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(54) **A METHOD FOR MONITORING A PRESSING OR CRIMPING PROCESS**

(57) A method for monitoring a pressing or crimping process performed on two work pieces, performed with a handheld pressing device, comprising: providing a pressing device including a pressing tool or crimping tool having a plurality of jaws, wherein one of the jaws coupled to the pressing tool or crimping tool, a drive adapted to drive the coupled jaw to apply a force to the work pieces; providing a sensor system adapted to measure data re-

lated to the force applied to the workpiece over a basically full pressing operation cycle; providing a controller adapted to assess if the measured data in step b) match the stored data in a memory unit of the pressing device; analysing, by the controller, the amount of deviation from the stored data to evaluate if the operation was successful or not.

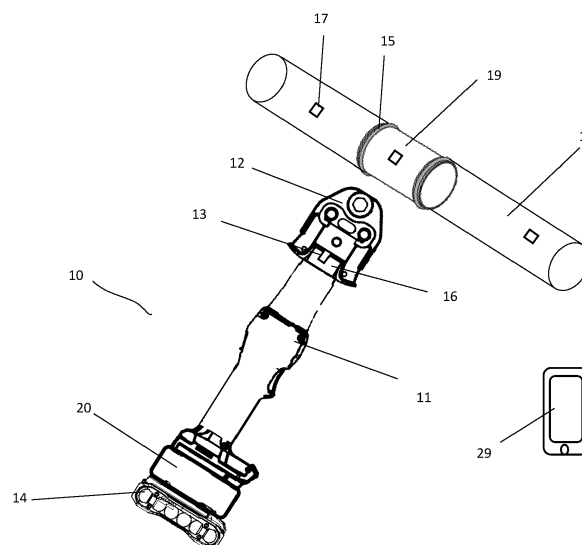


Fig. 1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a method for monitoring a pressing or crimping process which includes pressing operation is for joining pipe and fittings by pressing and/or the crimping operation for the electrical cables and connectors by crimping.

BACKGROUND OF THE INVENTION

[0002] There are different types of pressing or crimping tools available on the market today that all are intended to provide the joining between two work pieces, such as a pipe and a pipe fitting by pressing, or an electronic cable and a connector by crimping. For example, in US 6 662 621 B, a pressing tool apparatus and a control method are disclosed. The tool apparatus comprises sensors that are configured to verify that the clamping pincer is moved the correct distance to ensure the desired deformation of the end fitting or coupling when a predetermined pressure is applied.

[0003] However, the current tools known from the prior art are not able to evaluate the final press or crimp quality, if the used combination of the pressing or crimping tool, jaws, and fittings or connectors is correct or not, if there is any damage or defect in the tool, jaw, fittings or connectors. At most, current tools known from the prior art can only detect if the tool has performed the press or crimp with sufficient pressure or force.

[0004] Therefore, there is a need for further improved methods for monitoring a pressing or crimping operation to ensure an even higher accuracy in the crimping or pressing operation to ensure the desired mechanical and electrical properties.

SUMMARY OF THE INVENTION

[0005] An object of the present invention is to provide a method for monitoring a pressing or crimping process where an end fitting or coupling is secured to a pipe by a pressing tool or a crimping tool, which can then assess if the press or crimp operation was successful or not.

[0006] According to one embodiment of the present invention, a method for monitoring a pressing or crimping process performed on two work pieces, performed with a handheld pressing device, comprising:

- a) providing a pressing device including a pressing tool or a crimping tool having a plurality of jaws, wherein one of the jaws coupled to the pressing tool or crimping tool, a drive adapted to drive the coupled jaw to apply a force to the work pieces;
- b) providing a sensor system adapted to measure data related to the force applied to the workpiece over a basically full pressing operation cycle;
- c) providing a controller adapted to assess if the

measured data in step b) match the pre-stored data in a memory unit of the pressing device;

d) analysing, by the controller, the amount of deviation of the measured data from the stored data to evaluate if the operation was successful or not.

[0007] According to the monitoring method as described above, the controller will compare the measured data of the pressing operation collected by the sensor systems to the pre-stored data which have been stored in the memory unit in advanced. If the measured data match with the stored data, the amount of the deviation of measured data from the stored data being close to zero, the pressing operation will be regarded as successful. However, if the measured data have a deviation of high amount from with the stored data, then the pressing operation will be regarded as failed. Deviation from the stored data will help in detecting the success of the crimp or press operation more accurately.

[0008] According to a preferred embodiment of the present invention, the method further comprises the controller further assessing if the operation failure was due to wrong combination of pressing tool/crimping tool, jaws and/or fittings, or if there is any damage to the pressing/crimping tool, jaw or work pieces based on analysing the amount of deviation of the measured data from the stored data. For failed operation, the controller can analyse if there is any damage to the pressing tool or crimping tool, or if there is any damage on the jaw, or there is any damage on the fitting or connector by comparing the measured data with the pre-stored data of a correct operation which is stored in the memory of the tool, or an external device attached to the tool.

[0009] According to another preferred embodiment of the present invention, the method further comprises indicating to a user with an audio and/or visual feedback about the pressing or crimping operation failure. In order to achieve a reliable pressing, it is necessary to ensure the proper functionality of the pressing device.

[0010] According to another preferred embodiment of the present invention, for the pressing tool, the work pieces include a pipe and a fitting. For crimping tool, the work pieces include a cable and a connector.

[0011] According to another preferred embodiment of the present invention, the sensor system includes a strain gauge arranged on a head of the pressing tool or crimping tool close to a locking pin of the pressing jaw coupled to the pressing tool or crimping tool. By using an integrated sensor, like a strain gauge on the head of pressing tool or crimping tool close to the locking pin where the stress is the highest, it can be assessed if the press or crimp operation was successful or not.

[0012] Preferably, the measured data are strain values or deformation patterns.

[0013] According to another embodiment of the present invention, the method further comprises identifying the pressing devices before the pressing operation by a data collecting element provided with the pressing

device. Thus, it is possible to optically collect data specific to press joints, devices, or users. The optically collected data can be documented and read out at any later time.

[0014] Preferably, the data collecting element includes a scanner being configured to scan coding means 17, such as NFC tags, RFID tags, bar codes, data matrix codes or any combination thereof on the jaws and/or on the work pieces, in particular the press fitting, the pipe and/or the connectors, in order to identify the jaws used and/or the work pieces. Suitable distinguishing marks are colour marks, special characters or also barcodes or QR codes allow for a simple identification of the jaw and work pieces used. This allows for a simplified identification of the jaw and work pieces used in the pressing application. Further preferably, the data collecting element includes an input unit, being configured to receive the data of the pressing tool or crimping tool input manually by a user. The input unit may in particular be an internal display device to display the data of pressing tool or crimping tool. Storing data of pressing tool in advances allows the user select manually via the display device at a later time.

[0015] According to another embodiment of the present invention, the data collecting element is provided on an adapter which is configured to be attached to the pressing tool mechanically and/or electronically. In the context of the present invention, the adapter according to the present invention will preferably also be referred to as "external adapter". Using such an external adapter that can be attached to pressing tool or crimping tool can increase the adaptability of a pipe pressing device to different desired specifications in combination with a cost saving flexibility for the tool manufacturer who will be able to offer pressing tools with a wide range of specifications based on just a few basic tool models.

[0016] According to another preferred embodiment of the present invention, that the memory unit is also provided on the adapter. During each pressing operation, the data collecting element collects data specific to the jaws and work pieces, in particular to the pipe and fittings. During each crimping operation, the data collecting element collects data specific to the jaws and connectors. The data collected are stored in a memory unit and are associated to a defined pressing operation or crimping operation. It is thus possible later to prove the pressing operation or crimping operation and the proper execution thereof.

[0017] According to yet another embodiment of the present invention, both the identification data collected by the data collecting element and/or the measured data collected by the sensor system are transmitted in a wireless manner, in particular, via WLAN, Bluetooth, IR transmission or radio transmission to an external device by a transmission unit provided on the adapter. This external device may in particular be a laptop computer, a tablet PC or a smart phone. After performing the pressing operation, the data from the pressing tool will be transferred to the adapter, which will then tabulate and/or sequence all the information, which can then be read out via a com-

puter or a mobile device. This allows the manufacturer to perform a remote diagnosis. Further, the collected data can thus be stored for safe access so that they may be used as evidence if needed at a later time.

[0018] In a second aspect, the present invention further provides a pipe pressing device is designed to perform the method described above. The pipe device is used for jointing two work pieces, in particular a pipe and a press fitting, by pressing, comprising a pressing tool having a plurality of pressing jaws, wherein one of the pressing jaws coupled to the pressing tool, a drive adapted to drive the coupled pressing jaw to apply a force to the workpieces; a sensor system adapted to measure a data related to the force applied to the workpiece over the full pressing operation cycle; a controller; and a data collecting element.

[0019] Alternatively, a pipe pressing device is for joining two work pieces, in particular an electronic cable and a connector, by crimping, comprising a crimping tool having a plurality of jaws, wherein one of the jaws coupled to the crimping tool, a drive adapted to drive the coupled jaw to apply a force to the workpieces; a sensor system adapted to measure a data related to the force applied to the workpiece over the full crimping operation cycle; the pipe pressing device is designed to perform the method for monitoring the crimping operation.

[0020] According to a preferred embodiment of the present invention, an adapter is attached to the pressing tool or crimping tool mechanically and/or electronically, wherein the adapter comprises a scanner, a memory unit, an input unit, a controller and a transmitter unit.

BRIEF DESCRIPTION OF THE FIGURES

[0021] The embodiments mentioned can be better understood through the following detailed description while perusing the accompanying drawings. It is emphasized that the various components are not necessarily drawn to scale. In fact, dimensions can be enlarged or reduced at will for the purposes of clear discussion. In the drawings, identical reference labels denote identical elements.

Fig. 1 is a simplified schematic drawing of the pressing device provided in an embodiment of the present invention.

Fig. 2 is a simplified schematic drawing of the pressing device in the second embodiment of present invention.

Fig. 3 is simplified flowchart to show the workflow of the pressing device.

DETAILED DESCRIPTION OF THE INVENTION

[0022] Refer to fig. 1, according to one embodiment of the present invention, the handheld pressing device 10

is used for joining two work pieces, in particular a pipe 18 and a press fitting 19, by pressing. The pipe pressing device 10 comprises a pressing tool 11 with a plurality of jaws 12. The pressing tool 11 also includes a converting unit and a drive (not shown). A battery pack 14 is detachably mounted on the pressing tool 11 to supply power to the electric motor.

[0023] In a pressing operation, the jaws 12 of the pressing tool 11 are pressed apart at the rear part, i.e. on the side facing the drive. Thereby, the jaws 12 are pivoted about the pivot pins so that the jaws 12 approach each other at the front part, i.e. on the side averted from the drive. Thereby, a compression is achieved. Due to the pressing movement of the pressing tool 11, a press fitting 19 is joined with a pipe 18 by pressing and is thus joined with the same in a reliable and tight manner. A sensor system 13 is provided with the pressing device adapted to measure a data related to the force applied to the work-piece over the basically full pressing operation cycle. In particular, the sensor system includes a strain gauge arranged on a head 16 of the pressing tool 11 close to the pivoted pin of the jaw 12 coupled to the pressing tool 11. By using an integrated sensor system 13, e.g., a strain gauge on the head 16 of the pressing tool 11 close to the pivoting pin where the stress is the highest, it can then assess if the press operation was successful or not.

[0024] According to one embodiment of the present invention, an adapter 20 for pressing device for joining two work pieces is provided. The adapter 20 can be mechanically and/or electrically mounted onto between the housing 13 of the pressing tool 11 and the battery pack 14. By providing an external adapter 20 for a pressing device 10, the adapter 20 is easily to be attached to the pipe pressing tool 11, no change in the designs of either the battery pack 14 or the pressing tool 11 is necessary, and thus no additional costs are incurred. Also, the external adapter 20 is adapted to work with various pressing tools on a same platform, which means the interfaces between these pressing tools 11 and battery pack 14 are same.

[0025] The adapter 20 comprises at least one data collecting element for identifying the data of the jaw 12 and work pieces 15, and a memory unit 24 for storing the collected data. According to a preferred embodiment of the present invention, the at least one data collecting element is a scanner 25. In particular, the scanner 25 is for reading optical coding means 17 provided on the jaw 12, the end of the pipe 18 and the press fitting 19. The optical coding means 17 may be NFC tags, RFID tags, bar codes, data matrix codes or any of the combination. This allows for a simplified identification of the jaw and work pieces used in the pressing application.

[0026] Preferably, the adapter 20 may comprise an input unit 26. The input unit 26 may comprises an internal display device being configured to select the data of the pressing tool 11 which have been stored in the memory unit 24 of the adapter 20 in advance. Prestoring data of pressing tool 11 in advances allows the user select man-

ually via the display device at a later time. For example, the data of the pressing tool 11 can be input by a user, then the data such as, type, name, serial number, last service of the pressing tool 11 used will be collected.

[0027] Further, the adapter 20 comprises transmission unit 27 adapted to be connected to an external device 29 to transmit the collected data to the external device 29. Here, the information result from the collected data transmitted from the adapter 20 by the transmission unit 27 via Bluetooth. An overview of the collected data of the pressing operations stored in the memory unit 24 is reached via the external device 29. Hence, for each single pressing operation, the data can be well documented and/or read out at any time. It is thus possible at a later time to prove the pressing operation and the proper execution thereof.

[0028] Alternatively, different to the external adapter, an internal module comprising a scanner, a memory unit, an input unit, a controller and a transmitter unit is integrated into the pressing tool 11. Such an internal module can perform the same functions to the external adapter 20.

[0029] Now referring to Fig.2, according to the other embodiment of the present invention, the handheld pressing device 10 is used for joining two work pieces, in particular a connector 30 and a cable 32, by crimping. The pressing device 10 comprises a crimping tool 11' with a plurality of jaws 12. It is well known in the art that crimping tool for joining the electrical cables and connectors while pressing tool is used for joining fitting and pipes. Basically, the difference between a pressing tool and a crimping tool is only internal structures and mechanisms, otherwise the outer appearance could be exactly same. Thus, except for working pieces 15 in the embodiment shown as in fig.2 are in particular are connector 30 and electronical cable 11', the rest are all same to the first embodiment as described above and shown in fig. 1 that are omitted to repeat here.

[0030] In the other aspect, the present invention further provides a method for monitoring and documenting pressing operations performed on two work pieces. The monitoring method could be performed either in a pressing operation by a pressing tool or in a crimping operation by a crimping tool. The monitor method is basically same with pressing operation and crimping operation. Pressing operation would be taken as an example of the method of the present invention for monitoring and documenting the pressing operation for illustration.

[0031] Before the pressing operation - identifying the pressing devices 10 before pressing operation by a data collecting element provided with the pressing device. For example, using the scanner 25 to scan coding means 17, such as NFC tags, RFID tags, bar codes, data matrix codes or any combination thereof on the jaws 12 and/or on the work pieces 15, in particular, the press fitting 19 and the pipe 18, in order to identify the jaw12 and/or the press fitting19 and the pipe 18. Furthermore, the user could input the data of the pressing tool 11 used manually

by the input unit 26 provided on the adapter 20 to identify the data of the pressing tool 11 used.

[0032] During the pressing operation, the sensor system 13, in particular, a strain gauge measures the strain value or deformation patterns over a basically full pressing operation cycle. The controller 28 will assess if the strain value or deformation patterns match the pre-stored data in the memory unit 24. In particular, the controller 28 compares the measured data collected by the sensor system 13 and compare it to the stored data. If the measured data match with the stored data, no deviation of the measured data from the pre-stored data, the pressing operation will be regarded as successful. However, if the measured data have an amount of deviation from with the stored data, the pressing operation will be regarded as having failed.

[0033] According to another preferred embodiment of the present invention, the method further comprises that the controller 28 further assessing if the operation failure was due to wrong combination of the pressing tool 11, jaw 12 or work pieces 15; or if the operation failure was due to damage on the head 16 of the pressing tool 11, jaw 12 or fitting 19 based on analysing the amount of deviation of the measured data from the stored data. For failed operation, the controller 28 can analyse if there is any damage on the pressing tool, or if there is any damage on the Jaw 12, or there is any damage to the fitting 19 or connector 30 by comparing the measured data with the pre-stored data of a correct operation which is stored in the memory unit 24 of the adapter 20.

[0034] Furthermore, the method further comprises indicating to a user with an audio and/or visual feedback about the pressing operation failure. For example, a buzzing or a led indicator is provided on the adapter 20.

[0035] After the pressing operation, the adapter 20 may be connected to an external device 29. both the identification data collected by the adapter 20 and/or the measured data collected by the sensor system 13 are transmitted in a wireless manner, in particular via WLAN, Bluetooth, IR transmission or radio transmission to an external device 29. This external device 29 may in particular be a laptop computer, a tablet PC or a smart phone. As provided by the invention, this offers the advantage of a simple operation, while at the same time enabling a high degree of portability. This allows the manufacturer of the pressing device 10 to perform a remote diagnosis. Further, the collected data can thus be stored for safe access, so that they may be used as evidence if needed at a later time.

[0036] As stated above, although demonstrative embodiments of the present invention have already been explained herein with reference to the accompanying drawings, the present invention is not limited to the particular embodiments described above; many other embodiments are possible, and the scope of the present invention should be defined by the claims and their equivalent meaning.

Claims

1. A method for monitoring a pressing or crimping process performed on two work pieces (15), performed with a handheld pressing device (10), comprising:
 - a) providing the pressing device (10) including a pressing tool (11) or a crimping tool (11') having a plurality of jaws (12), wherein one of the jaws coupled to the pressing tool (11) or crimping tool (11'), a drive adapted to drive the coupled jaw (12) to apply a force to the work pieces (15);
 - b) providing a sensor system (13) adapted to measure a data related to the force applied to the workpiece over the full pressing or crimping operation cycle;
 - c) providing a controller (28) adapted to assess if the measured data in step b) match the pre-stored data in a memory unit (24) of the pressing device (10);
 - d) the controller (28) analysing the amount of deviation of the measured data from the stored data to evaluate if the pressing or crimping operation was successful or not.
2. The method according to claim 1, **characterized in that** the method further comprises the controller (28) further assessing if the operation failure was due to wrong combination, or if the operation failure was due to damage of the pressing tool (11) or crimping tool (11'), jaw (12) or work pieces (15) based on analysing the amount of deviation of the measured data from the stored data.
3. The method according to claim 2, **characterized in that** the method further comprises indicating to a user with an audio and/or visual feedback about the pressing operation failure.
4. The method according to claim 1 or 2 or 3, **characterized in that** the sensor system (13) includes a strain gauge arranged on a head of the pressing tool (11) or crimping tool (11'), close to a locking pin of the jaw (12) coupled to the pressing tool (11) or crimping tool (11').
5. The method according to claim 4, **characterized in that**, the measured data are strain values or deformation patterns.
6. The method according to any one of claims 1-5, **characterized in that** the method further comprises identifying the pressing device (10) by a data collecting element before pressing or crimping operation.
7. The method according to claim 6, **characterized in that** the data collecting element includes a scanner

(25) being configured to scan coding means (17), such as NFC tags, RFID tags, bar codes, data matrix codes or any combination thereof on the jaws (12) and/or on the work pieces (15).

8. The method according to claim 6, **characterized in that** the data collecting element includes an input unit, being configured to receive the data of the pressing tool (11) or crimping tool (11') manually input by a user. 5 10
9. The method according to claim 6 or 7 or 8, **characterized in that** the data collecting element is provided on an adapter (20), wherein the adapter being configured to attach to the pressing tool (11) or crimping tool (11') mechanically and electronically. 15
10. The method according to claim 9, **characterized in that** the memory unit (24) is provided on the adapter (20). 20
11. The method according to any one of claims 1-10, **characterized in that** both the identification data collected by the data collecting element and/or the measured data collected by the sensor system (13) are transmitted in a wireless manner, in particular in particular via WLAN, Bluetooth, IR transmission or radio transmission to an external device (28). 25
12. A pressing device (10) for joining two work pieces (15), in particular a pipe (18) and a press fitting (19) by pressing, the pressing device (10) comprising a pressing tool (11) having a plurality of jaws (12), wherein one of the jaws (12) is coupled to the pressing tool (11), a drive adapted to drive the coupled jaw (12) to apply a force to the work pieces; a sensor system (13) adapted to measure a data related to the force applied to the workpiece (15) over the pressing operation cycle; **characterized in that** the pressing device (10) is designed to perform the method for monitoring the pressing operation according to any one of Claims 1 - 11. 30 35 40
13. A pipe pressing device (10) for joining two work pieces (15), in particular a connector (30) and a cable (31) by crimping, the pipe pressing device (10) comprising a crimping tool (11') having a plurality of jaws (12), wherein one of the jaws (12) is coupled to the crimping tool (11'), a drive adapted to drive the coupled jaw (12) to apply a force to the work pieces; a sensor system (13) adapted to measure a data related to the force applied to the workpiece (15) over the crimping operation cycle; **characterized in that** the pipe pressing device (10) is designed to perform the method for monitoring the crimping operation according to any one of Claims 1 - 11. 45 50 55
14. A pipe pressing device according to claim 13, **char-**

acterized in that an adapter (20) being configured to attach to the pressing tool (11) or crimping tool (11') mechanically and/or electronically, wherein the adapter (20) comprises a scanner (25), a memory unit (24), an input unit (26), a controller (28) and a transmission unit (27).

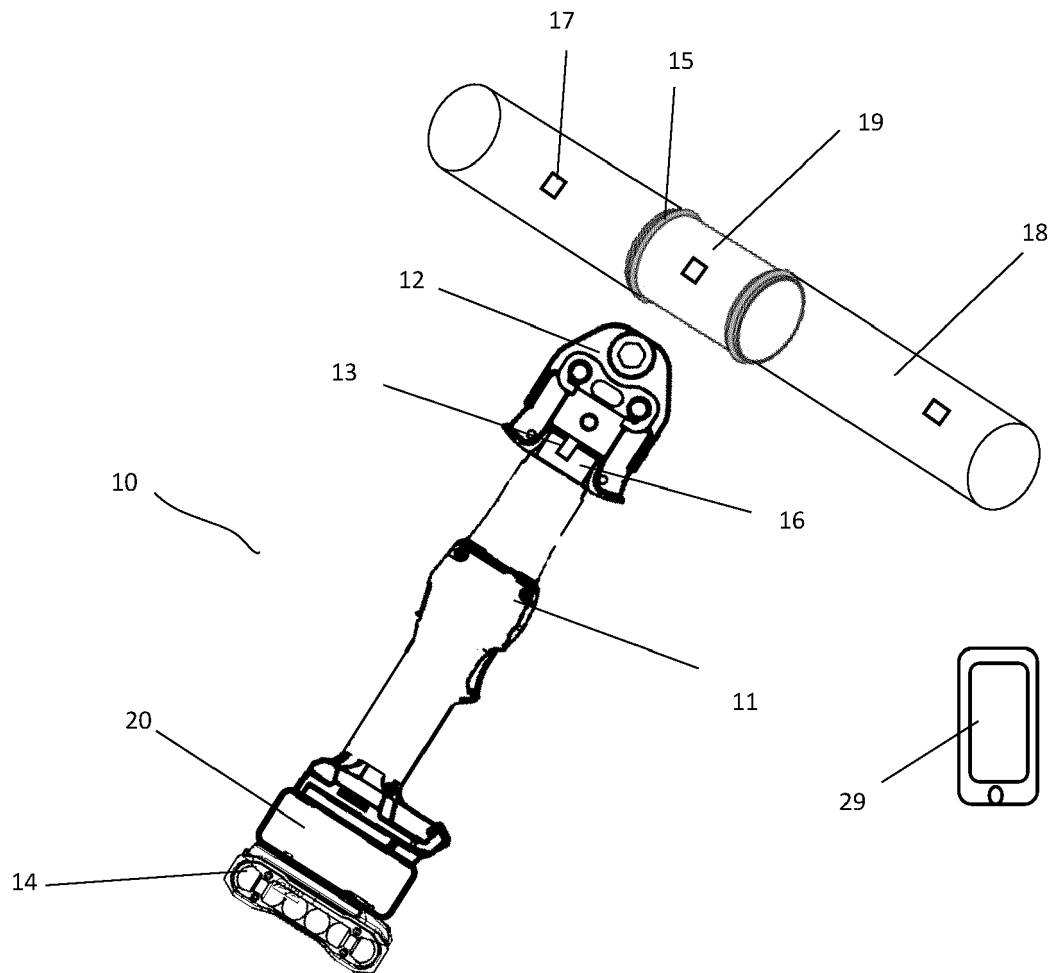


Fig. 1

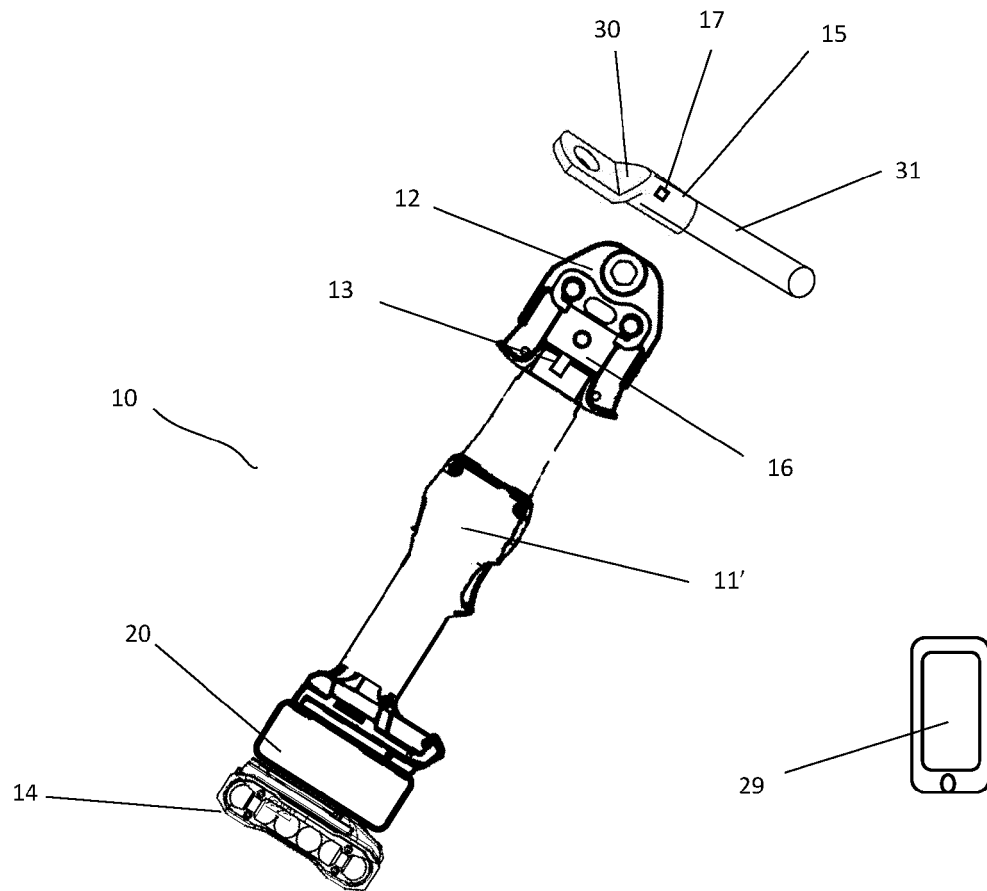


Fig. 2

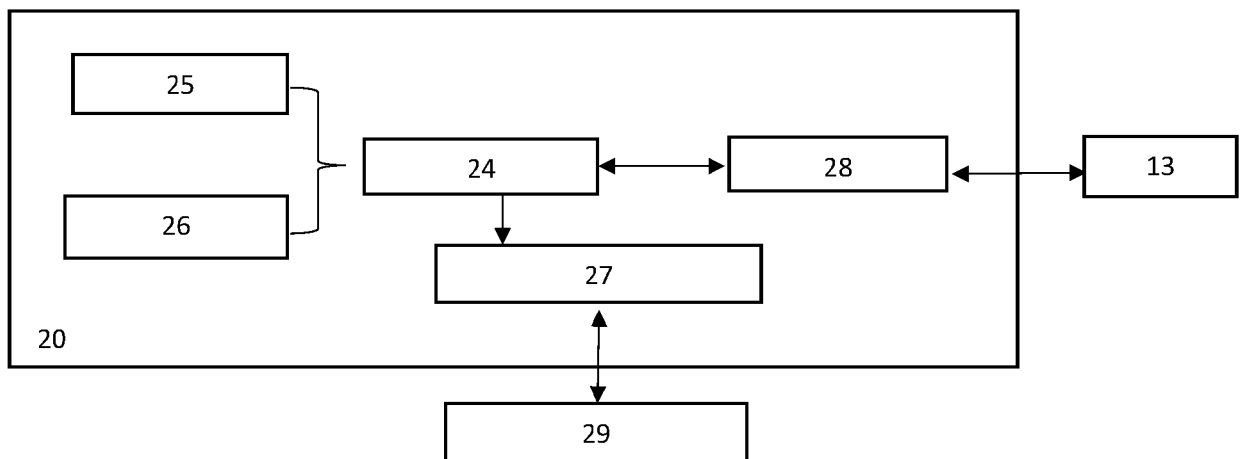


Fig. 3



EUROPEAN SEARCH REPORT

Application Number

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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 4 November 2022	Examiner Pastramas, Nikolaos
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	



EUROPEAN SEARCH REPORT

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Place of search The Hague			Date of completion of the search 4 November 2022
Examiner Pastramas, Nikolaos			
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X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			
T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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