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

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

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

(54) **PORTABLE HYDRAULIC TOOL AND HANDLE FOR A PORTABLE HYDRAULIC TOOL**

(57) Hydraulic tool (14) comprising
- a work unit (16) with a tool body (44) extending longitudinally along a tool axis (X), 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;
- an electro-hydraulic pump unit (20) with a reservoir for

a hydraulic liquid and an electro-hydraulic pump adapted to increase the pressure of a hydraulic liquid;
characterized in that
the handle (46) is pivotally mounted at a pivot (62) to the tool body (44) such that the handle (46) is rotatable with regard to the tool body (44) around a rotation axis (Xr) perpendicular to the tool axis (X).

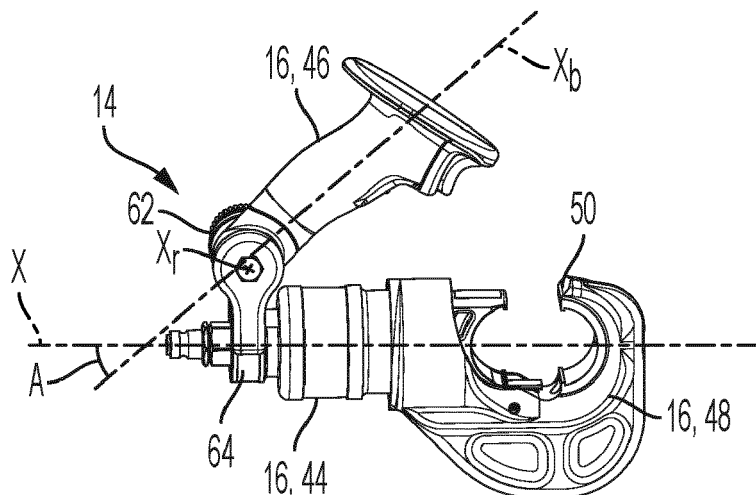


FIG. 1

Description

[0001] The present invention relates to a portable hydraulic tool and to a handle for portable hydraulic tool.

[0002] Portable hydraulic 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 for example can receive different die sets depending on the operation to be performed. An electric motor actuates the hydraulic pump. The hydraulic pump then 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 tools are very often used in external environments and sometimes for a long period of time. The known hydraulic tool have a certain weight or handling which is not always adapted. 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 and easily operated by an operator.

[0005] Over the years, several handles, and ways of holding such portable hydraulic tools have been developed. There are mainly inline tools like depicted in document EP2626608A1 or gun-like tools like disclosed in document EP3166755A1. However, there is still a need to provide portable hydraulic tools having an ergonomic handle easily operated by an operator and which can reduce physical and mental operator fatigue.

[0006] It is thus an object of the present invention to provide a portable hydraulic tool and a handle for a portable hydraulic tool which is ergonomic and such that an operator can easily and precisely control the portable hydraulic tool. Accordingly, the present invention provides

a portable hydraulic tool according to claim 1 and a handle according to claim 12. More particularly, the hydraulic tool comprises a work unit with a tool body extending longitudinally along a tool axis, 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; 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. The handle is pivotally mounted at a pivot to the work body such that the handle is rotatable with regard to the tool body around a rotation axis perpendicular to the tool axis. The portable tool can thus be held by an operator with one hand at a particular angle from the tool axis allowing a better orientation of the portable tool and in particular of the work unit during an operation. The term die set in the present specification is to be interpreted broadly and could correspond to blades, crimping parts, scissor blades, cutters, jaws, punching die, shears ... with at least one movable part (jaw, blade, cutter...) to apply an effort on a workpiece. The tool head can thus be a cutting head, a crimping head, a punching head, shearing head ...

[0007] In an embodiment, the handle is rotatable to several orientation positions, and each position can be fixed by a lock mechanism, such that a defined orientation of the handle with regard to the work tool can be fixed by an operator.

[0008] In an embodiment, a connecting portion for connecting the handle to the tool body is provided. Thus, a handle can be disassembled and re-arranged on the same or another tool body.

[0009] In an embodiment, the handle comprises a base adapted to conform to an operator's palm hand and a top, wherein the base extends from the connecting portion to the top, wherein a proximal end of the base is connected to the connecting portion and a distal end of the base supports the top, wherein the top has an internal surface facing the base and an external surface, opposite the internal surface, and wherein the internal surface is adapted to cradle the top of the operator's hand. Thus, the weight of the work unit and more particularly of the tool head is transferred to the top of the hand.

[0010] In an embodiment, the base comprises a trigger at its distal end, the trigger being adapted to release a working movement of the die set from the open position to the closed position. The trigger can easily be actuated by a finger, notably the index. Thus, the hydraulic tool is easily held and controlled by an operator with one hand.

[0011] In an embodiment, the connecting portion comprises a ring fixed on the tool body. The handle can easily be fixed to different tool bodies.

[0012] In an embodiment, the connecting portion comprises the pivot. In an embodiment, the lock mechanism is a screw-clamping mechanism. In an embodiment, the lock mechanism is arranged on the pivot. The lock mechanism is easy to implement and does not add an important additional weight.

[0013] In an embodiment, a determined number of orientation positions can be locked by the lock mechanism. This way, the operator can easily choose one orientation among the determined number of possible orientation positions and easily adjust it again to exactly the same orientation. In an embodiment, an infinite number of orientation positions can be locked by the lock mechanism. This way, an operator can choose the exact orientation which is convenient for him.

[0014] In an embodiment, the base longitudinally extends along a base axis, and wherein the base axis is inclined with regard to the tool axis at an orientation angle, wherein the orientation angle is between 5 and 175 degrees, and preferably between 5 and 90 degrees.

[0015] In an embodiment, the hydraulic tool comprises a battery unit. Such hydraulic 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.

[0016] In an embodiment, the tool head is arranged at a first end of the tool body and the connecting portion is arranged at a second end of the tool body, wherein the tool body and the electro-hydraulic pump unit are physically separate and the battery unit is physically separate from the electro-hydraulic pump unit, such that the handle moves and directs the work unit only.

[0017] 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 shows a hydraulic tool having a handle according to the invention. The hydraulic tool notably comprises a work unit having a tool body, a tool head, and the handle rotatably fixed to the tool unit;

Fig. 2 shows a perspective view the handle of Fig. 1;

Fig. 3 shows the handle of Fig. 2 with a connecting portion for connecting the handle to the tool body;

Fig. 4A and Fig. 4B show a detailed view of two different embodiment of a handle having different triggers;

Fig. 5A and Fig. 5B show two possible embodiments of a portable hydraulic tool and portable hydraulic tool arrangement; Fig. 5A schematically shows an operator with a portable hydraulic tool and an attaching device, wherein the hydraulic 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 by means of a handle according to the invention; Fig. 5B shows a portable hydraulic tool with a battery and pump unit in one casing and a work unit remote from the battery and pump unit;

Fig. 6A, Fig. 6B and Fig. 6C schematically show three different embodiments of a portable hydraulic tool according to the invention with three different tool head.

[0018] 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.

[0019] Fig. 1 shows a portable hydraulic tool 14 thereof having a handle 46 according to the invention. The portable hydraulic tool 14 notably comprises a work unit 16 with a tool body 44, a handle 46 and a tool head 48. The tool head 48 is for example 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 (and therefore not represented), 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 50, 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 tool body 44 extends longitudinally along a tool axis X. The work unit 16 may for example have a weight between 2 and 4 kilograms. The hydraulic tool 14 can be provided with different tool heads 48 as depicted notably, but not exclusively in Fig. 6A to Fig. 6B.

[0020] As non-limitative examples Fig. 6A shows a strut rail cutter head, Fig. 6B shows a scissor head, Fig. 6C shows a crimping head. All these heads are held by the handle 46. Other tool heads (not represented) can also be used with the handle as described below to form the hydraulic tool 14.

[0021] The handle 46 is rotatably fixed to the tool body 44. More particularly, the handle 46 is pivotally mounted at a pivot 62 to the tool body 44 such that the handle 46 is rotatable with regard to the tool body around a rotation axis Xr. The rotation axis Xr is orthogonal or sensibly orthogonal to the tool axis X. The handle 46, as seen in Fig. 1, has the shape of a joystick. The handle 46 allows thus for comfortable operation of the hydraulic tool 14 by an operator.

[0022] The handle 46 is connected to the tool body 44 by means of a connecting portion 64. The connecting position 64 is for instance a clamping ring (See Fig. 1 and Fig. 3). The clamping ring is wrapped, press-fitted, snap-fitted, clipped, glued, or welded around a portion of the tool body. More particularly, the clamping ring is clamped around a portion having a reduced cross-section of the tool body 44, as illustrated in Fig. 1. The clamping ring 64 is an opened clamping ring with a first and a second end. The first end is attached to a portion of the pivot 62. The second end is attached to another portion of the pivot 62. The pivot 62 is for instance realized by a

pivot bearing, wherein fixed segments are attached to the first and second ends. The movable segment of the pivot bearing is connected to the handle 46. A knob 78 can for instance be used to tighten the clamping ring 64 to the tool body 44. Two clamping pieces 80, 82 are provided to decrease the diameter of the clamping ring 64. The clamping ring 64 thus shrinks around a portion of the tool body 44. By turning the knob 78, the distance between the two clamping pieces 80, 82 decreases, which forces the diameter of the clamping ring to decrease. Thus, a quick locking is realized.

[0023] By means of the pivot bearing, the handle 46 is rotatable to several orientation positions. A lock mechanism 66 can be provided to lock a particular or predetermined position. The lock mechanism 66 is for instance a screw-clamping mechanism provided on the pivot bearing. The lock mechanism comprises for instance the knob 78 and the clamping pieces 80, 82. The knob 78 and the clamping pieces 80, 82 may also be used to lock the orientation of the handle around the rotation axis X_r . By turning the knob 78, the distance between the two clamping pieces 80, 82 decreases, which causes the handle (and more particularly an end of the handle) to be pressed fitted and thus locked in rotation around the rotation axis X_r . Thus, one knob may be used to lock the handle to the tool body and to lock the orientation of the handle. However, two knobs may also be provided, one for acting on the coupling of the clamping ring, the other for locking the orientation of the handle. Each knob can then act on different clamping pieces.

[0024] In an embodiment, the lock mechanism 66 can lock a determined number of stable positions of the handle. In another embodiment, the lock mechanism 66 can lock an infinite number of positions of the handle 46. The pivot and the lock mechanism form an adjustment orientation system of the handle with regard to the tool body. Thus, an operator may decide the most ergonomic position for an operation and adjust the angular position of the handle with regard to the tool axis.

[0025] The handle 46 comprises a base 68 adapted to conform to an operator's palm hand and a top 70, as depicted in Fig. 2. The base is directly connected to the pivot 62 and/or the connecting portion 64. More particularly, the base 68 extends from the connecting portion to the top 70. A proximal end of the base is connected to the connecting portion and a distal end of the base is supporting the top 70. The top 70 has an internal surface 72 facing the base and an external surface, opposite the internal surface. The internal surface 72 is adapted to cradle the top of the operator's hand. More particularly the internal surface 72 has a curved shape corresponding to the top of an operator's hand.

[0026] The base 68 comprises a trigger 74 at its distal end, see for instance Fig. 4A. The trigger 74 is adapted to release a working movement of the die set from the open position to the closed position. The trigger 74 has for instance one stable position corresponding to the open position of the die set. An action of the operator on

the trigger 74 against a resistance spring allows to move the die set from the open position to the closed position. In an embodiment, illustrated in Fig. 4B, the trigger 74 may have two parts 74a, 74b, controlling two different actions. A 2-finger rubber trigger 74 can be provided to increase comfort. In this configuration, the trigger 74a could command via an electromechanical control (for instance a distributor with an electromagnet) the activation of the decompression in the hydraulic pump, wherein the trigger 74b command the set of dies.

[0027] The base 68 may also be provided with a second trigger 76. The second trigger 76 may have two stable position. The second trigger 76 is for instance used to lock the first trigger 74 and avoid an untimely start when carrying the work unit.

[0028] The base 68 longitudinally extends along a base axis X_b . The base axis is inclined with regard to the tool axis at an orientation angle A (See Fig. 1, Fig. 6A, Fig. 6B or Fig. 6C). The orientation angle A can be adapted to the need of the operator, as mentioned above, and is for example between 5 and 175 degrees, and preferably between 5 and 90 degrees.

[0029] The portable hydraulic tool 14 is used by an operator. The operator first lock the handle in the needed position and then grips the handle with the operator's palm hand gripping the base 68 and the top of the operator's hand being cradle by the internal surface 72. The position of the handle on the tool body is preferably as near as possible from the tool head without interfering with the field of action of the tool head.

[0030] Fig. 5A schematically shows an embodiment of an hydraulic tool 14 with an operator P.

[0031] The hydraulic tool 14 is part of an hydraulic tool assembly 10 comprising an attaching device 12 and a portable hydraulic tool 14. In the embodiment of Fig. 5A, the hydraulic tool 14 comprises a work unit 16, a battery unit 18 and an electro-hydraulic pump unit 20. The attaching device 12 in the embodiment of Fig. 5A 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. In the embodiment shown in Fig. 5A, the work unit 16 is 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. In another embodiment, depicted in fig. 5B the electro-pump unit 20 and the battery unit 18 may be in one casing, whereas the work unit 16 is remote from said casing. In another embodiment the work unit, battery unit and electro-hydraulic pump unit could be directly connected to each other, for example within one unique housing.

[0032] The battery unit 18, for example may comprises

a battery support (or battery mount) 22 and a battery 24. The battery support 22 can be configured to release mechanically and electrically a rechargeable battery 24. The battery unit 18 is connected to the electro-hydraulic pump unit 20, for example by means of a cable (or more specifically by means of a power cable and decompression cable). Eventually, as depicted in the embodiment of Fig. 5A, 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.

[0033] The electro-hydraulic pump unit 20 comprises for instance a reservoir adapted to receive a hydraulic liquid and an electro-hydraulic pump adapted to increase the pressure of the hydraulic liquid. The electro-hydraulic pump and the reservoir forms a hydraulic sub-assembly which is well-known from persons skilled in the art and will not be described here in further details. A decompression trigger connected to a decompression cable such as to release pressure from the hydraulic liquid may also be provided.

[0034] According to the embodiments depicted in Fig. 5A or Fig. 5B, the work unit 16 is arranged remote from the electro-hydraulic pump unit 20, and a high pressure hose 54 is provided between the work unit 16 and the electro-hydraulic pump unit 20. However, in other embodiments, the work unit may be directly connected to the electro-hydraulic pump unit 20 and for example have a unique housing.

[0035] The hydraulic tool may also be provided without battery with a wired connection W, as schematically shown in Fig. 6C.

[0036] The handle 46 has thus the functions of carrying and controlling the hydraulic tool 14 or a portion thereof. The handle acts as a remote control by means of the trigger 74, 76.

Claims

1. Hydraulic tool (14) comprising:

- a work unit (16) with a tool body (44) extending longitudinally along a tool axis (X), 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;
- an electro-hydraulic pump unit (20) with a reservoir for a hydraulic liquid and an electro-hydraulic pump adapted to increase the pressure of a hydraulic liquid;

characterized in that

the handle (46) is pivotally mounted at a pivot (62) to the tool body (44) such that the handle (46) is rotatable with regard to the tool body (44) around a rotation axis (Xr) perpendicular to the tool axis (X).

2. Hydraulic tool (14) according to claim 1, wherein the

handle (46) is rotatable to several orientation positions, and each position can be fixed by a lock mechanism (66), such that a defined orientation of the handle (46) with regard to the tool body (44) can be fixed by an operator.

3. Hydraulic tool (14) according to claim 2, wherein the connecting portion comprises the pivot and wherein the lock mechanism (66) is a screw-clamping mechanism.

4. Hydraulic tool (14) according to claim 2 or claim 3, wherein a determined number of orientation positions can be locked by the lock mechanism (66).

5. Hydraulic tool (14) according to claim 2 or claim 3, wherein an infinite number of orientation positions can be locked by the lock mechanism (66).

6. Hydraulic tool (14) according to any of claims 2 to 4, wherein the lock mechanism (66) is arranged on the pivot (62).

7. Hydraulic tool (14) according to any of claims 1 to 6, wherein a connecting portion (64) is provided to connect the handle (46) to the tool body (44), and wherein the handle (46) comprises a base (68) adapted to conform to an operator's palm hand and a top (70), wherein the base (68) extends from the connecting portion to the top (70), wherein a proximal end of the base (68) is connected to the connecting portion and a distal end of the base is supporting the top, wherein the top (70) has an internal surface facing the base and an external surface, opposite the internal surface (72), and wherein the internal surface (72) is adapted to cradle the top of the operator's hand.

8. Hydraulic tool (14) according to claim 7, wherein the base (68) comprises a trigger (74) at its distal end, the trigger being adapted to release a working movement of the die set from the open position to the closed position.

9. Hydraulic tool (14) according to claim 7 or claim 8, wherein the connecting portion (64) comprises a clamping ring fixed on the tool body (44).

10. Hydraulic tool (14) according to any of claims 1 to 9, wherein the base (68) longitudinally extends along a base axis (Xb), and wherein the base axis is inclined with regard to the tool axis at an orientation angle (A), wherein the orientation angle is between 5 and 175 degrees, and preferably between 5 and 90 degrees.

11. Hydraulic tool (14) according to any of claims 1 to 10, further comprising a battery unit (18), wherein the tool head (48) is arranged at a first end of the

tool body and the connecting portion (64) is arranged at a second end of the tool body (44), wherein the tool body and the electro-hydraulic pump unit are physically separate and the battery unit is physically separate from the electro-hydraulic pump unit, such that the handle (46) moves and directs the work unit only. 5

12. Handle (46) for a portable hydraulic tool (14) according to any of claims 1 to 11, wherein the handle (46) is made in plastic material, and wherein the handle comprises a first trigger (74) at its distal end adapted to release a working movement of the die set from the open position to the closed position and a second trigger (76) in the vicinity of the first trigger (74). 10 15

13. Handle (46) according to claim 12, wherein the first trigger (74) has one stable position, and wherein the second trigger (76) has two stable position. 20

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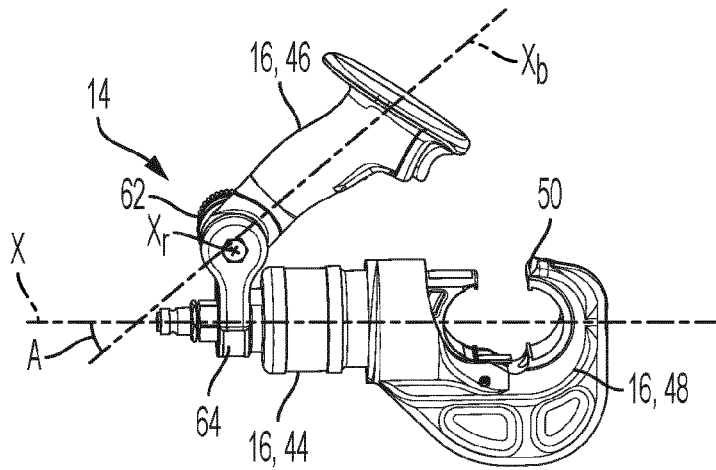


FIG. 1

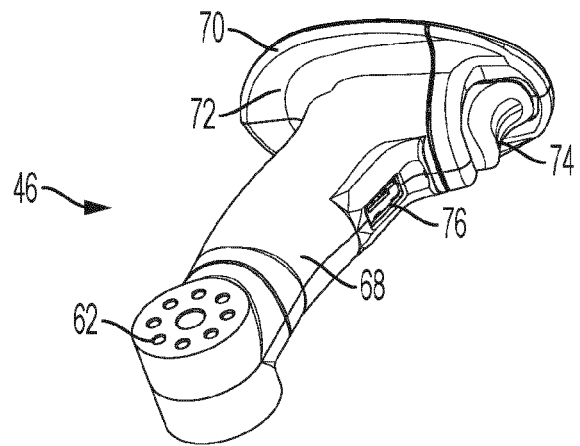


FIG. 2

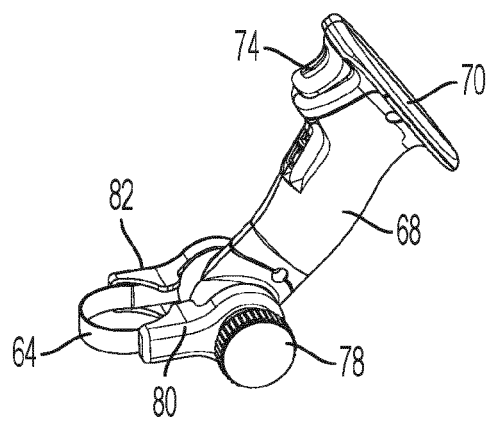


FIG. 3

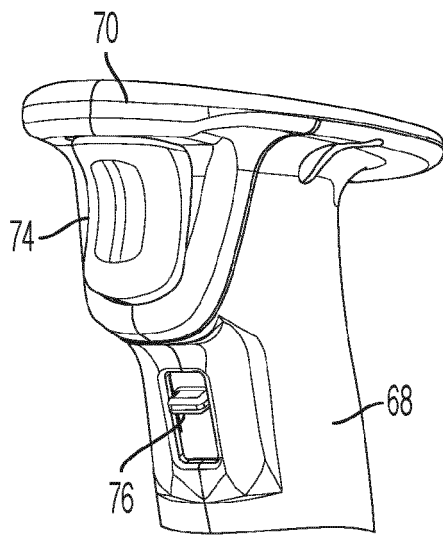


FIG. 4A

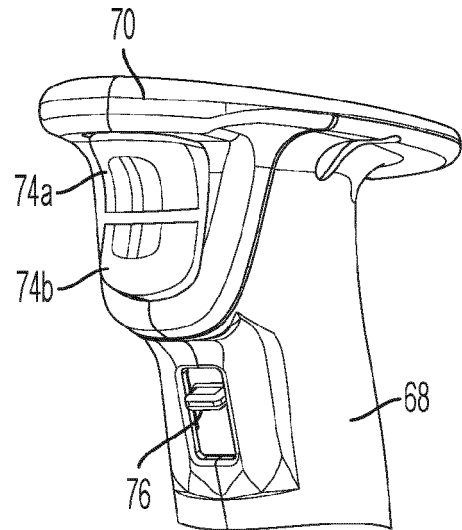


FIG. 4B

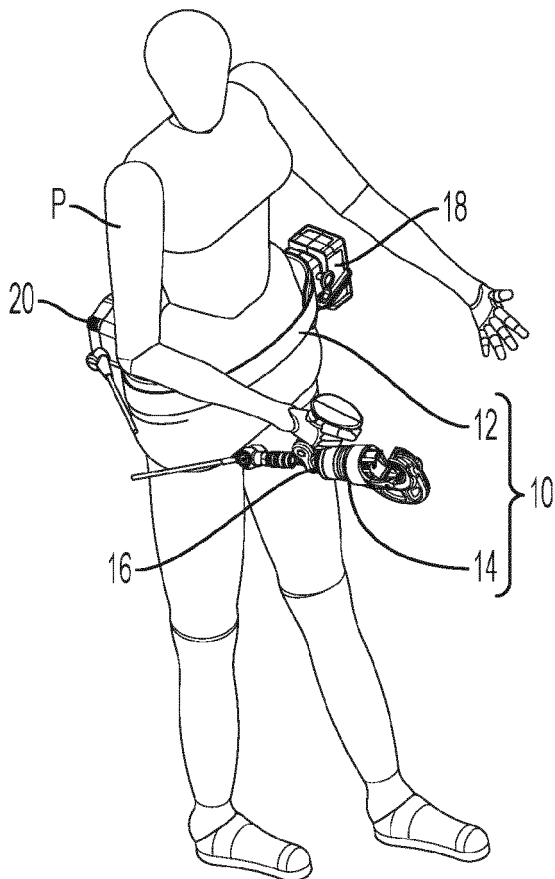


FIG. 5A

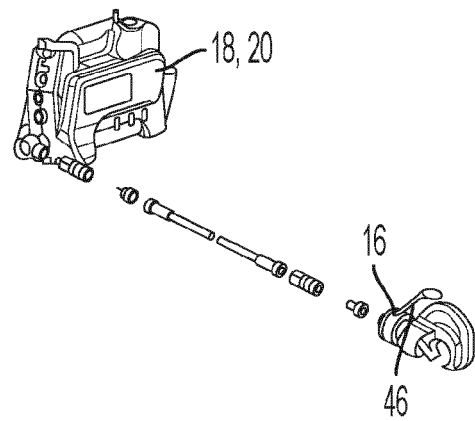


FIG. 5B

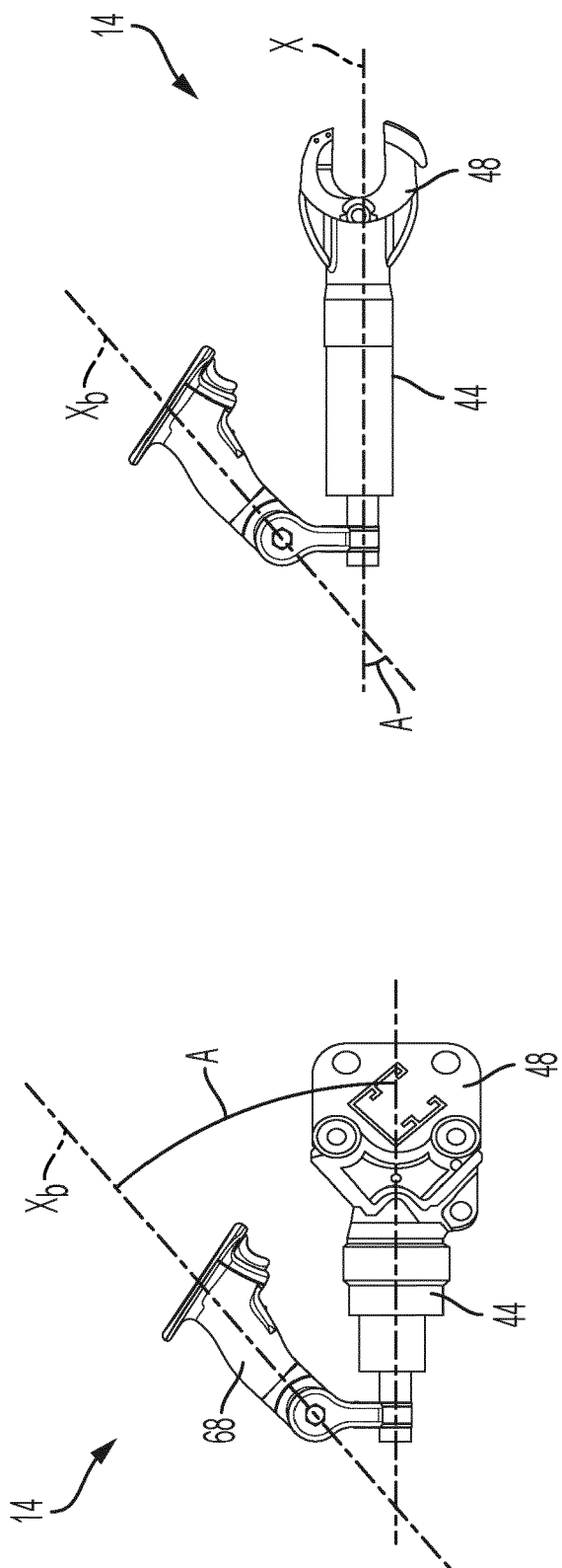


FIG. 6A

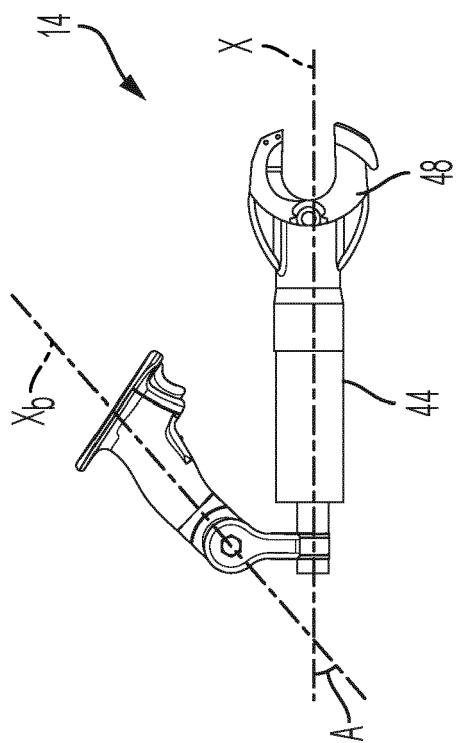


FIG. 6B

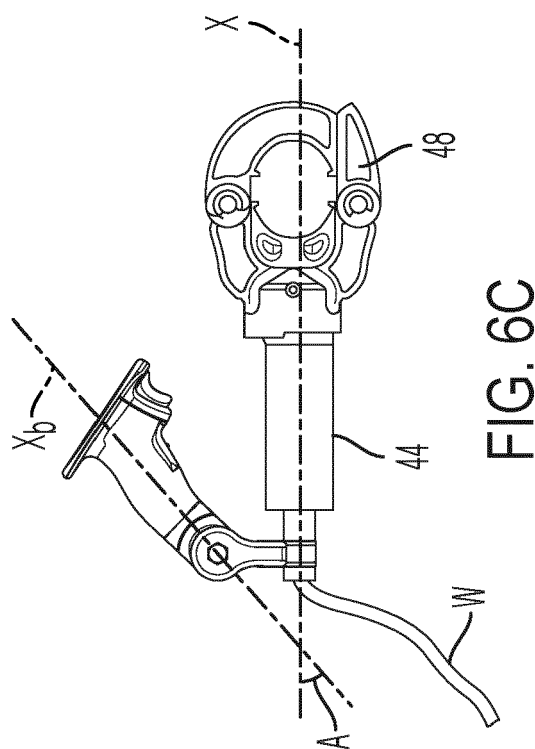


FIG. 6C



EUROPEAN SEARCH REPORT

Application Number

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 10 August 2022	Examiner Messai, Sonia
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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