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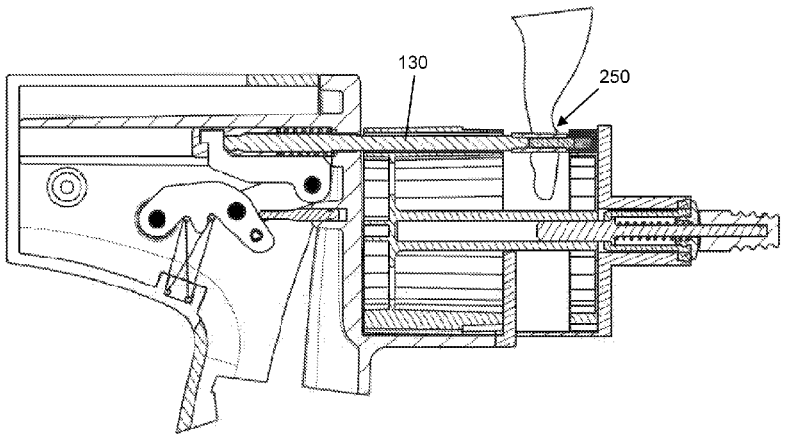


Fig 16

(57) Abstract: A biopsy sampler comprising a body carrying a ram able to be actuated to move along a path relative the body between a primed position and a second position, the body having a magazine receptacle at where a magazine, carrying a plurality of sample collectors that can cut and retain a biopsy sample from an organism in a magazine retained position, can be held in a movable manner to allow each sample collector retained by the magazine to be selectively presented in the path of the ram and be actuated by the ram and be moved at least partially from the magazine to take a sample from an organism as the ram moves to its second position and back to its magazine retained position, carrying a sample, as the ram moves from its second position back to its primed position.

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A BIOPSY SAMPLER, RELATED PARTS AND METHODS

FIELD OF THE INVENTION

The invention relates to a biopsy sampler, a magazine of sample collectors and related methods.

BACKGROUND OF THE INVENTION

To improve the tracking of livestock and to facilitate DNA testing, tissue samples may be collected from animals. A tissue sample may be taken from an animal at any time. The tissue sample is usually cut from an animal using a tissue sampling device and is placed in a storage container for laboratory analysis.

United States patent numbers US20110295148A1 and US20130204159A1 describe a tissue sampler in the shape of a clamp and comprising a pair of jaws that move toward each other. A punch having a cutting element and plunger is located in one of the jaws and is forced through an animal's ear, for example, to cut a plug of tissue from the ear as the jaws are clamped together using a first actuation action. A storage tube is held by the other jaw of the tissue sampler. At one end of the storage tube there is an aperture through which the tissue sample is pushed. A plunger is used to push the tissue sample out of the cutting element and into the storage tube at the time of sampling. The plunger remains in the aperture of the storage tube to seal the tube before the tube is removed from the jaws and taken away for analysis. The cutting element is separated from the plunger and the storage tube after the sample is collected and has been pushed into the storage tube.

The so dropped sample is located in the storage tube and is to some extent protected. However the sample may be exposed to light where the container is transparent or translucent. Over time this may affect the quality of the sample taken.

After sampling, the used cutting element needs to be removed from the sampler because a different cutting element needs to be used for each tissue sample to prevent contamination of the tissue sample. The cutting element can be automatically ejected through a second actuation action of the sampler. The cutting element is then discarded onto the ground or into a refuse container. The cutting elements are sharp so handling the cutting element carries a risk of being cut. Discarding the cutting element on the ground also carries this risk.

After the cutting element has been removed, a new punch and storage tube needs to be loaded into the tissue sampler before another tissue sample can be collected. The loading and unloading of punches is done manually and is a slow and fiddly process.

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Unloading is done individually. Prior to laboratory testing the storage tubes may be arranged manually in a tray of the like. Again this is time consuming.

When the sample containing storage container is processed at the laboratory, lab equipment is used to remove the sample from each container for further processing. The lab equipment may contact the sample to remove it from the container. To avoid cross contamination the equipment that contacts each sample must be cleaned between each sample removal step. This can be time consuming, adds costs and/or may not be 100% reliable.

It is an object of the present invention to provide a biopsy sampler, parts therefor and/or related methods that go at least some way toward overcoming the disadvantages as mentioned above and/or that will at least provide the public with a useful choice.

SUMMARY OF THE INVENTION

In a first aspect the present invention may broadly be said to be a biopsy sampler comprising:

a body carrying a ram able to be actuated to move along a path relative the body between a primed position and a second position, the body having a magazine receptacle at where a magazine, carrying a plurality of sample collectors that can cut and retain a biopsy sample from an organism in a magazine retained position, can be held in a movable manner to allow each sample collector retained by said magazine to be selectively presented in the path of the ram and be actuated by said ram and be moved at least partially from said magazine to take a sample from an organism as said ram moves to its second position and back to its magazine retained position, carrying a sample, as said ram moves from its second position back to its primed position.

Preferably the ram slides relative the body.

Preferably the ram is a rod..

Preferably the rod is a straight rod..

Preferably the rod has a distal end at where the collector is driven..

Preferably the distal end releasably engages with said collector..

Preferably the distal end releasably engages to said collector..

Preferably said ram comprises a gripper formation to grip each said sample collectors to draw each said collector back to its magazine retained position after cutting and removing a sample.

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Preferably said body includes a cutting region at where part of an organism from which the sample it to be removed is able to be positioned in line with said path and adjacent said magazine.

Preferably said ram moves into said magazine when moving from its primed position to its second position.

Preferably said body comprises a die to facilitate removal of said sample, aligned to the path of said ram and presented to allow each said collector to co-act therewith during sampling to facilitate cutting of said sample.

Preferably said body comprises a die to facilitate removal of said sample, aligned to the path of said ram and presented opposite said cutting region to where said magazine is held, to allow each said collector to react therewith during sampling to facilitate cutting of said sample.

Preferably said sample collectors are removable from the sampler as a magazine retained collection, with said magazine..

Preferably said sample collectors are, as a magazine retained collection, able to be associated with said sampler, with said magazine..

Preferably the end of the ram moves along the path in which the magazine retained collectors can be sequentially position..

Preferably the magazine receptacle comprises an axle to hold said magazine to said sampler in a manner to allow the magazine to rotate relative thereto..

Preferably said cutting region is adjacent said magazine receptacle, said magazine receptacle being intermediate of said ram when in its primed position and said cutting region..

Preferably said magazine receptacle comprises a magazine housing to in use accommodate said magazine..

Preferably said magazine can nest in said housing..

Preferably the sampler includes said magazine, said magazine retaining a plurality of collectors..

Preferably said body comprises a grip to allow the sampler to be handheld operated..

Preferably the grip comprises of two parts movable relative each other..

Preferably the two parts of the grip are able to be squeezed towards each other and upon which said ram is actuated to move from its primed position to its second position..

Preferably the two parts of the grip comprises a handle and a trigger..

Preferably the handle and grip are pivotally connected to each other..

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Preferably said ram is able to be actuated to reciprocally move along a path relative the body between said primed position and said second position..

Preferably the magazine housing comprises a front wall, a rear wall and a connecting wall and wherein a cutting region aperture is formed in the front wall and extends between the magazine housing and a cutting region at where the sample is cut from said organism, and a ram receiving aperture is formed in the rear wall and substantially aligns with the cutting region aperture.

Preferably a retractable magazine locator projects into the magazine housing to allow a rotational mounting of the magazine to said sampler..

Preferably the magazine has a plurality of chambers at each of which a collector is located..

Preferably a chamber locator is provided within the magazine housing and is adapted to engage with the magazine to help align a collector with the path of the ram..

Preferably said collector includes a punch that has a cutting end at where a cutter is presented for cutting and removing a sample from an organism..

Preferably said cutter is shaped and configured to remove a plug shaped sample from said organism and retain said sample in said cutter..

Preferably said ram acts at the end of said punch opposite said cutter..

Preferably said collector comprises a punch and a plunger, the punch having a cutting end and a pushing end, wherein the cutter is located at the cutting end of the punch, the cutter comprising a wall surrounding the pocket and comprising a cutting end, and wherein the plunger comprises a first end and an opposing second end and is held by said punch in slidable manner to allow the second end to push a cutter retained sample from the cutter..

Preferably the collector holds an EID tag..

Preferably the plunger holds said EID tag..

Preferably the EID tag is embedded in said collector so as to not be removeable..

Preferably the die includes an aperture for the cutter of the collectors to pass into in order to offer a shear surface for said cutter..

Preferably the die is a surface against which the cutter of the collector presses towards during cutting of the sample from the organism..

Preferably at least part of the magazine is transparent so that it can be looked through to determine the status collectors retained thereby..

Preferably each chamber has an open first end and an open second end and are adapted to hold a collector thereat..

In a second aspect the present invention may be said to be a biopsy sampler comprising:

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a body carrying a ram able to be actuated to move along a path relative the body between a primed position and a second position,

a magazine removably supported by said body in a manner to be movable relative thereto and carrying a plurality of sample collectors that can cut and retain a biopsy sample from an organism in a magazine retained position, each able to be selectively presented in the path of the ram by said magazine and be actuated by said ram and be moved at least partially from said magazine to take a sample from an organism as said ram moves to its second position and back to its magazine retained position, carrying a sample, as said ram moves from its second position back to its primed position.

In a further aspect the present invention may be said to be a biopsy sample collector magazine for use with the sampler as herein described.

Preferably said magazine includes a plurality of chambers each retaining a sample collector.

Preferably a plurality of biopsy samples are held by said magazine.

Preferably each sample collector holds a biopsy sample and is retained in a chamber of said magazine.

Preferably each sample collector comprises:

a punch that includes a cutter with a cutting edge formed at a cutting end of the punch to remove and retain a biopsy sample and a passage through said collector leading from said cutting edge via which a fluid (preferably air) can be driven to remove a cutter retained biopsy sample from the cutter.

Preferably each sample collector comprises:

a punch that includes a cutter with a cutting edge formed at a cutting end of the punch to remove and retain a biopsy sample and a plunger retained to said punch in a manner to allow it to move relative said cutter to remove a cutter retained biopsy sample from the cutter.

Preferably the plunger is mounted to said punch.

Preferably the plunger is secured to said punch in a movable manner..

Preferably the plunger is not caused to be moved relative said punch by said actuator upon driving of the collector into the organism..

Preferably the plunger is able to move relative said punch but is not able to be removed there from..

Preferably the plunger is actuatable to remove the cutter retained biopsy sample after sampling..

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Preferably just the cutter is driven through said organism..

Preferably at least the cutting edge is pushed through a part of the organism remove and retain a biopsy sample..

Preferably for each said collector said punch includes a passage there through extending from the cutting edge of said cutter to an opposed end of said punch, said plunger retained to said punch at said passage to be guided for movement thereby.

Preferably said plunger is positioned at least in part in said passage..

Preferably said plunger protrudes out of said passage at said opposed end..

Preferably he plunger is positioned entirely in said passage..

Preferably the plunger does not protrude out of said passage..

Preferably said punch includes an opposed end to said cutting end at where said punch can receive a force from said ram to drive said collector into said organism.

Preferably said punch is adapted and configured to be held to yet be releasable from said ram.

Preferably each said punch is adapted and configured to be held to said ram in a manner to allow said collector to be pulled back by said ram in a direction opposite to its collector driving direction.

Preferably the punch includes a graspable region at where said ram can be made to grip the punch and pull it back..

Preferably each said punch includes a recess at which said ram can become releasably wedged in order to allow the ram to pull the collectors back to the side of the organisms from which sample removal was initiated.

Preferably the recess is part of the passage or bore through said punch..

Preferably the recess includes a lip to encourage releasable holding of the collector by the ram..

Preferably the recess isolates the ram from contacting the organism when the sample is being taken..

Preferably the ram engages the punch by penetrating partially into said passage or bore, said ram causing the penetration of at least the cutting edge of said collector through said organism and not the entire collector, said ram being isolated from contact with said organism by said punch..

Preferably the collector is straight and elongate and preferably generally cylindrical..

Preferably the force applied by said ram is parallel the direction of elongate..

Preferably said magazine has a plurality of chambers at each of which a biopsy sample collector is retained..

Preferably each chamber houses a said colletor..

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Preferably each chamber houses a said collector prior to sample taking and after wherein after, the sample is held by said magazine..

Preferably a locator is provided and is adapted to engage with the sampler to help align a collector with the path of the ram..

Preferably each chamber has an open first end and an open second end and are adapted to hold a collector thereat..

Preferably the sampler includes actuation mechanism comprises the trigger and a ram connected to the trigger by a linkage, the ram being adapted to slide within a ram housing connected to a ram receiving aperture upon movement of the trigger, such that moving the trigger to an engaged position causes the ram to project from the ram housing and through the cutting region aperture..

Preferably the ram has a first end and a second end, and wherein a guiding recess is formed in the first end of the ram for receiving and end of the plunger of a collector therein..

Preferably a ram biasing means is provided that biases the ram to a rest position in which the first end of the ram is substantially held within the ram housing..

Preferably the sampler comprises a quick release mechanism that is adapted so that the sampler disengages from said organism when the trigger reaches tripping position corresponding to the ram being in the second position to retract, under the biasing means influence the ram and the collector to move the ram back towards its primed position..

Preferably at least part of the magazine is transparent so that it can be looked through to determine the status collectors retained thereby..

Also herein described is a sample collector to cut, remove and retain a sample from an organism, said collector comprises:

a punch that includes a cutter with a cutting edge formed at a cutting end of the punch to remove and retain a biopsy sample at said cutter and a passage through said punch leading from said cutting edge via which a fluid (preferably air) can be driven to remove a cutter retained biopsy sample from the cutter.

Preferably the sample collector is as herein described and without the inclusion of a plunger..

In yet a further aspect the present invention may be said to be a method of collecting a plurality of biopsy samples from a plurality of discreet organisms, the method comprising;

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a. moving a sample collector of a plurality of magazine retained sample collectors from a magazine stored position relative said magazine to cut, remove and retain a sample from a said organism, and

b. retracting said sample retaining sample collector back to its stored position,

c. repeating steps a and b for each remaining sample collector retained by said magazine that do not yet retain a sample.

Preferably said method results in the retention of collector held biopsy samples by said magazine.

Preferably the method utilizes a sampler tool that includes a ram for moving said sample collectors relative said magazine, and wherein said magazine is moved relative said sampler device after each sample retaining collector is retracted and before the next sample collector is discharged, to appropriately position the next sample collector relative said ram for movement to collect a sample and move the sample retaining collector back to its stored position.

Preferably when moved to a cutting position from said magazine, a said collector projects more from said magazine than when in its stored position.

Preferably the method is performed using the sampler as herein described..

In a further aspect the present invention may be said to be a method of collecting a plurality of biopsy samples from at least one organism, the method comprising sequentially discharging and retracting a sample collector of a plurality of magazine retained sample collectors from and back to said magazine, each collector to thereby cut, remove, retain a sample from the same or an organism from which a said sample is removed and retain each collector retained sample with said magazine.

Preferably the organism is an animal and the sample is animal tissue..

In still a further aspect the present invention may be said to be a biopsy sampling apparatus for collecting biopsy samples comprising:

a primary magazine comprising a plurality of chambers each housing a biopsy sample collector each said collector comprising a punch having at one end a cutter for cutting said sample away from said organism, each said collector to be (a) driven at least partially from said magazine into an organism from which a sample it to be cut, retained and stored by a said collector, and (b) retracted back to said primary magazine,

a secondary magazine comprising a plurality of dies each die presented spaced from a respective chamber of the primary magazine a distance to allow part of the organism to be positioned between the primary and secondary magazine in a cutting zone, yet aligned with the respective chamber in a manner to allow a collector to react

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with its respective said die during cutting of part of said organism located in said cutting zone.

Preferably the secondary magazine is coupled to the primary magazine to be able to move therewith.

Preferably said each said die defines a reaction surface for the cutter to press against, whether directly or indirectly.

Preferably, at each said die, a seal is provided removable from said die and to engage with said cutter and move back to said primary magazine with said collector and to seal the sample in said cutter.

Preferably the seal is a plug that locates into said cutter..

Preferably the seal is a cap that caps over said cutter..

Preferably the collector includes features for engaging a ram.

Preferably the force to release the collector from the ram is greater than the force to separate the seal from its support..

Preferably the distance across the gap is less than the length of the collector..

The present invention may also be said to be a biopsy sampling apparatus for collecting biopsy samples comprising

a. a spindle,

b. a primary magazine at one of the spindle and comprising a plurality of chambers each housing a biopsy sample collector each said collector comprising a punch having at one end a cutter for cutting said sample away from said organism, each said collector to be (a) driven at least partially from said magazine into an organism from which a sample it to be cut, retained and stored by a said collector, and (b) retracted back to said primary magazine,

c. a secondary magazine at the other end of the spindle and comprising a plurality of dies each die presented spaced from a respective chamber of the primary magazine a distance to allow part of the organism to be positioned between the primary and secondary magazine in a cutting zone, yet aligned with the respective chamber in a manner to allow a collector to react with its respective said die during cutting of part of said organism located in said cutting zone,

wherein the chambers of said primary magazine and the dies of said secondary magazine are equispaced at a pitch circle diameter from the axis of the spindle by a distance sufficient to provide a suitable space in the gap for receiving a part of the organism for sample cutting.

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Preferably the organism can be sampled at least 10mm away from an edge of the organism..

The present invention may also be said to be a biopsy sampling device of a kind having a revolver-like sequential presentation of sample punches from a revolving magazine to a sampling zone, the device being further characterised in that

- a reactive member acts as an anvil or die against which an organism (animal or otherwise) to be sampled can be positioned in the sampling zone for sample punch penetration
- that reactive member can be moved or moves to present an unused reactive surface to the sampling zone for any pass through emergence of a particular sampling punch
- each sampling punch with its sample is retained in the revolving magazine of the device for removal with the magazine.

The present invention may also be said to be a biopsy sampling apparatus, for collecting a biopsy sample from successively presented organisms (animal or otherwise), the apparatus comprising at least of

a mount

a magazine of sampling punches, the magazine of punches being movably carried by the mount [yet preferably removable from the mount], and

an abutment member or assembly ("member") carried directly or indirectly by the mount yet movable relative to the mount;

wherein each sampling punch in the magazine, in turn, can be presented by the magazine for both

(A) advancement to cut into its organism from which a biopsy sample is to be taken, the organism being in part at least interposed between the magazine and the abatement member, and

(B) withdrawal with its biopsy sample;

and wherein the abutment member can be moved or moves relative to the mount to present a different abutment surface for each organism as a reactive surface to its advancing sampling punch.

Preferably both the magazine of sampling punches and the abutment member can be removed from the mount..

Preferably the magazine is rotatably carried by the mount and the axis of advancement/withdrawal of each sampling punch is at least substantially parallel to and is planetarily to the rotational axis of the magazine..

Preferably the abutment member is rotatably carried by the mount and can move in an indexed manner or an unindexed manner, or both, relative to the magazine..

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Preferably both the magazine and the abutment member are rotatable about the same rotational axis..

Preferably the mount is part of an assembly providing, in turn for each sampling punch, both an advancement and withdrawal drive or a drive against a bias for one of the directions..

Preferably the abutment member provides a closure for each sampling punch.

Preferably each abutment surface may include a pocket to receive in part its sampling punch..

Preferably each sampling punch is tubular or at least in part tubular in cross section..

Preferably each sampling punch includes a biopsy sample expression plunger.

Preferably the mount is or includes a spindle..

Preferably the magazine and abutment member are indexed or connected or unitary so as to register a dedicated abutment surface for each sampling punch about to be advanced into an interposed organism to be sampled..

This invention may also be said broadly to consist in the parts, elements and features referred to or indicated in the specification of the application, individually or collectively, and any or all combinations of any two or more of said parts, elements or features, and where specific integers are mentioned herein which have known equivalents in the art to which this invention relates, such known equivalents are deemed to be incorporated herein as if individually set forth.

As used herein the term "and/or" means "and" or "or", or both.

As used herein "(s)" following a noun means the plural and/or singular forms of the noun.

The term "comprising" as used in this specification means "consisting at least in part of". When interpreting statements in this specification which include that term, the features, prefaced by that term in each statement, all need to be present but other features can also be present. Related terms such as "comprise" and "comprised" are to be interpreted in the same manner.

The entire disclosures of all applications, patents and publications, cited above and below, if any, are hereby incorporated by reference.

Reference to "movable" can be to any mode of movement, translational, rotational or otherwise. And where both the magazine and abutment member are rotationally mounted, it is only a preferment that their axes of rotation be aligned or at least substantially parallel. For example the abutment member can be a ball or wheel orthogonally rotational relative to the rotatable magazine's axis of rotation.

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Any reference to prior art documents in this specification is not to be considered an admission that such prior art is widely known or forms part of the common general knowledge in the field.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred forms of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

Figure 1a is an exploded view of one form of collector that may be used as part of the present invention;

Figure 1b is a side view of one form of the collector;

Figure 1c is a cross-sectional side view of the collector taken along line A-A of Figure 1b;

Figure 1d is an end view of the collector of Figure 1b;

Figure 1e is a perspective view of another form of the collector;

Figure 1f is a cross-sectional side view of the collector of Figure 1e;

Figure 1g is a view of the collector in a condition where the plunger is actuated;

Figure 2a is a perspective view of one form of punch for a collector

Figure 2b is a side view of the punch of Figure 2a;

Figure 2c is an end view showing the pushing end of the punch of Figure 2a;

Figure 2d is a side view of the punch taken along line A-A of Figure 2c;

Figure 2e is an end view showing the cutting end of the punch of Figure 2a;

Figure 3 is a side view of one form of tissue sampler;

Figure 3a is a perspective view of the tissue sampler with a collecting device magazine about to be placed into the magazine housing of the tissue sampler;

Figure 4 is a cross-sectional side view of the tissue sampler of Figure 3 in which an animal's ear is located in the cutting region;

Figure 4a is a cross-sectional side view of one form of collector before taking a tissue sample from an animal's ear;

Figure 4b is a cross-sectional side view of the collector of Figure 4a when cutting a tissue sample from the animal's ear;

Figure 4c is a cross-sectional side view of the collector of Figure 4a after a tissue sample has been cut;

Figure 5 is a cross-sectional side view of the tissue sampler of Figure 4 in which a tissue sample has been cut from the animal's ear;

Figure 6 is a cross-sectional side view of the tissue sampler of Figure 4 in which the animal's ear is removed from the cutting region and the collector has been retracted back into the magazine;

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Figure 7 is a cross-sectional side view of the tissue sampler of Figure 4 in which the ram has been retracted and is returned to its rest position;

Figure 8 is a perspective view of a collecting device magazine;

Figure 9 is an exploded perspective view of a magazine and one collector, including showing a removable cap for the magazine;

Figure 10 is a sectional view through the magazine showing one collector located therein;

Figure 11 is a close up sectional view of the sampler showing the ram prior to ejecting a collector from the magazine and showing a die that has an aperture to facilitate sample cutting;

Figure 12 is a close up sectional view of the sampler when driving a collector through an ear of an animal;

Figure 13 is a close up sectional view of the sampler when in the process of retracting a collector back to the magazine;

Figure 14 is a close up sectional view of the sampler and where the sample carrying collector is back to its original position in the magazine;

Figure 15 shows a close up sectional view of a variation of a sampler where the die forms part of the magazine assembly and is mounted for movement relative the sampler to present a fresh cutting surface and optionally a plug of cap for the cutter;

Figure 16 shows the sampler of Figure 15 wherein it has driven a collector through an ear of an animal;

Figure 17 shows the sampler of Figure 15 wherein the sample carrying collector is returned back to its original position in the magazine, and

Figure 18 is a close up sectional view of the end of a ram and the punch, showing detail of shape to help the ram retract a collector back into the magazine.

Figure 19 is a close up exploded perspective view of the primary and secondary magazine with the collector.

Figure 20 is a close up end view and associated cross section view of the collector, and primary and secondary magazine engaged in a 1st initial position

Figure 21 is a 2nd pushed out position of Figure 20.

Figure 22 is a 3rd retracted position of Figure 20.

Figure 23 is a view of a collector retaining magazine and tray.

Figure 24 is a sectional view of Figure 23.

DETAILED DESCRIPTION OF PREFERRED FORMS OF THE INVENTION

Reference will now be made to a sampler for collecting biopsy samples, related parts and methods. Such samples may be from organisms such as plants or animals

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particularly, including pigs, goats, cattle, sheep, poultry, and fish. The samples may be tissue samples such as ones taken from an ear of an animal. The sampler is used together with magazine retained collectors to each collect and store a biopsy sample for later analysis.

Figures 1a to 1g show a preferred form of a collector 250 that may be used. The collector can be used with the sampler as will herein after be described.

The collector 250 comprises a punch 251 having a body with a cutter 255 at a cutting end 252a of the punch 251. The punch 251 also has an opposing pushing end 252b. The body of the punch 251 preferably has a slot or bore 253. The bore 253 extends from one end of the punch to the other. It preferably extends along the length of the punch between the cutting end and the pushing end, as shown in Figures 2a to 2e. Preferably, the punch has an elongate straight body and the bore is centrally located within the body of the punch. In some forms the punch may not have a through bore. The bore is provided to help eject the sample taken by the collector from the collector.

A cutter 255 is provided at the cutting end 252a of the punch to remove a sample from a sample specimen, such as an animal or plant. The cutter may be attached to the punch or it may be integral with the punch so that the cutter and punch are formed as a single part. The cutter 255 may be cylindrical. It may alternatively be of another shape suitable to remove a sample. The sample may for example be taken from the tip of the ear of an animal and the cutter may as a result be U or V shaped or other shape. It need not take a core sample but an edge sample instead. Being of a hollow section such as cylindrical does offer the added benefit of being able to retain the sample, as a plug, by the cutter. The cutter can remove a sample plug that ends up sitting in the cutter.

A free end of the cutter 255 is presented to form a cutting edge 255a. The cutter 255 preferably extends from and surrounds one end of the bore 253 of the punch at the cutting end of the punch body to form a projecting surrounding wall or walls. Preferably, the bore 253 of the punch is cylindrical so that the cutting edge is substantially circular. A sample holding section 256 is formed by the cutter, preferably within the projecting wall(s) of the cutter. In this way, the cutter provides a sample holding section 256 such as a bore. The bore may be a blind bore terminated by the end of the plunger 257. It is aligned with the bore formed in the body of the punch. For the sake of simplicity, the bore 253 of the punch, when referred to in this specification, should be interpreted to include the bore formed in the body of the punch and the bore formed in the cutter because the two may be contiguous. No plunger may be provided so that an open bore may be formed through the punch.

An optional plunger 257 is held at the bore 253 of the punch and forms part of the collector. In one form the plunger protrudes at least partially from the punch. In

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another form it is contained entirely within the bore. Being within the bore helps protect it and prevent tampering therewith at least unless an appropriate tool is used.

The plunger has a first end 258a and an opposing second end 258b.

The plunger 257 can be seen to extend into the bore 253 of the punch 251. The fit of the plunger in the bore is snug yet allowing for the plunger to slide relative the punch. In the preferred form the plunger outer surface is contiguous the inner surface of the bore. This ensures that a seal is created there between, preventing ingress of contaminants from the pushing end of the punch to the cutting end, through the bore.

The plunger and punch are in a sliding relationship with each other whether it is using a bore and pin like relationship or other. They are in a sliding relationship so that the sample can be pushed off the cutter. To assist with the release of the tissue sample, the first end of the plunger may be enlarged and may comprise an anti-stick surface formed of a non-stick material, such as Teflon™.

The plunger in the preferred form extends into the bore of the punch and can push a plug of sample tissue from the sample holding section 256. This pushing may be to push the sample off so that it can be analysed in a laboratory. This pushing preferably occurs in the laboratory.

The plunger is able to be positioned in an active position as shown in figure 1b and be moved to a plunged position as seen in figure 1g.

When the plunger is in an active position, ready for the collector to remove a sample, the second end of the plunger may project from the pushing end of the punch and the first end of the plunger is held within the bore of the punch between the sample holding section and the pushing end of the punch. Preferably, at or near the first end 258a of the plunger is enlarged or provides some form that creates an interference to the removal of the plunger from the punch in one direction. A similar enlargement (not shown) may be provided at or near the other end of the plunger. The or each enlargement helps prevent the removal of the plunger that may carry an RFID that will be described, from the collector.

The collector is adapted to cut a sample of tissue from a sample, such as an animal or plant, using the cutter. The sample can temporarily be held by the cutter such as within the sample holding section. To release the sample from the sample holding section, the plunger can be pushed from its active position so that it moves in the direction of the sample. It may be pushed into the bore of the punch more and toward the cutting edge and through the sample holding cavity so that the tissue sample is pushed off the cutter.

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In a variation where no plunger is provided and an open passage/bore extends through the punch, air can be used to blow the sample out from the collector. Air can be blown in through the pushing end of the punch to push the sample off the cutter.

Although in a preferred form the punch is substantially tubular and the plunger is substantially cylindrical, it is envisaged that the punch and plunger may be of any suitable complementary shape. For example, the bore of the punch may have a square cross-section and the plunger may also have a square cross-section of a slightly smaller size so that the plunger can slide within the bore of the punch. It should be appreciated that the cutting edge of the cutter could also be of any suitable shape and size to cut a tissue sample that fits within the storage container for receiving the sample. For example, the cutting tip may be square, oval, star shaped or irregularly shaped.

As will now be described, the collector may be used with a magazine and a sampler to collect samples.

A plurality of collectors 250 may be positioned within a magazine housing 200 that can be loaded into and removed from the sampler. The magazine can sequentially present each collector for sampling. This is achieved by aligning the collectors individually with an actuator such as the ram 130 of the sampler 1.

As shown in Figure 10, the magazine housing 200 is sized to receive a magazine 240 comprising a plurality of chambers 241, each chamber being adapted to hold a collector 250 therein and having open first and second opposing ends 241a, 241b. The magazine, is preferably in the form of a cylinder having a centrally located axle or bore 242 that extends through or into the magazine. The chambers are positioned concentrically around the bore and preferably near the circumference of the magazine. Preferably, at least a portion of the chambers in the magazine 240 is of a transparent material, so that the presence of a collector in any of the chambers can be identified. In the embodiment shown in Figure 9, the magazine comprises 25 chambers, although the magazine may have any suitable number of chambers. The magazine may carry an EID or barcode or other machine readable code. In the preferred form the magazine can rotate to index collectors for actuation. In other forms the magazine may translate instead.

The second end of the collector aligns the ram 130 and the cutting edge 255a of the cutter 255 aligns with a cutting region aperture 211 of the sampler, as shown in Figure 4.

As shown in Figure 3 the cutting region 400 comprises a space in which tissue 450 from a sample specimen can be positioned. In Figure 4, an animal's ear 450 is schematically shown positioned within the cutting region. The ear, or other item, is kept in the cutting region as a tissue sample is cut from the ear.

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A ram 130 is positioned within the ram housing 120 of the sampler. The ram forms part of an actuating means, which also comprises a trigger 150 operably connected to the ram 130. The trigger and driving mechanism may be of a kind as described in our international application PCT/NZ2014/000106 which by way of cross reference is hereby incorporated. A guiding recess 132 is formed in the first end of the ram and is shaped to correspond with the second end 258b of the plunger, which projects from the punch. The guiding recess 132 is dimensioned so that the projecting portion of the plunger (if provided) can fit within the recess and so that the first end of the ram 121a can abut the pushing end 252b of the punch.

This prevents the ram actuating the plunger during sampling, only driving the collector into the sample specimen by pushing on the punch.

The ram 130 is adapted to slide back and forth within the ram housing 120 as the trigger 150 is engaged and disengaged. The ram can eject a collector (at least partially) from the magazine and then retract it back into the magazine after it has taken a sample. The ram may be shaped appropriately to be able to push a punch for sampling and be able to hold that punch for retraction. The end of end of the ram and the collector may interface in a manner to establish a connection that can achieve this. The ram and/or collector may include a taper shape that results in a wedging fit so that the ram can pull the collector back out through the ear of the animal. This is for example seen in figures 13 to 16. A barbed or arrow head or snap fit or other interference fit may also be utilised to create an ability for the ram to both push and pull the collector. An example is shown in Figure 18. A stop may be provided to prevent the collector from retracting too far and to help separate the collectors from the ram once back in the magazine.

To cut a tissue sample, a user may use the sampler as herein described. The magazine 240 is orientated so that the cutting edge of a punch 251 of the active collecting device 250 is aligned with the cutting region aperture 211 and the second end of the plunger 257 is aligned with the ram receiving aperture 221.

The user then holds the handle of the tissue sampler and positions the sampler so that tissue 450 to be sampled (such as of an animal's ear) is located in the cutting region 400, as shown in Figure 4. The user squeezes the trigger 150 toward the gripping member 160 to move the trigger from the disengaged position to the engaged position.

The ram moves through the ram receiving aperture and pushes against an active collector. The ram continues pushing to push the collector at least partially out of the chamber of the magazine, through the cutting region aperture, into the cutting region, and toward a die 279.

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The die cooperates with the punch to remove the sample. The die may be a flat surface towards which the punch presses. It may include an upstand or aperture 278 to help sheer the sample.

As the ram pushes the collector through the cutting region, the cutting end of the punch pushes the animal's ear (or other tissue) against the die 279. The cutting edge of the punch is then pushed through the ear or other tissue to cut a sample plug from the tissue.

The tissue sample is held within the sample holding region of the collector and the collector is retracted by the ram to the magazine.

It is therefore not necessary for the user to handle the punch with its sharp cutting edge or to otherwise remove and discard the punch from the sampler other than to remove the magazine from the sampler when desired.

The trigger mechanism of the sampler 1 is such that the action of cutting the tissue sample, and releasing the animal's ear is almost instantaneous so that if the animal reacts to having its ear cut and pulls away, there is little chance that the animal can pull the tissue sampler from the user's hand before the ear is released.

To take a new sample, the collector magazine is rotated incrementally until the next chamber containing an unused collector is aligned with the ram receiving aperture and cutting region aperture, ready for another tissue sample to be taken.

With reference to Figures 15-17 there is shown a variation of the sampler and magazine. In the variation a primary magazine 880 and a secondary magazine 881 may be provided as part of a magazine assembly 882 that may be loaded with the sampler. The assembly may be connected together or may alternatively consist of the primary and secondary magazines 880 and 881 that are assembled together with the sampler. Figures 19-22 show a more detailed view of the sequence of use shown in Figures 15-17. Figures 19-22 differ slightly from figures 15 to 17 in that the secondary magazine is not integrally formed with the primary magazine. The two part assembly of this embodiment allows for easy injection (two part) molding. In this embodiment the secondary magazine is fastened to the first magazine. It should be noted that the secondary magazine still rotates with the first magazine.

In the preferred form the primary and secondary magazines are connected together so that they can each rotate and index around for each sequential sampling of tissue. The primary magazine 880 is predominantly as hereinbefore described and carries a plurality of collectors. It is also provided to allow for sample retaining collectors to be retracted therewith and then be removed from the sampler for subsequent laboratory processing. The secondary magazine is provided for at least one and preferably two purposes. The primary purpose of the secondary magazine is to present a

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fresh die for each sample taken. In the sampler as described with reference to Figure 3 for example the die is a single die used for each sample taking. This may result in cross contamination occurring of samples where for example blood or other cross contaminants from an earlier taken sample may contaminate the subsequent sample or samples. The secondary magazine presents a fresh die for each sample taken so that no cross contamination can occur between samples. A secondary magazine may be of a disposable kind that after sampling can be ejected from the sampler and be disposed. The secondary magazine may also perform a second purpose and that is to provide a plug or cap 883 for the collector. The secondary magazine 881 may include a plurality of cavities that retain in a removable manner a cap or plug 883. The cap or plug 883 may be configured appropriately for the cutter of the collector to engage with. The cap or plug may locate inside of the cutter or may locate snugly about its exterior. The advantage of a plugging type relationship is that it will reduce the prospect of the plug 883 from being dislodged from the collector as it is retracted back through the aperture in the tissue. A cap if not securely fitted to the collector may have a tendency to be stripped off as the collector is withdrawn back through the aperture of the animal tissue. The cap or plug 883 together with any other features or configurations of the secondary cartridge 881 can help provide a die like surface or surfaces to facilitate the cutting preferably by shearing of the tissue by the cutter.

As the primary cartridge 880 is indexed to the next position for a fresh collector to be presented for tissue sampling the secondary cartridge may separately be moved by a user to present a fresh die surface and/or plug/cap. In other forms it will be appreciated that the primary magazine 880 and the secondary magazine 881 may be appropriately connected so that both are able to be moved simultaneously. This ensures appropriate alignment between a fresh collector and a fresh die surface and allows for convenient loading operation and removal.

The primary and secondary magazines may be connected together to be able to move in unison. They may instead not be connected together but still be move in unison by a mechanism of the sampler tool.

Where provided, the force to release cap from its secondary magazine is less than the force required to separate the ram from the collector as it moves back to its primed position. This ensures pick up of the cap without the ram separating from the collector.

The gap between the primary and secondary magazines (in the direction of travel of the ram) is less than the length of a collector. This means that the collector remains at least partially in its chamber when the cutter reached the die.

In the preferred from the magazine assembly comprising the primary and secondary magazines can be mounted for rotation relative the sampler. The central axle

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or spindle secures the two magazines together, preferably at each end of the spindle. The chambers of the primary magazine and the dies of the secondary magazine are located at a PCD about the spindle. The PCD is of a diameter to ensure that when for example the ear of an animal is presented for sampling, the sample is cut at a reasonable distance from the edge of the ear. This distance may be more than 10mm from the edge of the ear. The chambers are dies are preferably equispaced on the same PCD.

Once all or some of the collectors in the magazine have been used the magazine can be removed from the sampler 1. Both primary and secondary magazines (if used) may be removed as one or separately. A cap 280 may be provided to close or cover the collectors inside the magazine.

The magazine of sample retaining collectors can be capped after removal from the sampler, and sent to the lab. The lab can process the sample from the magazine into lab tubes, (after the samples are pushed or blown off the punch).

Preferably, the tissue sample is held at the sample holding region of each collector. The magazine 880 may hold many and preferably a full set of sample retaining collectors. At the lab the samples may be ejected from the collectors individually or at once and such may occur whilst the collectors are still in the magazine. Alternatively they may be removed from the magazine first.

A machine, shown as a rod 900 in Figure 23, may be used to depress the plungers automatically, either by depressing the plunger 257 consecutively or by simultaneously depressing the plungers of all in the magazine. Where no plunger is provided, air may be blast through each collector to remove samples. As each plunger is depressed and pushed deeper into or through the bore of the punch and through the sample holding region, the sample is pushed from of the sample holding region and is deposited for testing. The tool (e.g. rod 900) so used in the lab does not contact the sample.

The sample may be deposited into a laboratory collector 901. The laboratory collectors 901 may be arranged in a tray 902 or platform of some sort as shown in Figures 23 and 24.

The deposition process may be mechanised so that the magazine 880 is loaded into a moveable robotic or a stationary guide (not shown) and the tray 902 is loaded into a static guide or robotic guide respectively. The tray 902 or magazine 880 may being be automatically moved so the magazine 880 collectors line up with the laboratory collectors 901. Once lined up, the rod 900 may depress and push out the sample from the magazine collector into the laboratory collector 901. Once a sample is deposited into the laboratory collector 901 the rod 900 is retracted and the process is started again.

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I.e. the tray 902 or magazine 880 moves across so the next laboratory collector 901 and associated magazine collector are lined up.

Due to the rod 900 not making contact with the sample tissue there is no chance of cross contamination. Preferably the laboratory collectors 901 are sealed and sterilised before any insertion of a sample. Preferably the laboratory collectors 901 have a piercable top seal which the plunger and associated sample is pushed through.

The plunger preferably includes a machine readable electronic identity (EID) tag such as a radio frequency identity (RFID) tag. The RFID system may be selected according to the anticipated manufacturing and use conditions of the tissue sample collector. For example a typical passive tag, active reader, system operating at low frequency can provide robust identification devices suitable for embedding in molded plastic components at a unit cost that is appropriate. The tag 259 illustrated in Figures 1a and 1c is typical of the form of RFID tags of this type. However other systems, such as passive tag systems operating in the UH range can provide lower unit costs. Tags of this type are available that are claimed to be sufficiently robust for embedding in molded plastic components.

To work well with these small RFID tags, an RFID reader may be integrated to the tissue sampler, or mounted to the tissue sampler, immediately adjacent the position that a sample occupies at the time of use.

A collector located RFID tag is useful for tracking and tamper prevention purposes. The RFID may be used at the time the sample is taken, it identifies the sample to a collector ID.

Prior, during or immediately after the sample is taken, the sample collector RFID tag can be read and stored along with a unique ID that is derived from an animal associated ID such as from an ear tag carried by the animal tested. This will ensure that at least 2 individual identifiers (eg numbers) are locked to a sample taken. One from the collector RFID tag, and one from said animal associated ID. These linked numbers are stored at sampling time in a database. The aim is to make it tamper resistant and limit the options to substitute samples. The collector's ID may be read during the lab processing and again checked to the database. The methods to read/transfer information from the container, collectors and ear tags at sampling would be existing technologies of reader and an intended reader within the sampler if possible. The data collected at the laboratory from the RFID devices would be unique identifier with which information derived from sample testing can be associated

Advantages

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The present invention allows the sample that is taken by the biopsy collector to be retained by the collector. It can remain retained with the cutter and be carried thereby and be protected thereby.

The sample retaining collector is able to be retracted after sample removal into the magazine and be held thereby for transport to a laboratory for analysis. A plurality of sample retaining collectors in a magazine are able to be conveniently processed in the laboratory.

Where used a plunger of the biopsy collector stays associated with the biopsy collector after sampling and can be actuated at any time after sampling to eject the sample from the cutter. This allows the sample to be ejected by the still associated plunger at the laboratory and thereby avoid cross contamination. Such cross contamination may otherwise occur by use of a laboratory tool that comes into contact with the sample. Instead the tool contacts the plunger.

The sample retained by the cutter of the collector remains protected and well retained by the cutter.

The collector being pulled back into the magazine after sampling the animal, means no storage container is involved. Container costs and time handling such is eliminated. The cost of sampling would be less, and be quicker to complete.

Although the invention has been described by way of example, it should be appreciated that variations and modifications may be made without departing from the scope of the invention as defined in the claims. Furthermore, where known equivalents exist to specific features, such equivalents are incorporated as if specifically referred in this specification.

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CLAIMS

1. A sampler comprising:

a body carrying a ram able to be actuated to move along a path relative the body between a primed position and a second position, the body having a magazine receptacle at where a magazine, carrying a plurality of sample collectors that can cut a biopsy sample from an organism and retain the sample in a magazine retained position, can be held in a movable manner to allow each sample collector retained by said magazine to be selectively presented in the path of the ram and be actuated by said ram and be moved at least partially

- from said magazine to take a sample from an organism as said ram moves to its second position; and
- back to its magazine retained position, carrying the sample, as said ram moves from its second position back to its primed position.

2. A sampler as claimed in claim 1 wherein the ram slides relative the body.

3. A sampler as claimed in anyone of claims 1 or 2 wherein said ram comprises a gripper formation to grip each said sample collectors to draw each said collector back to its magazine retained position after cutting and removing a sample.

4. A sampler as claimed in anyone of claims 1 to 3 wherein said body includes a cutting region at where part of an organism from which the sample it to be removed is able to be positioned in line with said path and adjacent said magazine.

5. A sampler as claimed in anyone of claims 1 to 4 wherein said ram moves into said magazine when moving from its primed position to its second position.

6. A sampler as claimed in anyone of claims 1 to 5 wherein said body comprises a die to facilitate removal of said sample, aligned to the path of said ram and presented to allow each said collector to co-act therewith during sampling to facilitate cutting of said sample.

7. A sampler as claimed in claim 4 wherein said body comprises a die to facilitate removal of said sample, aligned to the path of said ram and presented opposite said cutting region to where said magazine is held, to allow each said collector to react therewith during sampling to facilitate cutting of said sample.

8. A sampler as claimed in anyone of claims 1 to 7 wherein said magazine receptacle comprises a magazine housing to in use accommodate said magazine..

9. A sampler as claimed in claim 8 wherein the magazine housing comprises a front wall, a rear wall and a connecting wall and wherein a cutting region aperture is formed in the front wall and extends between the magazine housing and a cutting region at where

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the sample is cut from said organism, and a ram receiving aperture is formed in the rear wall and substantially aligns with the cutting region aperture.

10. **A sampler** comprising:

a body carrying a ram able to be actuated to move along a path relative the body between a primed position and a second position,

a magazine removably supported by the body in a manner to be movable relative thereto and carrying a plurality of sample collectors that can take a sample from an organism and retain the sample in a magazine retained position, each sample collector able to be selectively presented in the path of the ram by the magazine and be actuated by the ram and

1. be moved at least partially from the magazine to take a sample from an organism as the ram moves to its second position and
2. back to its magazine retained position, whilst the sample collector is carrying said sample, as the ram moves from its second position back to its primed position.

11. A biopsy sample collector magazine for use with the sampler of claim 1.

12. A magazine as claimed in claim 11 wherein said magazine includes a plurality of chambers each retaining a sample collector.

13. A magazine as claimed in claim 11 or 12 wherein a plurality of biopsy samples are held by said magazine.

14. A magazine as claimed in claim 12 wherein each sample collector holds a biopsy sample and is retained in a chamber of said magazine.

15. A magazine as claimed in claim 11 wherein each sample collector comprises:

a punch that includes a cutter with a cutting edge formed at a cutting end of the punch to remove and retain a biopsy sample and a passage through said collector leading from said cutting edge via which a fluid (preferably air) can be driven to remove a cutter retained biopsy sample from the cutter.

16. A magazine as claimed in claim 11 wherein each sample collector comprises:

a punch that includes a cutter with a cutting edge formed at a cutting end of the punch to remove and retain a biopsy sample and a plunger retained to said punch in a manner to allow it to move relative said cutter to remove a cutter retained biopsy sample from the cutter.

17. A magazine as claimed in claim 16 wherein the plunger is mounted to said punch.

18. A magazine as claimed in claim 16 or 17 wherein for each said collector said punch includes a passage there through extending from the cutting edge of said cutter to

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an opposed end of said punch, said plunger retained to said punch at said passage to be guided for movement thereby.

19. A magazine as claimed in anyone of claims 16 to 18 wherein said punch is adapted and configured to be held to yet be releasable from said ram.

20. A magazine as claimed in claim 19 wherein each said punch is adapted and configured to be held to said ram in a manner to allow said collector to be pulled back by said ram in a direction opposite to its collector driving direction.

21. A magazine as claimed in any one of claims 11 to 20 wherein each said punch includes a recess at which said ram can become releasably wedged in order to allow the ram to pull the collectors back to the side of the organisms from which sample removal was initiated.

22. **A method of collecting** a plurality of biopsy samples from a plurality of discreet organisms, the method comprising;

a. moving a sample collector of a plurality of magazine retained sample collectors from a magazine stored position relative said magazine to cut, remove and retain a sample from a said organism, and

b. retracting said sample retaining sample collector back to its stored position,

c. repeating steps a and b for each remaining sample collector retained by said magazine that do not yet retain a sample.

23. A method as claimed in claim 22 wherein said method results in the retention of collector held biopsy samples by said magazine.

24. A method as claimed in claim 22 or 23 wherein the method utilizes a sampler tool that includes a ram for moving said sample collectors relative said magazine, and wherein said magazine is moved relative said sampler device after each sample retaining collector is retracted and before the next sample collector is discharged, to appropriately position the next sample collector relative said ram for movement to collect a sample and move the sample retaining collector back to its stored position.

25. A method as claimed in anyone of claims 22 to 24 wherein when moved to a cutting position from said magazine, a said collector projects more from said magazine than when in its stored position.

26. A method of collecting a plurality of biopsy samples from at least one organism, the method comprising sequentially discharging and retracting a sample collector of a plurality of magazine retained sample collectors from and back to said magazine, each collector to thereby cut, remove, retain a sample from the same or an organism from which a said sample is removed and retain each collector retained sample with said magazine.

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27. **A biopsy sampling apparatus** for collecting biopsy samples comprising:

a primary magazine comprising a plurality of chambers each housing a biopsy sample collector each said collector comprising a punch having at one end a cutter for cutting said sample away from said organism, each said collector to be (a) driven at least partially from said magazine into an organism from which a sample it to be cut, retained and stored by a said collector, and (b) retracted back to said primary magazine,

a secondary magazine comprising a plurality of dies each die presented spaced from a respective chamber of the primary magazine a distance to allow part of the organism to be positioned between the primary and secondary magazine in a cutting zone, yet aligned with the respective chamber in a manner to allow a collector to react with its respective said die during cutting of part of said organism located in said cutting zone.

28. An apparatus as claimed in claim 27 wherein the secondary magazine is coupled to the primary magazine to be able to move therewith.

29. An apparatus as claimed in claim 27 or 28 wherein said each said die defines a reaction surface for the cutter to press against, whether directly or indirectly.

30. An apparatus as claimed in any one of claims 27 to 29 wherein, at each said die, a seal is provided removable from said die and to engage with said cutter and move back to said primary magazine with said collector and to seal the sample in said cutter.

31. **A biopsy sampling apparatus** for collecting biopsy samples comprising

a. a spindle,

b. a primary magazine at one of the spindle and comprising a plurality of chambers each housing a biopsy sample collector each said collector comprising a punch having at one end a cutter for cutting said sample away from said organism, each said collector to be (a) driven at least partially from said magazine into an organism from which a sample it to be cut, retained and stored by a said collector, and (b) retracted back to said primary magazine,

c. a secondary magazine at the other end of the spindle and comprising a plurality of dies each die presented spaced from a respective chamber of the primary magazine a distance to allow part of the organism to be positioned between the primary and secondary magazine in a cutting zone, yet aligned with the respective chamber in a manner to allow a collector to react with its respective said die during cutting of part of said organism located in said cutting zone,

wherein the chambers of said primary magazine and the dies of said secondary magazine are equispaced at a pitch circle diameter from the axis of the spindle by a

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distance sufficient to provide a suitable space in the gap for receiving a part of the organism for sample cutting.

32. **A biopsy sampling device** of a kind having a revolver-like sequential presentation of sample punches from a revolving magazine to a sampling zone, the device being further characterised in that

- a reactive member acts as an anvil or die against which an organism (animal or otherwise) to be sampled can be positioned in the sampling zone for sample punch penetration
- that reactive member can be moved or moves to present an unused reactive surface to the sampling zone for any pass through emergence of a particular sampling punch
- each sampling punch with its sample is retained in the revolving magazine of the device for removal with the magazine.

33. A **biopsy sampling apparatus**, for collecting a biopsy sample from successively presented organisms (animal or otherwise), the apparatus comprising at least of

a mount

a magazine of sampling punches, the magazine of punches being movably carried by the mount [yet preferably removable from the mount], and

an abutment member or assembly ("member") carried directly or indirectly by the mount yet movable relative to the mount;

wherein each sampling punch in the magazine, in turn, can be presented by the magazine for both

(A) advancement to cut into its organism from which a biopsy sample is to be taken, the organism being in part at least interposed between the magazine and the abutment member, and

(B) withdrawal, with said biopsy sample, from the direction whence it came;

and wherein the abutment member can be moved or moves relative to the mount to present a different abutment surface for each organism as a reactive surface to its advancing sampling punch.

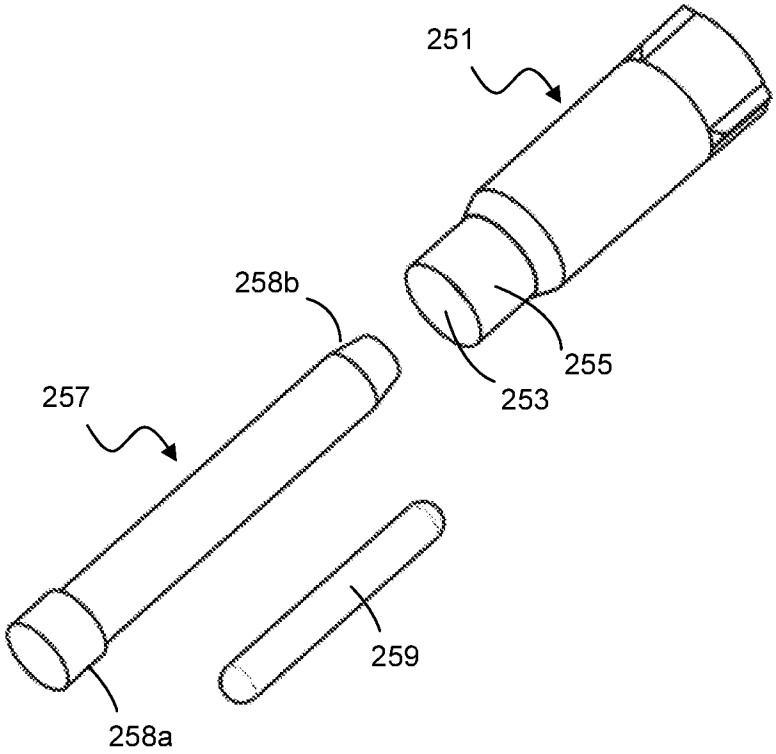


Fig 1a

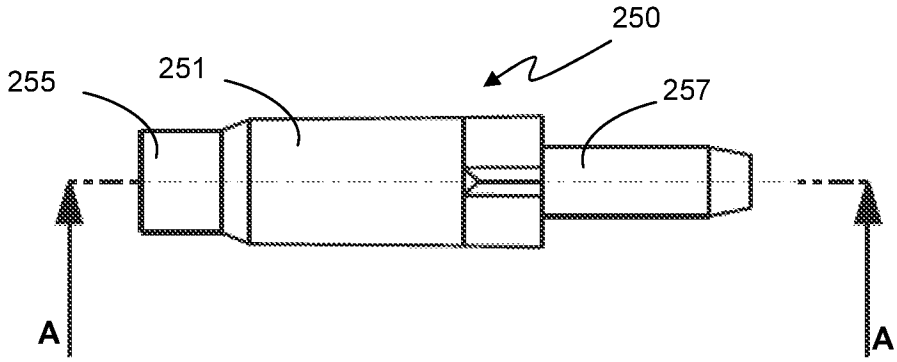


Fig 1b

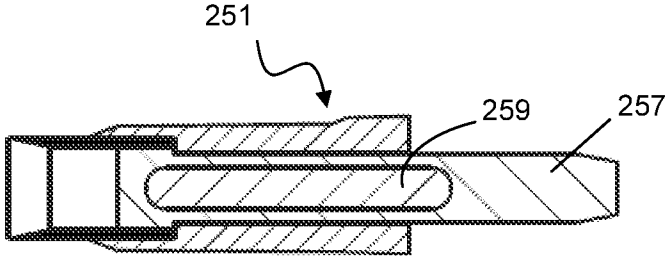


Fig 1c

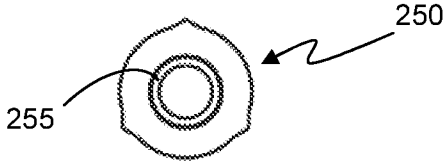


Fig 1d

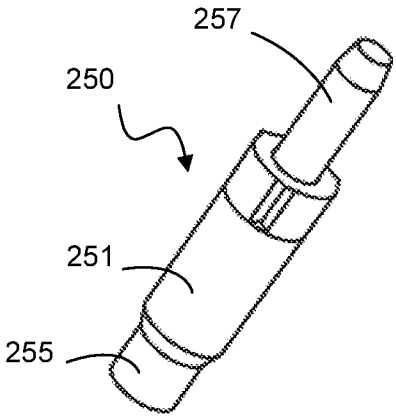


Fig 1e

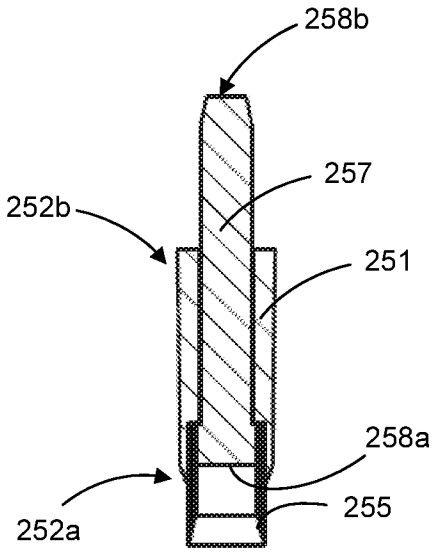


Fig 1f

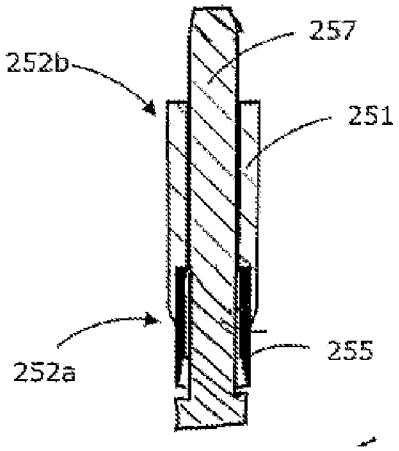


Fig 1g

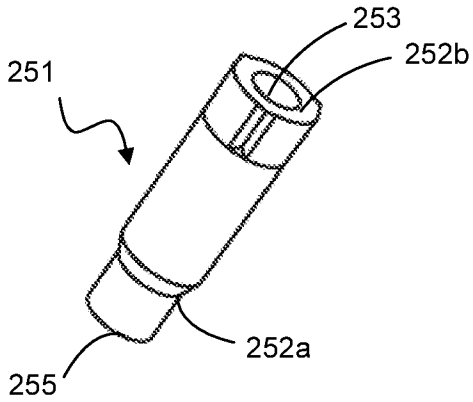


Fig 2a

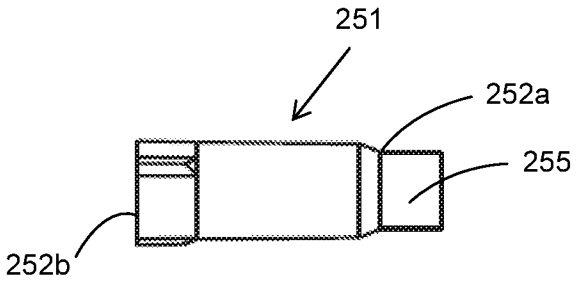


Fig 2b

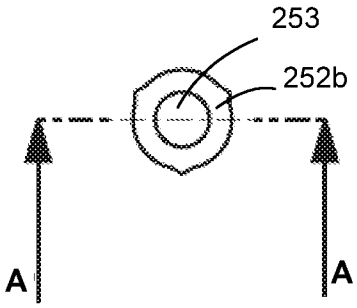


Fig 2c

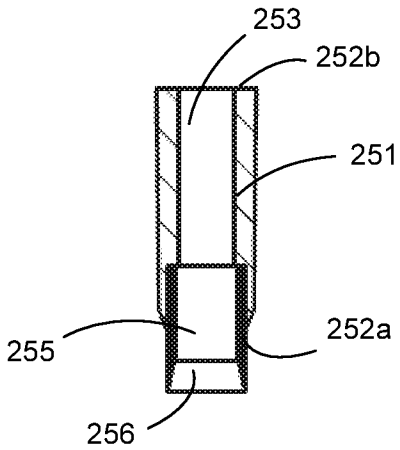


Fig 2d

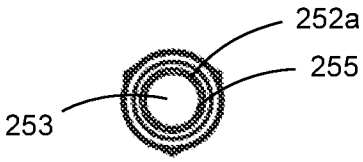


Fig 2e

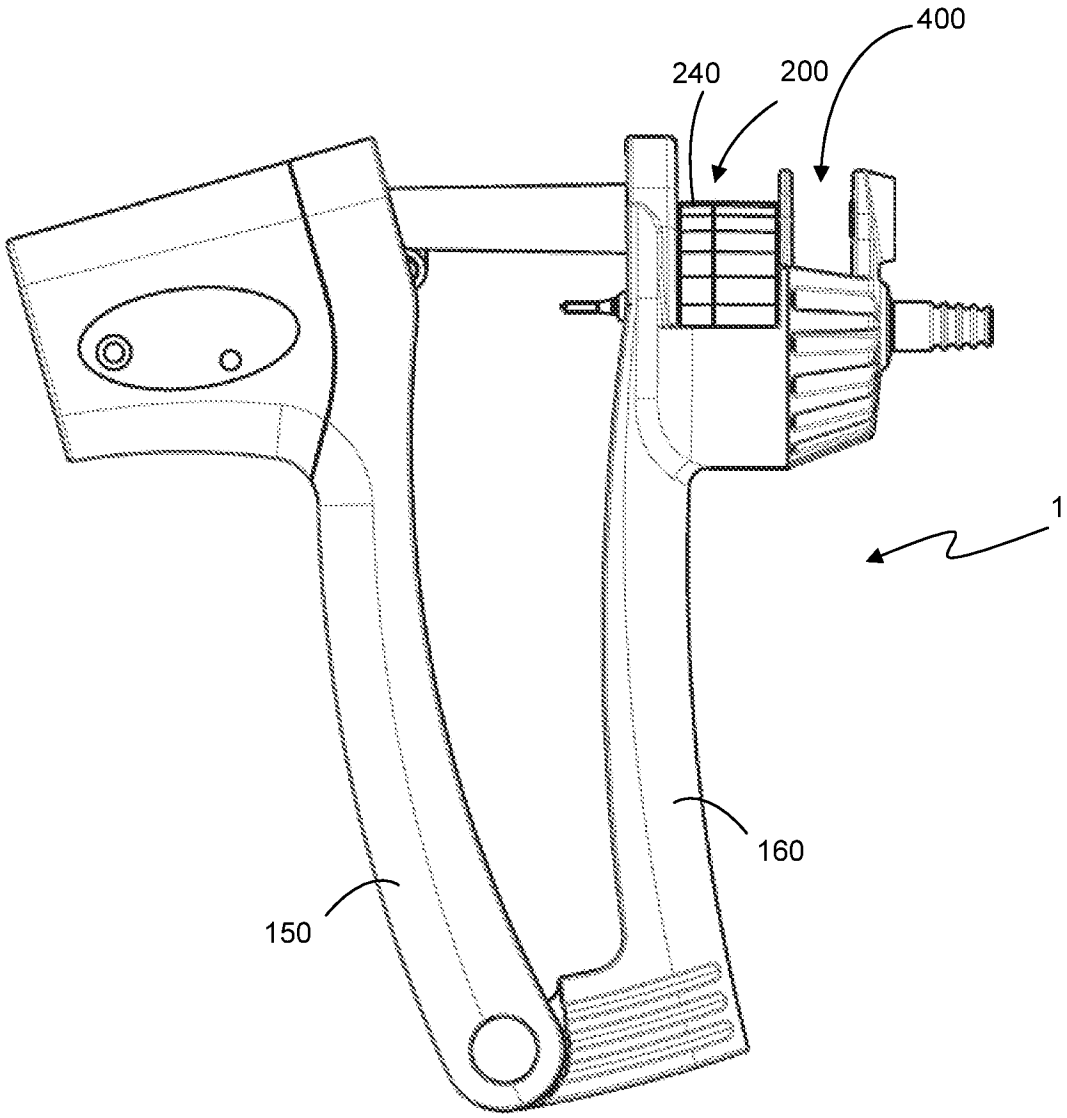


Fig 3

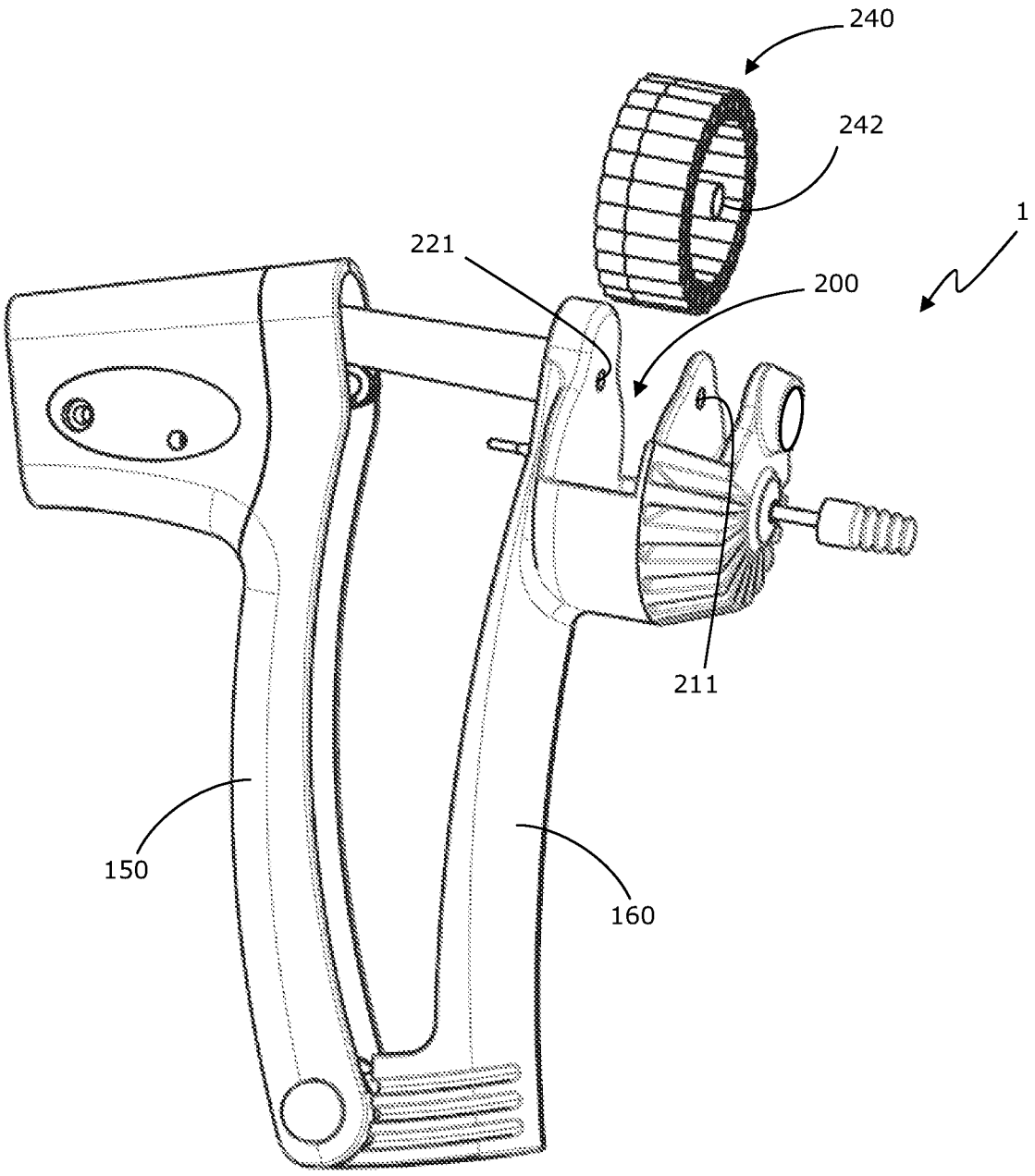


Fig 3a

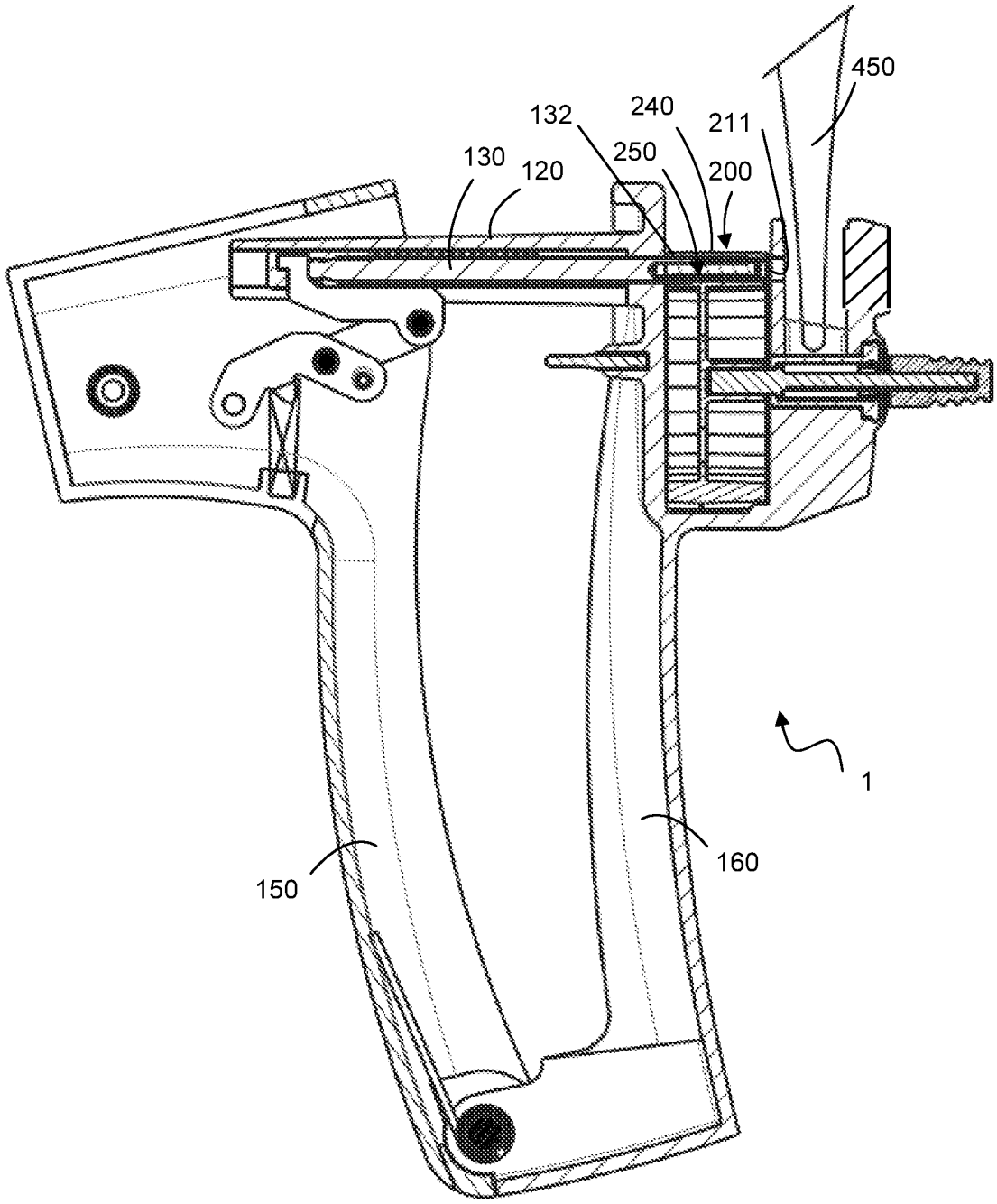


Fig 4

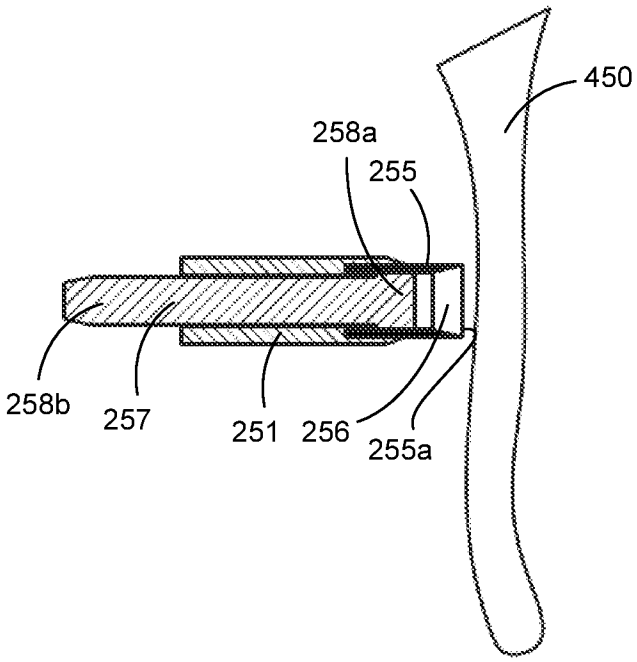


Fig 4a

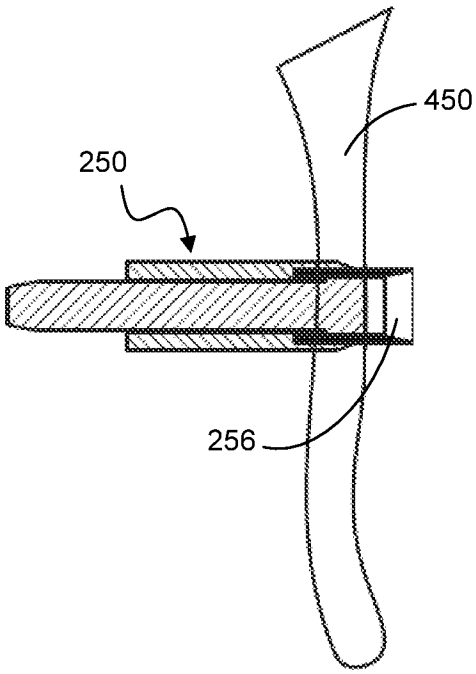


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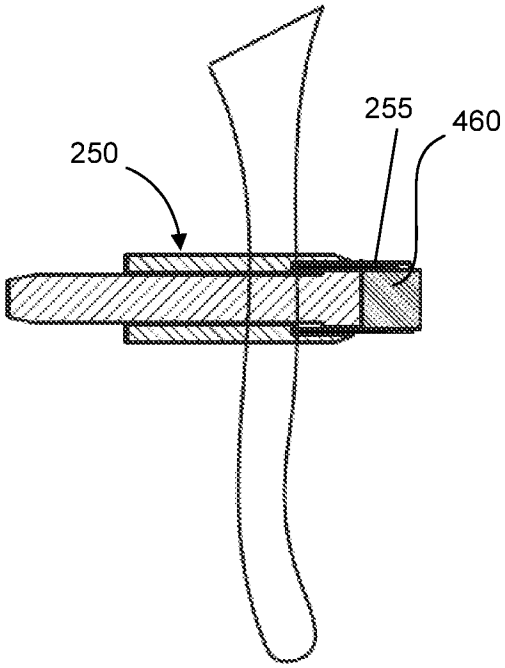


Fig 4c

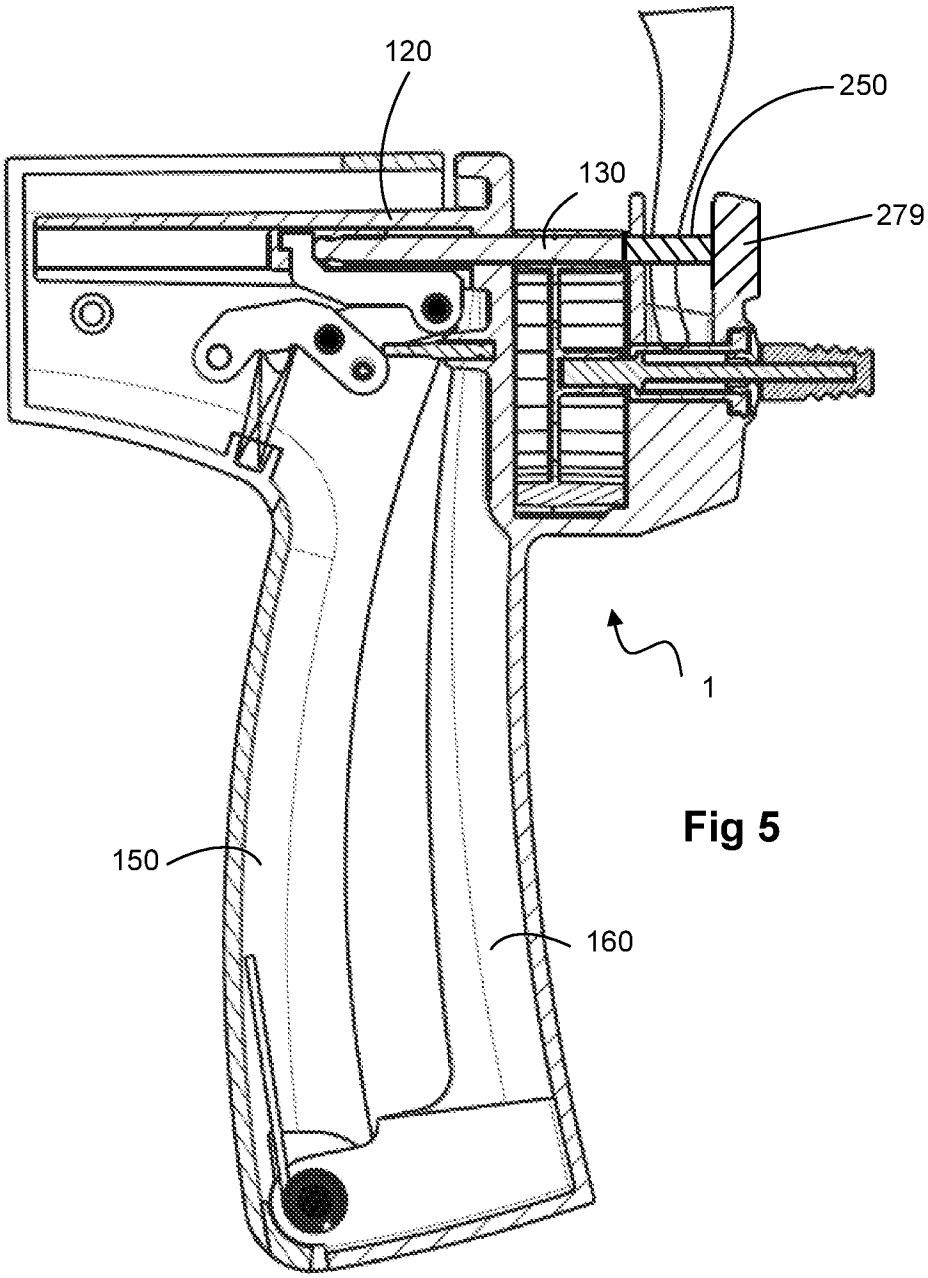


Fig 5

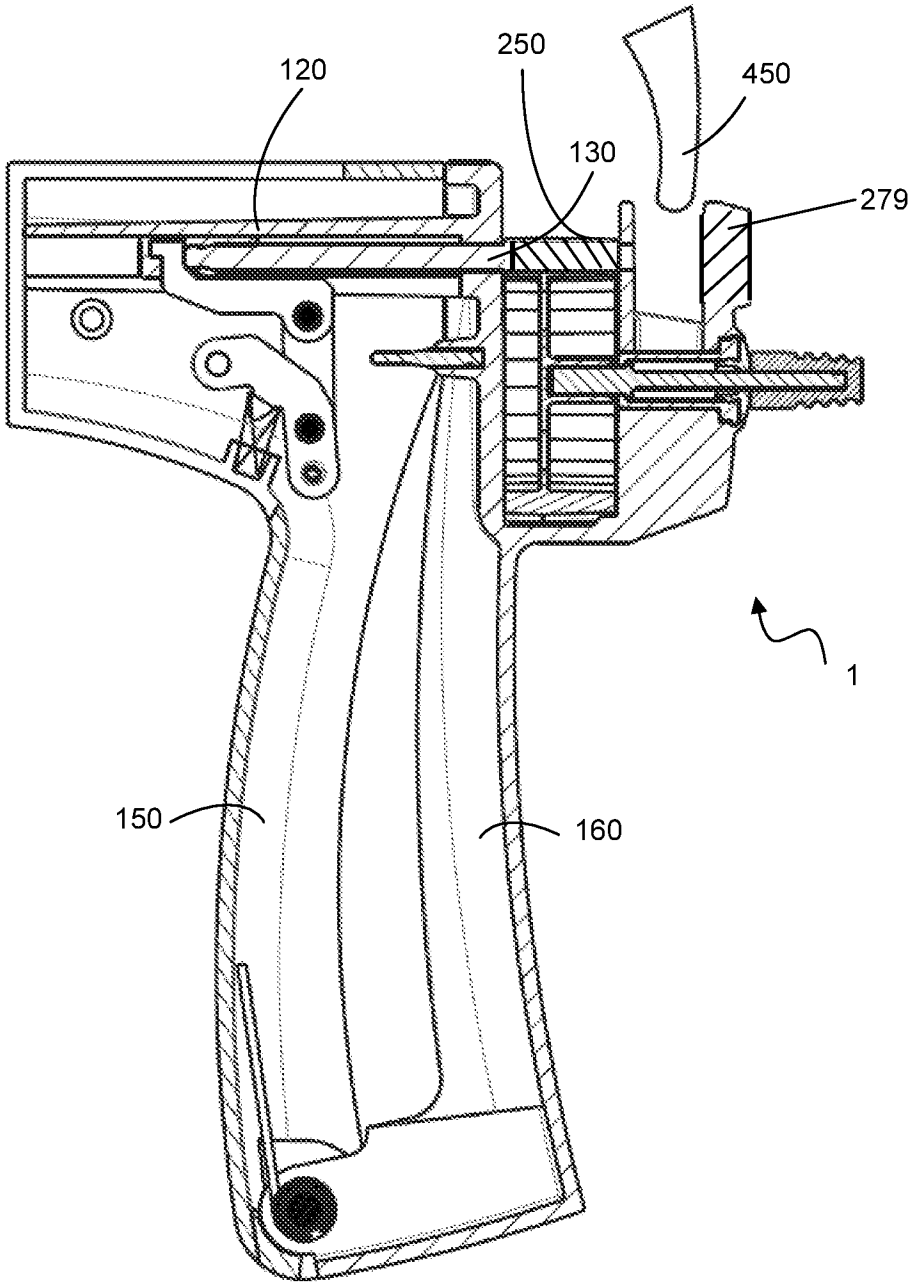


Fig 6

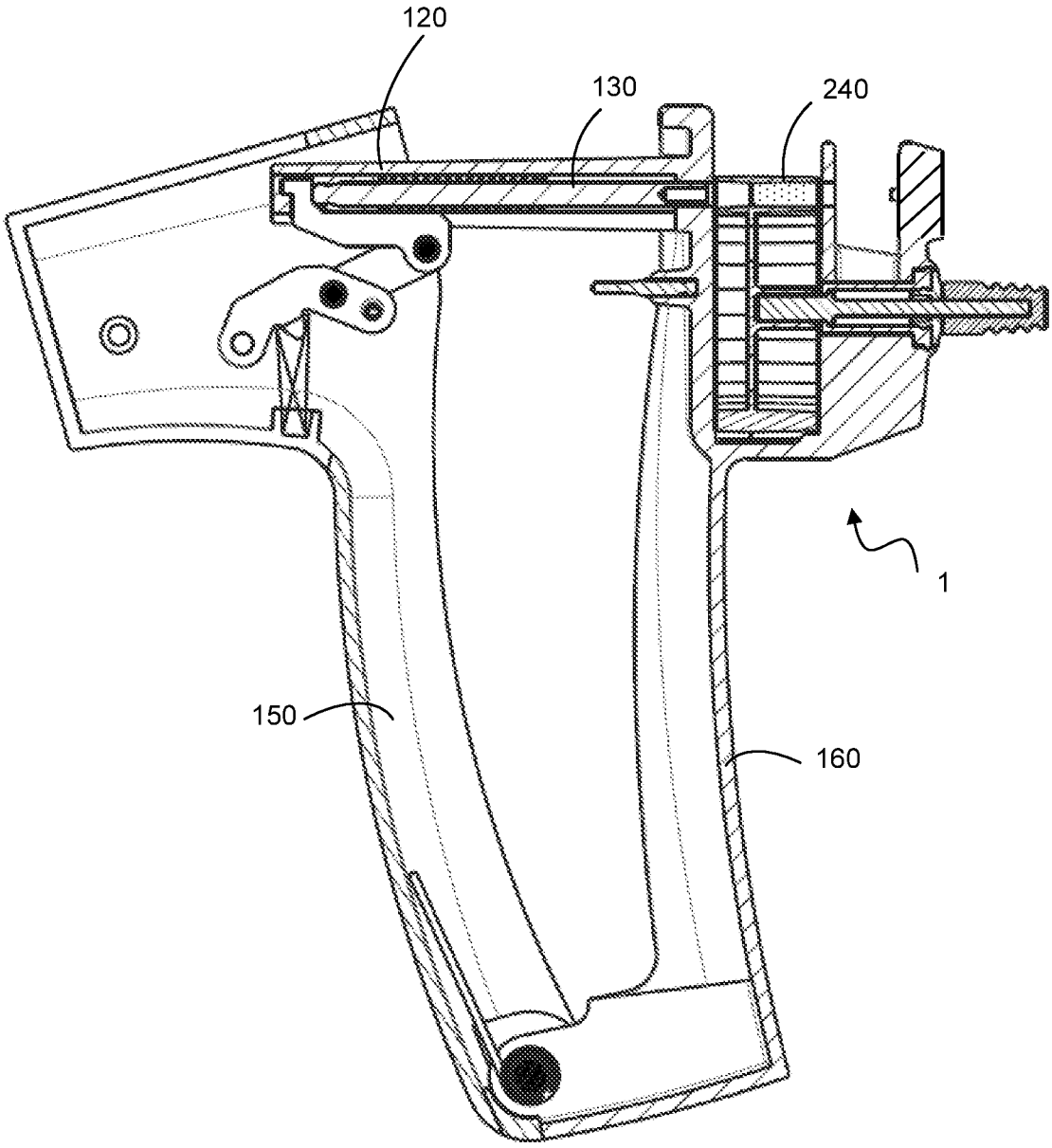


Fig 7

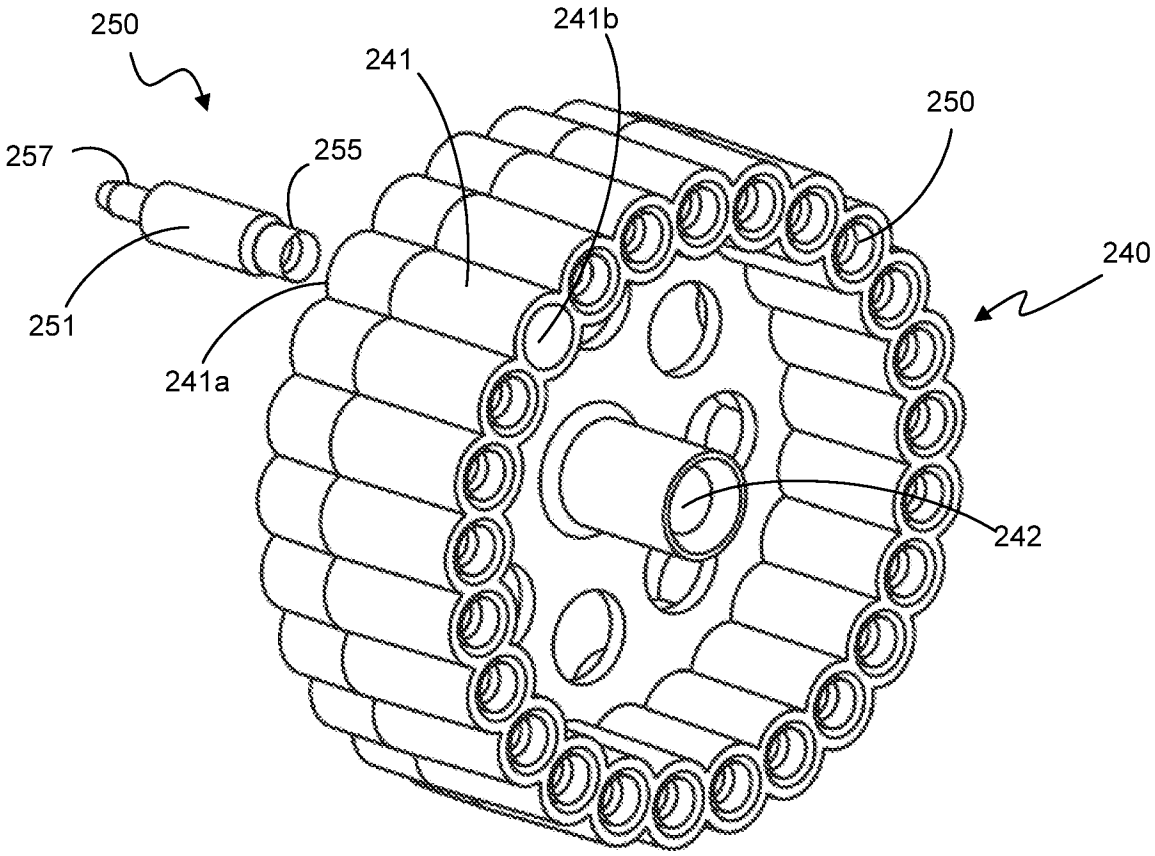


Fig 8

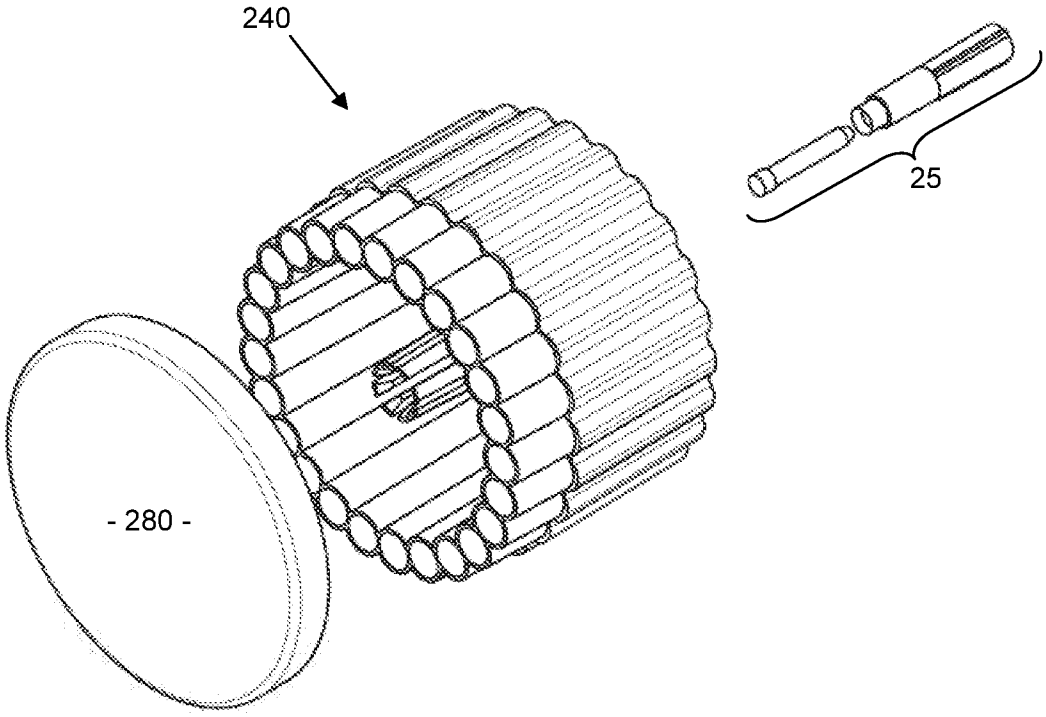


Fig 9

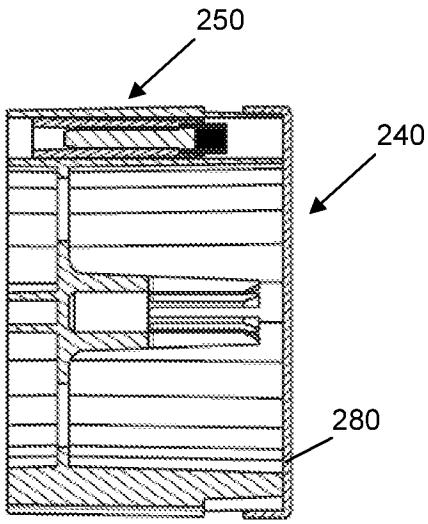


Fig 10

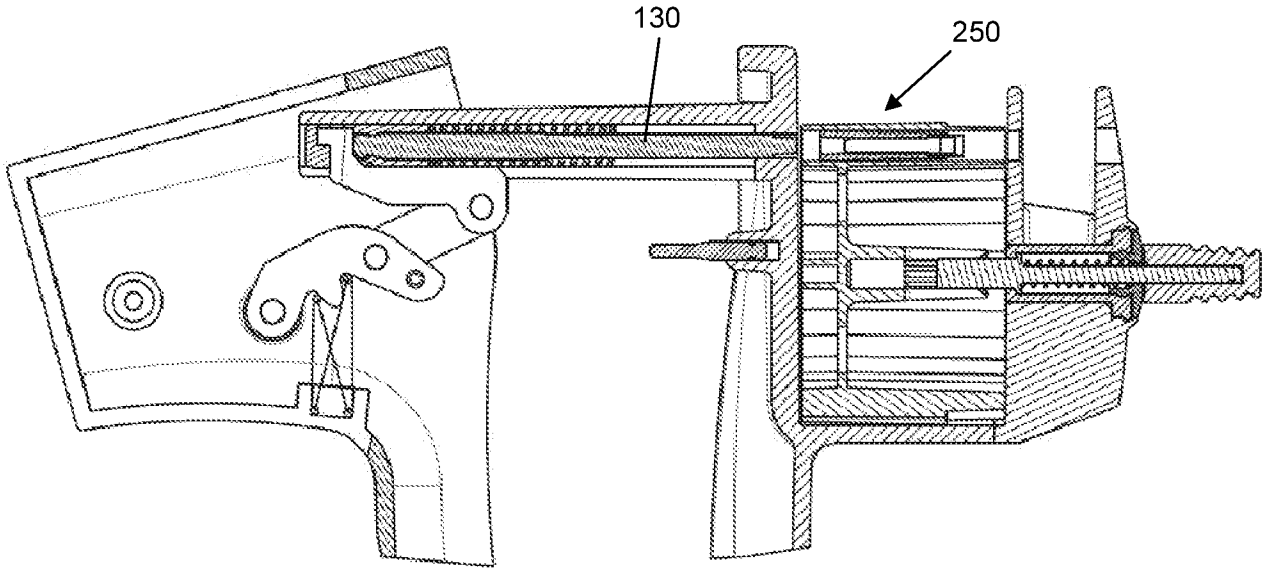


Fig 11

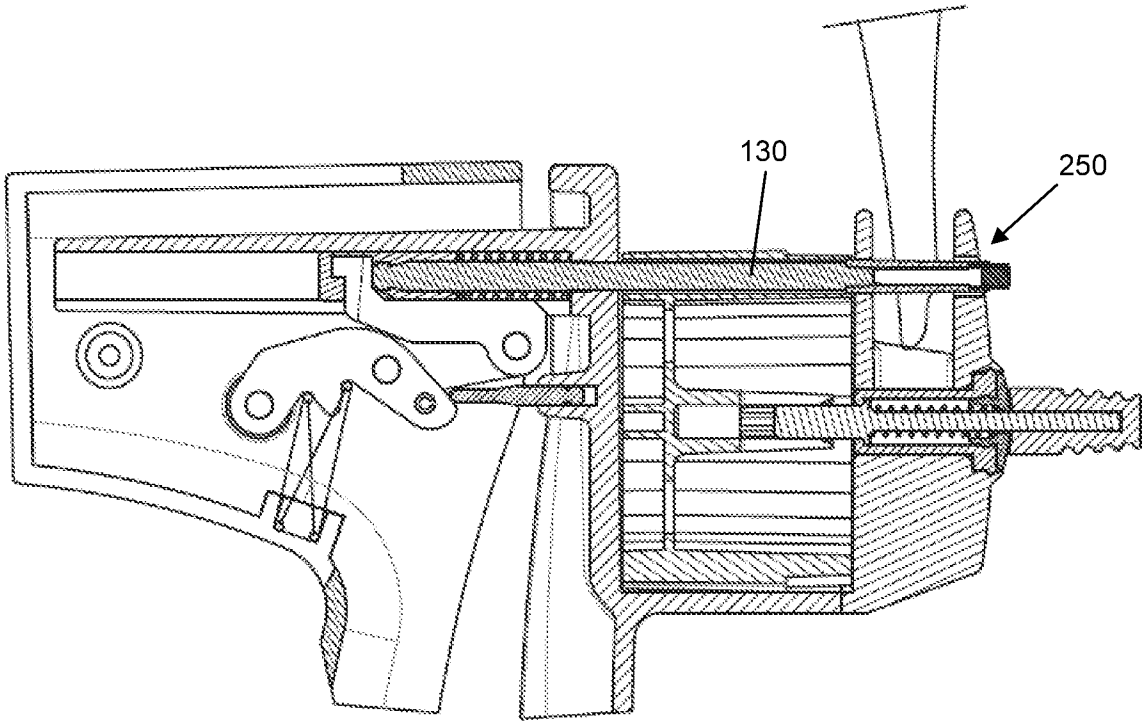


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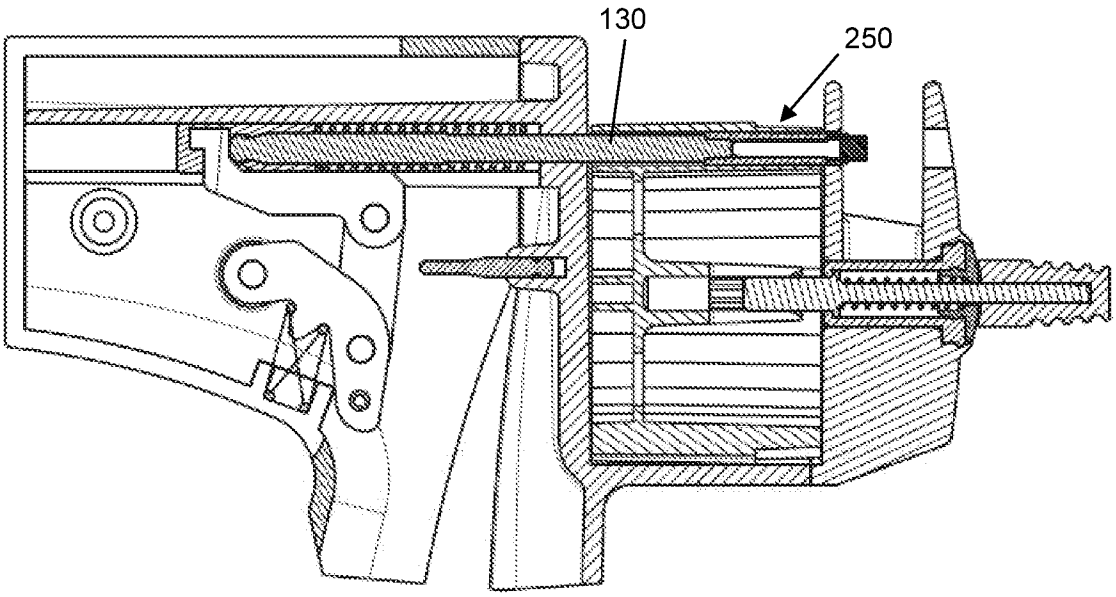


Fig 13

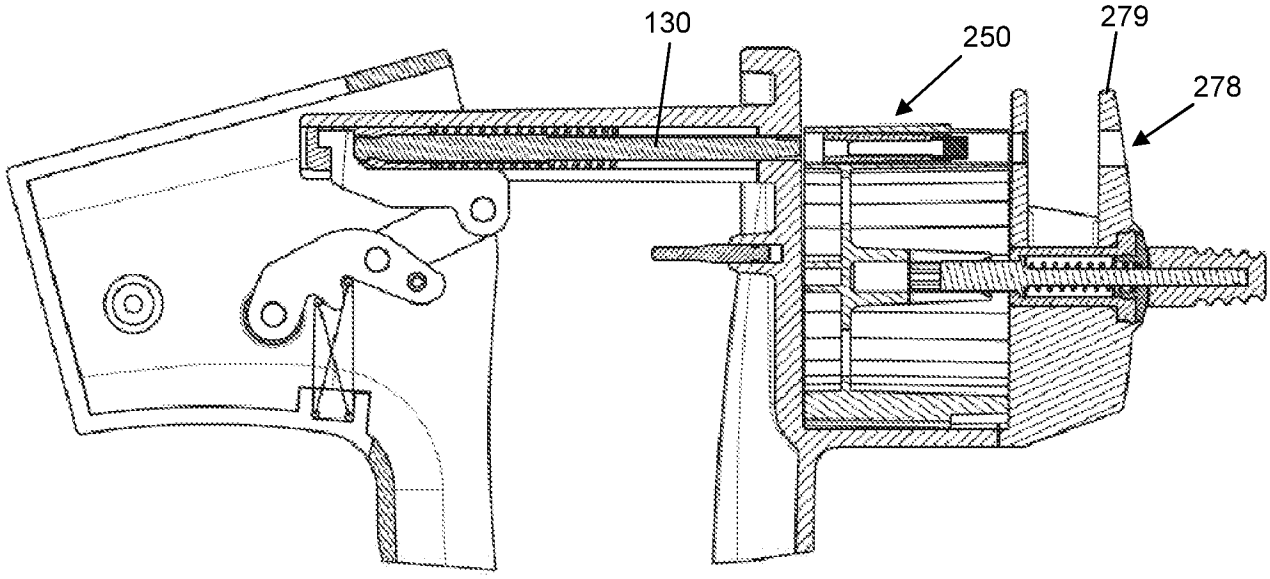


Fig 14

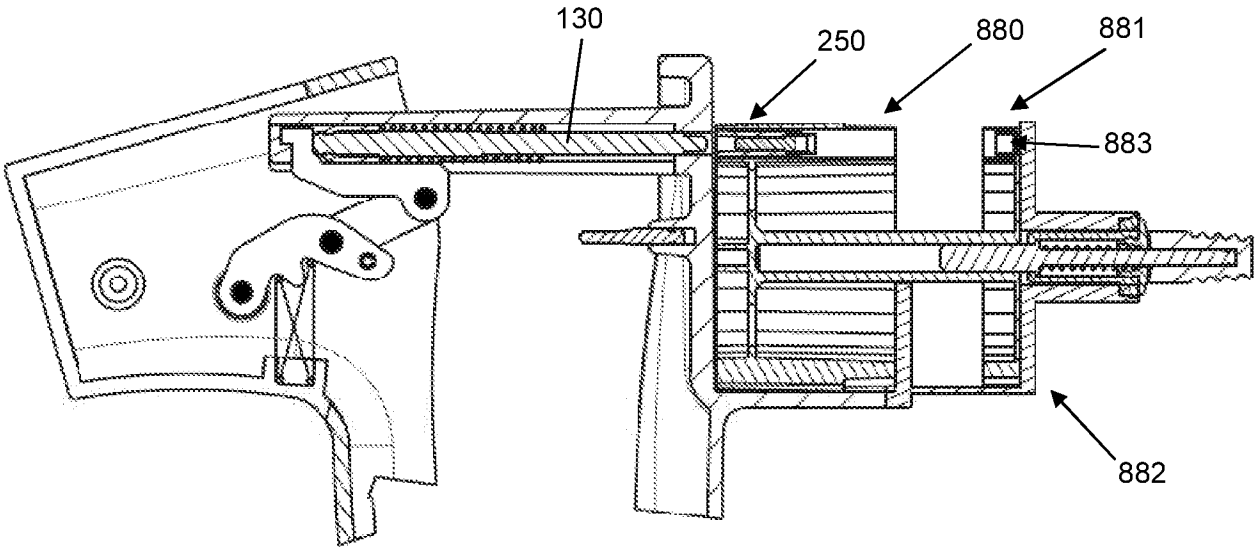


Fig 15

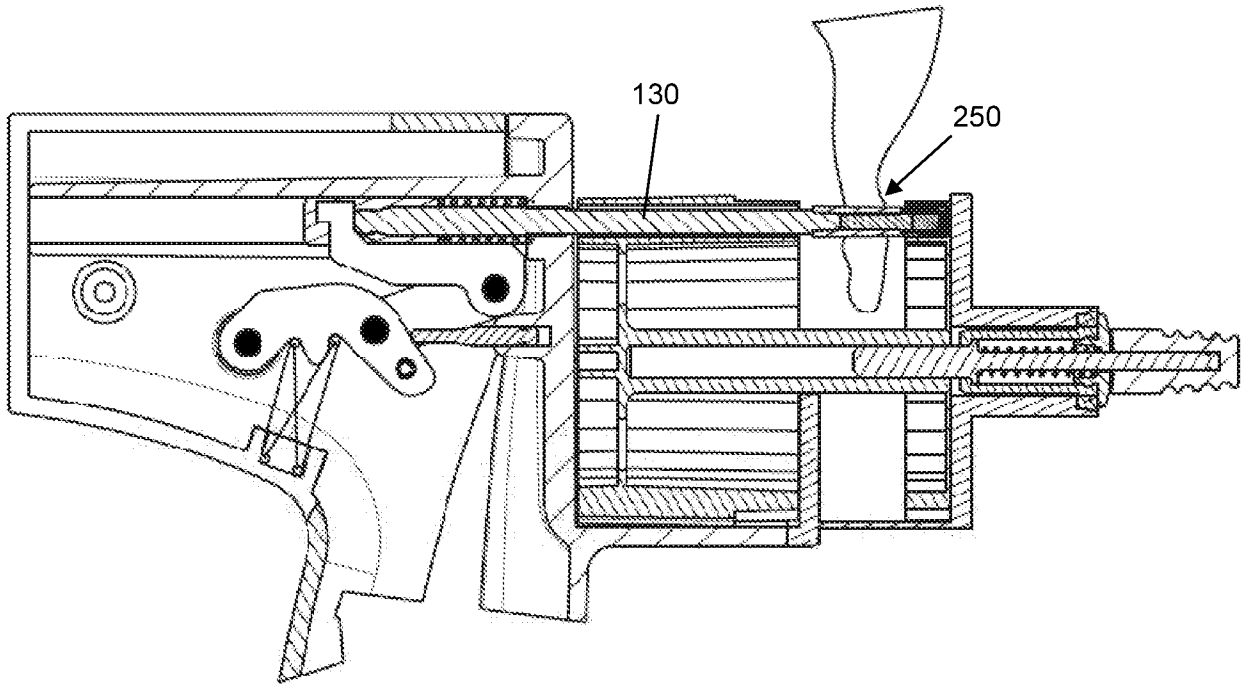


Fig 16

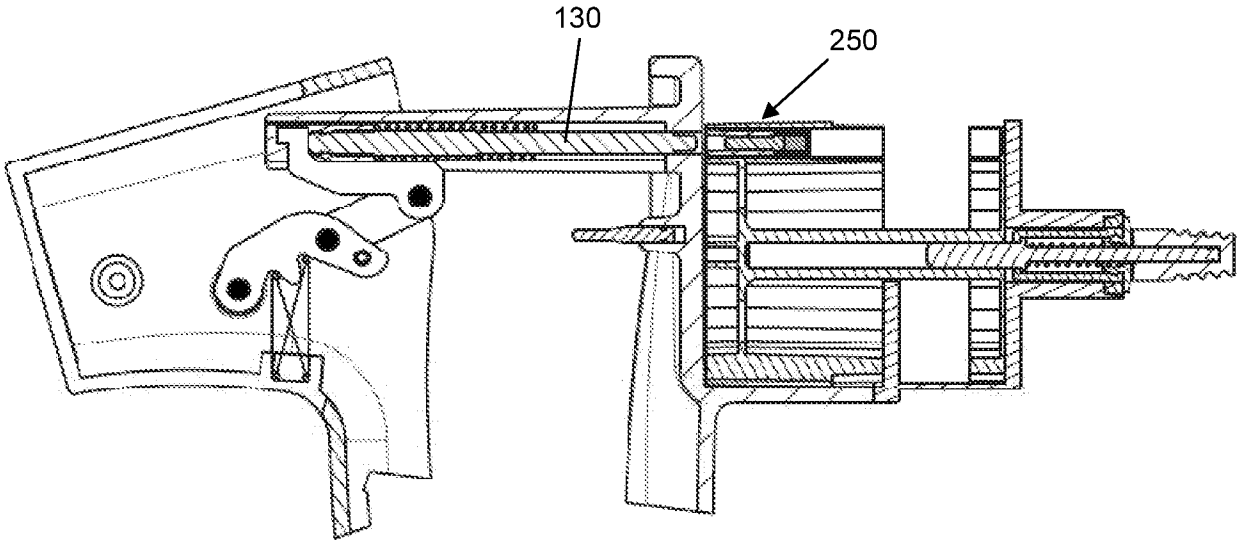


Fig 17

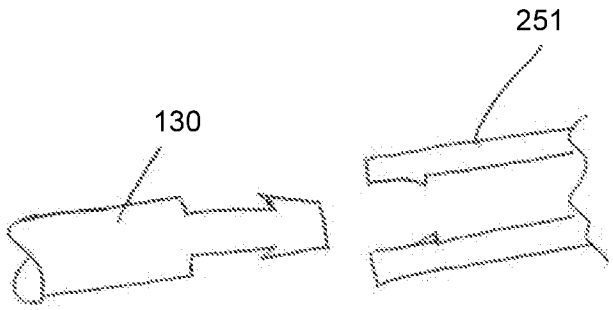


Fig 18

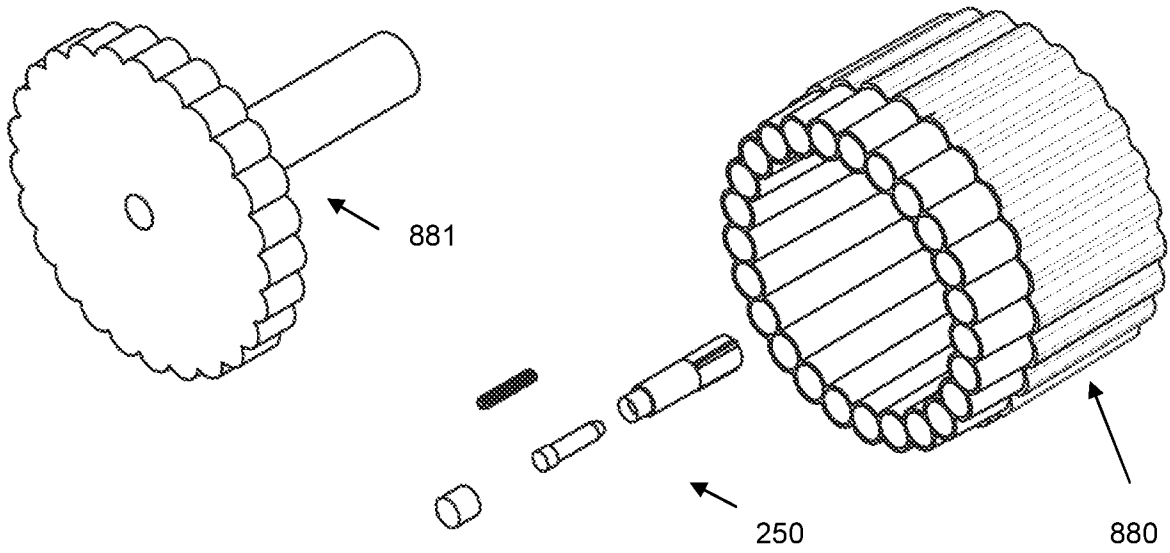


Fig 19

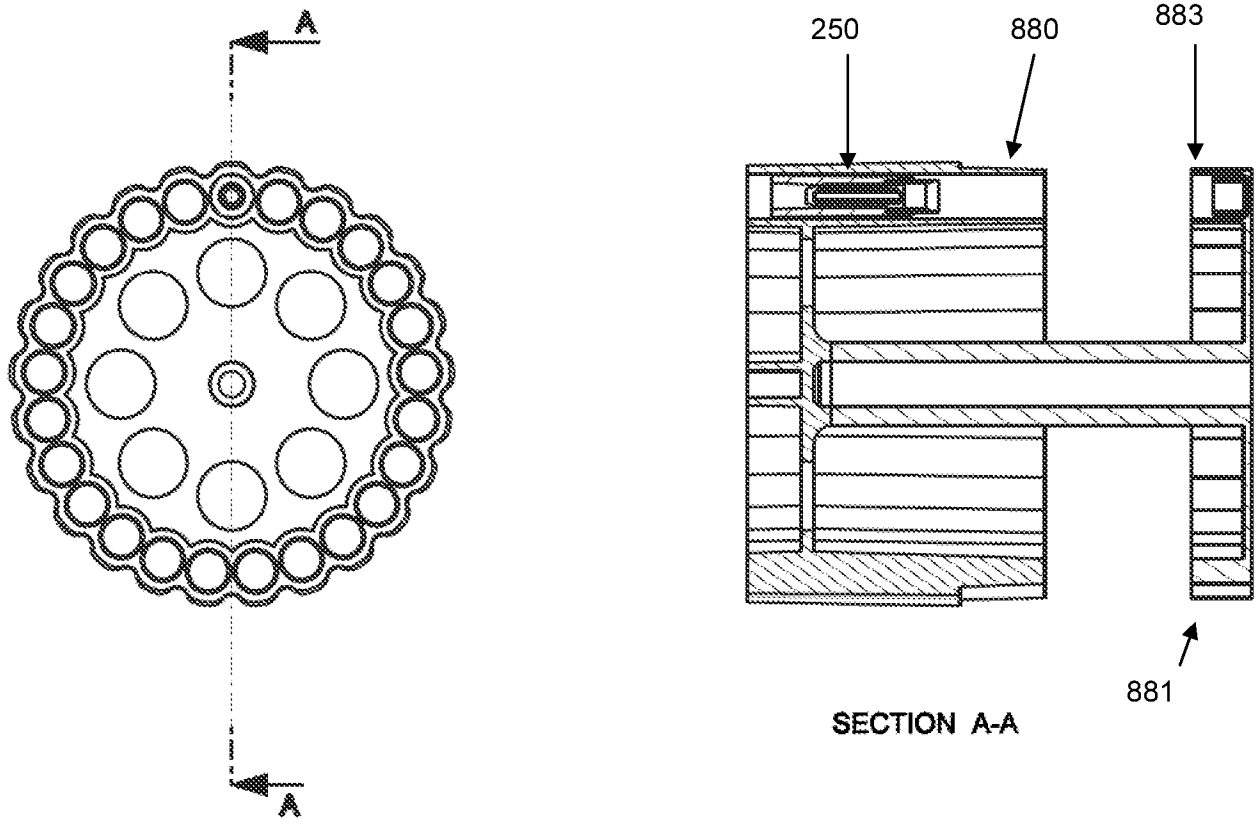


Fig 20

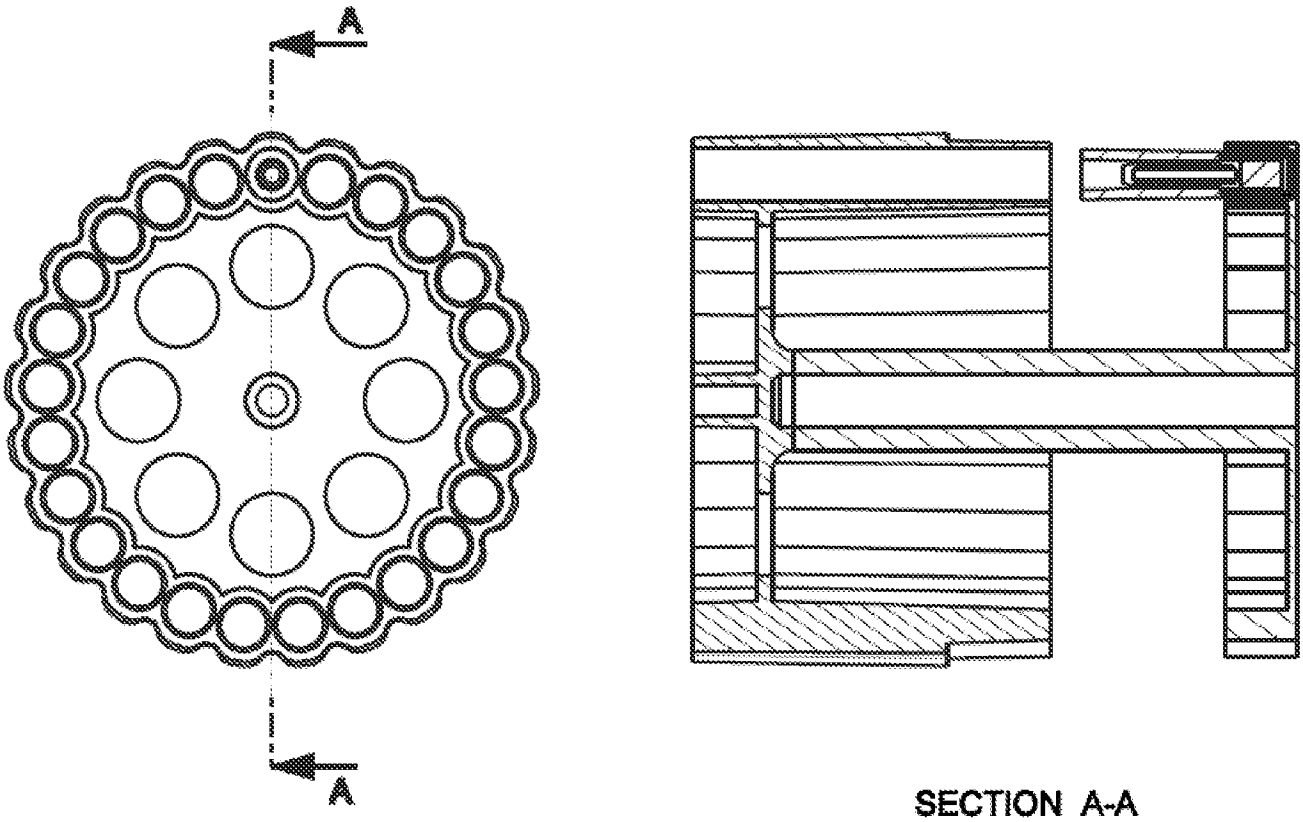


Fig 21

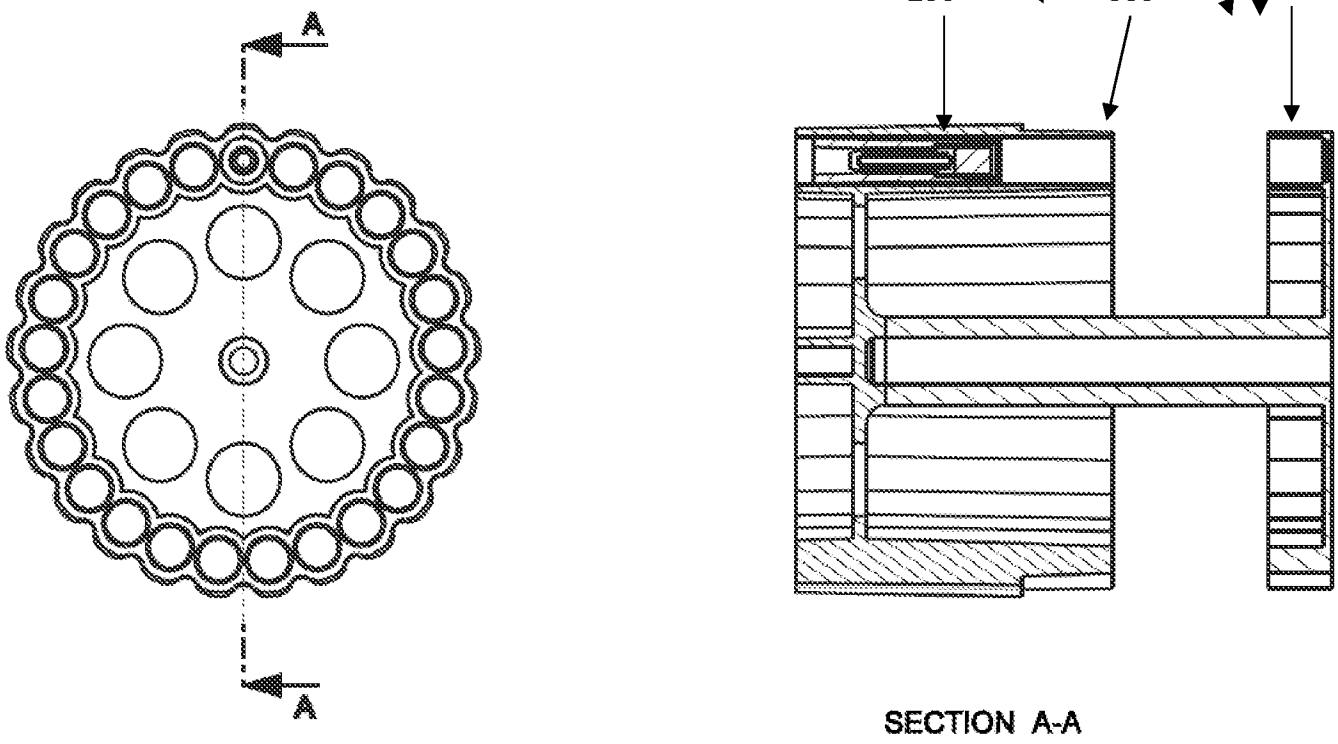


Fig 22

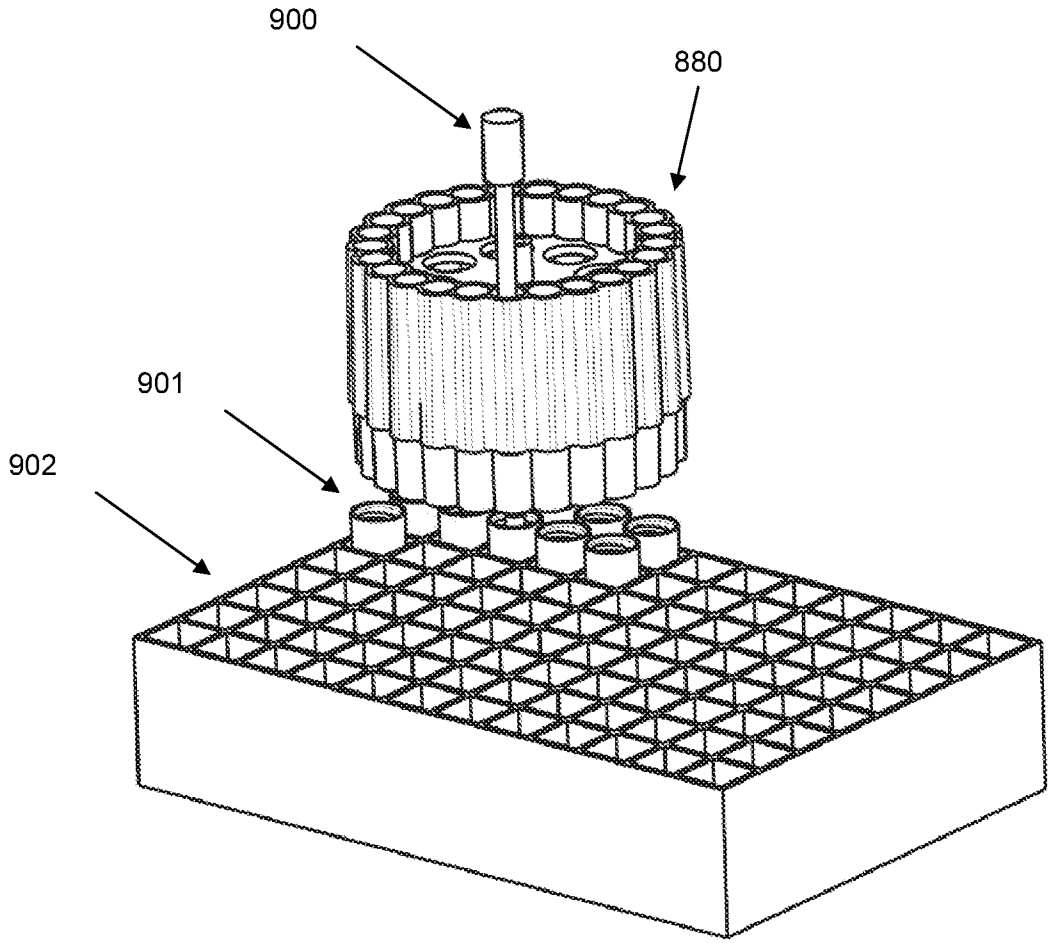


Fig 23

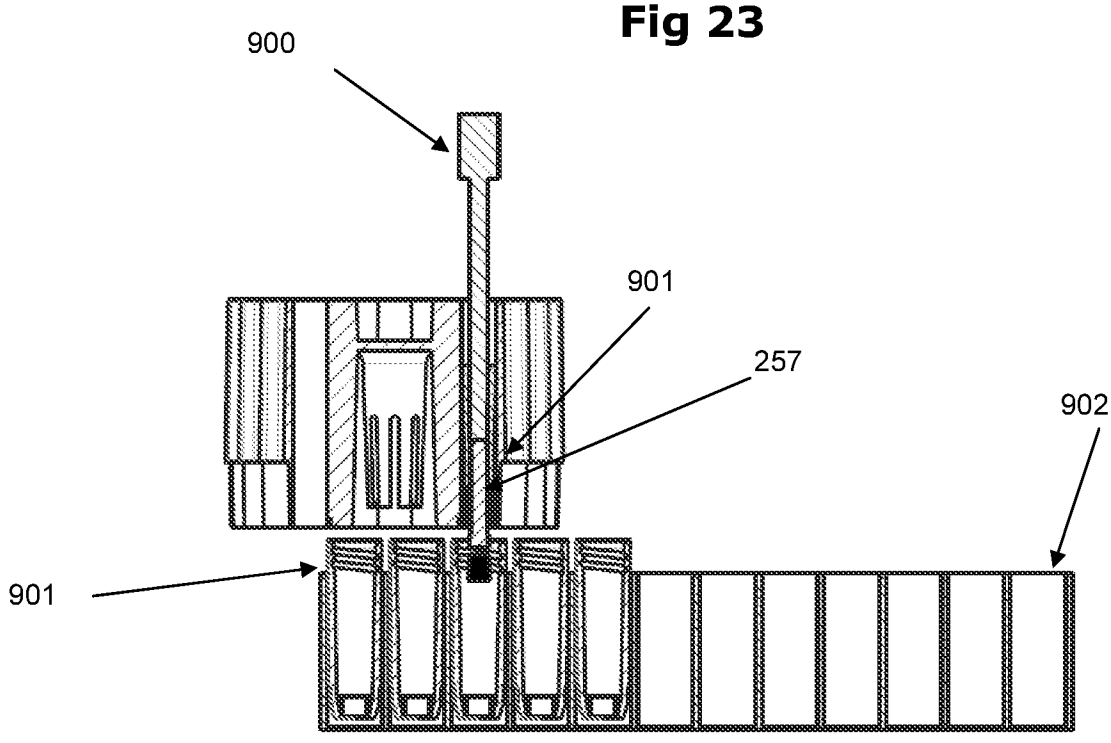


Fig 24