

TOOL FOR EXAMINING A BOLT AND TESTING METHOD

The present invention relates to a tool for checking a bolt, particularly for checking the positional fixing and/or the force transmission capability of a bolt, wherein the bolt is fixed in a surrounding structure, and to a checking method for checking the positional fixing and/or the force transmission capability of a bolt.

So-termed torque wrenches provided for application of a settable torque to a screw, a nut or a bolt are known per se. Thus, on the one hand a breakaway torque is settable between a thread and a nut and on the other hand a torque transmissible by means of a threaded bolt is determinable. In particular, turning of a bolt within a fastening can be checked, wherein a target torque which the bolt has to be able to transmit without unscrewing is predeterminable at the torque wrench.

The object of the invention is accordingly to check, by particularly simple means, a bolt with respect to a transmissible tension or compression force and/or with respect to the axial fixing thereof in a surrounding structure.

One aspect of the invention therefore relates to a tool for checking a bolt fixed in a surrounding structure, wherein the tool has a coupling element which is detachably connectible with the bolt in force-transmitting manner. The tool additionally has an engagement section detachably connectible with the coupling element in force-transmitting manner, a rocker connected with the engagement section and supportable at the surrounding structure to be pivotable, and an actuating element. A force and/or a torque is introducible into the rocker by way of the actuating element in such a manner that the engagement section can be displaced.

In that case the tool is constructed as, in particular, a manually operable means which is transportable by a person and which converts a torque generated by way of the actuating element into a displacing movement of the engagement section. With the help of the proposed tool it is possible to introduce a tension or compression force into a bolt, wherein a (blind) rivet, a pin, a screw, a nut, a dowel, a location pin, a tightening bolt, a spread pin or the like or a mixed form of the mentioned components can be provided as a bolt. Moreover, a fastening element for fixing a guide rail in a lift shaft can be provided as a bolt, wherein the fastening element is positioned particularly in a stone, brick or concrete

structure of a building and carries a claw or clamp which in turn further engages around and fixes a section of the guide rail.

The torque introducible into the rocker is selected in such a manner that a predetermined maximum tension or compression force, which corresponds at least with a holding force to be transmitted by the bolt, arises at the bolt and at the engagement section. Thus, the bolt can be checked with respect to its function, which can consist particularly in that a minimum holding force is to be introduced into the surrounding structure.

The displacing movement of the engagement section can include not only translational, but optionally also rotational movement components. In a particularly preferred manner associated with the engagement section when the tool is actuated is a circular path having, in the region of the engagement section, a tangent aligned approximately parallel to a longitudinal axis of the bolt and optionally coming into alignment with a longitudinal axis of the bolt. A substantially moment-free tension or compression force can thereby be introduced into the bolt. In that case, a fulcrum or axis of rotation for the entire tool, which is selected as, for example, a rocking or pivot axis of the rocker, is fixable by way of the rocker.

In one embodiment the engagement section is, in particular, formed integrally with the rocker, wherein the separate coupling element by way of which the rocker is connectible with the bolt is associated with the engagement section. The coupling element has a coupling section co-operating with the engagement section. In a first variant the coupling section is constructed as a separate component which is also connectible with the engagement section by friction couple and/or mechanically positively. In a further variant the coupling element is movably (and optionally non-detachably) connected with the engagement element or articulated thereto.

In a further embodiment the engagement section engages, by one or two grip elements, around the coupling element, wherein the engagement section is preferably constructed in the form of a fork or in the form of a ring. For this purpose, at least one actuating position of the tool is provided in which a grip element engages at least regionally around the coupling element. The grip element thus produces a sufficiently accurate alignment, particularly centring of the tool relative to the bolt.

In one embodiment the coupling element comprises a threaded section, particularly an internal thread, which can be screwed together with a threaded section at the bolt, as well as a joint section with which the engagement section co-operates. The coupling element thus enables a force transmission from the engagement section of the tool to the bolt. In particular, not only tension forces, but also compression forces can thereby be reliably introduced into the bolt, in which case the engagement section executes, in particular, a combined translational/rotational movement.

In one embodiment the coupling element has at least one rocking axis at which the engagement section engages and by way of which a tension or compression force is introducible into the coupling element and, further, into the bolt. The rocking axis has proved particularly advantageous when the engagement section during intended actuation of the tool executes an appreciable rotational movement. The rocking axis enables decoupling of rotational and translational movement components on the part of the engagement section, wherein the translational movement components are preferably passed on to the bolt.

In one embodiment the rocker has a support region by way of which the rocker is supportable at the structure surrounding the bolt. In that case a roller, particularly a roller rotatably mounted on the rocker, can be associated with the rocker in the region of a support region, the axis of rotation of the roller serving at the same time as pivot axis of the rocker and being supportable by way of the rocker at the structure surrounding the bolt. In addition, for example, associated with the rocker in the region of its support region can be a rolling and support surface, which has the form of a section of a cylinder and, in particular, is constructed integrally with the rocker and by way of which the rocker can be supported, for rolling, at the structure surrounding the bolt.

In an embodiment the actuating element is constructed as a manually actuable lever and is pivotably fastened to the rocker by way of, in particular, a force and/or torque limiting arrangement. In a first variant the force and/or torque limiting arrangement is constructed in such a manner that it can be detachably placed in force-locking manner against the rocker. For that purpose provided at, in particular, the rocker is a non-round recess in which a correspondingly non-round mating member at the actuating element engages. Conversely, a non-round receptacle for a non-round mating member projecting from the rocker can be provided at the force and/or torque limiting arrangement, wherein receptacle

and mating member preferably mechanically positively interengage.

In a second variant the actuating element is constructed at least regionally to be elastically resilient and/or designed for a predetermined maximum permissible bending load above which the actuating element is permanently plastically deformed. In this variant limitation of the moment introducible into the rocker arises due to a defined dimensioning of the actuating element. The stated dimensioning can, in particular, be effected by appropriate selection of the material and the (minimum) cross-sectional dimensions of the actuating element. In a further variant the actuating element is formed integrally with the rocker or non-detachably, particularly by material couple, connected therewith. In this variant, a limitation of the torque able to be generated is undertaken particularly by appropriate selection of the lever ratios. The lever ratios are, starting from a (average) possible exertion of force by a male person, selected in such a manner that a specific maximum torque at the rocker in the case of intended manipulation is not exceeded and a specific minimum torque can be reliably achieved. In a further variant a force-limiting and/or torque-limiting coupling element, for example a slip clutch or similar, is connected between rocker and actuating element. It will be obvious that the mentioned and equivalent variants can be combined with one another; in particular, a construction according to the first variant or variants can be supplemented and optimised by features of the second and/or third variant or variants.

In one embodiment the actuating element as well as the force and/or torque-limiting arrangement are constructed as a unit, particularly in the form of a torque wrench, which is detachably or non-detachably connected with the rocker. For this purpose, provided at the rocker is, in particular, a non-round recess in which a correspondingly non-round mating member at the unit or the torque wrench engages. Conversely, a non-round receptacle for a non-round mating member projecting from the rocker can be provided at the unit or the torque wrench, wherein the receptacle and mating member preferably mechanically positively interengage. A first exemplifying embodiment for a torque wrench to be used is known from EP 1306170 A2 according to Figs. 9 and 10 inclusive of the associated description and a further exemplifying embodiment for a torque wrench to be used is known according to Fig. 1 et seq inclusive of associated description. Moreover, further exemplifying embodiments for torque wrenches are known from EP 2003291555a (see, there, Fig. 1 et seq inclusive of associated description) which can be constructed to be able to be similarly brought into engagement with the rocker or connected with the rocker.

Reference is made to the cited documents to the full extent with respect to the construction of torque wrenches possibly capable of use.

A method for checking the positional fixing and/or the force transmission capability of a bolt in a structure surrounding the bolt comprises a method step in which a coupling element is detachably connected with the bolt, in particular screwed, in which tool with a rocker is pivotably applied to the structure surrounding the bolt, a method step in which the tool is loaded with torque by way of an actuating element and is rotated about a pivot axis substantially fixed relative to the structure and a method step in which by means of an engagement section at the tool a tension or compression force is introduced into the coupling element and thus into the bolt, wherein the engagement section and coupling element are pivoted relative to one another. Thus, a positional fixing of the bolt within the surrounding structure, i.e. the firm seating of the bolt, can be checked in simple manner. In particular, it can be checked whether the bolt can transmit sufficiently high tension and/or compression forces to the surrounding structure. In preferred manner a fastening element for a guide rail or another support arrangement in a lift system is selected as bolt, wherein the bolt can be connected by way of, in particular, a bracket penetrated by the bolt, a clamp or the like also indirectly with the guide rail or the support arrangement. In the latter case the tool can also be indirectly applied by way of the bracket to the surrounding structure.

With the help of the coupling element at the bolt a joint section or the like can be provided which is firmly connectible with the bolt. The engagement section can be pivotably attached to the joint section of the coupling element so that relevant forces can be introduced into the bolt by way of the tool.

Further objects, features and advantages are evident from the subclaims and the exemplifying embodiments described in the following, with respect to which and partly in schematic illustration:

Fig. 1 shows a schematic side view of an exemplifying embodiment of a tool in a first working position;

Fig. 2 shows a detail of the plan view of the tool according to Fig. 1;

Fig. 3 shows a perspective illustration of a rocker of a second exemplifying embodiment of a tool; and

Fig. 4 shows a schematic side view of a further exemplifying embodiment of a tool.

Fig. 1 shows a (first) tool 1 for checking the positional fixing and/or the force transmission capability of a bolt 2, wherein the bolt 2 is to be fixed in a surrounding structure 3. In one application, the bolt 2 is preferably constructed as fastening means of a guide rail in a lift system (not illustrated in more detail). In that case, in known manner a support arrangement 4 in the form of a plurality of clips or brackets is provided, which on the one hand are firmly connected with a guide rail and on the other hand firmly connected with a structure 3 in the form of a shaft wall of the lift system. In modified exemplifying embodiments, provided in addition to or instead of a guide rail are other lift system components which are fastened to a lift shaft wall by means of one or more bolts. With respect to reliable mounting of a support arrangement 4 with the help of the bolts 2 the latter have on the one hand - in a manner not illustrated in more detail - a respective thread and/or respective spread claws or the like, which engage an inner side of a bore 3a of a shaft wall 3 in mechanically positive and/or friction-coupling manner. On the other hand, the bolts 3 each have a thread 2a onto which a nut 4 with a washer 6 can be screwed. In modified exemplifying embodiments the bolts are constructed as (blind) rivets, tensile screws, dowels, tightening bolts or spread pins.

The tool 1 has, in one exemplifying embodiment, an engagement section 1a which is detachably connectible with the coupling element 7 in force-transmitting manner. The engagement section 1a is, in particular, constructed integrally with a rocker 1b and preferably comprises two grip elements 1c which together form a form of fork (cf. Fig. 2) and can engage around parts of the coupling element 7. In an alternative exemplifying embodiment an approximately G-shaped or ring-shaped grip element is provided. The engagement section 1a is provided for the purpose of producing a detachable and optionally pivotable connection with the coupling element 7.

The rocker 1b has a support region 1d by way of which the rocker or the tool 1 can be supported on the structure 3 surrounding the bolt 2 and/or on the support arrangement 4. The support region 1d has, regionally, a cylindrical outer contour on which the support region 1d is supported at the surrounding structure 3 (for example shaft wall) to be rollable

or pivotable.

In addition, provided at the tool is an actuating element 1e by way of which a force and/or a torque is or are introducible into the rocker 1b in such a manner that the engagement section 1a is displaced. In particular, it is provided that a person in the region of a handle 1f can manually introduce an actuating force f (cf. Fig. 1) into the tool 1 and, in correspondence with the lever ratios of the tool, a tension force P can be produced at the bolt with the help of the engagement section. In preferred manner the actuating element 1e is constructed as a plastics material or metal tube which is formed to be angled and which in clamping manner engages around a part of the rocker. In a modified exemplifying embodiment the rocker lever and actuating element are constructed integrally or are connected together by material bond through welding, glueing, etc. In further exemplifying embodiments the actuating element comprises an elastically deformable spring arrangement which in the case of exceeding a predetermined maximum actuating force $F_{\max}$ (for example $F_{\max1} = 400 \text{ N}$ or $F_{\max2} = 600 \text{ N}$) yields and/or shortens a lever arm of the actuating element or the rocker. A tension force introducible into the bolt in correspondence with the lever lengths of the tool is thus limited.

The tool comprises the coupling element 7, which is preferably constructed in the form of a bell with a blind bore 7a, inclusive of internal thread, at the lower side. At its upper side the coupling element 7 preferably has a transverse axle 7b which is, in particular, hollow and which preferably projects on both sides of the coupling element 7 (cf. Fig. 2). Moreover, an upwardly projecting ring can be firmly mounted on the coupling element in a manner which is not illustrated. The internal thread arranged in the blind bore 7a forms a threaded section which can be screwed together with a corresponding threaded section at the bolt 2. The bolt and coupling element can thus be detachably connected together quickly and simply. The transverse axle 7b thereagainst forms a joint section with a rocking axis K , which can provide articulating co-operation with the engagement section 1a. In particular, the coupling element 7 can be engaged around by the engagement section 1a below the transverse axle 7b. The coupling element 7 with its preferably continuous internal thread can be set by rotation to a desired horizontal level. A flexible positioning of the coupling element 7 on the bolt 2 is thereby made possible.

As already mentioned, for use of the tool 1 provision is preferably made for a person in the region of a handle 1f to manually introduce an actuating force F into the tool 1

approximately parallel to the axis of the bolt 2 (cf. Fig. 1). The tool 1, which in the region of the support region 1d is supported to be rollable or pivotable about a geometric axis 3b and, in particular, non-sliding, executes a defined rotational movement about the support region 1b and lifts the engagement section 1a in the direction of the arrow P insofar as the structure 3 is of substantially non-elastic construction. In correspondence with the lever ratios of the tool a force P is introduced into the coupling element 7 with the help of the engagement section, wherein introduction of a moment into the coupling element is substantially avoided by the fact that the engagement section 1a and coupling element 7 are arranged to be pivotable relative to one another about the rocking axis K.

In the present exemplifying embodiment a tension force P is introduced into the bolt by way of the coupling element 7. With the help of this tension force, which ideally approximates a predetermined target holding force (for example $P_{\min 1} = 800 \text{ N}$ or $P_{\min 2} = 1000 \text{ N}$) of the bolt, the bolt can be checked with respect to its fixing. In particular, loose or only insufficiently tightened bolts can be recognised and pulled from their position. In a modified exemplifying embodiment a pressure force is introducible into a bolt in accordance with the same principle.

A tool 1' comprises, in a second exemplifying embodiment, a rocker 1b' according to Fig. 3. The tool 1 again has an engagement section 1a, which is again detachably connectible with the coupling element (not illustrated) in force-transmitting manner. The engagement section 1a is, in particular, formed integrally with a rocker 1b' or connected therewith in force-transmitting manner.

The engagement section 1a' preferably comprises two grip elements 1c' which together form a kind of fork and can engage around a force transmission element connected therewith. In particular, recesses V in which an axle of the coupling element can lie are provided at the grip elements 1c'. Advantageously, two securing strips S, which engage over the recesses V, are fixed to the grip elements 1c'. The securing strips S are advantageously made of a resilient sheet steel and enable loose fixing between coupling element and grip element in that they hold an axle of the coupling element in the recesses. Further features with respect thereto are adopted from the first exemplifying embodiment.

The rocker 1b' has a support region 1d' by way of which the rocker or the tool 1' can be supported at the structure 3 surrounding the bolt and/or at a support arrangement. The

support region 1d' has, regionally, an outer contour which is cylindrical at least regionally and at which the support region 1d' is supported on the surrounding structure 3 (for example shaft wall) to be rollable or pivotable. Rocker 1b', engagement section 1a' and support region 1d' are preferably produced integrally from a metallic material. The support region can optionally be provided with a surface coating of a synthetic material.

In addition, an actuating element, which is not illustrated in more detail in Fig. 3, is provided at the tool. The actuating element, as shown in the exemplifying embodiment according to Fig. 4, is preferably constructed as a commercially available torque wrench or socket wrench. For this purpose the tool 1' has a connecting element 1g' with an approximately square recess A. The recess is, for example, matched to a half-inch socket wrench nut with flat width 19 and has a diameter of approximately 23 millimetres. Completely different geometries, particularly triangular, pentagonal or hexagonal geometries, for the recess can obviously also be provided insofar as a corresponding mating member is provided at the torque wrench. The torque wrench is pivotable through approximately 180° as indicated in Fig. 4. Preferably provided at the torque wrench is a torque limiter which limits the torque to be introduced into the rocker to a predetermined value (for example 100 Nm). A clicking noise occurs when the set torque (or tension force P) is reached.

In a modified exemplifying embodiment a force limiting arrangement is provided instead of a torque limiter. The force limiting arrangement can again be realised by an elastically resilient design of the actuating element.

In a further modified exemplifying embodiment the tool is characterised in that the actuating element is constructed as a manually actuatable lever and, in particular, is pivotably fastened to the rocker by way of a force and/or torque limiting arrangement. In that case, the actuating element as well as the force and/or torque limiting arrangement are preferably constructed as a unit, particularly in the form of a torque wrench, which is detachably or non-detachably connected with the rocker.

A method for checking the positional fixing and/or the force transmission capability of a bolt 2 in a structure 3 surrounding the bolt can be performed with the help of the described tool 1, 1'. In a method of that kind in a method step the coupling element 7 is detachably connected with the bolt 2, in particular by screwing, and in a subsequent method step the

tool 1, 1' is pivotably applied by a rocker 1b, 1b' to the structure 3 surrounding the bolt 2. A (vertical or horizontal) shaft wall of a passenger or goods lift can be provided as surrounding structure. Another wall of a non-metallic natural material, a wood, a stone or foamed material can also be provided as surrounding structure. In a further, in particular subsequent, method step the tool is loaded by way of an actuating element 1e, 1f with a torque (or a force) in such a manner that the tool is rotated about a pivot axis 3b which is substantially fixed relative to the structure 3. In a further method step a tension or compression force is introduced into the coupling element 7 and thus into the bolt 2 by means of an engagement section 1a, 1a' at the tool, in which case the engagement section 1a, 1a' and coupling element 7 are pivoted relative to one another about the axis K.

CLAIMS

1. Tool for checking a bolt (2) fixed in a surrounding structure (3), comprising
 - a coupling element (7) detachably connectible with the bolt (2) in force-transmitting manner, wherein the coupling element (7)
 - a) has a threaded section which can be screwed to a threaded section at the bolt (2) and
 - b) has a joint section,
 - an engagement section (1a, 1a') which is detachably connectible with the coupling element (7) in force-transmitting manner, wherein the joint section co-operates with the engagement section (1a, 1a'),
 - a rocker (1b, 1b') connected with the engagement section (1a, 1a') and supportable at the surrounding structure (3) to be pivotable and
 - an actuating element (1e) by way of which a force and/or a torque is so introducible into the rocker (1b, 1b') that the engagement section (1a, 1a') can be displaced.
2. Tool according to claim 1, characterised in that the engagement section (1a, 1a') has one or two grip elements (1c) in order to grip the coupling element (7), wherein the engagement section is constructed in a form of a fork or ring.
3. Tool according to one of the preceding claims, wherein the coupling element (7) has at least one rocking axis (K) at which the engagement section (1a, 1a') engages and by way of which a tension or compression force (P) is introducible into the coupling element (7) and further into the bolt (2).
4. Tool according to any one of the preceding claims, wherein the rocker (1b, 1b') has a support region (1d, 1d') by way of which the rocker (1b, 1b') can be supported at the structure (3) surrounding the bolt (2).
5. Tool according to any one of the preceding claims, wherein the actuating element (1e) is constructed as a manually actuable lever and is pivotably fastened to the rocker (1b, 1b') by way of a force and/or torque limiting arrangement.
6. Tool according to claim 5, wherein the actuating element (1e) as well as the force and/or torque limiting arrangement are part of a torque wrench detachably or non-

detachably connected with the rocker (1b').

7. Method of checking the positional fixing and/or the force transmission capability of a bolt (2) in a structure (3) surrounding the bolt, comprising the following steps:
- screwing a coupling element (7) to the bolt (2),
 - detachably connecting an engagement section (1a, 1a') of a tool (1, 1') with the coupling element (7), wherein the tool additionally comprises a rocker (1b, 1b') connected with the engagement section (1a, 1a') and an actuating element (1e) coupled with the rocker (1b, 1b'),
 - applying the rocker (1b, 1b') to the structure (3) surrounding the bolt and
 - loading the actuating element (1e) with a force and/or a torque in order to rotate the tool relative to the structure (3) about a substantially fixed pivot axis (3b) and thus to introduce by means of the engagement section (1a, 1a') a tension or compression force into the coupling element (7) and thus into the bolt (2).