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(71) Applicant: **Dubuis et Cie**
41000 Villebarrou (FR)

(72) Inventors:
- **Vervier, Patrick**
41000 Villebarou (FR)
- **Cerfeuillet, Vincent**
41000 Villebarou (FR)

(74) Representative: **SBD IPAdmin**
270 Bath Road
Slough, Berkshire SL1 4DX (GB)

(54) **HYDRAULIC PRESS TOOL AND PORTABLE HYDRAULIC PRESS TOOL ASSEMBLY**

(57) Hydraulic press tool (14) and hydraulic press tool assembly (10) comprising a hydraulic press tool (14) having a work unit (16) with a tool body (44), a handle (46) and a tool head (48) fitted to receive a die set (50) which can be displaced between an open and a closed position to operate a workpiece; a battery unit (18) comprising a battery support (22) and a battery; an electro-hydraulic pump unit (20) with an electro-hydraulic pump casing (32) fitting a reservoir (36) adapted to receive a hydraulic liquid and an electro-hydraulic pump (38) adapted to increase the pressure of a hydraulic liquid; wherein the electro-hydraulic pump unit (20) is powered by the battery unit (18), and wherein the work unit (16) is controlled by the electro-hydraulic pump unit (20). A high pressure hose (54) is provided between the work unit (44) and the electro-hydraulic pump unit (20) such that the work unit (44) is physically separate from the electro-hydraulic pump unit (20), and a power cable (28) is provided between the battery unit (18) and the electro-hydraulic pump unit (20) such that the battery unit (18) is physically separate from the electro-hydraulic pump unit (20).

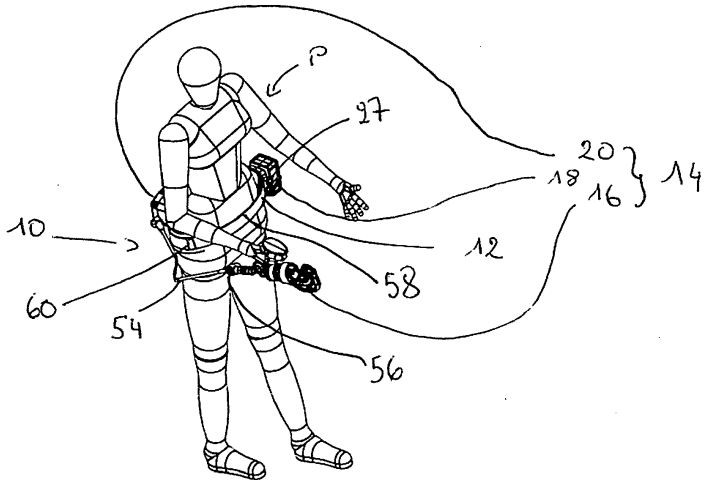

Fig. 1

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Description

[0001] The present invention relates to a hydraulic press tool and to a portable hydraulic press tool assembly.

[0002] Portable hydraulic press tools that allow compressive forces of approximately 20 to 150 kilonewtons to be achieved are already known. These tools are commonly used to perform determined connection operations, e.g. for crimping connectors about electrical wires or hydraulic pipes and for compressing rivets, or for determined cutting operations, e.g. cutting electric wires during electric system installation and maintenance.

[0003] These tools generally comprise a body in which are accommodated a fluid reservoir, a hydraulic pump, a cylinder, and a piston capable of being moved inside the cylinder under the effect of an injection of pressurised fluid into the interior of the cylinder. These tools also comprise a tool head fixed to the body and adapted to receive a die set, one of the dies being operated by the piston. The dies and/or the head can be removable. The head can receive different die sets depending on the operation to be performed. An electric motor and the hydraulic pump causes an increase of hydraulic fluid pressure operating on the piston to move the later against the bias of a pressure spring. In turn, the piston is connected to the tool head so as to move the die set. The die set may comprise a movable and a fixed jaw. In such case, the piston is connected to the tool head so as to move the movable jaw with respect to the fixed jaw. The jaws may be shaped and/or provided with interchangeable accessory elements so as to adapt to a particular object, e.g. an electrical contact to be compressed or a metallic bar to be cut. Document EP2626608A1 from the applicant discloses such a tool.

[0004] Such hydraulic press tools are very often used in external environments, e.g. along railway lines far from buildings provided with a connection to the electric power network, and require an electric energy source of their own, i.e. a portable electric accumulator or battery either integrated in or applied on the tool. The known hydraulic press tool have a certain weight. This can lead to physical and mental operator fatigue. A further requirement is due to the fact that most of the time operations, in particular those aimed at making connections between connectors and/or electrical cables are hampered by extremely restricted space conditions. It is therefore essential for compression tools to be a compact size.

[0005] Documents EP3519123 A1, EP3213880A1, WO2013143606A1, EP3166755A1 aim to disclose portable hydraulic tools and/or methods that ensure increased operational flexibility, operational safety as well as ease of use. Tools like those disclosed in document EP3166755A1 have notably a weight over 8 kilograms and are designed to be hold by an operator with one hand. Thus, such tools and method are still heavy for an operator and not ergonomic enough to sensibly reduce physical and mental operator fatigue, and to increase productivity of the operator.

[0006] It is thus an object of the present invention to provide a hydraulic press tool having features such to solve those drawbacks. Accordingly, the present invention provides a hydraulic press tool according to claim 1. More particularly, the hydraulic press tool comprises a work unit with a tool body, a handle and a tool head fitted to receive a die set which can be displaced between an open and a closed position to operate a workpiece; a battery unit comprising a battery support and a battery; an electro-hydraulic pump unit with an electro-hydraulic pump casing fitting a reservoir with a hydraulic liquid and an electro-hydraulic pump adapted to increase the pressure of a hydraulic liquid; wherein the electro-hydraulic pump unit is powered by the battery unit, and wherein the work unit is controlled by the electro-hydraulic pump unit. A high pressure hose is provided between the tool body and the electro-hydraulic pump unit such that the work unit is physically separate from the electro-hydraulic pump unit, and a power cable is provided between the battery unit and the electro-hydraulic pump unit such that the battery unit is physically separate from the electro-hydraulic pump unit. By physically separating the battery unit and the electro-hydraulic pump unit from the work tool, it is provided an ergonomic hydraulic press tool, which allows an operator to have a reduced work tool in the hand, without decreasing the performance of the tool. This can provide a reduced effective cycle time for the operator. Thus, tool and operator efficiency are increased.

[0007] In an embodiment, the outlet between the electro-hydraulic pump casing and the high pressure hose is a swivel and hooded hydraulic outlet. The work tool is easily manageable and easy to handle.

[0008] In an embodiment, a rotary connection is provided between the high pressure hose and the work unit. This also increase the handle of the work tool.

[0009] In an embodiment, a decompression cable is provided between the battery unit and the electro-hydraulic pump unit.

[0010] In an embodiment, the electro-hydraulic pump casing is further fitting a decompression trigger connected to the decompression cable such as to release pression from the hydraulic liquid. Thus, the operator's safety is ensured.

[0011] In an embodiment, the battery support is provided with an emergency decompression pull button. The emergency button can be easily reached by the operator, without risk of inadvertently triggering it, since it is not arranged on the work tool.

[0012] In an embodiment, the electro-hydraulic pump casing is fitting a control card. A wireless remote control can be provided. In another embodiment, a wired connection can also be provided. In that case an electric cable with a plug can be added between the work unit and the electro-hydraulic pump unit. A USB connector may be provided on the electro-hydraulic pump casing in order to communicate with the control card.

[0013] In an embodiment, the electro-hydraulic pump casing comprises a reservoir cap adapted to be opened to fill the reservoir with a hydraulic liquid. The reservoir can easily be filled or emptied when needed.

[0014] In an embodiment, the electro-hydraulic pump unit is arranged at a distance between 0.10 and 0.30 meters from the battery unit. This distance allows a good weight distribution.

[0015] In an embodiment, the power cable has a length between 0.10 and 0.5 meters. This allows flexibility regarding the arrangement of the battery unit and the electro-hydraulic pump unit.

[0016] In an embodiment, the high pressure hose has a length between 0.4 and 1.5 meters. This allows flexibility regarding the arrangement of electro-hydraulic pump unit with regard to the work unit and for the operator during an operation.

[0017] In an embodiment, the electro-hydraulic pump casing has a substantially parallelepipedal shape with a front wall, a rear wall a top wall, a bottom wall and lateral edges connecting the front and rear walls, the walls defining a closed recess, and wherein the reservoir and the electro-hydraulic pump are arranged within the recess. The casing is in plastic material and the plastic material fully surround the elements of the electro-hydraulic pump unit.

[0018] In an embodiment, anti-shock protection means are provided on the outside surfaces of the walls. Thus, the elements of the electro-hydraulic pump unit are fully protected, independently of the position of the operator.

[0019] In an embodiment, the battery is removably attached to the battery support. More particularly the battery support is a battery mount which can be configured to release a rechargeable battery or battery pack mechanically and electrically.

[0020] The purpose of the invention is also achieved by a hydraulic press tool assembly according to claim 13. More particularly, the hydraulic press tool assembly comprises a hydraulic press tool and an attaching device, wherein the attaching device comprises a belt, a strap or a harness configured or adapted to be worn on the user's body, and wherein the battery support and the electro-hydraulic pump casing are connected to the attaching device, at distance from each other. A good weight distribution with a direct control of the operation by the operator is thus realized. The operator can accomplish an operation independently without regard to where.

[0021] In an embodiment, the attaching device comprises receiving means adapted to receive the work unit. The receiving means can be a hook or a pocket or a recess adapted to receive the work unit in part or fully before or after an operation.

[0022] In an embodiment, the attaching device comprises a battery unit holder adapted to removably connect the battery unit to the attaching device, an electro-hydraulic pump unit holder adapted to removably connect the electro-hydraulic pump unit to the attaching device. For instance the battery unit holder and/or the electro-hydraulic pump unit holder can provide a snap fit connection, a hanging connection, a screwed connection, ..etc. For instance, quick-release fasteners can be provided to removably fix the battery unit and/or the electro-hydraulic pump unit.

[0023] A specific embodiment of the present invention will now be described, by way of example only and with reference to the accompanying drawings, of which:

Fig. 1 schematically shows an operator with a hydraulic press tool and an attaching device, wherein the hydraulic press tool comprises a work unit, a battery unit and an electro-hydraulic pump unit, and wherein the operator holds the work unit in one hand and the battery unit and the electro-hydraulic pump unit are connected to the attaching device;

Fig. 2A and Fig. 2B show in greater details the battery unit and the electro-hydraulic pump unit connected to the attaching device;

Fig. 3 shows the connection between a high pressure hose and the electro-hydraulic pump unit;

Fig. 4 shows different elements of the electro-hydraulic pump unit, and notably the electro-hydraulic pump and the decompression trigger;

Fig. 5 shows the work unit with a tool body, a handle, and a tool head;

Fig. 6 shows a work unit with a tool body, a handle, and a tool head according to another embodiment.

[0024] Some example embodiments now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all example embodiments are shown. Like reference numerals refer to like elements throughout.

[0025] Fig. 1 shows an operator P with a hydraulic press tool assembly 10. The hydraulic press tool assembly 10 comprises an attaching device 12 and a hydraulic press tool 14. The hydraulic press tool 14 comprises a work unit 16, a battery unit 18 and an electro-hydraulic pump unit 20. The work unit 16 is visible in Fig. 1 arranged in a hand of the operator, whereas the battery unit 18 and the electro-hydraulic pump unit 20 are arranged and attached on the attaching device 12. The attaching device 12 is for instance a belt, a strap or a harness configured or adapted to be worn on the operator's body. The attaching device 12 comprises connecting means to receive and securely fasten the battery unit 18 and the electro-hydraulic pump unit 20. More particularly, the attaching device 12 comprises a battery unit connector, to securely fasten the battery unit 18, and an electro-hydraulic pump unit connector to securely fasten the electro-hydraulic pump unit 20.

[0026] The battery unit 18, as seen in Fig. 1, 2A, 2B,

4 comprises a battery support 22 and a battery. The battery is for example a rechargeable battery. The battery is for instance in a battery casing 24 (or within the battery support 22). For example, the battery is a DEWALT XR 18V 5A.h battery. The battery support 22 is a battery mount for instance and can be configured to release mechanically and electrically a rechargeable battery. Eventually, one or more batteries can be provided and connected to the battery support. An electronic control circuit connected with and configured to manage and control the battery can also be provided. The battery unit 18, and more particularly the battery 28 may be provided with a battery charge reader. The battery support 22 is connected to the attaching device 12 for instance by means of a foam support 26. As seen in Fig. 1, the battery support 22 may also be provided with an emergency decompression pull button 27.

[0027] The battery unit 18, and more particularly the battery support 22 is connected to the electro-hydraulic pump unit 20 by means of a power cable 28. A decompression cable 30 is also provided between the battery support 22 and the electro-hydraulic pump unit 20. Thus, the battery unit 18 can be arranged remote from the electro-hydraulic pump unit 20. In other words, the electro-hydraulic pump unit 20 is physically separated from the battery unit 18. The electro-hydraulic pump unit 20 is for instance arranged at a distance between 0.10 and 0.30 meters from the battery unit 18. For example, the power cable 28 has a length between 0.10 and 0.5 meters. The decompression cable 30 may have sensibly the same length.

[0028] The electro-hydraulic pump unit 20 comprises an electro-hydraulic pump casing 32. The electro-hydraulic pump casing 32 is for instance a plastic casing 32. The electro-hydraulic pump casing 32 can be a two-parts casing 32a, 32b, first and second parts being connected together through fixing screws. The electro-hydraulic pump casing 32 has a substantially parallelepipedal shape with a front wall, a rear wall a top wall, a bottom wall and lateral edges connecting the front and rear walls, the walls defining a closed recess 34, as depicted in Fig. 2A. Anti-shock protection means 35 may be provided on the outside surfaces of the walls.

[0029] As better seen in Fig. 4, the recess 34 fits a reservoir 36 adapted to receive a hydraulic liquid. The electro-hydraulic pump casing 32 comprises a reservoir cap 37 adapted to be opened to fill or empty the reservoir 36 with a hydraulic liquid. The reservoir cap 37 is for instance arranged on the rear wall of the electro-hydraulic pump casing 32. The recess 34 further fits an electro-hydraulic pump 38 adapted to increase the pressure of the hydraulic liquid. The electro-hydraulic pump 38 and the reservoir 36 forms a hydraulic sub-assembly which is well-known from persons skilled in the art and will not be described in further details. Filters 39 are also arranged in the recess and are connected to the hydraulic sub-assembly. A decompression trigger 40 connected to the decompression cable 30 such as to release pression from the hydraulic liquid is also included in the electro-hydraulic pump casing 32. The decompression trigger 40 has for instance the shape of a lever and can be actuated by the decompression cable 30. The decompression cable 30 is for instance arranged between the emergency decompression pull button 27 and the decompression trigger 40, such that the decompression trigger 40 is notably actuated when the emergency decompression pull button 27 is activated.

[0030] A control card 42 is fitted within the electro-hydraulic pump casing. A wireless remote control can be provided. In another embodiment, a wired connection can also be provided. In that case an electric cable with a plug can be added between the work unit and the electro-hydraulic pump unit. A micro USB connector or the like may be provided on the electro-hydraulic pump casing in order to communicate with the control card.

[0031] The rear wall of the electro-hydraulic pump casing 32 is adapted to be connected to the attaching device 12. For instance, the head of the fixing screws may seat on the outside surface of the rear wall. The rear wall is connected (or fixed) to the attaching device 12 for example by means of a foam support 26b. The total weight of the electro-hydraulic pump unit 20 is for instance between 3 and 5 kilograms, and more particularly around 4,5 kilograms.

[0032] Remote from the electro-hydraulic pump casing 32, the work unit 16 is arranged. The work unit 16 comprises a tool body 44, a handle 46 and a tool head 48 fitted to receive a die set 50 which can be displaced between an open and a closed position to operate a workpiece. In a known manner, the tool body 44 comprises a cylinder, a piston capable of being moved inside the cylinder under the effect of an injection of pressurised fluid into the interior of the cylinder. The piston is adapted to operate the die set, and more particularly one of the dies of the set. The piston is movable between a retracted position and an extended position to operate the die. A spring, and more particularly a helical return spring urges the piston toward the retracted position. The handle 46 may have the shape of a joystick, as visible in Fig. 5 or may be formed directly by the tool body 44, as visible in Fig. 6. A depicted in Fig. 6, a remote control 52 is fixed to the tool body for controlling the tool. The work unit 16 may have a weight between 2 and 4 kilograms.

[0033] As better seen in Fig. 2A and Fig. 2B, a high pressure hose 54 is provided between the work unit 16 and the electro-hydraulic pump unit 20. More particularly the work unit 16 and the electro-hydraulic pump unit 20 are physically separated and the high pressure hose 54 connects both units. The high pressure hose 54 has for instance a length between 0.4 and 1.5 meters, such that both units can be arranged at non-zero distance. The high pressure hose is for instance a high pressure hose fitting up to 21.000 psi (1500 bar). The working pressure is for instance 700 bar. The high pressure hose 54 can eventually be a sheathed high pressure hose. For instance, the high pressure hose 22 is a flexible DN4 hose

1500 bar. The high pressure hose forms a fluid injection conduit extending between the reservoir (in the electro-hydraulic pump unit 20) and a cavity of the cylinder (in the tool body).

[0034] The high pressure hose 54 is directly connected at a first end to the hydraulic sub-assembly (of the electro-hydraulic pump unit 20). The outlet between the electro-hydraulic pump casing and the high pressure hose is a swivel and hooded hydraulic outlet. At a second end, the high pressure hose 54 is connected to the work unit 16, and more precisely to the tool body 44 through a rotary connection 56, in order to improve the ergonomic of the hydraulic press tool.

[0035] As already mentioned and visible in Fig. 1, the attaching device 12 comprises a belt 58 adapted to be worn be an operator's body. In the case of a right-handed operator, the battery unit 18 may be arranged on the belt 58 on the left side of the operator, the electro-hydraulic pump unit 20 may be arranged in the back of the operator and a hook 60 may be provided on the right side of the operator, on the belt 58. The hook 60 may be used to removably attach the work unit to the belt. However, other means such has a pouch can be used to removably connect the work unit to the attaching device before or after an operation. The operator can easily grip the work unit 16 only to realize an operation, the battery unit, and the electro-hydraulic pump unit 20 staying arranged on the attaching device 12. The arm of the operator thus only holds the work unit 16 (as depicted in Fig. 1). Battery unit 18 and electro-hydraulic pump unit 20 are worn by the operator, especially on his belt. Thus, a total freedom of movement is possible. Once the operation is done, the operator can reattach the work unit again to the belt 58. Battery unit 18 and/or electro-hydraulic pump unit 20 can be fixedly or removably attached to the attaching device 12. Besides, the battery unit 18 and/or the electro-hydraulic pump unit 20 can be movably attached to the attaching device 12, such that an operator can arranged the battery unit 18 at a chosen distance from the hydraulic pump unit 20.

hydraulic press tool assembly 10
operator P
USB connector C
attaching device 12
a hydraulic press tool 14
a work unit 16,
a battery unit 18
an electro-hydraulic pump unit 20
battery support 22battery casing 24
foam support 26a
emergency decompression pull button 27
power cable 28
a decompression cable 30
electro-hydraulic pump casing 32
two-parts casing 32a, 32b
recess 34
reservoir 36
a reservoir cap 37
electro-hydraulic pump 38
Filters 39
decompression trigger 40
control card 42
foam support 26b
tool body 44
a handle 46
a tool head 48
die set 50
remote control 52
high pressure hose 54
rotary connection 56
belt 58
hook 60

Claims

1. Hydraulic press tool (14) comprising:

- a work unit (16) with a tool body (44), a handle (46) and a tool head (48) fitted to receive a die set (50) which can be displaced between an open and a closed position to operate a workpiece;
- a battery unit (18) comprising a battery support (22) and a battery;
- an electro-hydraulic pump unit (20) with an electro-hydraulic pump casing (32) fitting a reservoir (36) adapted to receive a hydraulic liquid and an electro-hydraulic pump (38) adapted to increase the pressure of a hydraulic liquid;

wherein the electro-hydraulic pump unit (20) is powered by the battery unit (18), and wherein the work unit (16) is controlled by the electro-hydraulic pump unit (20), **characterized in that** a high pressure hose (54) is provided between the work unit (44) and the electro-hydraulic pump unit (20) such that the work unit (44) is physically separate from the electro-hydraulic pump unit (20) and a power cable (28) is provided between the battery unit (18) and the electro-hydraulic pump unit (20) such that the battery unit (18) is physically separate from the electro-hydraulic pump unit (20).

2. Hydraulic press tool (14) according to claim 1, wherein the outlet between the electro-hydraulic pump casing (32) and the high pressure hose is a swivel and hooded hydraulic outlet.

3. Hydraulic press tool (14) according to any of claims 1 to 2, wherein the high pressure hose (54) is rotatory connected to the tool body (44).

4. Hydraulic press tool (14) according to any of claims 1 to 3, wherein a decompression cable (30) is pro-

vided between the battery unit (18) and the electro-hydraulic pump unit (20), and wherein the electro-hydraulic pump casing (32) is further fitting a decompression trigger (40) connected to the decompression cable such as to release pression from the hydraulic liquid and, wherein the battery support (22) is provided with an emergency decompression pull button (27).

5. Hydraulic press tool (14) according to any of claims 1 to 4, wherein the electro-hydraulic pump casing (32) is fitting a control card (42).

6. Hydraulic press tool (14) according to any of claims 1 to 5, wherein the electro-hydraulic pump casing (32) comprises a reservoir cap (37) adapted to be opened to fill the reservoir (36) with a hydraulic liquid.

7. Hydraulic press tool (14) according to any of claims 1 to 6, wherein the electro-hydraulic pump unit (20) is arranged at a distance between 0.10 and 0.30 meters from the battery unit (18).

8. Hydraulic press tool (14) according to any of claims 1 to 7, wherein the power cable (28) has a length between 0.10 and 0.5 meters.

9. Hydraulic press tool (14) according to any of claims 1 to 8, wherein the high pressure hose (54) has a length between 0.4 and 1.5 meters.

10. Hydraulic press tool (14) according to any of claims 1 to 9, wherein the electro-hydraulic pump casing (32) has a substantially parallelepipedal shape with a front wall, a rear wall a top wall, a, bottom wall and lateral edges connecting the front and rear walls, the walls defining a closed recess, and wherein the reservoir and the electro-hydraulic pump are arranged within the recess.

11. Hydraulic press tool (14) according to claim 10, wherein anti-shock protection means (35) are provided on the outside surfaces of the walls.

12. Hydraulic press tool (14) according to any of claims 1 to 11, wherein the battery is removably attached to the battery support (22).

13. Hydraulic press tool assembly (10) comprising a hydraulic press tool (14) according to any of claims 1 to 12 and an attaching device (12), wherein the attaching device (12) comprises a belt, a strap or a harness configured or adapted to be worn on the user's body, and wherein the battery support (22) and the electro-hydraulic pump casing (32) are connected to the attaching device (12), at a non-zero distance from each other.

14. Hydraulic press tool assembly (10) according to claim 13, wherein the attaching device (12) comprises receiving means (60) adapted to receive the work unit (16).

15. Hydraulic press tool assembly (10) according to claim 13 or 14, wherein the attaching device (12) comprises a battery unit holder adapted to removably connect the battery unit to the attaching device, an electro-hydraulic pump unit holder adapted to removably connect the electro-hydraulic pump unit to the attaching device (12).

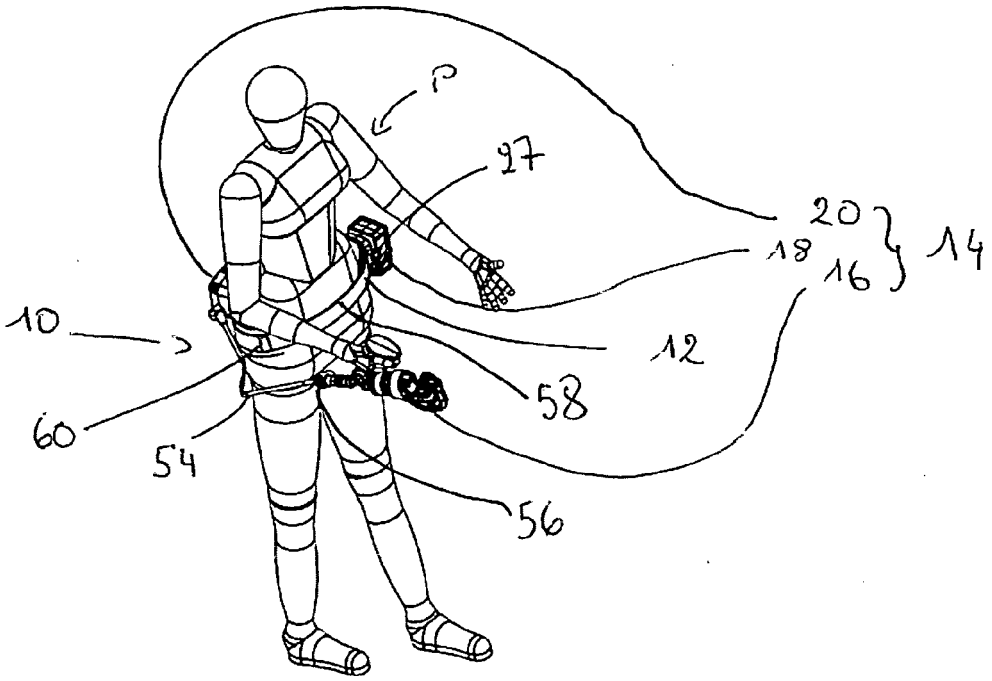
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Fig. 1

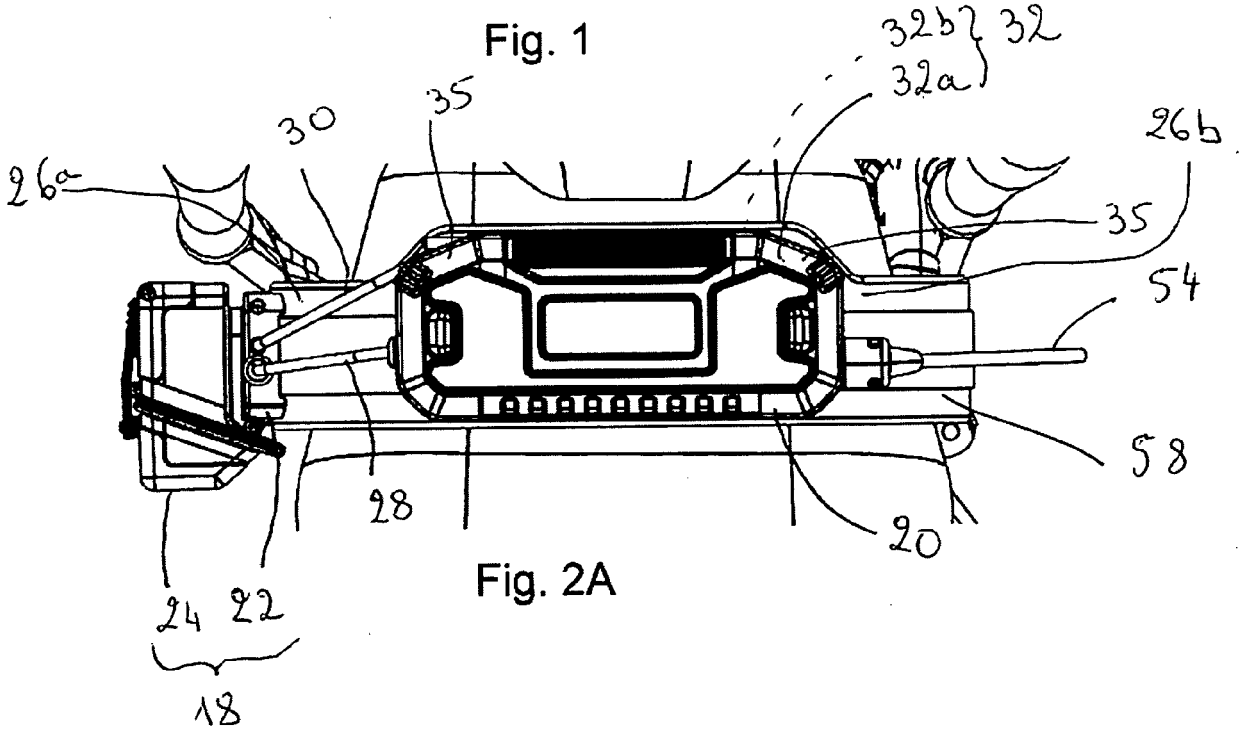
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Fig. 2A

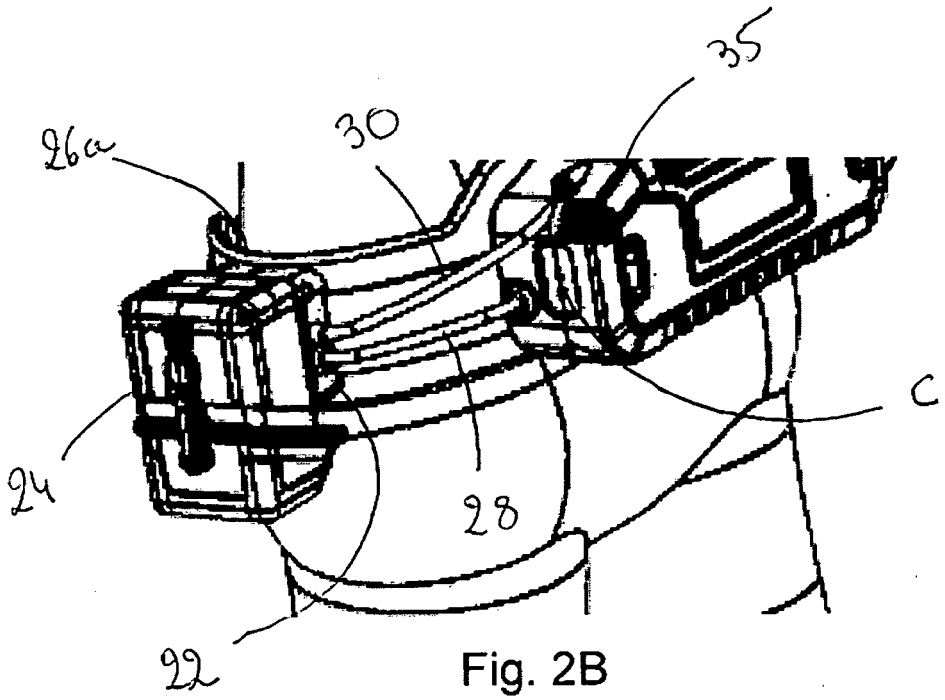

Fig. 2B

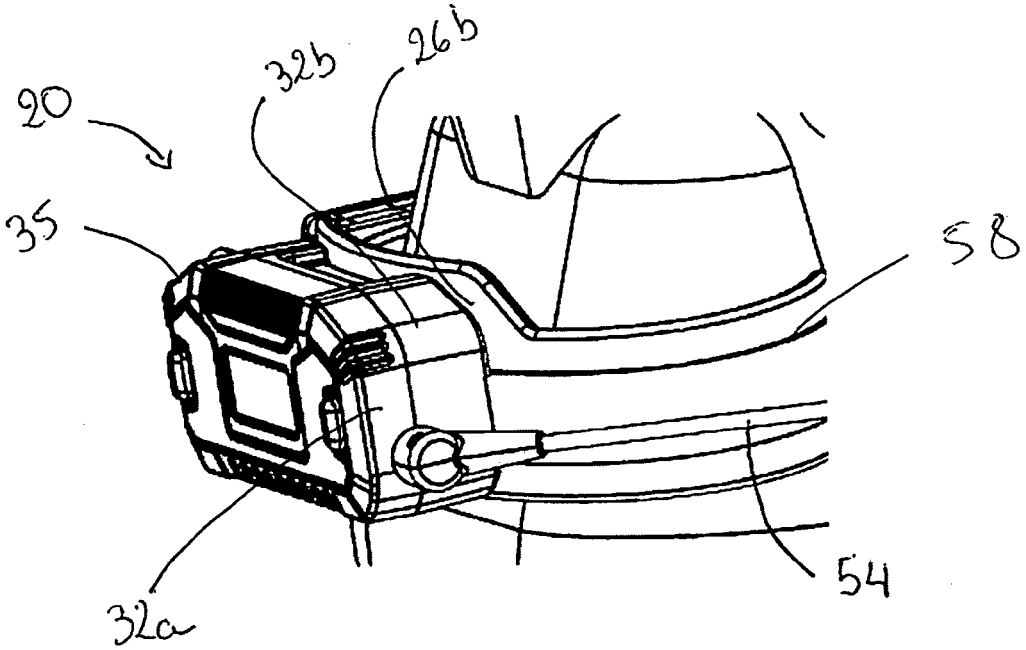

Fig. 3

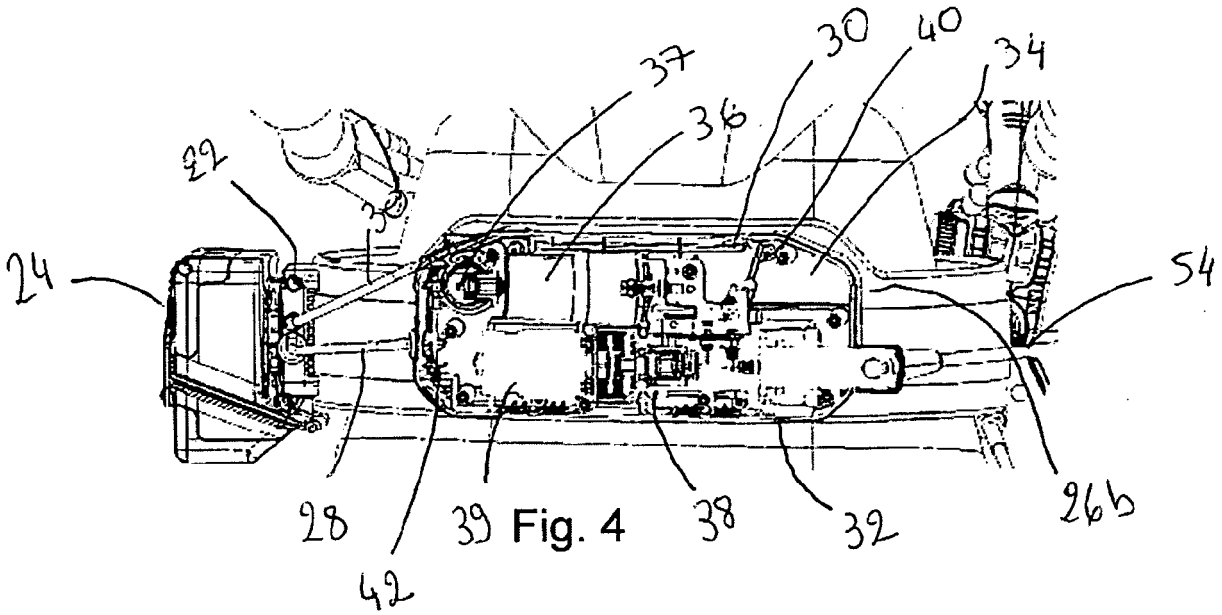

Fig. 4

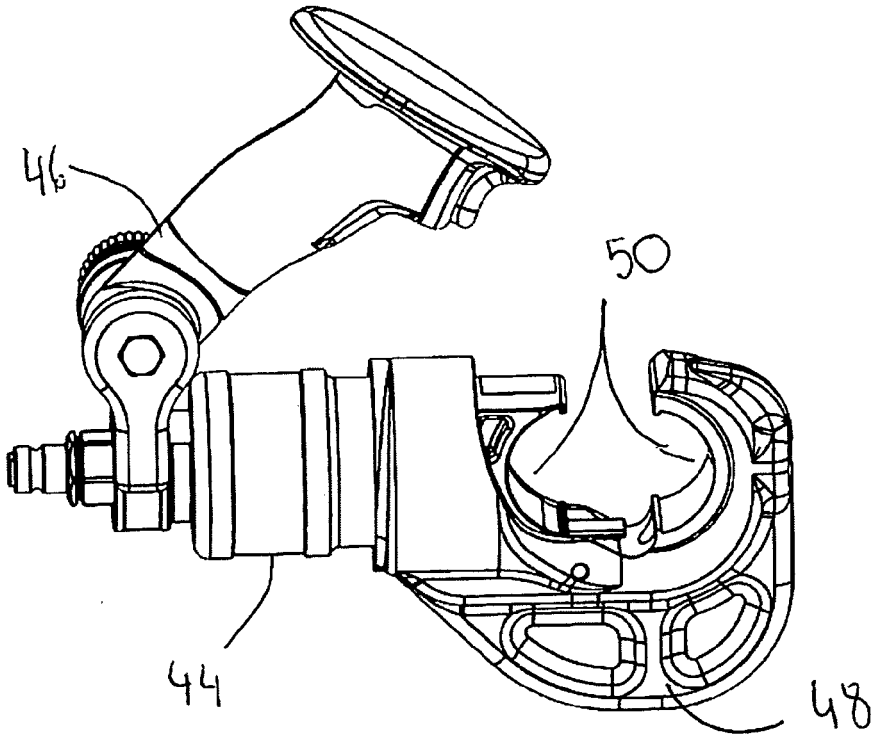

Fig. 5

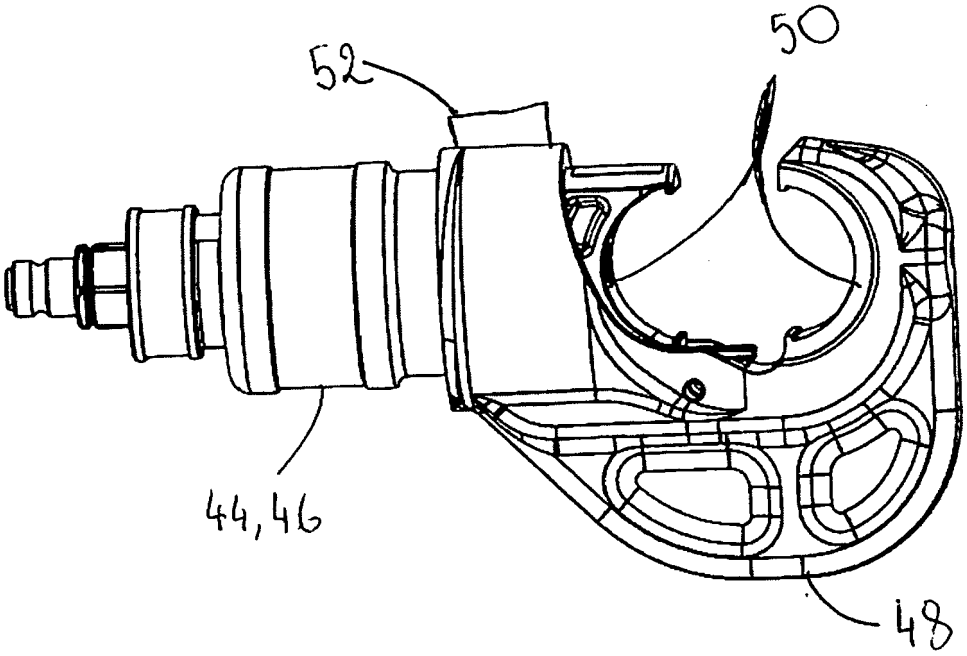

Fig. 6

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EUROPEAN SEARCH REPORT

Application Number
EP 22 31 5061

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	IT 2018 0000 7471 A1 (CEMBRE S.P.A.) 24 January 2020 (2020-01-24) * paragraphs [0020], [0021], [0022], [0037], [0043], [0054], [0068]; figure 1 *	1-15	INV. B25G1/02 H01R43/042
Y	EP 2 181 807 A2 (TYCO ELECTRONICS CORP [US]) 5 May 2010 (2010-05-05) * paragraphs [0019], [0022], [0023], [0027]; figures 1, 7 *	1-15	
A	GB 1 075 857 A (BURNDEPT LTD) 12 July 1967 (1967-07-12) * figure 2 *	14	

TECHNICAL FIELDS SEARCHED (IPC)

B25G
B25H
B23D
B25B
H01R
B23B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	8 August 2022	Messai, Sonia

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 31 5061

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
IT 201800007471 A1	24-01-2020		
EP 2181807 A2	05-05-2010	CN 102059686 A	18-05-2011
		EP 2181807 A2	05-05-2010
		JP 5495717 B2	21-05-2014
		JP 2010105048 A	13-05-2010
		US 2010107905 A1	06-05-2010
GB 1075857 A	12-07-1967	NONE	

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2626608 A1 **[0003]**
- EP 3519123 A1 **[0005]**
- EP 3213880 A1 **[0005]**
- WO 2013143606 A1 **[0005]**
- EP 3166755 A1 **[0005]**