Title of the Invention: Fastener holding spanner
Abstract Title: Fastener holding spanner

The spanner 10 is for use with fasteners such as polygonally-shaped nuts or threaded studs and bolts having polygonally-shaped heads. The spanner includes a head 18 defining a polygonally-shaped aperture 22 capable of engaging during use in a close fit with a nut or bolt head 102 of a fastener. An arm 16 extends from the head generally perpendicularly to a central axis of the aperture. The arm is capable of engaging with an abutment surface adjacent to the nut or bolt head of the fastener engaged by the spanner head upon rotation of the nut or bolt head under applied torque. The spanner head further defines a through passage 34 penetrating a face of the aperture and being at least partially threaded (34A, Figure 3) over part of its length. In use, a threaded member 48 may be screwed into the passage to contact under pressure a face of the nut or bolt head engaged by the spanner to prevent relative rotation between the spanner and the nut or bolt head. The arm 16 may form a second spanner head, preferably having an aperture 20 of a different size.
FASTENER HOLDING SPANNER

Field of the Invention

The present invention relates to a fastener holding spanner.

Background of the Invention

Fasteners in the form of polygonally-shaped nuts, threaded studs (both continuously-threaded and partially-threaded) and bolts having polygonally-shaped heads are used in many industries for many applications to hold components together. The polygonally-shaped nuts and bolt heads are typically hexagonally shaped, although other polygonal shapes, e.g. square, may be used.

In assembling or disassembling components held together by nuts and studs or bolts, it is usually necessary to restrain one nut or bolt from rotation whilst the other nut or bolt is rotated to tighten or loosen it. One option for restraining a nut or bolt is to provide a complementarily-shaped opening in one component into which the nut or bolt head fits and is held against rotation when torque is applied to the other nut or bolt. Alternatively, a pair of spanners (wrenches) or spanner and socket combination or the like may be used to hold one nut or bolt stationary whilst the other nut has torque applied to it. As will be appreciated, the pair of spanners or the like may each be rotated to apply torque in opposite senses to one another. As is well understood, spanners have complementarily-shaped polygonal apertures or multi-point apertures into which a nut or bolt head may be located.

In applications in which small and relatively small fasteners are used to hold components together, the assembly and disassembly of components to be held or held by the fasteners is relatively simple and the levels of torque applied to the fasteners is limited as it is relatively easy to shear the stud or bolt used or to damage the nut if too much torque is applied or to damage the components being secured together.

However, in applications in which larger fasteners are used, such as in flanged connections in pipelines, flanged closures for pressure vessels etc, the levels of torque required to achieve the necessary joint tightness during assembly may be very high. The disassembly of such joints may require even higher torque to overcome corrosion etc caused by bad weather and chemicals, especially in applications in chemical plants, oilfields and refineries. Such problems may be exacerbated if the bolt or stud was preheated prior to the application of nut(s) thereto to create a compression joint. Additionally, in such applications, to add to the difficulties of assembly or disassembly of such joints, access to one side or other of the joint may be limited.

In many such applications, the assembly or disassembly of such components has been a two-person job: one person using an appropriate torque tool, e.g. a manually-applied spanner but more
usually a fluid-operated (normally hydraulic) torque wrench, and the other a manually-applied spanner to restrain the other nut or bolt head from rotating. However, owing to the levels of the torque applied, it may be beyond the physical ability of the other person to prevent rotation or may be dangerous to do so, especially when access may be limited. In such circumstances, the handle of the spanner is allowed to contact an abutment surface, frequently an adjacent nut or bolt head but not necessarily always so, to prevent rotation of it by the torque applied to the bolt head or other nut, the person merely being present to ensure proper engagement of the spanner with the nut or bolt head until such engagement with the abutment surface occurs.

Although such assembly and disassembly of these types of joints has been performed in this manner for many years, a problem which occurs is that, owing to a slight rotation of the nut or bolt head of the fastener within the polygonally-shaped opening of the manually-applied spanner under the applied torque, the spanner and the nut or bolt head bind together in a significant frictional relationship with one another which is very difficult to break to enable release of the spanner for removal. Frequently, it is necessary to resort to force, eg by hitting the spanner handle with a hammer, to effect release of the spanner.

It has previously been proposed to enable one man to perform such assembly or disassembly and, in some instances, to address the issue of release of the spanner. Examples of such previous proposals may be found in US 1431832, US 2664770, US 4104936 and US 5954466. These proposals provide a spanner having a truncated handle which terminates in a flange-engaging arm extending substantially parallel to the centre axis of spanner aperture. Thus, rotation of the spanner under the torque applied to the other nut or bolt head results in engagement of the arm with the flange of the joint being assembled or disassembled.

It will be appreciated that engagement of the arm with the flange may still result in a frictional binding of the arm with the flange. In US 2664770, such binding may be relieved by disassembling the spanner to remove the arm; in US 4104936, such binding may be relieved by rotation of a cam member forming part of the arm; and in US 5954466, such binding may be relieved by rotation of a threaded member engaging a threaded hole in the arm. In use, the spanner in US 1431832 would still require a force to be exerted on the spanner to relieve the binding.

The spanners described in US 1431832, and US 5954466 also have the disadvantage of not being positively retained relative to the nut or bolt head until rotation engages the arm with the flange, although in some embodiments of US 5954466 the nut may be retained relative to the spanner upon removal by a resilient ring located within the aperture thereof or a resiliently-mounted pin extending through the wall of the aperture thereof. The spanner described in US 4104936 is relatively mechanically complex and will therefore be relatively expensive to manufacture and
may be prone to damage arising from misuse or just the general conditions prevalent in the local environments of oilfields, pipelines or chemical plants.

In an alternative proposal, US 6427588 describes a spanner which engages two adjacent nuts or bolt heads of fasteners, the engagement of one nut or bolt head being through a cam mechanism whereby rotation of the cam is used to release post-operation binding forces. This spanner is also relatively mechanically complex and will therefore be relatively expensive to manufacture and may be prone to damage arising from misuse or just the general conditions prevalent in the local environments of oilfields, pipelines or chemical plants. It is also not clear how the use of this spanner would enable the application of the first fastener during assembly or removal of the last fastener during disassembly.

It is an object of the present invention to provide a fastener holding spanner which is easy to use by one person, is positively retained relative to a nut or bolt head and is mechanically simple.

Summary of the Invention

According to the present invention there is provided a fastener holding spanner comprising a spanner head defining an aperture capable of engaging during use in a close fit with a correspondingly-sized nut or bolt head of a fastener and an arm extending from the spanner head, which arm during use of the spanner being capable of engaging with an abutment surface adjacent to a nut or bolt head of a fastener engaged by the spanner head upon rotation of the nut or bolt head under applied torque, the spanner head further defining a through passage penetrating a face of the aperture and being at least partially threaded over at least a part of its length whereby, in use, a threaded member may be screwed into the passage to contact under pressure a face of a nut or bolt head engaged by the spanner to prevent relative rotation between the spanner and the nut or bolt head.

Preferably, the arm extends from the spanner head generally perpendicularly to a central axis of said aperture.

The aperture may be polygonal in shape. In a preferred embodiment, the polygonally-shaped aperture has an even number of faces, typically four or six faces corresponding to square or hexagon nuts or bolt heads. However, as will be appreciated, the aperture may be provided with say eight or twelve vertices for receiving respectively a square or hexagonal nut or bolt head in which instance the number of faces will be sixteen and twenty-four respectively. In a particularly preferred embodiment, the polygonally-shaped aperture has an even number of faces and the perpendicular bisector of two opposed faces thereof is coincident with or parallel to a longitudinal axis of the arm. Preferably, the through passage penetrates a face of the aperture
other than said two opposed faces through which said bisector passes that is coincident with or parallel to a longitudinal axis of the arm.

Although the through passage may be centrally located relative to the face of the aperture which it penetrates, it preferably is offset from the centre of said face towards one of the vertices formed between said face and one or other of the faces of the aperture adjacent thereto. In a preferred embodiment, a wall defining the through passage is, at said face, tangential to the vertex between said face and an adjacent face.

The longitudinal axis of the through passage may be perpendicular to the face of the aperture which it penetrates. Preferably, however, the longitudinal axis of the through passage is inclined at a slight angle to a perpendicular to the face of the aperture which it penetrates. The inclination may be in a direction towards an adjacent vertex between said face and an adjacent face. In particular, the longitudinal axis of the through passage is inclined at an angle of between greater than 0° and up to 10°, more preferably between 3° and 7° and, in particular, at about 5° to a perpendicular to the face of the aperture which it penetrates. The inclination of said axis enables the threaded member to be about perpendicular to a face of a nut or bolt head engaged by the spanner which it contacts when it is screwed into the through passage.

Preferably, the arm of the spanner comprises a second spanner head integral with and having the same features as the first spanner head. In a preferred embodiment, the through passage of the second spanner head may be located on a side of the spanner opposite to the side of the spanner containing the through passage of the first spanner head. Alternatively, the through passages may be located on the same side of the spanner. The apertures in the two spanner heads may be the same size or, alternatively, in a preferred embodiment the apertures in the two spanner heads may be different sizes.

The threaded member or members used with the spanner to engage with a nut or bolt head may be a bolt but is more preferably a grub (set) screw typically of hardened steel. The end of the member to engage the nut or bolt head may be flat but may be of a rounded shape, i.e. domed or cup pointed. When the member is a grub screw, the opposite, non-engagement end may be provided with a slot, hexagonal or square aperture or protrusion etc to drive the grub screw as is well understood in the art.

The invention includes a set of spanners comprising at least two spanners according to the invention as herein described, the apertures of the spanner heads being selected to provide a range of sizes suitable for use with common nut and bolt head sizes.

**Brief Description of the Drawings**
In the drawings, which illustrate a preferred embodiment of a spanner according to the invention and are by way of example:

Figure 1 is a schematic end view of a pipe flange showing the fastener holding spanner in an operating position on a nut on the flange;

Figure 2 is an enlarged fragmentary view of the pipe flange and fastener holding spanner in accordance with the invention shown in Figure 1; and

Figure 3 is an enlarged view of the fastener holding spanner of Figures 1 and 2 in an operating position on the nut.

**Detailed Description of the Preferred Embodiments**

Referring to the Figures, an annular pipe flange 100 is shown, the flange 100 being attached to a second flange not shown by a series of fasteners in the form of polygonally-shaped nuts, threaded studs (both continuously-threaded and partially-threaded) and bolts having polygonally-shaped heads, in this instance hexagonally-shaped nuts and bolt heads 102.

The nuts may be tightened on to the bolts by the use of an appropriate torque spanner or wrench (not shown). To prevent rotation of the bolt heads 102 by the applied torque so that the fastener is tightened by the applied torque, a fastener holding spanner 10 in accordance with the invention is used to prevent such rotation.

The spanner 10 has a unitary body 12 forming two spanner heads 16, 18 lying in a common plane and in each of which is provided a respective hexagonally-shaped aperture 20, 22 for engaging with corresponding bolt heads 102 when in use. In this example, the apertures 20, 22 are of different sizes to accommodate different nut or bolt head sizes using the one spanner 10. As will be apparent, it is common practise to provide a set of spanners 10 of varying sizes to accommodate a variety of nut and bolt head sizes commonly used.

As will become apparent from the following description, each head 16, 18 functions as an arm for the other head 16, 18, which arm engages with an adjacent abutment surface in use of the spanner 10.

In the illustrated embodiment, the hexagonally-shaped apertures 20, 22 are oriented in the body 12 such that the perpendicular bisector of two opposed faces 24, 26 and 28, 30 of each aperture 20, 22 is coincident with the respective longitudinal axis of the other spanner head 16, 18. In this instance, the longitudinal axis of each head 16, 18 is coincident with the other and is the longitudinal axis 14 of the body 12. Preferably, the through passage penetrates a face of the aperture other than said two opposed faces through which said bisector passes that is coincident with or parallel to a longitudinal axis of the arm.
Each spanner head 16, 18 is provided with a respective through passage 32, 34 which penetrates a respective face 36, 38 of the apertures 20, 22. The passages 32, 34 each have an inner, threaded portion 32A, 34A and an outer, unthreaded portion 32B, 34B having a greater diameter than the inner portion 32A, 34A. As may be seen from the Figures, the through passages 32, 34 penetrate the respective faces 36, 38 at a position that is offset from the centre of the respective face 36, 38. The offset positions of the through passages 32, 34 are determined by the walls defining the inner, threaded portions 32A, 34A of the passages 32, 34 being, at the respective faces 36, 38, tangential to the vertices 40, 42 between said faces 36, 38 and adjacent faces 26, 28 thereof.

The longitudinal axes 44 (only one shown – see Figure 3) of the through passages 32, 34 are inclined at a slight angle to a perpendicular 46 to the faces 36, 38 of the apertures 20, 22 which they respectively penetrate. The inclinations of the longitudinal axes 44 are in a direction towards an adjacent respective vertex 40, 42 and preferably is between greater than 0° and up to 10°, and as shown in the Figures is 5° to the perpendicular 46 to the faces 36, 38 of the respective apertures 20, 22.

Each through passage 32, 34 is provided with a grub screw 48 typically of hardened steel. The end of the grub screw 48 which engages the nut or bolt head 102 is flat. The opposite end of the grub screw 48 hexagonal aperture by which it may be screwed into or out of its respective through passage 32, 34.

In use, to assemble the pipe joint, the respective pipe flanges 100 are aligned with one another so that the holes for receiving the bolt are in alignment with one another and bolts are passed through the holes. Nuts are screwed on to the free ends of the bolts on the opposite side of the flanges 100 to the bolt heads 102.

To tighten the fasteners to the required level, a torque spanner or wrench is used to tighten the nuts in sequence to a preset torque. To prevent the bolt rotating under the application of the applied torque as it is applied to the respective nut, prior to the application of torque one spanner head 16, 18 (in this instance head 18) of the spanner 10 is located on the respective bolt head 102 (see particularly Figure 3). The grub screw 48 is screwed into its through passage 32 to engage an opposed face 104 of the bolt head 102 and to lock the spanner 10 relative to the bolt head 102. The inclination of the axis 44 of the passage 32 enables the grub screw 48 to be about perpendicular to the face 104 of bolt head 102 when the spanner 10 is locked on to the bolt head 102, the flat end of the grub screw 48 is consequently substantially fully in engagement with the face 104 of the bolt head 102.

Further, the spanner 10 is caused to rotate slightly relative to the bolt head 102 on which it is situated. With the bolt head fully tightened, releasing the grub screw 48 allows the spanner to
rotate in the opposite direction and release from the adjacent nut against which it was in
abutment with during the tightening process.

As torque is applied to the opposed nut, the bolt head 102 on which the spanner 10 is locked also
rotates slightly until the spanner contacts an adjacent bolt head 102 (see Figures 1 and 2) and is
prevented from rotating further. This abutment of the spanner 10 on the adjacent bolt head 102
enables the torque applied to the opposed nut to rotate the nut relative to the bolt and enable it
to be fully tightened to the required torque level. Once the nut is fully tightened on the bolt, the
grub screw 48 is unscrewed to release the locking effect thereof and enable the spanner 10 to be
easily removed from the bolt head 102.

This procedure is repeated until all of the nuts have been tightened to the required torque level;
and even, if necessary, on fasteners that have already been tightened to check the applied torque
levels are correct.

To disassemble the pipe joint, the reverse procedure is used.

Whilst in the preferred embodiment, a spanner 10 having two spanner heads 16 and 18 one of
which in use functions as an arm to abut an adjacent abutment surface is described, it will be
appreciated that, in an alternative embodiment, the spanner may have an arm without an aperture
therein depending from a single head of the spanner generally perpendicular to the central axis of
the aperture of the head. In this instance, in use the arm would abut against the adjacent bolt
head or nut upon rotation of the bolt or stud under applied torque.

Although in the described embodiments the abutment surfaces engaged by the arm of the
spanner 10 constitutes a surface on an adjacent bolt head or nut of a fastener, it will be
appreciated that in other configurations of components to be assembled together or
disassembled, the abutment surface may be provided on a part of the components other than the
fastener therefor.

As has been previously described, the aperture(s) of the fastener holding spanner according to
the present invention preferably has an even number of faces and in the preferred embodiment
as described with reference to the Figures has six faces corresponding to hexagonal fastener
components in the form of nuts or bolt heads. Alternative configurations of aperture(s) include
those with four faces, ie square for square fastener components in the form of nuts or bolt heads
and apertures which are provided with say eight or twelve vertices for receiving respectively a
square or hexagonal nut or bolt head in which instance the number of faces will be sixteen and
twenty-four respectively.
Claims

1. A fastener holding spanner comprises a spanner head defining an aperture capable of engaging during use in a close fit with a correspondingly-sized nut or bolt head of a fastener and an arm extending from the spanner head, which arm during use of the spanner being capable of engaging with an abutment surface adjacent to a nut or bolt head of a fastener engaged by the spanner head upon rotation of the nut or bolt head under applied torque, the spanner head further defining a through passage penetrating a face of the aperture and being at least partially threaded over at least part of its length whereby, in use, a threaded member may be screwed into the passage to contact under pressure a face of a nut or bolt head engaged by the spanner to prevent relative rotation between the spanner and the nut or bolt head.

2. A fastener holding spanner according to claim 1 in which the aperture is polygonally-shaped and the aperture is configured to engage during use in a close fit with a correspondingly-sized and shaped part of a fastener.

3. A fastener holding spanner according to claim 1 or claim 2 in which the arm of the spanner comprises a second spanner head integral with and having the same features as the first spanner head.

4. A fastener holding spanner according to claim 3 in which the through passage of the second spanner head is located on a side of the spanner opposite to the side of the spanner containing the through passage of the first spanner head.

5. A fastener holding spanner according to claim 3 or claim 4 in which the apertures in the two spanner heads are of different sizes. A fastener holding spanner according to any preceding claim, wherein the arm extends from the spanner head generally perpendicularly to a central axis of said aperture.

6. A fastener holding spanner according to any one of the preceding claims in which the through passage is offset from the centre of the face of the aperture it penetrates towards one of the vertices formed between said face and a face of the aperture adjacent thereto.

7. A fastener holding spanner according to claim 6 in which a wall defining the through passage is, at said face, tangential to the vertex between said face and an adjacent face.

8. A fastener holding spanner according to any one of the preceding claims in which the longitudinal axis of the through passage is inclined at a slight angle to a perpendicular to
the face of the aperture which it penetrates, the inclination being in a direction towards an adjacent vertex between said face and an adjacent face.

9. A fastener holding spanner according to claim 8 in which the longitudinal axis of the through passage is inclined at an angle of between greater than 0° and up to 10°, more preferably between 3° and 7° and, in particular, at about 5° to a perpendicular to the face of the aperture which it penetrates.

10. A set of spanners comprising at least two spanners according to any one of the preceding claims, the apertures of the spanner heads being selected to provide a range of sizes suitable for use with common nut and bolt head sizes.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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<td>DE20221584 U (GEDORE) see WPI Abstract Accession No.2004-296322 [28]</td>
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<td>DE10242511 A (GEDORE II) see WPI Abstract Accession No.2004-296322 [28]</td>
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<td>WO95/04635 A (HERMANN) see figure 5 and 6 and abstract</td>
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<td>FR2906487 A (SAVEY) see WPI Abstract Accession No.2008-D39710 [25]</td>
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<td>US2659258 A (DILLARD) see figures 1-4</td>
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Categories:

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Field of Search:
Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

Worldwide search of patent documents classified in the following areas of the IPC:
B25B

The following online and other databases have been used in the preparation of this search report:
EPODOC, WPI

International Classification:

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