

DESCRIPTION

TITLE OF THE INVENTION: BOLT TIGHTENING TRAINING DEVICE

TECHNICAL FIELD

[0001] The present invention relates to a bolt tightening training device. More specifically, the present invention relates to a bolt tightening training device which allows training for proper tightening of bolts when a fastening body such as a pair of flanges is tightened with bolts at a connecting portion of pipes. The bolt tightening training device according to the present invention can be preferably used in educational lectures for controlling a torque when a fastening body is tightened with a bolt, or a tightening torque is checked before tightening a fastening body with a bolt.

BACKGROUND ART

[0002] An operation for tightening a fastening body such as a pair of flanges of pipes with bolts in a plant is very important for ensuring safe running of the plant. In general, when a pair of the flanges of pipes is tightened with a bolt, a tightening force is controlled by a torque method, and a torque wrench is recommended for controlling the tightening force.

[0003] However, since the torque wrench is expensive, it is not economical to provide a large number of operators with a torque wrench, respectively. In addition, when the torque wrench is used, since it is necessary to change the setting of a torque value of the torque wrench for respective flanges, the use

of a torque wrench has a drawback such that operational efficiency is lowered. Moreover, there arise some drawbacks in use of the torque wrench such that a box portion of the torque wrench becomes an obstacle when the torque wrench is set on a bolt, which makes a tightening operation difficult in general. Therefore, when a pair of flanges of pipes is tightened with a bolt, in many cases, a spanner or the like is used in place of the torque wrench, and the flanges of pipes are tightened by intuition of an operator at the site. In the case where a fluid having a high pressure flows in a pipe or the case where a fluid having a high risk flows in a pipe, tightening is carried out with the torque wrench while checking a torque value (see, for example, paragraph [0035] of Patent Literature 1, paragraph [0018] of Patent Literature 2, paragraph [0012] of Patent Literature 3, and paragraph [0032] of Patent Literature 4).

[0004] When a pair of flanges of pipes is tightened with a bolt, since a target tightening force differs depending on the kind of a gasket being used, an environmental temperature of the gasket and the like, and load of the gasket is lowered with passage of time, it is necessary to control a tightening load of the gasket in view of these factors. However, when tightening is carried out without using a torque wrench, an operator sometimes cannot confirm whether or not a target tightening force is achieved, or variations are sometimes generated in tightening force for respective bolts. Therefore, tightening of the bolts requires a considerably skilled technique. In addition, misalignment sometimes occurs due to not only tightening of the individual flanges but also interaction between complicatedly assembled pipes.

[0005] Furthermore, a tightening force applied to the bolt by a spanner is determined based on intuition of an operator, and the operator cannot accurately grasp a relationship between the tightening force and a tightening torque. Therefore, there is a possibility that a tightening force of the bolt becomes excessively large or excessively small due to the generation of variation in tightening force among operators. In view of the above possibility, it is necessary for an operator to acquire a technique with which the operator can properly control a tightening force of a bolt.

[0006] Conventionally, in order to learn an operation for tightening a pair of flanges of pipes with a bolt, it has been desired for a trainee to actually carry out an operation for a pair of tightening flanges of pipes with a bolt under the guidance of a skilled operator. However, in recent years, there is a tendency that the number of engineers skilled in tightening flanges of pipes with a bolt decreases. Therefore, learning such tightening under the guidance of a skilled operator has become difficult.

[0007] Accordingly, in recent years, when a fastening body such as a pair of flanges of pipes is tightened with a bolt by means of a tightening tool such as a spanner, it has been urged to develop a bolt tightening training device with which a trainee can properly grasp a relationship between a tightening force at the time of tightening a bolt and a torque generated at the time of actual tightening.

PRIOR ART LITERATURES

PATENT LITERATURES

[0008] Patent Literature 1: Japanese Patent Unexamined Publication No.

2012-2199329

Patent Literature 2: Japanese Patent Unexamined Publication No.

2013-0204713

Patent Literature 3: Japanese Patent Unexamined Publication No.

2013-0221577

Patent Literature 4: Japanese Patent Unexamined Publication No.

2013-0241951

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0009] The present invention has been made in view of the prior art described above. An object of the present invention is to provide a bolt tightening training device which requires no skilled operator, and allows a trainee to properly grasp a relationship between a tightening force at the time of tightening a bolt and a torque generated at the time of actual tightening of the bolt when a fastening body such as a pair of flanges of pipes is tightened with bolts by means of a tightening tool such as a torque wrench or a spanner.

MEANS FOR SOLVING THE PROBLEMS

[0010] The present invention relates to:

(1) a bolt tightening training device which allows training for proper tightening of a bolt at the time of tightening a fastening body with the bolt, which includes a bolt tightening practice means including a torque detector, a tool-attached part to which a tightening tool is attached, and a strain

gauge for detecting a strain generated when the tightening tool is attached to the tool-attached part, and the tool-attached part is tightened, wherein the tool-attached part is disposed on one end of the torque detector, the other end of the torque detector is fixed, and the strain gauge is attached to an outer peripheral surface of the torque detector; an arithmetic calculation means for converting information obtained by reading with the strain gauge a strain which is generated when the tool-attached part of the bolt tightening practice means is tightened into data; and a display means for visualizing the data obtained in the arithmetic calculation means;

(2) the bolt tightening training device according to the above-mentioned item (1), including a mounting base for the bolt tightening training device below the bolt tightening training device, wherein the bolt tightening training device is rotatably mounted on the mounting base so that the tool-attached part of the bolt tightening training device is rotatable at an arbitrary angle in a horizontal direction or in a vertical direction; and

(3) the bolt tightening training device according to the above-mentioned item (1) or (2), including a mounting base for the bolt tightening training device below the bolt tightening training device, wherein the bolt tightening training device is connected with the mounting base through an extension and contraction mechanism which is elevatable in a vertical direction.

EFFECTS OF THE INVENTION

[0011] The bolt tightening training device according to the present invention exhibits some excellent effects such that the bolt tightening

training device requires no skilled operator, and that the bolt tightening training device allows a trainee to properly grasp a relationship between a tightening force at the time of tightening the bolt and a torque generated at the time of actual tightening of a bolt when a fastening body such as a pair of flanges of pipes is tightened with a bolt by means of a tightening tool such as a torque wrench or a spanner.

[0012] In addition, according to the bolt tightening training device of the present invention, when the mounting base for the bolt tightening training device is provided below the bolt tightening training device, and the bolt tightening training device is rotatably mounted on the mounting base so that the tool-attached part of the bolt tightening training device is rotatable at an arbitrary angle in a horizontal direction or in a vertical direction, the bolt tightening training device can be applied to various bolt attaching angles at which an actual bolt tightening operation is carried out in a plant and the like.

[0013] Furthermore, according to the bolt tightening training device of the present invention, when the mounting base for the bolt tightening training device is provided below the bolt tightening training device, and the bolt tightening training device is connected with the mounting base through the extension and contraction mechanism which is elevatable in a vertical direction, the bolt tightening training device can be applied to various bolt attaching positions at which an actual bolt tightening operation is carried out.

BRIEF DESCRIPTION OF DRAWINGS

[0014] Fig. 1 is a schematic explanatory view showing one embodiment of the bolt tightening training device according to the present invention.

Fig. 2 is a schematic perspective view showing one embodiment of the bolt tightening training device according to the present invention.

MODE FOR CARRYING OUT THE INVENTION

[0015] The bolt tightening training device according to the present invention is, as described above, a bolt tightening training device which allows training for proper tightening of a bolt at the time of tightening a fastening body with a bolt. The bolt tightening training device includes a bolt tightening practice means including a torque detector, a tool-attached part to which a tightening tool is attached, and a strain gauge for detecting a strain generated when the tightening tool is attached to the tool-attached part, and the tool-attached part is tightened, wherein the tool-attached part is disposed on one end of the torque detector, the other end of the torque detector is fixed, and the strain gauge is attached to an outer peripheral surface of the torque detector; an arithmetic calculation means for converting information obtained by reading with the strain gauge a strain which is generated when the tool-attached part of the bolt tightening practice means is tightened into data; and a display means for visualizing the data obtained in the arithmetic calculation means.

[0016] Since the bolt tightening training device according to the present invention has the above-mentioned configuration, a trainee can properly learn a relationship between a bolt tightening force which the trainee feels and a torque generated at the time of actual tightening of a bolt without

guidance of a skilled operator when a fastening body such as a pair of flanges of pipes is tightened with a bolt by using a tightening tool such as a torque wrench or a spanner. In addition, the trainee can acquire a technique necessary for tightening a fastening body such as a pair of flanges at a connecting portion of pipes with a bolt by using the bolt tightening training device according to the present invention.

[0017] The bolt tightening training device according to the present invention allows training for proper tightening of a bolt at the time of tightening a fastening body with the bolt. The bolt tightening training device includes the bolt tightening practice means, the arithmetic calculation means and the display means.

[0018] The fastening body includes, for example, a pair of flanges of pipes used in a plant and the like, and the present invention is not limited only to those exemplified ones.

[0019] The bolt is used as a tightening tool for tightening a fastening body. The bolt tightening training device according to the present invention can be preferably used for not only training of tightening of a bolt but also training of tightening of a nut. Accordingly, the bolt is described as the tightening tool for the sake of convenience in the present specification, and the concept of the bolt embraces not only a bolt but also a nut.

[0020] Examples of the tightening tool which can be used in the bolt tightening training device according to the present invention include, for example, a torque wrench, a spanner, an adjustable wrench, a box wrench and the like, and the present invention is not limited only to those exemplified ones.

[0021] Hereinafter, the bolt tightening training device according to the present invention will be described specifically with reference to drawings. However, the present invention is not limited only to the embodiments shown in the drawings.

[0022] Fig. 1 is a schematic explanatory view showing one embodiment of the bolt tightening training device according to the present invention. The bolt tightening training device shown in Fig. 1 includes a bolt tightening practice means 1, an arithmetic calculation means 5 and a display means 6 as main constituents.

[0023] The bolt tightening practice means 1 includes a torque detector 3, a tool-attached part 2 to which a tightening tool (not shown in the figure) is attached, and a strain gauge 4 for detecting a strain generated when the tightening tool is attached to the tool-attached part 2, and the tool-attached part 2 is tightened.

[0024] In the bolt tightening practice means 1, the tool-attached part 2 is disposed on one end of the torque detector 3, and the other end of the torque detector 3 is fixed. The strain gauge 4 is attached to an outer peripheral surface of the torque detector 3.

[0025] It is preferred that the tool-attached part 2 has a shape and a size corresponding to a shape and a size of a bolt which is used in an actual bolt tightening operation. In general, the tool-attached part 2 has a hexagonal cross-sectional shape as well as a bolt which is used in an actual bolt tightening operation. The tool-attached part 2 can be detachably disposed on the torque detector 3 so as to be able to carry out training in accordance with an actual bolt tightening operation. The tool-attached part 2 can be

configured so as to be exchangeable with another tool-attached part having a shape and a size corresponding to a shape and a size of a bolt which is used in an actual bolt tightening operation. When the tool-attached part 2 is detachably disposed on the torque detector 3, and the tool-attached part 2 is disposed so as to be exchangeable with another tool-attached part, a trainee can execute a training in accordance with an actual bolt tightening operation by exchanging the tool-attached part 2 with a tool-attached part having the same shape and size as a bolt which is used in the actual bolt tightening operation.

[0026] The tool-attached part 2 is disposed on one end of the torque detector 3, and the other end of the torque detector 3 is fixed, in which the other end is not shown in the drawing. When a tightening tool is attached to the tool-attached part 2, and a bolt tightening operation is carried out by, for example, rotating the tightening tool in a direction as indicated by an arrow A in Fig. 1 (in a clockwise direction), a stress is generated in the torque detector 3 of which one end is fixed, and the torque detector 3 is deformed. A strain generated due to the deformation of the torque detector 3 is proportional to a stress (torque) generated by rotating the tightening tool in carrying out a bolt tightening operation.

[0027] When bolt tightening is carried out by rotating the tightening tool, a strain is generated in the torque detector 3. The generated strain brings about a change in electric resistance of the torque detector 3. Accordingly, the strain gauge 4 can detect a minute change in voltage in the torque detector 3 when electricity is supplied to the torque detector 3. A change in voltage detected by the strain gauge 4 is transmitted to the arithmetic

calculation means 5 as an electric signal via an electric wire (not shown in the figure).

[0028] The arithmetic calculation means 5 is a unit for converting information into data, wherein the information is obtained by reading a strain with the strain gauge 4, in which the strain is generated when the tool-attached part 2 of the bolt tightening practice means 1 is tightened. In the arithmetic calculation means 5, a stress applied to the torque detector 3 is calculated based on intensity (voltage) of an electric signal transmitted from the strain gauge 4. As the arithmetic calculation means 5, for example, a computer or the like can be preferably used. A data of stress obtained by the arithmetic calculation means 5 is transmitted to the display means 6 as, for example, an electronic data via an electric wire (not shown in the figure).

[0029] The display means 6 is a unit for visualizing data obtained by the arithmetic calculation means 5. As the display means 6, for example, a monitor which can display a stress as a concrete numerical value, such as a digital liquid crystal monitor can be used.

[0030] Fig. 2 is a schematic perspective view showing one embodiment of the bolt tightening training device according to the present invention. In the bolt tightening training device shown in Fig. 2, the torque detector 3 and the tool-attached part 2 are attached to an upper surface of the bolt tightening training device, and a tightening tool 7 is attached to the tool-attached part 2. The tool-attached part 2 can be attached not to the upper surface of the bolt tightening training device but to a side surface of the bolt tightening training device.

[0031] A mounting base 8 for the bolt tightening training device is disposed

below the bolt tightening training device as shown in Fig. 2. The bolt tightening training device is connected with the mounting base 8 through stand poles 9a, 9b, 9c and 9d. According to Fig. 2, the stand poles 9a, 9b, 9c and 9d are formed of four poles. However, the stand poles can be formed of one to three poles.

[0032] It is preferred that any one of the stand poles 9a, 9b, 9c and 9d is rotatably attached to the bolt tightening training device so that the tool-attached part 2 of the bolt tightening training device is rotatable at an arbitrary angle in a horizontal direction or in a vertical direction as shown in Fig. 2. For example, according to the embodiment shown in Fig. 2, a recess (not shown in the figure) is formed on a lower end of the stand pole 9a, a projection (not shown in the figure) is formed on an upper end of the stand pole 9b, and the projection formed on the upper end of the stand pole 9b is inserted into the recess formed on the lower end of the stand pole 9a. The recess formed on the lower end of the stand pole 9a is connected with the projection formed on the upper end of the stand pole 9b by a bolt 10. The bolt tightening training device can be rotated at an arbitrary angle by rotating the stand pole 9a, in which the bolt 10 is used as a rotary shaft. When the bolt tightening training device is rotatably to the mounting base 8 as described above, since the tool-attached part 2 can be disposed on the upper surface or the side surface of the bolt tightening training device by rotating the bolt tightening training device at an arbitrary angle, there is an advantage in that the bolt tightening training device can be applied to various bolt attaching angles at which an actual bolt tightening operation is carried out in a plant and the like.

[0033] It is preferred that an extension and contraction mechanism 11 which enables movement of the bolt tightening training device in a vertical direction is provided to any one of the stand poles 9a, 9b, 9c and 9d in order to enable movement of the bolt tightening training device in a vertical direction. In the embodiment shown in Fig. 2, a lower end of the stand pole 9b is inserted into an opening existing in an upper end of the stand pole 9c in an extendable and contractable manner, and a lower end of the stand pole 9c is inserted into an opening existing in an upper end of the stand pole 9d in an extendable and contractable manner. The stand pole 9b can be extended or contracted by, for example, forming a screw thread on an outer peripheral surface of the stand pole 9b and on an inner peripheral surface of the stand pole 9c, respectively, threadedly engaging the stand pole 9b with the stand pole 9c, and rotating the stand pole 9b or the stand pole 9c. When the height of the bolt tightening training device can be freely adjusted as mentioned above, the bolt tightening training device can be applied to various bolt attaching positions at the time of carrying out an actual bolt tightening operation.

[0034] The display means 6 includes, for example, a digital display device and the like. When the digital display device is used as the display means 6, data obtained by the arithmetic calculation means can be digitally displayed with specific numerical values.

[0035] Incidentally, in the bolt tightening training device shown in Fig. 2, both of the torque detector (not shown in the figure) and the strain gauge (not shown in the figure) are incorporated in the bolt tightening training device.

[0036] When a trainee carries out a bolt tightening operation by rotating the tightening tool with the bolt tightening training device having the above construction according to the present invention, since a strain generated can be detected by the strain gauge attached to the outer peripheral surface of the torque detector, the trainee can properly learn a relationship between a stress which the trainee actually feels and an actual bolt tightening force. Accordingly, when the bolt tightening training device according to the present invention is used, since the trainee can grasp proper tightening of a bolt at the time of tightening the fastening body with the bolt in real time, the trainee can easily acquire a technique necessary for properly tightening a bolt while viewing a display screen of the display device.

EXPLANATION OF REFERENTIAL NUMBERS

[0037] 1: bolt tightening practice means

2: tool-attached part

3: torque detector

4: strain gauge

5: arithmetic calculation means

6: display means

7: tightening tool

8: mounting base

9a: stand pole

9b: stand pole

9c: stand pole

9d: stand pole

10: bolt

11: extension and contraction mechanism

CLAIMS

1. A bolt tightening training device which allows training for proper tightening of a bolt at the time of tightening a fastening body with the bolt, which comprises:

a bolt tightening practice means comprising a torque detector, a tool-attached part to which a tightening tool is attached, and a strain gauge for detecting a strain generated when the tightening tool is attached to the tool-attached part, and the tool-attached part is tightened, wherein the tool-attached part is disposed on one end of the torque detector, the other end of the torque detector is fixed, and the strain gauge is attached to an outer peripheral surface of the torque detector;

an arithmetic calculation means for converting information obtained by reading with the strain gauge a strain which is generated when the tool-attached part of the bolt tightening practice means is tightened into data; and

a display means for visualizing the data obtained in the arithmetic calculation means.

2. The bolt tightening training device according to claim 1, comprising a mounting base for the bolt tightening training device below the bolt tightening training device, wherein the bolt tightening training device is rotatably mounted on the mounting base so that the tool-attached part of the bolt tightening training device is rotatable at an arbitrary angle in a horizontal direction or in a vertical direction.

3. The bolt tightening training device according to claim 1 or claim 2, comprising a mounting base for the bolt tightening training device below the bolt tightening training device, wherein the bolt tightening training device is connected with the mounting base through an extension and contraction mechanism which is elevatable in a vertical direction.