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CRIMPING TOOL

BACKGROUND OF THE INVENTION

Field of the invention

5 The present invention relates to a crimping tool which is used to crimp a crimping terminal.

Description of the prior art

10 In an operation for crimping a crimping terminal, there is often used a crimping tool which is operated by hand or by electricity. Also, such crimping tool is used not only to apply pressure directly to a crimping terminal using a gear mechanism or a link mechanism but also to apply pressure through oil pressure.

15 Now, description will be given below of a structure example of an electrically-operated oil-pressure crimping tool with reference to Fig. 9. This electrically-operated oil-pressure crimping tool is of a type that, using a piston 2 which can be moved forwardly from a main body 1, applies pressure to a crimping terminal set on a tool head portion 3. Specifically, a DC motor disposed in the interior of the main body is rotated
20 to thereby drive an oil-pressure pump through a planetary gear reduction mechanism, the oil-pressure pump feeds oil within an oil tank to an oil-pressure cylinder, so that the piston 2 can be moved forwardly from the main body 1.

25 In the present electrically-operated oil-pressure crimping tool, in case where a handle portion 4 is gripped by hand and

a trigger switch 5 is pressed with a finger, a drive current is supplied from a battery pack 6 to the DC motor to thereby move the piston 2 forwardly from the main body 1. Also, in case where an oil pressure removal button 7 is pressed with a finger, oil within the oil-pressure cylinder is relieved to the oil tank side, so that the piston 2 is pulled back by a spring.

By the way, in the above-mentioned conventional electrically-operated oil-pressure crimping tool, unless the piston 2 presses the crimping terminal with oil pressure of a given value or more, a normal crimping operation cannot be carried out. However, for example, even in case where oil pressure of a sufficient value cannot be output due to the end of the life of an oil pressure circuit of an oil-pressure pump and thus the piston 2 presses the crimping terminal with pressure of less than a given value, when the crimping terminal is observed after completion of the crimping operation, it is difficult to judge that the pressure of the piston 2 has been short and thus the normal crimping operation could not have been executed.

That is, in the conventional electrically-operated oil-pressure crimping tool, it is impossible to know exactly whether a sufficient value of pressure has been obtained in the crimping operation or not. Due to this, even in case where the pressure is short to thereby cause poor crimping in the crimping operation, there is no way to confirm the occurrence of such poor crimping.

Also, the above-mentioned problems are similarly found not only in the above-mentioned electrically-operated oil-pressure crimping tool but also in a crimping tool which can be operated by hand or by other kinds of driving power.

5 That is, the problems are not limited to the oil-pressure crimping tool.

SUMMARY OF THE INVENTION

The present invention aims at eliminating the drawbacks
10 found in the conventional crimping tool. Accordingly, it is an object of the invention to provide a crimping tool which not only can display pressure given in a crimping operation or the number of times of execution of crimping operations, whereby it is possible not only to judge easily whether any
15 poor crimping has occurred in a crimping operation or not but also to judge whether the pressure applied in the crimping operation has been normal or not, thereby being able to confirm positively the occurrence of poor crimping in the crimping operation.

20 In attaining the above object, according to the invention, there is provided a crimping tool, having a crimping operation information detect unit for detecting information concerning a crimping operation; a pressure judge unit for judging, in accordance with the information detected by the crimping
25 operation information detect unit, whether the pressure is normal

or abnormal; and, a notifying unit for notifying the judge result.

An operator, who uses the present crimping tool, is able to know easily whether the crimping operation has been executed normally or not. Also, the operator is also able to immediately
5 stop the crimping operation and take appropriate measures.

Also, in attaining the above object, according to the invention, there is provided a crimping tool having a crimping operation information detect unit for detecting information concerning a crimping operation; a display unit for displaying
10 quantity information; and, a display control unit for allowing the display unit to display the quantity information in accordance with information detected by the crimping operation information detect unit. An operator, who uses the present crimping tool, by referring to the quantity information display, is able to
15 judge easily whether the crimping operation has been executed normally or not as well as whether the maintenance of the present crimping tool is necessary or not.

By the way, a crimping tool according to the invention is not limited to a crimping tool which can obtain the pressure
20 thereof from the driving power of an electric motor but it may be a crimping tool which can obtain the pressure thereof by hand. Also, in a crimping tool according to the invention, oil pressure may be used or may not in order to obtain the pressure thereof.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows an embodiment of a crimping tool according to the invention; specifically, Fig. 1 is a block diagram of a circuit which detects the oil pressure of an oil-pressure cylinder and displays the thus detected oil pressure on an LED display device;

Fig. 2 shows an embodiment of a crimping tool according to the invention; specifically, Fig. 2 is a plan view of an electrically-operated oil-pressure crimping tool, showing the LED display device disposed in a main body thereof;

Fig. 3 shows an embodiment of a crimping tool according to the invention; specifically, Fig. 3 is a block diagram of a circuit which detects the drive current of a DC motor and displays the detected drive current on an LED display device;

Fig. 4 shows an embodiment of a crimping tool according to the invention; specifically, Fig. 4 is a block diagram of a circuit using an LED display device which can display bar graphs;

Fig. 5 shows an embodiment of a crimping tool according to the invention; specifically, Fig. 5 is a block diagram of a circuit which counts the number of times of execution of crimping operations and displays the count results on an LED display device;

Fig. 6 shows an embodiment of a crimping tool according to the invention; specifically, Fig. 6 is a block diagram of

a circuit which, when the oil pressure of the oil-pressure cylinder in the crimping operation increases up to a sufficiently high value, turns on an LED;

Fig. 7 shows an embodiment of a crimping tool according to the invention; specifically, Fig. 7 is a block diagram of a circuit which, when the drive current of the DC motor increases up to a sufficiently high value, sounds a buzzer;

Fig. 8 shows an embodiment of a crimping tool according to the invention; specifically, Fig. 8 is a block diagram of a circuit which, when the oil pressure of the oil-pressure cylinder in the crimping operation increases up to a sufficiently high value, turns on an LED and also displays the maximum value of the present oil pressure; and,

Fig. 9 is a side view of the whole structure of a conventional electrically-operated oil-pressure crimping tool.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In attaining the above object, according to the invention, there is provided a crimping tool having a crimping operation information detect unit for detecting information concerning a crimping operation; a pressure judge unit for judging, in accordance with the information detected by the crimping operation information detect unit, whether the pressure is normal or abnormal; and, a notifying unit for notifying the judge result.

An operator, who uses the present crimping tool, is able to

know easily whether the crimping operation has been executed normally or not. Also, the operator is also able to immediately stop the crimping operation and take appropriate measures.

By the way, a crimping tool according to the invention is not limited to a crimping tool which can obtain pressure from the driving power of an electric motor but it may be a crimping tool which can obtain pressure by hand. Also, in a crimping tool according to the invention, oil pressure may be used or may not in order to obtain the pressure thereof.

In a crimping tool according to the invention, as the crimping operation information detect unit, there can be used a pressure sensor for detecting pressure or an operation detector for detecting the execution of a crimping operation.

Also, in an electrically-operated crimping tool which generates pressure by driving an electric motor, although a pressure sensor may be used, there can also be used a current detector for detecting the drive current of the electric motor used when executing the crimping operation. A DC motor provides an almost linear relationship between the drive current and output torque thereof; and, in most of other types of electric motors as well, the drive current and output torque thereof are mutually related. Therefore, in case where the maximum value of the drive current is known, the maximum pressure applied to the crimping operation can be obtained by analogy and, using the pressure judge unit, it can be judged whether the crimping

operation has been executed normally or not. Also, in case where the current detector is used, there is eliminated the need to dispose a pressure sensor in the oil-pressure cylinder and, therefore, simply by modifying an electric circuit, the invention can be enforced easily.

By the way, an electrically-operated crimping tool according to the invention is not limited to a tool which directly applies pressure to the crimping terminal using the drive power of an electric motor, but it may also be a tool which applies pressure to the crimping terminal through oil pressure using the drive power of an electric motor.

However, of electrically-operated crimping tools, an electrically-operated oil-pressure crimping tool, which uses an electric motor to drive an oil-pressure cylinder to thereby generate pressure to be applied in a crimping operation, not only is simple in structure but also, even in case where various unit according to the invention are incorporated therein, can be made compact. That is, preferably, there may be used such electrically-operated oil-pressure crimping tool.

Also, as the electric motor, preferably, there may be used a DC motor. The reason for this is as follows: that is, since the DC motor has an almost linear relationship between the drive current and output torque thereof, circuits are easy to design and thus the DC motor is easy to control, and also a battery can be used as the power supply of the DC motor, which not only

allows an operator to carry the crimping tool with him or her but also permits the crimping tool to be used regardless of an operation place.

These crimping operation information detect unit may be used independently or may be used in combination; for example, a pressure sensor and an operation detector may be combined together, or, a current detector and an operation detector may be combined together.

In case where a pressure sensor is used as the crimping operation information detect member, the display control unit may be structured such that it allows the maximum pressure value detected by the present pressure sensor during one crimping operation to be displayed. In case where a current detector is used as the crimping operation information detect member, the display control unit may be structured such that it allows the maximum current value detected by the present current detector during one crimping operation to be displayed. Also, in case where an operation detector is used as the crimping operation information detect member, the display control unit may be structured such that it not only counts the number of times of execution of crimping operations detected by the present detector but also allows the count result to be displayed.

The display unit, which is used to display the quantity information, displays a numerical value or a quantity through a display state including three or more conditions. The display

of numerical values is executed, for example, by displaying single figures or more according to the decimal display system; and, such numerical value display has an advantage that the pressure value of oil pressure and the number of times of execution
5 of operations can be clearly shown to the operator. As a display device for displaying figures according to the decimal display system in this manner, for example, there can be used an LED (Light Emitting Diode) display device or a liquid crystal display device which uses a 7-segment display or a dot matrix display.

10 The display of quantities is executed by displaying the quantities of the numerical value information through graphical representation; and, such quantity display has an advantage that the pressure value of oil pressure and the number of times of execution of operations can be shown to the operator in an
15 intuitively-easy-to-understand manner. For example, when the numerical values such as the pressure values of the oil pressure are displayed, the operator must have knowledge about the range of the normal pressure values. However, in case where the pressure values are displayed by the quantity display system, the operator
20 can judge by intuition from proper indexes whether the pressure values are normal or not. As a display device for displaying the quantities through graphical representation, for example, there can be used an LED display device or a liquid crystal display device which, by enlarging or reducing lighted or
25 transmitted ranges which are continuous with one another,

displays the quantities in bar graphs or in circle graphs, using a 7-segment display or a dot matrix display. Also, the bar graphs or circle graphs can also be displayed stagelessly in an analog manner, for example, by rotating a cylinder or a disk
5 by a proper angle. Further, instead of the above enlargement or reduction of the ranges, the quantities can also be displayed through varying shades or colors.

The display unit for displaying the quantities includes a printer which prints the quantities on paper to thereby put
10 them on record.

In case where a pressure sensor is used as the crimping operation information detect unit, the pressure to be applied in a crimping operation is detected by the pressure sensor and the maximum value of the pressure is displayed by the display
15 unit. This allows the operator to judge easily whether a sufficient value of pressure has been applied by the crimping operation or not.

In case where a current detector is used as the crimping operation information detect unit, the drive current of a DC
20 motor in a crimping operation is detected by the current detector and the maximum value of the drive current is displayed by the display unit. Since the DC motor has an almost linear relationship between the drive current and output torque thereof, in case where the maximum value of the drive current is known, the maximum
25 oil pressure applied in the crimping operation can be found,

which makes it possible to judge easily whether the crimping has been executed with a sufficient value of pressure or not.

Also, because there is eliminated the need for provision of a sensor in the interior of an oil pressure cylinder, only by
5 modifying an electric circuit, the invention can be enforced simply. By the way, the display control unit can also be structured such that, instead of allowing the maximum value of the drive current to be displayed as it is, it allows the display unit to display the maximum value of the drive current
10 in the form of a numerical value converted into oil pressure.

In case where an operation detector is used as the crimping operation information detect unit, the execution of individual crimping operations is detected and the count results of the number of times of detection is displayed by the display unit.
15 Thanks to this, it is possible for the operator to confirm whether a poor condition can occur in the crimping operation due to the life of the crimping tool itself or the life of the headportion of the tool; and also, it is possible for the operator to know whether the crimping tool itself or the parts of the
20 tool must be replaced or not.

Also, according to the invention, there is provided a crimping tool having crimping operating information detect unit for detecting information concerning a crimping operation; pressure judge unit for judging in accordance with the information
25 detected by the crimping operation information detect unit

whether the pressure is normal or abnormal; and, notifying unit for notifying the judgment result. According to the present invention, a user, who uses the present crimping tool, is allowed to know easily whether the crimping operation has been executed normally or not. Further, in case where it is found that the crimping operation has been executed abnormally, the user is allowed to immediately stop the operation and take appropriate measures.

Further, in case where the crimping tool of the invention comprises not only the above-mentioned crimping operation information detect unit, pressure judge unit and notifying unit but also display unit for displaying quantity information and display control unit for allowing the display unit to display the quantity information. Therefore, a user, who uses the present crimping tool, is allowed to judge easily by referring to the thus displayed quantity information whether the crimping operation has been executed normally or not.

And, these crimping operation information detect unit may be used independently or may be used in combination; for example, a pressure sensor and an operation detector may be combined together, or, a current detector and an operation detector may be combined together.

Also, according to the crimping tool of the invention, the pressure sensor can also be used in combination with the current detector. In case where the pressure sensor and current

detector are used in combination, the value detected by the pressure sensor can be compared with the value detected by the current detector and thus the detected values can be corrected, which makes it possible to judge the pressure with more accuracy.

5 By the way, according to the invention, the crimping tool is not limited to a tool of an electrically-operated type that the pressure thereof can be obtained through the drive force of an electric motor. For example, the crimping tool may also be a tool of a type that the pressure thereof can be obtained
10 by hand. Also, the pressure may be obtained through oil pressure or not through the oil pressure.

As the crimping operation information detect unit for detecting information concerning pressure applied in a crimping operation, there can be used a pressure sensor for detecting
15 the pressure in the crimping operation; and, in the case of an electrically-operated crimping tool, there can be used a current detector for detecting the drive current of an electric motor.

Also, the pressure judge unit is unit which, in accordance
20 with a pressure value detected by the pressure sensor or a drive current value detected by the current detector, judges whether the pressure is normal or abnormal. For example, the pressure judge unit may be composed of a comparison circuit capable of setting a given voltage value or a given current value serving
25 as a standard for judgment, and a record circuit for recording

the normal or abnormal state of the pressure.

Further, the notifying unit is unit which notifies a user, who uses the present crimping tool, of the judgment results through lights or sounds. For example, in case where the pressure is found abnormal, an LED may be turned on or a buzzer may be sounded. Due to this, the user using the present crimping tool is allowed to know immediately whether the crimping operation is good or not. By the way, the notifying unit has only to notify at least one of the normal and abnormal judgment results.

According to the crimping tool of the invention, since the pressure detected by the crimping operation information detect unit is judged by the pressure judge unit, it is possible to know whether the crimping operation has been carried out normally or not. Such judgment result can be notified immediately to the user using the present crimping tool; and, at the same time, in the case of an electrically-operated oil-pressure crimping tool, there may be disposed unit which, when the crimping operation is found abnormal, shuts off the current and oil pressure system, so that the operation can be forcibly stopped immediately.

Also, the judgment results of the pressure may be put on record or, in case where there is disposed unit for transferring the record to a management department, thereby being able to add such recording function to the crimping tool. Thanks to this, the parts of the crimping tool, which has a possibility of being poorly crimped, can be collected before the present crimping

tool is delivered.

Now, description will be given below of the preferred embodiments of a crimping tool according to the invention with reference to the accompanying drawings.

5 Figs. 1 to 5 show an embodiment of a crimping tool according to the invention. Specifically, Fig. 1 is a block diagram of a circuit which detects the oil pressure of an oil-pressure cylinder and displays the thus detected oil pressure on an LED display device; Fig. 2 is a plan view of an electrically-operated
10 oil-pressure crimping tool, showing the LED display device disposed in a main body thereof; Fig. 3 is a block diagram of a circuit which detects the drive current of a DC motor and displays the detected drive current on an LED display device; Fig. 4 is a block diagram of a circuit using an LED display
15 device which can display bar graphs; and, Fig. 5 is a block diagram of a circuit which counts the number of times of execution of crimping operations and displays the count results on an LED display device.

Further, Figs. 6 to 8 also show the above embodiment of
20 a crimping tool according to the invention. Specifically, Fig. 6 is a block diagram of a circuit which, when the oil pressure of the oil-pressure cylinder in the crimping operation increases up to a sufficiently high value, turns on an LED; Fig. 7 is a block diagram of a circuit which, when the drive current of
25 the DC motor increases up to a sufficiently high value, sounds

a buzzer; and, Fig. 8 is a block diagram of a circuit which, when the oil pressure of the oil-pressure cylinder in the crimping operation increases up to a sufficiently high value, turns on an LED and also displays the maximum value of the present oil
5 pressure.

By the way, in the present embodiment, the composing parts thereof having similar functions to those of the conventional crimping tool shown in Fig. 9 are given the same designations.

In the present embodiment, description will be given below
10 of an electrically-operated oil-pressure crimping tool which is similar to the conventional crimping tool shown in Fig. 9.

In an electrically-operated oil-pressure crimping tool according to the present embodiment, as shown in Fig. 2, on the upper surface of a main body 1 thereof, there are disposed
15 an LED display device 8 and a display button 9. The LED display device 8 is a display device which displays six-figure numbers through the 7-segment display of an LED. And, the display button 9 is a switch which switches the on/off of the display by the LED display device 8.

20 Also, in the present electrically-operated oil-pressure crimping tool, as shown in Fig. 1, a pressure sensor 11 is mounted on an oil-pressure cylinder 10 which is disposed in the interior of the main body 1. The pressure sensor 11 is a sensor which detects the oil pressure in the interior of the oil-pressure
25 cylinder 10 for pressing against a piston 2. The pressure value

of the oil pressure detected by the pressure sensor 11 is transmitted to a peak hold circuit 12. This peak hold circuit 12 is a circuit which holds the maximum value of the oil pressure detected by the pressure sensor 11 and, by resetting a value held in the start time of a crimping operation, at the time of the end of the present crimping operation, is able to continue to output the maximum value of the oil pressure obtained during the present crimping operation. The maximum value of the oil pressure output by the peak hold circuit 12 is transmitted to a display driver 13. This display driver 13 is a circuit which allows the LED display device 8 to display the maximum value of the oil pressure output by the peak hold circuit 12 in the form of figures according to the decimal display system.

The detect value to be output by the pressure sensor 11 is an analog signal which is normally composed of a voltage value. And, the peak hold circuit 12, using an operational amplifier and a condenser, can be configured as an analog circuit which outputs the maximum value of the voltage value. Also, the display driver 13 is able to quantize the present maximum value and control the 7-segment displays of the respective figures numbers of the LED display device 8 to thereby display them as figures according to the decimal display system.

However, according to the present embodiment, the peak hold circuit 12 and display driver 13 are respectively composed of a microcomputer mounted on the back surface of a substrate

on which the LED display device 8 is disposed. Therefore, the detect value of the oil pressure output by the pressure sensor 11 is input to the analog input terminal of this microcomputer, where it is A-D converted and is thereby processed as a digital signal. Also, the peak hold circuit and display driver 13 are respectively composed of the program of the microcomputer. That is, in the case of the peak hold circuit 12, in the start time of a crimping operation, the initial value of the oil pressure is set in a given rewritable storage area; and, in each sampling, the detect value of the oil pressure input from the pressure sensor 11 is compared with the initial value set in the given storage area and, only when the detect value is larger than the initial value, the initial value is replaced with the present detect value, while such replacement processings are repeated, thereby being able to hold the maximum value of the oil pressure obtained during the present crimping operation after completion of the present crimping operation. In the display driver 13, for example, in the case of a dynamic display, in each display scan, the value set in the given storage area is read out and is converted into data for a 7-segment display, and on/off signals are sequentially output to the respective segments of the respective figures of the LED display device 8, thereby being able to display figures according to the decimal display system.

According to the above-structured electrically-operated oil-pressure crimping tool, in case where the operator presses

down the display button 9 to turn on the LED display device 8, whenever a crimping operation is completed, the maximum value of the oil pressure in the present crimping operation can be displayed by the LED display device 8. Therefore, by confirming
5 whether the present maximum value exceeds a given value and thus the oil pressure has been sufficient for the crimping or not, the operator is able to judge whether the crimping operation has been performed normally or not.

By the way, in the above-mentioned embodiment, in the case
10 of the crimping operation information detect unit, description has been given of a structure using the pressure sensor 11 disposed in the interior of the oil-pressure cylinder 10. However, this is not limitative but, for example, provided that it is capable of detecting the pressure of the piston 2, the pressure sensor
15 11 may also be disposed at any position on the oil pressure circuit, or the pressure sensor 11 may be disposed at a position where it is able to detect directly the pressure of the piston 2.

Also, as shown in Fig. 3, the drive current of a DC motor
20 14 disposed in the interior of the main body 1 may be detected by a current detector 15 and the present detect value may be used instead of the detect value of the pressure sensor 11. Since the DC motor 14 provides an almost linear relationship between the drive current and output torque thereof, by detecting
25 the drive current, it is possible to know the output torque

of the DC motor 14, that is, the oil pressure to be applied to the oil-pressure cylinder 10 by an oil-pressure pump. In the case of the structure shown in Fig. 3, the maximum value of the drive current is held by the peak hold circuit 12 and is displayed on the LED display device 8 through the display driver 13. In this case, the numeric value representing the maximum value of the drive current can also be displayed after it is converted into a numeric value representing the maximum value of the oil pressure. In case where the current detector 15 is used in this manner, not only there can be eliminated the need for use of the pressure sensor 11 which is expensive and troublesome to handle, but also there can be avoided the need for time and labor for sealing and fixing the pressure sensor 11 to the interior of the oil-pressure cylinder 10. That is, simply by modifying the electric circuit, the invention can be enforced at a low cost.

Also, in the above embodiment, description has been given of the LED display device 8 for displaying numeric values. However, as shown in Fig. 4, there can also be used an LED display device 16 which displays quantities. In this LED display device 16, twelve narrow and long LED display segments are arranged in a row and, as the value to be displayed increases, these twelve display segments are turned on sequentially in the order starting from the left side shown in Fig. 4, that is, the number of the turned-on or lighted display segments is increased in

this order to thereby display the values in a bar-graph manner.

Use of such LED display device 16 can provide the following advantage: that is, even when the actual value of the oil pressure or drive current necessary in the crimping operation is not known, in case where the number of the turned-on display segments exceeds nine but any one of the remaining three display segments disposed on the right end side in Fig. 4 and differing in the light emitting colors is not turned on, the operator can understand by intuition that a sufficient value of oil pressure has not been obtained; that is, there can be obtained an advantage that it is easy for the operator to judge whether the crimping operation has been executed normally or not. As the LED display device 16 for displaying quantities, there can be used not only an LED display device which displays the quantities in such a bar-graph manner as illustrated in Fig. 4 but also an LED display device which displays the quantities in a circular-graph manner.

Further, there can also be used a display device which can changes the light emitting colors or the light emitting intensities step by step or steplessly according to the values to be displayed.

Also, in the above embodiment, in the case of the display unit, description has been given of the structure using the LED display device 8 and the structure using the LED display device 16. However, there can also be used any other display unit, provided that it can display numeric values or quantities

using a display manner including at least three states; for example, there can be used an LED display device 8 and an LED display device 16 each of a dot matrix system. Further, the display unit is not limited to a display device using an LED
5 but it is also possible to use a liquid crystal display device.

Also, the display unit may be linked with a printer; that is, whenever a crimping operation is executed, the operation is printed on paper to thereby display the execution of the operation, so that the crimping operations, which have been executed
10 previously, can be put on record.

Also, in the above-mentioned embodiment, description has been given of the structure in which the oil pressure of the oil-pressure cylinder 10 and the pressure of the piston 2, or the drive current of the DC motor 14 having a given relationship
15 with respect to the oil pressure or the pressure is detected and the maximum value of the detected values is displayed. However, alternatively, as shown in Fig. 5, the execution of individual crimping operations can be detected by a crimping operation detector 17, the number of times of execution of the
20 crimping operations detected by the crimping operation detector 17 can be counted by a counter circuit 18, and the count results of the crimping operations can be displayed through the display driver 13 on the LED display device 8.

In actual execution of individual crimping operations,
25 there is a possibility that an operator continues to depress

the trigger switch 5, or presses back the trigger switch 5 suddenly,
or fails to execute a crimping operation and thus executes the
crimping operation again. Thus, it is not always easy for the
crimping operation detector 17 to detect the execution of the
5 individual crimping operations one by one with accuracy.
Therefore, the crimping operation detector 17 may be structured
such that it need not always detect the execution of the individual
crimping operations one by one with accuracy. For example,
the operation of the piston 2 may be detected by a microswitch;
10 that is, in case where the piston 2 advances a given distance
or more and then returns, it may be defined uniformly that one
crimping operation is completed. And, the start and completion
of the crimping operation may also be detected through the varying
patterns of the oil pressure in the interior of the oil-pressure
15 cylinder 10 or through the varying patterns of the drive current
of the DC motor 14. The counter circuit 18 and display driver
13 may be respectively composed of a logical circuit, or, similarly
to the above-mentioned embodiment, they may be composed of a
microcomputer. In case where the number of times of execution
20 of the crimping operations is counted and displayed in the above
manner, it is possible to confirm not only the need for replacement
of the parts of the electrically-operated oil-pressure crimping
tool but also the life of the electrically-operated oil-pressure
crimping tool itself in accordance with the thus displayed number
25 of times.

Further, what is displayed by the display unit such as the LED display device 8 is not limited to the maximum pressure value and the number of times of execution of crimping operations that are mentioned above, but other pieces of information concerning the crimping operations can also be displayed by the display unit. For example, in case where pressures respectively applied to the piston 2 in the respective crimping operations are time integrated and the thus integrated values are added up together and displayed, the life of the electrically-operated oil-pressure crimping tool can be surmised more accurately while differences between the habits of operators, differences between the materials and shapes of crimping terminals are taken into consideration.

Also, in the above-mentioned embodiment, description has been given only of the case in which, only when the display button 9 is depressed to turn on the display unit such as the LED display device 8, the numeric information can be displayed.

However, alternatively, the information can also be displayed independently of the display button 9. For example, such display can be executed when the main switch of the electrically-operated oil-pressure crimping tool is put into operation, or such display can be executed only for a given period of time after completion of each crimping operation. Also, there can be employed a structure in which, only when the cover of the main body 1 is removed, the display unit such as the LED display device 8 is

allowed to appear and carry out such display. Further, such display can be performed for a given period of time after the display button 9 is depressed. Or, the maximum pressure may be previously detected and the number of times of execution
5 of crimping operations may be previously counted using a microcomputer; and, these displays can be switched over to each other by pressing down the display button 9.

Further, in the above-mentioned embodiment, description has been given only of the case in which the numeric information
10 concerning the maximum pressure value and the number of times of execution of crimping operations are displayed by the display unit such as the LED display device 8. However, the present numeric information not only can be displayed by the display unit such as the LED display device 8 but also can be automatically
15 printed on paper by a printer each time the crimping operation is executed or can be printed while an operator is operating a printer. Also, when the maximum value does not reach a given value or when the number of times of execution of crimping operations exceeds a given value, an LED may be blinked in red
20 for display or alarm unit such as a buzzer may give an alarm.

Next, description will be given below of an embodiment shown in Fig. 6 of an electrically-operated oil-pressure crimping tool according to the invention. In Fig. 6, a pressure sensor 11 is mounted on an oil-pressure cylinder 10 which is disposed
25 in the interior of a main body 1. This pressure sensor 11 is

a sensor which is used to detect the oil pressure in the interior of the oil-pressure cylinder 10 for pressing against a piston 2. The pressure value of oil pressure detected by the pressure sensor 11 is transmitted to a comparison circuit 19. Also, 5 the output of the comparison circuit 19 is transmitted to a memory circuit 20, while the output of the memory circuit 20 is transmitted to an LED 21.

The detect value of the oil pressure to be output from the pressure sensor 11 is an analog signal which normally includes 10 a voltage value. And, the comparison circuit 19 can compare the voltage value of the oil pressure with a given voltage value V_{ref} using an operational amplifier and also can output a binary signal indicating whether the voltage value of the oil pressure exceeds the given voltage value V_{ref} or not. Also, in the case 15 of the memory circuit 20, for example, using a flipflop circuit, in the start time of a crimping operation, a reset signal is transmitted to a reset terminal RESET thereof to thereby previously prepare the memory circuit 20 so as to allow an abnormal signal to be output from an output terminal Q thereof as an 20 initial value. In case where a signal, which shows that the voltage value of the oil pressure during the crimping operation exceeds the given voltage value V_{ref} , is input to a set terminal SET once or more times, the memory circuit 20 can switch the state of the flipflop circuit to thereby allow a normal signal 25 to be output from the output terminal Q from that time on.

That is, in case where the voltage value of the oil pressure from the start of the crimping operation to the end thereof never exceeds the given voltage value V_{ref} , the memory circuit 20 continues to output an abnormal signal; and, on the other hand, in case where the voltage value of the oil pressure exceeds the given voltage value V_{ref} at least once, the memory circuit 20 outputs a normal signal. The given voltage value V_{ref} is a voltage value which is obtained when the minimum value for making the oil pressure value sufficiently high for a crimping operation is made to correspond to the detect value of the oil pressure of the pressure sensor 11. Now, an LED 21 is a light emitting diode element which is disposed on the upper surface of the main body 1 and has a green color as the light emitting color thereof. In case where a normal signal is output from the memory circuit 20, the LED 21 is turned on, which makes it possible to notify an operator that the crimping operation is completed.

However, in the present embodiment, the comparison circuit 19 and memory circuit 20 are respectively composed of a microcomputer mounted on a substrate which is disposed in the interior of the main body 1. Therefore, the detect value of the oil pressure output from the pressure sensor 11 is input to the analog input terminal of this microcomputer, where the detect value is A-D converted and is thereby processed as a digital signal. Also, the comparison circuit 19 and memory

circuit 20 are respectively composed of the programs of the microcomputers. That is, the comparison circuit 19 is composed of a program which, in each sampling, compares the detect value of the oil pressure input therein through the analog input terminal with its associated one of the given voltage values V_{ref} stored in the appropriate storage areas. In case where the detect value of the oil pressure is equal to or less than the given voltage values V_{ref} , the comparison circuit 19 executes no processing and, in case where the detect value of the oil pressure exceeds the given voltage values V_{ref} , the comparison circuit 19 shifts its control to the program of the memory circuit 20. The memory circuit 20 is composed of a program which rewrites the data of a specific output port. This output port is set in a data output state which, in the start time of a crimping operation, shows an abnormal state as an initial value. In case where the comparison circuit 19 judges that the detect value of the oil pressure exceeds the given voltage values V_{ref} , the output port is rewritten to a data output state which shows a normal state by the memory circuit 20. The LED 21 is connected to the present output port and, when data showing the normal state is output, the LED 21 can be turned on.

According to the above structured electrically-operated oil-pressure crimping tool, whenever one crimping operation is ended, the operator is able to know from the turned-on LED 21 that the oil pressure during the present crimping operation

has exceeded the given voltage value V_{ref} at least once and thus there has been obtained a sufficient output for the present crimping. Also, in case where the LED 21 is structured such that it can be turned on only when the crimping operation is executed normally, there can be eliminated a fear that occurrence of poor crimping can be overlooked when the LED 21 is not turned on due to its breakdown.

By the way, in the above-mentioned embodiment, description has been given of the case using the pressure sensor 11 that is disposed in the interior of the oil-pressure cylinder 10.

However, according to the invention, the pressure sensor 11 may be disposed at any position on the oil-pressure circuit, provided that it is able to detect the pressure of the piston 2; or, the pressure sensor 11 can also be disposed at such a position that permits direct detection of the pressure of the piston 2.

Also, as shown in Fig. 7, the drive current of a DC motor 14 disposed in the interior of the main body 1 may be detected by a current detector 15 and the thus detected value may be used instead of the detect value of the pressure sensor 11. Since the DC motor 14 has an almost linear relationship between the drive current and output torque thereof, by detecting the drive current, it is possible to know the output torque of the DC motor 14, that is, the oil pressure that is applied to the oil-pressure cylinder 10 by an oil-pressure pump. Also, it

is also possible to use any one of other electric motors than the DC motor 14, provided that it has a correlation between the drive current and output torque thereof. In the case of the structure shown in Fig. 7, the value of the drive current is compared with a given voltage value V_{ref} V by a comparison circuit 19 and the comparison result is transmitted through a memory circuit 20 to a buzzer 22. In this case, the drive current of the DC motor 14 is detected as a voltage value by the current detector 15; and, the given voltage value V_{ref} V is a voltage value which can be obtained when the minimum pressure value necessary for the oil pressure to be sufficiently high pressure for a crimping operation is made to correspond to the detected voltage value of the current detector 15. Use of such current detector 15 not only can eliminate the need for use of the pressure sensor 11 which is expensive and troublesome to handle, but also can avoid the time and labor to seal and fix the pressure sensor 11 to the interior of the oil-pressure cylinder 10. That is, only by modifying the electric circuit, the invention can be enforced at low cost.

The buzzer 22 is structured such that, when the memory circuit 20 outputs data showing a normal state, it gives out a sound to thereby notify the operator of the effect that a sufficiently large value of pressure has been obtained. However, such confirming sound may only be given for a short period of time and, therefore, preferably, after completion of the crimping

operation, a reset signal may be transmitted immediately to the memory circuit 20 to stop the sound. Also, the buzzer 22 may also be structured such that, only when the memory circuit 20 is outputting data showing an abnormal state even after
5 completion of the crimping operation, it can give out an alarm sound to thereby notify the operator of the effect that the pressing force of the crimping operation has been short. In such case where the shortage of the pressure of the crimping operation is notified, instead of the buzzer 22, an LED 21 may
10 also be blinked in red as an alarm light. However, to stop the confirming sound, or to give out the alarm sound, or to use the LED 21 as an alarm light, it is necessary to detect the completion of the crimping operation. The completion of the crimping operation can be detected by detecting, for example,
15 the operation of the piston 2. That is, in case where the piston 2 is advanced and returned by a given distance or more, it can be considered uniformly that one crimping operation is completed. Also, the completion of the crimping operation can be detected through the varying pattern of the oil pressure within the
20 oil-pressure cylinder 10 or through the varying pattern of the drive current of the DC motor 14.

Also, in the above-mentioned embodiment, description has been given of the case in which the judgment result of the normal or abnormal state of the crimping operation is notified to the
25 operator using the LED 21 or buzzer 22. However, there can

also be used other unit, for example, other visual or acoustic notifying unit and, in some cases, there can be used notifying unit which appeals to the sense of touch. Further, without using such notifying unit, or in combination with such notifying unit, the judgment result of the normal or abnormal state of the crimping operation can also be recorded in a memory or in other storage medium; or, only when it is judged that a certain crimping operation has been abnormal, its following crimping operations can be prevented from being executed.

Also, as shown in Fig. 8, the maximum value of oil pressure detected by the pressure sensor 11 can be displayed by an LED display device 16 of a seven-segment display type. In this case, the detect value of the pressure sensor 11 is transmitted to a peak hold circuit 12, where the maximum value is detected.

The peak hold circuit 12 is a circuit which holds the maximum value of the oil pressure detected by the pressure sensor 11.

As the peak hold circuit 12, for example, there can be used the analog circuit such as an operational amplifier or a condenser; and, the peak hold circuit 12 can also be composed of the program of a microcomputer. And, the maximum value of the oil pressure held by the peak hold circuit 12 is displayed as decimal figures through a display driver 13 by the LED display device 16. In case where the maximum value of the oil pressure in the crimping operation is displayed in this manner, the operator is able to know more specific information. For example, even in case

where a crimping operation is ended normally, when there has been output only the oil pressure that exceeds the necessary pressure only slightly, there can be surmised a high possibility that, in case where the crimping operation is repeated as it is, poor crimping can occur in the crimping operation. Here, there is shown the case in which, to display the maximum value of the oil pressure, there is used the LED display device 16.

However, it is also possible to use other display device such as a liquid crystal display device. Also, not only the numeric values may be displayed on the display device but also quantities corresponding to these numeric values may be displayed using bar graphs.

In the structure shown in Fig. 8, the comparison circuit 19 compares the maximum value of the oil pressure held by the peak hold circuit 12 with a given value to thereby check whether the former has exceeded the latter or not, and the comparison result the comparison circuit 19 is transmitted to the LED 21.

That is, here, since the peak hold circuit 12 holds the maximum value of the oil pressure, there is eliminated the need for use of the memory circuit 20. Also, in case where it is necessary to obtain only the judgment result by comparison, the memory unit such as the memory circuit 20 and peak hold circuit 12 is not always necessary. And, what is detected by the pressure sensor 11 is not limited to the oil pressure of the oil-pressure cylinder 10 but the pressure of the piston 2 can be detected

directly by the pressure sensor 11. Also, as shown in Fig. 7, the drive current of the DC motor 14 can be detected.

Also, in the above-mentioned embodiment, description has been given of the electrically-operated oil-pressure crimping tool. However, the invention can also be applied similarly to other oil-pressure crimping tools which can be operated by other drive power than the electric power or by hand. Further, the invention can also be applied to a crimping tool which does not use oil pressure.

As can be understood clearly from the foregoing description, according to the crimping tool of the invention, since information concerning a crimping operation such as the maximum pressure in the crimping operation and the number of times of execution of crimping operations is displayed as quantity information, it is possible to judge easily whether the crimping operation has been executed normally or not as well as whether the crimping tool needs maintenance or not.

Also, according to the crimping tool of the invention, because it is possible to judge whether the pressure in the crimping operation has been equal to or more than a given value, the possibility of occurrence of poor crimping in the crimping operation can be grasped with accuracy. For example, in case where a normal level of pressure has not been obtained, when such judgment result is notified to an operator, the operator is able to immediately stop the present crimping operation and

take appropriate measures. Also, in case where the present judgment result is recorded, the parts of the crimping tool, which hold the possibility of causing poor crimping, can be collected before the present crimping tool is delivered.

5 The description of Japanese Patent Application No. 2001-329299 filed on October 26, 2001 and 2001-329300 filed on October 26, 2001 including the specification, drawings and abstract is incorporated by reference in its entirety.

WHAT IS CLAIMED IS:

1. A crimping tool, comprising:

a crimping operation information detect unit for detecting
5 information concerning a crimping operation;

a display unit for displaying quantity information; and,

a display control unit for allowing the display unit to
display the quantity information in accordance with the
information detected by the crimping operation information detect
10 unit.

2. The crimping tool as set forth in Claim 1, wherein
the crimping operation information detect unit includes a
pressure sensor for detecting pressure of the crimping tool,
15 and the display control unit allows the display unit to display
the maximum pressure value detected during one crimping operation
by the pressure sensor.

3. The crimping tool as set forth in Claim 1, wherein
20 the crimping operation information detect unit includes an
operation detector for detecting execution of a crimping
operation, and the display control unit counts the number of
times of the execution of crimping operations detected by the
operation detector and allows the display unit to display the
25 count results.

4. The crimping tool as set forth in Claim 1, further comprising an electric motor for generating a pressing force.

5 5. The crimping tool as set forth in Claim 4, wherein the crimping operation information detect unit includes a current detector for detecting the drive current of the electric motor, and the display control unit allows the display unit to display the maximum current value detected during one crimping operation
10 by the current detector.

6. The crimping tool as set forth in Claim 4, further including an oil-pressure pump drivable by the electric motor to generate a pressure,

15 wherein the crimping operation information detect unit includes an oil pressure sensor disposed in the oil pressure pump for detecting the pressure, and the display control unit allows the display unit to display the maximum pressure value detected during one crimping operation by the oil pressure sensor.

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7. The crimping tool as set forth in Claim 4, wherein the crimping operation information detect unit includes an operation detector for detecting execution of a crimping operation, and the display control unit counts the
25 number of times of the execution of crimping operations detected

by the operation detector and allows the display unit to display the count results.

8. A crimping tool, comprising:

5 a crimping operation information detect unit for detecting information concerning a crimping operation; and,

a pressure judge unit for judging, in accordance with information detected by the crimping operation information detect unit, whether pressure is normal or abnormal.

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9. The crimping tool as set forth in Claim 8, wherein the crimping operation information detect unit includes a pressure sensor for detecting the pressure, and the pressure judge unit judges, in accordance with a pressure value detected by the pressure sensor, whether the pressure is normal or abnormal.

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10. The crimping tool as set forth in Claim 9, further comprising a notifying unit for notifying the normal or abnormal judgment result obtained by the pressure judge unit.

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11. The crimping tool as set forth in Claim 9, further comprising a display unit for displaying quantity information; and, a display control unit for allowing the display unit to display the maximum pressure value detected during one crimping operation by the pressure sensor.

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12. The crimping tool as set forth in Claim 8, further including an electric motor for generating pressure of the crimping tool.

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13. The crimping tool as set forth in Claim 12, wherein the crimping operation information detect unit includes a current detector for detecting the drive current of the electric motor, and the pressure judge unit judges, in accordance with a current value detected by the current detector, whether the pressure is normal or abnormal.

14. The crimping tool as set forth in Claim 13, further comprising a notifying unit for notifying the normal or abnormal judgment result obtained by the pressure judge unit.

15. The crimping tool as set forth in Claim 13, further comprising a display unit for displaying quantity information; and, a display control unit for allowing the display unit to display the maximum current value detected during one crimping operation by the current detector.

16. The crimping tool as set forth in Claim 12, wherein the crimping operation information detect unit includes a pressure sensor for detecting the pressure, and the pressure

judge unit judges, in accordance with a pressure value detected by the pressure sensor, whether the pressure is normal or abnormal.

17. The crimping tool as set forth in Claim 16, further
5 comprising a notifying unit for notifying the normal or abnormal judgment result obtained by the pressure judge unit.

18. The crimping tool as set forth in Claim 16, further
comprising a display unit for displaying quantity information;
10 and, a display control unit for allowing the display unit to display the maximum pressure value detected during one crimping operation by the pressure sensor.