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(54) **TERMINAL RELEASE TOOL**

(57) The present disclosure relates to a terminal release tool (10) for releasing at least two terminals (21a-21h) being fastened within an electrical connector (20) at once. The terminal release tool (10) comprises an elongated base body (11) having a longitudinal axis (a), and an insertion portion (13) for being inserted into the electrical connector (20). The insertion portion (13) comprises a plurality of release fingers (14a-14j) extending from the insertion portion (13) substantially parallel to the longitudinal axis (a).

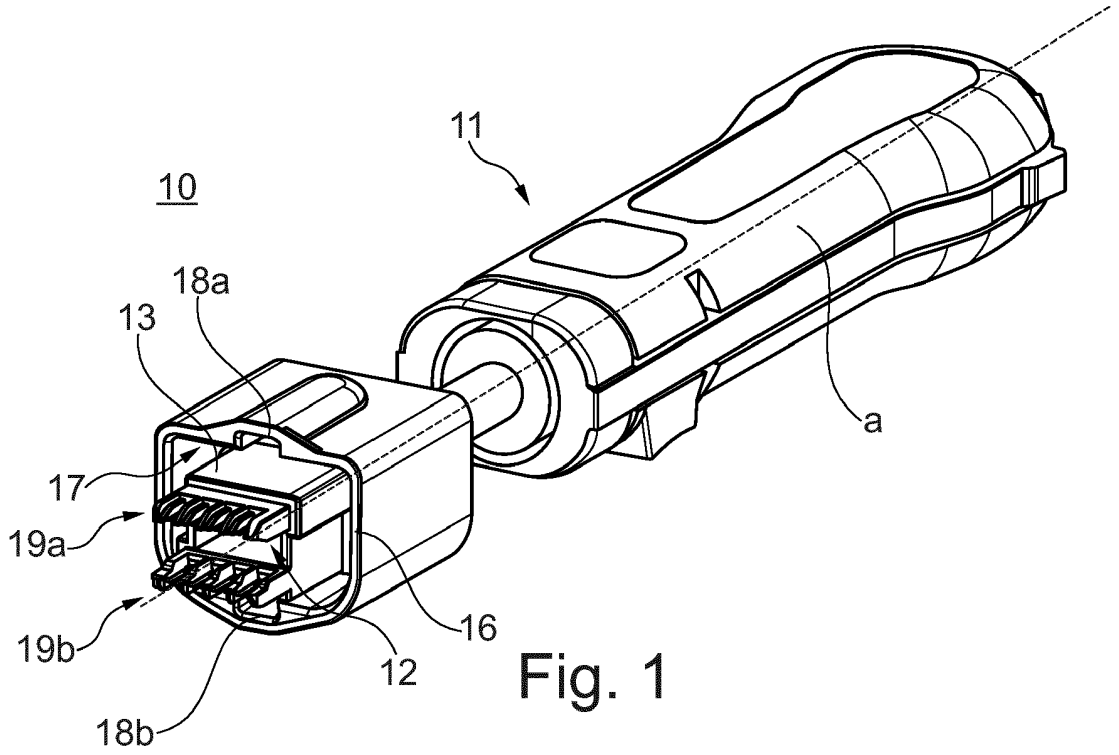

Fig. 1

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Description

1. Technical field

[0001] The present disclosure relates to a terminal release tool and a terminal release system.

2. Prior art

[0002] A variety of electrical connectors have terminals as electrical contact elements, for example to establish contact with corresponding mating connectors. These terminals are regularly formed at the end of a cable and are held positively and/or non-positively within the electrical connectors. For example, it is known that terminals are held in an electrical connector by a locking arm of the electrical connector housing engaging with an undercut of the terminal so that the terminal is held in the electrical connector housing.

[0003] There are various situations in which it may be necessary to release the terminals from the electrical connector. For example, to carry out a repair, to replace an electrical component, for example for modernization purposes, or for recycling. Solutions are already known for releasing the terminals from the electrical connector. However, these solutions have considerable disadvantages, as explained below.

[0004] To release terminals from an electrical connector, an elongated tool is usually inserted into the electrical connector. The tool is shaped such that it can release the interlocking of one terminal within the electrical connector in one step. For example, tools are known that have a recess at their end that can receive a locking arm of the connector housing so that the worker can lift the locking arm out of engagement with the terminal.

[0005] First, with the known solutions, it is regularly necessary for the worker to manually place and operate the tool at the correct position within the electrical connector in order to release one terminal. On the one hand, this is visually complicated, for example due to limited lighting conditions, e.g. inside the electrical connector. On the other hand, the manual positioning of the tool is error-prone and time-consuming.

[0006] Second, electrical connectors regularly have several terminals, so that many individual steps are necessary to remove all terminals from the electrical connector. This is not only time-consuming, but also more prone to errors.

[0007] Third, often the cables at the ends of which the terminals are attached are fixed to each other, for example by means of cable ties, to facilitate assembly and/or to ensure a clear installation condition. Accordingly, a terminal can be temporarily released using the tool described above, but it cannot be removed from the electrical connector because its associated cable is connected to other cables. Since the terminal cannot be removed, the terminal is regularly locked again inside the electrical connector after the tool has been removed. The remaining option is to loosen the fixation of the cables to each other, which is associated with increased effort.

[0008] Thus, it is an object of the present disclosure to provide a terminal release tool and a terminal release system that overcome the aforementioned drawbacks at least partially.

3. Summary of the invention

[0009] This object is achieved, at least partly, by a terminal release tool and a terminal release system, as defined in the independent claims. Further aspects of the present disclosure are defined in the dependent claims.

[0010] In particular, the object is achieved by a terminal release tool for releasing at least two terminals being fastened within an electrical connector at once. The terminal release tool comprises an elongated base body having a longitudinal axis, and an insertion portion for being inserted into the electrical connector, wherein the insertion portion comprises a plurality of release fingers extending from the insertion portion substantially parallel to the longitudinal axis.

[0011] It is understood that electrical connectors are used in a variety of industries. Hence, the terminal release tool is not limited to a particular application and/or industry. Exemplarily the terminal release tool may be used in the automotive industry, the aerospace industry, and/or plant construction. Each of the terminals may be fastened within the electrical connector by means of a respective locking element. For example by means of a locking arm of the connector housing which engages with an undercut of the respective terminal so that the terminal is held in the electrical connector.

[0012] Further, terminals according to the present disclosure may comprise crimp terminals, pin terminals, male terminals, and/or combinations thereof. Nevertheless, it is understood that a variety of terminals exists for which the terminal release tool may be also utilized.

[0013] The elongated base body may be directly or indirectly attached to the insertion portion. Exemplarily, the elongated base body may be integrally formed with the insertion portion. In this regard, it is to be noted that according to the present disclosure the term "integrally formed" may refer to the aspect that no material boundary can be identified between the respective parts. Moreover, the elongated base body may comprise a handle that allows the user to operate the tool.

[0014] The insertion portion may have a cross-section in a plane being perpendicular to the longitudinal axis which allows for the insertion portion to be inserted into a variety of existing electrical connectors. Exemplarily, the insertion portion may have a substantially rectangular or a substantially circular cross-section in the plane being perpendicular to the longitudinal axis.

[0015] The plurality of release fingers allows for releasing at least two terminals being fastened within an electrical connector at once, when the terminal release tool is inserted into the electrical connector. For example, the

release fingers may individually or in partial cooperation disengage resilient locking elements, such as locking arms, within the electrical connector, thereby releasing the terminals. Said release fingers may be elongated protrusions. Further, said release fingers may be integrally formed with the insertion portion. Exemplarily, the plurality of release fingers may comprise at least three release fingers, optionally at least four release fingers, and further optionally at least five release fingers. Thereby the skilled person understands that a large number of release fingers may be required for electrical connectors with a large number of terminals fastened therein.

[0016] The terminal release tool according to the present disclosure has a variety of advantages over the prior art, wherein three of them are set out below. Thereby the skilled reader will understand from the present disclosure that a variety of other advantages may also be present.

[0017] First, the present terminal release tool allows that the worker does not need to manually place and operate the tool at the correct position within the electrical connector for releasing each single terminal. Rather, placing and operating the tool once allows for releasing more than one terminal, namely at least two terminals. Hence, the time required for releasing terminals from electrical connectors can be reduced and/or the error rate can be minimized.

[0018] Second, as electrical connectors often have several terminals and the present terminal release tool allows for releasing at least two terminals at once, the number of individual steps being necessary to remove all terminals from the electrical connector can be reduced.

[0019] Third, the described terminal release tool enables and/or enhances the release and removal of terminals from electrical connectors in which the cables to the ends of which the terminals are attached are fixed to each other, for example, with cable ties. Particularly without first loosening the fixation of the cables to each other.

[0020] It is understood that these advantages may also apply for the specific embodiments described throughout the disclosure in different emphasis.

[0021] Each release finger of the plurality of release fingers may comprise a ramp surface being inclined relative to the longitudinal axis. The term "inclined" in this context may refer to the aspect that the ramp surface is not parallel and/or perpendicular to the longitudinal axis. By means of the ramp surfaces, it can be achieved that a movement of the terminal release tool into the electrical connector along the longitudinal axis leads to an unlocking of the terminals without the need for further movements of the terminal release tool inside the electrical connector. This can facilitate and/or accelerate the release of terminals. Exemplarily, when the terminal release tool is inserted into the electrical connector along the longitudinal axis the ramp surface of a release finger may laterally push away a resilient locking element and thereby release a respective terminal.

[0022] At least one release finger may comprise two ramp surfaces separated by a rib element. Optionally, said two ramp surfaces have the same inclination relative to the longitudinal axis. Further, the rib element may protrude from the at least one release finger in a direction which is perpendicular to the longitudinal axis. Moreover, the rib element may extend along the at least one release finger. By means of the two ramp surfaces said at least one release finger may actuate two separate locking elements of the electrical connector. Further, the rib element may allow for a reliable positioning of the release finger between these two locking elements.

[0023] Each ramp surface may comprise a width measured in a direction perpendicular to the longitudinal axis which lies in a range from 0.1 mm to 5 mm, optionally from 0.2 mm to 1 mm, and further optionally from 0.3 mm to 0.5 mm. These widths have proven to allow for establishing a reliable contact between the release fingers and the locking elements of electrical connectors.

[0024] The plurality of release fingers may comprise three release fingers being shaped to jointly release two terminals being fastened within the electrical connector. It has shown that with this configuration a smaller space requirement can be realized than if each release arm is configured to release one terminal each. This makes it possible to release even closely spaced terminals. Exemplarily, a first of the three release fingers may be shaped to release a first terminal together with a second of the three release fingers and to release a second terminal together with a third of the three release fingers. Further exemplarily, the three release fingers may be arranged in a respective pattern, such as a row, and have the above-described ramp surfaces.

[0025] Said three release fingers may be shaped to jointly lift two locking arms of the electrical connector out of engagement with said two terminals. Particularly, the three release fingers may be configured as described above, whereas other configurations are also conceivable.

[0026] The terminal release tool may further comprise a sleeve surrounding the insertion portion such that a circumferential recess extending in the direction of the longitudinal axis is formed between the sleeve and the insertion portion. By means of the circumferential recess a reliable guiding for the terminal release tool along the longitudinal axis can be provided. Exemplarily, the circumferential recess may serve to guide a portion of the connector housing of the electrical connector. This allows that the worker does not need to manually place and operate the tool at the correct position inside the electrical connector to release a terminal. Rather, the worker only needs to align the electrical connector with the terminal release tool and move them against each other in the longitudinal direction.

[0027] The sleeve may further comprise at least one elongated recess formed on the inside surface of the sleeve, wherein the elongated recess extends substantially parallel to the longitudinal axis and is adjacent to

the circumferential recess, wherein optionally the sleeve comprises two elongated recesses formed on the inside surface of the sleeve. The elongated recess can provide additional guidance. This allows even more precise guidance of the terminal release tool to the electrical connector.

[0028] The plurality of release fingers may comprise at least two rows of release fingers, wherein the release fingers may be arranged in a first row and a second row, wherein optionally the first row and the second row each comprise the same number of release fingers. A variety of electrical connectors includes two rows of terminals. Hence, by the release fingers being arranged in two rows, it is possible to release the terminals of such electrical connectors. Particularly, the plurality of release fingers may comprise at least eight release fingers, optionally at least ten release fingers, and further optionally exactly ten release fingers.

[0029] The insertion portion may comprise a recess being arranged between the first row and the second row, wherein the recess may extend substantially along the longitudinal axis into the insertion portion, wherein the recess optionally extends along the longitudinal axis for a length which lies in a range from 2 mm to 100 mm, optionally from 4 mm to 30 mm, and further optionally from 6 mm to 20 mm. Said recess may provide an accommodation for the terminals to be released by the terminal release tool when the terminal release tool is inserted into the electrical connector. The mentioned lengths allow for accommodating a large number of commonly used terminals.

[0030] The first row and the second row may be substantially parallel to each other, wherein optionally the first row and the second row each extend in a direction which extends substantially perpendicular to the longitudinal axis. Thereby the terminal release tool may be adapted to a variety of commonly used electrical connectors.

[0031] Further, a minimum distance between the release fingers may be at least 0.5 mm, optionally at least 0.7 mm, and further optionally at least 0.8 mm. These minimum distances allow for the terminal release tool to be used for a variety of electrical connectors.

[0032] Preferably the insertion portion has a length measured along the longitudinal axis of at least 10 mm, optionally at least 15 mm, and further optionally at least 17 mm. These lengths may ensure that the release fingers reach a position within an electrical connector to release the terminals.

[0033] The above object is further achieved by a terminal release system configured for releasing at least two terminals being fastened within an electrical connector by means of a terminal release tool at once. The terminal release system comprises an electrical connector having a connector housing and a plurality of terminals fastened within the connector housing, and a terminal release tool as described above. Since the system comprises the terminal release tool as described above, it is understood that the advantages and features described with regards to the terminal release tool may also apply for the terminal release system and vice versa. The insertion portion may be shaped such that the terminal release tool is guided by the connector housing along the longitudinal axis, when inserted into the electrical connector.

[0034] Preferably, the connector housing has a plurality of locking arms, wherein the plurality of terminals is fastened within the connector housing by means of the locking arms, wherein the above-described terminal release tool is configured such that the plurality of release fingers comprises three release fingers being shaped to jointly release two terminals being fastened within the electrical connector, wherein said three release fingers are shaped to jointly lift two locking arms of the electrical connector out of engagement with said two terminals. Optionally the terminal release tool comprises more release fingers than the connector housing comprises locking arms.

[0035] Further preferably, the above-described terminal release tool further comprises a sleeve surrounding the insertion portion such that a circumferential recess extending in the direction of the longitudinal axis is formed between the sleeve and the insertion portion, wherein a portion of the connector housing is shaped for being inserted into the circumferential recess of the terminal release tool.

4. Brief description of the accompanying figures

[0036] In the following, the accompanying figures are briefly described:

Fig. 1 shows a perspective view of a terminal release tool according to the present invention;

Fig. 2 shows a detail of the terminal release tool depicted in Fig. 1;

Fig. 3 shows a perspective view of a terminal release system according to the present invention;

Fig. 4 shows a detail of the electrical connector of the terminal release system depicted in Fig. 3;

Fig. 5 shows a cut view of the terminal release system, and

Fig. 6 illustrates the functionality of the terminal release tool and the terminal release system.

5. Detailed description of the figures

[0037] **Fig. 1** shows a terminal release tool 10 for releasing eight terminals 21a-21h being fastened within an electrical connector 20 (s. Fig. 4) at once. The terminal release tool 10 comprises an elongated base body 11

having a longitudinal axis a. Said elongated base body has a handle. Further, the terminal release tool 10 comprises an insertion portion 13 for being inserted into the electrical connector 20. The insertion portion 13 comprises a plurality of release fingers 14a-14j, namely ten, extending from the insertion portion 13 substantially parallel to the longitudinal axis a.

[0038] Also shown in **Fig. 1,** the terminal release tool 10 further comprises a sleeve 16 surrounding the insertion portion 13 such that a circumferential recess 17 extending in the direction of the longitudinal axis a is formed between the sleeve 16 and the insertion portion 13. Said sleeve 16 further comprises two elongated recesses 18a, 18b formed on the inside surface of the sleeve 16. The two elongated recesses 18a, 18b extend substantially parallel to the longitudinal axis a and are adjacent to the circumferential recess 17.

[0039] As shown in **Fig. 1** but particularly in **Fig. 2,** each release finger of the plurality of release fingers 14a-14j comprises a ramp surface 15a, 15b being inclined relative to the longitudinal axis a. Thereby six release fingers 14b-14d, 14g-14i each comprise two ramp surfaces 15a, 15b each separated by a rib element 151. Moreover, each ramp surface 15a, 15b comprises a width measured in a direction perpendicular to the longitudinal axis a which lies in a range from 0.2 mm to 1 mm.

[0040] Furthermore, also shown in **Fig. 1** and **Fig. 2,** the plurality of release fingers 14a-14j comprises ten release fingers, wherein the release fingers are arranged in a first row 19a and a second row 19b. The first row 19a and the second row 19b each comprise the same number of release fingers, namely five. Further, the insertion portion 13 comprises a recess 12 being arranged between the first row 19a and the second row 19b, wherein the recess 12 extends substantially along the longitudinal axis a into the insertion portion 13. The first row 19a and the second row 19b are substantially parallel to each other and each extend in a direction which extends substantially perpendicular to the longitudinal axis a.

[0041] Moreover, as depicted in **Fig. 5,** the plurality of release fingers 14a-14j comprises three release fingers 14a, 14b, 14c being shaped to jointly release two terminals 21a, 21b being fastened within the electrical connector 20. Said three release fingers 14a, 14b, 14c are shaped to jointly lift two locking arms 23a, 23b of the electrical connector 20 out of engagement with said two terminals 21a, 21b.

[0042] **Fig. 3** shows a terminal release system 30 configured for releasing eight terminals 21a-21h being fastened within an electrical connector 20 (s. Fig. 4) by means of a terminal release tool 10 at once. The terminal release system 30 comprises an electrical connector 20 having a connector housing 22 and eight terminals 21a-21h fastened within the connector housing 22. Further, the terminal release system 30 comprises a terminal release tool 10 as described above an exemplarily shown in Fig. 1.

[0043] As shown in **Fig. 4** and **Fig. 5,** the connector housing 22 has eight locking arms 23a-23h, wherein the eight terminals 21a-21h are fastened within the connector housing 22 by means of the locking arms 23a-23h. As shown, the terminal release tool 10 comprises more release fingers 14a-14j than the connector housing 22 comprises locking arms 23a-23h.

[0044] As shown in **Fig. 5** and **Fig. 6,** a portion of the connector housing 22 is shaped for being inserted into the circumferential recess 17 of the terminal release tool 10.

List of reference signs

[0045]

10	terminal release tool
11	elongated base body
12	recess
13	insertion portion
14a-14j	release fingers
15a, 15b	ramp surfaces
151	rib element
16	sleeve
17	circumferential recess
18a, 18b	elongated recesses
19a, 19b	first row, second row
20	electrical connector
21a-21h	terminals
22	connector housing
23a-23h	locking arms
30	terminal release system
a	longitudinal axis

Claims

1. A terminal release tool (10) for releasing at least two terminals (21a-21h) being fastened within an electrical connector (20) at once, the terminal release tool (10) comprising

   an elongated base body (11) having a longitudinal axis (a), and
   an insertion portion (13) for being inserted into the electrical connector (20), wherein the insertion portion (13) comprises a plurality of release fingers (14a-14j) extending from the insertion portion (13) substantially parallel to the longitudinal axis (a).

2. The terminal release tool (10) according to the preceding claim, wherein each release finger of the plurality of release fingers (14a-14j) comprises a ramp surface (15a, 15b) being inclined relative to the longitudinal axis (a).

3. The terminal release tool (10) according to the preceding claim, wherein at least one release finger

(14b-14d, 14g-14i) comprises two ramp surfaces (15a, 15b) separated by a rib element (151).

4. The terminal release tool (10) according to any one of claims 2 to 3, wherein each ramp surface (15a, 15b) comprises a width measured in a direction perpendicular to the longitudinal axis (a) which lies in a range from 0.1 mm to 5 mm, optionally from 0.2 mm to 1 mm, and further optionally from 0.3 mm to 0.5 mm.

5. The terminal release tool (10) according to any one of the preceding claims, wherein the plurality of release fingers (14a-14j) comprises three release fingers (14a, 14b, 14c) being shaped to jointly release two terminals (21a, 21b) being fastened within the electrical connector (20).

6. The terminal release tool (10) according to the preceding claim, wherein said three release fingers (14a, 14b, 14c) are shaped to jointly lift two locking arms (23a, 23b) of the electrical connector (20) out of engagement with said two terminals (21a, 21b).

7. The terminal release tool (10) according to any one of the preceding claims, wherein the terminal release tool (10) further comprises a sleeve (16) surrounding the insertion portion (13) such that a circumferential recess (17) extending in the direction of the longitudinal axis (a) is formed between the sleeve (16) and the insertion portion (13).

8. The terminal release tool (10) according to the preceding claim, wherein the sleeve (16) further comprises at least one elongated recess (18a, 18b) formed on the inside surface of the sleeve (16), wherein the elongated recess (18a, 18b) extends substantially parallel to the longitudinal axis (a) and is adjacent to the circumferential recess (17), wherein optionally the sleeve (16) comprises two elongated recesses (18a, 18b) formed on the inside surface of the sleeve (16).

9. The terminal release tool (10) according to any one of the preceding claims, wherein the plurality of release fingers (14a-14j) comprises two rows of release fingers, wherein the release fingers are arranged in a first row (19a) and a second row (19b), wherein optionally the first row (19a) and the second row (19b) each comprise the same number of release fingers.

10. The terminal release tool (10) according to the preceding claim, wherein the insertion portion (13) comprises a recess (12) being arranged between the first row (19a) and the second row (19b), wherein the recess (12) extends substantially along the longitudinal axis (a) into the insertion portion (13), wherein the recess (12) optionally extends along the longitudinal axis (a) for a length which lies in a range from 2 mm to 100 mm, optionally from 4 mm to 30 mm, and further optionally from 6 mm to 20 mm.

11. The terminal release tool (10) according to any one of claims 9 to 10, wherein the first row (19a) and the second row (19b) are substantially parallel to each other, wherein optionally the first row (19a) and the second row (19b) each extend in a direction which extends substantially perpendicular to the longitudinal axis (a).

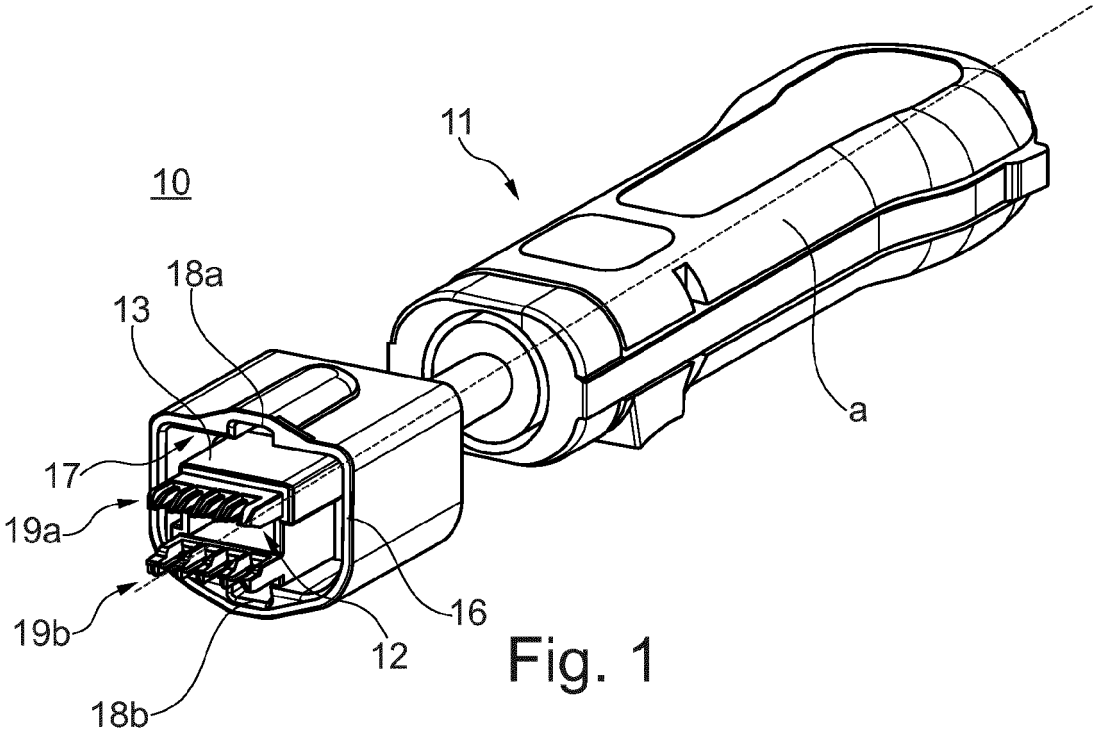
12. The terminal release tool (10) according to any one of the preceding claims, wherein a minimum distance between the release fingers (14a-14j) is at least 0.5 mm, optionally at least 0.7 mm, and further optionally at least 0.8 mm, wherein preferably the insertion portion (13) has a length measured along the longitudinal axis (a) of at least 10 mm, optionally at least 15 mm, and further optionally at least 17 mm.

13. A terminal release system (30) configured for releasing at least two terminals (21a-21h) being fastened within an electrical connector (20) by means of a terminal release tool (10) at once, the terminal release system (30) comprising

an electrical connector (20) having a connector housing (22) and a plurality of terminals (21a-21h) fastened within the connector housing (22), and
a terminal release tool (10) according to any one of the preceding claims.

14. The terminal release system (30) according to the preceding claim, wherein the connector housing (22) has a plurality of locking arms (23a-23h), wherein the plurality of terminals (21a-21h) is fastened within the connector housing (22) by means of the locking arms (23a-23h), wherein the terminal release tool (10) is configured according to claim 6, wherein optionally the terminal release tool (10) comprises more release fingers (14a-14j) than the connector housing (22) comprises locking arms (23a-23h).

15. The terminal release system (30) according to any one of claims 13 to 14, wherein the terminal release tool (10) is configured according to one of claims 7 or 8, wherein a portion of the connector housing (22) is shaped for being inserted into the circumferential recess (17) of the terminal release tool (10).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11
18a
13
17
19a
19b
18b
12
16
a

Fig. 1

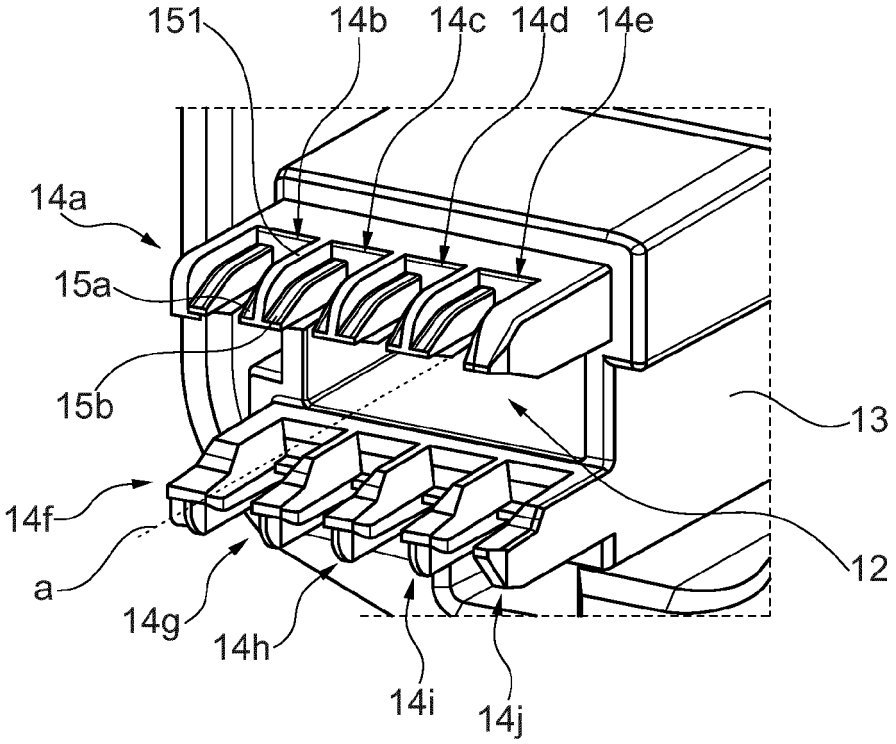
151
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Fig. 2

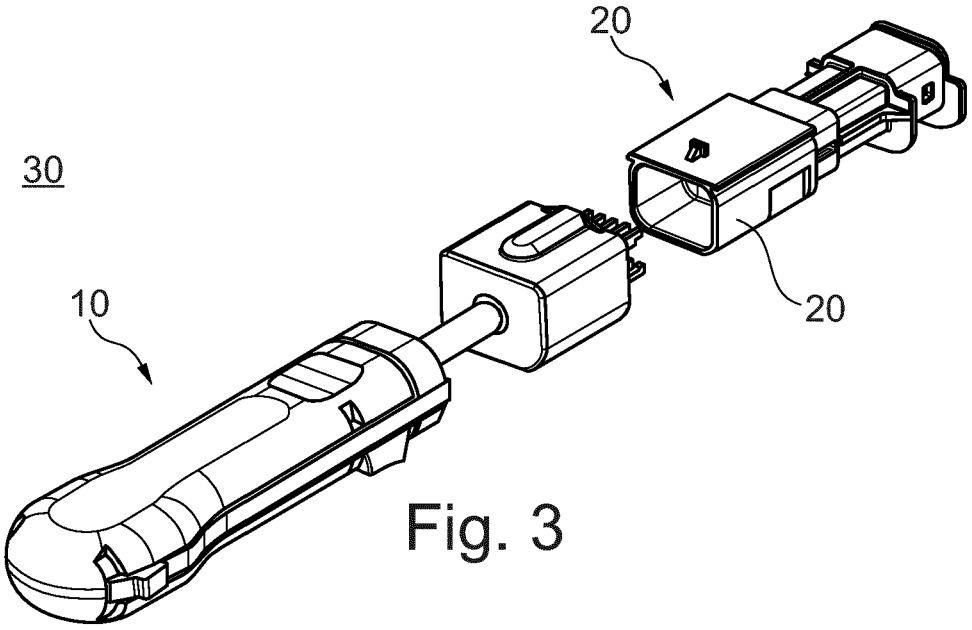
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Fig. 3

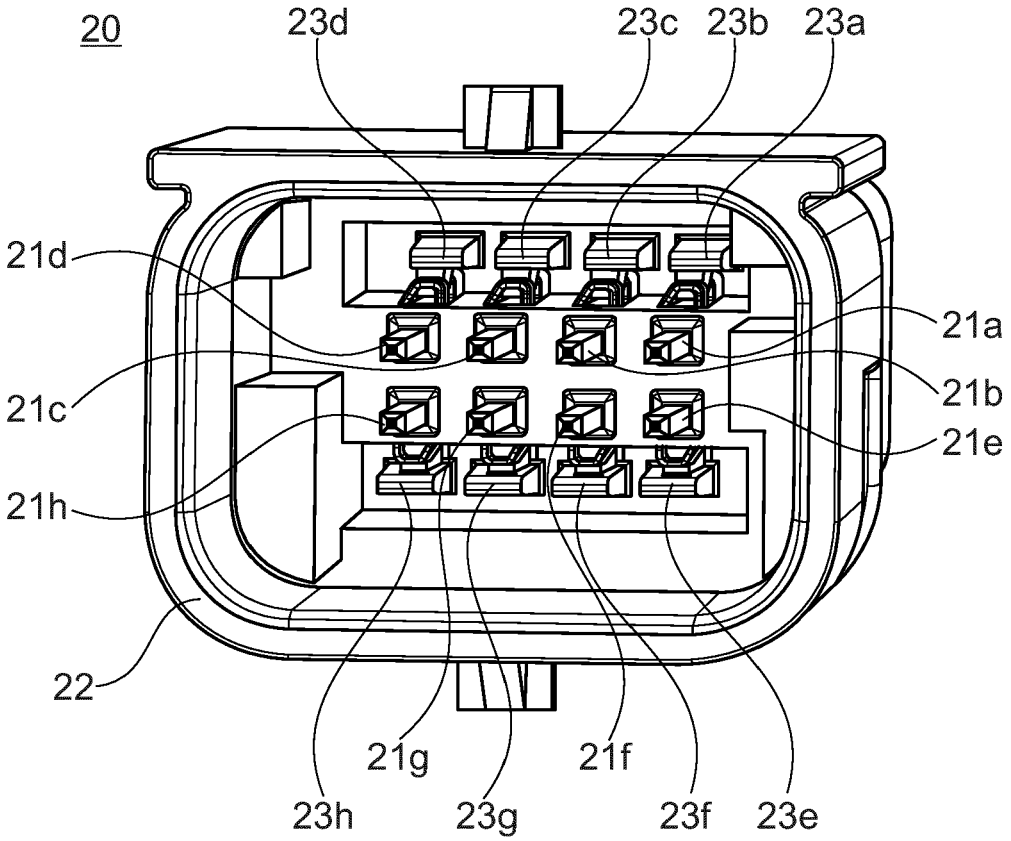
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Fig. 4

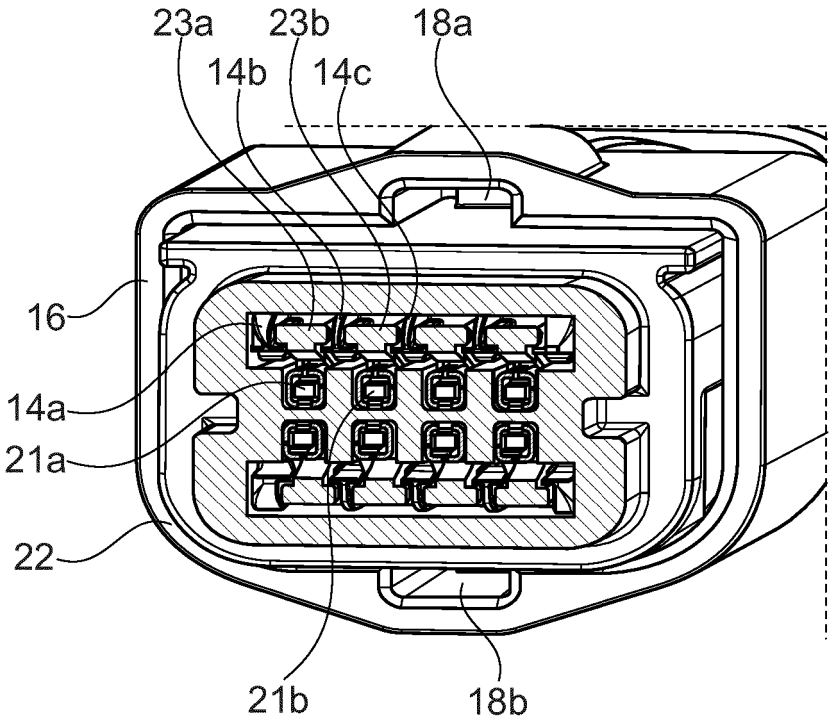

Fig. 5

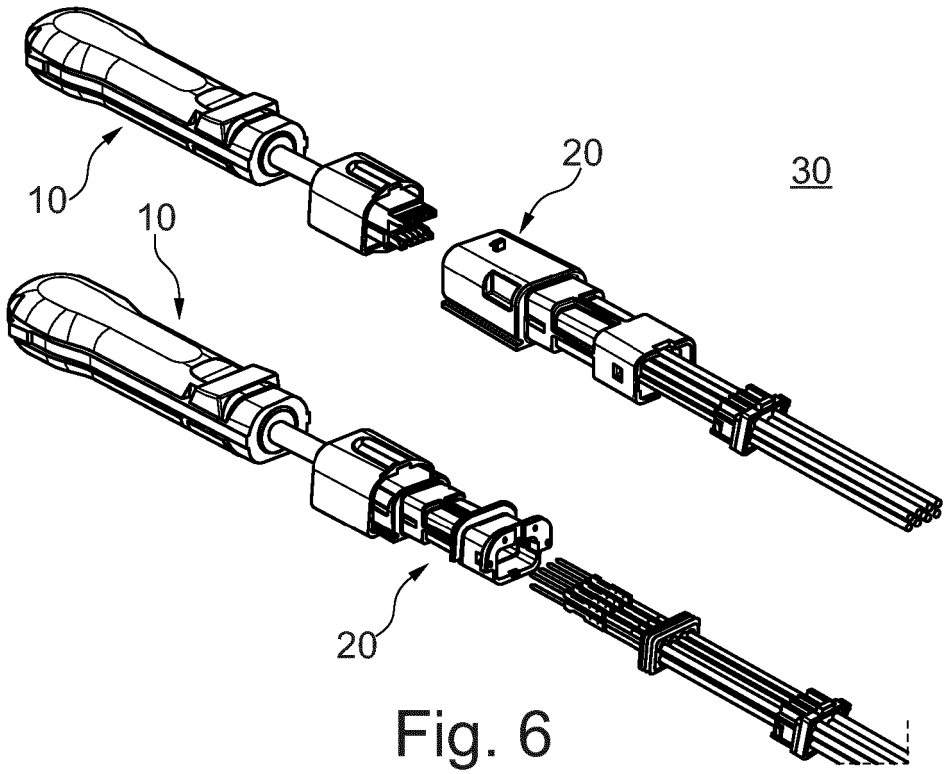

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 22 21 6306

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	25 May 2023	Jiménez, Jesús

CATEGORY OF CITED DOCUMENTS

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82