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(54) **DEVICE TO CAPTURE PRESSURE DATA
FROM A WEAPONS HANDGRIP AND
TRIGGER DURING LIVE FIRE**

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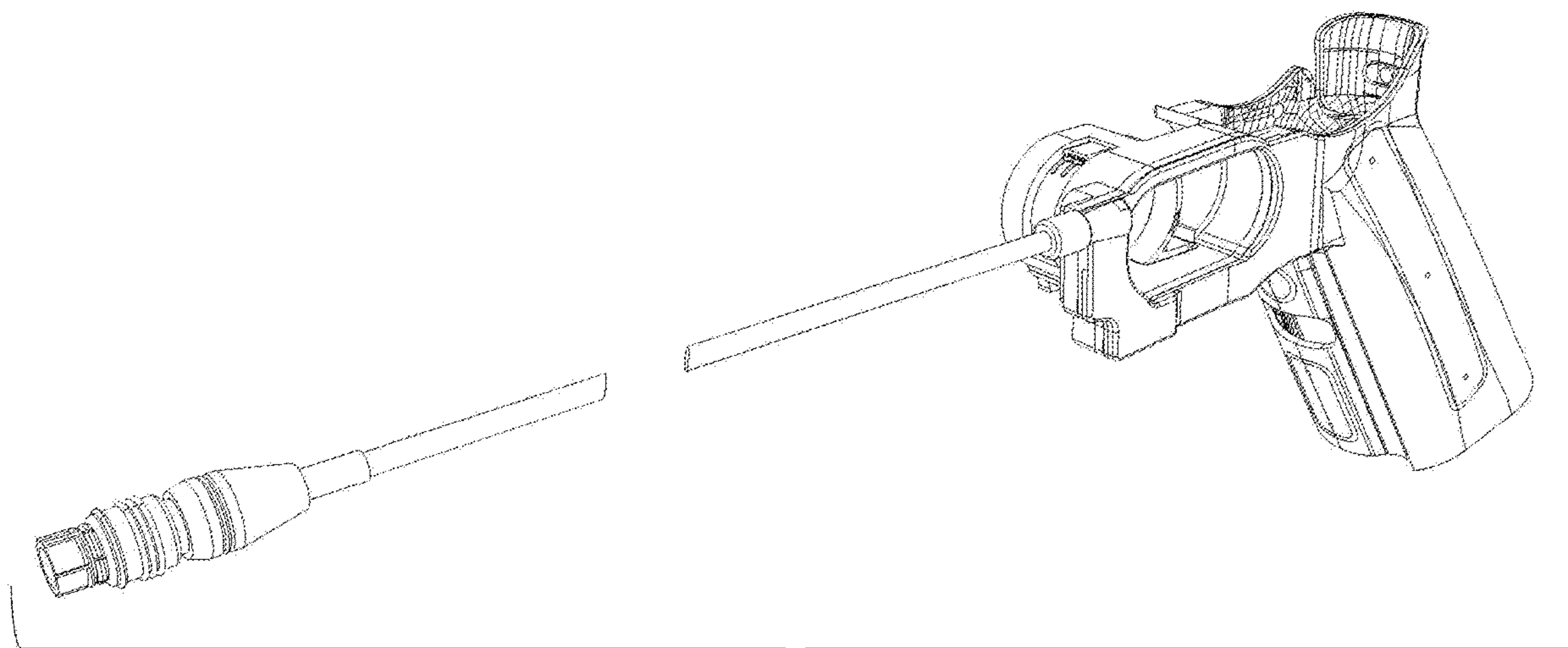
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(57) **ABSTRACT**

A device to capture pressure data from a weapon's handgrip and trigger during live fire, the device comprising a shell that fits around the handgrip, a network of pressure sensors disposed within the shell such that when the shell is on the handgrip and pressure is applied to the handgrip, the network of pressure sensors is able to record the pressure applied to all sides of the handgrip, and a communication assembly that allows data communication between the network of sensors and a computer.



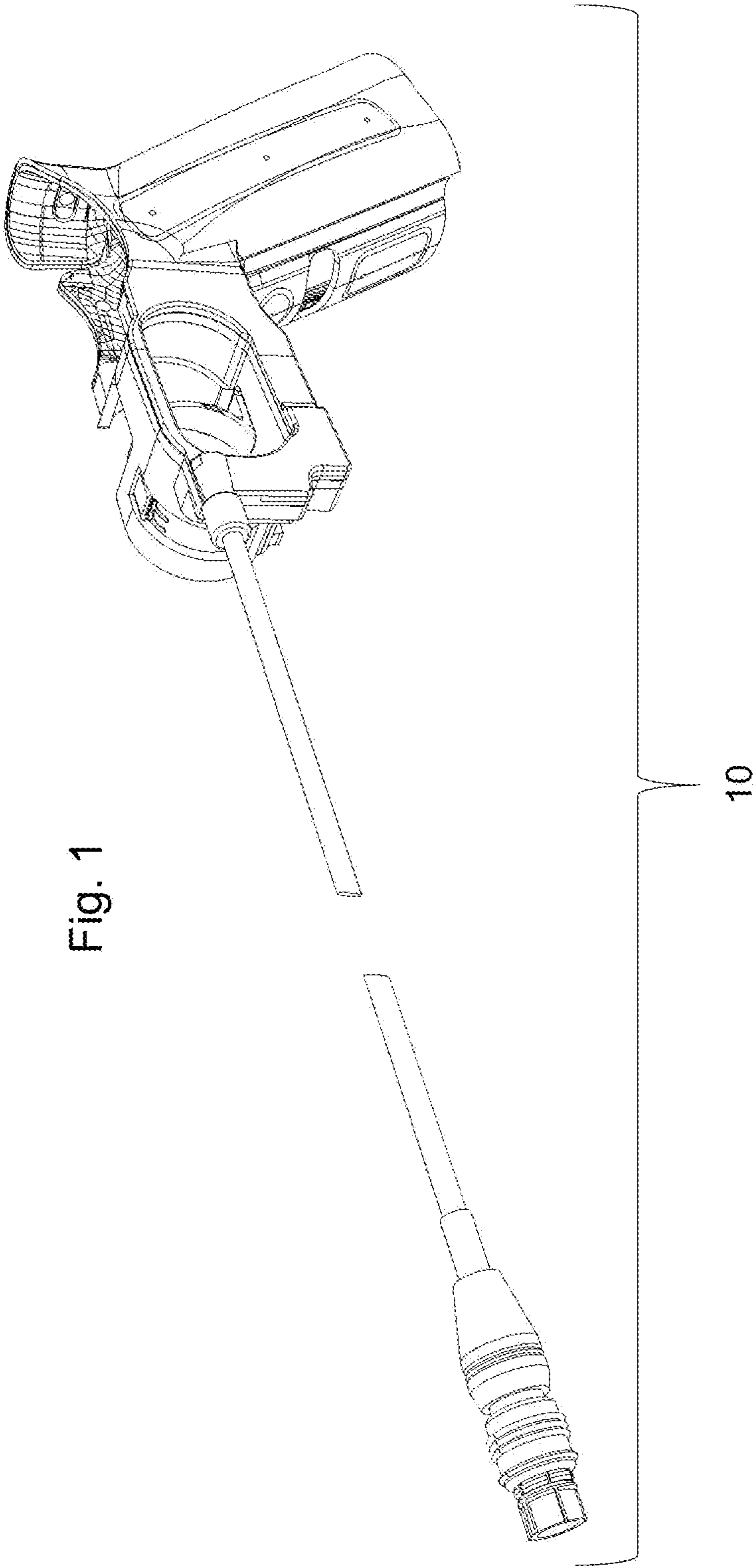
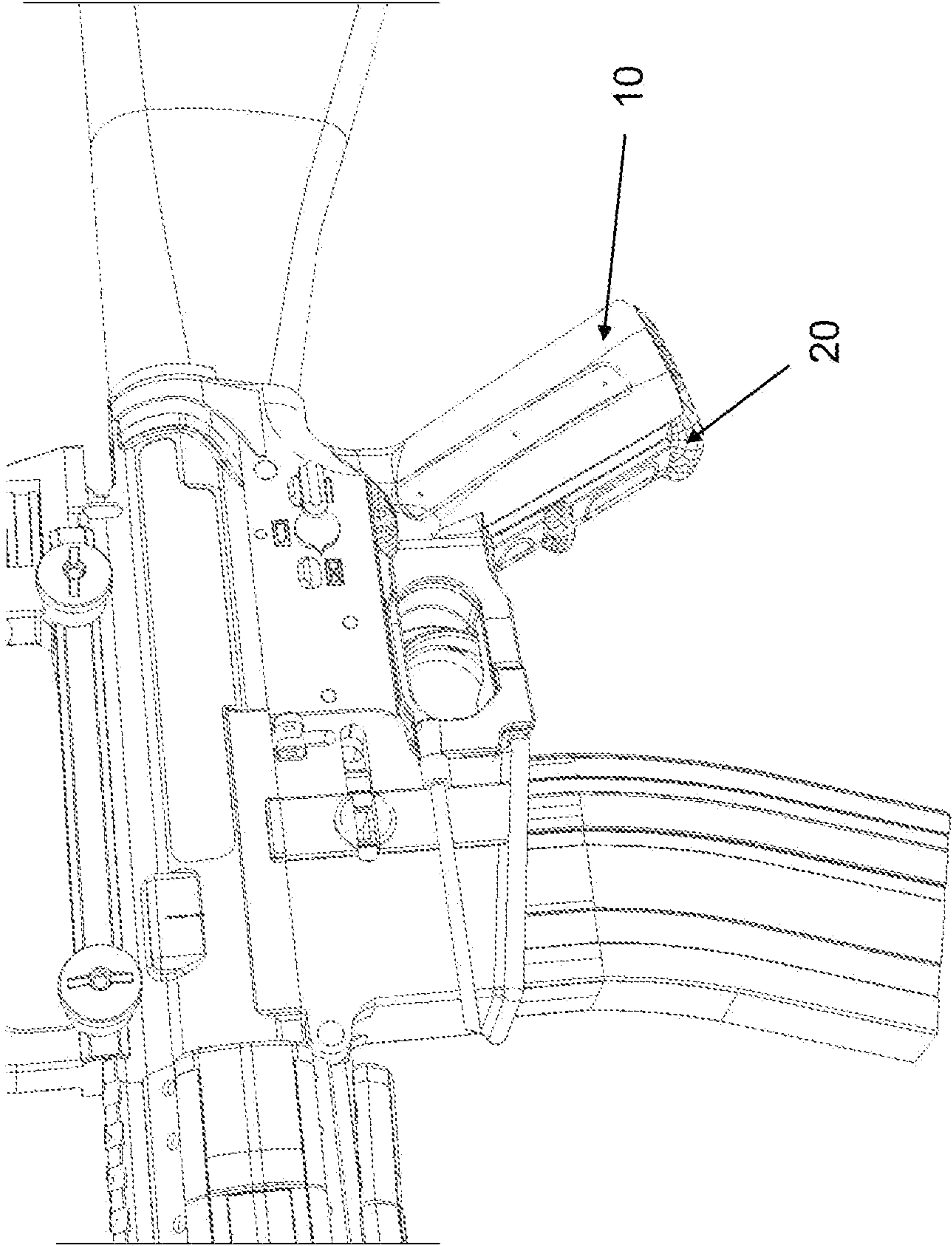


Fig. 2



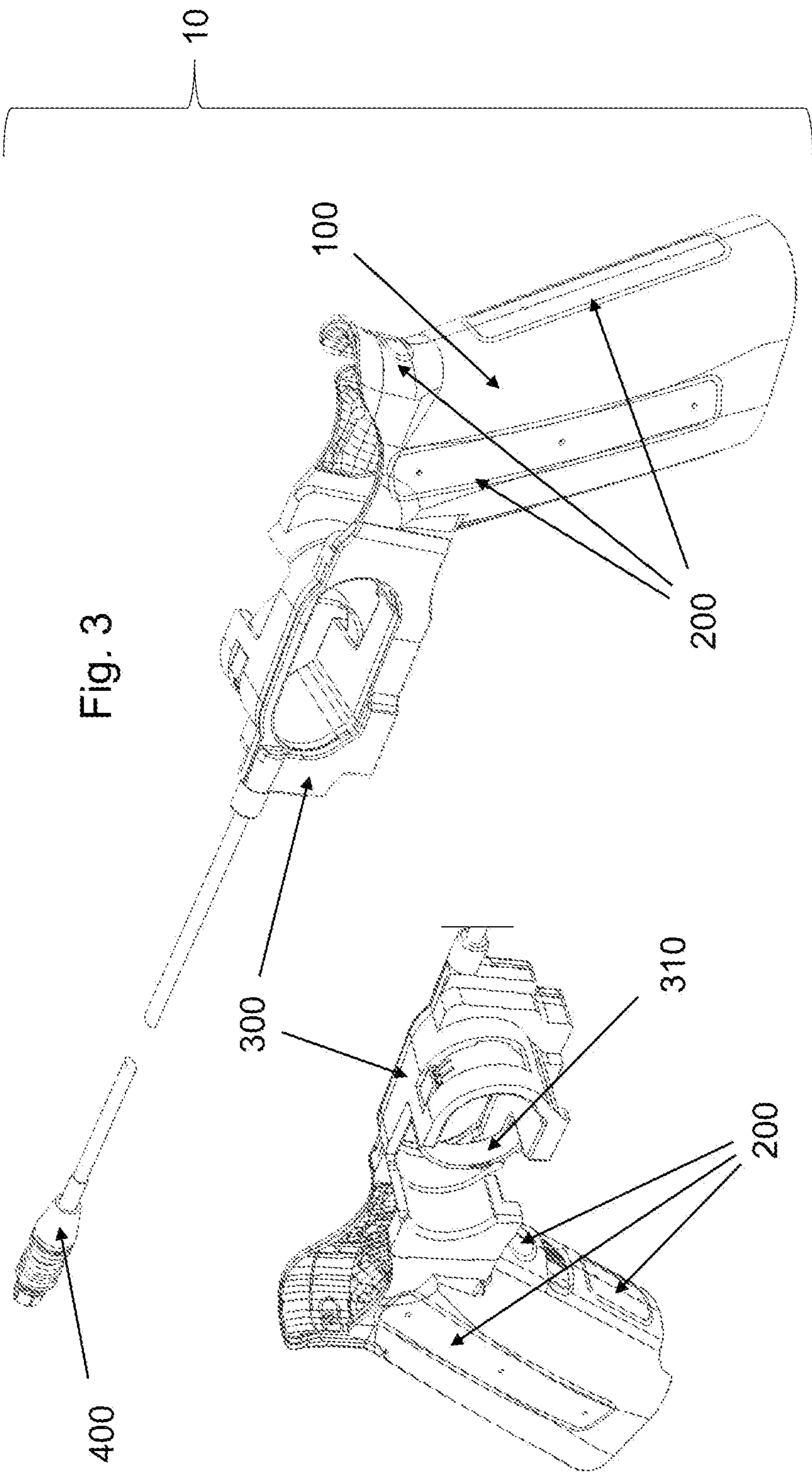
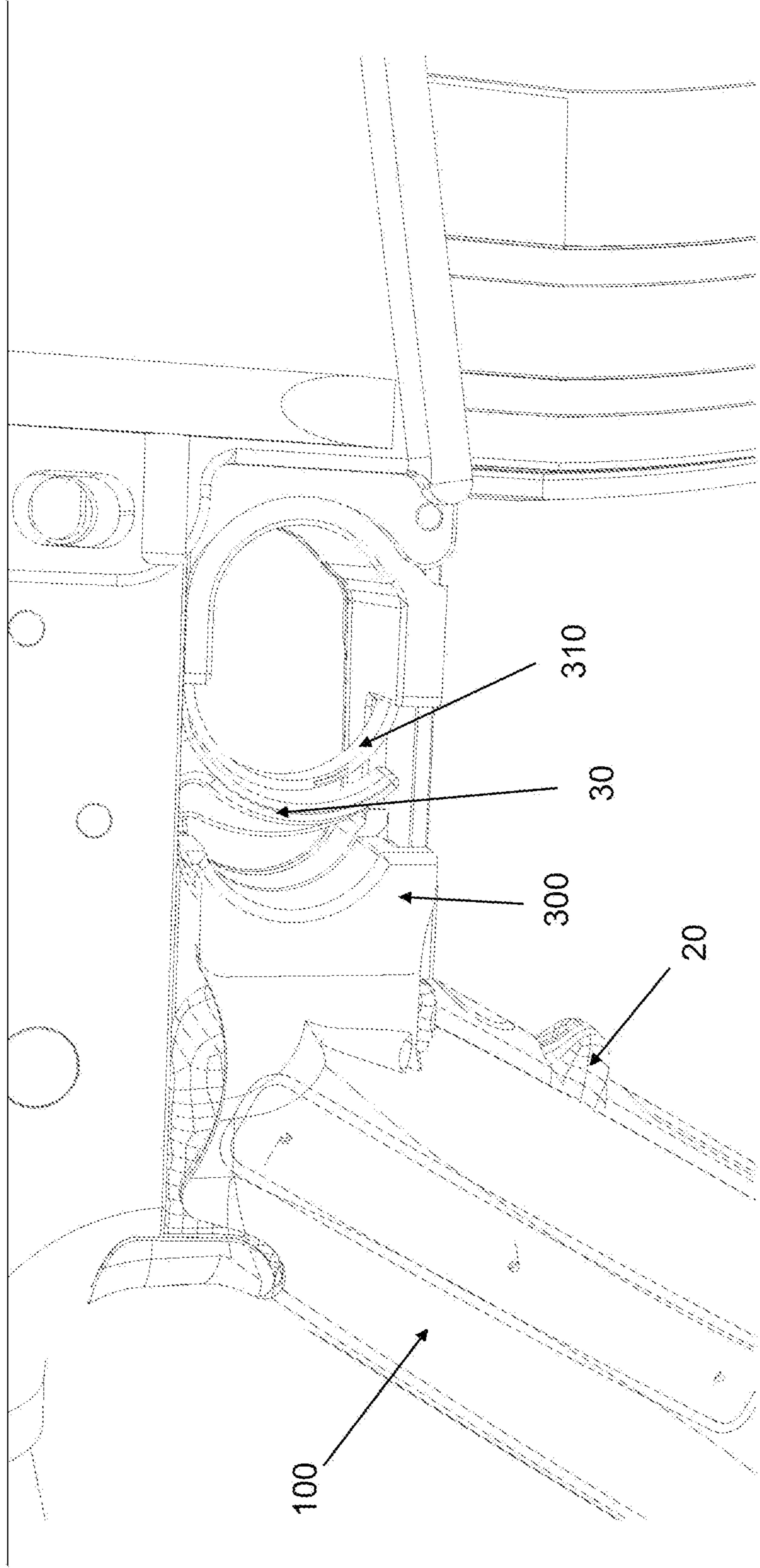


Fig. 4



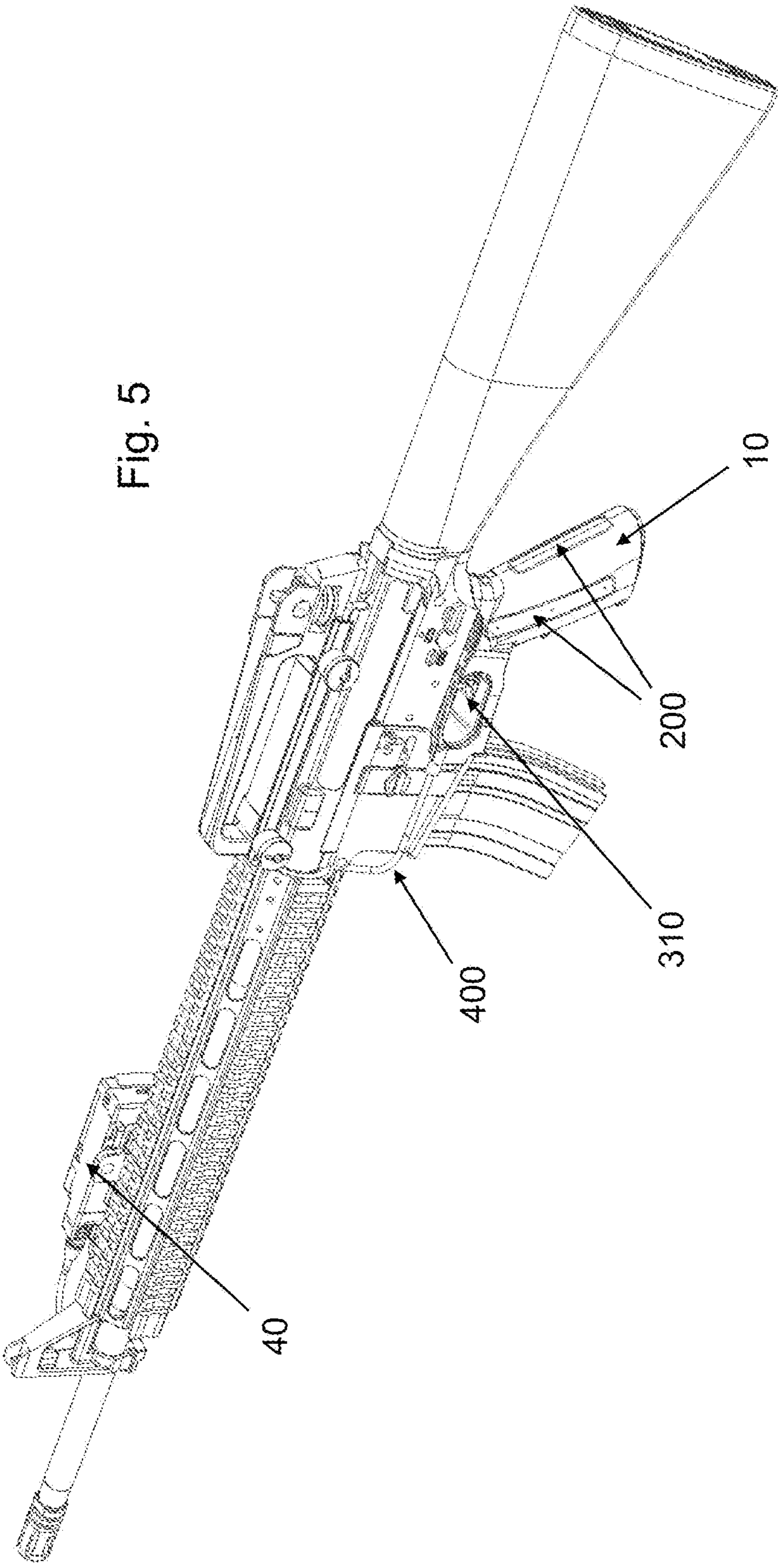


Fig. 5

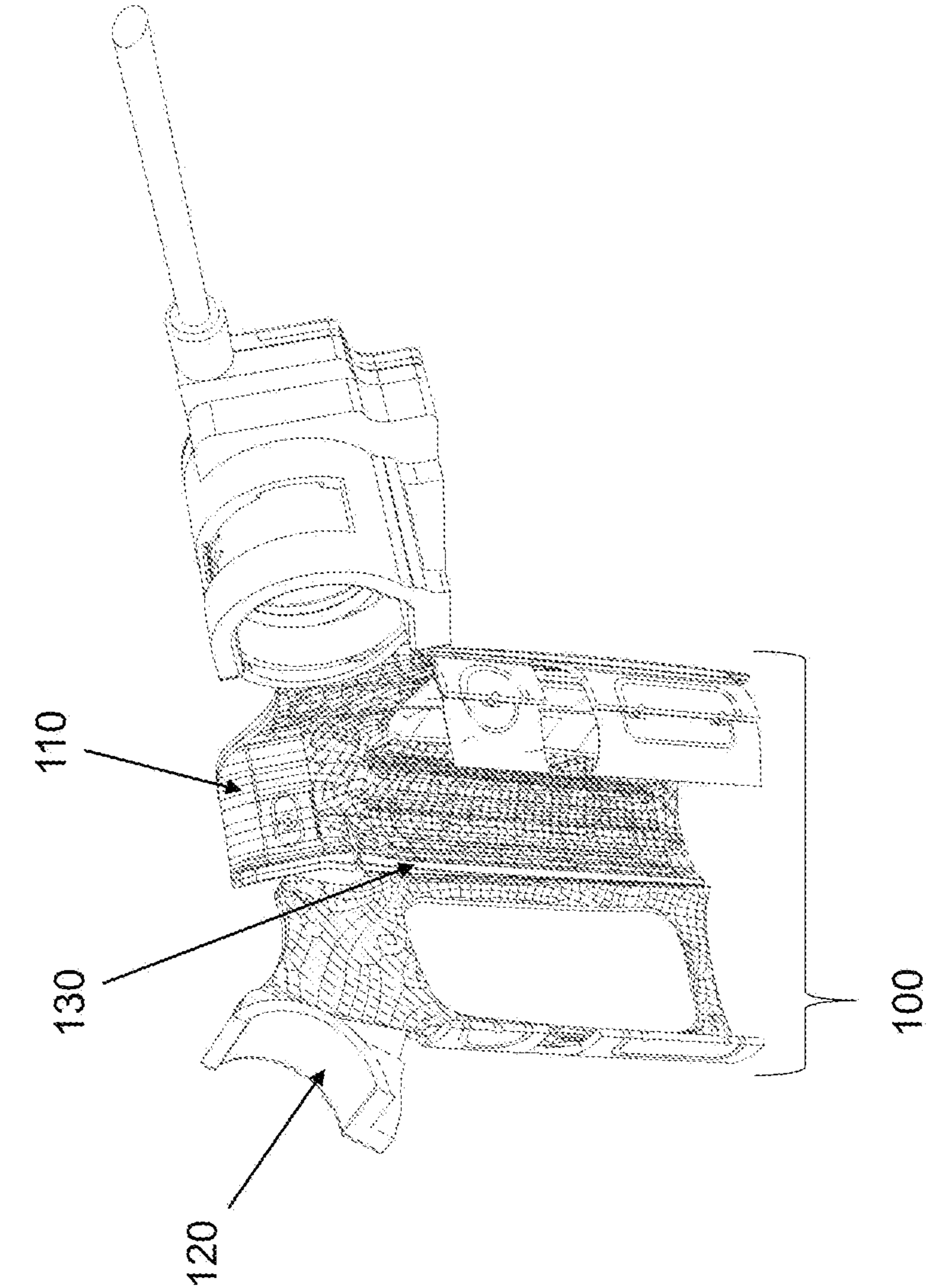


Fig. 6

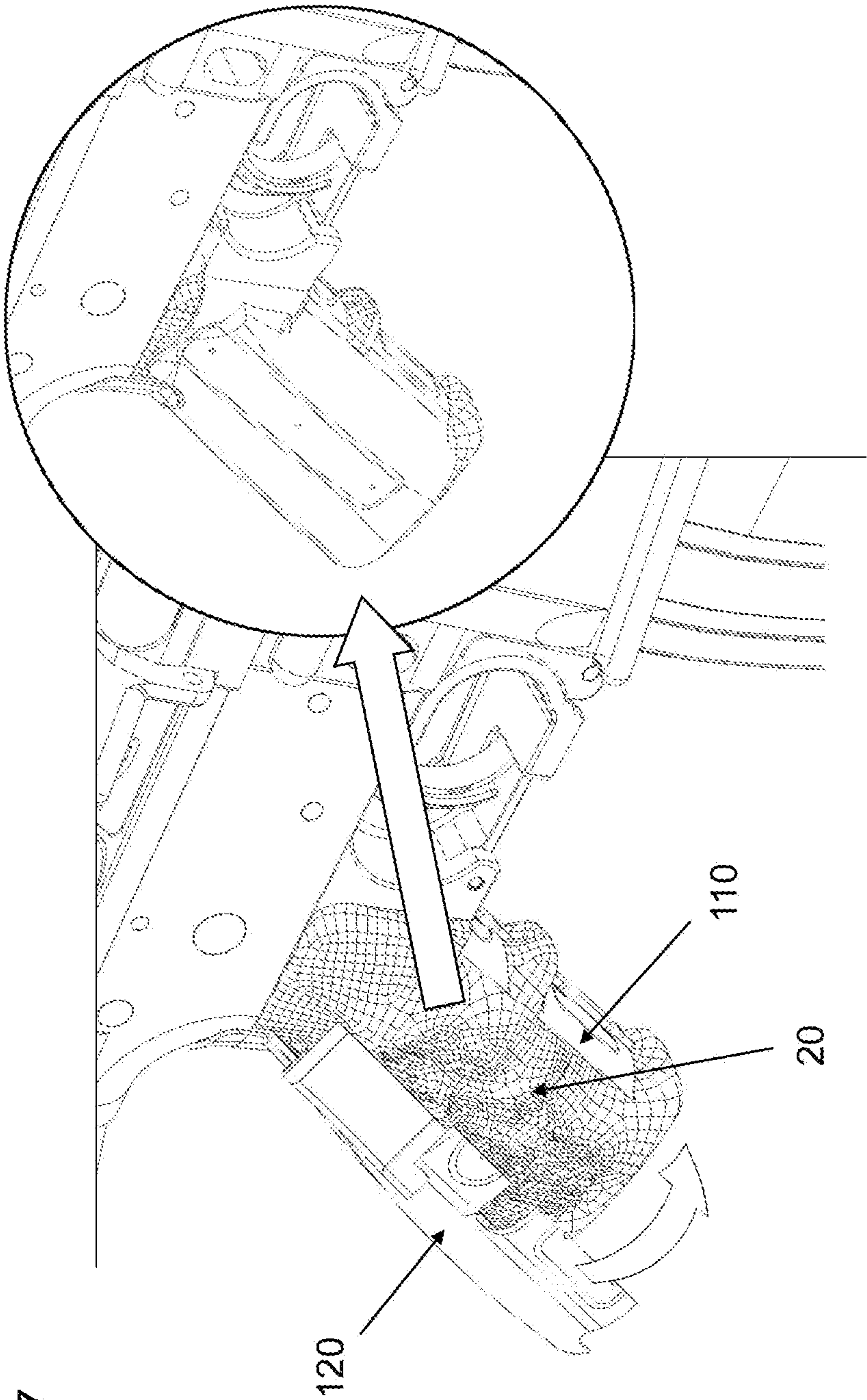


Fig. 7

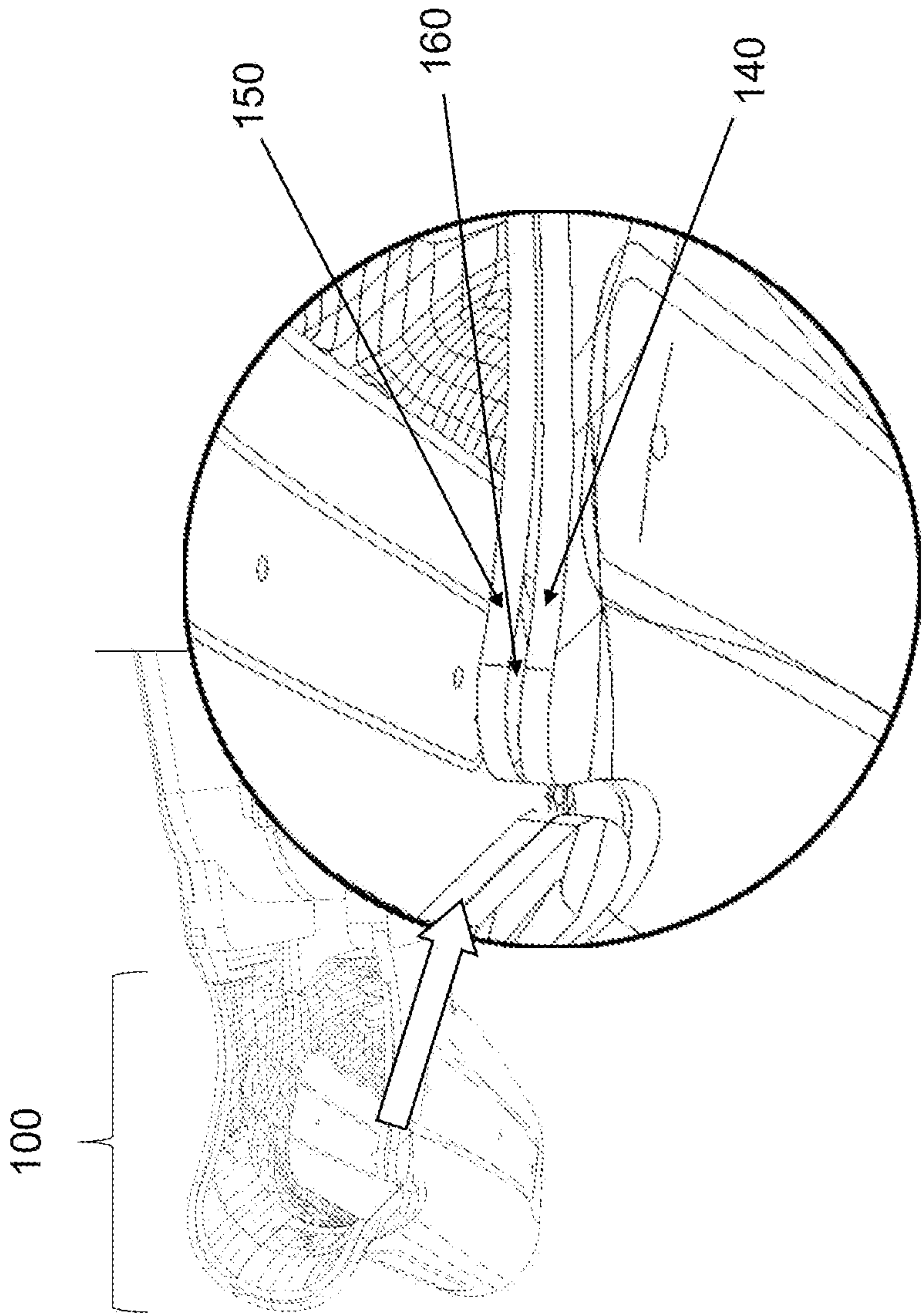
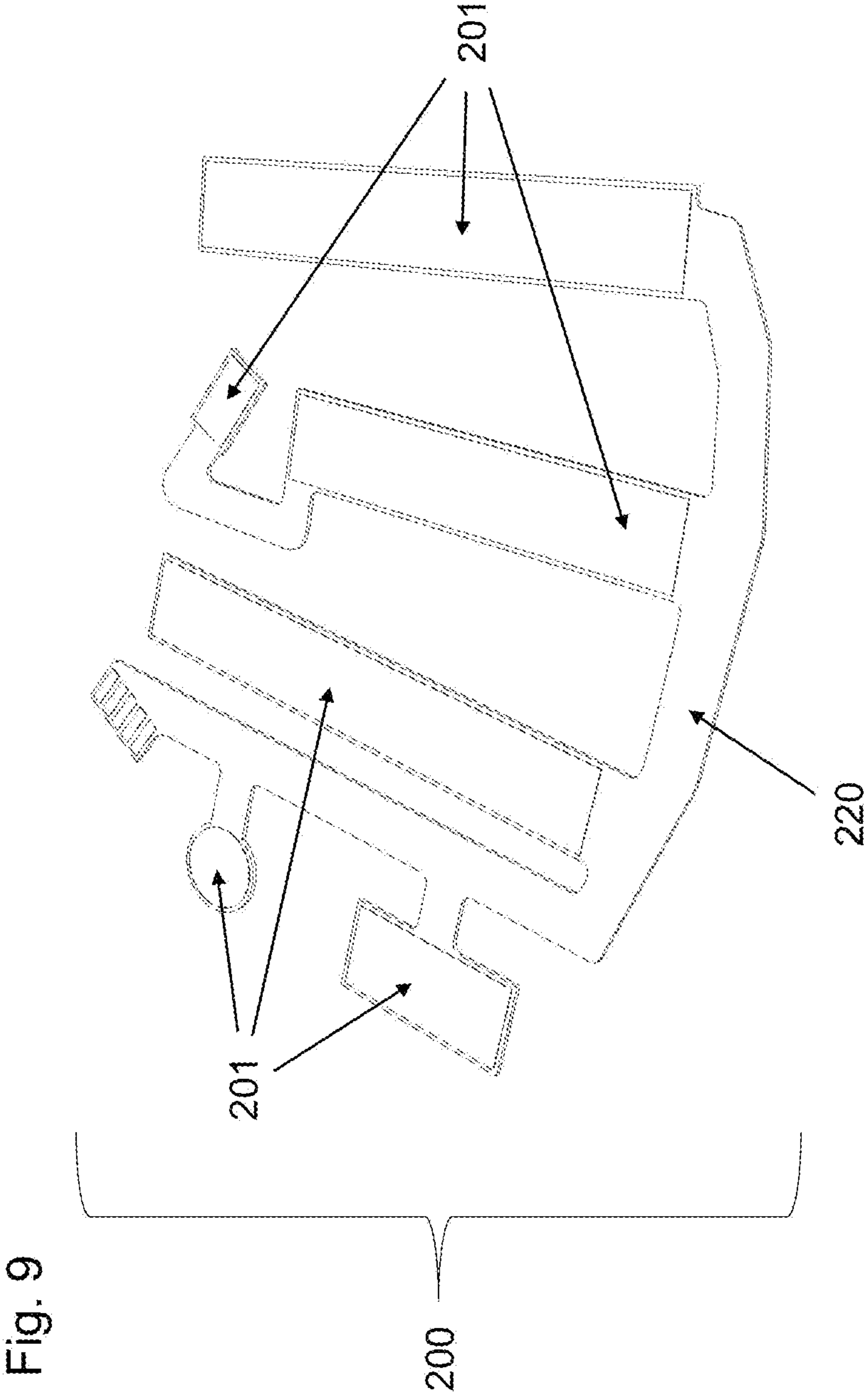


Fig. 8



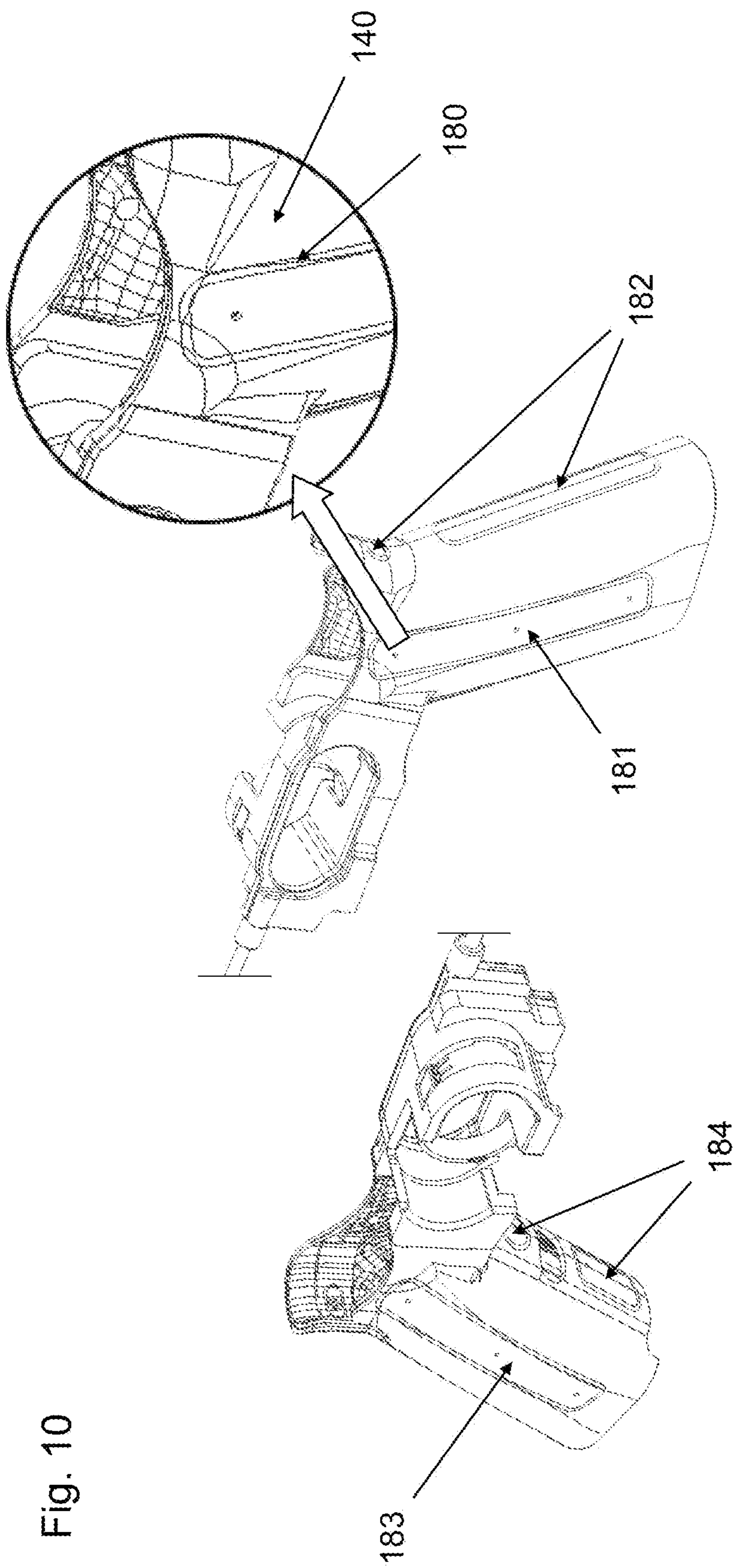


Fig. 10

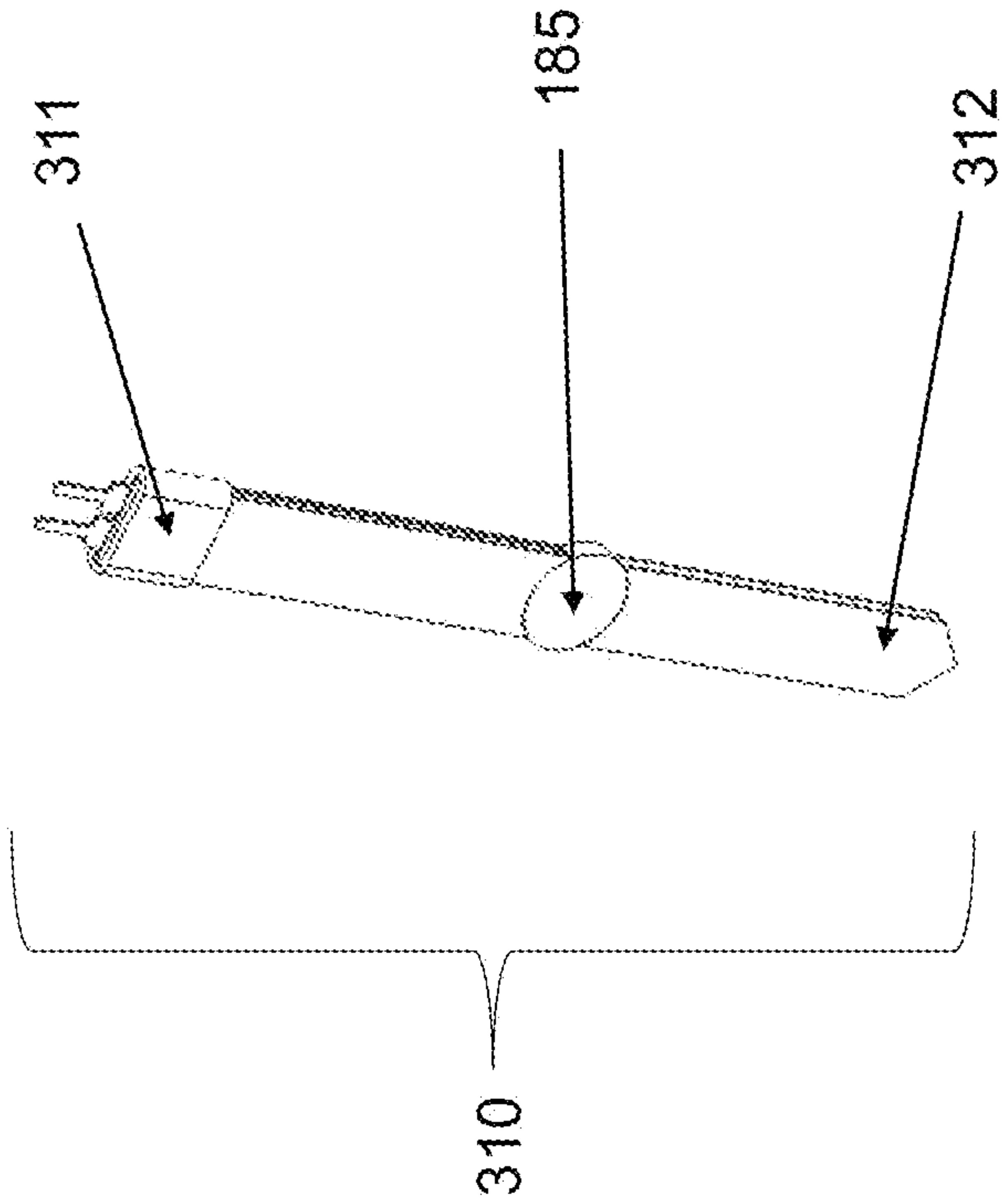


Fig. 11

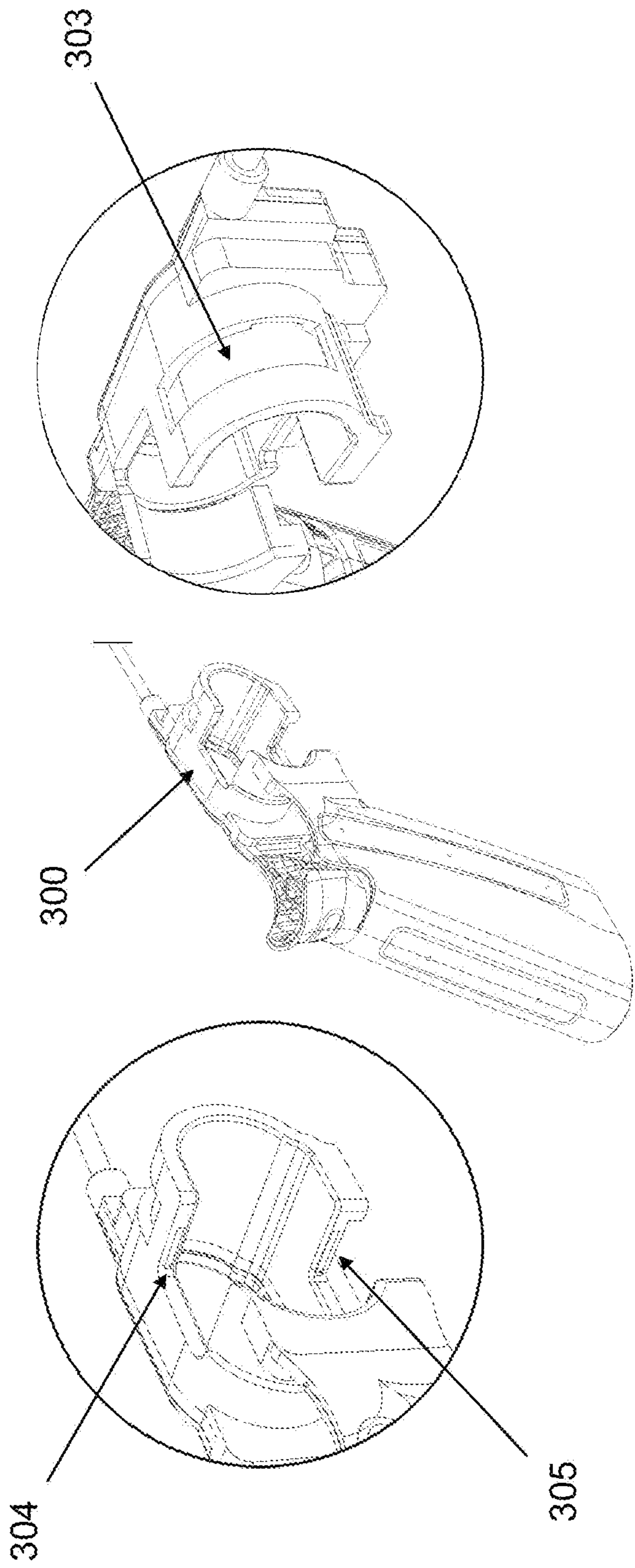
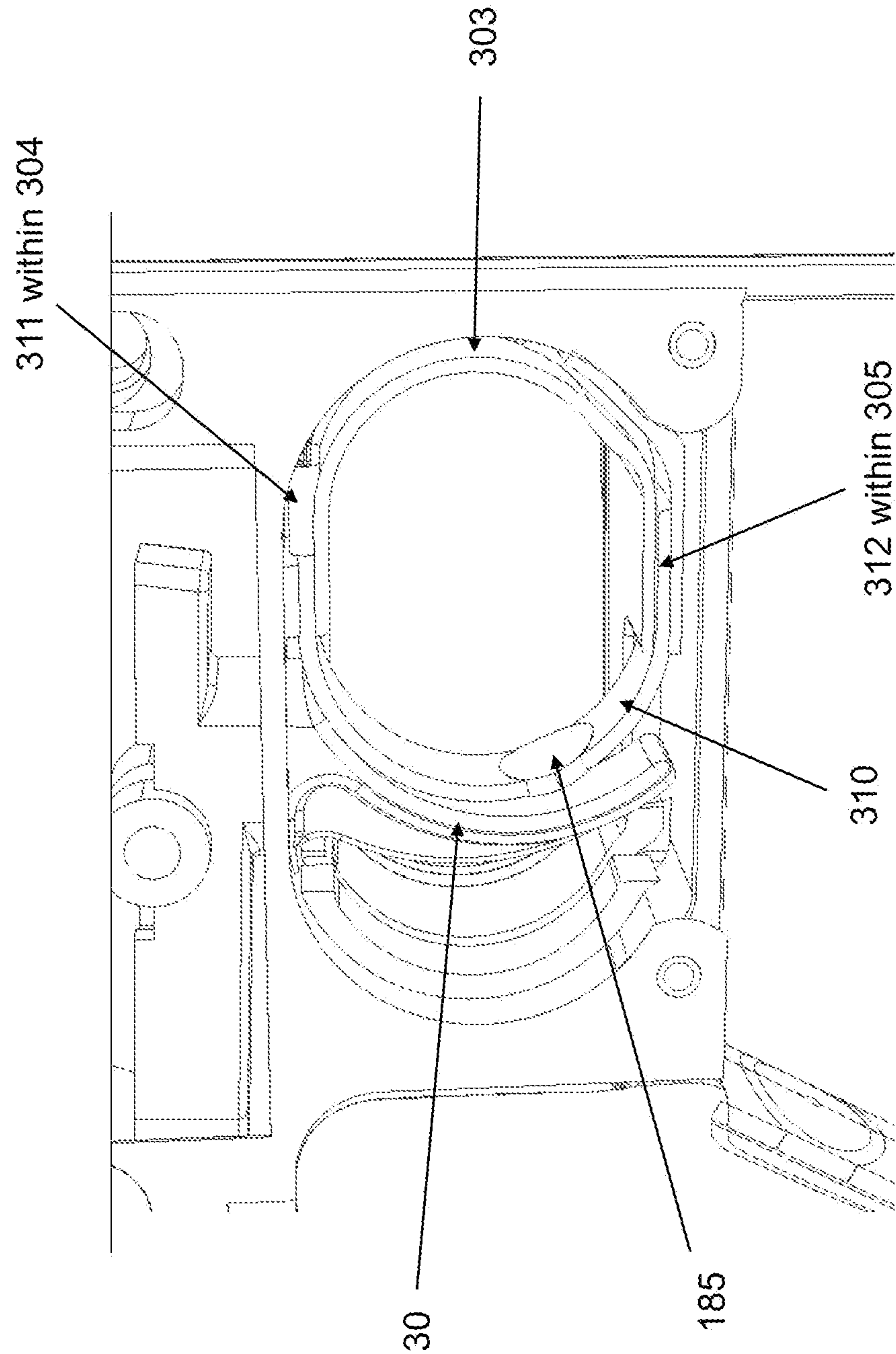


Fig. 12

Fig. 13



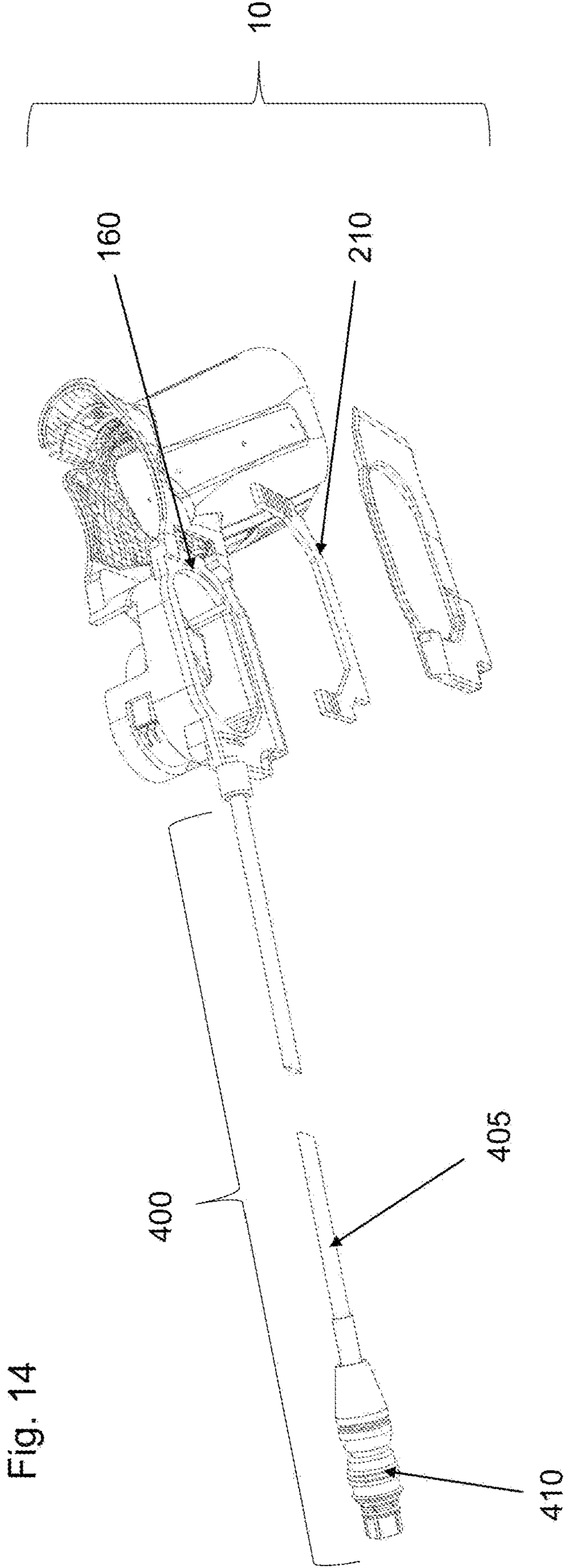


Fig. 14

DEVICE TO CAPTURE PRESSURE DATA FROM A WEAPONS HANDGRIP AND TRIGGER DURING LIVE FIRE

STATEMENT OF GOVERNMENT INTEREST

[0001] The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without payment of any royalties thereon or therefor.

BACKGROUND

[0002] Marksmanship is a foundational skill required of military personnel, law enforcement personnel, and any civil servant entrusted with a firearm. Great emphasis is placed upon the acquisition and maintenance of marksmanship, especially for military and law enforcement personnel. A marksmanship instructor is a shooter's first and best resource for the acquisition and maintenance of this vital skill. The marksmanship instructor faces many demands upon his/her time and abilities. In modern military and law enforcement firing ranges, each instructor typically oversees multiple students. Time on the firing range and ammunition for training is limited and expensive. Any deficiencies in a particular shooter's performance that require a disproportionate amount of an instructor's time to diagnose and remediate takes instruction away from other trainees. Reshoots and retries consume both valuable time and ammunition. Furthermore, a shooter that cannot demonstrate proper marksmanship at the range quickly enough is in danger of being removed from the firing line and forced to repeat more basic training, incurring yet more expense.

[0003] The marksmanship instructor is tasked with teaching his/her students the fundamentals of marksmanship in the safest, quickest, and most effective way possible. The Armed Services have identified several marksmanship fundamentals including aiming, breath control, trigger squeeze, and steady position. If a shooter is not accurate, he/she is usually deficient in one or more of these fundamentals. However, the root cause of a shooter's poor marksmanship is not always readily apparent even to an experienced instructor. The difficulty and danger of close observation of the shooter at a live fire range, the small physical differences between acceptable and poor weapon handling, and the extremely transient nature of firing events force instructors to very often rely solely on the most heuristic measure of performance available to them—the fall of shot. A poor fall of shot, however, is only the symptom of poor marksmanship. The marksmanship instructor often cannot determine in which fundamental the shooter is lacking solely from their fall of shot. Therefore, marksmanship instructors need something to aid them in monitoring marksmanship fundamentals. Technology that can mitigate these inherent difficulties and expose the root causes of poor marksmanship will increase the marksmanship instructor's efficiency, effectiveness, and analytic capability and is consequently of great value to both the instructor and the student.

[0004] The Naval Air Warfare Center Training Systems Division (NAWCTSD) recently invented a system to provide a marksmanship instructor with a set of technological tools to allow him/her to more effectively and quickly diagnose and remediate poor shooting at the live fire range. This invention was granted U.S. Pat. No. 10,024,631 on Jul. 17, 2018 (this patent is herein incorporated by reference and

is not admitted to be prior art). The invention, among other things, determines pressure that a shooter places on a trigger. However, it does not collect or determine pressure placed by a shooter on the handgrip of the weapon. Marksmanship instructors have indicated that it would be useful to be able to observe the pressure applied to not only the weapon's trigger but the weapon's handgrip. Tendencies that lead to poor marksmanship, such as squeezing, twisting, or applying lateral pressure to the handgrip when aiming or jerking on the handgrip during trigger pull could be detected if grip pressure were measured. Thus, there was a need for a device that also measures and records grip pressure of a shooter on a handgrip.

SUMMARY

[0005] The present invention is directed to an apparatus for providing a device to capture pressure data from a weapon's handgrip, fulfilling the needs enumerated above and below.

[0006] The present invention is directed to a device to capture pressure data from a weapon's handgrip and trigger during live fire wherein the device includes a shell that fits around the handgrip, a network of pressure sensors disposed within the shell such that when the shell is on the handgrip and pressure is applied to the handgrip, the network of pressure sensors is able to record the pressure applied to all sides of the handgrip, and a communication assembly that allows data communication between the network of sensors and a computer.

[0007] It is a feature of the invention to provide a device to capture pressure data from a weapon's handgrip and trigger during live fire wherein the device can be used to help with a shooter's performance issues, particularly incorrect trigger squeeze pressure by the shooter.

[0008] It is a feature of the invention to provide a device to capture pressure data from a weapon's handgrip and trigger during live fire that captures the pressure applied to the handgrip and trigger without affecting the trigger pull or feel of the weapon.

[0009] It is a feature of the present invention to provide a device to capture pressure data from a weapon's handgrip and trigger during live fire that is installed on a shooter's own weapon within seconds and is easy to use.

[0010] It is a feature of the present invention to provide a device to capture pressure data from a weapon's handgrip and trigger during live fire that does not significantly increase the size of the handgrip and does not add enough bulk to adversely or noticeably affect weapon handling.

DRAWINGS

[0011] These and other features, aspects and advantages of the present invention will become better understood with reference to the following description and appended claims, and accompanying drawings wherein:

[0012] FIG. 1 is a perspective view of the invention;

[0013] FIG. 2 is a perspective view of the invention installed on a weapon handgrip;

[0014] FIG. 3 is two perspective views of the invention;

[0015] FIG. 4 is a perspective view of the trigger of a weapon when the invention is mounted on the weapon;

[0016] FIG. 5 is a perspective view of the invention mounted on a weapon with a data collection device;

[0017] FIG. 6 is a perspective view of the invention, opened for installation on a weapon;

[0018] FIG. 7 is a perspective view of the process of installation of the invention on a weapon;

[0019] FIG. 8 is a perspective view of the construction of the invention;

[0020] FIG. 9 is a perspective view of a flexible printed circuit membrane incorporated into the invention;

[0021] FIG. 10 is several perspective views of the pressure sensitive regions of the invention's handgrip shell;

[0022] FIG. 11 is a perspective view of the trigger pressure sensor;

[0023] FIG. 12 is several perspective views of the trigger pressure sensor pathways and cavity;

[0024] FIG. 13 is a cutaway view of the trigger area of a weapon with the invention installed, and;

[0025] FIG. 14 is an exploded diagram showing several components of the invention.

DESCRIPTION

[0026] The preferred embodiments of the present invention are illustrated by way of example below and in FIGS. 1-14. FIG. 1 shows the device 10 to capture pressure data from a weapon's handgrip and trigger during live fire. FIG. 2 shows the device 10 installed around a weapon handgrip 20. As shown in FIG. 3, the device 10 includes a shell 100 that fits around the weapon handgrip 20, a trigger pressure sensor 310, network of grip pressure sensors 200, a shell extension 300 and a communication assembly 400. The network of grip pressure sensors 200 are disposed within the shell 100 such that when the shell 100 is on the weapon handgrip 20, and pressure is applied, the network of grip pressure sensors 200 is able to record the pressure applied to all sides of the shell 100. As shown in FIG. 4, the shell extension 300 includes a trigger sensor 310. The extension 300 is connected to the shell 100 and is positioned such that the trigger sensor 310 can communicate with the trigger 30 and record the pressure applied on the trigger 30. FIG. 5 shows the communication assembly 400 providing data communication between the trigger pressure sensor 310 and grip pressure sensors 200 contained within the device 10 and a data collection device 40.

[0027] In the description of the present invention, the invention will be discussed in a military environment; however, this invention can be utilized for any type of application related to weapons training.

[0028] In the preferred embodiment of the invention, the shell 100, shown in FIG. 6, may include a first shell section 110 and a second shell section 120. The first shell section 110 and the second shell section 120 may be connected, but without limitation, to each other via hinges 130 (or any other connecting assembly practicable), such that the shell 100 can be in a closed and open position. In the closed position, the device 10 can envelop the weapon handgrip and can take pressure readings from a shooter gripping the handgrip 20. In the open position, the device 10 can be removed from the weapon. In operation, as shown in FIG. 7, the shell 100 is placed in the closed position by bringing the first shell section 110 and the second shell section 120 together and enveloping the handgrip 20.

[0029] FIG. 8 shows the shell 100 may further include an outer casing 140 and an inner casing 150, with the outer casing 140 and inner casing 150 forming a chamber 160

between the two. The network of pressure sensors 200 for sensing pressure on the handgrip 20 may be disposed in the chamber 160.

[0030] In another embodiment of the invention, the network of pressure sensors 200 may be built upon a flexible printed circuit membrane 220 as shown in FIG. 9. The flexible printed circuit membrane 220 contains multiple discreet force sensitive resistors 201. The resistivity of the force sensitive resistors 201 are inversely proportional to the pressure applied to their surface. The resistors 201 have a high impedance, 100 Mohms or more, when no pressure is applied. Pressure reduces the resistance seen across the affected resistor 201 to as low as a few hundred ohms when the handgrip 20 is tightly squeezed. As shown in FIG. 10, rubber isolation rings 180 placed in the shell 100 outer casing 140 over the resistors 201, may create left 181, rear 182, right 183, and front 184 sensitive regions that can transmit pressure on the surface of the outer shell 140 to the pressure sensitive resistors 201 beneath. The rear 182 and front 184 sensitive regions may be two separate force sensitive resistors 201 and may be wired in parallel to create a single multi-resistor sensitive region.

[0031] Another embodiment of the invention may include an exposed force sensitive resistor as a trigger pressure sensor 310, shown in FIG. 11. The trigger pressure sensor 310 may include a connected head 311, a free hanging tail 312, and a pressure sensitive region 185. As shown in FIG. 12, the shell extension 300 may also contain a trigger sensor cavity 303, upper trigger sensor pathway 304, and a lower trigger sensor pathway 305. Shown in FIG. 13, the trigger pressure sensor 310 is installed within the trigger sensor cavity 303 so that the connected head 311 of the trigger pressure sensor 310 passes through the upper trigger sensor pathway 304, the free-hanging tail 312 rests within the lower trigger sensor pathway 305, and the pressure sensitive region 185 rests over the trigger 30 at the natural point of trigger finger placement. To accommodate the movement of the trigger 30, both the connected head 311 and the free-hanging tail 312 of the trigger pressure sensor 310 are allowed to move within the trigger sensor cavity 303. In this way, the shooter's finger will always lay the pressure sensitive region 185 against the face of the trigger without changing the pull or feel of trigger movement.

[0032] As shown in FIG. 14, the five channels of sensor data may be brought to an interconnected circuit board 210 disposed in the chamber 160, where they are sent via the communication assembly 400 to the data collection device 40. The communication assembly 400 may be, but without limitation, an integral cable 405 and connector 410 (or any type of assembly practicable), which is attached to a data collector for digitization, storage and/or transmission of pressure data.

[0033] When introducing elements of the present invention or the preferred embodiment(s) thereof, the articles "a," "an," "the," and "said" are intended to mean there are one or more of the elements. The terms "comprising," "including," and "having" are intended to be inclusive and mean that there may be additional elements other than the listed elements.

[0034] Although the present invention has been described in considerable detail with reference to certain preferred embodiments thereof, other embodiments are possible. Therefore, the spirit and scope of the appended claims

should not be limited to the description of the preferred embodiment(s) contained herein.

What is claimed is:

1. A device to capture pressure data from a weapon's handgrip and trigger during live fire, the device comprising:
 - a shell that fits around the handgrip;
 - a network of pressure sensors disposed within the shell such that when the shell is on the handgrip and pressure is applied to the handgrip, the network of pressure sensors is able to record the pressure applied to all sides of the handgrip; and,
 - a communication assembly that allows data communication between the network of sensors and a computer.
2. The device of claim 1, wherein the device further includes an extension including a sensor that can communicate with the trigger and record the pressure applied on the trigger.

* * * * *