(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 July 2009 (23.07.2009)

PCT

(10) International Publication Number
WO 2009/090637 A2

(51) International Patent Classification:
B62H 1/02 (2006.01)

(21) International Application Number:
PCT/IL2009/000051

(22) International Filing Date: 14 January 2009 (14.01.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0800525.8 14 January 2008 (14.01.2008) GB

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

(54) **Title:** TOWING MECHANISM FOR BICYCLE TRAILERS

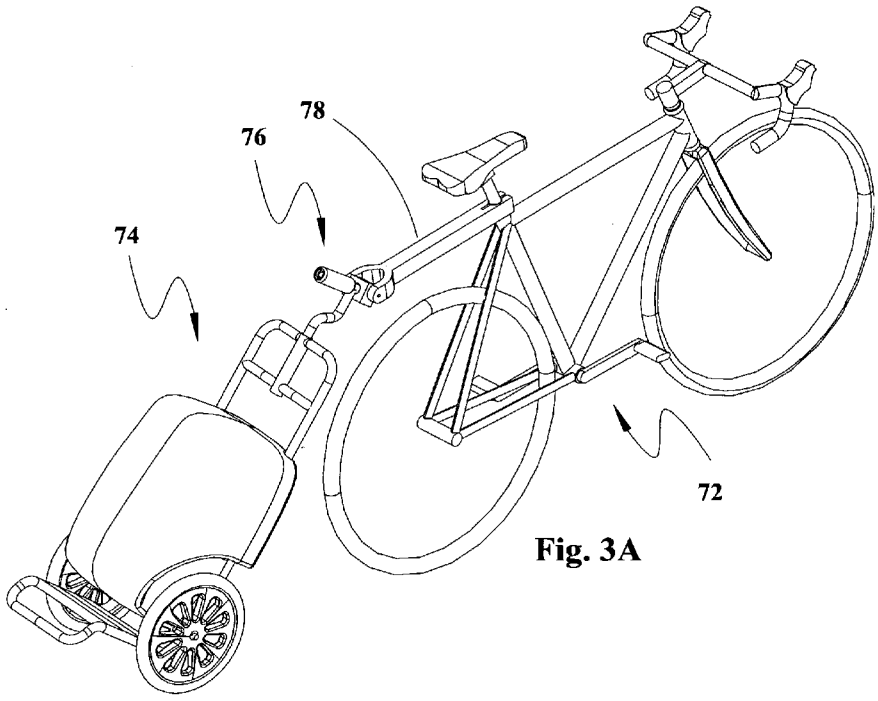


Fig. 3A

(57) **Abstract:** A three axis bicycle-to-trailer connecting device which a flexible connecting mechanism includes three axes of rotation each implemented by a different pivot. Such a pivot may be implemented on an independent connecting device or on the trailer or on the bicycle. A retaining mechanism keeps the trailer linked to the bicycle, in such a manner as the trailer may be easily connected or disconnected, typically to be carried manually.

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TOWING MECHANISM FOR BICYCLE TRAILERS

FIELD OF THE INVENTION

The present invention relates to personal transportation means, and specifically to auxiliary bicycle transportation means.

BACKGROUND OF THE INVENTION

Two wheeled transporting means, mainly bicycles, are sometimes used for towing a trailer for enhancing the haulage capacity of the transporting means. Such a trailer is to follow the bicycle and therefore has to be compatible with the characteristics of bicycle transportation, such as agility, maneuverability and roughness of subtending terrain. The connection between the bicycle and the trailer has to provide for very sharp turns an es of the driver, with minimal vulnerability of the connection as well as low interference with the drivers actions.

Several other specific physical features of a trailer may be required in order for it to be fit for haulage inside railway carriages, and useful in supermarket shopping. In the first case narrow dimensions are an advantage, and in the second case, large enough carriage volume is required.

An essential feature of the invention is that it is extremely easy to use and allows for quick release and re-connection of the trailer from and to the bicycle with little time or effort.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic isometric description of a bicycle to trailer connection in a setup as provided by the implementation of the present invention;

Fig. 2A is a schematic isometric description of a bicycle to trailer connection showing the connecting mechanism;

Fig. 2B is a schematic isometri on of a bicycle to trailer connection showing the trailer detached from the bicycle;

Fig. 2C is a schematic isometric description of a connection mechanism, of the invention showing the three axes of rotation and a handle;

Fig. 2D is a schematic isometric description of a handle of a trailer held by a partially exposed retaining mechanism;

Fig. 2E is a schematic isometric description of a handle of a trailer held by a partially exposed retaining mechanism;

Fig. 2F is a schematic isometric description of a retaining mechanism in a closed position;

Fig. 2G is a schematic isometric description of a retaining mechanism in an opened position;

Fig. 3A is a schematic isometric description of a sports bicycle to trailer conn a setup as provided by the implementation of the present invention;

Fig. 3B is a schematic isometric description of a sports bicycle to trailer connection showing axes of rotation of the connection mechanism;

Fig. 3C is a schematic isometric description of a bicycle having a rear suspension, and connected to a trailer;

Fig. 3D is a schematic isometric description of the connecting mechanism of the bicycle having a rear suspension, showing two axes of rotation;

Fig. 3E s a schematic isometric description of the connecting mechanism of the bicycle having a rear suspension, showing a horizontal axis rotation;

Fig. 4 is a block diagram representing the principle building blocks of the connection mechanism of the invention and their interconnections;

Fig. 5A is a schematic representation of a bi-functional connecting device implementing both a rotation axes and quick connecting disconnecting device having a withdrawble toot55H schematic representation of a bi-functional connecting device as in Fig. 5A, describing the tooth in more detail;

Fig. 6 is a schematic representation of a bi-functional connecting device as in Fig. 5A but employing retractable balls instead of a tooth.

Fig. 7 is a schematic representation of a trailer attached to another towing mechanism which is a part of a rear rack which mounted to the seat post of a bicycle.

Fig 7A is a schematic representation of a gripper mechanism which connected by 3 damped axis of rotation to a rear rack of a bicycle.

Fig 7B is a schematic representation of griping mechanism in details including a one of the axis dumper.

Fig. 8 is a schematic representation of a trolley and its dumped handle including the dumper, a level mechanism and trolley rotating stopper.

Fig. 8A is a schematic representation of the trolley's dumper in details.

Fig. 9 is a schematic representation of a bi functional push-push retaining mechanism, in its position while it is disconnected from the towing device.

Fig. 9A is a schematic representation of a trolley's handle quick connecting push-push retaining mechanism while its button is pushed and it is about to be insert into the towing device.

Fig. 9B a schematic representation of a quick connecting push-push retaining mechanism's sliding piston, in its first cycle while it pushed inserted and rotated in the towing device.

Fig. 9C a schematic representation of a quick connecting push-push retaining mechanism's sliding piston, in its 2nd cycle while it is locked in the towing device.

Fig 9D a schematic representation of a quick connecting push-push retaining mechanism's sliding piston, in its 3rd cycle while it is pushed again and rotated in the towing device.

Fig. 9E a schematic representation of a quick connecting push-push retaining mechanism's sliding piston, in its 4th cycle while it is rotated and pulled out from the towing device.

Fig. 10, a schematic representation of a sliding retaining mechanism

Fig 10A, a schematic representation of a sliding retaining mechanism in detail while it is attach to the towing mechanism.

Fig 10B, a schematic representation of a sliding retaining mechanism in detail as the handle button has been pushed to release.

Fig 10C, a schematic representation of a sliding retaining mechanism in detail as it slide out of the towing mechanism.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

In accordance with the present invention a connecting mechanism which can envisaged as an articulated towbar (ATG) is provided for coupling between a trailer and a bicycle. The connecting mechanism of the invention is non rigid, connected on the one end to the rear side of a bicycle and on the other end to a trailer or is a part of a trailer. A typical connecting mechanism of the invention has three consecutive joints each facilitating rotational displacement of the ATG, each in a unique plane. The consecutive arrangement of the joints allows for safe yet convenient, minimally constraining, on all three dimensions, connection to the bicycle. The ATG of the invention typically connects to a rear part uch as to the rear rack also known as carrier. The ATG typically connects at an inclination angle relative to the earth of about 45^{O}. As can be seen in **Fig. 1**, bicycle **14** is connected to a cargo bearing trailer **16**, via connecting mechanism **18**. The connecting mechanism connects to the trailer in its lower end, and to rack **20** in its upper hand. The connecting mechanism is sturdy enough to hold the trailer which bears cargo including cargo bag **22** and may be substantially heavy. In this exemplary embodiment of the invention, more features of the invention are shown in **Figs 2A-E** to which reference is now made the trailer **16** described above is stripped off of its cargo and cargo bag. In **Fig. 2A**, trailer **16** is stripped, showing handle assembly **26**. In this drawing, the handle is shown secured by a retaining mechanism connected in series to a flexible connecting device, together designated **30**. More detailed description of the retaining mechanism and flexible connecting device will be given in subsequent drawings. In **Fig. 2B**, with respect to the figure described formerly, the connecting mechanism, latch and rack are removed. In this drawing, the trailer is shown (without the

cargo) as detached from the bicycle, assuming an independent status, ready to be picked by hand and used as a manual cart, or be connected to the bicycle by the handle assembly **26** using the retaining mechanism.

Other features and aspects of the connecting mechanism of the invention are explained with reference to the drawings. In **Fig. 2C** the three axes of rotation relating to the three degree of freedom that the connecting mechanism of the invention provides are shown. Axis of rotation **36** is implemented by a pivoted connection at the rear of connecting mechanism usually forming a permanent pivoted link with the rack (not shown), axis of rotation **56** allows rotation in another plain, and axis of rotation **58** permits rotation in yet another plain. It is not necessary that all three plain are orthogonal, because the deviation of the trailer movement from the bicycle's movement is not expected to be completely random in all plains. Shown in the drawing is locking handle **60** which the user actuates to lock or unlock the retaining mechanism. In **Fig. 2D** additional features of the trailer's retaining mechanism are described schematically. Handle retaining hooks **62** hold handle **28,** bearing the weight of the trailer and the mechanical stresses produced by the trailer as it is towed by the bicycle to which it is connected. The retaining mechanism in this drawing is shown stripped of its locking lever, thereby exposing spring **68** biasing a pawl (not shown) in the locking position, such that it is urged into a gap in the toothed surfaces **70**. In **Fig. 2E** the retaining mechanism is shown with locking handle removed and pawl assembly **72** inserted between the teeth of toothed surfaces **70**, thereby securing locking lever **76**. In **Fig. 2F** the retaining mechanism is shown closed with locking lever **76** in closed position without the trailer. In this drawing, axis **36** is drawn showing its position relative to the connecting mechanism. In **Fig. 2G** the locking lever **76** is opened, naturally allowing

dismissal or engagement of the handle of the trailer, In the example described above all the axes of rotation are implemented on the connecting mechanism, while none are implemented on the trailer. The trailer's handle assembly is in this case rigid and non changeable. In a preferred embodiment of the invention, the locking lever, when the trailer is detached, can be raised to a secured parking condition, to prevent dangling and interference with the management of the bicycle. The trailer is in this case an independent device capable of being used as a manually handled carriage.

In **Fig. 3A** to which reference is now made, the connection between the bicycle and the trailer is somewhat different than the one described above. Bicycle **72** is connected to trailer **74** using a connecting mechanism **76** coupled directly to an extension bar **78**. The extension bar replaces the rack that is typically lacking in sports bicycles, and is connected at the bicycle end to the seat post or seat tube or seat stay. More details of this specific embodiment are described in **Fig. 3B** to which reference is now made. The three axes of rotation associated with the three dimensional freedom of the trailer are as follows. For axis **84** rotation is provided by a pivot disposed along the main frame of the trailer. For axis **86** rotation is provided by a pivot disposed extending from block **88** in a slant angle relative to extension bar **78**. For axis **90** rotation is provided by a pivot running through extensions **80** of extension bar **78** and through block **88**. Handle **92** enables the user to detach the trailer from the bicycle and carry it manually. To that effect, a quick connection mechanism is employed such that by pressing or turning of the handle, the link between the trailer and block **88** is disabled, freeing the trailer. In this case, the trailer and the extra trailing assembly are complementary and would accomplish their assigned task only as linked together.

A connecting mechanism in accordance with the present invention fit for implementing in bicycles having a rear suspension, is described in **Figs 3C – 3E** to which reference is now made. To the rear of rear suspension **90** is attached a connection mechanism **92**. Some details of the connection mechanism are described in **Fig. 3D**, axis of rotation **94**, is implemented in the trailer itself, while axis of rotation **96** is implemented in the connecting mechanism, sharing location with the physical axis of handle **98**. The handle extends into block **100**, better seen in **Fig. 3E** in which the external part of the handle is removed. This block is pivotally connected to bracket **102**, while the bracket is affixed to the rear suspension assembly **90**. The pivoted **connection** of block **100** to bracket **102** implements the rotational axis **104** of this particular connecting mechanism. Typically, handle **98** is bi-functional, on the one hand it is used to actuate a quick decoupling of the trailer from the bicycle and on the other hand, it provides a carrying handle for the trailer when detached from the bicycle.

The schematic structural principles of the connecting mechanism of the invention are summarized in **Fig. 4** to which reference is now made. A chain of connected mechanical entities is described Bicycle **112** is connected through pivot A **114** which is connected indirectly to pivot B **116** again connected indirectly to pivot **118**, which is connected to trailer **120**. In some embodiments handle **124** is disposed any where along that chain. The handle may be connected directly to the trailer or to any link to which the trailer is connected that allows manual carriage of the trailer.

A quick connection/disconnecting device is in some embodiments implemented to facilitate fast attachment/ detachment of the trailer. In **Fig. 5A** to which reference is now made an exemplary device for implementing the task is described schematically. Shaft between a bicycle at the right and a trailer at the

left. Cylinder **166**, which at its upper portion **168** forms a gripping handle, includes piston **170**, moveable up and down inside the cylinder as described by double arrow **172**. Cylinder **166** and its upper portion **188** can be each or both constructed forming a telescopic contractible barrel, for permitting the user to change the extent of projection below or above the connection mechanism. When pushed down against the urge of spring **174**, by button **178**, retaining tooth **182** which is generally located under block **100**, is pulled inside the cylinder allowing smooth release of the cylinder from its lodgment inside the block (not shown). The quick release mechanism is shown in more detail in enlarged section shown in **Fig. 5B**. Prong **188**, constituting an extension of piston **170**, tapers almost to its end, forming a slanted surface **190**. As this slanted surface is pushed down when the piston is depressed, retaining tooth **182** is urged inside the cylinder urged against horizontal spring **194**. Ball retainers as described in **Figs. 6A - 6B** may be used as well to implement quick attachment / detachment of the trailer, by mechanisms known in the art, sometimes referred to as quick connection mechanisms. In **Fig. 6A**, the bottom part of cylinder **166** is shown. One to several balls **198** are urged by enlarged lower section **200** of prong **188**. As the prong is depressed against the urge of spring **202**, the balls are released allowing cylinder to be pulled out of the block.

Another quick connection/disconnecting **device described** In **Fig. 7**. The trailer **208** is connected to the towing mechanism which is a part of a rear rack seat post's mount **206** which mounts permanently to the bicycle **204**.

In **Fig 7A** the three axes of rotation relating to the three degrees of freedom that the connecting mechanism of the invention provides are shown. Axis of rotation **214** is provided by a pivot between the gripping locking mechanism **210** and the

perpendicular shape link **218,** axis of rotation **216** is provided by a pivot between the perpendicular shape link **218** and the main U shape link **220,** and axis of rotation **222 is** provided by a pivot between main U shape link **220** and the rack **212,** each axis can optionally restrains by a damper to apply stability to the trolley.

The gripping mechanism is described by details in **Fig. 7B,** in which the mechanism **208** is assembled from a main slide bar **224** which is a hook-shaped bar, and a slider **228** which can slides one way down on the sliding bar in the direction of the arrow **229.** The braking lever **230** is pivotally captured in the slot **232,** the force of the spring **234** create a torque **235,** that creates a great friction on the bar's **224** surface and the braking lever **230** on the contact edges **231,** which locks the slider. The greater the forces create by the handle **226** on the slider **228,** upwards in the direction of the arrow **239,** the greater torque is, as well as the friction forces between the slider **228** and the slide bar **224.**The trolley is connected by placing the trolley's handle **226** on the slide bar's hook **224** while the slider **228** is up, than the slider 228 pressed down by hand until its squeezes the trolley's handle **226.** Releasing the slider **228** is accomplished by pulling up the breaking lever **230** in the direction of the arrow **239,** this action causes the edges **231** to unattach from the sliding bar **224** which causes the friction between the sliding bar and the slider to significantly reduce, at which point the spring **236** assists in lifting up the slider, then the trolley handle **226** is no longer locked and can be lifted up from the mechanism hook **224.**The center of gravity of the gripping mechanism **210** and the three axes locations, set the mechanism **210** in a position that the hook cavity's sliding bar **224** is facing up and makes it easier to place on trolley's handle, and to push down the slider **228.**

Each axis can be restrain by oil radial dumper or a spring damper **237** as shown on the upper side of the sliding bar **224,** the perpendicular profile link**218** which is squeeze by a bolt **246** and a spring **242** between two low-friction plastic washers and the sliding bar **224**. The mechanism creates friction between the connecting mechanism **208** and the perpendicular profiled link **218.**

To stabilize the trolley which presented on **Fig. 3A-3E** and prevent it from overturning, the trolley is equipped with radial shock absorber, and in a certain position of the handle, the angle of rotation is limited. As shown on **Fig. 8**, inside the trolley's main frame cylinder **250** there is a rotational mid cylinder **252** around axis **260**, which works as a radial shock absorber and allow the trolleys handle **254** to move vertically along the mid cylinder **252**, by pulling the normally close pin **258** and moving the handle **254** along until it is in aligned with one of the holes **260** on the handle's **254** bar. When the handle **254** is in its upper position the stopper plate **262** limits the rotating angle around axis **260** of the handle **254** by making contact with the trolley's frame **264** on either side. The trolley's damper and stopper are described in details on **Fig. 8A**. The trolley's handle **254** which is inside the mid cylinder **252** which is inside the main frame cylinder **250** as well, separate on both side of the frame's cylinder **250** by two low friction plastic washers **262**, The mid cylinder **252** is tightened to the frame's cylinder **250** by the two nuts **268** onto two metal washers **264** with a spring, or Belleville washers **266** in between them.

Fig. 9 describes a push-push mechanism, which is one of the mechanism designs to be implement in the trolley's handle which described in **Fig. 3A-3D**. This quick connecting/ cuduHo w the user to push on the button **272** on

the top of the handle **274** and connecting the trolley to a towing device which is connected permanently to bicycle, and push it again, in order to disconnect it from the towing device. That why it is called push-push mechanism. The button **272** moves vertically inside the trolley's handle's **274** cylinder and it is in a normally open position by the spring **276** which pushed it up against the stopper **278** (which is a part of the handle), On the other side of the button **272**, attached a free rotating piston slider 280 which is retracts inside the handles cylinder while it is not in use. Connecting the trolley to the towing cylinder is done by pressing the button **272** down as shown in **Fig 9A** and inserting it into the towing cylinder **284**.Inside the towing cylinder **284** there are 4 guiding pins **286** which guides the slider piston **280** and rotates it. Sliding piston **280** divided into two guiding rails: Upper guide rail **288** whose function is to rotate the slider **280** to the right in each pressing of the button **272**, And lower guide rail **290** whose function is to rotate the sliding piston **280** in and out the cylinder and to lock the sliding piston in the cylinder.

The push-push functions in four steps cycle:

On the first step which is described in **Fig. 8B**, the sliding piston **280** is pushed into the cylinder **284**, the lower guide rail **290** forces the guiding pins **286** to slide along, until it comes into contact with upper guide rails **288** and rotate the slider piston **280** one notch to the right. **Fig. 8C** shows the second step, in which the button **272** is released and the pins **286** fit into a slot in upper guide rails **288,** which locks the trolley to the towing mechanism and to the bicycle. On the third when the user push the button again, as shown in **Fig 8D**, the pins **286** are rotating the slider piston **280** again one notch to right, and on the fourth step when the button **272** is released, as shown on **Fig. 9E** the

pins **286** force the lower slidin c5.fH0-q to rotate to the right and release the trolley's handle piston from the towing cylinder **284** and allowing it to disconnect from the bicycle.

Another mechanism to connect/disconnect the trolley which describes on **Fig 3A-3B** is shown on **Fig 10**. This slide connecting mechanism has again 3 axes: Axis of rotation **292** is provided by a pivot between by the trolley handle **294** and the U profile link **296**, Axis of rotation **298** is provided by a pivot between towing mechanism **296** and the rack **300** and the third axis is provided by a pivot disposed along the main frame of the trailer, as shown on **Fig. 5A. Fig 10A** shows the trolley handle **294** connected to the towing mechanism **296**. The trolley cylinder **302** has a slot **304** which slides between three plates, main plate **306**, mid plate **308** and upper plate **310**.Those plates create a path on which the slotted handle can slide in.The normally open slanted retaining tooth **312** which pressed up by the spring **314** is pressed down by the handle's cylinder **302** while it slides in until it is aligned with the handle's cylinder's hole **313**, than the retaining tooth **312** release into the cylinder's hole 313 and prevent the handle's cylinder **302** to slide out. the trolley's handle button **314** is normally pressed up by the spring 316, in ordered to release the trolley, as describes on **Fig. 10B** the button **314** is pressed down in the direction of the arrow **318**, which presses the retaining tooth **312** down until the top of the retaining tooth **312** is aligned with the surface of the main plate **306**, than the handle's cylinder is free to slide out forward as shown on **Fig.10C** in the direction of the arrow **320**.

CLAIMS

1. A three axis bicycle to trailer connecting means comprising:
   - a flexible connecting mechanism
   - a retaining mechanism

   Wherein said connecting mechanism includes three axes of rotation each implemented by a different pivot, each associated with a rotational motion;

2. A three axis bicycle to trailer connecting means as in claim 1, wherein at least one pivot is implemented in said trailer;

3. A three axis bicycle to trailer connecting means as in claim 1, where in at list one pivot is restrain by a radial dumper;

4. A -trailer connecting means as in claim 1, wherein said retaining mechanism is quick connecting;

5. A connecting system which is used for attaching standard shopping trolley's handle to a bicycle frame in order to tow the trolley while riding the bicycle comprising: a bar or a rack; first link; second link; a towing hook ; gripping means;

Where in the bar or the said rack is rigidly connected to the bicycle frame by any mean and on the other side it is connected any way of pivotally connection to the said first link;

Where in the said first link is connected in any pivotally connection to the said second link:

Where in the said second link is connected in any pivotally connection to the said towing hook;

Where in the said towing hook is allow to place the said shopping trolley's handle in the towing hook's cavity from the top side;

Where in the said gripping means is connected to the said towing hook which locks the shopping trolley's handle after it was placed in the said towing hook;

Where by the said three axes applying changing of the angles between the bicycle and the shopping trolley in three degrees of freedom;

6. a trolley which is design to connect to the bicycle's frame in order to tow it while riding the bicycle which contain mean to connect and disconnect from the bicycle comprising;

a trolley which built from main frame which two or more wheel attach to its bottom and the top of the trolley's frame is connecting pivotally central bar; a handle; a link with cylindrical hole; a bar or a rack;

Where in the said rod or a rack is rigidly connected rigidly on it one side to the said bicycle frame;

Where in the other side of the said rod or rack is pivotally connected to the said link with a cylindrical hole;

Where in the said central rod connected in it low side to the said trolley's frame;

Where in upper side of the rod connected to the said handle;

Where in the said handle connected by any pivotally to the said cylindrical holed link as well as the lower side of the said handle inserted in the said cylinder hole link;

Where in allow to connect and disconnect the said trolley from and to the bicycle by inserting or sliding the lower part of the said handle from the said cylinder hole;

Where in the lower part of the said handle includes a locking mechanism which allows quick connecting and disconnecting of the said trolley to the bicycle.

7. The said trolley on claim 6 wherein the locking means assembled in the lower part of the said handle which includes a retaining tooth which is controlled by available button;

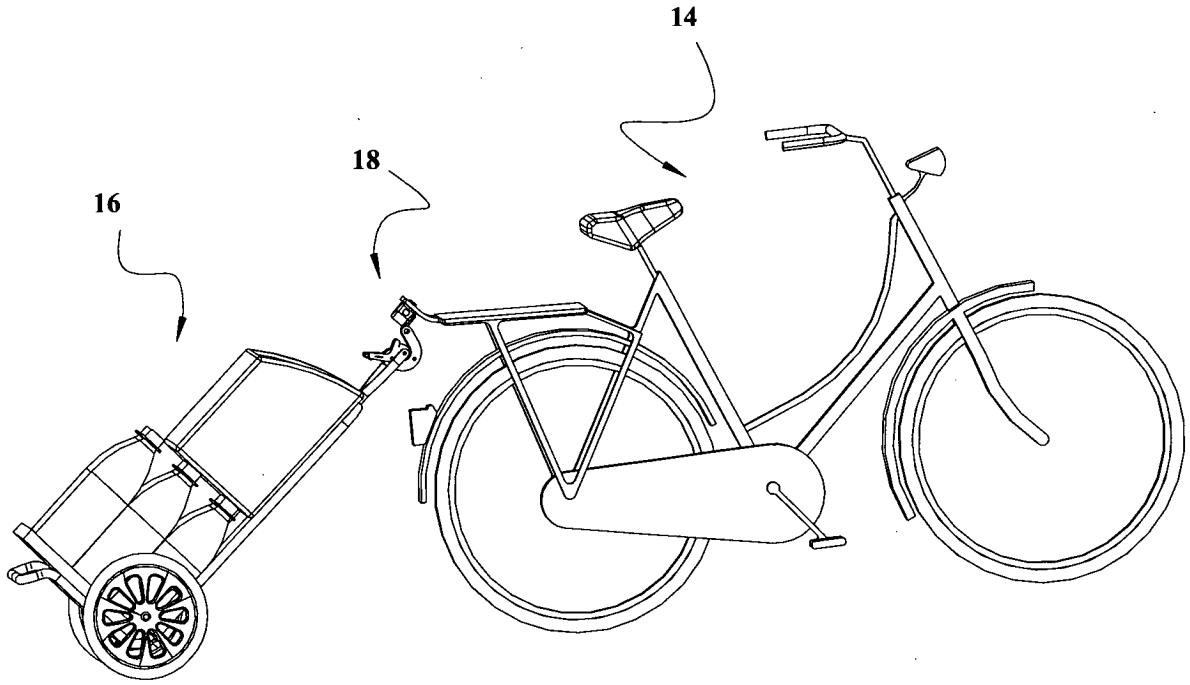


Fig. 1

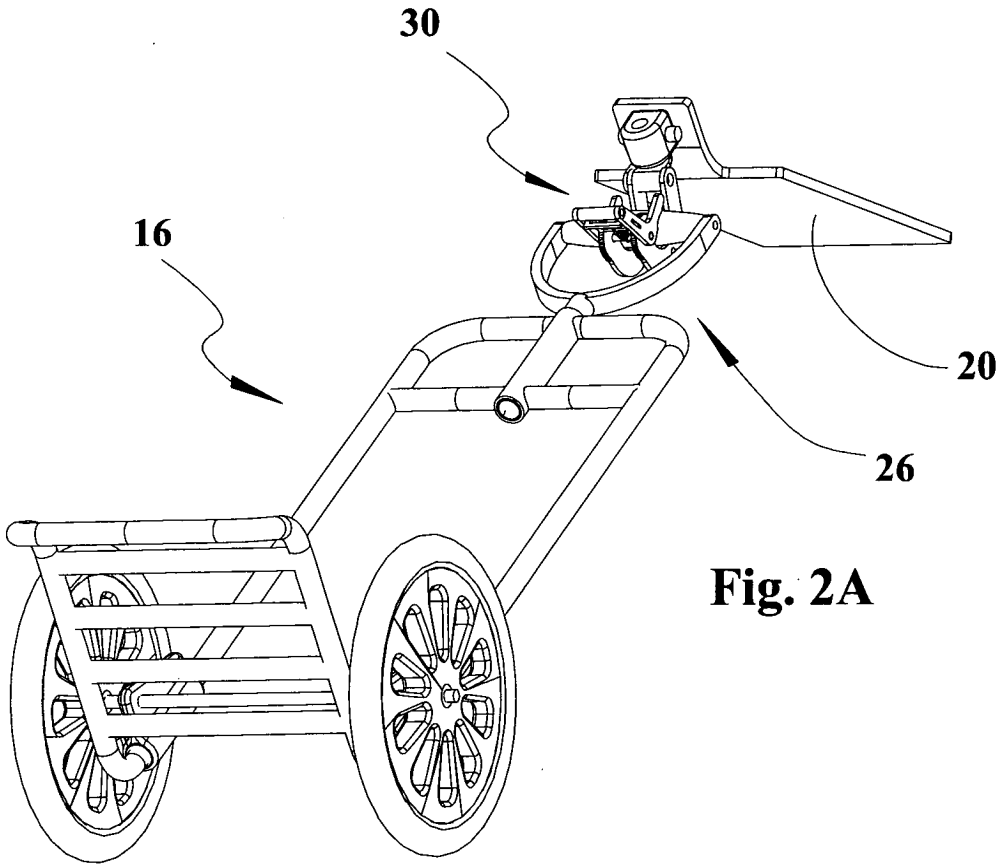


Fig. 2A

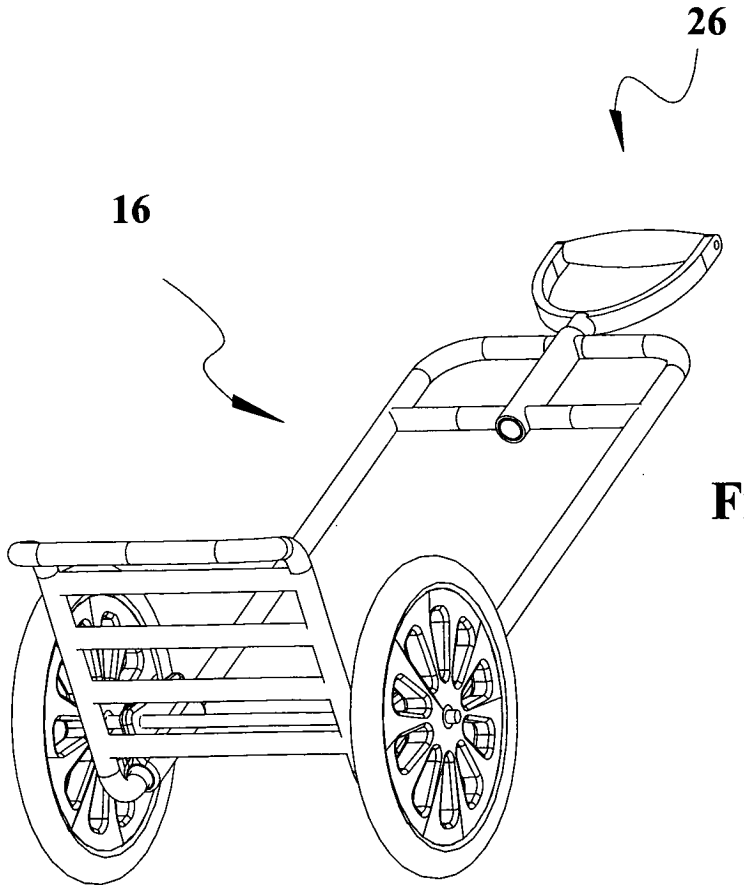


Fig. 2B

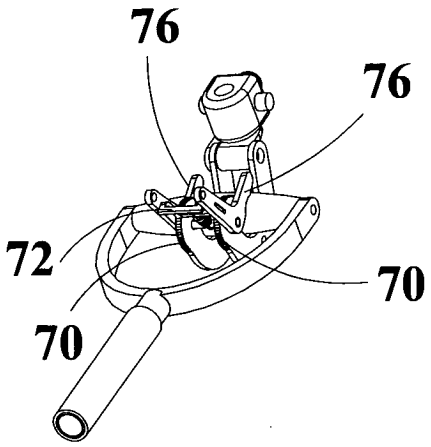


Fig. 2E

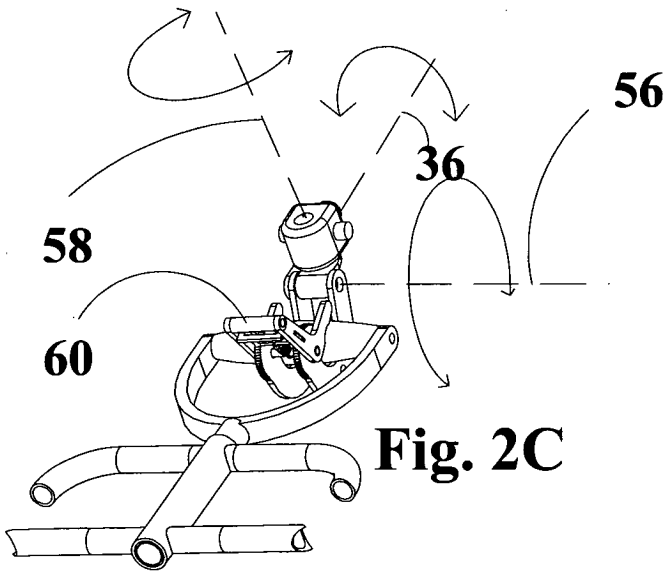


Fig. 2C

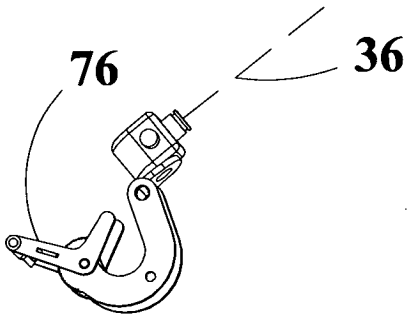


Fig. 2F

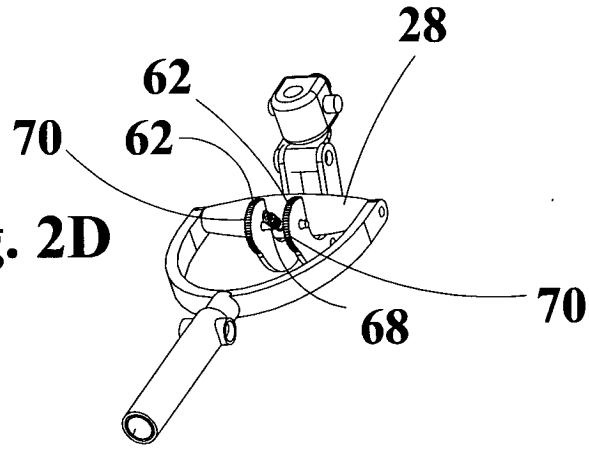
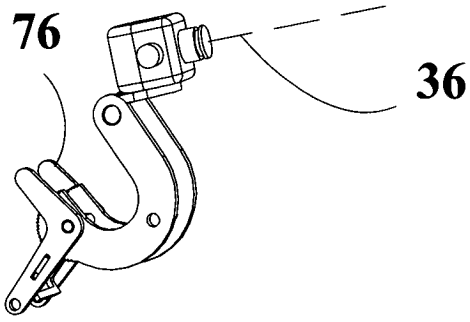


Fig. 2D

Fig. 2G



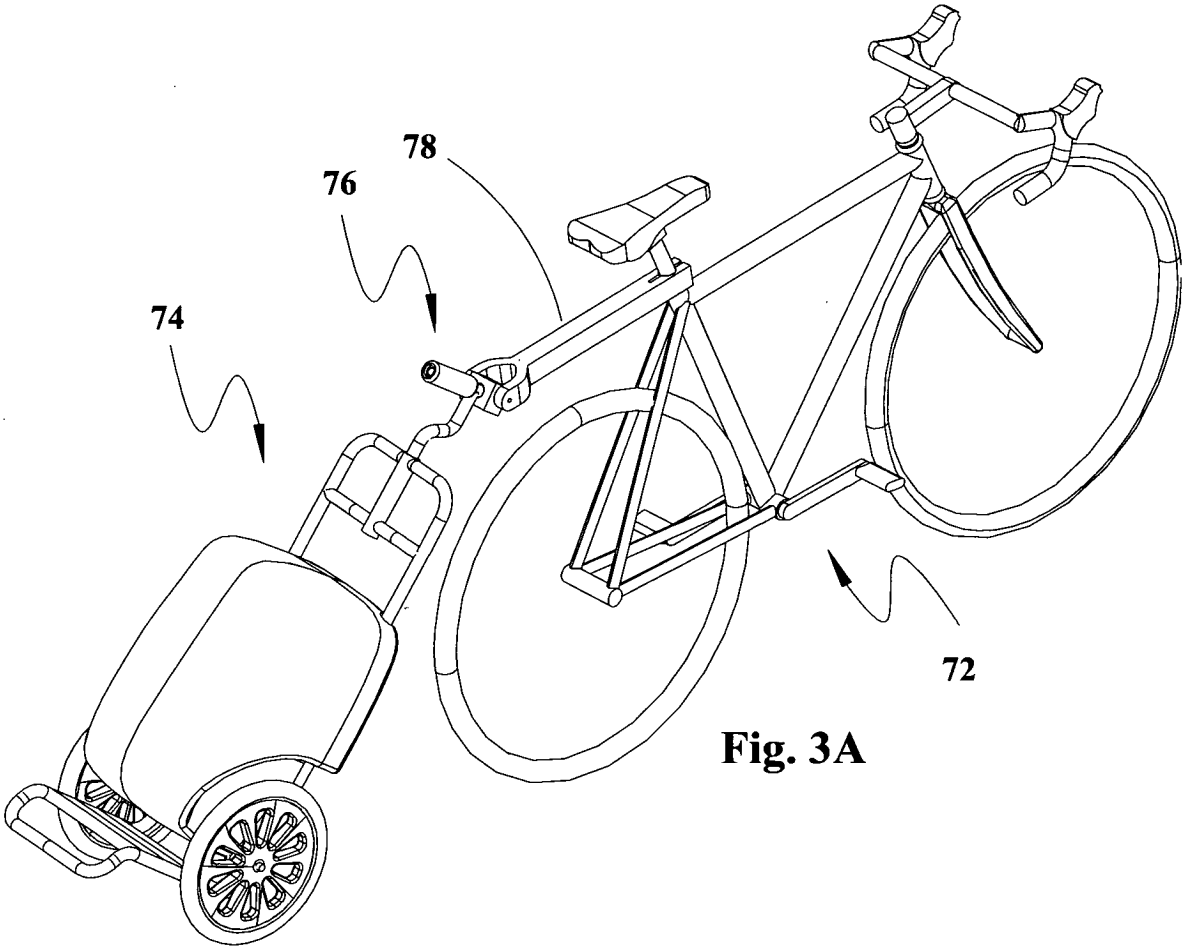


Fig. 3A

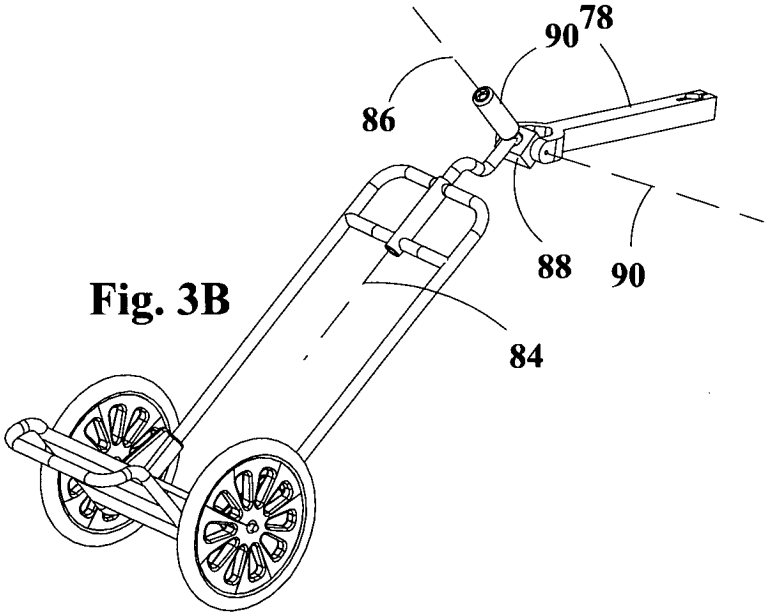


Fig. 3B

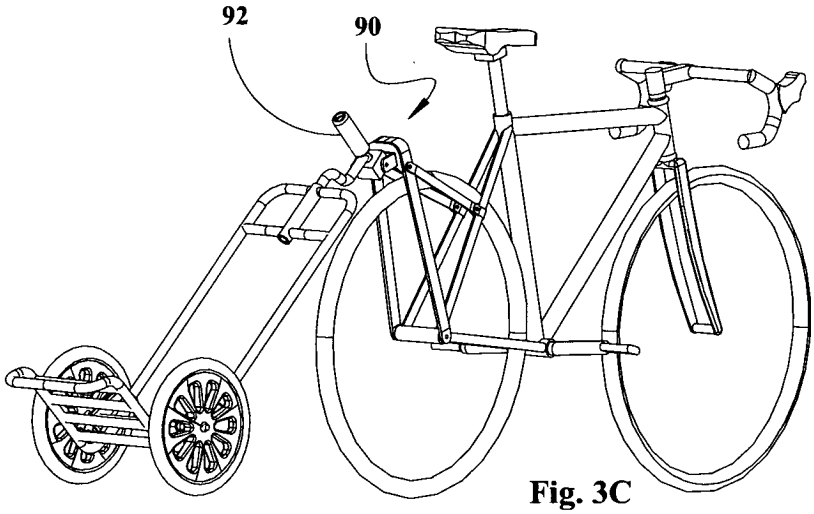


Fig. 3C

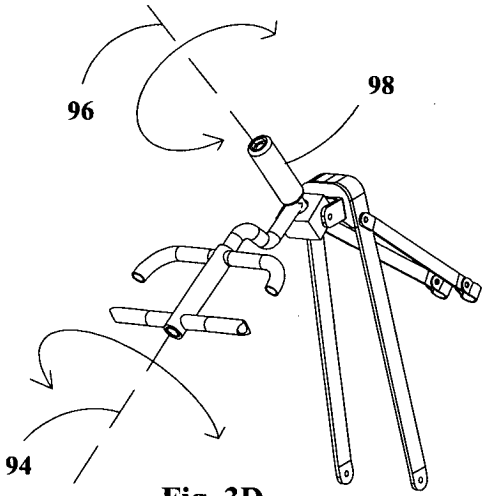


Fig. 3D

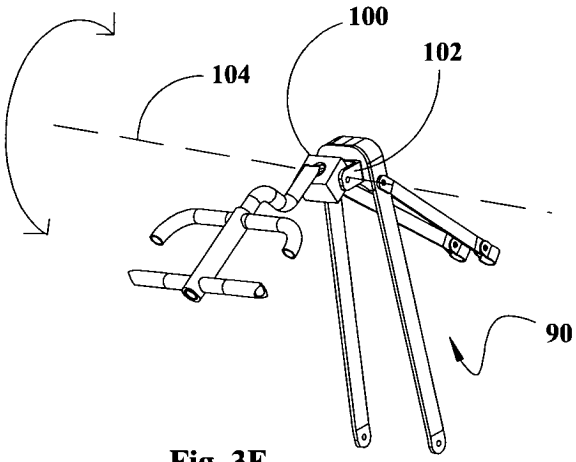


Fig. 3E

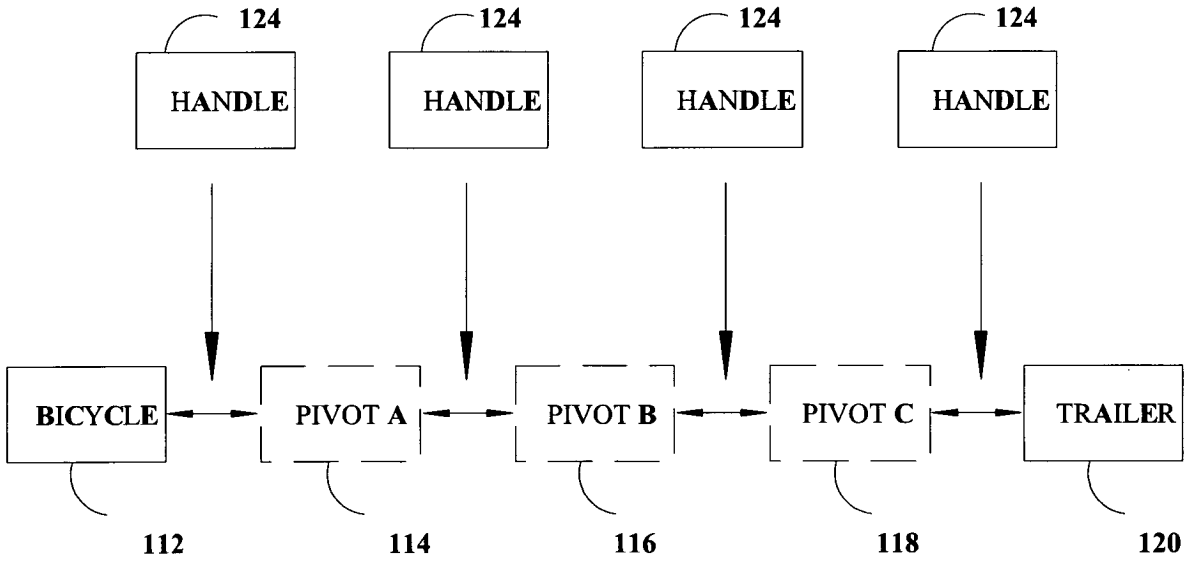

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Fig. 4

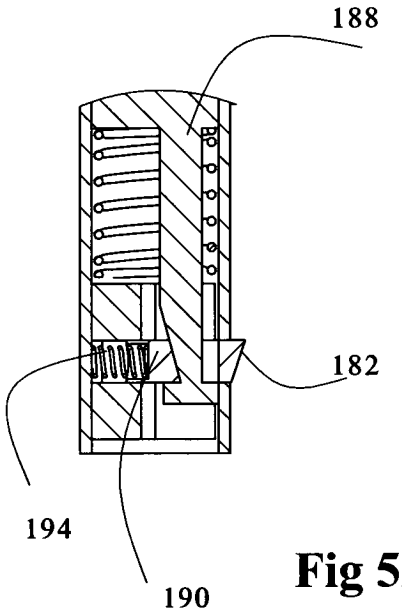


Fig 5B

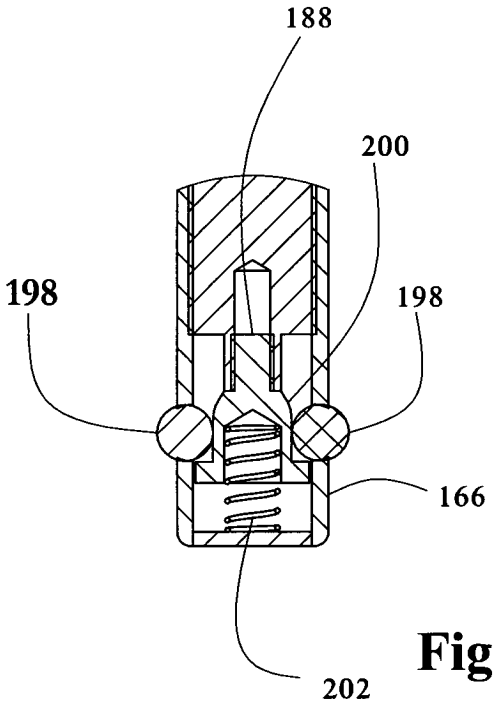


Fig 6

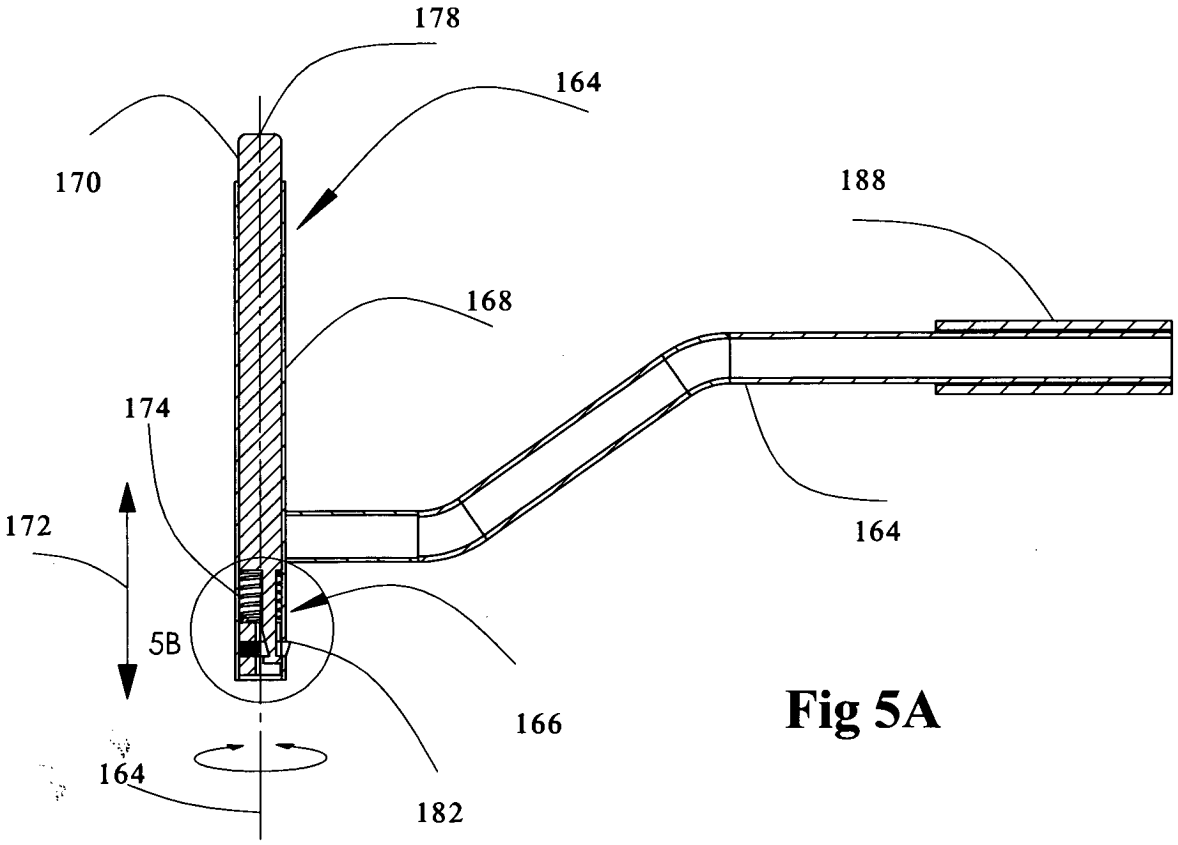


Fig 5A

Fig 7

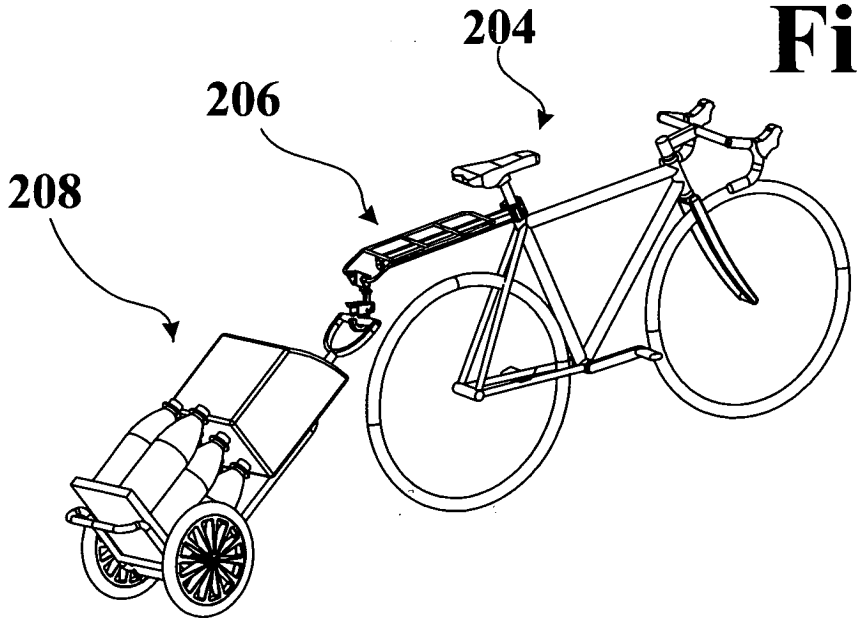


Fig 7A

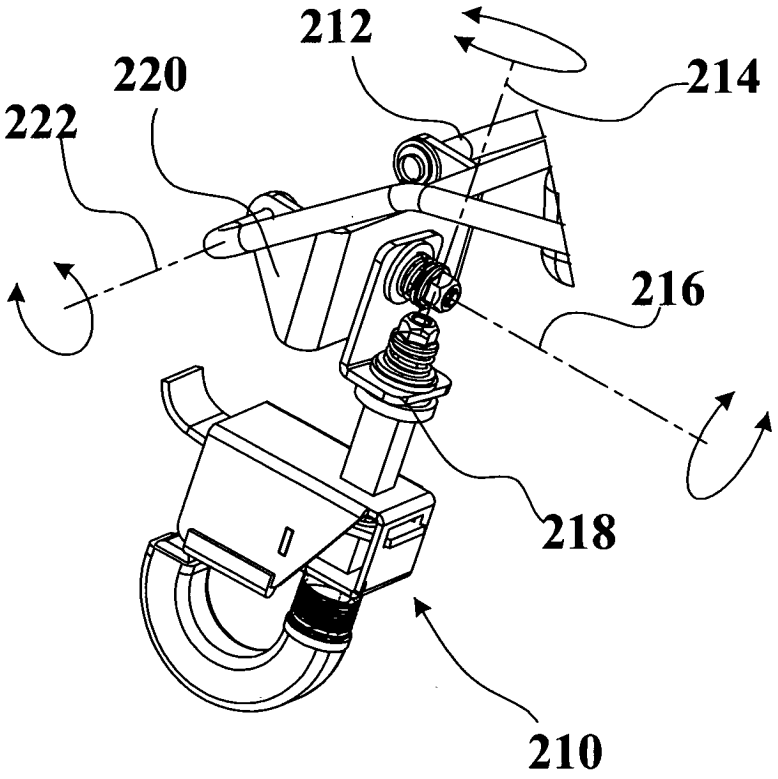


Fig 7B

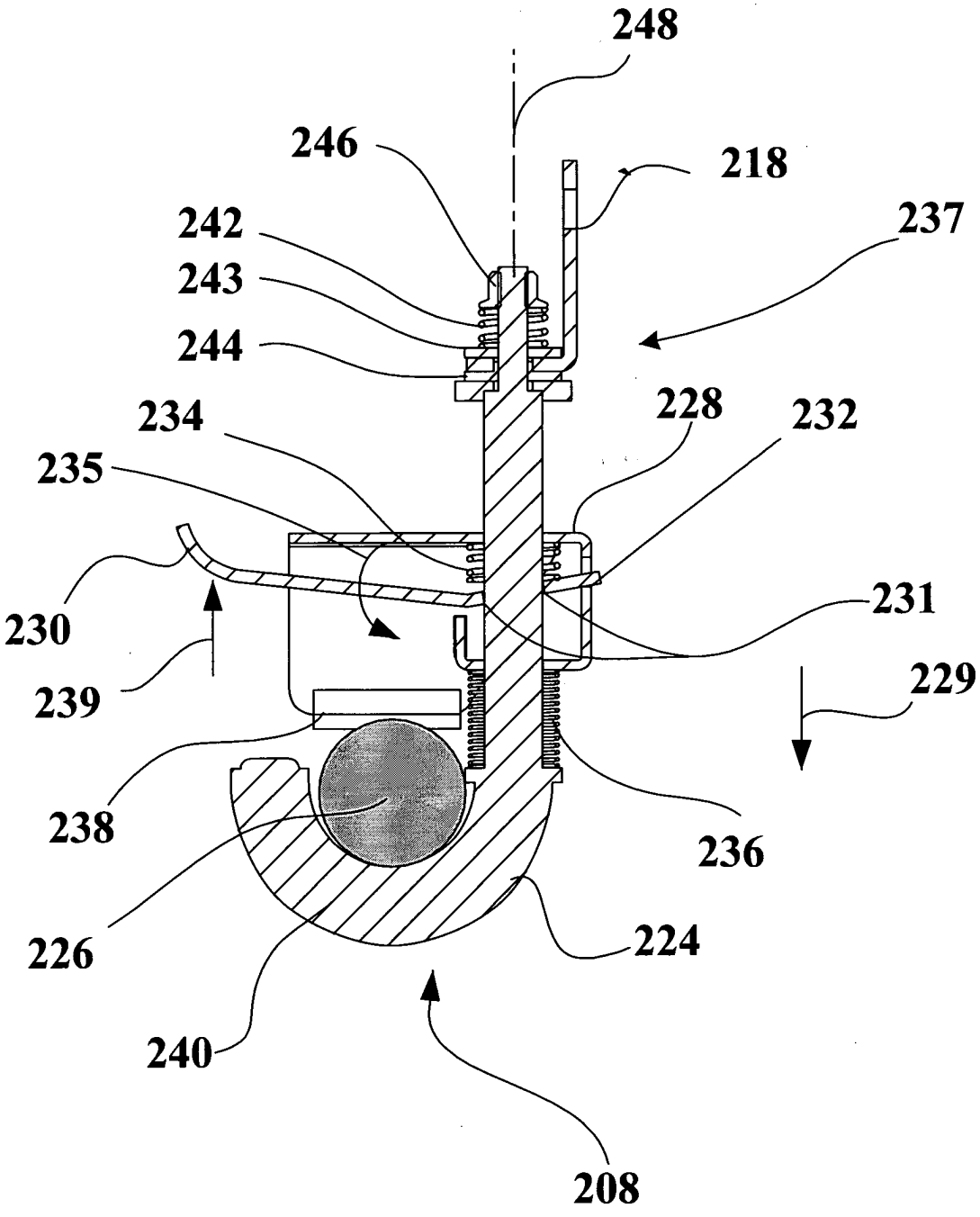

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Fig 8

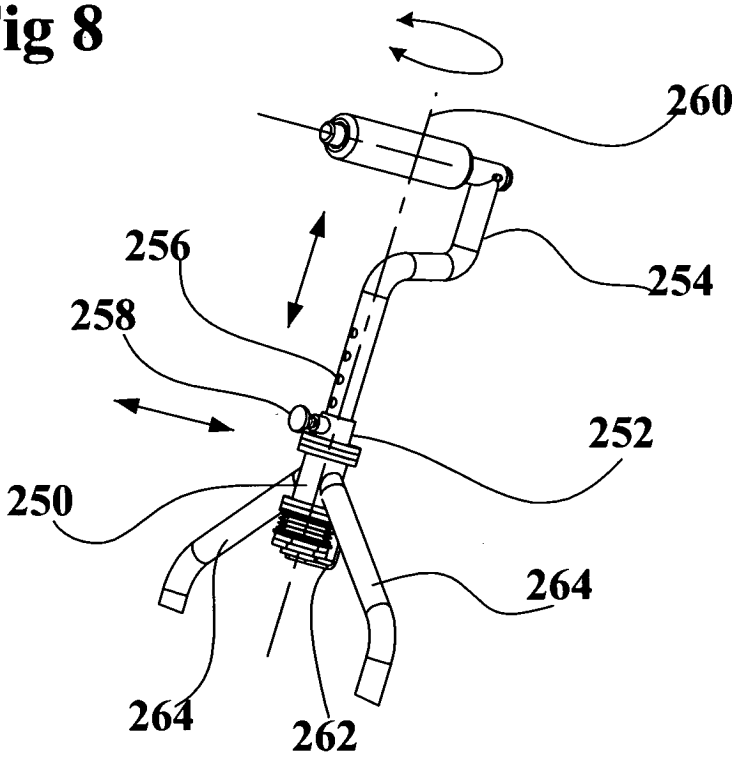

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Fig 8A

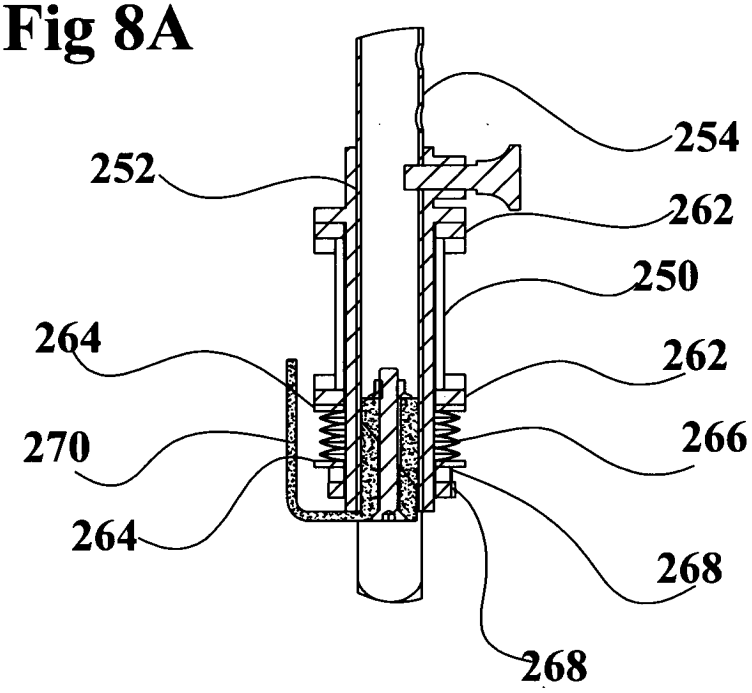

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Fig 9

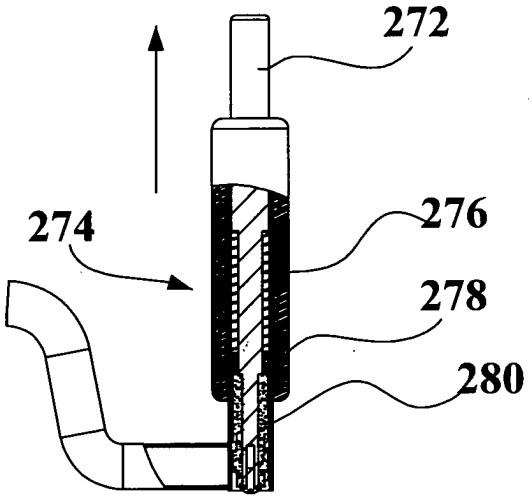


Fig 9A

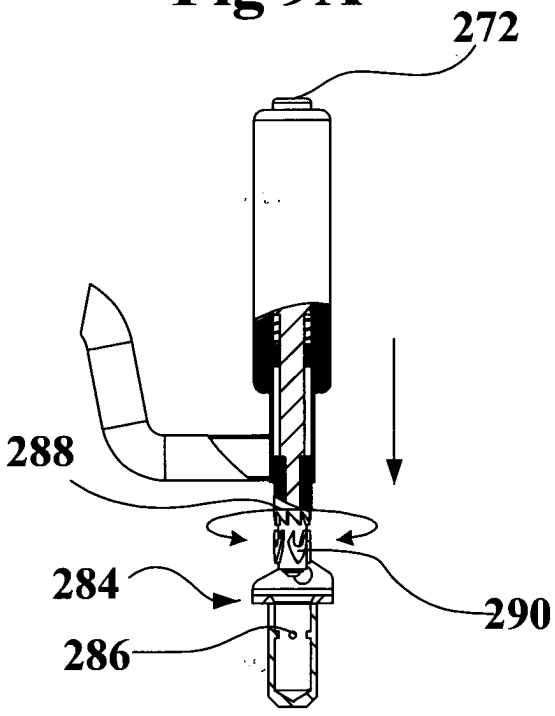


Fig 9C

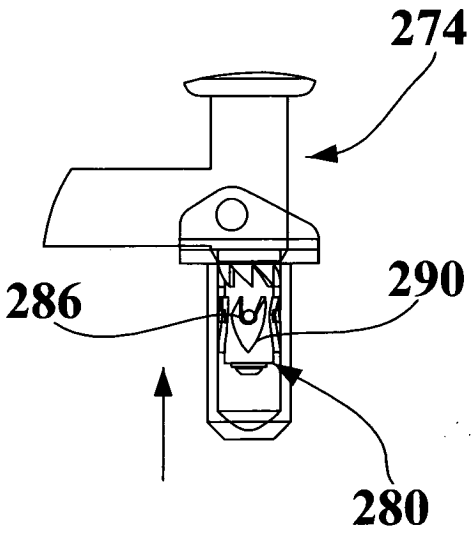


Fig 9B

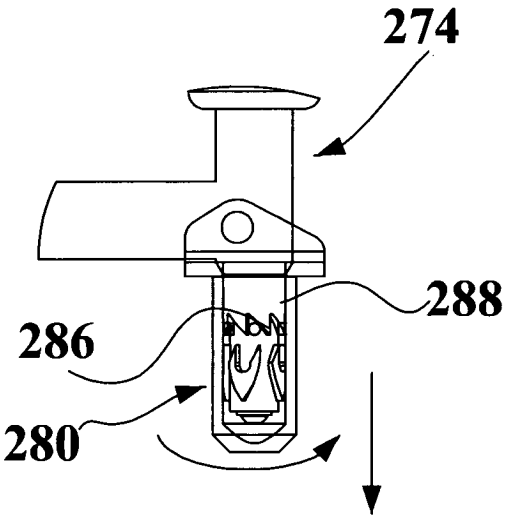


Fig 9E

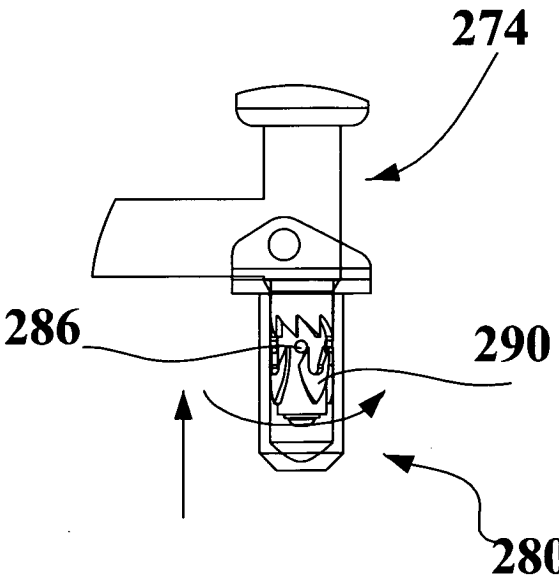


Fig 9D

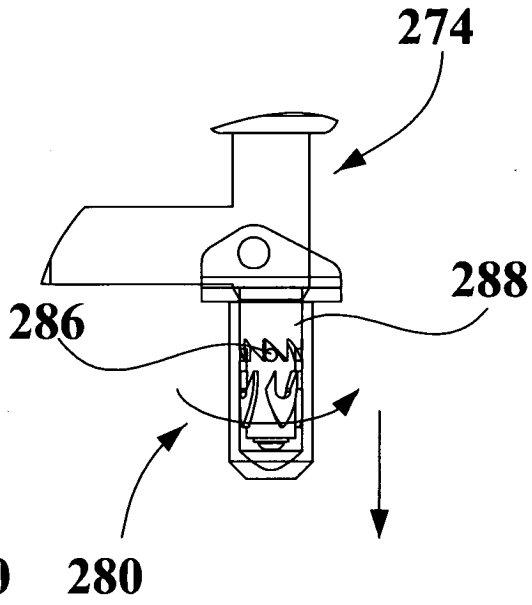


Fig 10A

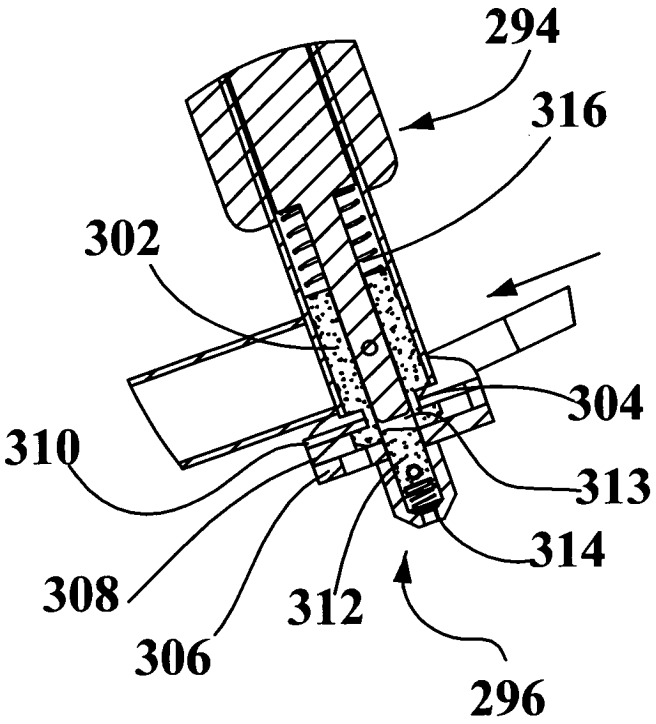


Fig 10

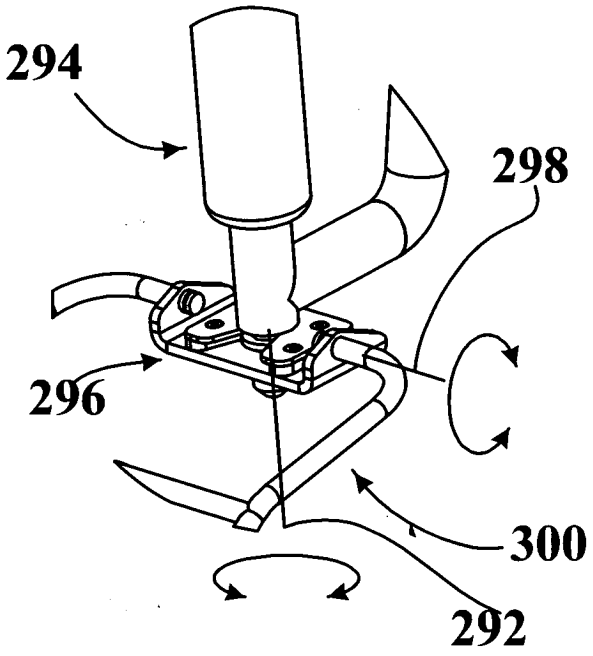


Fig 10B

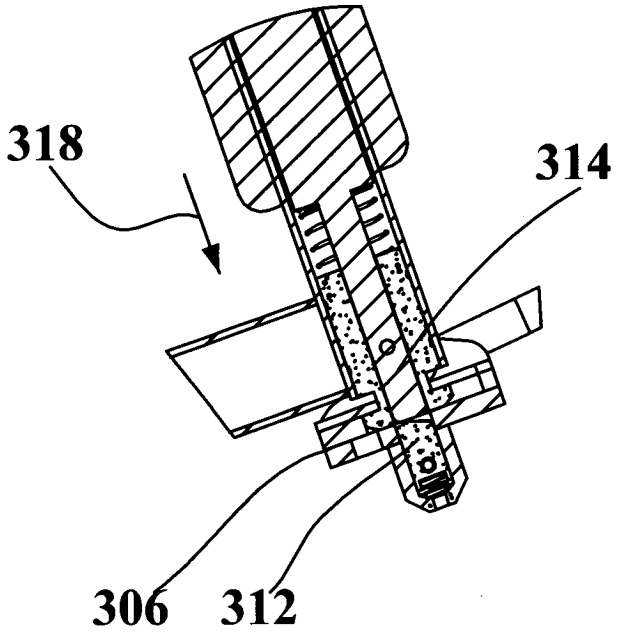


Fig 10C

