**CLAIMS:-**

1. A setting device for setting a threaded fastener to a predetermined torque, comprising a body having a portion for engagement with the threaded fastener, and a driving portion for engagement with a torque-applying tool, means defining a first torque-transmitting connection between the portions so as to transmit torque from the driving portion to the fastener, said first torque-transmitting connection being adapted to break when a predetermined torque is attained, and means defining a further torque-transmitting connection between the portions, said further torque-transmitting connection being adapted to break the driving connection provided thereby at a torque less than said prescribed torque after the first torque-transmitting connection has broken, said further torque-transmitting connection being such that breakage of the driving connection takes place after substantial deformation of the further torque-transmitting connection which will be detectable by an operator.
2. A setting device for setting a threaded fastener to a predetermined torque, comprising a body having a portion for engagement with the threaded fastener, a driving portion for engagement with a torque-applying tool, and first torque-transmitting means between the portions so as to transmit torque from the driving portion to the fastener, said first torque-transmitting means being adapted to shear when a predetermined torque is attained, and further torque-transmitting means between the portions, said further torque-transmitting means being adapted to break the driving connection provided thereby at a torque less than the prescribed torque after the first torque-transmitting means has sheared, wherein the first torque-transmitting means shears relatively rapidly upon application of the required torque without substantial movement occurring of the driving portion relative to the engaging portion and the further torque-transmitting means then acts to transmit torque between the portions, the further torque-transmitting means permitting the driving portion to rotate relative to the engaging portion against resistance provided by deformation of the further torque-transmitting means until the driving connection provided thereby breaks after a progressive deformation which will be sensed by an operator.



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3. A device according to claim 1 or claim 2, wherein the body of the device is of integral construction, with the first torque-transmitting means being defined by a thin-walled zone of the body.
- 5 4. A device according to claim 3, wherein the thin-walled zone is an annular zone.
5. A device according to any one of claims 1 to 4, wherein the further torque-transmitting means is composed of a non-brittle plastics or alloy which is capable of substantial plastic deformation.
- 10 6. A device according to any one of claims 1 to 5, wherein the further torque-transmitting means comprises a coupling mounted on the axis of the body in driving relationship with the driving portion and engaging portion of the body.
- 15 7. A device according to claim 6, wherein the coupling is adapted to break the driving connection between the driving portion and engaging portion by shearing of the coupling in a predetermined zone of the coupling.
8. A device according to claim 6, wherein the driving connection between the coupling  
20 and the driving portion and engaging portion of the body is provided by zones of non-circular shape on the coupling engaging with correspondingly shaped zones of the driving portion and engaging portion of the body, and wherein breakage of the driving connection occurs as a result of distortion of the shape of one of said non-circular zones of the coupling under the effect of the applied torque whereby continued application of torque to the driving portion  
25 will result in rotation of the driving portion about the axis of the device but without further torque transmission via the coupling to the engaging portion.
9. A device according to claim 8, wherein the said one zone of the coupling is shaped to provide driving teeth which strip or otherwise deform under the application of the applied  
30 torque.



10. A device according to any one of claims 6 to 9, wherein the said coupling forming the further torque-transmitting means comprises a pin.

11. A device according to claim 10 for use in setting a masonry anchor into a hole drilled  
5 into masonry, with the head of an anchor bolt being engageable to the engaging portion of the body of the setting device, wherein said pin has an exposed end to which hammer blows can be applied and an opposite end engageable with the head of the anchor bolt to transmit the hammer blows directly to the head of the anchor bolt without affecting the integrity of the first torque-transmitting means.

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12. A device according to any one of claims 1 to 11, wherein the driving portion is completely removable from the engaging portion after setting to the predetermined torque has taken place.

15 13. A device according to claim 12, further comprising indicator means visible from a remote location to facilitate remote visual verification of removal of the driving portion after setting to the predetermined torque.

14. A device according to claim 13, wherein the indicator means is such that it is at least  
20 partially obscured from view by the driving portion when still attached to the engaging portion of the device.

15. A device according to claim 13, wherein the body of the device comprises an annular groove having opposed walls defined by the engaging portion and driving portion and the  
25 indicator means comprises a ring mounted within the groove with the ring being partially obscured from view by the driving portion when still attached to the engaging portion.

16. A device according to any one of claims 1 to 14, wherein the engaging portion has a configuration to permit application of further torque directly to the engaging portion after  
30 setting, said device further comprising means for providing an indication of the application



of such further torque.

17. A device according to claim 16, wherein the indicator means comprises a ring associated with the engaging portion, the ring being broken upon application of a ring spanner  
5 or socket to the engaging portion to apply torque directly thereto.

18. A device according to any one of claims 13 to 15, wherein the engaging portion is of a configuration to permit application of further torque directly to the engaging portion after setting to the predetermined torque, said indicator means being such as to prevent application  
10 of a torque-applying tool to the engaging portion without removal of the indicator means.

19. A setting device for setting a threaded fastener to a predetermined torque, comprising a torque-transmitting body interposed between a tool and the threaded fastener, said body shearing in a predetermined zone at application of the predetermined torque, and coupling  
15 means within the body to maintain a secondary torque-transmitting connection after shearing of said zone, said coupling means being subject to substantial plastic deformation after shearing of said zone to provide a cushioning effect which prevents sudden release of the setting device.