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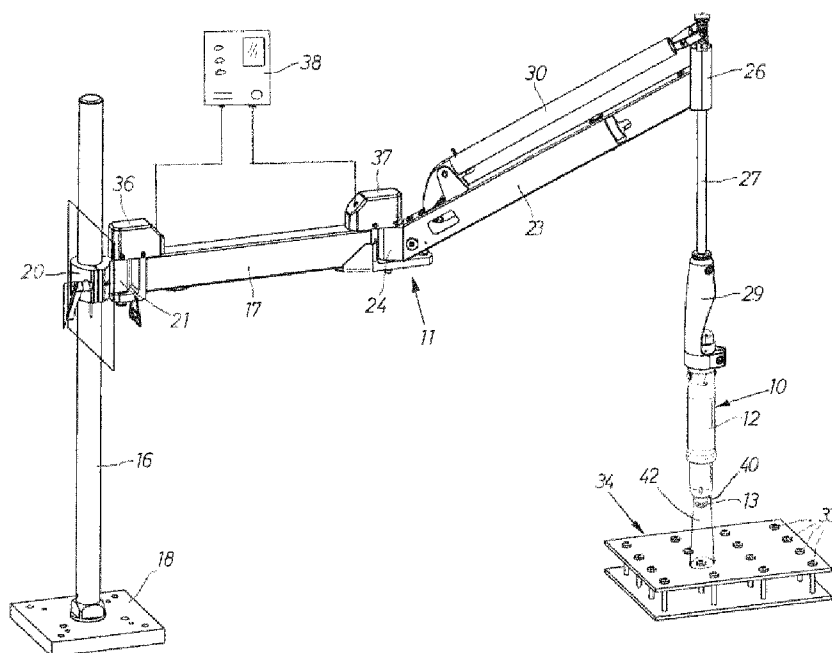
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(54) Title: A TIGHTENING SUPERVISING SYSTEM FOR A POWER SCREW DRIVER



(57) Abstract: A tightening supervising system for a power screw driver (10) which is connected to a reaction support (11) and movable between a number of screw joints (33) on an object (34) to be assembled, wherein the system comprises a process control unit (38) that is programmable with desired screw joint tightening data including the coordinates of the screw joints (33) to be tightened. The system is arranged to indicate the position of anyone of the screw joints (33) that is the next in sequence to be tightened according to a control unit (38) program, and a light emitting device (40) is provided on the power screw driver (10) and arranged to selectively direct a light beam onto that next screw joint in a programmed sequence. The light emitting device (40) is also arranged to direct a light beam onto a screw joint or joints that have been left unattended or indicated as unsatisfactory tightened according to the control unit (38) program.

A tightening supervising system for a power screw driver

TECHNICAL FIELD

The invention relates to a tightening supervising system for a power screw driver during tightening of a number of screw joints on an object to be assembled.

In particular the invention concerns a tightening supervising system for a power screw driver during tightening of a number of screw joints on an object to be assembled, wherein the system is programmable with tightening data and the position coordinates of the screw joints on an object to be assembled and comprises means for indicating selectively occurring unattended or erroneously tightened screw joints during the assembly of the object. The invention also concerns an indicating system for showing the operator which screw joint is the next to be tightened.

BACKGROUND

A problem concerned with this type of prior art power screw driver application is that the operator sometimes makes the mistake to believe that he/she has properly tightened all the screw joints on the object, whereas in fact screw joints erroneously may have been left unattended or unsatisfactory tightened. This could have a serious negative effect on the function and/or durability of the object or structure being assembled by the screw joints.

Another problem inherent in prior art assembly operations is for the operator to know in which order the screw joints shall be tightened for obtaining an acceptable quality on the object being assembled and in order not to leave anyone of the screw joints unattended during the operation. This could cause an incomplete assembly.

In order to avoid such problems prior art tightening supervising systems have some sort of display or warning light provided on a separate process control unit to alert the operator to awareness of the fact that a certain screw joint erroneously has been left unattended or unsatisfactory tightened. To find out which one of the screw joints was not properly tightened the operator had to move the power screw driver across the object and simultaneously look at the display or warning light on the process control unit to see in which one of the screw joint positions the alert signal was generated. This error tracing method is quite awkward and tends to prolong the assembly process unnecessarily. The operator had to remember himself which screw joint was the next to be tightened to obtain the desired assembly result.

SUMMARY OF THE INVENTION

It is an object of the invention to ensure a high and acceptable quality of an assembly process by providing a simple and time saving tightening supervising system for preventing screw joints on an assembled object from being tightened in an erroneous order or left unattended or unsatisfactory tightened during the assembly process.

It is a further object of the invention to ensure a high assembly process quality by providing a power screw driver with a tightening supervising system which is programmable with the position coordinates of the screw joints to be tightened, whereby the system is arranged not only to keep track on the correct number of screw joints that have been properly attended to but to indicate in a quick and easy way which screw joint or joints have not and to indicate in what order the screw joints should be tightened.

A still further object of the invention is to provide a tightening supervising system for a power screw driver, wherein the power screw driver is connected to an articulated reaction support provided with a position sensing means, wherein the system comprises a programmable control unit for identifying the

positions of each one of a number of screw joints to be tightened and to provide a quick and easily apprehensible indication on which screw joint or joints that have not been properly attended to and in what order the screw joints should be tightened during an assembly process.

Other objects and characteristic features of the invention will appear from the following specification and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention is described below with reference to the accompanying figure 1 which shows a perspective view of a tightening supervising system according to the invention.

DETAILED DESCRIPTION OF THE SHOWN EMBODIMENT

In figure 1 there is shown the tightening supervising system illustrated in the drawing and which includes a manually guided straight type power screw driver 10 and an articulated reaction support 11. The power screw driver 10 comprises an elongate tubular housing 12 intended to be used as a handle for manual guiding of the screw driver 10, and an output shaft 13 extending coaxially with the housing 12. The reaction support 11 comprises a vertical pillar 16 rigidly secured to a fixed structure by means of a base plate 18. An inner arm 17 is supported on the pillar 16 via a connection piece 20 which is vertically adjustable on the pillar 16. The arm 17 is movable relative to the connection piece 20 via a vertical axis pivot 21. An outer arm 23 is connected to the inner arm 17 via a vertical axis pivot 24 and has a certain upwardly slanting disposition. At the outer end of the arm 23 there is provided a vertically directed guide sleeve 26 for an axially displaceable support rod 27. The latter is rigidly connected to the power screw driver 10 via a connection piece 29 and has a non-circular cross section for transferring the torque reaction from the screw driver 10 to the support arm 23 via the guide sleeve 26. By rotating the arms 17

and 23 with respect to the pivots 21 and 24 the power screw driver 10 is displaceable over a certain area covering a work space suitable for assembly operations.

The upper end of the support rod 27 extends above the guide sleeve 26 and is connected to a balancing cylinder 30 which is connected at its lower end to the outer arm 23 and arranged to exert an upwardly directed thrust force on the support rod 27 to balance the total weight of the rod 27, the connection piece 29 and the power screw driver 10.

The power screw driver 10 is intended for tightening a number of screw joints 33 on an object 34 to be assembled. The object 34 which comprises two parts to be assembled is kept stationary in an exactly defined position during the screw joint tightening operations. The screw joints 33 are located at different positions on the object 34, and in order to obtain a desired clamping load on the parts of the object 34 the screw joints 33 may be tightened in a certain sequence.

The pivots 21 and 24 on the inner arm 17 and the outer arm 23, respectively, are provided with angle sensors 36 and 37 which are connected to a separate process control unit 38 and arranged to generate signals in response to the actual position of the power screw driver 10. The process control unit 38 is programmed with the number and the individual coordinates of the screw joints 33a-f of the object 34, and by using the signals generated by the angle sensors 36,37 the actual position of the power screw driver 10 is calculated. By comparing the calculated actual position of the screw driver 10 with the screw joint coordinates it can be determined which one of the screw joints is presently attended to by the screw driver 10 and whether the screw driver 10 has attended all of the screw joints on the object 34. If an assembly process has been completed without one or more screw joints have been attended to, i.e. one or more screw joints have been missed during the assembly process, there is generated a signal to alert the operator about the problem.

Such signal may be generated by a warning light or a buzzer on the process control unit 34.

The control unit 38 is also programmable with data by which the screw joints should be tightened and in which sequence the screw joints should be tightened, and if a deviation between the programmed data and the data actually experienced during tightening of each screw joint a faulty tightening operation is indicated. Such an indication initiates an alert signal to make the operator aware that a tightening error has occurred. Detailed information of the detected tightening error may be specified on a display on the process control unit 38.

In order to obtain quick and easily apprehensible information on which screw joint is the next to be tightened and or which screw joint have been left unattended or improperly tightened during the assembly process the power screw driver 10 is provided with a light emitting device 40 which is connected to the process control unit 38 and intended to be selectively lit up and direct a light beam onto a screw joint that is the next one to be tightened. In some application the absolute order of tightening of the screw joints is not crucial. In such cases all screw joints that has not yet been tightened will be lit up when the tool and lamp is located above them, such that a light beam will be directed onto a screw joint that is one of several that is the next one to be tightened.

The process control unit 38 may also be configured to control the light emitting device 40 to lit up and direct a light beam onto a screw joint on which screw joint the tightening has failed, possibly with another colour. As an alert signal is generated indicating that an error has been detected the operator only has to move the screw driver 10 across the assembled object 34 and the light emitting device 40 will selectively direct a light beam 42 onto the faulty screw joint or joints. Accordingly, the screw joint tightening sequence and a faulty screw joint or joints are clearly pointed out, and the

operator is quickly and easily informed which one of the screw joints has not been attended to in correct order or not been tightened properly during the assembly process. A correction of the faulty joint or joints may then be made to complete the assembly process such that the quality of the assembled object is guaranteed.

The process control unit 38 may also be configured to control the light emitting device 40 to lit up and direct a light beam of yet a different colour when all joints of work piece have been correctly tightened. The operation could e.g. involve the steps of lighting up a first joint to be tightened in a white light. Shifting the light to green when a desired target, such as a target torque has been met for said joint. Lighting a next joint to be tightened by a white light and shifting to green when the desired target has been met, or shifting to red if the desired target is not met, such that the operator is urged to repeat the tightening of the specific joint. When all joints have been correctly tightened a distinct light, e.g. a blue light, may be provided by the light emitting device 40 to indicate that all joints have been correctly tightened. The operator will then repeat the operation on a different work piece.

It is to be understood that the embodiments of the invention are not limited to the described example but may be freely varied within the scope of the claims. For instance, the reaction support may be of a different kind but still comprise means for determining the actual position of the power screw driver in relation to screw joints on an object to be assembled.

Claims

1. A tightening supervising system for a power screw driver (10) coupled to a position sensing system and movable between a number of screw joints (33) on an object (34) to be assembled, wherein the supervising system comprises a process control unit (38) connected to said position sensing system and programmed with desired screw joint tightening data including the coordinates of the screw joints (33),

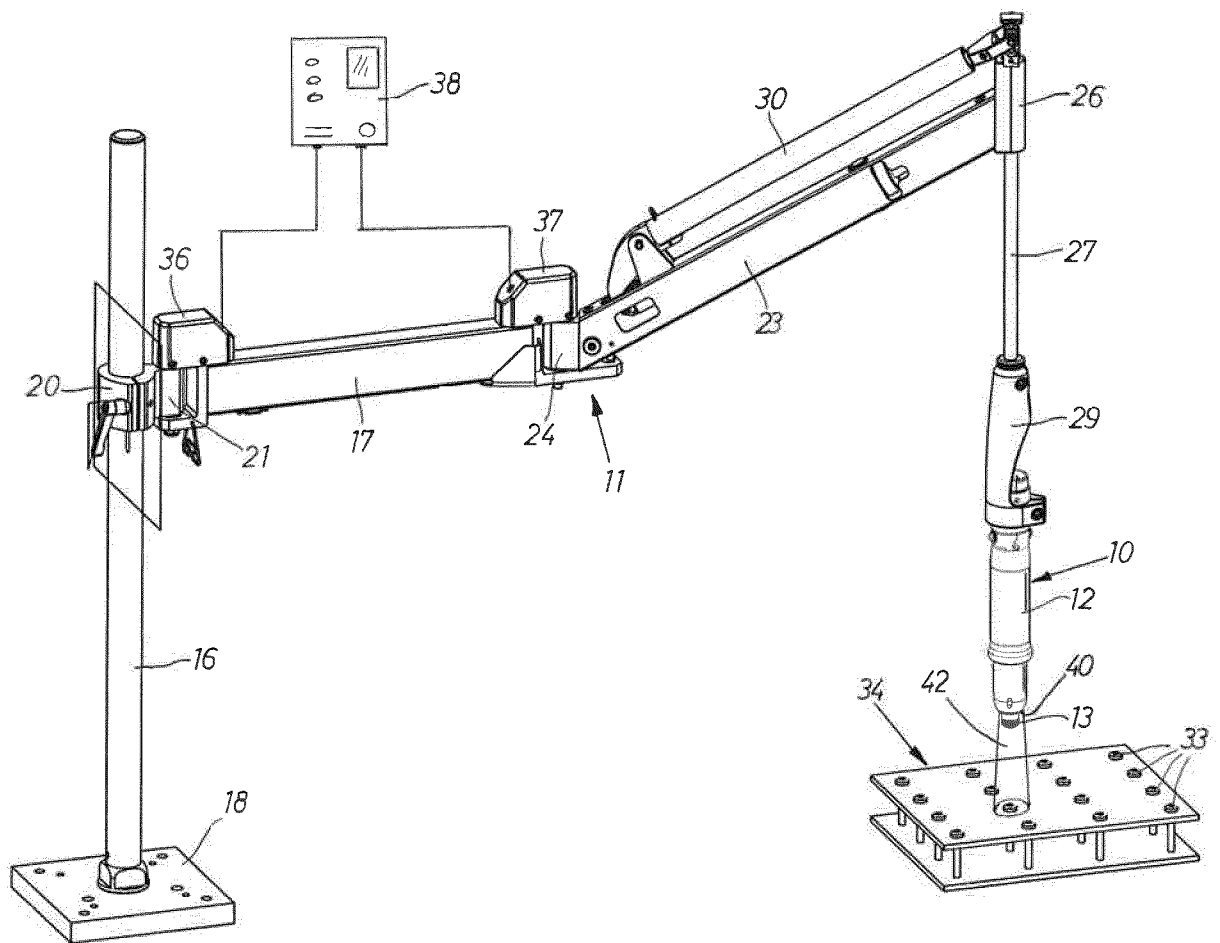
c h a r a c t e r i z e d in that the process control unit (38) is arranged to provide indications as to the position of the screw joints, and a light emitting device (40) is connected to the process control unit (38) and arranged to selectively direct a light beam (42) onto a screw joint to be the next in sequence to be tightened according to a control unit (38) program.

2 A tightening supervising system according to claim 1, wherein the light emitting device is arranged also to direct selectively a light beam onto a screw joint which is indicated by the process control unit (38) to have been left unattended or improperly tightened during assembly of the object (34).

3. A tightening supervising system according to claim 1 or 2, wherein said light emitting device (40) is provided on the power screw driver (10).

4. A tightening supervising system according to anyone of claims 1 - 3, wherein the power screw driver (10) is continuously connected to a fixed structure via a reaction support (11) while permitting free movability of the power screw driver (10), and said position sensing system includes sensors (36,37) provided on the reaction support (11) to provide signals corresponding to the actual position of the power screw driver (10).

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A. CLASSIFICATION OF SUBJECT MATTER
INV. B23P19/06 B25H1/00 B25B21/00 B25B23/14 G05B19/402
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B23P B25H B25B G05B B21J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

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Y	paragraphs [0007], [0020] - [0021], [0033], [0034], [0041] - [0044], [0054] - [0055]; figures 1-13	4
X	WO 2007/038740 A2 (VIRTEK VISION INTERNATIONAL IN [US]; MORDEN JARRAD V [CA]; UNDERHILL R) 5 April 2007 (2007-04-05) paragraphs [0017] - [0019], [0028], [0052] - [0054], [0087]; figures 1-10	1,2
X	US 2008/115589 A1 (DEROSE LYNN ANN [US] ET AL) 22 May 2008 (2008-05-22) paragraph [0013]; figures 1-4	1
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Further documents are listed in the continuation of Box C.



See patent family annex.

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INTERNATIONAL SEARCH REPORT

International application No
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