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(54) Title: IMAGE CAPTURING APPARATUS, SYSTEM, AND METHOD

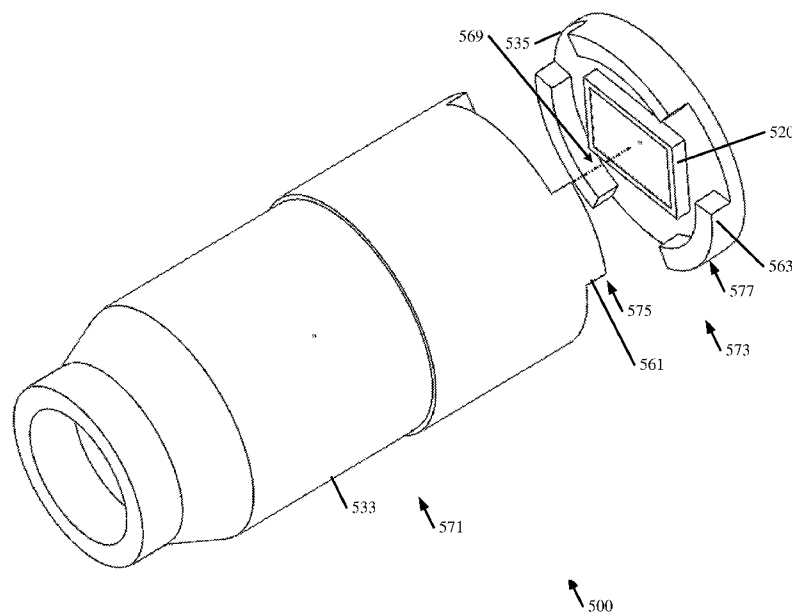


Fig. 5A

(57) Abstract: For example, a device may include a lens assembly and an image sensor assembly. For example, the lens assembly may include a lens barrel; an optical device secured to the lens barrel; and a first engaging section extending from the lens barrel. For example, the image sensor assembly may include an image sensor holder configured to support an image sensor to capture one or more images via the optical device; and a second engaging section extending from the image sensor holder. For example, the first engaging section and the second engaging section may be configured to engage the lens assembly with the image sensor assembly at an engaged state. For example, at the engaged state the second engaging section may be in contact with the first engaging section at a plurality of contact areas, and may be securable to the first engaging section.

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IMAGE CAPTURING APPARATUS, SYSTEM, AND METHOD

CROSS REFERENCE

[0001] This application claims the benefit of, and priority from, US Provisional Patent Application No. 63/486,417 entitled “APPARATUS, SYSTEM, AND METHOD OF ALIGNMENT BETWEEN LENS AND IMAGE SENSOR”, filed February 22, 2023, and US Provisional Patent Application No. 63/596,281 entitled “APPARATUS, SYSTEM, AND METHOD OF ALIGNMENT BETWEEN LENS AND IMAGE SENSOR”, filed November 5, 2023, the entire disclosures of which are incorporated herein by reference.

BACKGROUND

[0002] An image capturing device, e.g., a camera, may include an image sensor to capture one or more images, photos, videos, and/or the like.

[0003] Many image capturing devices may utilize a combination of a lens attached to an image sensor.

[0004] In many implementations, it may be important to align between the lens and the image sensor with a high degree of accuracy, for example, to achieve a high level of image resolution and/or precision.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] For simplicity and clarity of illustration, elements shown in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity of presentation. Furthermore, reference numerals may be repeated among the figures to indicate corresponding or analogous elements. The figures are listed below.

[0006] Fig. 1 is a schematic block diagram illustration of a vehicle implementing an image-capturing device, in accordance with some demonstrative aspects.

[0007] Fig. 2 is a schematic block diagram illustration of a robot implementing an image-capturing device, in accordance with some demonstrative aspects.

[0008] Fig. 3 is a schematic block-diagram illustration of an image capturing device, in accordance with some demonstrative aspects.

[0009] Fig. 4 is a schematic flow-chart illustration of a method of camera structure assembly alignment, in accordance with some demonstrative aspects.

[00010] Figs. 5A, 5B, 5C, 5D, 5E, 5F, and 5G are schematic illustrations of a camera structure assembly, in accordance with some demonstrative aspects.

[00011] Figs. 6A, 6B, 6C, 6D, 6E, 6F, and 6G are schematic illustrations of a camera structure assembly, in accordance with some demonstrative aspects.

[00012] Figs. 7A, 7B, 7C, 7D, and 7E are schematic illustrations of a camera structure assembly, in accordance with some demonstrative aspects.

[00013] Figs. 8A, 8B, 8C, 8D, and 8E are schematic illustrations of a camera structure assembly, in accordance with some demonstrative aspects.

[00014] Figs. 9A, 9B, 9C, 9D, and 9E are schematic illustrations of a camera structure assembly, in accordance with some demonstrative aspects.

[00015] Figs. 10A, 10B, 10C, 10D, 10E, 10F, and 10G are schematic illustrations of a camera structure assembly, in accordance with some demonstrative aspects.

[00016] Figs. 11A, 11B, 11C, 11D, 11E, 11F, and 11G are schematic illustrations of a camera structure assembly, in accordance with some demonstrative aspects.

DETAILED DESCRIPTION

[00017] In the following detailed description, numerous specific details are set forth in order to provide a thorough understanding of some aspects. However, it will be understood by persons of ordinary skill in the art that some aspects may be practiced without these specific details. In other instances, well-known methods, procedures, components, units and/or circuits have not been described in detail so as not to obscure the discussion.

[00018] The terms “plurality” and “a plurality”, as used herein, include, for example, “multiple” or “two or more”. For example, “a plurality of items” includes two or more items.

[00019] The words “exemplary” and “demonstrative” are used herein to mean “serving as an example, instance, demonstration, or illustration”. Any aspect, or design described herein as “exemplary” or “demonstrative” is not necessarily to be construed as preferred or advantageous over other aspects, or designs.

[00020] References to “one aspect”, “an aspect”, “demonstrative aspect”, “various aspects” etc., indicate that the aspect(s) so described may include a particular feature, structure, or characteristic, but not every aspect necessarily includes the particular feature, structure, or characteristic. Further, repeated use of the phrase “in one aspect” does not necessarily refer to the same aspect, although it may.

[00021] As used herein, unless otherwise specified the use of the ordinal adjectives “first”, “second”, “third” etc., to describe a common object, merely indicate that different instances of like objects are being referred to, and are not intended to imply that the objects so described must be in a given sequence, either temporally, spatially, in ranking, or in any other manner.

[00022] The phrases “at least one” and “one or more” may be understood to include a numerical quantity greater than or equal to one, e.g., one, two, three, four, [...], etc. The phrase “at least one of” with regard to a group of elements may be used herein to mean at least one element from the group consisting of the elements. For example, the phrase “at least one of” with regard to a group of elements may be used herein to mean one of the listed elements, a plurality of one of the listed elements, a plurality of individual listed elements, or a plurality of a multiple of individual listed elements.

[00023] The term “data” as used herein may be understood to include information in any suitable analog or digital form, e.g., provided as a file, a portion of a file, a set of files, a signal or stream, a portion of a signal or stream, a set of signals or streams, and the like. Further, the

term “data” may also be used to mean a reference to information, e.g., in form of a pointer. The term “data”, however, is not limited to the aforementioned examples and may take various forms and/or may represent any information as understood in the art.

[00024] The terms “processor” or “controller” may be understood to include any kind of technological entity that allows handling of any suitable type of data and/or information. The data and/or information may be handled according to one or more specific functions executed by the processor or controller. Further, a processor or a controller may be understood as any kind of circuit, e.g., any kind of analog or digital circuit. A processor or a controller may thus be or include an analog circuit, digital circuit, mixed-signal circuit, logic circuit, processor, microprocessor, Central Processing Unit (CPU), Graphics Processing Unit (GPU), Digital Signal Processor (DSP), Field Programmable Gate Array (FPGA), integrated circuit, Application Specific Integrated Circuit (ASIC), and the like, or any combination thereof. Any other kind of implementation of the respective functions, which will be described below in further detail, may also be understood as a processor, controller, or logic circuit. It is understood that any two (or more) processors, controllers, or logic circuits detailed herein may be realized as a single entity with equivalent functionality or the like, and conversely that any single processor, controller, or logic circuit detailed herein may be realized as two (or more) separate entities with equivalent functionality or the like.

[00025] The term “memory” is understood as a computer-readable medium (e.g., a non-transitory computer-readable medium) in which data or information can be stored for retrieval. References to “memory” may thus be understood as referring to volatile or non-volatile memory, including random access memory (RAM), read-only memory (ROM), flash memory, solid-state storage, magnetic tape, hard disk drive, optical drive, among others, or any combination thereof. Registers, shift registers, processor registers, data buffers, among others, are also embraced herein by the term memory. The term “software” may be used to refer to any type of executable instruction and/or logic, including firmware.

[00026] A “vehicle” may be understood to include any type of driven object. By way of example, a vehicle may be a driven object with a combustion engine, an electric engine, a reaction engine, an electrically driven object, a hybrid driven object, or a combination thereof. A vehicle may be, or may include, an automobile, a bus, a mini bus, a van, a truck, a mobile home, a vehicle trailer, a motorcycle, a bicycle, a tricycle, a train locomotive, a train wagon, a

moving robot, a personal transporter, a boat, a ship, a submersible, a submarine, a drone, an aircraft, a rocket, among others.

[00027] A “ground vehicle” may be understood to include any type of vehicle, which is configured to traverse the ground, e.g., on a street, on a road, on a track, on one or more rails, off-road, or the like.

[00028] An “autonomous vehicle” may describe a vehicle capable of implementing at least one navigational change without driver input. A navigational change may describe or include a change in one or more of steering, braking, acceleration/deceleration, or any other operation relating to movement, of the vehicle. A vehicle may be described as autonomous even in case the vehicle is not fully autonomous, for example, fully operational with driver or without driver input. Autonomous vehicles may include those vehicles that can operate under driver control during certain time periods, and without driver control during other time periods. Additionally or alternatively, autonomous vehicles may include vehicles that control only some aspects of vehicle navigation, such as steering, e.g., to maintain a vehicle course between vehicle lane constraints, or some steering operations under certain circumstances, e.g., not under all circumstances, but may leave other aspects of vehicle navigation to the driver, e.g., braking or braking under certain circumstances. Additionally or alternatively, autonomous vehicles may include vehicles that share the control of one or more aspects of vehicle navigation under certain circumstances, e.g., hands-on, such as responsive to a driver input; and/or vehicles that control one or more aspects of vehicle navigation under certain circumstances, e.g., hands-off, such as independent of driver input. Additionally or alternatively, autonomous vehicles may include vehicles that control one or more aspects of vehicle navigation under certain circumstances, such as under certain environmental conditions, e.g., spatial areas, roadway conditions, or the like. In some aspects, autonomous vehicles may handle some or all aspects of braking, speed control, velocity control, steering, and/or any other additional operations, of the vehicle. An autonomous vehicle may include those vehicles that can operate without a driver. The level of autonomy of a vehicle may be described or determined by the Society of Automotive Engineers (SAE) level of the vehicle, e.g., as defined by the SAE, for example in *SAE J3016 2018: Taxonomy and definitions for terms related to driving automation systems for on road motor vehicles*, or by other relevant professional organizations. The SAE level may have a value ranging from a minimum level, e.g., level 0 (illustratively, substantially no driving automation), to a maximum level, e.g., level 5 (illustratively, full driving automation).

[00029] An “assisted vehicle” may describe a vehicle capable of informing a driver or occupant of the vehicle of sensed data or information derived therefrom.

[00030] The phrase “vehicle operation data” may be understood to describe any type of feature related to the operation of a vehicle. By way of example, “vehicle operation data” may describe the status of the vehicle, such as, the type of tires of the vehicle, the type of vehicle, and/or the age of the manufacturing of the vehicle. More generally, “vehicle operation data” may describe or include static features or static vehicle operation data (illustratively, features or data not changing over time). As another example, additionally or alternatively, “vehicle operation data” may describe or include features changing during the operation of the vehicle, for example, environmental conditions, such as weather conditions or road conditions during the operation of the vehicle, fuel levels, fluid levels, operational parameters of the driving source of the vehicle, or the like. More generally, “vehicle operation data” may describe or include varying features or varying vehicle operation data (illustratively, time varying features or data).

[00031] Some aspects may be used in conjunction with various devices and systems, for example, an imaging device, a digital camera device, a video device, a camera module, a vehicular imaging device, a medical imaging device, an electronic device, a computing device, an integrated computing device, an integrated chip, electronic circuitry, a processing device, an electronic device, a mobile computer, a laptop computer, a notebook computer, a tablet computer, a handheld computer, a handheld device, a mobile or portable device, a consumer device, a Smartphone and the like.

[00032] Some aspects may be used in conjunction with image processing systems, vehicular image-processing systems, image capturing systems, vehicular image capturing systems, image-based sensors, vehicular image-based sensors, autonomous systems, robotic systems, detection systems, or the like.

[00033] Reference is now made to Fig. 1, which schematically illustrates a block diagram of a vehicle 100 implementing an image-based sensor device, in accordance with some demonstrative aspects.

[00034] In some demonstrative aspects, vehicle 100 may include a car, a truck, a motorcycle, a bus, a train, an airborne vehicle, a waterborne vehicle, a cart, a golf cart, an electric cart, a road agent, or any other vehicle.

[00035] In some demonstrative aspects, vehicle 100 may include an image-based sensor device 101, e.g., as described below. For example, an image-based sensor device 101 may include an image-based detecting device, an image-based sensing device, or the like, e.g., as described below.

[00036] In some demonstrative aspects, image-based sensor device 101 may be implemented as part of a vehicular system, for example, a system to be implemented and/or mounted in vehicle 100.

[00037] In one example, image-based sensor device 101 may be implemented as part of an autonomous vehicle system, an automated driving system, an assisted vehicle system, a driver assistance and/or support system, and/or the like.

[00038] For example, image-based sensor device 101 may be installed in vehicle 100 for detection of nearby objects, e.g., for autonomous driving.

[00039] In some demonstrative aspects, image-based sensor device 101 may be configured to detect targets in a vicinity of vehicle 100, e.g., in a far vicinity and/or a near vicinity, for example, using images, e.g., as described below.

[00040] In one example, image-based sensor device 101 may be mounted onto, placed, e.g., directly, onto, or attached to, vehicle 100.

[00041] In some demonstrative aspects, vehicle 100 may include a plurality of image-based sensor devices 101. In other aspects, vehicle 100 may include a single image-based sensor device 101.

[00042] In some demonstrative aspects, vehicle 100 may include a plurality of image-based sensor devices 101, which may be configured to cover a field of view of 360 degrees around vehicle 100.

[00043] In other aspects, vehicle 100 may include any other suitable count, arrangement, and/or configuration of image-based sensor devices and/or units, which may be suitable to cover any other field of view, e.g., a field of view of less than 360 degrees.

[00044] In some demonstrative aspects, image-based sensor device 101 may be implemented as a component in a suite of sensors used for driver assistance and/or autonomous vehicles.

[00045] In some demonstrative aspects, image-based sensor device 101 may be configured to support autonomous vehicle usage, e.g., as described below.

[00046] In one example, image-based sensor device 101 may determine a class, a location, a distance, a range, an orientation, a velocity, an intention, a perceptual understanding of the environment, and/or any other information corresponding to an object in the environment.

[00047] In another example, image-based sensor device 101 may be configured to determine one or more parameters and/or information for one or more operations and/or tasks, e.g., path planning, and/or any other tasks.

[00048] In some demonstrative aspects, image-based sensor device 101 may be configured to map a scene by measuring targets' reflectivity and discriminating them, for example, mainly in range, velocity, azimuth and/or elevation, e.g., as described below.

[00049] In some demonstrative aspects, image-based sensor device 101 may be configured to detect, and/or sense, one or more objects, which are located in a vicinity, e.g., a far vicinity and/or a near vicinity, of the vehicle 100, and to provide one or more parameters, attributes, and/or information with respect to the objects.

[00050] In some demonstrative aspects, the objects may include other vehicles; pedestrians; traffic signs; traffic lights; roads, road elements, e.g., a pavement-road meeting, an edge line; a hazard, e.g., a tire, a box, a crack in the road surface; and/or the like.

[00051] In some demonstrative aspects, the one or more parameters, attributes and/or information with respect to the object may include a range of the objects from the vehicle 100, an angle of the object with respect to the vehicle 100, a location of the object with respect to the vehicle 100, a relative speed of the object with respect to vehicle 100, and/or the like.

[00052] In some demonstrative aspects, image-based sensor device 101 may include an image-capturing device 103 configured to capture one or more images, e.g., as described below.

[00053] In some demonstrative aspects, image-based sensor device 101 may include a processor 104, which may be configured to generate image-based sensor information based on the captured images, e.g., as described below.

[00054] In some demonstrative aspects, processor 104 may be configured to process the image-based sensor information of image-based sensor device 101 and/or to control one or more operations of image-based sensor device 101, e.g., as described below.

[00055] In some demonstrative aspects, processor 104 may include, or may be implemented, partially or entirely, by circuitry and/or logic, e.g., one or more processors including circuitry and/or logic, memory circuitry and/or logic. Additionally or alternatively, one or more functionalities of processor 104 may be implemented by logic, which may be executed by a machine and/or one or more processors, e.g., as described below.

[00056] In one example, processor 104 may include at least one memory, e.g., coupled to the one or more processors, which may be configured, for example, to store, e.g., at least temporarily, at least some of the information processed by the one or more processors and/or circuitry, and/or which may be configured to store logic to be utilized by the processors and/or circuitry.

[00057] In other aspects, processor 104 may be implemented by one or more additional or alternative elements of vehicle 100.

[00058] In some demonstrative aspects, as shown in Fig. 1, the image capturing device 103 may be controlled, e.g., by processor 104, to capture one or more images of an object 106.

[00059] In some demonstrative aspects, processor 104 may process the one or more images to generate sensor information, for example, by calculating information about position, radial velocity, and/or direction of the object 106, e.g., with respect to vehicle 100.

[00060] In some demonstrative aspects, processor 104 may be configured to provide the sensor information to a vehicle controller 108 of the vehicle 100, e.g., for autonomous driving of the vehicle 100.

[00061] In some demonstrative aspects, at least part of the functionality of processor 104 may be implemented as part of vehicle controller 108. In other aspects, the functionality of processor 104 may be implemented as part of any other element of image-based sensor device 101 and/or vehicle 100. In other aspects, processor 104 may be implemented, as a separate part of, or as part of any other element of image-based sensor device 101 and/or vehicle 100.

[00062] In some demonstrative aspects, vehicle controller 108 may be configured to control one or more functionalities, modes of operation, components, devices, systems and/or elements of vehicle 100.

[00063] In some demonstrative aspects, vehicle controller 108 may be configured to control one or more vehicular systems of vehicle 100, e.g., as described below.

[00064] In some demonstrative aspects, the vehicular systems may include, for example, a user interface, a steering system, a braking system, a driving system, and/or any other system of the vehicle 100.

[00065] In some demonstrative aspects, vehicle controller 108 may be configured to control image-based sensor device 101, and/or to process one or more parameters, attributes and/or information from image-based sensor device 101.

[00066] In some demonstrative aspects, vehicle controller 108 may be configured, for example, to control the vehicular systems of the vehicle 100, for example, based on the image information from image-based sensor device 101 and/or one or more other sensors of the vehicle 100, e.g., radar sensors, Light Detection and Ranging (LiDAR) sensors, and/or the like.

[00067] In one example, vehicle controller 108 may control the user interface, the steering system, the braking system, and/or any other vehicular systems of vehicle 100, for example, based on the information from image-based sensor device 101, e.g., based on one or more objects detected by image-based sensor device 101.

[00068] In other aspects, vehicle controller 108 may be configured to control any other additional or alternative functionalities of vehicle 100.

[00069] Some demonstrative aspects are described herein with respect to an image-based sensor device 101 implemented in a vehicle, e.g., vehicle 100.

[00070] In other aspects an image-based sensor device, e.g., image-based sensor device 101, may be implemented as part of any other element of a traffic system or network, for example, as part of a road infrastructure, and/or any other element of a traffic network or system. Other aspects may be implemented with respect to any other system, environment, and/or apparatus, which may be implemented in any other object, environment, location, or place.

[00071] In one example, image-based sensor device 101 may be part of a non-vehicular device, which may be implemented, for example, in an indoor location, a stationary infrastructure outdoors, or any other location.

[00072] In another example, image-based sensor device 101 may be part of a mobile or non-mobile device. For example, image-based sensor device 101 may be implemented as part of a smartphone, a tablet, a computing device, or the like.

[00073] In another example, image-based sensor device 101 may be part of an optical device. For example, image-based sensor device 101 may be implemented as part of a camera, a spectrometer, a microscope, or the like.

[00074] In some demonstrative aspects, image-based sensor device 101 may be configured to support security usage. In one example, image-based sensor device 101 may be configured to determine a nature of an operation, e.g., a human entry, an animal entry, an environmental movement, and the like, to identity a threat level of a detected event, and/or any other additional or alternative operations.

[00075] Some demonstrative aspects may be implemented with respect to any other additional or alternative devices and/or systems, for example, for a robot, e.g., as described below.

[00076] In other aspects, image-based sensor device 101 may be configured to support any other usages and/or applications.

[00077] Reference is now made to Fig. 2, which schematically illustrates a block diagram of a robot 200 implementing an image-based sensor 211, in accordance with some demonstrative aspects.

[00078] In some demonstrative aspects, robot 200 may include a robot arm 201. The robot 200 may be implemented, for example, in a factory for handling an object 213, which may be, for example, a part that should be affixed to a product that is being manufactured. The robot arm 201 may include a plurality of movable members, for example, movable members 202, 203, 204, and a support 205. Moving the movable members 202, 203, and/or 204 of the robot arm 201, e.g., by actuation of associated motors, may allow physical interaction with the environment to carry out a task, e.g., handling the object 213.

[00079] In some demonstrative aspects, the robot arm 201 may include a plurality of joint elements, e.g., joint elements 207, 208, 209, which may connect, for example, the members 202, 203, and/or 204 with each other, and with the support 205. For example, a joint element 207, 208, 209 may have one or more joints, each of which may provide rotatable motion, e.g., rotational motion, and/or translatory motion, e.g., displacement, to associated members and/or

motion of members relative to each other. The movement of the members 202, 203, 204 may be initiated by suitable actuators.

[00080] In some demonstrative aspects, the member furthest from the support 205, e.g., member 204, may also be referred to as the end-effector 204 and may include one or more tools, such as, a claw for gripping an object, a welding tool, or the like. Other members, e.g., members 202, 203, closer to the support 205, may be utilized to change the position of the end-effector 204, e.g., in three-dimensional space. For example, the robot arm 201 may be configured to function similarly to a human arm, e.g., possibly with a tool at its end.

[00081] In some demonstrative aspects, robot 200 may include a (robot) controller 206 configured to implement interaction with the environment, e.g., by controlling the robot arm's actuators, according to a control program, for example, in order to control the robot arm 201 according to the task to be performed.

[00082] In some demonstrative aspects, an actuator may include a component adapted to affect a mechanism or process in response to being driven. The actuator can respond to commands given by the controller 206 (the so-called activation) by performing mechanical movement. This means that an actuator, typically a motor (or electromechanical converter), may be configured to convert electrical energy into mechanical energy when it is activated (i.e. actuated).

[00083] In some demonstrative aspects, controller 206 may be in communication with a processor 210 of the robot 200.

[00084] In some demonstrative aspects, image-based sensor 211 may be coupled to the processor 210. In one example, image-based sensor 211 may be included, for example, as part of the robot arm 201.

[00085] In some demonstrative aspects, the image-based sensor, and the processor 210 may be operable as, and/or may be configured to form, an image-based sensor device. For example, image-based sensor 211 may be configured to perform one or more functionalities of image-based sensor 101 (Fig. 1), and/or processor 210 may be configured to perform one or more functionalities of processor 104 (Fig. 1), e.g., as described above.

[00086] In some demonstrative aspects, for example, the image-based sensor 211 may be controlled, e.g., by processor 210, to capture one or more images.

[00087] In some demonstrative aspects, processor 210 may be configured to process information of the one or more captured images, for example, generate sensor information, for example, by calculating information about position, speed and/or direction of the object 213, e.g., with respect to robot arm 201.

[00088] In some demonstrative aspects, processor 210 may be configured to provide the sensor information to the robot controller 206 of the robot arm 201, e.g., to control robot arm 201. For example, robot controller 206 may be configured to control robot arm 201 based on the sensor information, e.g., to grab the object 213 and/or to perform any other operation.

[00089] Reference is made to Fig. 3, which schematically illustrates an image capturing device 300, in accordance with some demonstrative aspects.

[00090] For example, image capturing device 300 may be implemented as part of, and/or may be configured to perform one or more operations and/or functionalities of, the devices or systems described above with reference to Fig. 1 and/or Fig. 2. In other aspects, image capturing device 300 may be implemented as part of any other device or system. For example, image-based sensor device 103 (Fig. 1), and/or image-based sensor 211 (Fig. 2), may include one or more elements of image capturing device 300, and/or may perform one or more operations and/or functionalities of image capturing device 300.

[00091] In some demonstrative aspects, image capturing device 300 may be configured to capture one or more images.

[00092] In one example, image capturing device 300 may be configured to capture, record, process, handle, and/or store one or more photos, videos, movies, clips and/or the like.

[00093] In some demonstrative aspects, image capturing device 300 may include, or may be implemented as part of, a camera, e.g., a digital camera, a digital video camera, a digital photo camera, a webcam, a mobile device, an imaging device, a medical imaging device, a mobile phone, e.g., including a camera, a Smartphone, a computing device, and/or the like.

[00094] In some demonstrative aspects, image capturing device 300 may be implemented, for example, as part of a device, system, and/or platform, for example, a vehicle, e.g., to support an autonomous vehicle controller.

[00095] In some demonstrative aspects, image capturing device 300 may be implemented, for example, to support automotive applications, e.g., within an Autonomous Vehicle (AV), and/or the like.

[00096] In some demonstrative aspects, image capturing device 300 may be implemented, for example, to support applications utilizing high-precision fixed-focus imaging, satellite imaging applications, military imaging applications, and/or any other applications.

[00097] In some demonstrative aspects, image capturing device 300 may include an image sensor 320, which may be configured to capture one or more images via an optical device 329, e.g., as described below.

[00098] In some demonstrative aspects, image sensor 320 may be configured to capture one or more images, for example, by converting incoming photons via the optical device 329 into electronic signals.

[00099] For example, optical device 329 may include one or more optical elements, for example, a lens, a lens system, an optical system, one or more filters, a filter system, or the like.

[000100] In some demonstrative aspects, image capturing device 300 may optionally include, for example, a processor 391, an input unit 392, an output unit 393, a memory unit 394, and/or a storage unit 395. Image capturing device 300 may optionally include other suitable hardware components and/or software components. In some demonstrative aspects, some or all of the components of image capturing device 300 may be enclosed in a common housing or packaging, and may be interconnected or operably associated using one or more wired or wireless links. In other aspects, components of image sensing device 300 may be distributed among multiple or separate devices.

[000101] In some demonstrative aspects, processor 391 may include, for example, a Central Processing Unit (CPU), a Digital Signal Processor (DSP), one or more processor cores, a single-core processor, a dual-core processor, a multiple-core processor, a microprocessor, a host processor, a controller, a plurality of processors or controllers, a chip, a microchip, one or more circuits, circuitry, a logic unit, an Integrated Circuit (IC), an Application-Specific IC (ASIC), or any other suitable multi-purpose or specific processor or controller. For example, processor 391 executes instructions, for example, of an Operating System (OS) of image capturing device 300 and/or of one or more suitable applications.

[000102] In some demonstrative aspects, memory unit 394 may include, for example, a Random Access Memory (RAM), a Read Only Memory (ROM), a Dynamic RAM (DRAM), a Synchronous DRAM (SD-RAM), a flash memory, a volatile memory, a non-volatile memory,

a cache memory, a buffer, a short term memory unit, a long term memory unit, or other suitable memory units. Storage unit 395 may include, for example, a hard disk drive, a disk drive, a solid-state drive (SSD), and/or other suitable removable or non-removable storage units. For example, memory unit 394 and/or storage unit 395, for example, may store data processed by image capturing device 300.

[000103] In some demonstrative aspects, input unit 392 may include, for example, a keyboard, a keypad, a mouse, a touch-screen, a touch-pad, a track-ball, a stylus, a microphone, or other suitable pointing device or input device. Output unit 393 includes, for example, a monitor, a screen, a touch-screen, a flat panel display, a Light Emitting Diode (LED) display unit, an Organic LED (OLED) display unit, a Liquid Crystal Display (LCD) display unit, a plasma display unit, one or more audio speakers or earphones, or other suitable output devices.

[000104] In some demonstrative aspects, image sensor 320 may include and/or may be implemented as an IC.

[000105] In some demonstrative aspects, the IC may include a complementary metal–oxide–semiconductor (CMOS) IC formed on a wafer.

[000106] In some demonstrative aspects, image sensor 320 may include a CMOS Image Sensor (CIS).

[000107] In some demonstrative aspects, image sensor 320 may include analog circuitry, and/or digital circuitry, for example, to process, handle and/or store one or more images, photos, videos, movies, clips and/or the like.

[000108] In some demonstrative aspects, image sensor 320 may include a pixel array 302 including a plurality of pixels configured to sense and/or to capture an image, for example, via the optical device 329.

[000109] In some demonstrative aspects, pixel array 302 may be configured to capture photons corresponding to an image, and to convert the photons into analog pixel data, for example, to allow image capturing device 300 to process the image and/or to output the image, e.g., to an image processor, a display, a memory and/or a processor.

[000110] In some demonstrative aspects, processor 391 may be configured to generate processed information, for example, based on the one or more images captured by the image sensor 320, e.g., as described above.

[000111] In some demonstrative aspects, the optical device 329 may include a lens structure, which may include a plurality of lens elements. In other aspects, optical device 329 may be implemented according to any other lens architecture and/or mechanism.

[000112] In some demonstrative aspects, image capturing device 300 may include a structure 331 (also referred to as “camera structure”, “imaging device structure”, “lens-sensor alignment structure”, or “lens-sensor fixation structure”), which may be configured to support, hold, and/or maintain the optical device 329 and the image sensor 302, e.g., as described below.

[000113] In some demonstrative aspects, structure 331 may include a lens assembly 371, which may be configured to support, hold, and/or maintain the optical device 329, e.g., as described below.

[000114] In some demonstrative aspects, lens assembly 371 may include a lens barrel 333, which may be configured to support, hold, and/or maintain the optical device 329, e.g., as described below.

[000115] In some demonstrative aspects, optical device 329 may be secured to the lens barrel 333.

[000116] In some demonstrative aspects, structure 331 may include an image sensor assembly 373, which may be configured to support, hold, and/or maintain the image sensor 320, e.g., as described below.

[000117] In some demonstrative aspects, image sensor assembly 373 may include an image sensor holder 335, which may be configured to support, hold, and/or maintain the image sensor 320 to capture one or more images via the optical device 329, e.g., as described below.

[000118] In some demonstrative aspects, camera structure 331 may be configured according to a lens to image sensor (“lens-sensor”) alignment technique, which may be configured to provide a technical solution to support and/or maintain an alignment between optical device 329 and image sensor 320, e.g., as described below.

[000119] In some demonstrative aspects, the lens-sensor alignment technique may be configured to support and/or maintain an alignment between optical device 329 and image sensor 320, for example, even when image capturing device 300 is subject to adverse environmental conditions, e.g., as described below.

[000120] For example, in some use cases, deployments and/or implementations, there may be one or more technical issues when using a glue joint to fix a relative position between a lens and an image sensor.

[000121] In one example, in some camera structure implementations, a gap may be maintained between a structure supporting a lens (lens structure) and a structure supporting an image sensor (image sensor structure), for example, to support an Active Alignment (AA) procedure, which may be implemented to align between the lens and the image sensor. For example, the gap may be filled with glue and/or another soldering material, for example, after the AA procedure. However, such an implementation of the glue-filled gap may result in instability and inaccuracy of the glued joint between the lens structure and the image sensor structure.

[000122] For example, some imaging devices, e.g., automotive cameras, may be subject to structure variations, which may occur due to environmental conditions, e.g., temperature, humidity, or the like, and/or over time, e.g., aging. These changes may affect the glue joint, which, in turn, may degrade the alignment between the lens and the image sensor.

[000123] In some demonstrative aspects, camera structure 331 may be configured according to a lens-sensor alignment technique, which may be configured to provide a technical solution to join, connect, and/or attach between the lens assembly 371 and the image sensor assembly 373, for example, in a manner which may mitigate one or more technical issues of the implementation of the unreliable gap-filling technique between the joint parts, e.g., as described below.

[000124] In some demonstrative aspects, camera structure 331 may be configured according to a lens-sensor alignment technique, which may be configured to provide a technical solution to joint, connect, and/or attach between the lens assembly 371 and the image sensor assembly 373, for example, over a closed gap, e.g., a fully closed gap, a minimal gap, or a substantially closed gap, for example, instead of the glue-filled gap, e.g., as described below.

[000125] In some demonstrative aspects, camera structure 331 may be configured according to a lens-sensor alignment technique, which may be configured to provide a technical solution to support a relatively stiff joint between the lens assembly 371 and the image sensor assembly 373, e.g., as described below.

[000126] In some demonstrative aspects, camera structure 331 may be configured according to a lens-sensor alignment technique, which may be configured to provide a technical solution to support implementation of a welded, soldered, and/or brazed, joint between the lens assembly 371 and the image sensor assembly 373, e.g., as described below. In other aspects, any other stiff and/or strong jointing mechanism may be implemented.

[000127] In some demonstrative aspects, the attachment between the lens assembly 371 and the image sensor assembly 373 over a closed gap may be implemented to provide a technical solution to support the stiff joint between the lens assembly 371 and the image sensor assembly 373, e.g., via welding, soldering and/or brazing, and/or any other stiff-joint mechanism, which may be less vulnerable to variation over environmental conditions and/or time, and/or may be applied even without changes, which may be caused by the jointing process, e.g., as described below.

[000128] In some demonstrative aspects, structure 331 may be configured to support alignment between the optical device 329 and the image sensor 320, for example, according to an AA procedure, e.g., as described below.

[000129] In some demonstrative aspects, the lens-sensor alignment structure 331 may be configured to provide a gap between the lens barrel 333 and the image sensor holder 335, for example, to support alignment between the optical device 329 and the image sensor 320, for example, according to an AA procedure and/or any other suitable procedure, e.g., as described below.

[000130] In some demonstrative aspects, the lens-sensor alignment structure 331 may be configured to support a gap-closing of the gap between the lens barrel 333 and the image sensor holder 335, for example, by rotation, for example, once the alignment between the optical device 329 and the image sensor 320 is achieved, for example, according to the AA procedure and/or any other suitable procedure, e.g., as described below.

[000131] In some demonstrative aspects, the lens-sensor fixation structure 331 may be configured to support maintaining, securing, and/or fixing a relative positioning, e.g., an aligned positioning, between the optical device 329 and the image sensor 320, for example, following the AA procedure and/or any other alignment procedure, e.g., as described below.

[000132] In some demonstrative aspects, structure 331 may include a stiff jointing, e.g., welding, soldering, brazing, or the like, which may be applied over substantially no gap, or

over a reduced or minimal gap, for example, after substantially closing of the gap between the lens barrel 333 and the image sensor holder 335, e.g., as described below.

[000133] In some demonstrative aspects, the lens-sensor alignment structure 331 may be configured to provide a gap between the lens barrel 333 and the image sensor holder 335, which may be configured, for example, to support an AA procedure, which may be applied, for example, in 3 Degrees of Freedom (DOF), e.g., along three axes (Z, Theta_X, Theta_Y), and/or any other additional or alternative axes, e.g., as described below.

[000134] In some demonstrative aspects, the lens-sensor alignment structure 331 may be configured to support closing the gap, for example, by rotation of the lens barrel 333, for example, about an optical axis of the optical device 329, e.g., the axis (Z).

[000135] In some demonstrative aspects, the lens-sensor alignment structure 331 may be configured to support implementation of an inventive alignment approach, e.g., an AA approach, which may support AA between optical device 329 and image sensor 320 in one or more axes, for example, in the X axis and/or the Y axis, e.g., as described below.

[000136] In some demonstrative aspects, the alignment approach, e.g., the AA approach, may be configured to provide a technical solution suitable for characteristics of automotive image sensing applications and/or any other suitable additional or alternative applications.

[000137] In some demonstrative aspects, the alignment approach, e.g., the AA approach, may be configured for imaging systems where certain requirements of AA design may be sufficiently met by one or more assumptions, e.g., as described below.

[000138] For example, upon consideration of characteristics of applications which may be served by an imaging system, it has been discovered that certain requirements of AA design for imaging systems may be sufficiently met by an inventive alignment approach, e.g., AA approach, which may be implemented as an alternative to conventional AA approaches, e.g., as described below.

[000139] In some demonstrative aspects, in some applications, for example, automotive image sensing applications and/or other applications, it may be assumed that high precision may not be required with respect to one or more axes, e.g., the X axis and/or the Y axis.

[000140] For example, in some applications, an image center (X, Y) final location may be measured, e.g., per camera, for example, as part of an “intrinsic calibration” process.

[000141] For example, an actual measured image center may be used by the application and, therefore, geometrical centering errors may not result in substantial application problems, e.g., as long as no very large errors “shift the image out” of the image sensor 320.

[000142] In some demonstrative aspects, in some applications, for example, automotive image sensing applications and/or other applications, it may be assumed that rotation about an axis, e.g., the Z axis, may not substantially change the optical alignment between the optical device 329 and the image sensor 320, e.g., due to an axial symmetry of the optical device 329.

[000143] In some demonstrative aspects, image sensor holder 335 may include, or may be structured as, a camera housing, which may be configured to support, maintain, and/or position, the image sensor 320, for example, relative to the optical device 329, e.g., as described below.

[000144] In some demonstrative aspects, the optical device 329 may include a plurality of optical elements, e.g., glass parts and/or any other optical elements, which may be assembled in lens barrel 333, e.g., a metal barrel. In other aspects, the optical device 329 may be implemented according to any other architecture.

[000145] In some demonstrative aspects, camera structure 331 may include a joint area 337, which may be configured to provide a technical solution to support contacting the lens assembly 371 to the image sensor assembly 373, for example, by rotation about the optical axis of the optical device 329, e.g., as described below.

[000146] In some demonstrative aspects, the joint area 337 may be configured to provide a gap to support an alignment procedure, e.g., an AA procedure, between optical device 329 and image sensor 320 in one or more axes, for example, in the X axis and/or the Y axis, e.g., as described below.

[000147] In some demonstrative aspects, the joint area 337 of the camera structure 331 may be configured to support closing of the gap, for example, such that the lens assembly 371 may be connected to, e.g., physically in contact with, the image sensor assembly 373, for example, following the AA procedure.

[000148] In some demonstrative aspects, the joint area 337 of the camera structure 331 may be configured to provide a technical solution to support stiff jointing of the lens assembly 371 and the image sensor assembly 373, e.g., via welding, soldering, brazing, and/or any other fixation mechanism, e.g., as described below.

[000149] In some demonstrative aspects, lens assembly 371 may include a first engaging section (also referred to as “engaging portion”, “joint section” or “engaging portion”) 375, for example, extending from the lens barrel 333, e.g., as described below.

[000150] In some demonstrative aspects, image sensor assembly 373 may include a second engaging section 377, for example, extending from the image sensor holder 335, e.g., as described below.

[000151] In some demonstrative aspects, the first engaging section 375 and the second engaging section 377 may be configured, for example, to engage the lens assembly 371 with the image sensor assembly 373 at an engaged state, e.g., as described below.

[000152] In some demonstrative aspects, the first engaging section 375 and the second engaging section 377 may be configured, for example, such that at the engaged state, the second engaging section 377 is in contact with the first engaging section 375 at a plurality of contact areas (not shown in Fig. 3), e.g., as described below.

[000153] In some demonstrative aspects, the first engaging section 375 and the second engaging section 377 may be configured, for example, such that at the engaged state, the second engaging section 377 is securable to the first engaging section 375, e.g., as described below.

[000154] In some demonstrative aspects, the plurality of contact areas between the first engaging section 375 and the second engaging section 377 may be configured to include one or more radial contact areas, e.g., as described below.

[000155] In some demonstrative aspects, the plurality of contact areas between the first engaging section 375 and the second engaging section 377 may be configured to include one or more spiral contact areas, e.g., as described below.

[000156] In some demonstrative aspects, the plurality of contact areas between the first engaging section 375 and the second engaging section 377 may be arranged, for example, with substantially equal spacing between adjacent contact areas, e.g., as described below.

[000157] In some demonstrative aspects, the plurality of contact areas between the first engaging section 375 and the second engaging section 377 may be arranged, for example, on a circumference of a circle around the image sensor 320, e.g., as described below.

[000158] In some demonstrative aspects, camera structure 331 may include at least one soldering joint, for example, to secure the second engaging section 377 to the first engaging section 375 at the engaged state, e.g., as described below.

[000159] In some demonstrative aspects, camera structure 331 may include at least one welding joint, for example, to secure the second engaging section 377 to the first engaging section 375 at the engaged state, e.g., as described below.

[000160] In some demonstrative aspects, camera structure 331 may include at least one brazing joint, for example, to secure the second engaging section 377 to the first engaging section 375 at the engaged state, e.g., as described below.

[000161] In some demonstrative aspects, camera structure 331 may include at least one adhesive joint, for example, to secure the second engaging section 377 to the first engaging section 375 at the engaged state, e.g., as described below.

[000162] In some demonstrative aspects, camera structure 331 may be configured to maintain the lens barrel 333 tilted, for example, with respect to the image sensor holder 335, for example, to align between the optical device 329 and the image sensor 320, e.g., as described below.

[000163] In some demonstrative aspects, camera structure 331 may be configured to maintain the lens barrel 333 shifted, for example, with respect to an optical axis of the optical device 329, for example, to align between the optical device 329 and the image sensor 320, e.g., as described below.

[000164] In some demonstrative aspects, the first engaging section 375 and the second engaging section 377 may be configured, for example, to allow rotation of the first engaging section 375 relative to the second engaging section 377, for example, from a disengaged state to the engaged state, for example, when the second engaging section 377 is not secured to the first engaging section 375, e.g., as described below.

[000165] In some demonstrative aspects, the first engaging section 375 and the second engaging section 377 may be configured, for example, such that the rotation of the first engaging section 375 relative to the second engaging section 377 may include rotation of the lens assembly 371 relative the image sensor assembly 373, for example, about an optical axis of the optical device 329, e.g., as described below.

[000166] In some demonstrative aspects, the first engaging section 375 and the second engaging section 377 may be configured, for example, to maintain an alignment setting

substantially unchanged, for example, during the rotation of the first engaging section 375 relative to the second engaging section 377, for example, from the disengaged state to the engaged state, e.g., as described below.

[000167] In some demonstrative aspects, the alignment setting may include an alignment between the optical device 329 and the image sensor 320, e.g., as described below.

[000168] In some demonstrative aspects, the alignment between the optical device 329 and the image sensor 320 may include, for example, a tilt of a mechanical axis of the lens barrel 333, for example, relative to an axis perpendicular to a plane of the image sensor 320, e.g., as described below.

[000169] In other aspects, the first engaging section 375 and the second engaging section 377 may be configured to maintain any other alignment and/or setting.

[000170] In some demonstrative aspects, the first engaging section 375 may include a first plurality of engaging extensions (not shown in Fig. 3), for example, extending from the lens barrel 333, e.g., described below.

[000171] In some demonstrative aspects, the second engaging section 377 may include a second plurality of engaging extensions (not shown in Fig. 3), for example, extending from the image sensor holder 335, e.g., as described below.

[000172] In some demonstrative aspects, the first plurality of engaging extensions of the first engaging section 375 may be configured, for example, to extend from an end of the lens barrel 333, for example, in a direction substantially parallel to a mechanical axis of the lens barrel 333, e.g., as described below.

[000173] In some demonstrative aspects, the first plurality of engaging extensions of the first engaging section 375 may be configured, for example, to extend from an outer surface (not shown in Fig. 3) of the lens barrel 333, for example, in a direction substantially perpendicular to the outer surface of the lens barrel 333 and substantially perpendicular to a mechanical axis of the lens barrel 333, e.g., as described below.

[000174] In other aspects, the first plurality of engaging extensions of the first engaging section 375 may be configured to extend from the lens barrel 333 in any other suitable manner.

[000175] In some demonstrative aspects, the first plurality of engaging extensions of the first engaging section 375 may include, for example, two first engaging extensions, e.g., as described below.

[000176] In some demonstrative aspects, the second plurality of engaging extensions of the second engaging section 377 may include, for example, two second engaging extensions, e.g., as described below.

[000177] In some demonstrative aspects, the first plurality of engaging extensions of the first engaging section 375 may include, for example, at least three first engaging extensions, e.g., as described below.

[000178] In some demonstrative aspects, the second plurality of engaging extensions of the second engaging section 377 may include, for example, at least three second engaging extensions, e.g., as described below.

[000179] In some demonstrative aspects, the first plurality of engaging extensions of the first engaging section 375 may include, for example, four or more first engaging extensions, e.g., as described below.

[000180] In some demonstrative aspects, the second plurality of engaging extensions of the second engaging section 377 may include, for example, four or more second engaging extensions, e.g., as described below.

[000181] In some demonstrative aspects, the first plurality of engaging extensions of the first engaging section 375 and the second plurality of engaging extensions of the second engaging section 377 may be arranged, for example, in a plurality of pairs of engaging extensions (not shown in Fig. 3), e.g., as described below.

[000182] In some demonstrative aspects, a pair of engaging extensions may include, for example, a first engaging extension of the first plurality of engaging extensions of the first engaging section 375, and a second engaging extension of the second plurality of engaging extensions of the second engaging section 377, e.g., as described below.

[000183] In some demonstrative aspects, the first engaging extension and the second engaging extension of the pair of engaging extensions may be configured, for example, to be in contact at the engaged state, e.g., as described below.

[000184] In some demonstrative aspects, the first plurality of engaging extensions of the first engaging section 375 may be arranged, for example, on a circumference of a first circle (not shown in Fig. 3), e.g., as described below.

[000185] In some demonstrative aspects, the second plurality of engaging extensions of the second engaging section 377 may be arranged, for example, on a circumference of a second circle (not shown in Fig. 3), e.g., as described below.

[000186] In some demonstrative aspects, the second circle may be, for example, substantially concentric with the first circle, e.g., as described below.

[000187] In other aspects, the first plurality of engaging extensions of the first engaging section 375 and/or the second plurality of engaging extensions of the second engaging section 377 may be arranged according to any other arrangement corresponding to any other suitable circles and/or geometric shapes.

[000188] In some demonstrative aspects, the second plurality of engaging extensions of the second engaging section 377 may be arranged, for example, to fit in spaces (not shown in Fig. 3) between the first plurality of engaging extensions of the first engaging section 375, e.g., as described below.

[000189] In some demonstrative aspects, the first engaging extension and the second engaging extension of the pair of engaging extensions may be configured, for example, according to a radial engagement mechanism, e.g., as described below.

[000190] In some demonstrative aspects, one engagement extension of the pair of engaging extensions may include a radial surface (not shown in Fig. 3), which may be configured, for example, to be in contact with a surface (not shown in Fig. 3) of another engagement extension of the pair of engaging extensions, for example, at the engaged state, e.g., as described below.

[000191] In some demonstrative aspects, the first engaging extension and the second engaging extension of the pair of engaging extensions may be configured, for example, according to a spiral engagement mechanism, e.g., as described below.

[000192] In some demonstrative aspects, the first engaging extension and the second engaging extension of the pair of engaging extensions may be configured, for example, such that the first engaging extension may have a first spiral shape (not shown in Fig. 3), and the second engaging extension may have a second spiral shape (not shown in Fig. 3), which may be, for example, complementary to the first spiral shape, e.g., as described below.

[000193] In some demonstrative aspects, the first engaging extension and the second engaging extension of the pair of engaging extensions may be configured, for example, such that at the engaged state an inner surface of one of the first or second spiral shapes is in contact with an outer surface of another one of the first or second spiral shapes (not shown in Fig. 3), e.g., as described below.

[000194] In other aspects, the first engaging extension and the second engaging extension of the pair of engaging extensions may be configured, for example, according to any other engagement mechanism utilizing any other geometric shape and/or configuration, which may be configured to engage between the first and second engaging extensions of the pair of engaging extensions.

[000195] In some demonstrative aspects, image sensor holder 320 may be configured to include a camera housing, which may be joined with the lens barrel 333, e.g., as described below.

[000196] In some demonstrative aspects, the camera structure 331 may be configured as a unibody camera structure. For example, the unibody camera structure may include the lens assembly 371 and a part, e.g., a relatively small part, which may be configured as the image sensor assembly 373, for example, to hold, support, and/or maintain the image sensor 320, e.g., as described below.

[000197] In some demonstrative aspects, the camera structure 331 may be formed and/or assembled according to a method (“sensor-lens alignment method”), which may be configured to maintain, secure, and/or fix an alignment between the optical device 329 and the image sensor 320, e.g., as described below.

[000198] Reference is made to Fig. 4, which schematically illustrates a method of camera structure assembly alignment, in accordance with some demonstrative aspects. For example, one or more, e.g., some or all, operations of the method of Fig. 4 may be implemented to manufacture, generate, provide, form, and/or assemble at least part of a camera structure, e.g., camera structure 331 (Fig. 3).

[000199] In some demonstrative aspects, as indicated at block 402, the method may include aligning a relative position between an optical device, e.g., optical device 329 (Fig. 3), and an image sensor, e.g., image sensor 320 (Fig. 3), for example, according to an AA procedure, e.g., as described below.

[000200] In some demonstrative aspects, as indicated at block 404, aligning the relative position between the optical device and the image sensor may include applying an AA procedure, which may include changing and/or modifying a relative positioning between the optical device, e.g., optical device 329 (Fig. 3), and the image sensor, e.g., image sensor 320 (Fig. 3), in one or more directions and/or axes, for example, while monitoring an image captured by the image sensor, e.g., image sensor 320 (Fig. 3), via the optical device, e.g., optical device 329 (Fig. 3).

[000201] In some demonstrative aspects, aligning the relative position between the optical device and the image sensor may include, for example, applying the AA procedure, which may include changing the relative positioning between the optical device, e.g., optical device 329 (Fig. 3), and the image sensor, e.g., image sensor 320 (Fig. 3), for example, in the Z, Theta X and/or Theta Y axes, for example, while performing image optimization, e.g., of the image captured by the image sensor, e.g., image sensor 320 (Fig. 3), via the optical device, e.g., optical device 329 (Fig. 3).

[000202] In some demonstrative aspects, the engaging section 375 (Fig. 3) of the lens assembly 371 (Fig. 3) and the engaging section 377 (Fig. 3) of image sensor assembly 373 (Fig. 3) may be configured to support the relative movement between the optical device 329 (Fig. 3) and the image sensor 320 (Fig. 3) in one or more axes, e.g., according to the AA procedure described above and/or any other additional or alternative alignment procedure.

[000203] In some demonstrative aspects, the engaging section 375 (Fig. 3) of the lens assembly 371 (Fig. 3) and the engaging section 377 (Fig. 3) of image sensor assembly 373 (Fig. 3) may be configured to provide a technical solution to support performing the AA

procedure, for example, while there is substantially no contact, or reduced contact, e.g., minimal contact, between the lens assembly 371 (Fig. 3) and the image sensor assembly 373 (Fig. 3).

[000204] In some demonstrative aspects, as indicated at block 406, the method may include identifying a selected (“aligned”) relative positioning between the optical device, e.g., optical device 329 (Fig. 3), and the image sensor, e.g., image sensor 320 (Fig. 3), for example, based on the AA procedure.

[000205] In one example, the selected relative positioning between the optical device, e.g., optical device 329 (Fig. 3), and the image sensor, e.g., image sensor 320 (Fig. 3), may be identified as a position at which a substantially optimal image is captured by the image sensor, e.g., image sensor 320 (Fig. 3), via the optical device, e.g., optical device 329 (Fig. 3).

[000206] In other aspects, the selected relative positioning between the optical device, e.g., optical device 329 (Fig. 3), and the image sensor, e.g., image sensor 320 (Fig. 3), may be identified based on any other additional or alternative suitable criteria.

[000207] In some demonstrative aspects, the selected relative positioning between the optical device, e.g., optical device 329 (Fig. 3), and the image sensor, e.g., image sensor 320 (Fig. 3), may be identified based on the AA procedure, e.g., as described above. In other aspects, the selected relative positioning between the optical device, e.g., optical device 329 (Fig. 3), and the image sensor, e.g., image sensor 320 (Fig. 3), may be identified based on any other additional or alternative alignment operations, method, and/or procedure.

[000208] In some demonstrative aspects, as indicated at block 408, the method may include rotating the optical device, e.g., optical device 329 (Fig. 3), relative to a predefined axis, for example, after identifying the selected relative positioning between the optical device, e.g., optical device 329 (Fig. 3), and the image sensor, e.g., image sensor 320 (Fig. 3), for example, based on the AA procedure, e.g., as described below.

[000209] In some demonstrative aspects, as indicated at block 410, the method may include rotating the optical device, e.g., optical device 329 (Fig. 3), about its optical axis, for example, until reaching a position where a lens assembly holding the optical device, e.g., lens assembly 371 (Fig. 3), is in contact with, e.g., touching, an image sensor assembly holding the image sensor, e.g., image sensor assembly 373 (Fig. 3).

[000210] In some demonstrative aspects, the method may include, for example, rotating the optical device, e.g., optical device 329 (Fig. 3), for example, relative to the Z axis.

[000211] In some demonstrative aspects, for example, optical alignment between the optical device, e.g., optical device 329 (Fig. 3), and the image sensor, e.g., image sensor 320 (Fig. 3), e.g., which may provide the optimized image captured by the image sensor, e.g., image sensor 320 (Fig. 3), via the optical device, e.g., optical device 329 (Fig. 3), may be substantially maintained, for example, while rotating the optical device, e.g., optical device 329 (Fig. 3), e.g., about the Z axis. For example, this alignment may be substantially maintained due to a substantially axial symmetry of the optical device, e.g., as described above.

[000212] In some demonstrative aspects, the engaging section 375 (Fig. 3) of the lens assembly 371 (Fig. 3) and the engaging section 377 (Fig. 3) of image sensor assembly 373 (Fig. 3) may be configured to support the rotation of the lens barrel 333 (Fig. 3), for example, about the optical axis of optical device 329 (Fig. 3), for example, while maintaining the alignment between the optical device 329 (Fig. 3) and the image sensor 320 (Fig. 3), e.g., according to the AA procedure.

[000213] In some demonstrative aspects, the engaging section 375 (Fig. 3) of the lens assembly 371 (Fig. 3) and the engaging section 377 (Fig. 3) of image sensor assembly 373 (Fig. 3) may be configured to support relative rotation between the lens assembly 371 (Fig. 3) and the image sensor assembly 373 (Fig. 3), for example, until a position where the engaging section 375 (Fig. 3) of the lens assembly 371 (Fig. 3) is in contact with, e.g., touching, the engaging section 377 (Fig. 3) of image sensor assembly 373 (Fig. 3), for example, while maintaining the alignment between the optical device 329 (Fig. 3) and the image sensor 320 (Fig. 3), e.g., as obtained according to the AA procedure.

[000214] In some demonstrative aspects, as indicated at block 412, the method may include applying a torque to the lens assembly, e.g., lens assembly 371, and/or to the image sensor assembly, e.g., image sensor assembly 373 (Fig. 3), for example, such that the lens assembly and the image sensor assembly may be maintained in contact, e.g., without substantial movement.

[000215] In some demonstrative aspects, as indicated at block 414, the method may include jointing between the lens assembly, e.g., the lens assembly 371 (Fig. 3), and the image sensor assembly, e.g., image sensor assembly 373 (Fig. 3).

[000216] In some demonstrative aspects, the lens assembly, e.g., the lens assembly 371 (Fig. 3), may be welded to the image sensor assembly, e.g., image sensor assembly 373 (Fig. 3), for example, by laser welding, Tungsten Inert Gas (TIG) welding, and/or any other suitable welding technique.

[000217] In some demonstrative aspects, the lens assembly, e.g., the lens assembly 371 (Fig. 3), may be secured to the image sensor assembly, e.g., image sensor assembly 373 (Fig. 3), for example, by soldering, brazing, and/or any other suitable jointing technique.

[000218] In some demonstrative aspects, the lens assembly 371 (Fig. 3) and the image sensor assembly 373 (Fig. 3) may be configured to support fixation of the lens assembly 371 (Fig. 3) and the image sensor assembly 373 (Fig. 3) by an adhesive, e.g., as described below.

[000219] In other aspects, the lens assembly 371 (Fig. 3) and the image sensor assembly 373 (Fig. 3) may be configured to support fixation of the lens assembly 371 (Fig. 3) and the image sensor assembly 373 (Fig. 3) by any other additional or alternative fixation and/or jointing mechanism.

[000220] Reference is made to Figs. 5A, 5B, 5C, 5D, 5E, 5F and 5G, which schematically illustrate a camera structure assembly 500, in accordance with some demonstrative aspects. For example, camera structure 331 (Fig. 3) may include one or more elements of, and/or perform one or more functionalities of, the camera structure assembly 500.

[000221] In some demonstrative aspects, camera structure assembly 500 may include a unibody structure, e.g., as described below.

[000222] In some demonstrative aspects, camera structure assembly 500 may be configured according to a radial engagement mechanism, e.g., as described below.

[000223] In some demonstrative aspects, the camera structure assembly 500 may include a lens assembly 571 and an image sensor assembly 573, e.g., as described below.

[000224] In some demonstrative aspects, lens assembly 571 may include a lens barrel 533, and an engaging section (first joint portion) 575 extending from the lens barrel 533.

[000225] In some demonstrative aspects, the lens barrel 533 may be configured to house and/or support an optical device 529 (Fig. 5B), e.g., the optical device 329 (Fig. 3). For example, the lens barrel 333 (Fig. 3) may include lens barrel 533.

[000226] In some demonstrative aspects, image sensor assembly 573 may include an image sensor holder 535, which may be configured to support, hold and/or house an image sensor 520, e.g., the image sensor 320 (Fig. 3). For example, image sensor holder 335 (Fig. 3) may include the image sensor holder 535.

[000227] In some demonstrative aspects, image sensor assembly 573 may include an engaging section (second joint portion) 577 extending from the image sensor holder 535.

[000228] In some demonstrative aspects, the engaging section 575 and the engaging section 577 may be configured to engage the lens assembly 571 with the image sensor assembly 573 at an engaged state 591 (Figs. 5F and 5G).

[000229] In some demonstrative aspects, when at the engaged state 591, the engaging section 577 may be in contact with the engaging section 575 at a plurality of contact areas 593, e.g., as described above.

[000230] In some demonstrative aspects, the engaging section 577 may be securable to the engaging section 575, for example, at the engaged state 591, e.g., as described above.

[000231] In some demonstrative aspects, the engaging section 577 may be securable to the engaging section 575, for example, with one or more joints 595 (Fig. 5G).

[000232] In some demonstrative aspects, the one or more joints 595 may include, for example, at least one of a soldering joint, a welding joint, a brazing joint, and/or an adhesive joint, e.g., as described above.

[000233] In some demonstrative aspects, the one or more joints 595 may be configured, for example, to maintain alignment between the optical device 529 and the image sensor 520, for example, at an aligned position after the AA procedure, e.g., as described above.

[000234] In some demonstrative aspects, engaging section 575 may include a first plurality of engaging extensions 561 extending from the lens barrel 533, e.g., as described below.

[000235] In some demonstrative aspects, second engaging section 577 may include a second plurality of engaging extensions 563 extending from the image sensor holder 535, e.g., as described below.

[000236] In some demonstrative aspects, the first plurality of engaging extensions 561 may include three first engaging extensions 561, and the second plurality of engaging extensions 563 may include three second engaging extensions 563.

[000237] In other aspects, any other suitable count of first engaging extensions 561 and/or second engaging extensions 563 may be implemented.

[000238] In some demonstrative aspects, the first plurality of engaging extensions 561 may be configured, for example, to extend from an end of the lens barrel 533, for example, in a direction substantially parallel to a mechanical axis 569 of the lens barrel 533.

[000239] In some demonstrative aspects, the first plurality of engaging extensions 561 may be configured, for example, to protrude from an end of the lens barrel 533 facing the image sensor holder 535.

[000240] In some demonstrative aspects, the second plurality of engaging extensions 563 may be configured, for example, to protrude from an end of the image sensor holder 535 facing the lens barrel 533.

[000241] In some demonstrative aspects, the first plurality of engaging extensions 561 and the second plurality of engaging extensions 563 may be arranged, for example, in a plurality of pairs 565 of engaging extensions.

[000242] In some demonstrative aspects, a pair 565 of engaging extensions may include a first engaging extension of the first plurality of engaging extensions 561 and a second engaging extension of the second plurality of engaging extensions 563.

[000243] In some demonstrative aspects, the first engaging extension and the second engaging extension may be configured to be in contact at the engaged state 591.

[000244] In some demonstrative aspects, as shown in Figs. 5E-5G, the first plurality of engaging extensions 561 may be arranged, for example, on a circumference of a first circle, and the second plurality of engaging extensions 563 may be arranged, for example, on a circumference of a second circle.

[000245] In some demonstrative aspects, as shown in Figs. 5E-5G, the second circle may be substantially concentric with the first circle. For example, as shown in Figs. 5E-5G, the first circle and the second circle may have substantially the same radius.

[000246] In some demonstrative aspects, the second plurality of engaging extensions 563 may be arranged, for example, to fit in spaces between the first plurality of engaging extensions 561.

[000247] In some demonstrative aspects, the plurality of contact areas 593 may be arranged, for example, with substantially equal spacing between adjacent contact areas 593.

[000248] In some demonstrative aspects, as shown in Figs. 5F-5G, the plurality of contact areas 593 may be arranged, for example, on a circumference of a circle around the image sensor 520.

[000249] In some demonstrative aspects, the plurality of contact areas 593 may be configured, for example, to include one or more radial contact areas, e.g., as described below.

[000250] In some demonstrative aspects, the engaging section 575 and the engaging section 577 may be configured to provide a technical solution to support radial contact between the lens assembly 571 and the image sensor assembly 573, for example, by relative rotation of the lens barrel 533 and the image sensor holder 535, for example, about an axis of the optical device 529, e.g., device 329 (Fig. 3), supported by lens barrel 533, e.g., as described above.

[000251] In some demonstrative aspects, one engagement extension of the pair of engaging extensions, e.g., an engaging extension 561, may include a radial surface, which may be configured to be in contact with a surface of another engagement extension of the pair of engaging extensions, e.g., an engaging extension 561, for example, at the engaged state 591.

[000252] In other aspects, any other surface form and/or shape may be implemented.

[000253] In some demonstrative aspects, the engaging section 575 and the engaging section 577 may be configured to provide a technical solution to support relative movement of the lens barrel 533 and the image sensor holder 535, for example, in one or more axes, for example during an AA procedure, e.g., as described above.

[000254] In some demonstrative aspects, the engaging section 575 and the engaging section 577 may be configured, for example, to allow rotation of the engaging section 575 relative to the engaging section 577, for example, from a disengaged state 590 (Fig. 5E) to the engaged state 591 (Figs. 5F-5G), for example, when the engaging section 577 is not secured to the engaging section 575, e.g., as described above.

[000255] In some demonstrative aspects, the rotation of the engaging section 575 relative to the engaging section 577 may include, for example, rotation of the lens assembly 571 relative to the image sensor assembly 573, for example, about an optical axis 598 of the optical device 529.

[000256] In some demonstrative aspects, the first plurality of engaging extensions 561 may be configured to engage with the second plurality of engaging extensions 563, for example, when the lens barrel 533 is rotated relative to the image sensor holder 535, for example, around an axis of the optical device 529, e.g., as described above.

[000257] In some demonstrative aspects, the engaging section 575 and the engaging section 577 may be configured, for example, to maintain an alignment setting 511 substantially unchanged, for example, during the rotation of the engaging section 575 relative to the engaging section 577 from the disengaged state 590 to the engaged state 591, e.g., as described above.

[000258] In some demonstrative aspects, the alignment setting 511 may include, for example, an alignment between the optical device 529 and the image sensor 520, which may be obtained, for example, based on the AA procedure, e.g., as described above.

[000259] In some demonstrative aspects, the alignment between the optical device 529 and the image sensor 520 may include, for example, a tilt, e.g., at a tilt angle, denoted α , of a mechanical axis 569 of the lens barrel 533, e.g., relative to an axis perpendicular to a plane of the image sensor 520, e.g., which may be substantially aligned with the optical axis 598 of the optical device 529.

[000260] In some demonstrative aspects, the engaging section 575 and the engaging section 577 may be configured, for example, such that the lens barrel 533 may be maintained tilted with respect to the image sensor holder 535, for example, to maintain the alignment between the optical device 529 and the image sensor 520, for example, at the engaged state 591, e.g., as described above.

[000261] In some demonstrative aspects, as shown in Figs. 5D-5G, the engaging section 575 and the engaging section 577 may be configured, for example, such that the lens barrel 533 may be maintained shifted with respect to the optical axis of the optical device 529, for example, to maintain the alignment between the optical device 529 and the image sensor 520, for example, at the engaged state 591, e.g., as described above.

[000262] Reference is made to Figs. 6A, 6B, 6C, 6D, 6E, 6F and 6G, which schematically illustrate a camera structure assembly 600, in accordance with some demonstrative aspects. For example, camera structure 331 (Fig. 3) may include one or more elements of, and/or perform one or more functionalities of, the camera structure assembly 600.

[000263] In some demonstrative aspects, camera structure assembly 600 may include a unibody structure, e.g., as described below.

[000264] In some demonstrative aspects, camera structure assembly 600 may be configured according to a spiral engagement mechanism, e.g., as described below.

[000265] In some demonstrative aspects, the camera structure assembly 600 may include a lens assembly 671 and an image sensor assembly 673, e.g., as described below.

[000266] In some demonstrative aspects, lens assembly 671 may include a lens barrel 633, and an engaging section (first joint portion) 675 extending from the lens barrel 633.

[000267] In some demonstrative aspects, the lens barrel 633 may be configured to house and/or support an optical device 629 (Fig. 6B), e.g., the optical device 329 (Fig. 3). For example, the lens barrel 333 (Fig. 3) may include lens barrel 633.

[000268] In some demonstrative aspects, image sensor assembly 673 may include an image sensor holder 635, which may be configured to support, hold and/or house an image sensor 620, e.g., the image sensor 320 (Fig. 3). For example, image sensor holder 335 (Fig. 3) may include the image sensor holder 635.

[000269] In some demonstrative aspects, image sensor assembly 673 may include an engaging section (second joint portion) 677 extending from the image sensor holder 635.

[000270] In some demonstrative aspects, the engaging section 675 and the engaging section 677 may be configured to engage the lens assembly 671 with the image sensor assembly 673 at an engaged state 691 (Figs. 6F and 6G).

[000271] In some demonstrative aspects, when at the engaged state 691, the engaging section 677 may be in contact with the engaging section 675 at a plurality of contact areas 693, e.g., as described above.

[000272] In some demonstrative aspects, the engaging section 677 may be securable to the engaging section 675, for example, at the engaged state 691, e.g., as described above.

[000273] In some demonstrative aspects, the engaging section 677 may be securable to the engaging section 675, for example, with one or more joints 695 (Fig. 6G).

[000274] In some demonstrative aspects, the one or more joints 695 may include, for example, at least one of a soldering joint, a welding joint, a brazing joint, and/or an adhesive joint, e.g., as described above.

[000275] In some demonstrative aspects, the one or more joints 695 may be configured, for example, to maintain alignment between the optical device 629 and the image sensor 620, for example, at an aligned position after the AA procedure, e.g., as described above.

[000276] In some demonstrative aspects, engaging section 675 may include a first plurality of engaging extensions 661 extending from the lens barrel 633, e.g., as described below.

[000277] In some demonstrative aspects, second engaging section 677 may include a second plurality of engaging extensions 663 extending from the image sensor holder 635, e.g., as described below.

[000278] In some demonstrative aspects, the first plurality of engaging extensions 661 may include two first engaging extensions 661, and the second plurality of engaging extensions 663 may include two second engaging extensions 663.

[000279] In other aspects, any other suitable count of first engaging extensions 661 and/or second engaging extensions 663 may be implemented.

[000280] In some demonstrative aspects, the first plurality of engaging extensions 661 may be configured, for example, to extend from an end of the lens barrel 633, for example, in a direction substantially parallel to a mechanical axis 669 of the lens barrel 633.

[000281] In some demonstrative aspects, the first plurality of engaging extensions 661 may be configured, for example, to protrude from an end of the lens barrel 633 facing the image sensor holder 635.

[000282] In some demonstrative aspects, the second plurality of engaging extensions 663 may be configured, for example, to protrude from an end of the image sensor holder 635 facing the lens barrel 633.

[000283] In some demonstrative aspects, the first plurality of engaging extensions 661 and the second plurality of engaging extensions 663 may be arranged, for example, in a plurality of pairs 665 of engaging extensions.

[000284] In some demonstrative aspects, a pair 665 of engaging extensions may include a first engaging extension of the first plurality of engaging extensions 661 and a second engaging extension of the second plurality of engaging extensions 663.

[000285] In some demonstrative aspects, the first engaging extension and the second engaging extension may be configured to be in contact at the engaged state 691.

[000286] In some demonstrative aspects, as shown in Figs. 6E-6G, the first plurality of engaging extensions 661 may be arranged, for example, on a circumference of a first circle, and the second plurality of engaging extensions 663 may be arranged, for example, on a circumference of a second circle.

[000287] In some demonstrative aspects, as shown in Figs. 6E-6G, the second circle may be substantially concentric with the first circle.

[000288] In some demonstrative aspects, the plurality of contact areas 693 may be arranged, for example, with substantially equal spacing between adjacent contact areas 693.

[000289] In some demonstrative aspects, as shown in Figs. 6F-6G, the plurality of contact areas 693 may be arranged, for example, on a circumference of a circle around the image sensor 620.

[000290] In some demonstrative aspects, the plurality of contact areas 693 may be configured, for example, to include one or more spiral contact areas, e.g., as described below.

[000291] In some demonstrative aspects, the engaging section 675 and the engaging section 677 may be configured to provide a technical solution to support spiral contact between the lens assembly 671 and the image sensor assembly 673, for example, by relative rotation of the lens barrel 633 and the image sensor holder 635, for example, about an axis of the optical device 629, e.g., device 329 (Fig. 3), supported by lens barrel 633, e.g., as described above.

[000292] In some demonstrative aspects, as shown in Figs. 6E-6G, an engaging extension of the first plurality of engaging extensions 661 may have a first spiral shape, and an engaging extension of the second plurality of engaging extensions 663 may have a second spiral shape, which may be, for example, complementary to the first spiral shape.

[000293] In some demonstrative aspects, as shown in Figs. 6E-6G, the first and second spiral shapes may be configured, for example, such that at the engaged state 691, an inner surface of one of the first or second spiral shapes may be in contact, e.g., over a contact area 693, with an outer surface of another one of the first or second spiral shapes.

[000294] In some demonstrative aspects, the engaging section 675 and the engaging section 677 may be configured to provide a technical solution to support relative movement of the lens barrel 633 and the image sensor holder 635, for example, in one or more axes, for example during an AA procedure, e.g., as described above.

[000295] In some demonstrative aspects, the engaging section 675 and the engaging section 677 may be configured, for example, to allow rotation of the engaging section 675 relative to the engaging section 677, for example, from a disengaged state 690 (Fig. 6E) to the engaged state 691 (Figs. 6F-6G), for example, when the engaging section 677 is not secured to the engaging section 675, e.g., as described above.

[000296] In some demonstrative aspects, the rotation of the engaging section 675 relative to the engaging section 677 may include, for example, rotation of the lens assembly 671 relative to the image sensor assembly 673, for example, about an optical axis 698 of the optical device 629.

[000297] In some demonstrative aspects, the first plurality of engaging extensions 661 may be configured to engage with the second plurality of engaging extensions 663, for example, when the lens barrel 633 is rotated relative to the image sensor holder 635, for example, around an axis of the optical device 629, e.g., as described above.

[000298] In some demonstrative aspects, the engaging section 675 and the engaging section 677 may be configured, for example, to maintain an alignment setting 611 substantially unchanged, for example, during the rotation of the engaging section 675 relative to the engaging section 677 from the disengaged state 690 to the engaged state 691, e.g., as described above.

[000299] In some demonstrative aspects, the alignment setting 611 may include, for example, an alignment between the optical device 629 and the image sensor 620, which may be obtained, for example, based on the AA procedure, e.g., as described above.

[000300] In some demonstrative aspects, the alignment between the optical device 629 and the image sensor 620 may include, for example, a tilt, e.g., at a tilt angle, denoted α , of a mechanical axis 669 of the lens barrel 633, e.g., relative to an axis perpendicular to a plane of the image sensor 620, e.g., which may be substantially aligned with the optical axis 698 of the optical device 629.

[000301] In some demonstrative aspects, the engaging section 675 and the engaging section 677 may be configured, for example, such that the lens barrel 633 may be maintained tilted with respect to the image sensor holder 635, for example, to maintain the alignment between the optical device 629 and the image sensor 620, for example, at the engaged state 691, e.g., as described above.

[000302] In some demonstrative aspects, as shown in Figs. 6D-6G, the engaging section 675 and the engaging section 677 may be configured, for example, such that the lens barrel 633 may be maintained shifted with respect to the optical axis of the optical device 629, for example, to maintain the alignment between the optical device 629 and the image sensor 620, for example, at the engaged state 691, e.g., as described above.

[000303] Reference is made to Figs. 7A, 7B, 7C, 7D, and 7E, which schematically illustrate a camera structure assembly 700, in accordance with some demonstrative aspects. For example, camera structure 331 (Fig. 3) may include one or more elements of, and/or perform one or more functionalities of, the camera structure assembly 700.

[000304] In some demonstrative aspects, camera structure assembly 700 may include a camera housing structure, e.g., as described below.

[000305] In some demonstrative aspects, camera structure assembly 700 may be configured according to a radial engagement mechanism, e.g., as described below.

[000306] In some demonstrative aspects, the camera structure assembly 700 may include a lens assembly 771 and an image sensor assembly 773, e.g., as described below.

[000307] In some demonstrative aspects, lens assembly 771 may include a lens barrel 733, and an engaging section (first joint portion) 775 extending from the lens barrel 733.

[000308] In some demonstrative aspects, the lens barrel 733 may be configured to house and/or support an optical device 729 (Fig. 7B), e.g., the optical device 329 (Fig. 3). For example, the lens barrel 333 (Fig. 3) may include lens barrel 733.

[000309] In some demonstrative aspects, image sensor assembly 773 may include an image sensor holder 735, which may be configured to support, hold and/or house an image sensor 720, e.g., the image sensor 320 (Fig. 3). For example, image sensor holder 335 (Fig. 3) may include the image sensor holder 735.

[000310] In some demonstrative aspects, image sensor assembly 773 may include an engaging section (second joint portion) 777 extending from the image sensor holder 735.

[000311] In some demonstrative aspects, the engaging section 775 and the engaging section 777 may be configured to engage the lens assembly 771 with the image sensor assembly 773 at an engaged state 791 (Fig. 7E).

[000312] In some demonstrative aspects, when at the engaged state 791, the engaging section 777 may be in contact with the engaging section 775 at a plurality of contact areas 793, e.g., as described above.

[000313] In some demonstrative aspects, the engaging section 777 may be securable to the engaging section 775, for example, at the engaged state 791, e.g., as described above.

[000314] In some demonstrative aspects, the engaging section 777 may be securable to the engaging section 775, for example, with one or more joints 795 (Fig. 7E).

[000315] In some demonstrative aspects, the one or more joints 795 may include, for example, at least one of a soldering joint, a welding joint, a brazing joint, and/or an adhesive joint, e.g., as described above.

[000316] In some demonstrative aspects, the one or more joints 795 may be configured, for example, to maintain alignment between the optical device 729 and the image sensor 720, for example, at an aligned position after the AA procedure, e.g., as described above.

[000317] In some demonstrative aspects, engaging section 775 may include a first plurality of engaging extensions 761 extending from the lens barrel 733, e.g., as described below.

[000318] In some demonstrative aspects, second engaging section 777 may include a second plurality of engaging extensions 763 extending from the image sensor holder 735, e.g., as described below.

[000319] In some demonstrative aspects, the first plurality of engaging extensions 761 may include three first engaging extensions 761, and the second plurality of engaging extensions 763 may include three second engaging extensions 763.

[000320] In other aspects, any other suitable count of first engaging extensions 761 and/or second engaging extensions 763 may be implemented.

[000321] In some demonstrative aspects, the first plurality of engaging extensions 761 may be configured, for example, to extend from an outer surface of the lens barrel 733, for example, in a direction substantially perpendicular to the outer surface of the lens barrel 733 and, for example, substantially perpendicular to a mechanical axis 769 of the lens barrel 733.

[000322] In some demonstrative aspects, the second plurality of engaging extensions 763 may be configured, for example, to protrude from an end of the image sensor holder 735 facing the lens barrel 733.

[000323] In some demonstrative aspects, the first plurality of engaging extensions 761 and the second plurality of engaging extensions 763 may be arranged, for example, in a plurality of pairs 765 of engaging extensions.

[000324] In some demonstrative aspects, a pair 765 of engaging extensions may include a first engaging extension of the first plurality of engaging extensions 761 and a second engaging extension of the second plurality of engaging extensions 763.

[000325] In some demonstrative aspects, the first engaging extension and the second engaging extension may be configured to be in contact at the engaged state 791.

[000326] In some demonstrative aspects, as shown in Fig. 7E, the first plurality of engaging extensions 761 may be arranged, for example, on a circumference of a first circle, and the second plurality of engaging extensions 763 may be arranged, for example, on a circumference of a second circle.

[000327] In some demonstrative aspects, as shown in Fig. 7E, the second circle may be substantially concentric with the first circle. For example, as shown in Fig. 7E, the first circle and the second circle may have substantially the same radius.

[000328] In some demonstrative aspects, the second plurality of engaging extensions 763 may be arranged, for example, to fit in spaces between the first plurality of engaging extensions 761.

[000329] In some demonstrative aspects, the plurality of contact areas 793 may be arranged, for example, with substantially equal spacing between adjacent contact areas 793.

[000330] In some demonstrative aspects, the plurality of contact areas 793 may be arranged, for example, on a circumference of a circle around the image sensor 720.

[000331] In some demonstrative aspects, the plurality of contact areas 793 may be configured, for example, to include one or more radial contact areas, e.g., as described below.

[000332] In some demonstrative aspects, the engaging section 775 and the engaging section 777 may be configured to provide a technical solution to support radial contact between the lens assembly 771 and the image sensor assembly 773, for example, by relative rotation of the lens barrel 733 and the image sensor holder 735, for example, about an axis of the optical device 729, e.g., device 329 (Fig. 3), supported by lens barrel 733, e.g., as described above.

[000333] In some demonstrative aspects, one engagement extension of the pair of engaging extensions, e.g., an engaging extension 761, may include a radial surface, which may be configured to be in contact with a surface of another engagement extension of the pair of engaging extensions, e.g., an engaging extension 761, for example, at the engaged state 791.

[000334] In other aspects, any other surface form and/or shape may be implemented.

[000335] In some demonstrative aspects, the engaging section 775 and the engaging section 777 may be configured to provide a technical solution to support relative movement of the lens barrel 733 and the image sensor holder 735, for example, in one or more axes, for example during an AA procedure, e.g., as described above.

[000336] In some demonstrative aspects, the engaging section 775 and the engaging section 777 may be configured, for example, to allow rotation of the engaging section 775 relative to the engaging section 777, for example, from a disengaged state 790 (Fig. 7E) to the engaged state 791 (Figs. 7F-7G), for example, when the engaging section 777 is not secured to the engaging section 775, e.g., as described above.

[000337] In some demonstrative aspects, the rotation of the engaging section 775 relative to the engaging section 777 may include, for example, rotation of the lens assembly 771 relative to the image sensor assembly 773, for example, about an optical axis 798 of the optical device 729.

[000338] In some demonstrative aspects, the first plurality of engaging extensions 761 may be configured to engage with the second plurality of engaging extensions 763, for example, when the lens barrel 733 is rotated relative to the image sensor holder 735, for example, around an axis of the optical device 729, e.g., as described above.

[000339] In some demonstrative aspects, the engaging section 775 and the engaging section 777 may be configured, for example, to maintain an alignment setting 711 substantially unchanged, for example, during the rotation of the engaging section 775 relative to the engaging section 777 from the disengaged state 790 to the engaged state 791, e.g., as described above.

[000340] In some demonstrative aspects, the alignment setting 711 may include, for example, an alignment between the optical device 729 and the image sensor 720, which may be obtained, for example, based on the AA procedure, e.g., as described above.

[000341] In some demonstrative aspects, the alignment between the optical device 729 and the image sensor 720 may include, for example, a tilt, e.g., at a tilt angle, denoted a , of a mechanical axis 769 of the lens barrel 733, e.g., relative to an axis perpendicular to a plane of the image sensor 720, e.g., which may be substantially aligned with the optical axis 798 of the optical device 729.

[000342] In some demonstrative aspects, the engaging section 775 and the engaging section 777 may be configured, for example, such that the lens barrel 733 may be maintained tilted with respect to the image sensor holder 735, for example, to maintain the alignment between the optical device 729 and the image sensor 720, for example, at the engaged state 791, e.g., as described above.

[000343] In some demonstrative aspects, as shown in Fig. 7D, the engaging section 775 and the engaging section 777 may be configured, for example, such that the lens barrel 733 may be maintained shifted with respect to the optical axis of the optical device 729, for example, to maintain the alignment between the optical device 729 and the image sensor 720, for example, at the engaged state 791, e.g., as described above.

[000344] Reference is made to Figs. 8A, 8B, 8C, 8D, and 8E, which schematically illustrate a camera structure assembly 800, in accordance with some demonstrative aspects. For example, camera structure 331 (Fig. 3) may include one or more elements of, and/or perform one or more functionalities of, the camera structure assembly 800.

[000345] In some demonstrative aspects, camera structure assembly 800 may include a camera housing structure, e.g., as described below.

[000346] In some demonstrative aspects, camera structure assembly 800 may be configured according to a spiral engagement mechanism, e.g., as described below.

[000347] In some demonstrative aspects, the camera structure assembly 800 may include a lens assembly 871 and an image sensor assembly 873, e.g., as described below.

[000348] In some demonstrative aspects, lens assembly 871 may include a lens barrel 833, and an engaging section (first joint portion) 875 extending from the lens barrel 833.

[000349] In some demonstrative aspects, the lens barrel 833 may be configured to house and/or support an optical device 829 (Fig. 8B), e.g., the optical device 329 (Fig. 3). For example, the lens barrel 333 (Fig. 3) may include lens barrel 833.

[000350] In some demonstrative aspects, image sensor assembly 873 may include an image sensor holder 835, which may be configured to support, hold and/or house an image sensor 820, e.g., the image sensor 320 (Fig. 3). For example, image sensor holder 335 (Fig. 3) may include the image sensor holder 835.

[000351] In some demonstrative aspects, image sensor assembly 873 may include an engaging section (second joint portion) 877 extending from the image sensor holder 835.

[000352] In some demonstrative aspects, the engaging section 875 and the engaging section 877 may be configured to engage the lens assembly 871 with the image sensor assembly 873 at an engaged state 891 (Fig. 8E).

[000353] In some demonstrative aspects, when at the engaged state 891, the engaging section 877 may be in contact with the engaging section 875 at a plurality of contact areas 893, e.g., as described above.

[000354] In some demonstrative aspects, the engaging section 877 may be securable to the engaging section 875, for example, at the engaged state 891, e.g., as described above.

[000355] In some demonstrative aspects, the engaging section 877 may be securable to the engaging section 875, for example, with one or more joints 895 (Fig. 8E).

[000356] In some demonstrative aspects, the one or more joints 895 may include, for example, at least one of a soldering joint, a welding joint, a brazing joint, and/or an adhesive joint, e.g., as described above.

[000357] In some demonstrative aspects, the one or more joints 895 may be configured, for example, to maintain alignment between the optical device 829 and the image sensor 820, for example, at an aligned position after the AA procedure, e.g., as described above.

[000358] In some demonstrative aspects, engaging section 875 may include a first plurality of engaging extensions 861 extending from the lens barrel 833, e.g., as described below.

[000359] In some demonstrative aspects, second engaging section 877 may include a second plurality of engaging extensions 863 extending from the image sensor holder 835, e.g., as described below.

[000360] In some demonstrative aspects, the first plurality of engaging extensions 861 may include three first engaging extensions 861, and the second plurality of engaging extensions 863 may include three second engaging extensions 863.

[000361] In other aspects, any other suitable count of first engaging extensions 861 and/or second engaging extensions 863 may be implemented.

[000362] In some demonstrative aspects, the first plurality of engaging extensions 861 may be configured, for example, to extend from an outer surface of the lens barrel 833, for example, in a direction substantially perpendicular to the outer surface of the lens barrel 833 and, for example, substantially perpendicular to a mechanical axis 869 of the lens barrel 833.

[000363] In some demonstrative aspects, the second plurality of engaging extensions 863 may be configured, for example, to protrude from an end of the image sensor holder 835 facing the lens barrel 833.

[000364] In some demonstrative aspects, the first plurality of engaging extensions 861 and the second plurality of engaging extensions 863 may be arranged, for example, in a plurality of pairs 865 of engaging extensions.

[000365] In some demonstrative aspects, a pair 865 of engaging extensions may include a first engaging extension of the first plurality of engaging extensions 861 and a second engaging extension of the second plurality of engaging extensions 863.

[000366] In some demonstrative aspects, the first engaging extension and the second engaging extension may be configured to be in contact at the engaged state 891.

[000367] In some demonstrative aspects, as shown in Fig. 8E, the first plurality of engaging extensions 861 may be arranged, for example, on a circumference of a first circle, and the second plurality of engaging extensions 863 may be arranged, for example, on a circumference of a second circle.

[000368] In some demonstrative aspects, as shown in Fig. 8E, the second circle may be substantially concentric with the first circle.

[000369] In some demonstrative aspects, the plurality of contact areas 893 may be arranged, for example, with substantially equal spacing between adjacent contact areas 893.

[000370] In some demonstrative aspects, as shown in Fig. 8E, the plurality of contact areas 893 may be arranged, for example, on a circumference of a circle around the image sensor 820.

[000371] In some demonstrative aspects, the plurality of contact areas 893 may be configured, for example, to include one or more spiral contact areas, e.g., as described below.

[000372] In some demonstrative aspects, the engaging section 875 and the engaging section 877 may be configured to provide a technical solution to support spiral contact between the lens assembly 871 and the image sensor assembly 873, for example, by relative rotation of the lens barrel 833 and the image sensor holder 835, for example, about an axis of the optical device 829, e.g., device 329 (Fig. 3), supported by lens barrel 833, e.g., as described above.

[000373] In some demonstrative aspects, as shown in Fig. 8E, an engaging extension of the first plurality of engaging extensions 861 may have a first spiral shape, and an engaging extension of the second plurality of engaging extensions 863 may have a second spiral shape, which may be, for example, complementary to the first spiral shape.

[000374] In some demonstrative aspects, as shown in Fig. 8E, the first and second spiral shapes may be configured, for example, such that at the engaged state 891, an inner surface of one of the first or second spiral shapes may be in contact, e.g., over a contact area 893, with an outer surface of another one of the first or second spiral shapes.

[000375] In some demonstrative aspects, the engaging section 875 and the engaging section 877 may be configured to provide a technical solution to support relative movement of the lens barrel 833 and the image sensor holder 835, for example, in one or more axes, for example during an AA procedure, e.g., as described above.

[000376] In some demonstrative aspects, the engaging section 875 and the engaging section 877 may be configured, for example, to allow rotation of the engaging section 875 relative to the engaging section 877, for example, from a disengaged state 890 to the engaged state 891, for example, when the engaging section 877 is not secured to the engaging section 875, e.g., as described above.

[000377] In some demonstrative aspects, the rotation of the engaging section 875 relative to the engaging section 877 may include, for example, rotation of the lens assembly 871 relative to the image sensor assembly 873, for example, about an optical axis 898 of the optical device 829.

[000378] In some demonstrative aspects, the first plurality of engaging extensions 861 may be configured to engage with the second plurality of engaging extensions 863, for example, when the lens barrel 833 is rotated relative to the image sensor holder 835, for example, around an axis of the optical device 829, e.g., as described above.

[000379] In some demonstrative aspects, the engaging section 875 and the engaging section 877 may be configured, for example, to maintain an alignment setting 811 substantially unchanged, for example, during the rotation of the engaging section 875 relative to the engaging section 877 from the disengaged state 890 to the engaged state 891, e.g., as described above.

[000380] In some demonstrative aspects, the alignment setting 811 may include, for example, an alignment between the optical device 829 and the image sensor 820, which may be obtained, for example, based on the AA procedure, e.g., as described above.

[000381] In some demonstrative aspects, the alignment between the optical device 829 and the image sensor 820 may include, for example, a tilt, e.g., at a tilt angle, denoted α , of a mechanical axis 869 of the lens barrel 833, e.g., relative to an axis perpendicular to a plane of the image sensor 820, e.g., which may be substantially aligned with the optical axis 898 of the optical device 829.

[000382] In some demonstrative aspects, the engaging section 875 and the engaging section 877 may be configured, for example, such that the lens barrel 833 may be maintained tilted with respect to the image sensor holder 835, for example, to maintain the alignment between the optical device 829 and the image sensor 820, for example, at the engaged state 891, e.g., as described above.

[000383] In some demonstrative aspects, as shown in Figs. 8D-8E, the engaging section 875 and the engaging section 877 may be configured, for example, such that the lens barrel 833 may be maintained shifted with respect to the optical axis of the optical device 829, for example, to maintain the alignment between the optical device 829 and the image sensor 820, for example, at the engaged state 891, e.g., as described above.

[000384] Reference is made to Figs. 9A, 9B, 9C, 9D, and 9E, which schematically illustrate a camera structure assembly 900, in accordance with some demonstrative aspects. For example, camera structure 331 (Fig. 3) may include one or more elements of, and/or perform one or more functionalities of, the camera structure assembly 900.

[000385] In some demonstrative aspects, camera structure assembly 900 may include a camera housing structure, e.g., as described below.

[000386] In some demonstrative aspects, camera structure assembly 900 may be configured according to a spiral engagement mechanism, e.g., as described below.

[000387] In some demonstrative aspects, the camera structure assembly 900 may include a lens assembly 971 and an image sensor assembly 973, e.g., as described below.

[000388] In some demonstrative aspects, lens assembly 971 may include a lens barrel 933, and an engaging section (first joint portion) 975 extending from the lens barrel 933.

[000389] In some demonstrative aspects, the lens barrel 933 may be configured to house and/or support an optical device 929 (Fig. 9B), e.g., the optical device 329 (Fig. 3). For example, the lens barrel 333 (Fig. 3) may include lens barrel 933.

[000390] In some demonstrative aspects, image sensor assembly 973 may include an image sensor holder 935, which may be configured to support, hold and/or house an image sensor 920 (Fig. 9E), e.g., the image sensor 320 (Fig. 3). For example, image sensor holder 335 (Fig. 3) may include the image sensor holder 935.

[000391] In some demonstrative aspects, image sensor assembly 973 may include an engaging section (second joint portion) 977 extending from the image sensor holder 935.

[000392] In some demonstrative aspects, the engaging section 975 and the engaging section 977 may be configured to engage the lens assembly 971 with the image sensor assembly 973 at an engaged state 991 (Fig. 9E).

[000393] In some demonstrative aspects, when at the engaged state 991, the engaging section 977 may be in contact with the engaging section 975 at a plurality of contact areas 993, e.g., as described above.

[000394] In some demonstrative aspects, the engaging section 977 may be securable to the engaging section 975, for example, at the engaged state 991, e.g., as described above.

[000395] In some demonstrative aspects, the engaging section 977 may be securable to the engaging section 975, for example, with one or more joints 995 (Fig. 9E).

[000396] In some demonstrative aspects, the one or more joints 995 may include, for example, at least one of a soldering joint, a welding joint, a brazing joint, and/or an adhesive joint, e.g., as described above.

[000397] In some demonstrative aspects, the one or more joints 995 may be configured, for example, to maintain alignment between the optical device 929 and the image sensor 920, for example, at an aligned position after the AA procedure, e.g., as described above.

[000398] In some demonstrative aspects, engaging section 975 may include a first plurality of engaging extensions 961 extending from the lens barrel 933, e.g., as described below.

[000399] In some demonstrative aspects, second engaging section 977 may include a second plurality of engaging extensions 963 extending from the image sensor holder 935, e.g., as described below.

[000400] In some demonstrative aspects, the first plurality of engaging extensions 961 may include three first engaging extensions 961, and the second plurality of engaging extensions 963 may include three second engaging extensions 963.

[000401] In other aspects, any other suitable count of first engaging extensions 961 and/or second engaging extensions 963 may be implemented.

[000402] In some demonstrative aspects, the first plurality of engaging extensions 961 may be configured, for example, to extend from an outer surface of the lens barrel 933, for example, in a direction substantially perpendicular to the outer surface of the lens barrel 933 and, for example, substantially perpendicular to a mechanical axis 969 of the lens barrel 933.

[000403] In some demonstrative aspects, the second plurality of engaging extensions 963 may be configured, for example, to protrude from an end of the image sensor holder 935 facing the lens barrel 933.

[000404] In some demonstrative aspects, the first plurality of engaging extensions 961 and the second plurality of engaging extensions 963 may be arranged, for example, in a plurality of pairs 965 of engaging extensions.

[000405] In some demonstrative aspects, a pair 965 of engaging extensions may include a first engaging extension of the first plurality of engaging extensions 961 and a second engaging extension of the second plurality of engaging extensions 963.

[000406] In some demonstrative aspects, the first engaging extension and the second engaging extension may be configured to be in contact at the engaged state 991.

[000407] In some demonstrative aspects, as shown in Fig. 9E, the first plurality of engaging extensions 961 may be arranged, for example, on a circumference of a first circle, and the second plurality of engaging extensions 963 may be arranged, for example, on a circumference of a second circle.

[000408] In some demonstrative aspects, as shown in Fig. 9E, the second circle may be substantially concentric with the first circle.

[000409] In some demonstrative aspects, the plurality of contact areas 993 may be arranged, for example, with substantially equal spacing between adjacent contact areas 993.

[000410] In some demonstrative aspects, as shown in Fig. 9E, the plurality of contact areas 993 may be arranged, for example, on a circumference of a circle around the image sensor 920.

[000411] In some demonstrative aspects, the plurality of contact areas 993 may be configured, for example, to include one or more spiral contact areas, e.g., as described below.

[000412] In some demonstrative aspects, the engaging section 975 and the engaging section 977 may be configured to provide a technical solution to support contact, e.g., spiral contact, between the lens assembly 971 and the image sensor assembly 973, for example, by relative rotation of the lens barrel 933 and the image sensor holder 935, for example, about an axis of the optical device 929, e.g., device 329 (Fig. 3), supported by lens barrel 933, e.g., as described above.

[000413] In some demonstrative aspects, as shown in Fig. 9E, an engaging extension of the first plurality of engaging extensions 961 may have a surface having a first predefined shape, and an engaging extension of the second plurality of engaging extensions 963 may have a second predefined shape, which may be, for example, complementary to the first predefined shape.

[000414] In some demonstrative aspects, as shown in Fig. 9E, the first and second predefined shapes may be configured, for example, such that at the engaged state 991, the surfaces of the pair of engaging extensions 965 may be in contact, e.g., over a contact area 993.

[000415] In some demonstrative aspects, the engaging section 975 and the engaging section 977 may be configured to provide a technical solution to support relative movement of the lens barrel 933 and the image sensor holder 935, for example, in one or more axes, for example during an AA procedure, e.g., as described above.

[000416] In some demonstrative aspects, the engaging section 975 and the engaging section 977 may be configured, for example, to allow rotation of the engaging section 975 relative to the engaging section 977, for example, from a disengaged state 990 to the engaged state 991, for example, when the engaging section 977 is not secured to the engaging section 975, e.g., as described above.

[000417] In some demonstrative aspects, the rotation of the engaging section 975 relative to the engaging section 977 may include, for example, rotation of the lens assembly 971 relative to the image sensor assembly 973, for example, about an optical axis 998 of the optical device 929.

[000418] In some demonstrative aspects, the first plurality of engaging extensions 961 may be configured to engage with the second plurality of engaging extensions 963, for example, when the lens barrel 933 is rotated relative to the image sensor holder 935, for example, around an axis of the optical device 929, e.g., as described above.

[000419] In some demonstrative aspects, the engaging section 975 and the engaging section 977 may be configured, for example, to maintain an alignment setting 911 substantially unchanged, for example, during the rotation of the engaging section 975 relative to the engaging section 977 from the disengaged state 990 to the engaged state 991, e.g., as described above.

[000420] In some demonstrative aspects, the alignment setting 911 may include, for example, an alignment between the optical device 929 and the image sensor 920, which may be obtained, for example, based on the AA procedure, e.g., as described above.

[000421] In some demonstrative aspects, the alignment between the optical device 929 and the image sensor 920 may include, for example, a tilt, e.g., at a tilt angle, denoted a , of the mechanical axis 969 of the lens barrel 933, e.g., relative to an axis perpendicular to a plane of the image sensor 920, e.g., which may be substantially aligned with the optical axis 998 of the optical device 929.

[000422] In some demonstrative aspects, the engaging section 975 and the engaging section 977 may be configured, for example, such that the lens barrel 933 may be maintained tilted with respect to the image sensor holder 935, for example, to maintain the alignment between the optical device 929 and the image sensor 920, for example, at the engaged state 991, e.g., as described above.

[000423] In some demonstrative aspects, as shown in Figs. 9D-8E, the engaging section 975 and the engaging section 977 may be configured, for example, such that the lens barrel 933 may be maintained shifted with respect to the optical axis of the optical device 929, for example, to maintain the alignment between the optical device 929 and the image sensor 920, for example, at the engaged state 991, e.g., as described above.

[000424] In some demonstrative aspects, a camera structure may be configured to support fixation of a lens assembly and an image sensor assembly, for example, by one or more joints, e.g., welding joints, soldering joints, brazing joints, and/or adhesive joints, which may be applied on an external surfaces of the camera structure, e.g., as described above.

[000425] In some demonstrative aspects, a camera structure may be configured to support fixation of a lens assembly and an image sensor assembly, for example, by an adhesive, which may be applied between internal surfaces of the camera structure, e.g., as described below.

[000426] Referring back to Fig. 3, in some demonstrative aspects, camera structure 331 may be configured to support fixation of the lens assembly 371 and the image sensor assembly 373 by an adhesive, e.g., as described below.

[000427] In some demonstrative aspects, at least one engagement extension in a pair of engaging extensions (not shown in Fig. 3) of the engaging section 375 and the engaging section 377 may include a cavity (nowt shown in Fig. 3), which may be configured, for example, to maintain an adhesive to bond between the pair of engaging extensions at the engaged state, e.g., as described below.

[000428] In some demonstrative aspects, the engaging section 375 and the engaging section 377 may be configured to include a plurality of pairs of gap-defining extensions (not shown in Fig. 3), which may be configured to maintain a plurality of gaps, for example, when the engaging section 375 and the engaging section 377 are at the engaged state, e.g., as described below.

[000429] In some demonstrative aspects, the engaging section 375 and the engaging section 377 may be configured, for example, such that a pair of gap-defining extensions may include a first gap-defining extension (not shown in Fig. 3) extending from the lens barrel 333 and a second gap-defining extension (not shown in Fig. 3) extending from the image sensor holder 335, e.g., as described below.

[000430] In some demonstrative aspects, the engaging section 375 and the engaging section 377 may be configured, for example, such that the pair of gap-defining extensions may be configured to maintain a gap at the engaged state.

[000431] In some demonstrative aspects, the gap may be configured to maintain an adhesive, for example, to bond between the pair of gap-defining extensions, e.g., as described below.

[000432] In some demonstrative aspects, joint area 337 may include one or more notches, gaps, cavities, spaces, and/or apertures (also referred to as “adhesive-holding gaps”) (not shown in Fig. 3), which may be configured to maintain, contain and/or hold an adhesive, for example, to adhere between the lens barrel 333 and the image sensor holder 335, for example, after engaging between engaging section 375 and engaging section 377, for example, following the AA procedure, e.g., as described below.

[000433] In some demonstrative aspects, the adhesive-holding gaps and/or gap-defining extensions may be configured to provide a technical solution to support applying the adhesive prior to, or during, the AA procedure, e.g., while the optical device 329 and the image sensor 320 and not yet aligned.

[000434] In some demonstrative aspects, the adhesive-holding gaps and/or gap-defining extensions may be configured to provide a technical solution to support applying the adhesive following the AA procedure, for example, after the alignment of the optical device 329 and the image sensor 320.

[000435] In some demonstrative aspects, one or more adhesive-holding gaps may be formed as part of an engaging extension (joint element) in the joint area 337, which is to connect between the lens barrel 333 and the image sensor holder 335, e.g., as described below.

[000436] In some demonstrative aspects, one or more adhesive-holding gaps may be formed in portions of the joint area 337, for example, separate from the engaging extensions (joint elements), which are to connect between the lens barrel 333 and the image sensor holder 335, e.g., as described below.

[000437] In some demonstrative aspects, an adhesive-holding gap may be configured to maintain, contain and/or hold an adhesive, for example, such that the adhesive may be able to adhere between the lens barrel 333 and the image sensor holder 335, for example, following the AA procedure, e.g., as described below.

[000438] In some demonstrative aspects, a shape and/or form of joint area 337 may be configured, for example, such that the one or more adhesive-holding gaps may be formed when the engaging section 375 of lens barrel 333 is in contact with the engaging section 377 of image sensor holder 335, for example, following the AA procedure, e.g., as described below.

[000439] Reference is made to Figs. 10A, 10B, 10C, 10D, 10E, 10F and 10G, which schematically illustrate a camera structure assembly 1000, in accordance with some demonstrative aspects. For example, camera structure 331 (Fig. 3) may include one or more elements of, and/or perform one or more functionalities of, the camera structure assembly 1000.

[000440] In some demonstrative aspects, camera structure assembly 1000 may include a unibody structure, e.g., as described below.

[000441] In some demonstrative aspects, camera structure assembly 1000 may be configured according to a radial engagement mechanism, e.g., as described below.

[000442] In some demonstrative aspects, the camera structure assembly 1000 may include a lens assembly 1071 and an image sensor assembly 1073, e.g., as described below.

[000443] In some demonstrative aspects, lens assembly 1071 may include a lens barrel 1033, and an engaging section (first joint portion) 1075 extending from the lens barrel 1033.

[000444] In some demonstrative aspects, the lens barrel 1033 may be configured to house and/or support an optical device 1029 (Fig. 10B), e.g., the optical device 329 (Fig. 3). For example, the lens barrel 333 (Fig. 3) may include lens barrel 1033.

[000445] In some demonstrative aspects, image sensor assembly 1073 may include an image sensor holder 1035, which may be configured to support, hold and/or house an image sensor 1020, e.g., the image sensor 320 (Fig. 3). For example, image sensor holder 335 (Fig. 3) may include the image sensor holder 1035.

[000446] In some demonstrative aspects, image sensor assembly 1073 may include an engaging section (second joint portion) 1077 extending from the image sensor holder 1035.

[000447] In some demonstrative aspects, the engaging section 1075 and the engaging section 1077 may be configured to engage the lens assembly 1071 with the image sensor assembly 1073 at an engaged state 1091 (Figs. 10F and 10G).

[000448] In some demonstrative aspects, when at the engaged state 1091, the engaging section 1077 may be in contact with the engaging section 1075 at a plurality of contact areas 1093, e.g., as described above.

[000449] In some demonstrative aspects, engaging section 1075 may include a first plurality of engaging extensions 1061 extending from the lens barrel 1033, e.g., as described below.

[000450] In some demonstrative aspects, second engaging section 1077 may include a second plurality of engaging extensions 1063 extending from the image sensor holder 1035, e.g., as described below.

[000451] In some demonstrative aspects, the first plurality of engaging extensions 1061 may include three first engaging extensions 1061, and the second plurality of engaging extensions 1063 may include three second engaging extensions 1063.

[000452] In other aspects, any other suitable count of first engaging extensions 1061 and/or second engaging extensions 1063 may be implemented.

[000453] In some demonstrative aspects, the first plurality of engaging extensions 1061 may be configured, for example, to extend from an end of the lens barrel 1033, for example, in a direction substantially parallel to a mechanical axis 1069 of the lens barrel 1033.

[000454] In some demonstrative aspects, the first plurality of engaging extensions 1061 may be configured, for example, to protrude from an end of the lens barrel 1033 facing the image sensor holder 1035.

[000455] In some demonstrative aspects, the second plurality of engaging extensions 1063 may be configured, for example, to protrude from an end of the image sensor holder 1035 facing the lens barrel 1033.

[000456] In some demonstrative aspects, the first plurality of engaging extensions 1061 and the second plurality of engaging extensions 1063 may be arranged, for example, in a plurality of pairs 1065 of engaging extensions.

[000457] In some demonstrative aspects, a pair 1065 of engaging extensions may include a first engaging extension of the first plurality of engaging extensions 1061 and a second engaging extension of the second plurality of engaging extensions 1063.

[000458] In some demonstrative aspects, the first engaging extension and the second engaging extension may be configured to be in contact at the engaged state 1091.

[000459] In some demonstrative aspects, as shown in Figs. 10E-10G, the first plurality of engaging extensions 1061 may be arranged, for example, on a circumference of a first circle, and the second plurality of engaging extensions 1063 may be arranged, for example, on a circumference of a second circle.

[000460] In some demonstrative aspects, as shown in Figs. 10E-10G, the second circle may be substantially concentric with the first circle. For example, as shown in Figs. 10E-10G, the first circle and the second circle may have substantially the same radius.

[000461] In some demonstrative aspects, the second plurality of engaging extensions 1063 may be arranged, for example, to fit in spaces between the first plurality of engaging extensions 1061.

[000462] In some demonstrative aspects, the plurality of contact areas 1093 may be arranged, for example, with substantially equal spacing between adjacent contact areas 1093.

[000463] In some demonstrative aspects, as shown in Figs. 10F-10G, the plurality of contact areas 1093 may be arranged, for example, on a circumference of a circle around the image sensor 1020.

[000464] In some demonstrative aspects, the plurality of contact areas 1093 may be configured, for example, to include one or more radial contact areas, e.g., as described below.

[000465] In some demonstrative aspects, the engaging section 1075 and the engaging section 1077 may be configured to provide a technical solution to support radial contact between the lens assembly 1071 and the image sensor assembly 1073, for example, by relative rotation of the lens barrel 1033 and the image sensor holder 1035, for example, about an axis of the optical device 1029, e.g., device 329 (Fig. 3), supported by lens barrel 1033, e.g., as described above.

[000466] In some demonstrative aspects, one engagement extension of the pair of engaging extensions, e.g., an engaging extension 1061, may include a radial surface, which may be configured to be in contact with a surface of another engagement extension of the pair of engaging extensions, e.g., an engaging extension 1061, for example, at the engaged state 1091.

[000467] In other aspects, any other surface form and/or shape may be implemented.

[000468] In some demonstrative aspects, the engaging section 1075 and the engaging section 1077 may be configured to provide a technical solution to support relative movement of the lens barrel 1033 and the image sensor holder 1035, for example, in one or more axes, for example during an AA procedure, e.g., as described above.

[000469] In some demonstrative aspects, the engaging section 1075 and the engaging section 1077 may be configured, for example, to allow rotation of the engaging section 1075 relative to the engaging section 1077, for example, from a disengaged state 1090 (Fig. 10E) to the

engaged state 1091 (Figs. 10F-10G), for example, when the engaging section 1077 is not secured to the engaging section 1075, e.g., as described above.

[000470] In some demonstrative aspects, the rotation of the engaging section 1075 relative to the engaging section 1077 may include, for example, rotation of the lens assembly 1071 relative to the image sensor assembly 1073, for example, about an optical axis 1098 of the optical device 1029.

[000471] In some demonstrative aspects, the first plurality of engaging extensions 1061 may be configured to engage with the second plurality of engaging extensions 1063, for example, when the lens barrel 1033 is rotated relative to the image sensor holder 1035, for example, around an axis of the optical device 1029, e.g., as described above.

[000472] In some demonstrative aspects, the engaging section 1075 and the engaging section 1077 may be configured, for example, to maintain an alignment setting 1011 substantially unchanged, for example, during the rotation of the engaging section 1075 relative to the engaging section 1077 from the disengaged state 1090 to the engaged state 1091, e.g., as described above.

[000473] In some demonstrative aspects, the alignment setting 1011 may include, for example, an alignment between the optical device 1029 and the image sensor 1020, which may be obtained, for example, based on the AA procedure, e.g., as described above.

[000474] In some demonstrative aspects, the alignment between the optical device 1029 and the image sensor 1020 may include, for example, a tilt, e.g., at a tilt angle, denoted a , of a mechanical axis 1069 of the lens barrel 1033, e.g., relative to an axis perpendicular to a plane of the image sensor 1020, e.g., which may be substantially aligned with the optical axis 1098 of the optical device 1029.

[000475] In some demonstrative aspects, the engaging section 1075 and the engaging section 1077 may be configured, for example, such that the lens barrel 1033 may be maintained tilted with respect to the image sensor holder 1035, for example, to maintain the alignment between the optical device 1029 and the image sensor 1020, for example, at the engaged state 1091, e.g., as described above.

[000476] In some demonstrative aspects, as shown in Figs. 10D-10G, the engaging section 1075 and the engaging section 1077 may be configured, for example, such that the lens barrel 1033 may be maintained shifted with respect to the optical axis of the optical device 1029, for

example, to maintain the alignment between the optical device 1029 and the image sensor 1020, for example, at the engaged state 1091, e.g., as described above.

[000477] In some demonstrative aspects, the engaging section 1077 may be securable to the engaging section 1075, for example, at the engaged state 1091, e.g., as described above.

[000478] In some demonstrative aspects, the engaging section 1077 may be securable to the engaging section 1075, for example, by an adhesive 1095 (Fig. 10G).

[000479] In some demonstrative aspects, the adhesive 1095 may include any suitable adhesive.

[000480] In some demonstrative aspects, camera structure assembly 1000 may include a plurality of pairs of gap-defining extensions, e.g., as described below.

[000481] In some demonstrative aspects, as shown in Figs. 10A-10G, two or more pairs of engaging extensions 1065 may be configured to perform the functionality of the plurality of pairs of gap-defining extensions, e.g., as described below.

[000482] In other aspects, one or more pairs of gap-defining extensions may be formed by elements separate from the pairs of engaging extensions 1065.

[000483] In some demonstrative aspects, the pair of gap-defining extensions may include a first gap-defining extension 1061 extending from the lens barrel 1033 and a second gap-defining extension 1063 extending from the image sensor holder 1035.

[000484] In some demonstrative aspects, the pair of gap-defining extensions may be configured to maintain a gap at the engaged state 1091.

[000485] In some demonstrative aspects, the gap may be configured to maintain an adhesive to bond between the pair of gap-defining extensions, e.g., as described below.

[000486] In some demonstrative aspects, at least one engagement extension of a pair of engaging extensions 1065 may include a cavity 1055, which may be configured, for example, to maintain an adhesive to bond between the pair of engaging extensions at the engaged state 1091, e.g., as described below.

[000487] In some demonstrative aspects, the engaging section 1075 and/or the engaging section 1077 may be formed to include one or more adhesive-holding gaps 1055, which may be configured to maintain an adhesive.

[000488] In some demonstrative aspects, as shown in Fig. 10G, an adhesive 1095 may be applied to the adhesive-holding gaps 1055, for example, to maintain alignment between the optical device 1029 and the image sensor 1020, for example, at an aligned position, for example, after the AA procedure, e.g., as described above.

[000489] In some demonstrative aspects, the adhesive 1095 may include a glue, a polymer, a paste, and/or any other suitable binding material or substance.

[000490] In some demonstrative aspects, the adhesive-holding gaps 1055 may be formed on a perimeter of an engaging extension 1063 of the engaging section 1077.

[000491] In other aspects, one or more of the adhesive-holding gaps may be formed on a perimeter of an engaging extension 1061 of the engaging section 1075.

[000492] In some demonstrative aspects, the adhesive-holding gaps 1055 may be formed along part of the perimeter of the engaging extension 1063 of the engaging section 1077.

[000493] In some demonstrative aspects, a first portion of the perimeter of the engaging extension 1063 of the engaging section 1077 may be configured to be fastened against a corresponding engaging extension 1061 of the engaging section 1075, e.g., along the contact area 1093.

[000494] In some demonstrative aspects, a second portion of the perimeter of the engaging extension 1063 of the engaging section 1077 may be configured to form an adhesive-holding gap 1055.

[000495] In some demonstrative aspects, the first and second portions of the perimeter of the engaging extension 1063 of the engaging section 1077 may be configured to form a “step-like” shape of the adhesive-holding gap 1055.

[000496] In some demonstrative aspects, the adhesive-holding gap 1055 may have a substantially rectangular cross-section.

[000497] In other aspects, the holding gap 1055 may be configured to have any other suitable shape and/or form.

[000498] In some demonstrative aspects, the adhesive-holding gap 1055 may be formed to be in fluidic contact with an outer surface of the engaging section 1077, for example, to provide a technical solution to support applying the adhesive to the adhesive-holding gap 1055, for example, either before or after the AA procedure.

[000499] In other aspects, the adhesive-holding gap 1055 may be formed at an internal portion of the engaging section 1077.

[000500] Reference is made to Figs. 11A, 11B, 11C, 11D, 11E, 11F and 11G, which schematically illustrate a camera structure assembly 1100, in accordance with some demonstrative aspects. For example, camera structure 331 (Fig. 3) may include one or more elements of, and/or perform one or more functionalities of, the camera structure assembly 1100.

[000501] In some demonstrative aspects, camera structure assembly 1100 may include a unibody structure, e.g., as described below.

[000502] In some demonstrative aspects, camera structure assembly 1100 may be configured according to a radial engagement mechanism, e.g., as described below.

[000503] In some demonstrative aspects, the camera structure assembly 1100 may include a lens assembly 1171 and an image sensor assembly 1173, e.g., as described below.

[000504] In some demonstrative aspects, lens assembly 1171 may include a lens barrel 1133, and an engaging section (first joint portion) 1175 extending from the lens barrel 1133.

[000505] In some demonstrative aspects, the lens barrel 1133 may be configured to house and/or support an optical device 1129 (Fig. 11B), e.g., the optical device 329 (Fig. 3). For example, the lens barrel 333 (Fig. 3) may include lens barrel 1133.

[000506] In some demonstrative aspects, image sensor assembly 1173 may include an image sensor holder 1135, which may be configured to support, hold and/or house an image sensor 1120, e.g., the image sensor 320 (Fig. 3). For example, image sensor holder 335 (Fig. 3) may include the image sensor holder 1135.

[000507] In some demonstrative aspects, image sensor assembly 1173 may include an engaging section (second joint portion) 1177 extending from the image sensor holder 1135.

[000508] In some demonstrative aspects, the engaging section 1175 and the engaging section 1177 may be configured to engage the lens assembly 1171 with the image sensor assembly 1173 at an engaged state 1191 (Figs. 11F and 11G).

[000509] In some demonstrative aspects, when at the engaged state 1191, the engaging section 1177 may be in contact with the engaging section 1175 at a plurality of contact areas 1193, e.g., as described above.

[000510] In some demonstrative aspects, engaging section 1175 may include a first plurality of engaging extensions 1161 extending from the lens barrel 1133, e.g., as described below.

[000511] In some demonstrative aspects, second engaging section 1177 may include a second plurality of engaging extensions 1163 extending from the image sensor holder 1135, e.g., as described below.

[000512] In some demonstrative aspects, the first plurality of engaging extensions 1161 may include three first engaging extensions 1161, and the second plurality of engaging extensions 1163 may include three second engaging extensions 1163.

[000513] In other aspects, any other suitable count of first engaging extensions 1161 and/or second engaging extensions 1163 may be implemented.

[000514] In some demonstrative aspects, the first plurality of engaging extensions 1161 may be configured, for example, to extend from an end of the lens barrel 1133, for example, in a direction substantially parallel to a mechanical axis 1169 of the lens barrel 1133.

[000515] In some demonstrative aspects, the first plurality of engaging extensions 1161 may be configured, for example, to protrude from an end of the lens barrel 1133 facing the image sensor holder 1135.

[000516] In some demonstrative aspects, the second plurality of engaging extensions 1163 may be configured, for example, to protrude from an end of the image sensor holder 1135 facing the lens barrel 1133.

[000517] In some demonstrative aspects, the first plurality of engaging extensions 1161 and the second plurality of engaging extensions 1163 may be arranged, for example, in a plurality of pairs 1165 of engaging extensions.

[000518] In some demonstrative aspects, a pair 1165 of engaging extensions may include a first engaging extension of the first plurality of engaging extensions 1161 and a second engaging extension of the second plurality of engaging extensions 1163.

[000519] In some demonstrative aspects, the first engaging extension and the second engaging extension may be configured to be in contact at the engaged state 1191.

[000520] In some demonstrative aspects, as shown in Figs. 11E-11G, the first plurality of engaging extensions 1161 may be arranged, for example, on a circumference of a first circle,

and the second plurality of engaging extensions 1163 may be arranged, for example, on a circumference of a second circle.

[000521] In some demonstrative aspects, as shown in Figs. 11E-11G, the second circle may be substantially concentric with the first circle. For example, as shown in Figs. 11E-11G, the first circle and the second circle may have substantially the same radius.

[000522] In some demonstrative aspects, the second plurality of engaging extensions 1163 may be arranged, for example, to fit in spaces between the first plurality of engaging extensions 1161.

[000523] In some demonstrative aspects, the plurality of contact areas 1193 may be arranged, for example, with substantially equal spacing between adjacent contact areas 1193.

[000524] In some demonstrative aspects, as shown in Figs. 11F-11G, the plurality of contact areas 1193 may be arranged, for example, on a circumference of a circle around the image sensor 1120.

[000525] In some demonstrative aspects, the plurality of contact areas 1193 may be configured, for example, to include one or more radial contact areas, e.g., as described below.

[000526] In some demonstrative aspects, the engaging section 1175 and the engaging section 1177 may be configured to provide a technical solution to support radial contact between the lens assembly 1171 and the image sensor assembly 1173, for example, by relative rotation of the lens barrel 1133 and the image sensor holder 1135, for example, about an axis of the optical device 1129, e.g., device 329 (Fig. 3), supported by lens barrel 1133, e.g., as described above.

[000527] In some demonstrative aspects, one engagement extension of the pair of engaging extensions, e.g., an engaging extension 1161, may include a radial surface, which may be configured to be in contact with a surface of another engagement extension of the pair of engaging extensions, e.g., an engaging extension 1161, for example, at the engaged state 1191.

[000528] In other aspects, any other surface form and/or shape may be implemented.

[000529] In some demonstrative aspects, the engaging section 1175 and the engaging section 1177 may be configured to provide a technical solution to support relative movement of the lens barrel 1133 and the image sensor holder 1135, for example, in one or more axes, for example during an AA procedure, e.g., as described above.

[000530] In some demonstrative aspects, the engaging section 1175 and the engaging section 1177 may be configured, for example, to allow rotation of the engaging section 1175 relative to the engaging section 1177, for example, from a disengaged state 1190 (Fig. 11E) to the engaged state 1191 (Figs. 11F-11G), for example, when the engaging section 1177 is not secured to the engaging section 1175, e.g., as described above.

[000531] In some demonstrative aspects, the rotation of the engaging section 1175 relative to the engaging section 1177 may include, for example, rotation of the lens assembly 1171 relative to the image sensor assembly 1173, for example, about an optical axis 1198 of the optical device 1129.

[000532] In some demonstrative aspects, the first plurality of engaging extensions 1161 may be configured to engage with the second plurality of engaging extensions 1163, for example, when the lens barrel 1133 is rotated relative to the image sensor holder 1135, for example, around an axis of the optical device 1129, e.g., as described above.

[000533] In some demonstrative aspects, the engaging section 1175 and the engaging section 1177 may be configured, for example, to maintain an alignment setting 1111 substantially unchanged, for example, during the rotation of the engaging section 1175 relative to the engaging section 1177 from the disengaged state 1190 to the engaged state 1191, e.g., as described above.

[000534] In some demonstrative aspects, the alignment setting 1111 may include, for example, an alignment between the optical device 1129 and the image sensor 1120, which may be obtained, for example, based on the AA procedure, e.g., as described above.

[000535] In some demonstrative aspects, the alignment between the optical device 1129 and the image sensor 1120 may include, for example, a tilt, e.g., at a tilt angle, denoted α , of a mechanical axis 1169 of the lens barrel 1133, e.g., relative to an axis perpendicular to a plane of the image sensor 1120, e.g., which may be substantially aligned with the optical axis 1198 of the optical device 1129.

[000536] In some demonstrative aspects, the engaging section 1175 and the engaging section 1177 may be configured, for example, such that the lens barrel 1133 may be maintained tilted with respect to the image sensor holder 1135, for example, to maintain the alignment between the optical device 1129 and the image sensor 1120, for example, at the engaged state 1191, e.g., as described above.

[000537] In some demonstrative aspects, as shown in Figs. 11D-11G, the engaging section 1175 and the engaging section 1177 may be configured, for example, such that the lens barrel 1133 may be maintained shifted with respect to the optical axis of the optical device 1129, for example, to maintain the alignment between the optical device 1129 and the image sensor 1120, for example, at the engaged state 1191, e.g., as described above.

[000538] In some demonstrative aspects, the engaging section 1177 may be securable to the engaging section 1175, for example, at the engaged state 1191, e.g., as described above.

[000539] In some demonstrative aspects, the engaging section 1177 may be securable to the engaging section 1175, for example, by an adhesive 1195 (Fig. 11G).

[000540] In some demonstrative aspects, the adhesive 1195 may include any suitable adhesive.

[000541] In some demonstrative aspects, camera structure assembly 1100 may include a plurality of pairs of gap-defining extensions 1159, e.g., as described below.

[000542] In some demonstrative aspects, as shown in Figs. 11E-11G, two or more of the pairs of gap-defining extensions 1159 may be formed by elements separate from the pairs of engaging extensions 1165.

[000543] In some demonstrative aspects, a pair of gap-defining extensions 1159 may include a first gap-defining extension 1157 extending from the lens barrel 1133 and a second gap-defining extension 1158 extending from the image sensor holder 1135.

[000544] In some demonstrative aspects, the pair of gap-defining extensions 1159 may be configured to maintain a gap 1155 at the engaged state 1191.

[000545] In some demonstrative aspects, the gap 1155 may be configured to maintain an adhesive 1195 to bond between the pair of gap-defining extensions 1159, e.g., as described below.

[000546] In some demonstrative aspects, the engaging section 1175 and/or the engaging section 1177 may be formed to include one or more adhesive-holding gaps 1155, which may be configured to maintain the adhesive 1195.

[000547] In some demonstrative aspects, as shown in Fig. 11G, the adhesive 1195 may be applied to the adhesive-holding gaps 1155, for example, to maintain alignment between the

optical device 1129 and the image sensor 1120, for example, at an aligned position, for example, after the AA procedure, e.g., as described above.

[000548] In some demonstrative aspects, the adhesive 1195 may include a glue, a polymer, a paste, and/or any other suitable binding material or substance.

[000549] In some demonstrative aspects, the adhesive-holding gap 1155 may have a substantially rectangular cross-section.

[000550] In other aspects, the holding gap 1155 may be configured to have any other suitable shape and/or form.

[000551] In some demonstrative aspects, as shown in Figs. 11E-11G, the engaging section 1175 and/or the engaging section 1177 may be configured, for example, such that one or more engaging extensions 1161 of the engaging section 1175 may be fastened against one or more corresponding engaging extensions 1163 of the engaging section 1177.

[000552] In some demonstrative aspects, as shown in Figs. 11E-11G, the engaging section 1175 and/or the engaging section 1177 may be configured, for example, such that one or more adhesive-holding gaps 1155 may be maintained, for example, when the engaging extensions 1161 of the engaging section 1175 are fastened against the corresponding engaging extensions 1163 of the engaging section 1177.

[000553] In some demonstrative aspects, as shown in Figs. 11A-11G, the engaging section 1177 may be configured, for example, such that there may be gaps of different sizes between pairs of neighboring extensions of the engaging section 1177.

[000554] In some demonstrative aspects, as shown in Figs. 11A-11G, the engaging section 1177 may be configured, for example, such that there may be gaps of a first size between one or more pairs of neighboring joint elements of the second joint portion 783, and gaps of a second size between one or more pairs of neighboring gap-defining extensions 1159.

[000555] In some demonstrative aspects, the second gap size may be larger than the first gap size. For example, a size of an adhesive-holding gap 1155 may be based on a difference between the second gap size and the first gap size.

[000556] For example, the gaps of the first size may be substantially closed, for example, when the engaging extensions 1161 of the engaging section 1175 are fastened against the corresponding engaging extensions 1163 of the engaging section 1177.

[000557] For example, the adhesive-holding gaps 1155 may be formed by partial closing of the gaps of the second size between the pairs of neighboring gap-defining extensions 1159, for example, when the engaging extensions 1161 of the engaging section 1175 are fastened against the corresponding engaging extensions 1163 of the engaging section 1177.

[000558] In other aspects, the engaging section 1175 may be configured, for example, such that one or more engaging extensions 1163 may have a first element size, and one or more gap-defining extension 1157 may have a second element size.

[000559] For example, the second element size may be smaller than the first element size. For example, a size of an adhesive-holding gap 1155 may be based on a difference between the first element size and the second element size.

[000560] In some demonstrative aspects, a camera structure assembly, e.g., camera structure assembly 1000 (Fig. 10) and/or camera structure assembly 1100, may be configured to include one or more adhesive-holding gaps, e.g., adhesive-holding gaps 1055 (Fig. 10) and/or adhesive-holding gaps 1155, for example, according to a radial engagement mechanism, e.g., as described above with reference to Figs. 10A-10G and/or Figs. 11A-11G.

[000561] In other aspects, the adhesive-holding gaps may be implemented by a camera structure assembly configured according to a spiral engagement mechanism, e.g., as described above with reference to Figs. 6A-6G, 8A-8E, and/or 9Ae-9E.

EXAMPLES

[000562] The following examples pertain to further aspects.

[000563] Example 1 includes an image capturing apparatus comprising a lens assembly comprising a lens barrel; an optical device secured to the lens barrel; and a first engaging section extending from the lens barrel; and an image sensor assembly comprising an image sensor holder configured to support an image sensor to capture one or more images via the optical device; and a second engaging section extending from the image sensor holder, wherein the first engaging section and the second engaging section are configured to engage the lens assembly with the image sensor assembly at an engaged state, wherein at the engaged state the second engaging section is in contact with the first engaging section at a plurality of contact areas and is securable to the first engaging section.

[000564] Example 2 includes the subject matter of Example 1, and optionally, wherein the first engaging section and the second engaging section are configured to allow rotation of the first engaging section relative to the second engaging section from a disengaged state to the engaged state when the second engaging section is not secured to the first engaging section.

[000565] Example 3 includes the subject matter of Example 2, and optionally, wherein the rotation of the first engaging section relative to the second engaging section comprises rotation of the lens assembly relative the image sensor assembly about an optical axis of the optical device.

[000566] Example 4 includes the subject matter of Example 2 or 3, and optionally, wherein the first engaging section and the second engaging section are configured to maintain an alignment setting substantially unchanged during the rotation of the first engaging section relative to the second engaging section from the disengaged state to the engaged state, the alignment setting comprising an alignment between the optical device and the image sensor.

[000567] Example 5 includes the subject matter of Example 4, and optionally, wherein the alignment between the optical device and the image sensor comprises a tilt of a mechanical axis of the lens barrel relative to an axis perpendicular to a plane of the image sensor.

[000568] Example 6 includes the subject matter of any one of Examples 1-6, and optionally, wherein the first engaging section comprises a first plurality of engaging extensions extending from the lens barrel, wherein the second engaging section comprises a second plurality of engaging extensions extending from the image sensor holder, wherein the first plurality of engaging extensions and the second plurality of engaging extensions are arranged in a plurality of pairs of engaging extensions, wherein a pair of engaging extensions comprises a first engaging extension of the first plurality of engaging extensions and a second engaging extension of the second plurality of engaging extensions, wherein the first engaging extension and the second engaging extension are configured to be in contact at the engaged state.

[000569] Example 7 includes the subject matter of Example 6, and optionally, wherein the first plurality of engaging extensions are arranged on a circumference of a first circle, wherein the second plurality of engaging extensions are arranged on a circumference of a second circle substantially concentric with the first circle.

[000570] Example 8 includes the subject matter of Example 6 or 7, and optionally, wherein the second plurality of engaging extensions are arranged to fit in spaces between the first plurality of engaging extensions.

[000571] Example 9 includes the subject matter of any one of Examples 6-8, and optionally, wherein one engagement extension of the pair of engaging extensions comprises a radial surface configured to be in contact with a surface of another engagement extension of the pair of engaging extensions at the engaged state.

[000572] Example 10 includes the subject matter of any one of Examples 6-8, and optionally, wherein the first engaging extension has a first spiral shape, and the second engaging extension has a second spiral shape complementary to the first spiral shape.

[000573] Example 11 includes the subject matter of Example 10, and optionally, wherein at the engaged state an inner surface of one of the first or second spiral shapes is in contact with an outer surface of another one of the first or second spiral shapes.

[000574] Example 12 includes the subject matter of any one of Examples 6-11, and optionally, wherein at least one engagement extension of the pair of engaging extensions comprises a cavity to maintain an adhesive to bond between the pair of engaging extensions at the engaged state.

[000575] Example 13 includes the subject matter of any one of Examples 6-12, and optionally, comprising a plurality of pairs of gap-defining extensions, wherein a pair of gap-defining extensions comprises a first gap-defining extension extending from the lens barrel and a second gap-defining extension extending from the image sensor holder, the pair of gap-defining extensions configured to maintain a gap at the engaged state, wherein the gap is configured to maintain an adhesive to bond between the pair of gap-defining extensions.

[000576] Example 14 includes the subject matter of any one of Examples 6-13, and optionally, wherein the first plurality of engaging extensions extend from an end of the lens barrel in a direction substantially parallel to a mechanical axis of the lens barrel.

[000577] Example 15 includes the subject matter of any one of Examples 6-13, and optionally, wherein the first plurality of engaging extensions extend from an outer surface of the lens barrel in a direction substantially perpendicular to the outer surface of the lens barrel and substantially perpendicular to a mechanical axis of the lens barrel.

[000578] Example 16 includes the subject matter of any one of Examples 6-15, and optionally, wherein the first plurality of engaging extensions comprises two first engaging extensions, wherein the second plurality of engaging extensions comprises two second engaging extensions.

[000579] Example 17 includes the subject matter of any one of Examples 6-15, and optionally, wherein the first plurality of engaging extensions comprises at least three first engaging extensions, wherein the second plurality of engaging extensions comprises at least three second engaging extensions.

[000580] Example 18 includes the subject matter of any one of Examples 1-17, and optionally, wherein the plurality of contact areas are arranged with substantially equal spacing between adjacent contact areas.

[000581] Example 19 includes the subject matter of any one of Examples 1-18, and optionally, comprising at least one of a soldering joint, a welding joint, or a brazing joint to secure the second engaging section to the first engaging section at the engaged state.

[000582] Example 20 includes the subject matter of any one of Examples 1-19, and optionally, comprising an adhesive joint to secure the second engaging section to the first engaging section at the engaged state.

[000583] Example 21 includes the subject matter of any one of Examples 1-20, and optionally, wherein the lens barrel is tilted with respect to the image sensor holder to align between the optical device and the image sensor.

[000584] Example 22 includes the subject matter of any one of Examples 1-21, and optionally, wherein the lens barrel is shifted with respect to an optical axis of the optical device to align between the optical device and the image sensor.

[000585] Example 23 includes the subject matter of any one of Examples 1-22, and optionally, wherein the plurality of contact areas are arranged on a circumference of a circle around the image sensor.

[000586] Example 24 includes the subject matter of any one of Examples 1-23, and optionally, wherein the plurality of contact areas comprise one or more radial contact areas.

[000587] Example 25 includes the subject matter of any one of Examples 1-24, and optionally, wherein the plurality of contact areas comprise one or more spiral contact areas.

[000588] Example 26 includes the subject matter of any one of Examples 1-25, and optionally, comprising a processor to generate processed information based on the one or more images captured by the image sensor.

[000589] Example 27 includes an image-based sensing device comprising an image capturing device comprising a lens assembly comprising a lens barrel; an optical device secured to the lens barrel; and a first engaging section extending from the lens barrel; and an image sensor assembly comprising an image sensor holder configured to support an image sensor to capture one or more images via the optical device; and a second engaging section extending from the image sensor holder, wherein the first engaging section and the second engaging section are configured to engage the lens assembly with the image sensor assembly at an engaged state, wherein at the engaged state the second engaging section is in contact with the first engaging section at a plurality of contact areas and is securable to the first engaging section; and a processor configured to generate image-based sensor information based on the one or more images.

[000590] Example 28 includes the subject matter of Example 27, and optionally, comprising the subject matter of any of Examples 1-25.

[000591] Example 29 includes a vehicle comprising an image-based sensing device comprising an image capturing device comprising a lens assembly comprising a lens barrel; an optical device secured to the lens barrel; and a first engaging section extending from the lens barrel; and an image sensor assembly comprising an image sensor holder configured to support an image sensor to capture one or more images via the optical device; and a second engaging section extending from the image sensor holder, wherein the first engaging section and the second engaging section are configured to engage the lens assembly with the image sensor assembly at an engaged state, wherein at the engaged state the second engaging section is in contact with the first engaging section at a plurality of contact areas and is securable to the first engaging section; and a processor configured to generate image-based sensor information based on the one or more images; and a system controller to control one or more systems of the vehicle based on the image-based sensor information.

[000592] Example 30 includes the subject matter of Example 29, and optionally, comprising the subject matter of any of Examples 1-25.

[000593] Example 31 includes an apparatus comprising means for performing any of the described operations of any of Examples 1-30.

[000594] Example 32 includes a system comprising means for performing any of the described operations of any of Examples 1-30.

[000595] Example 33 includes a method including any of the described operations of any of Examples 1-30.

[000596] Functions, operations, components and/or features described herein with reference to one or more aspects, may be combined with, or may be utilized in combination with, one or more other functions, operations, components and/or features described herein with reference to one or more other aspects, or vice versa.

[000597] While certain features have been illustrated and described herein, many modifications, substitutions, changes, and equivalents may occur to those skilled in the art. It is, therefore, to be understood that the appended claims are intended to cover all such modifications and changes as fall within the true spirit of the disclosure.

CLAIMS

What is claimed is:

1. An image capturing apparatus comprising:
a lens assembly comprising:
a lens barrel;
an optical device secured to the lens barrel; and
a first engaging section extending from the lens barrel; and
an image sensor assembly comprising:
an image sensor holder configured to support an image sensor to capture one or more images via the optical device; and
a second engaging section extending from the image sensor holder, wherein the first engaging section and the second engaging section are configured to engage the lens assembly with the image sensor assembly at an engaged state, wherein at the engaged state the second engaging section is in contact with the first engaging section at a plurality of contact areas and is securable to the first engaging section.
2. The image capturing apparatus of claim 1, wherein the first engaging section and the second engaging section are configured to allow rotation of the first engaging section relative to the second engaging section from a disengaged state to the engaged state when the second engaging section is not secured to the first engaging section.
3. The image capturing apparatus of claim 2, wherein the rotation of the first engaging section relative to the second engaging section comprises rotation of the lens assembly relative to the image sensor assembly about an optical axis of the optical device.
4. The image capturing apparatus of claim 2, wherein the first engaging section and the second engaging section are configured to maintain an alignment setting substantially unchanged during the rotation of the first engaging section relative to the second engaging section from the disengaged state to the engaged state, the alignment setting comprising an alignment between the optical device and the image sensor.
5. The image capturing apparatus of claim 4, wherein the alignment between the optical device and the image sensor comprises a tilt of a mechanical axis of the lens barrel relative to an axis perpendicular to a plane of the image sensor.

6. The image capturing apparatus of claim 1, wherein the first engaging section comprises a first plurality of engaging extensions extending from the lens barrel, wherein the second engaging section comprises a second plurality of engaging extensions extending from the image sensor holder, wherein the first plurality of engaging extensions and the second plurality of engaging extensions are arranged in a plurality of pairs of engaging extensions, wherein a pair of engaging extensions comprises a first engaging extension of the first plurality of engaging extensions and a second engaging extension of the second plurality of engaging extensions, wherein the first engaging extension and the second engaging extension are configured to be in contact at the engaged state.
7. The image capturing apparatus of claim 6, wherein the first plurality of engaging extensions are arranged on a circumference of a first circle, wherein the second plurality of engaging extensions are arranged on a circumference of a second circle substantially concentric with the first circle.
8. The image capturing apparatus of claim 6, wherein the second plurality of engaging extensions are arranged to fit in spaces between the first plurality of engaging extensions.
9. The image capturing apparatus of claim 6, wherein one engagement extension of the pair of engaging extensions comprises a radial surface configured to be in contact with a surface of another engagement extension of the pair of engaging extensions at the engaged state.
10. The image capturing apparatus of claim 6, wherein the first engaging extension has a first spiral shape, and the second engaging extension has a second spiral shape complementary to the first spiral shape.
11. The image capturing apparatus of claim 10, wherein at the engaged state an inner surface of one of the first or second spiral shapes is in contact with an outer surface of another one of the first or second spiral shapes.
12. The image capturing apparatus of claim 6, wherein at least one engagement extension of the pair of engaging extensions comprises a cavity to maintain an adhesive to bond between the pair of engaging extensions at the engaged state.
13. The image capturing apparatus of claim 6 comprising a plurality of pairs of gap-defining extensions, wherein a pair of gap-defining extensions comprises a first gap-defining

extension extending from the lens barrel and a second gap-defining extension extending from the image sensor holder, the pair of gap-defining extensions configured to maintain a gap at the engaged state, wherein the gap is configured to maintain an adhesive to bond between the pair of gap-defining extensions.

14. The image capturing apparatus of claim 6, wherein the first plurality of engaging extensions extend from an end of the lens barrel in a direction substantially parallel to a mechanical axis of the lens barrel.

15. The image capturing apparatus of claim 6, wherein the first plurality of engaging extensions extend from an outer surface of the lens barrel in a direction substantially perpendicular to the outer surface of the lens barrel and substantially perpendicular to a mechanical axis of the lens barrel.

16. The image capturing apparatus of claim 6, wherein the first plurality of engaging extensions comprises two first engaging extensions, wherein the second plurality of engaging extensions comprises two second engaging extensions.

17. The image capturing apparatus of claim 6, wherein the first plurality of engaging extensions comprises at least three first engaging extensions, wherein the second plurality of engaging extensions comprises at least three second engaging extensions.

18. The image capturing apparatus of any one of claims 1-17, wherein the plurality of contact areas are arranged with substantially equal spacing between adjacent contact areas.

19. The image capturing apparatus of any one of claims 1-17 comprising at least one of a soldering joint, a welding joint, or a brazing joint to secure the second engaging section to the first engaging section at the engaged state.

20. The image capturing apparatus of any one of claims 1-17 comprising an adhesive joint to secure the second engaging section to the first engaging section at the engaged state.

21. The image capturing apparatus of any one of claims 1-17, wherein the lens barrel is tilted with respect to the image sensor holder to align between the optical device and the image sensor.

22. The image capturing apparatus of any one of claims 1-17, wherein the lens barrel is shifted with respect to an optical axis of the optical device to align between the optical device and the image sensor.
23. The image capturing apparatus of any one of claims 1-17, wherein the plurality of contact areas are arranged on a circumference of a circle around the image sensor.
24. The image capturing apparatus of any one of claims 1-17, wherein the plurality of contact areas comprise one or more radial contact areas.
25. The image capturing apparatus of any one of claims 1-17, wherein the plurality of contact areas comprise one or more spiral contact areas.
26. An image-based sensing device comprising:
an image capturing device comprising:
a lens assembly comprising:
a lens barrel;
an optical device secured to the lens barrel; and
a first engaging section extending from the lens barrel; and
an image sensor assembly comprising:
an image sensor holder configured to support an image sensor to capture one or more images via the optical device; and
a second engaging section extending from the image sensor holder, wherein the first engaging section and the second engaging section are configured to engage the lens assembly with the image sensor assembly at an engaged state, wherein at the engaged state the second engaging section is in contact with the first engaging section at a plurality of contact areas and is securable to the first engaging section; and
a processor configured to generate image-based sensor information based on the one or more images.
27. The image-based sensing device of claim 26, wherein the first engaging section and the second engaging section are configured to allow rotation of the first engaging section relative to the second engaging section from a disengaged state to the engaged state when the second engaging section is not secured to the first engaging section.

28. A vehicle comprising:
an image-based sensing device comprising:
an image capturing device comprising:
a lens assembly comprising:
a lens barrel;
an optical device secured to the lens barrel; and
a first engaging section extending from the lens barrel; and
an image sensor assembly comprising:
an image sensor holder configured to support an image sensor to capture one or more images via the optical device; and
a second engaging section extending from the image sensor holder, wherein the first engaging section and the second engaging section are configured to engage the lens assembly with the image sensor assembly at an engaged state, wherein at the engaged state the second engaging section is in contact with the first engaging section at a plurality of contact areas and is securable to the first engaging section; and
a processor configured to generate image-based sensor information based on the one or more images; and
a system controller to control one or more systems of the vehicle based on the image-based sensor information.

29. The vehicle of claim 28, wherein the first engaging section comprises a first plurality of engaging extensions extending from the lens barrel, wherein the second engaging section comprises a second plurality of engaging extensions extending from the image sensor holder, wherein the first plurality of engaging extensions and the second plurality of engaging extensions are arranged in a plurality of pairs of engaging extensions, wherein a pair of engaging extensions comprises a first engaging extension of the first plurality of engaging extensions and a second engaging extension of the second plurality of engaging extensions, wherein the first engaging extension and the second engaging extension are configured to be in contact at the engaged state.

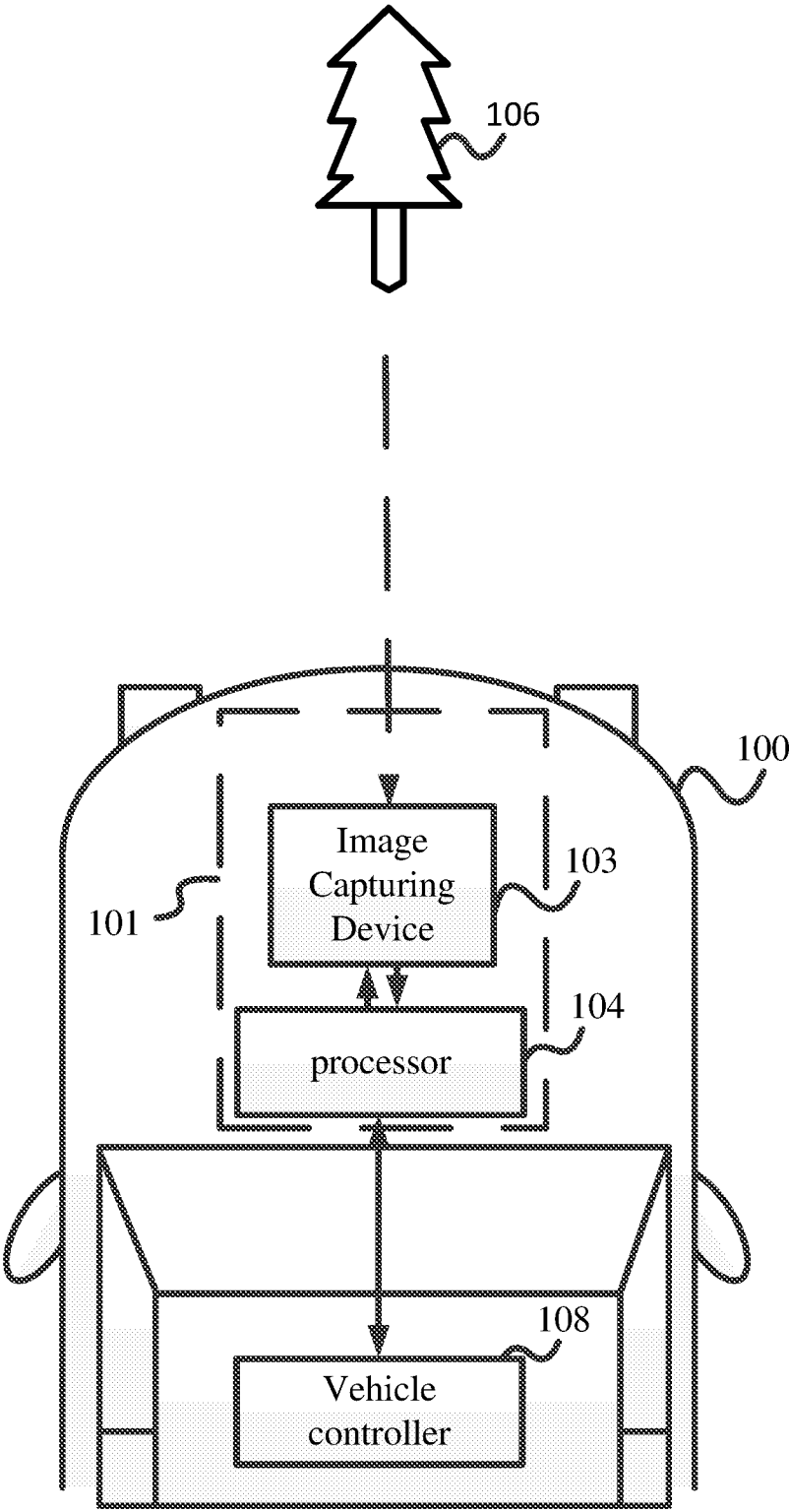


Fig. 1

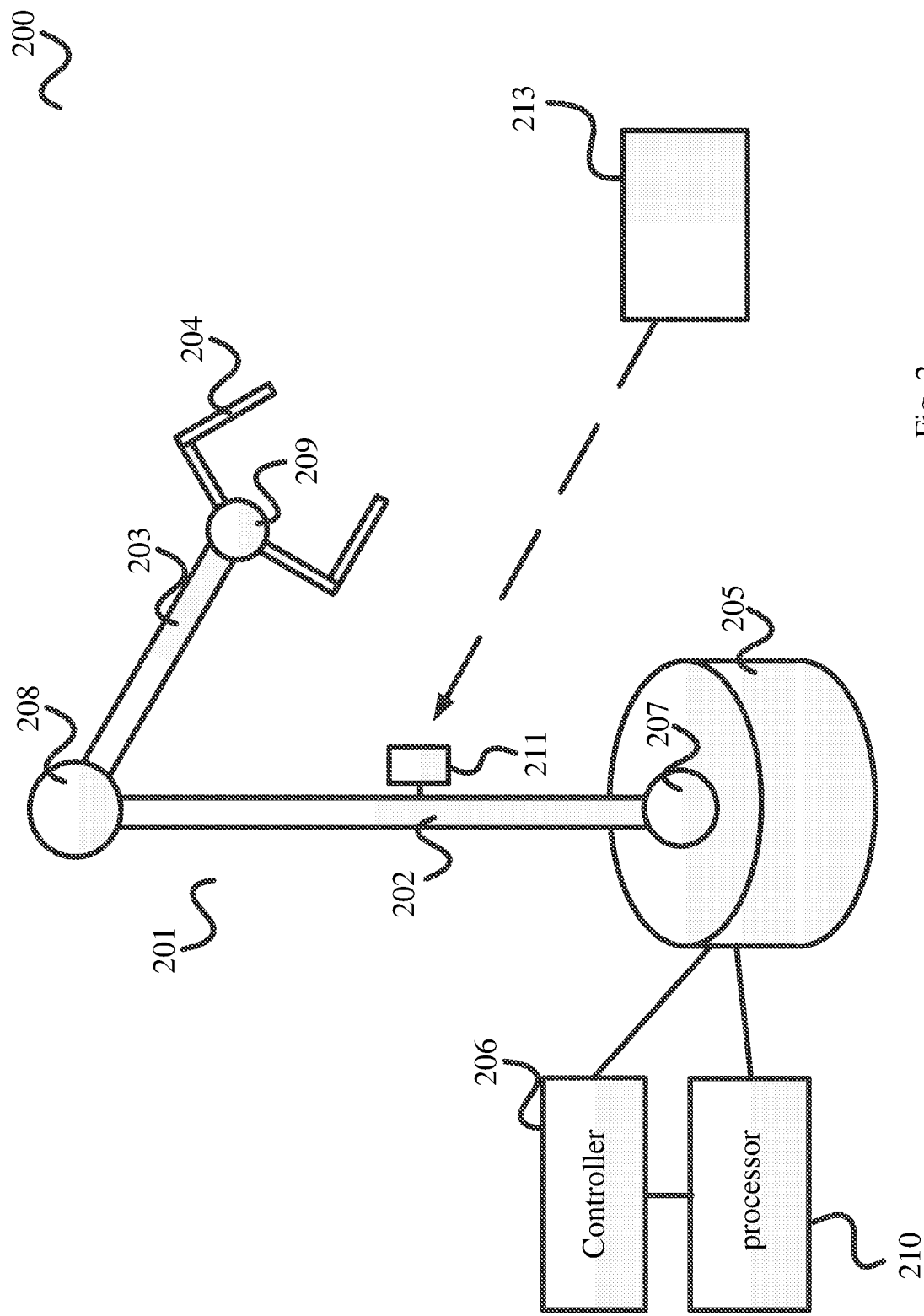


Fig. 2

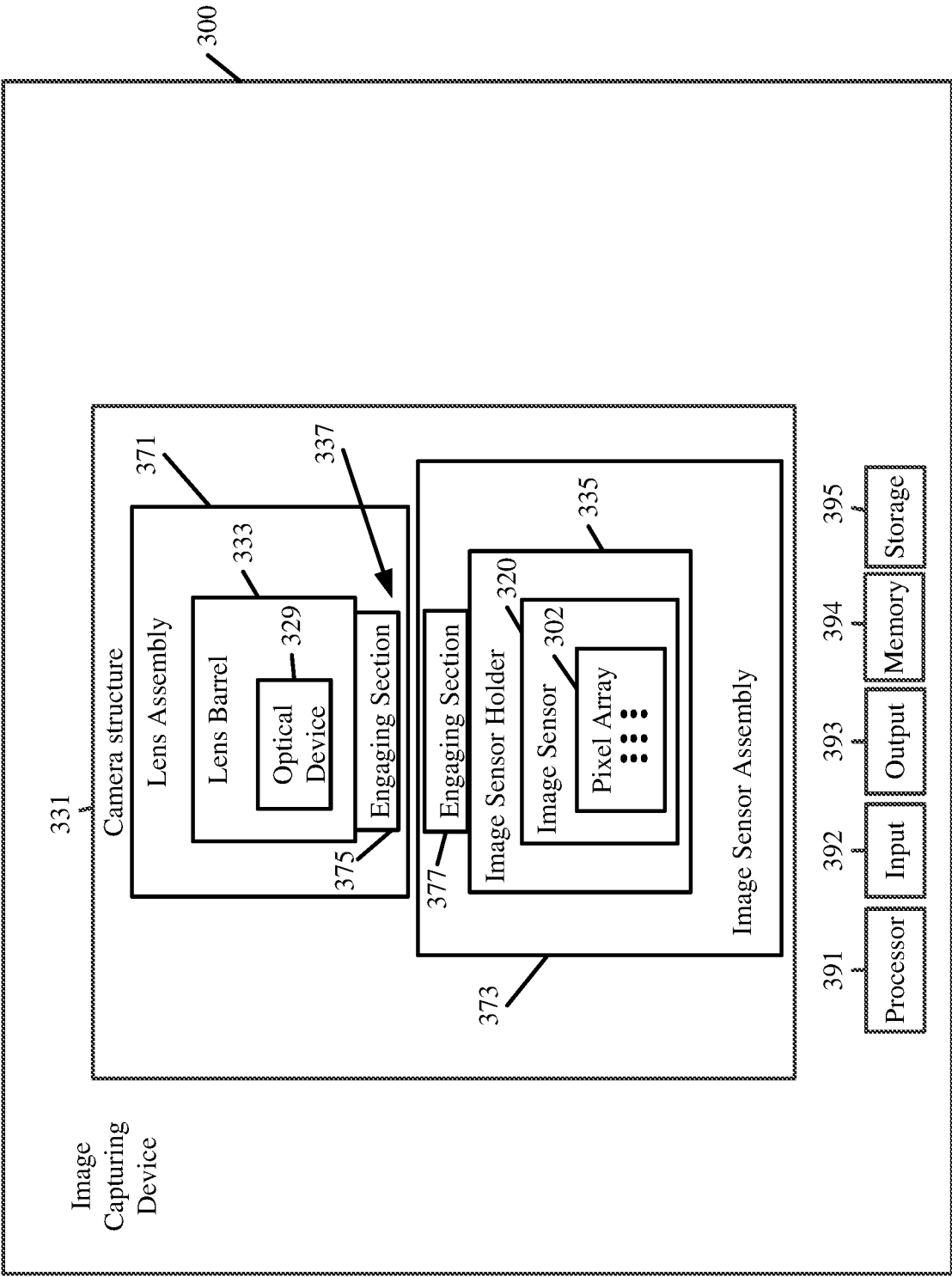


Fig. 3

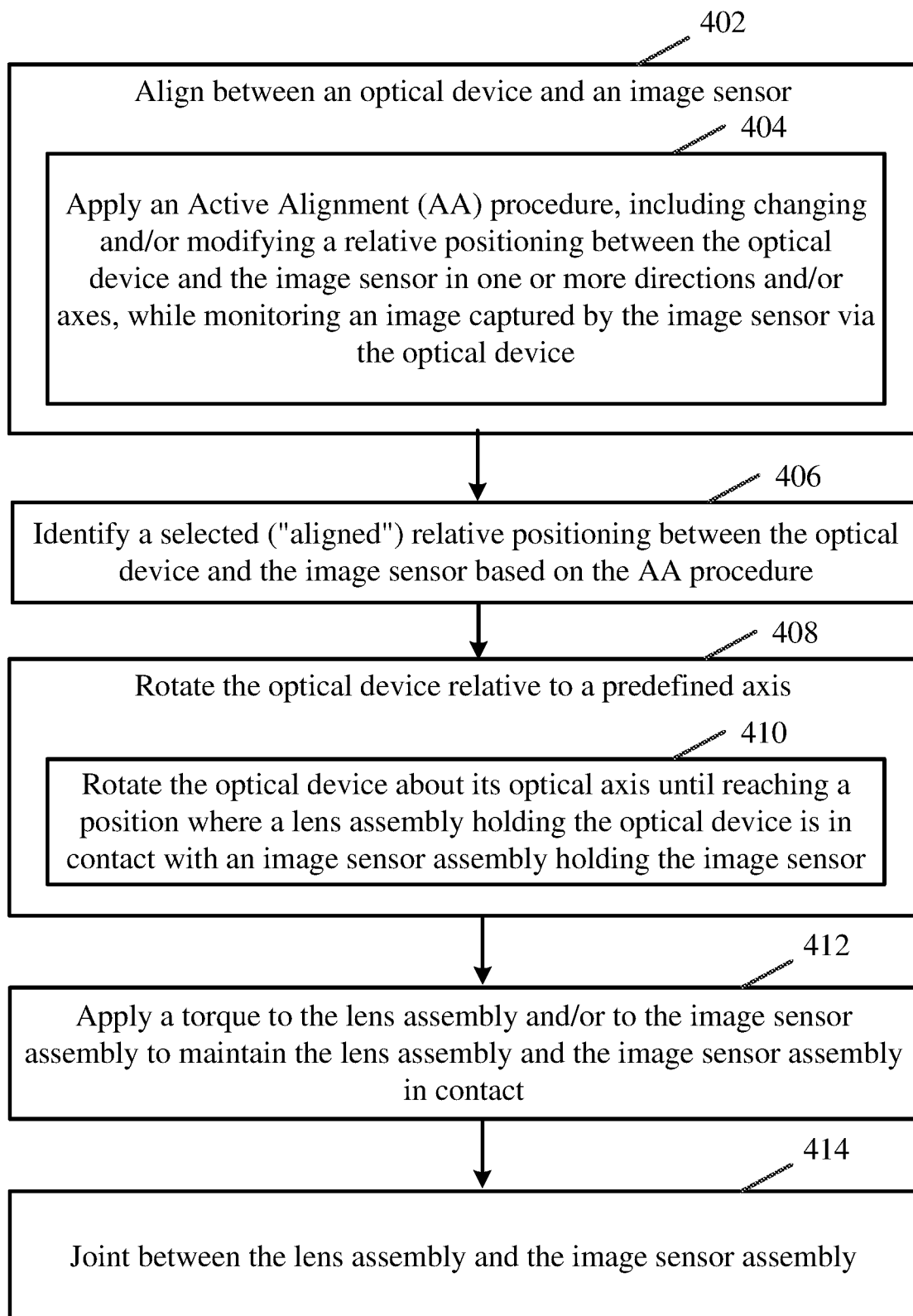


Fig. 4

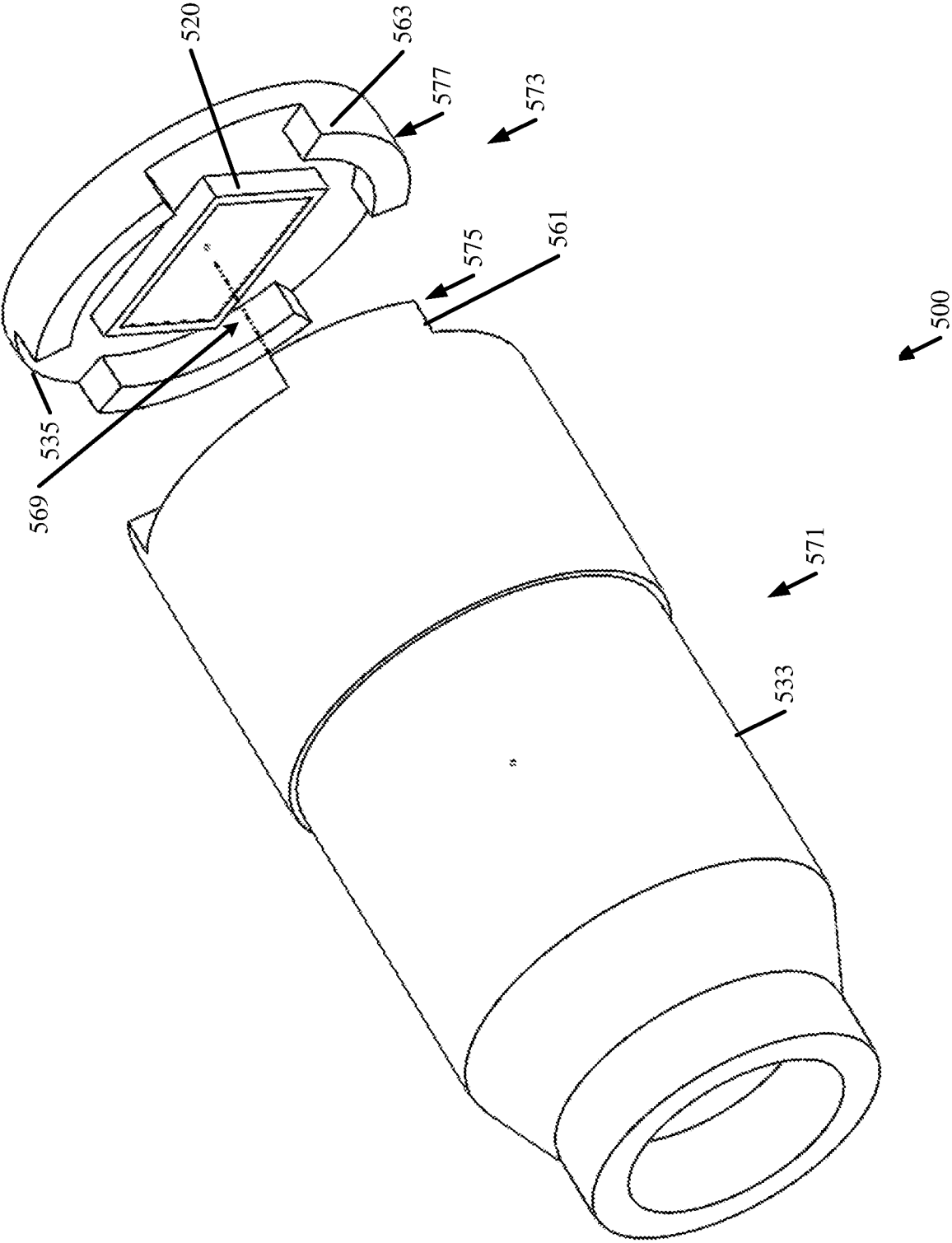


Fig. 5A

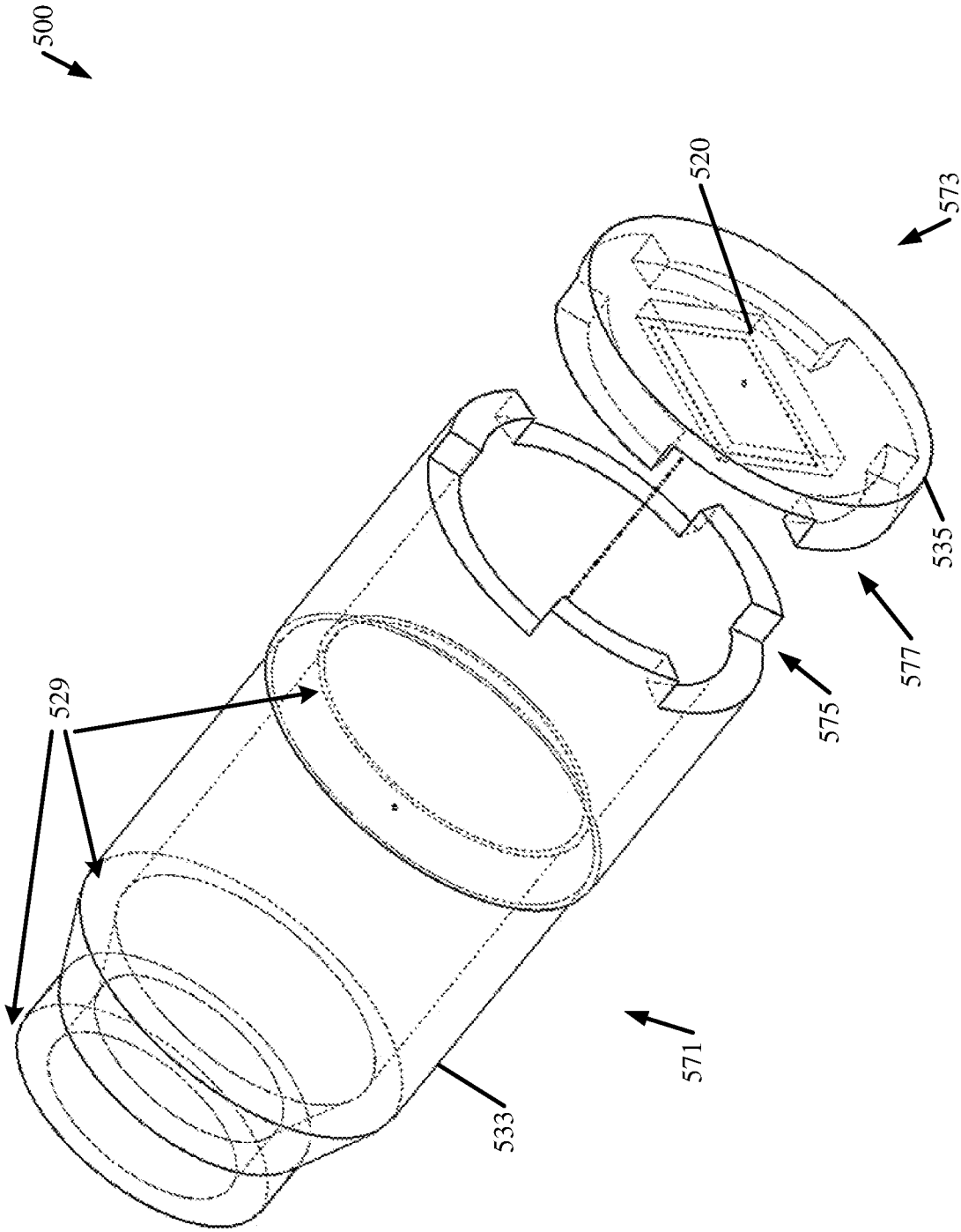


Fig. 5B

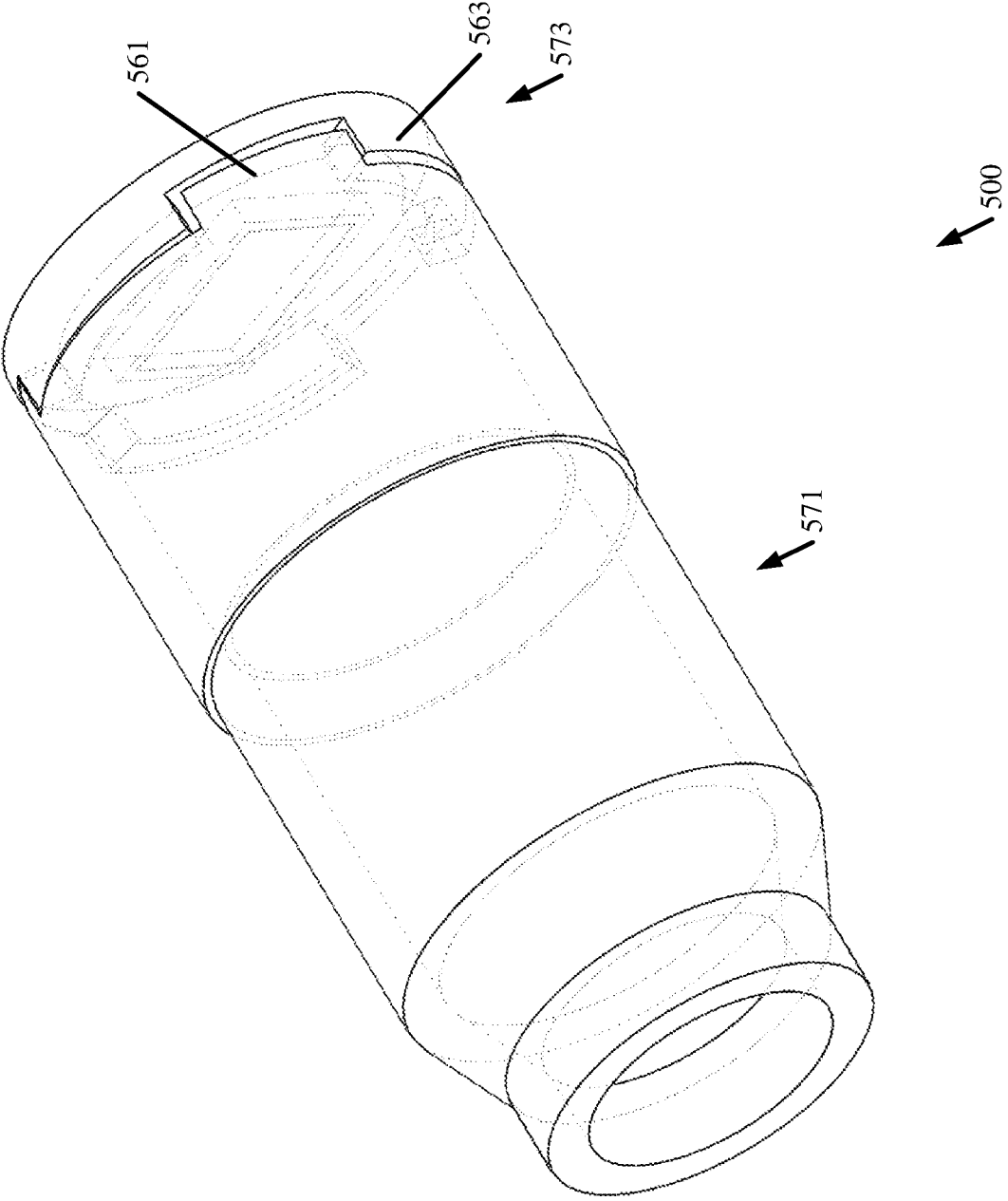


Fig. 5C

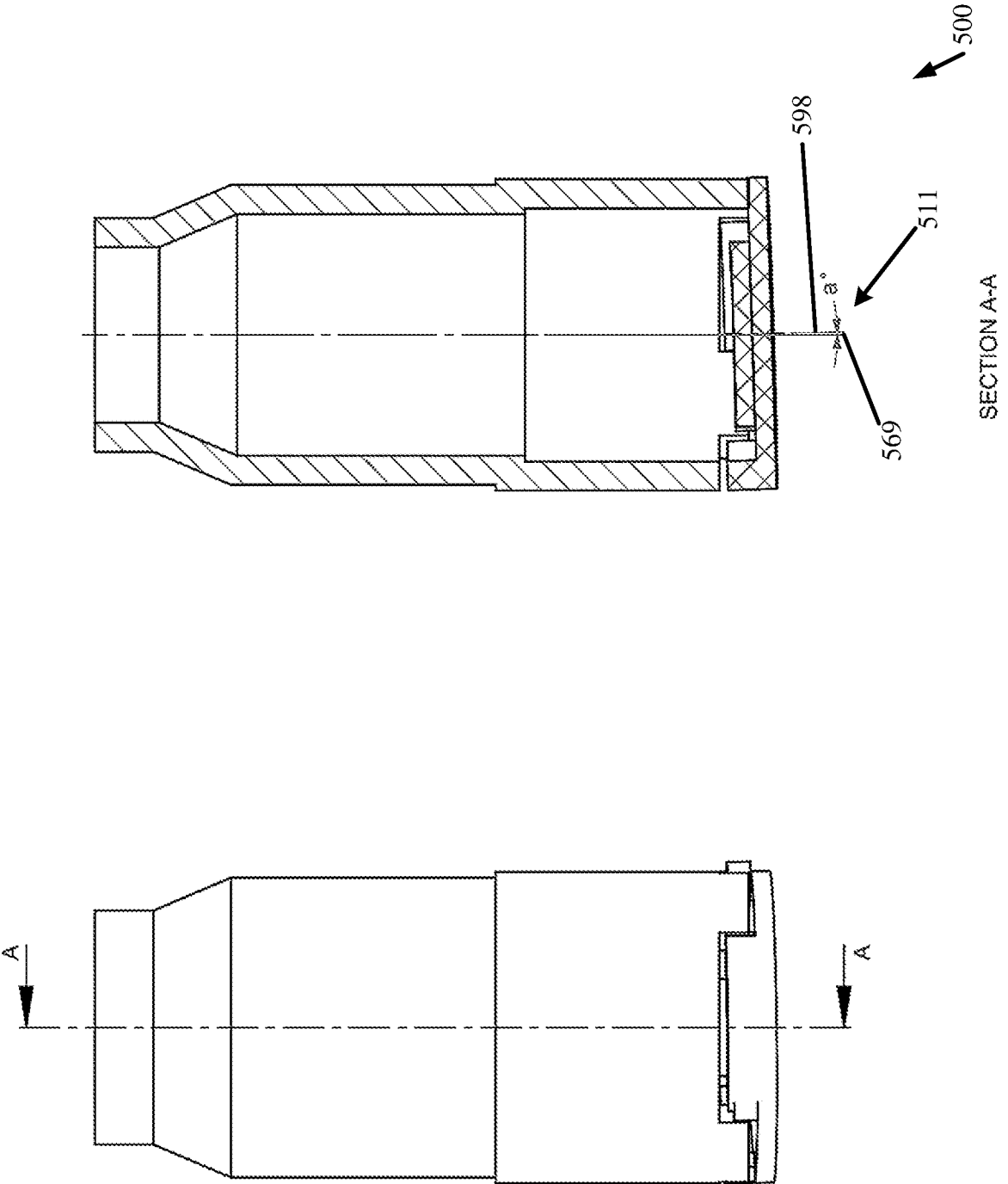


Fig. 5D

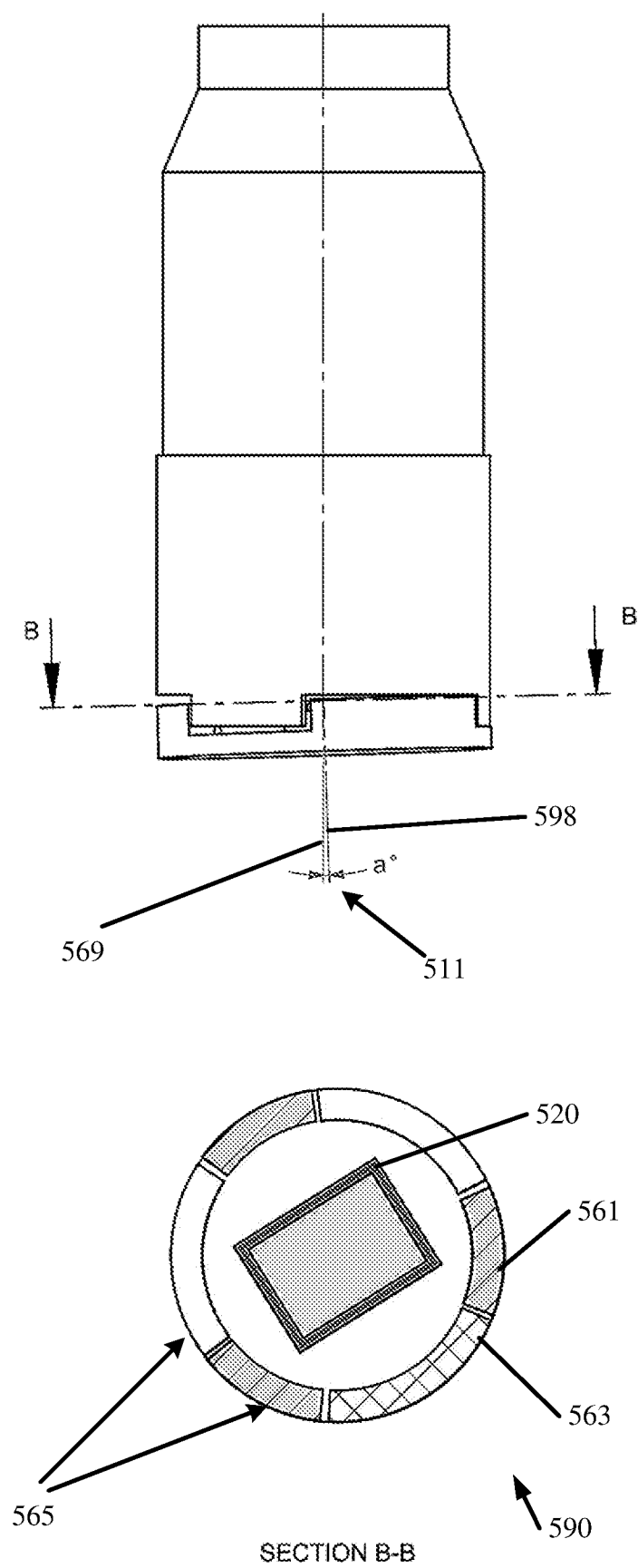


Fig. 5E

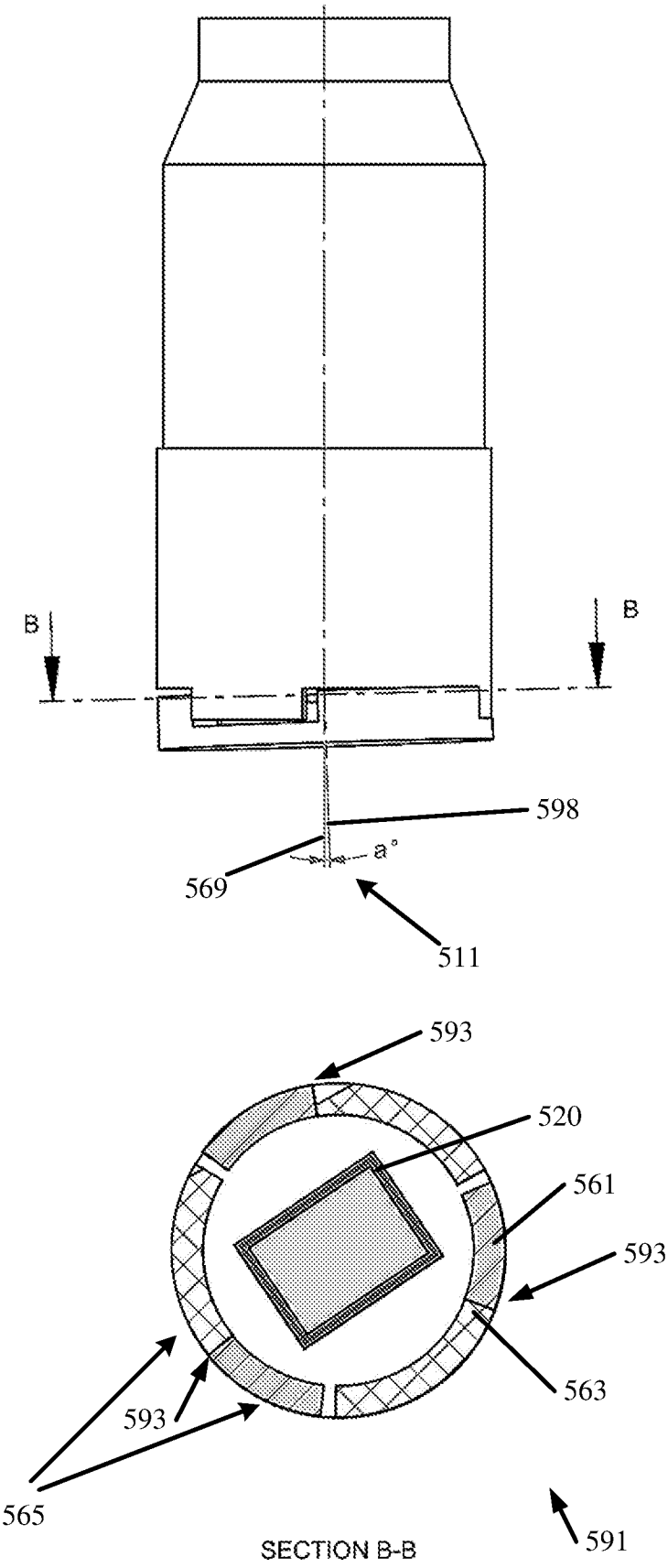


Fig. 5F

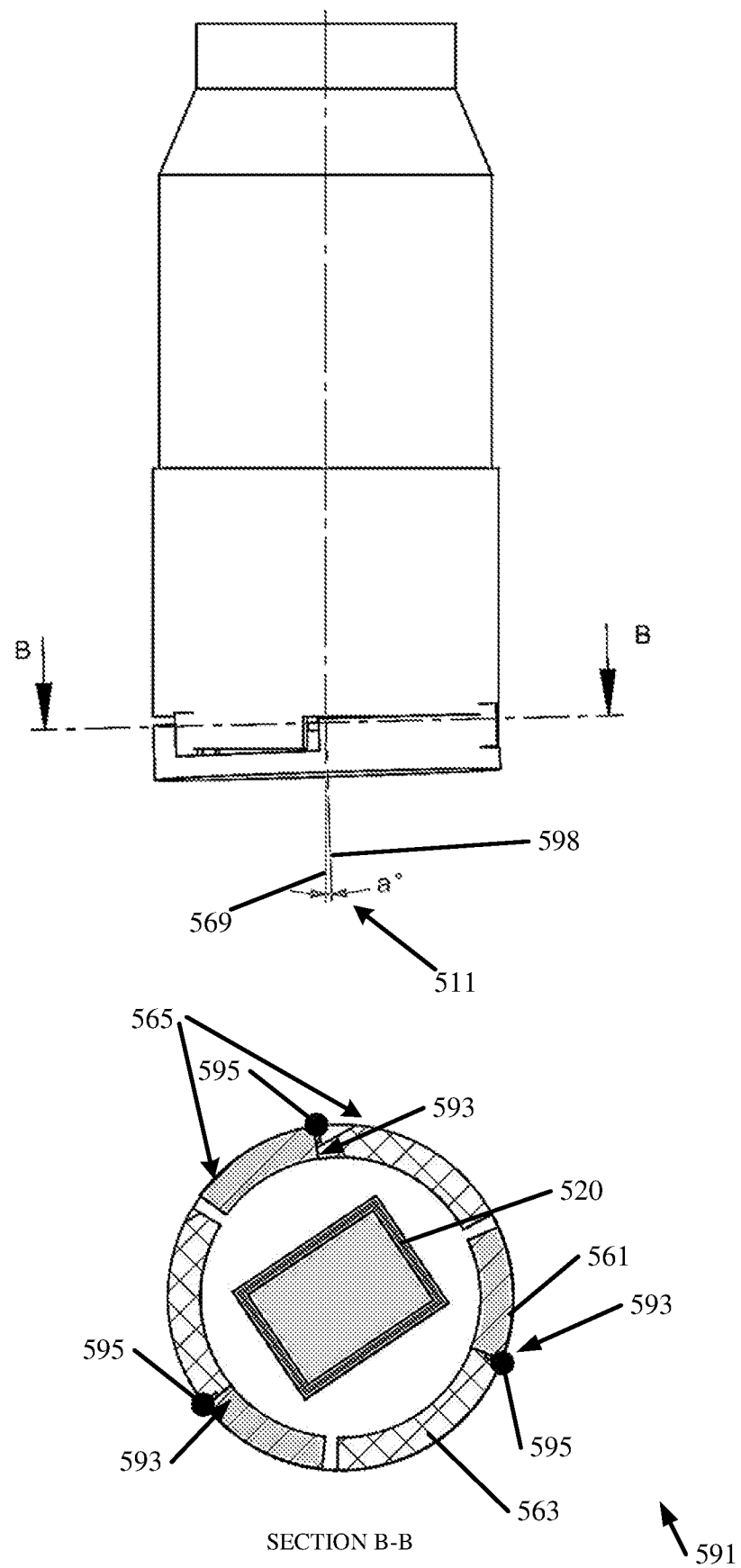


Fig. 5G

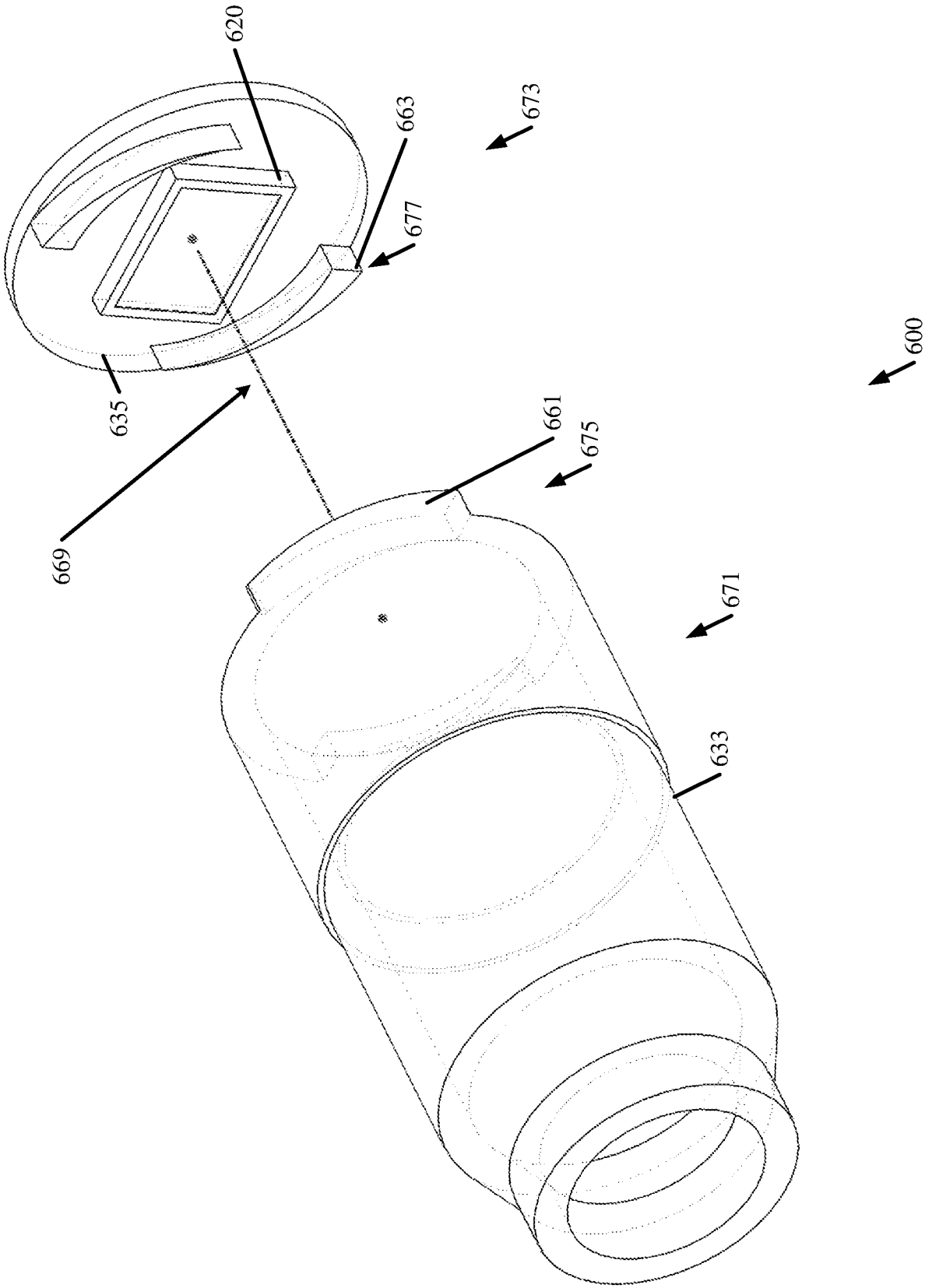


Fig. 6A

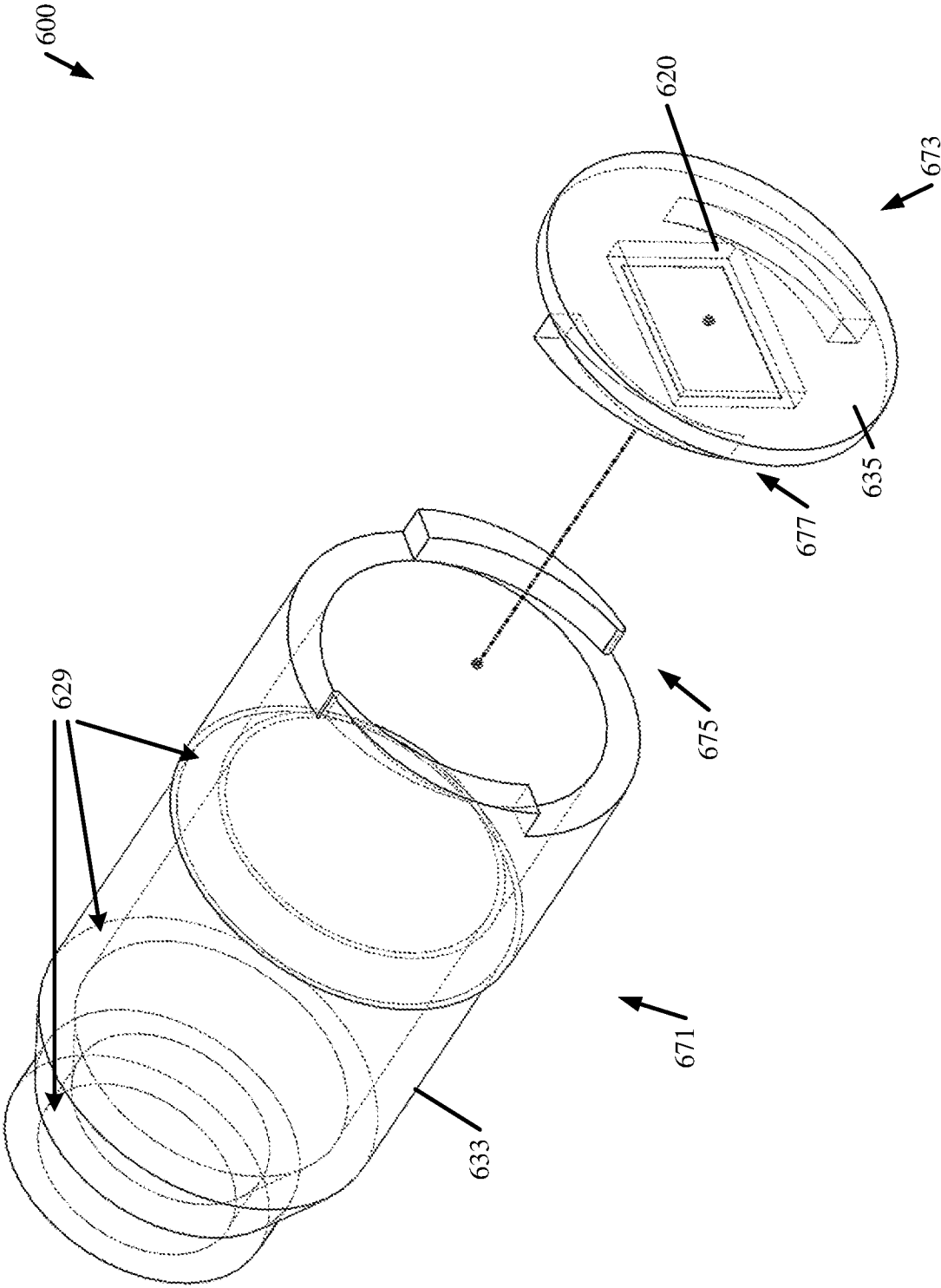


Fig. 6B

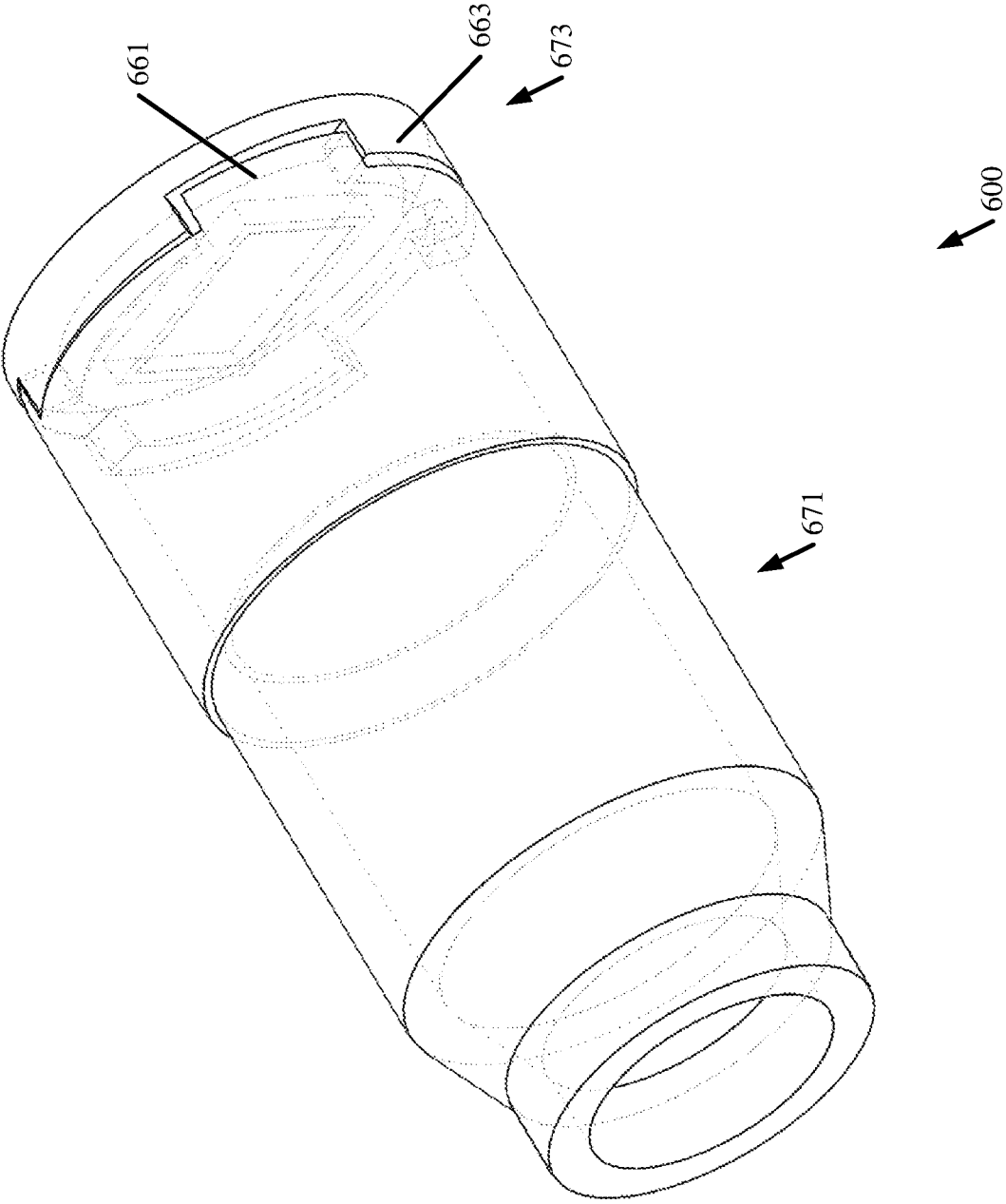


Fig. 6C

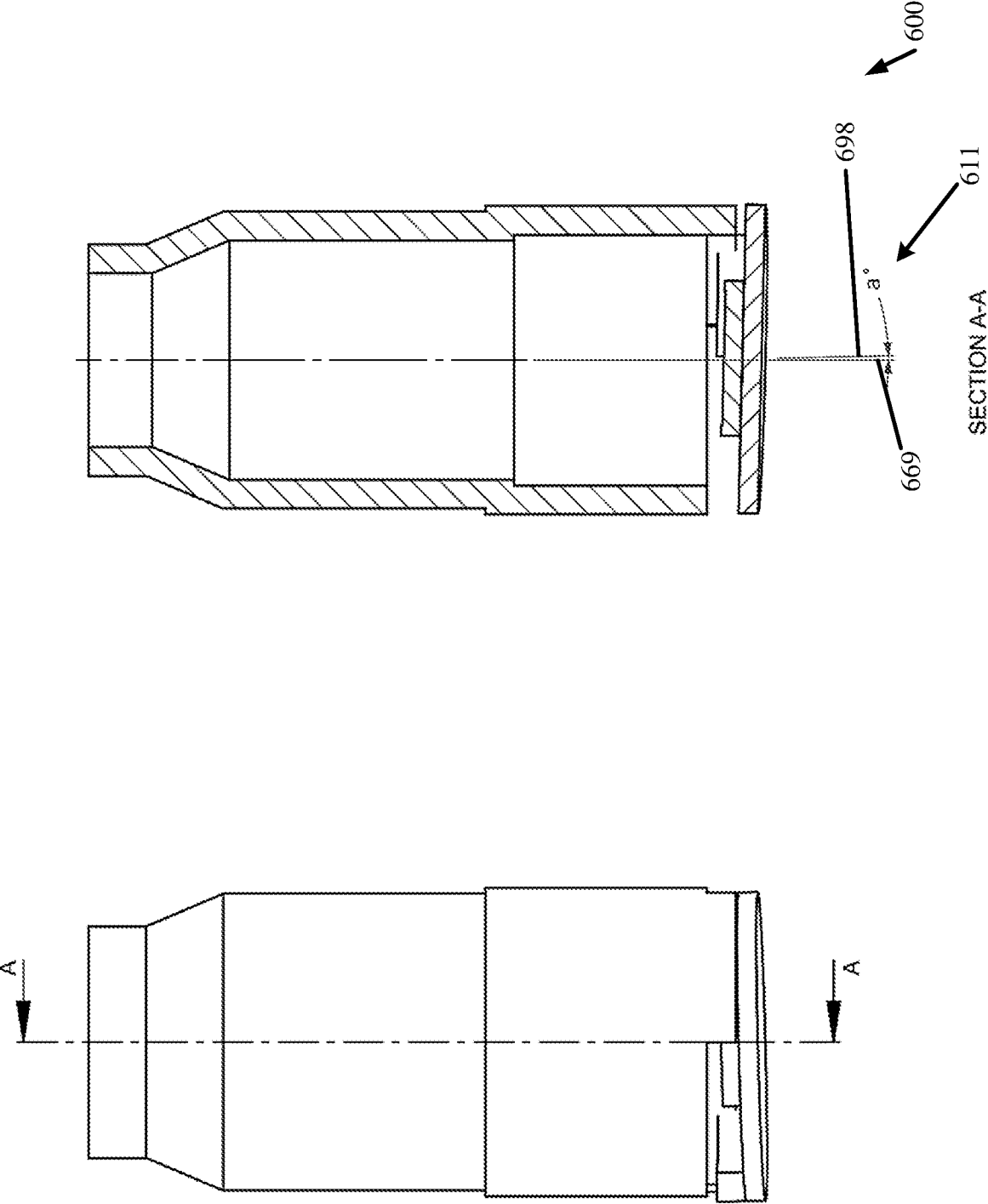


Fig. 6D

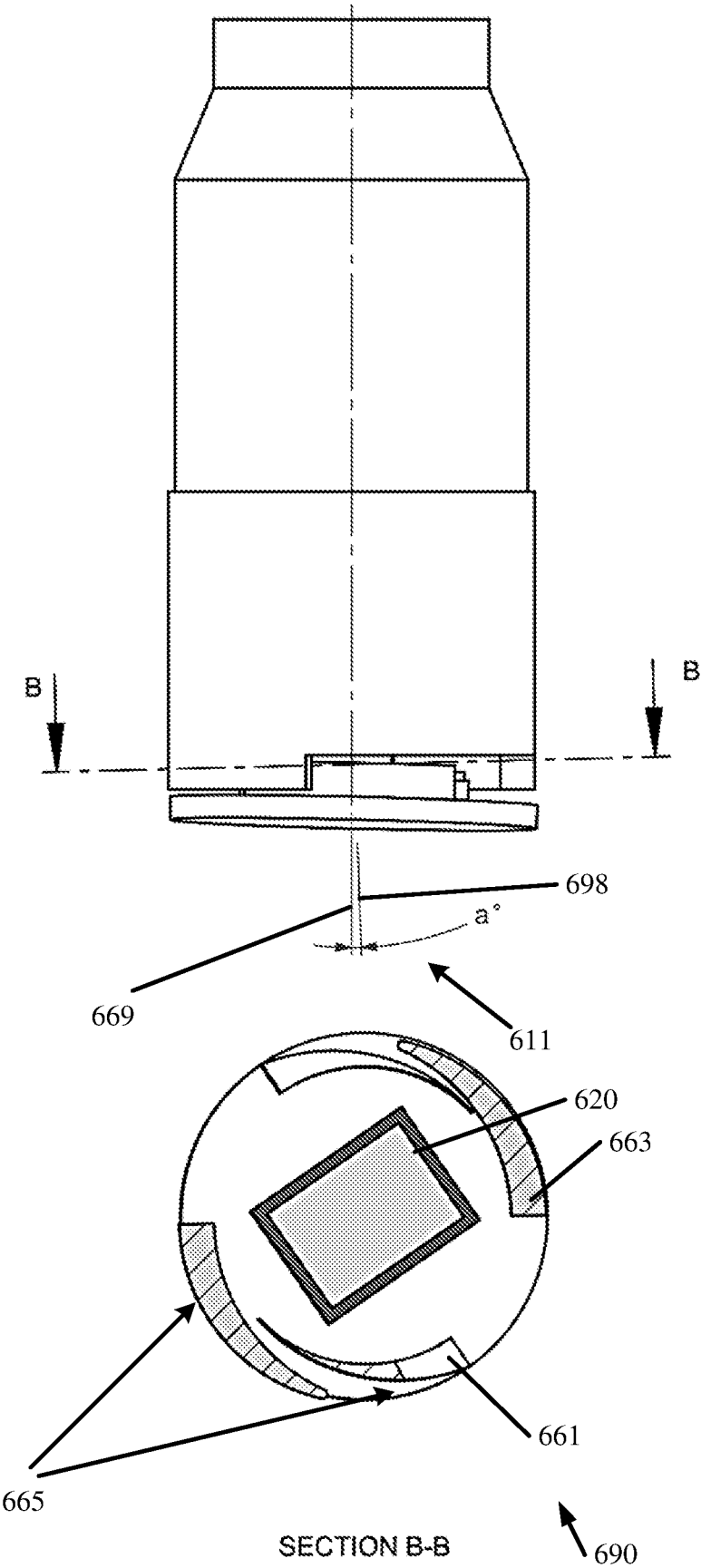


Fig. 6E

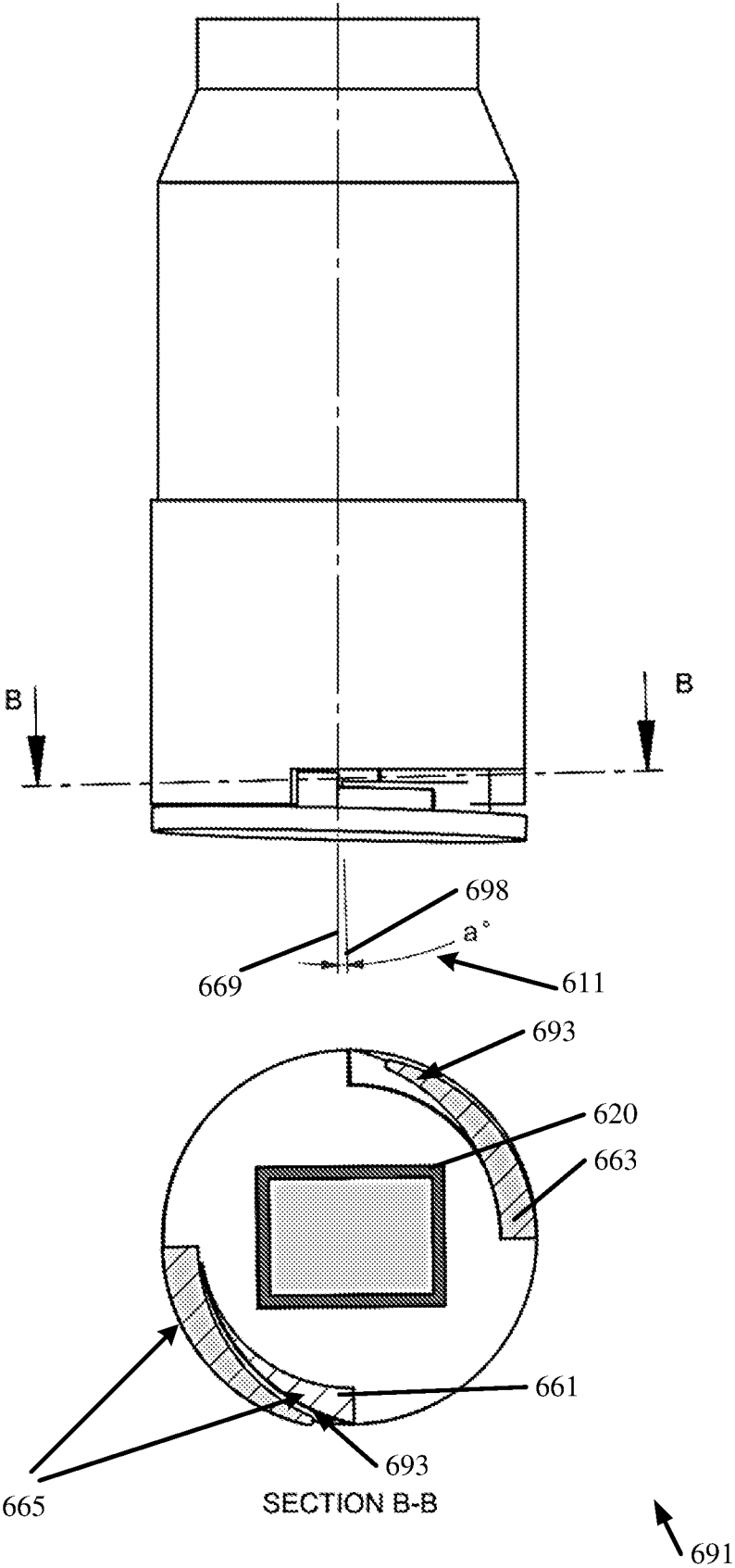


Fig. 6F

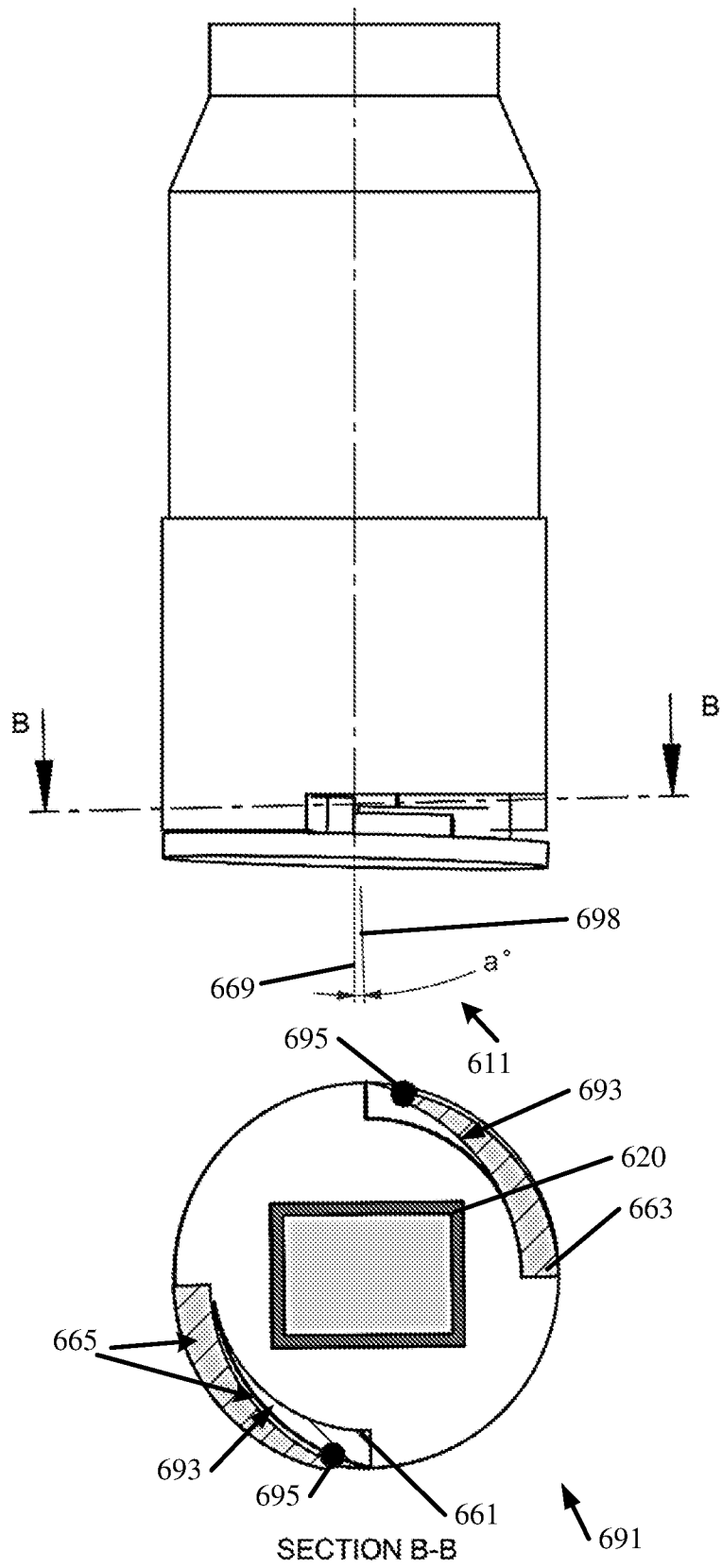


Fig. 6G

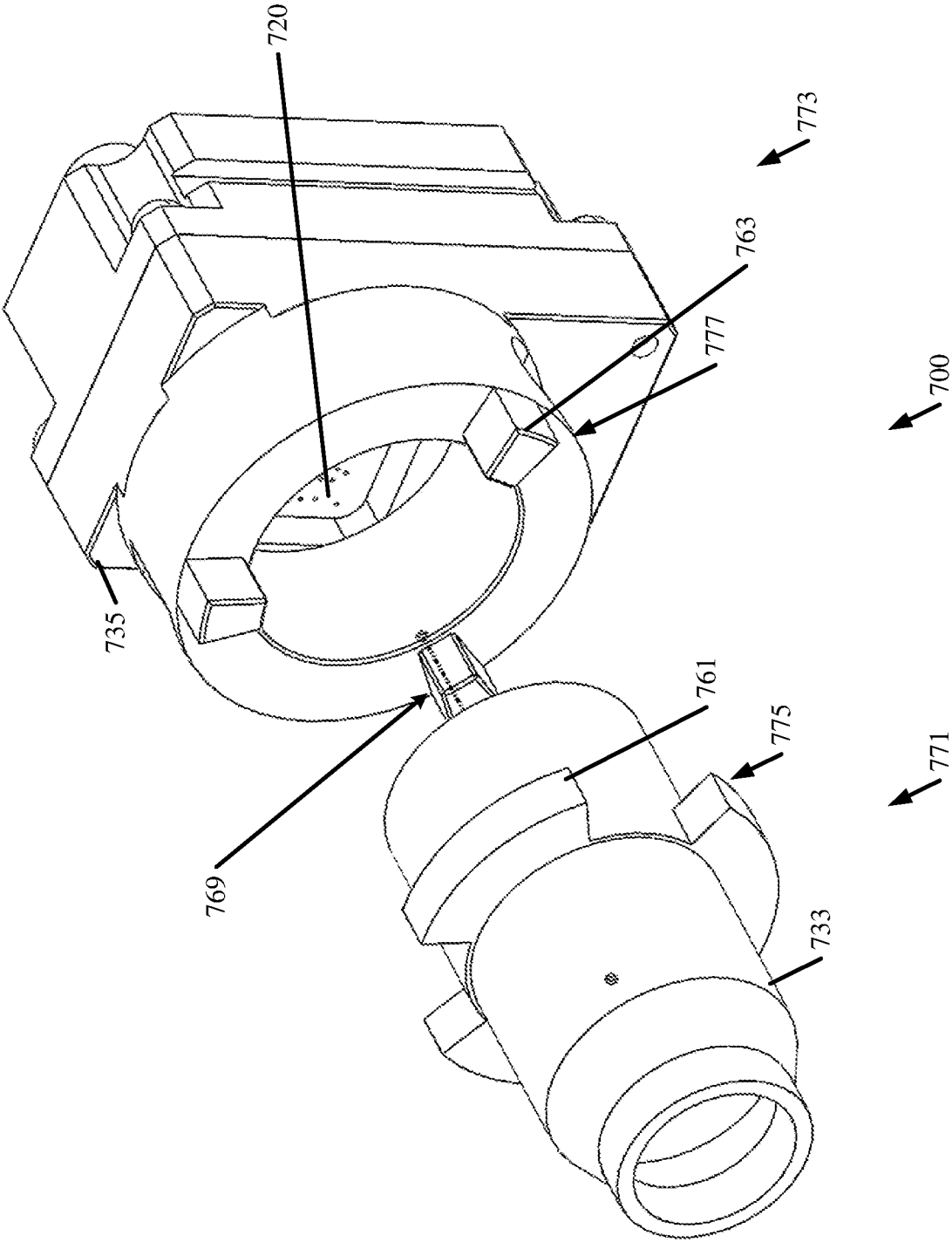


Fig. 7A

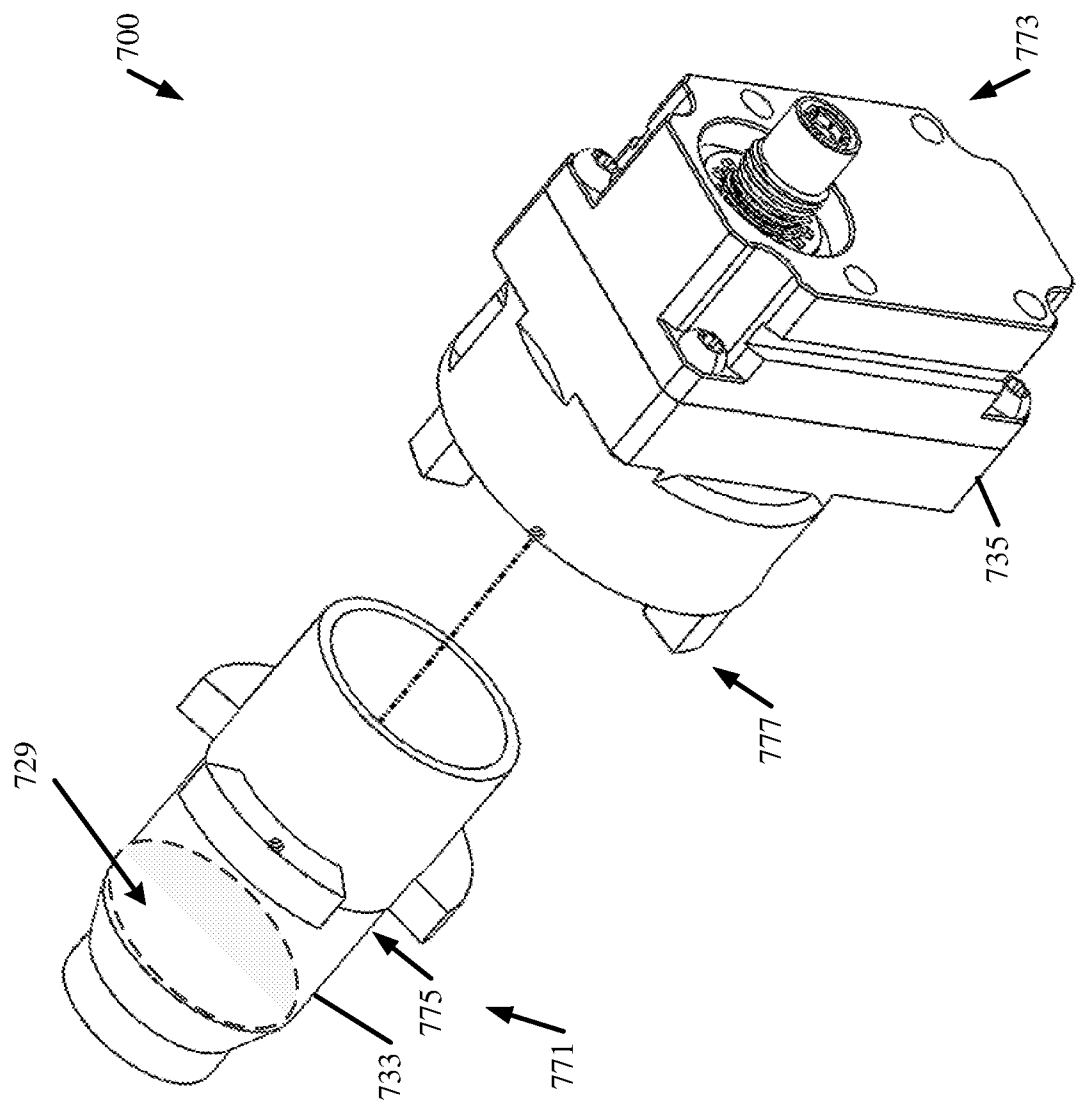


Fig. 7B

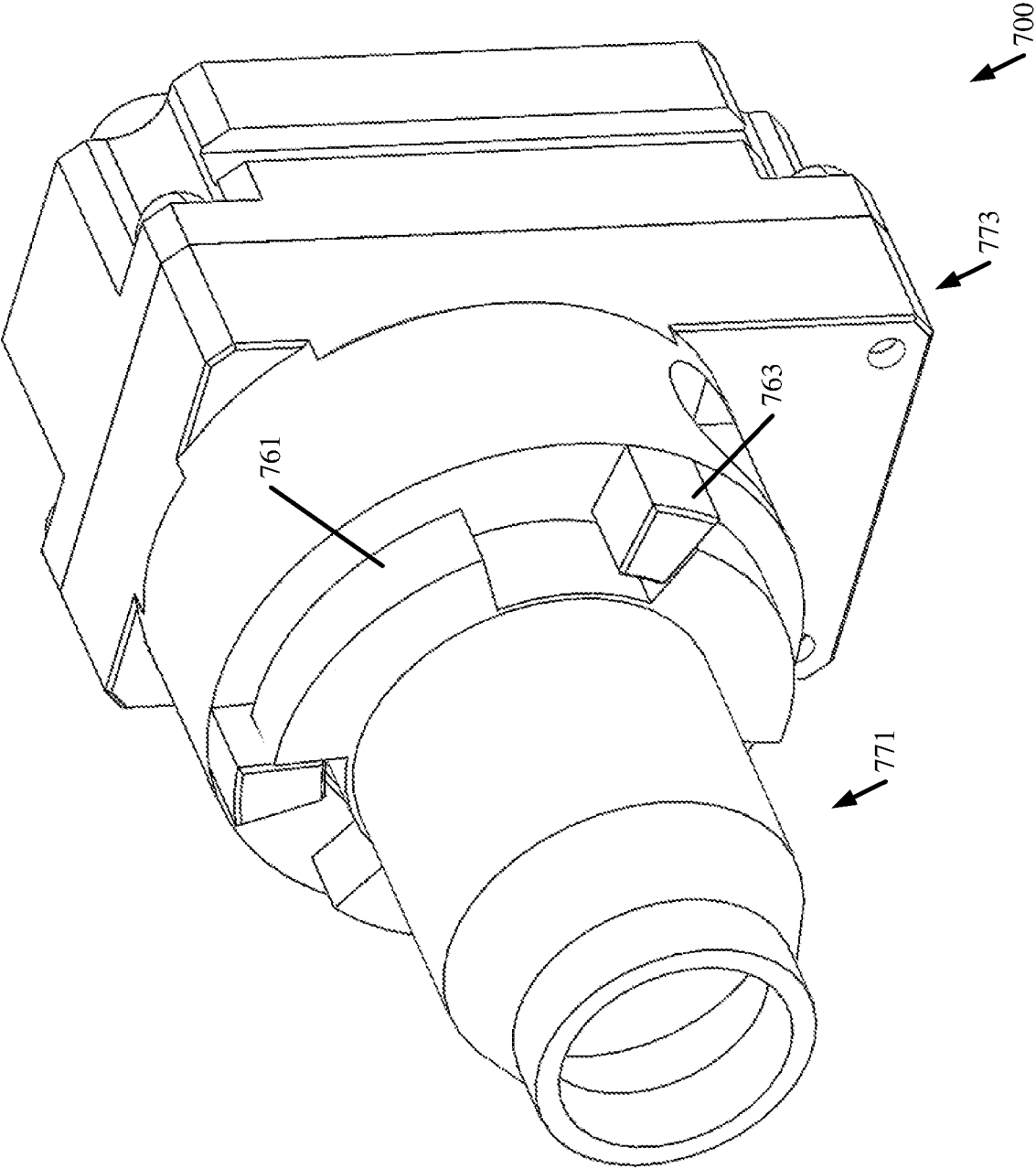


Fig. 7C

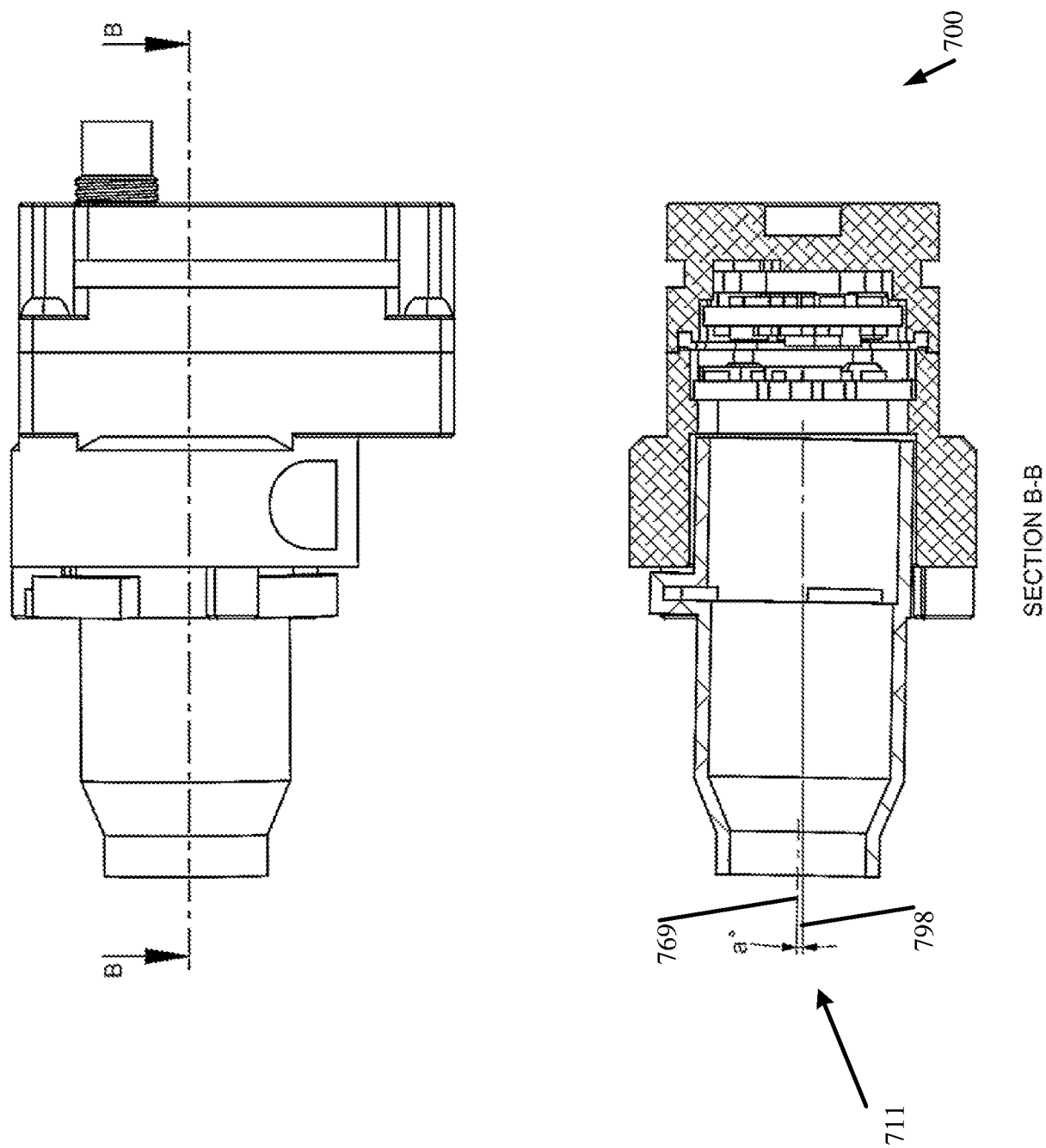


Fig. 7D

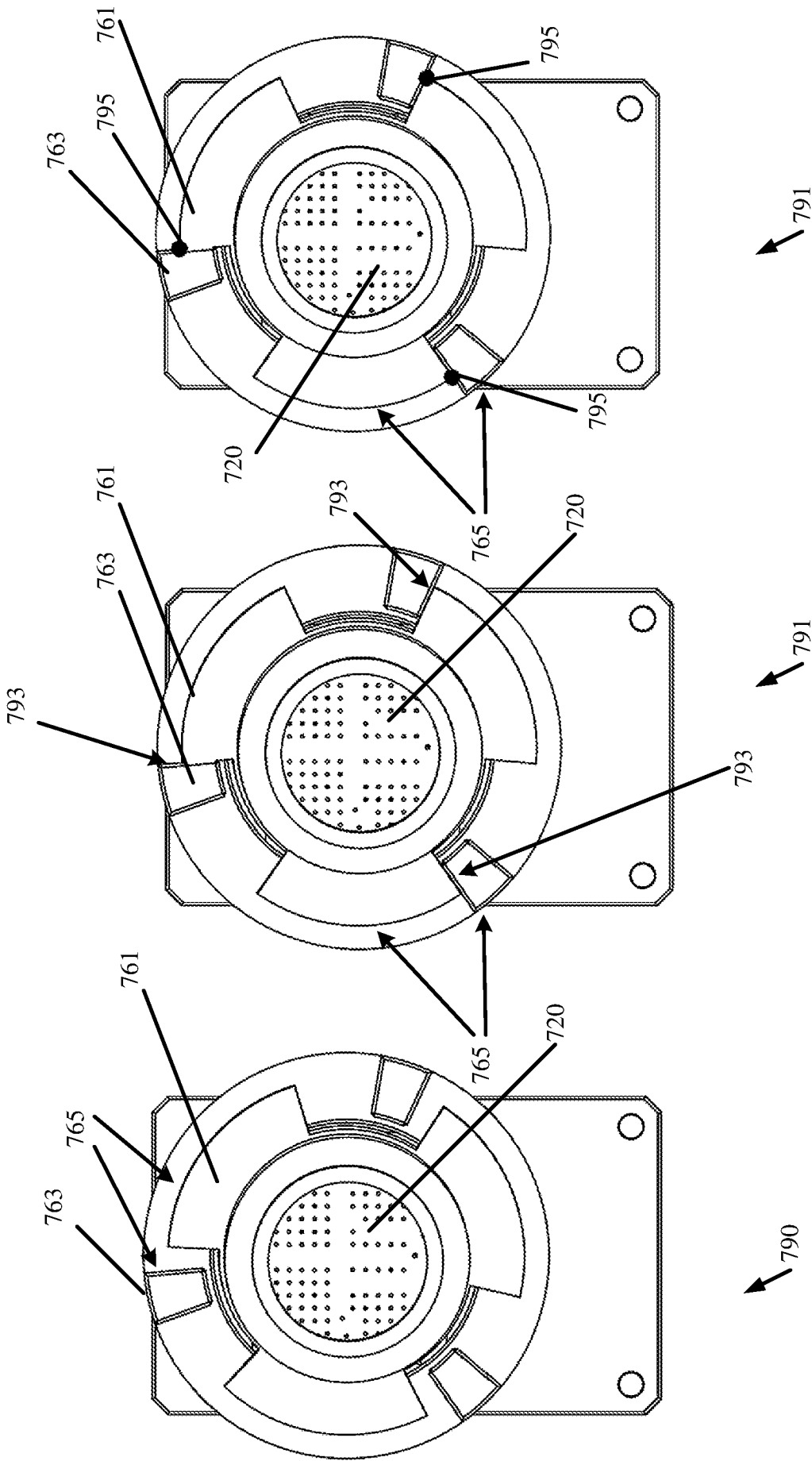


Fig. 7E

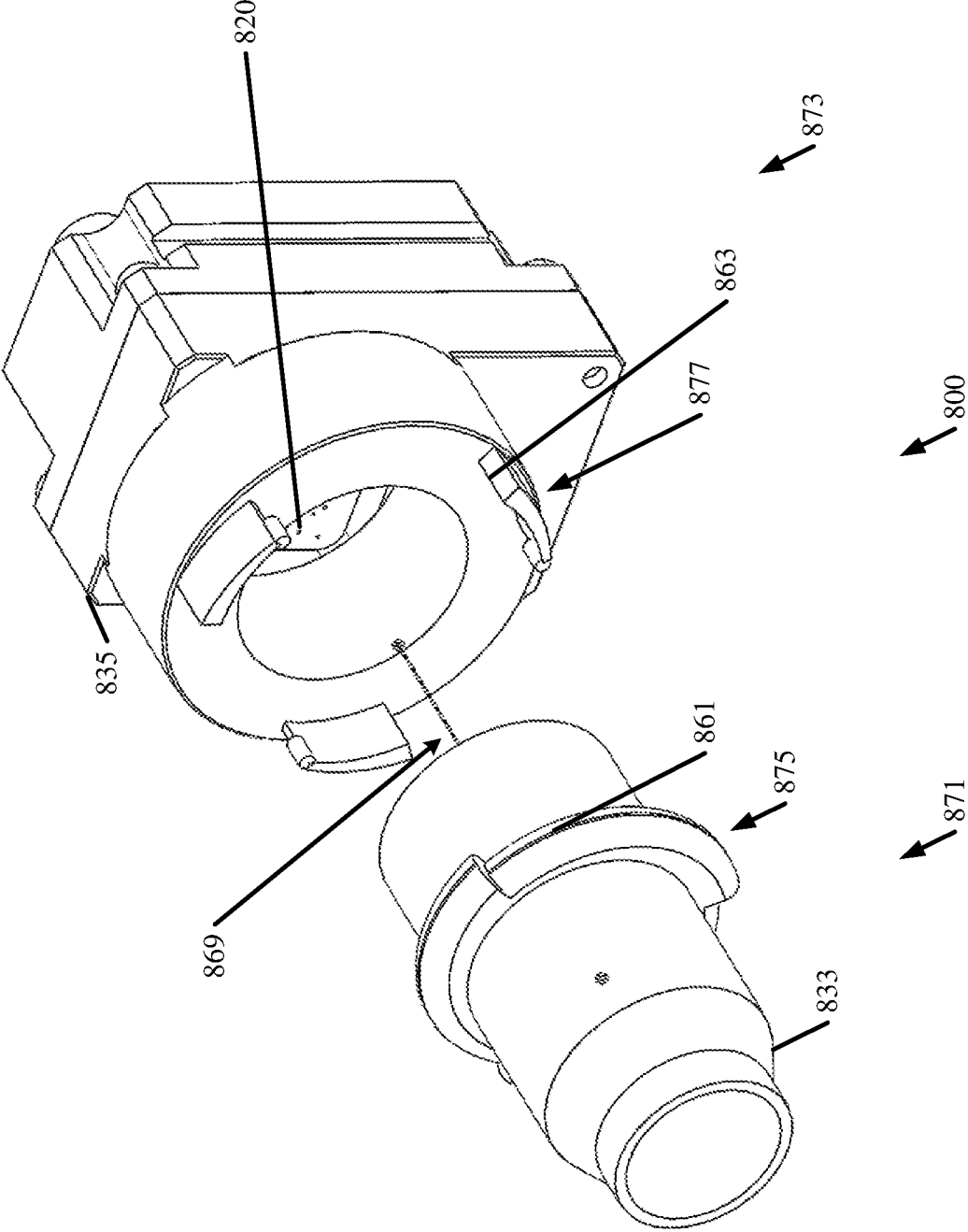


Fig. 8A

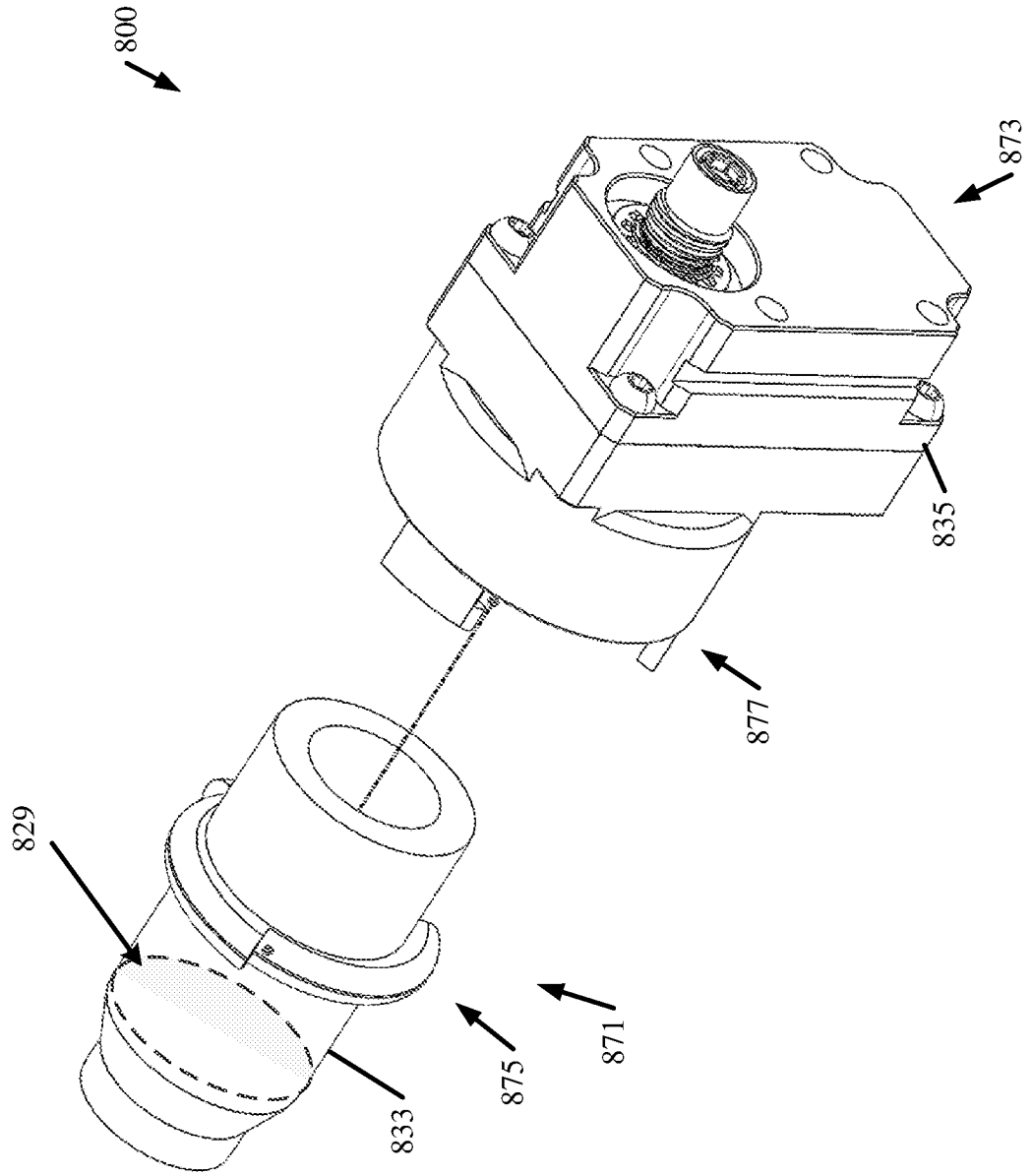


Fig. 8B

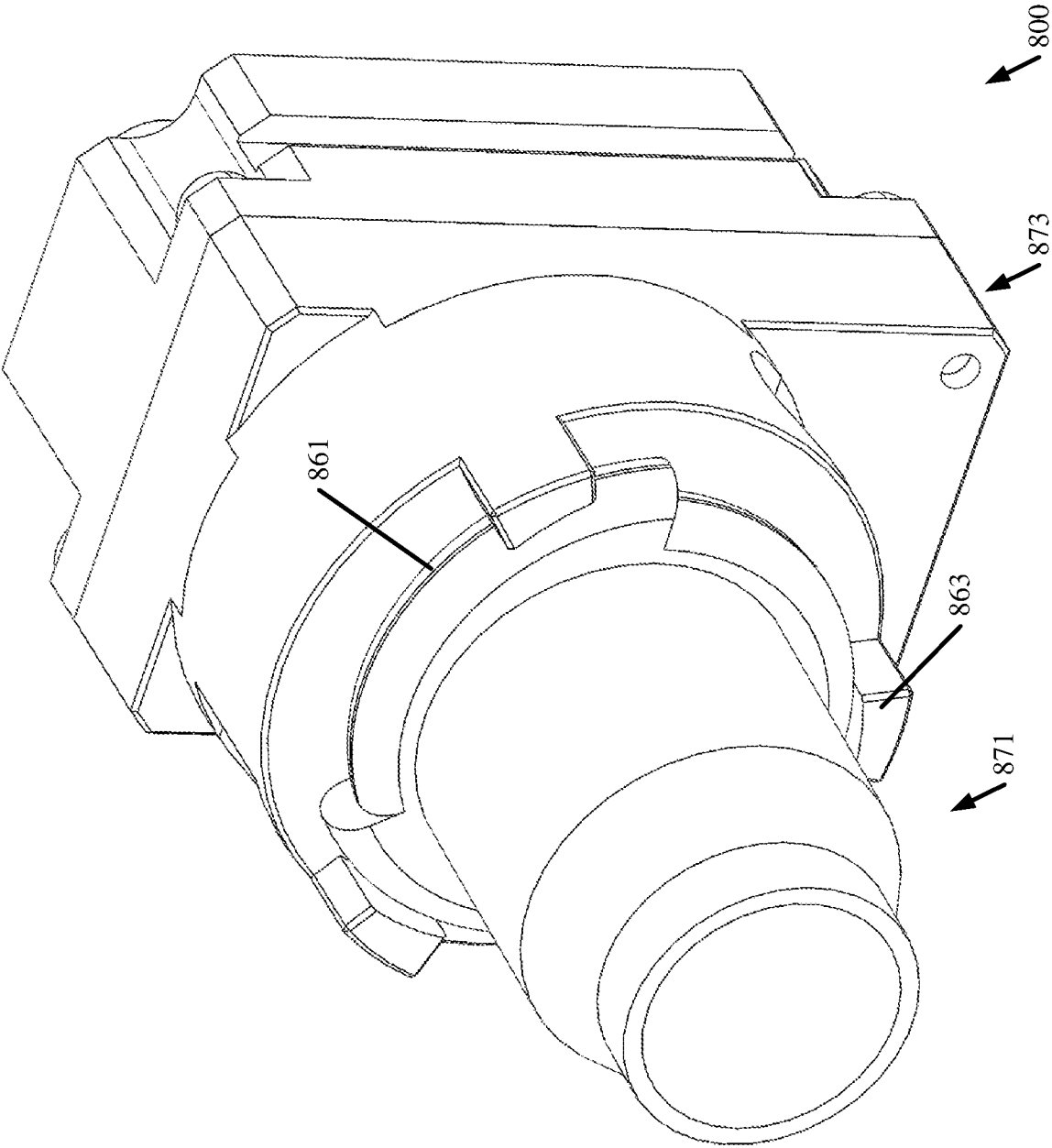


Fig. 8C

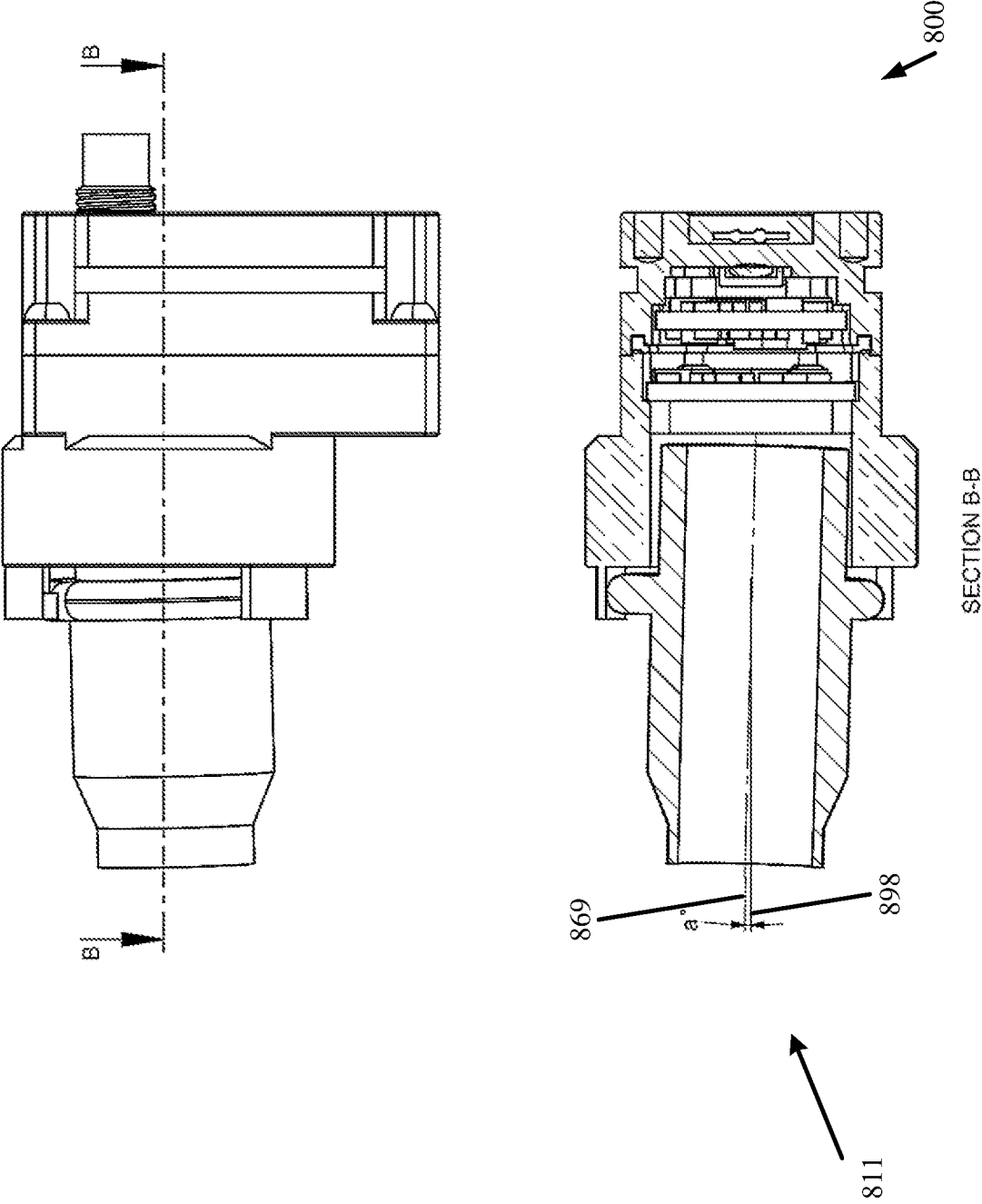


Fig. 8D

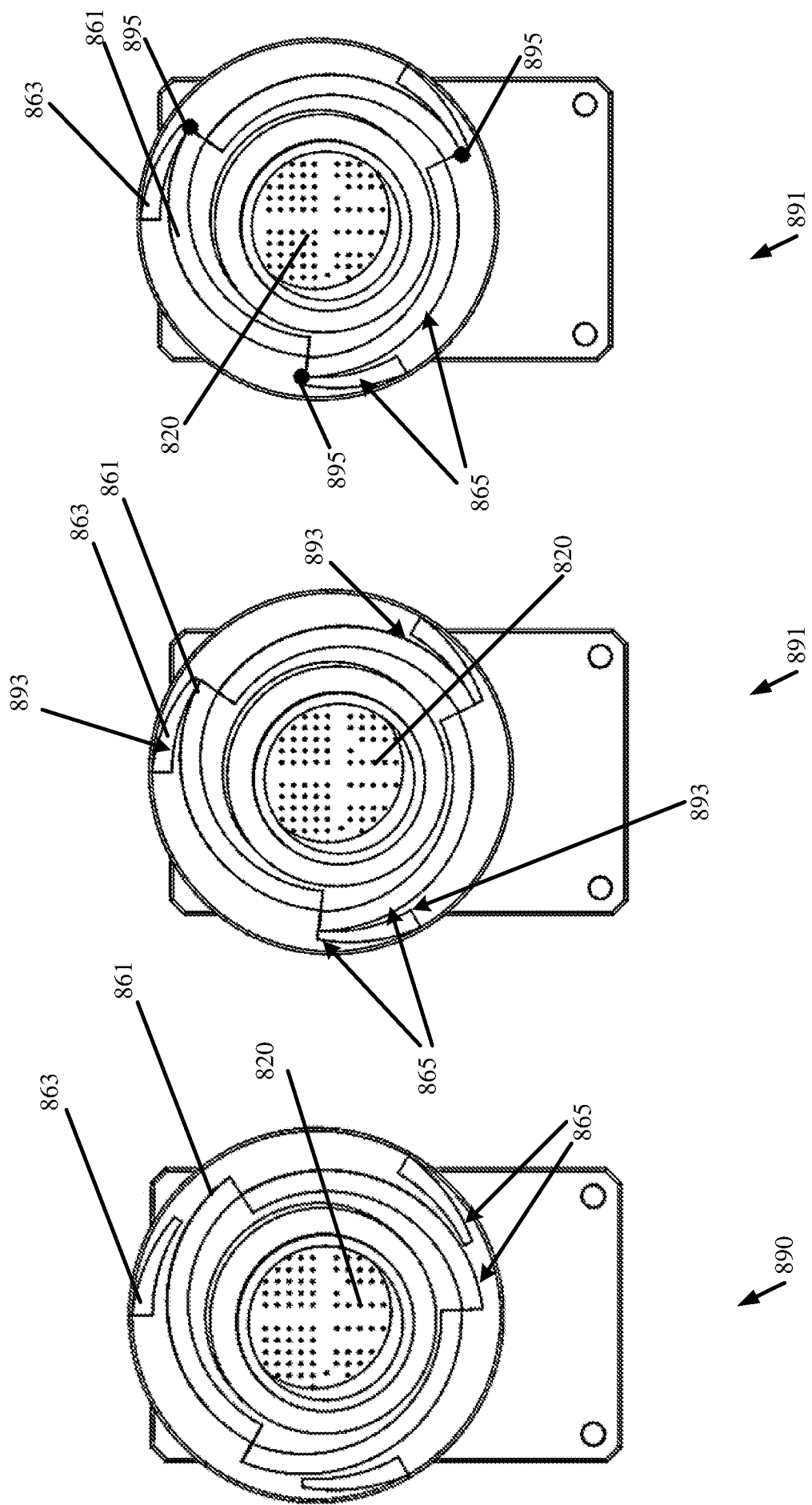


Fig. 8E

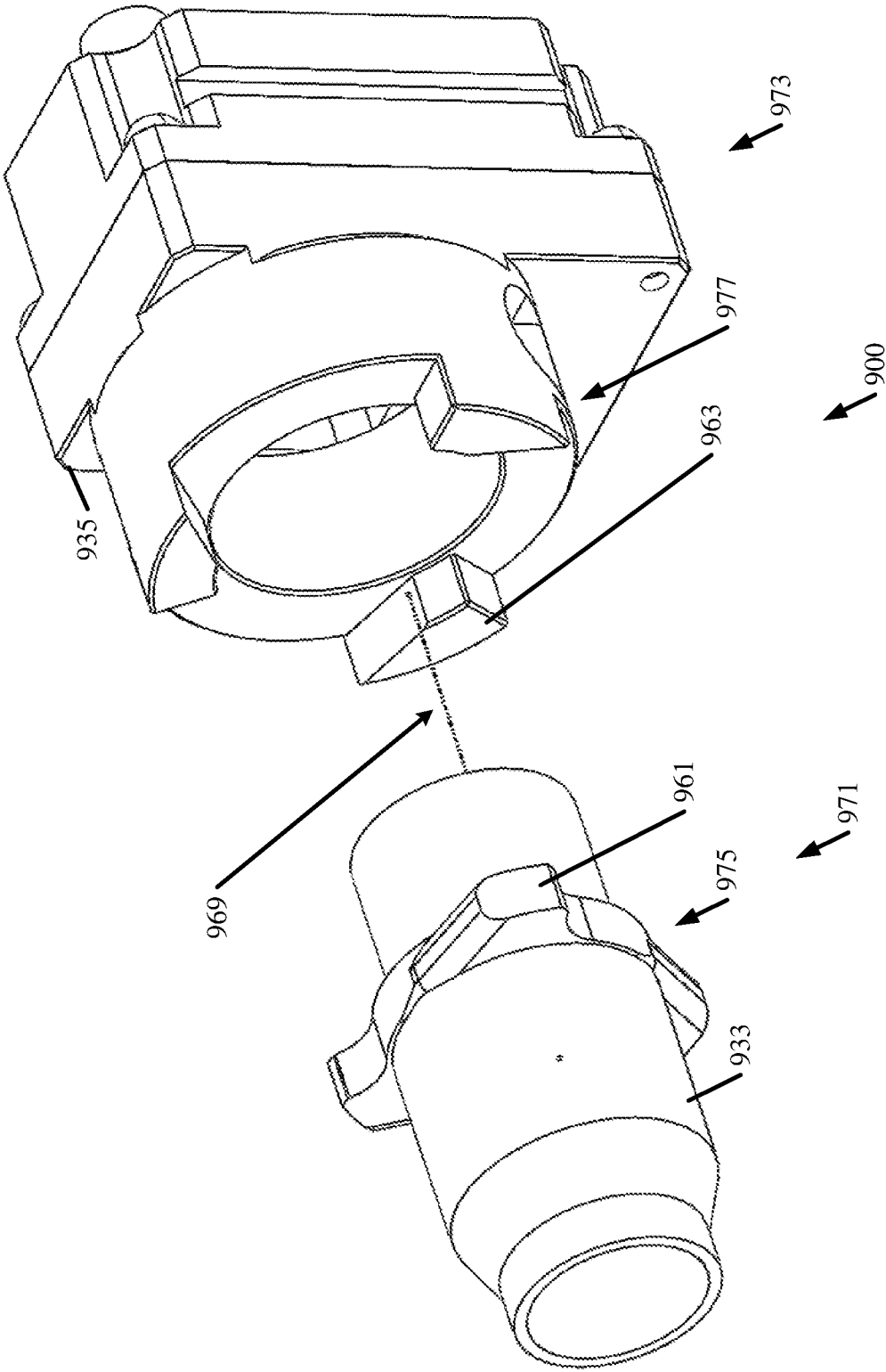


Fig. 9A

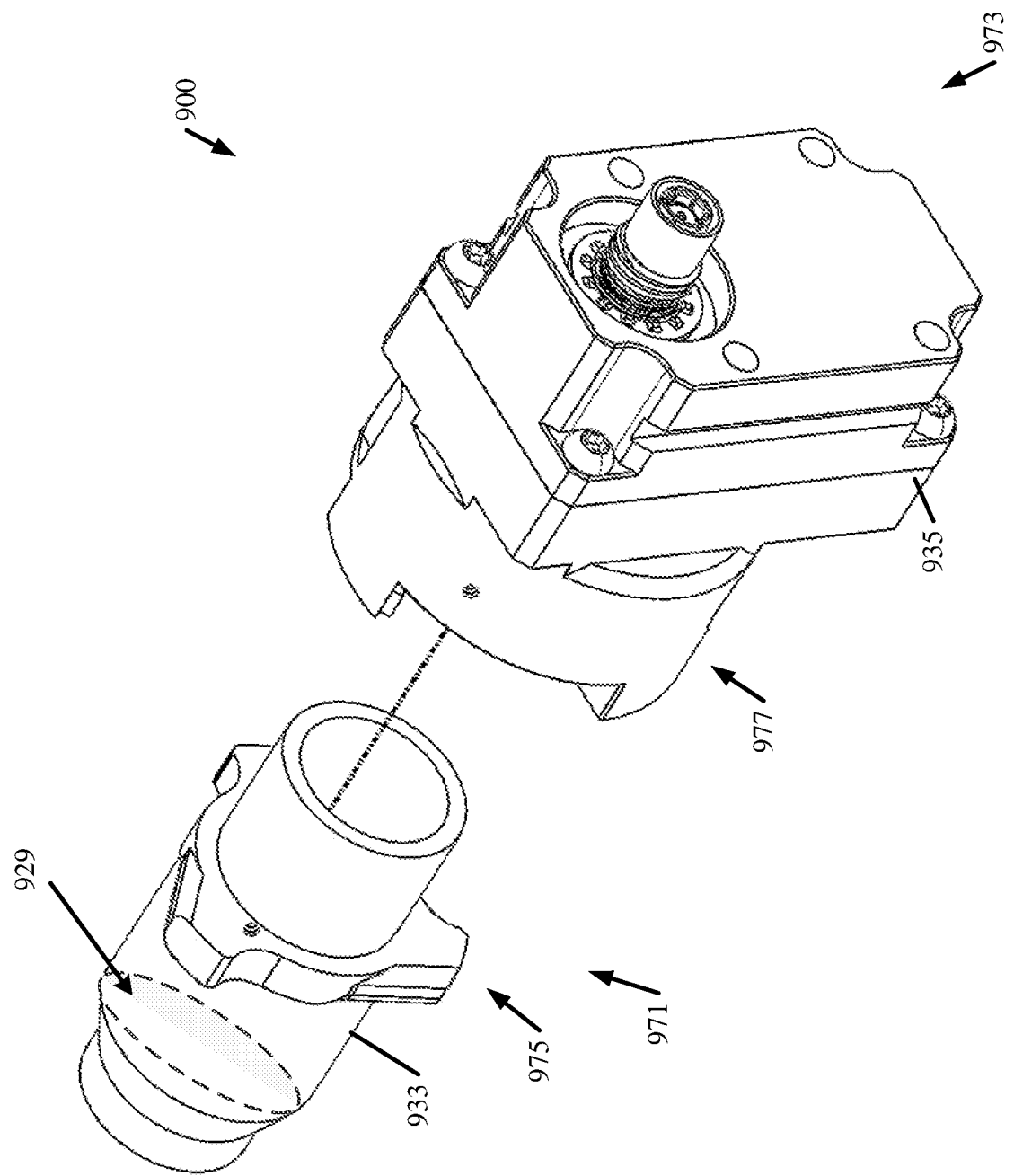


Fig. 9B

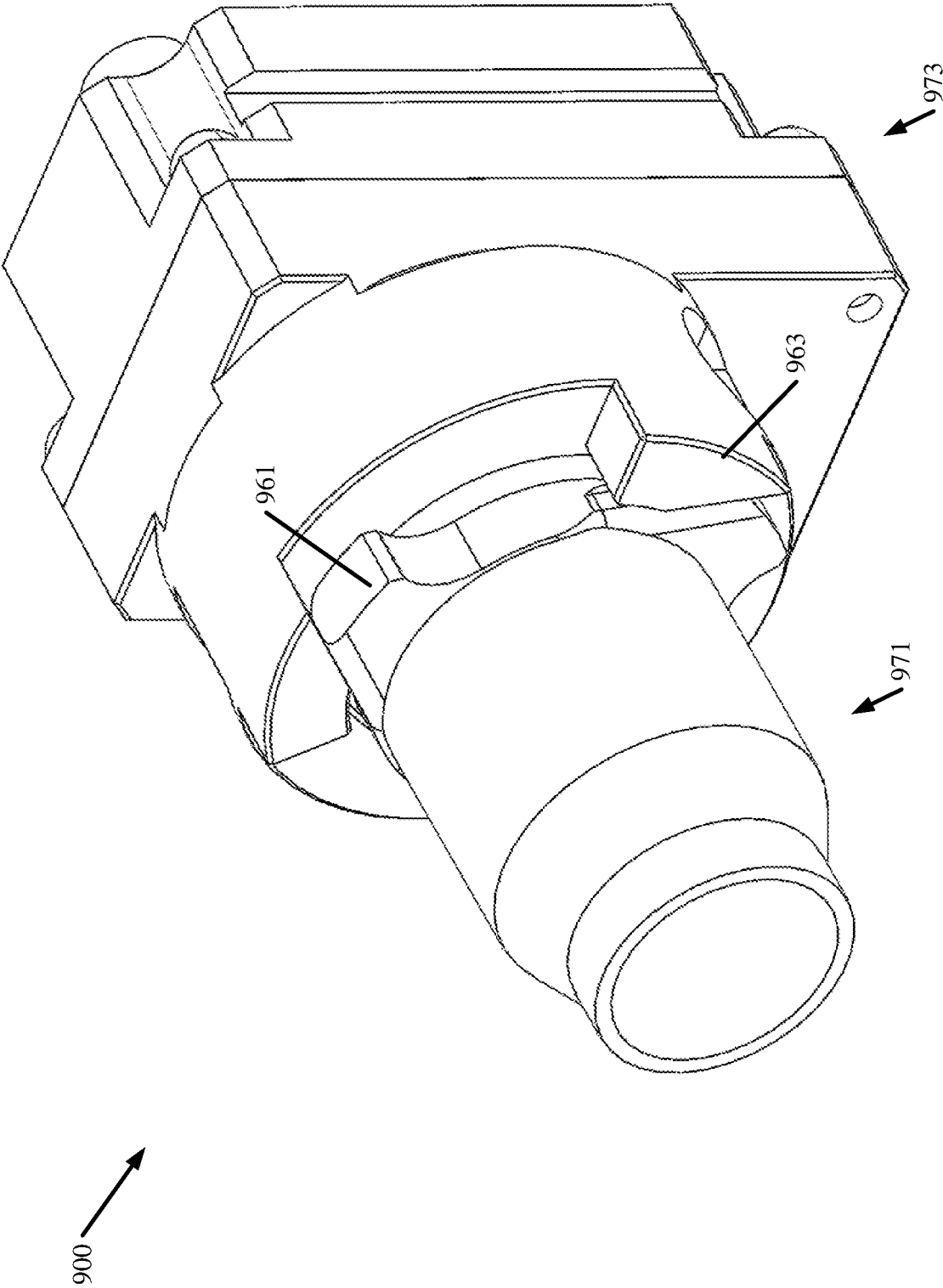
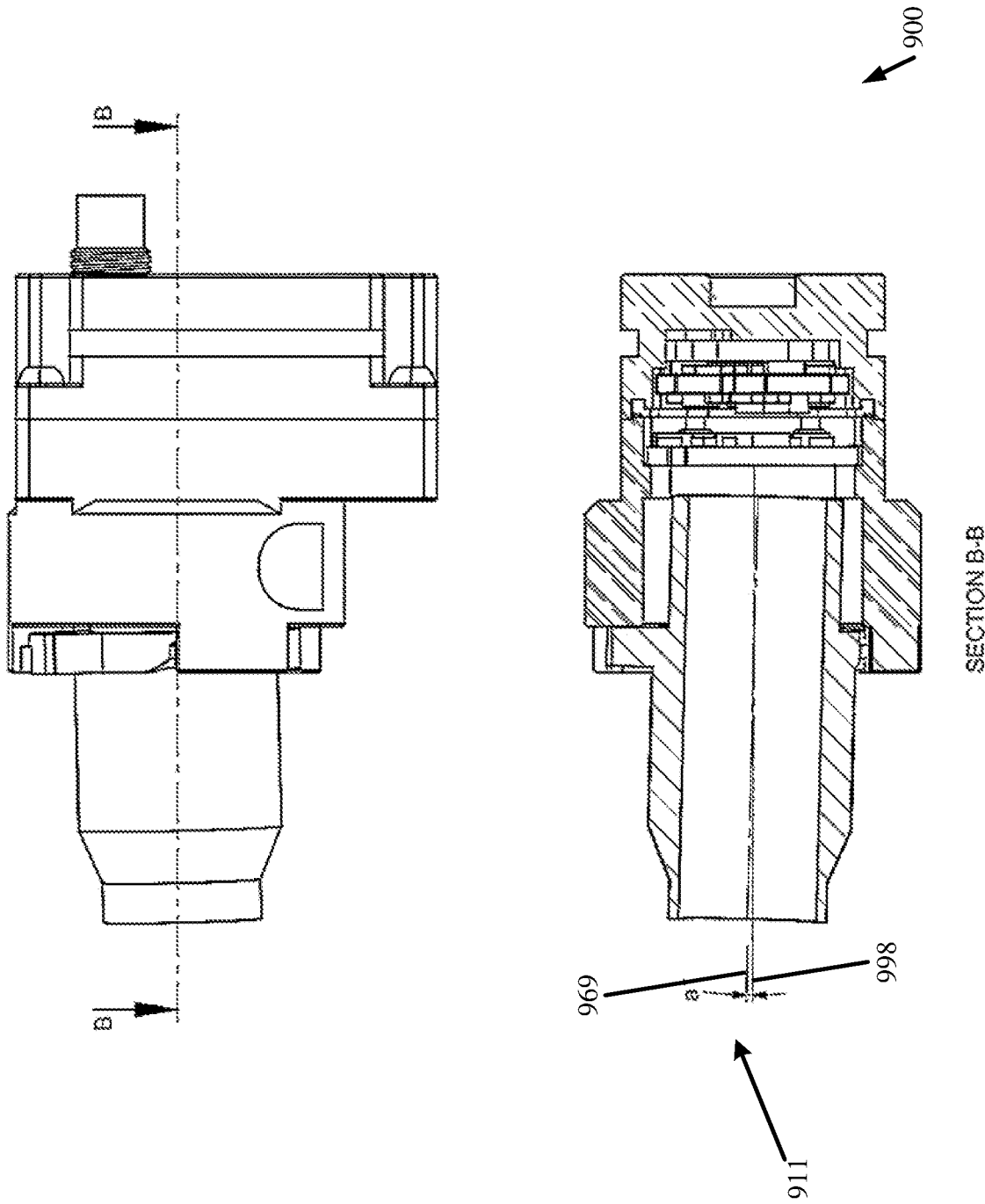


Fig. 9C



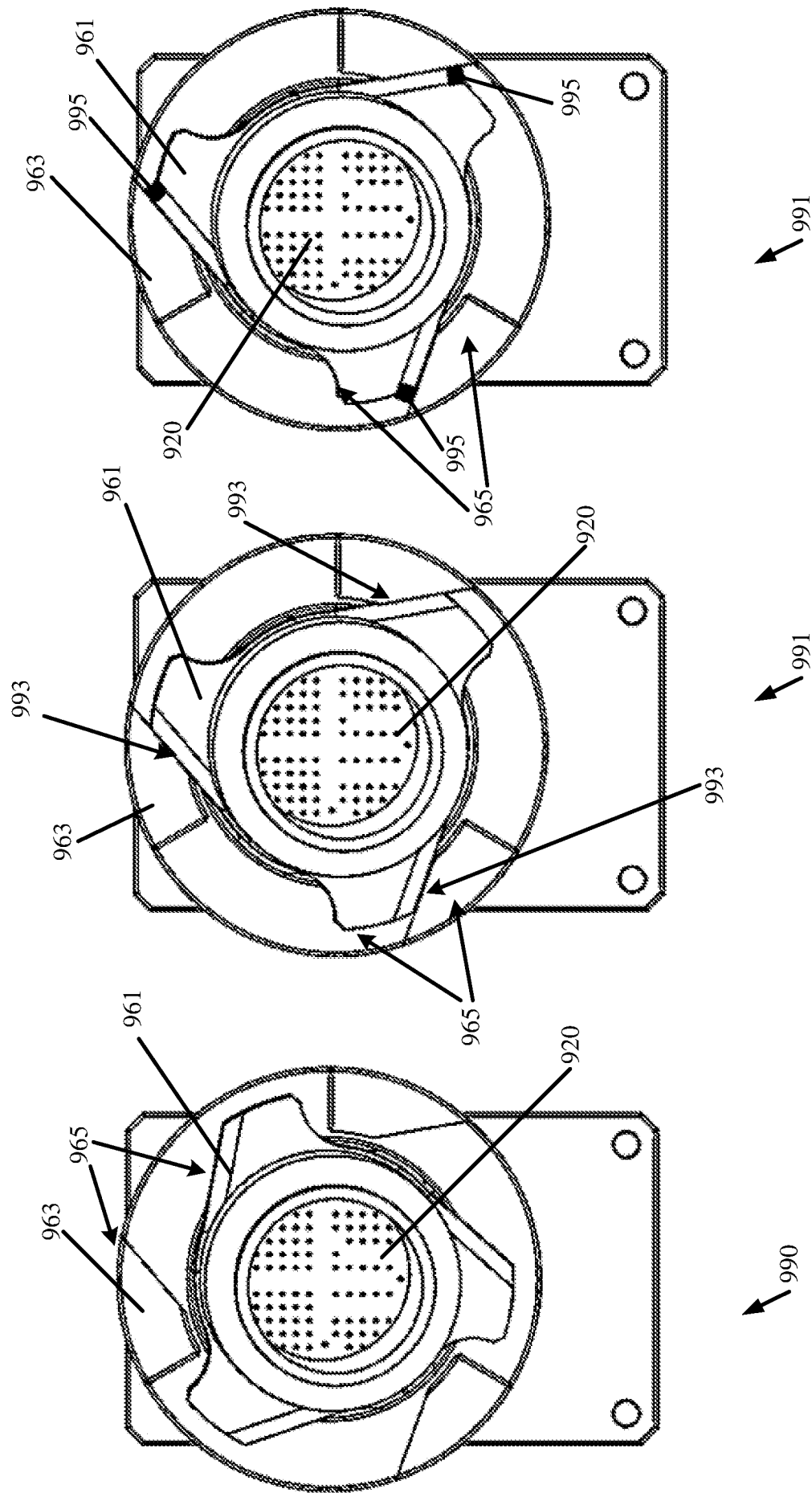


Fig. 9E

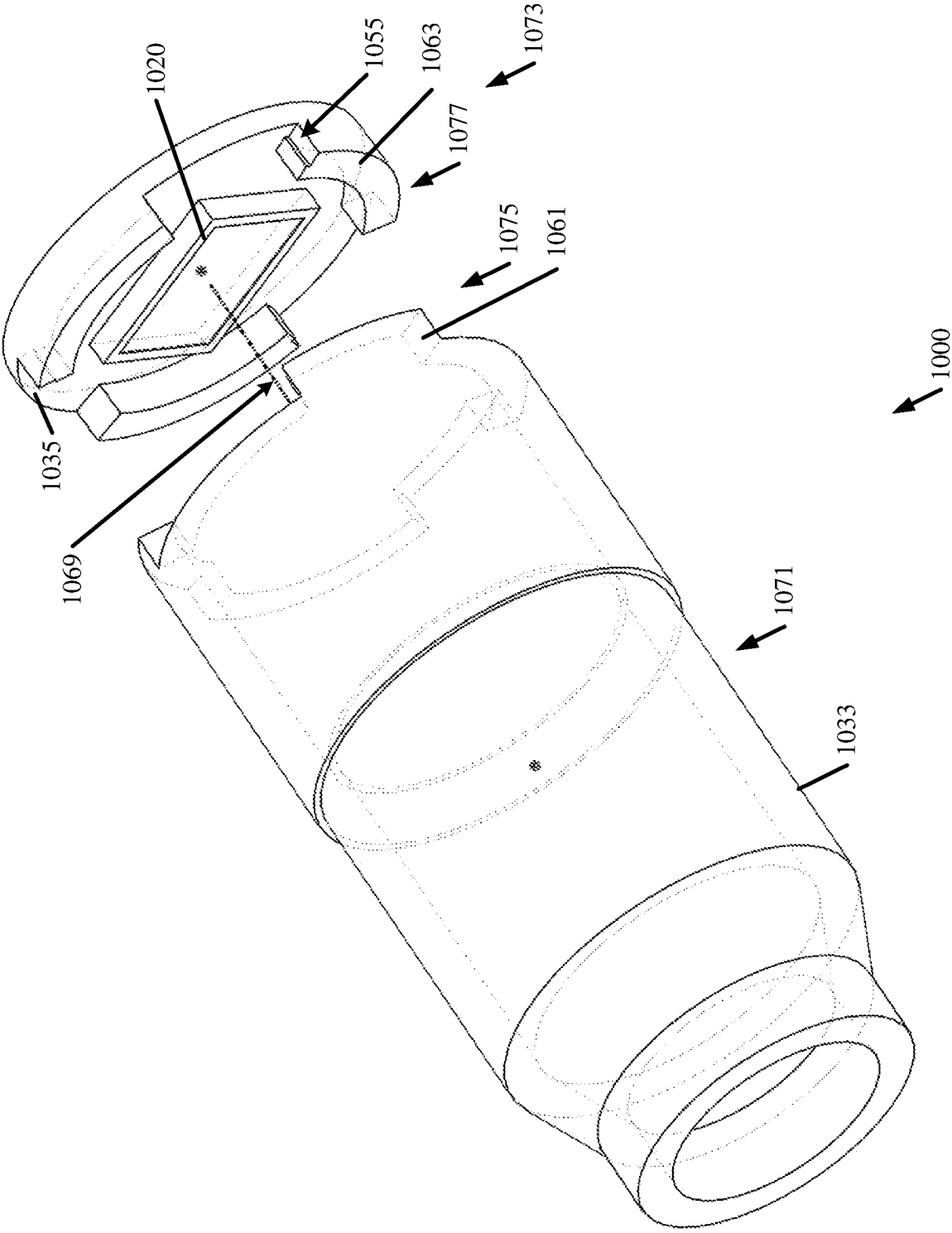


Fig. 10A

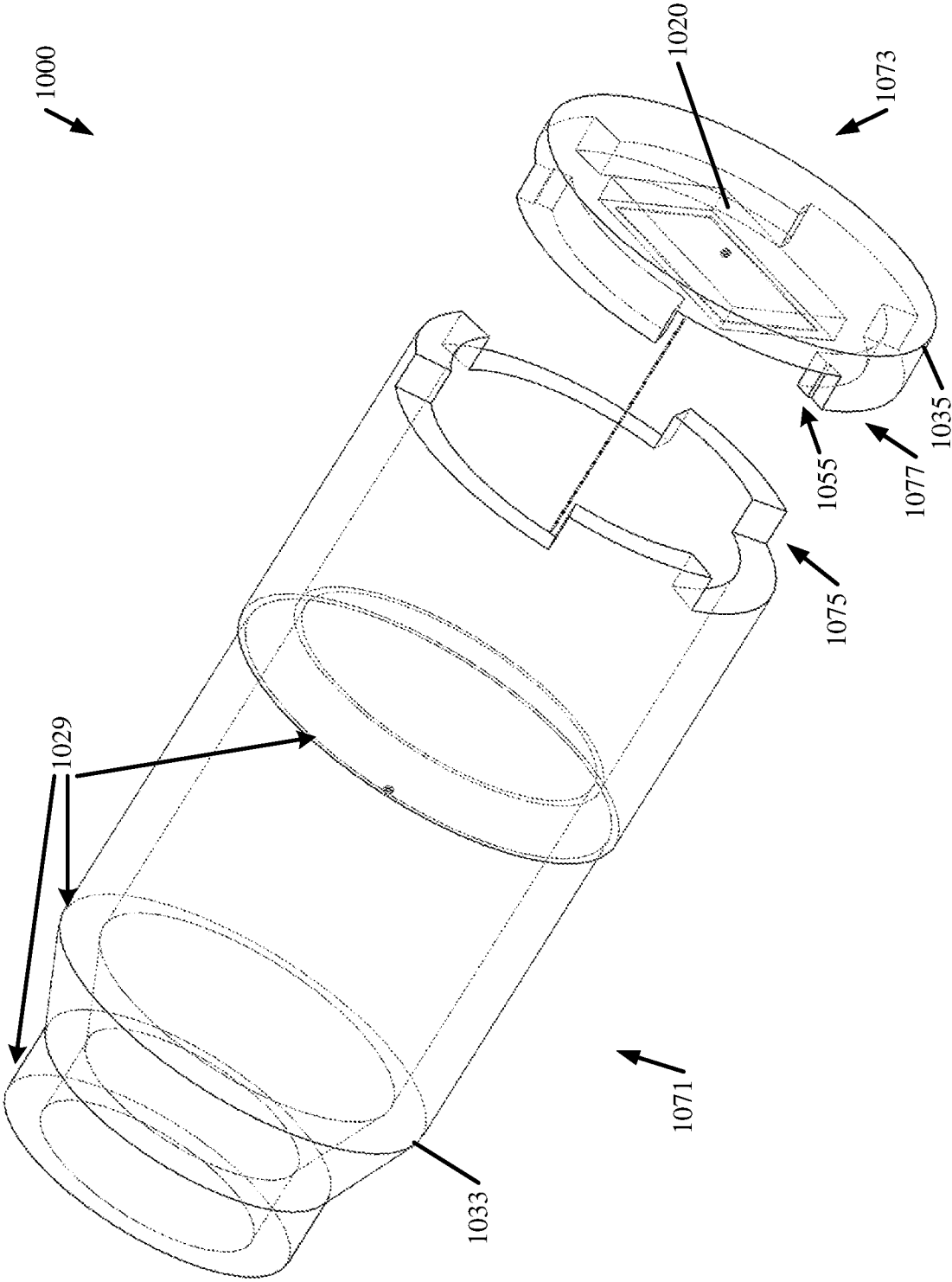


Fig. 10B

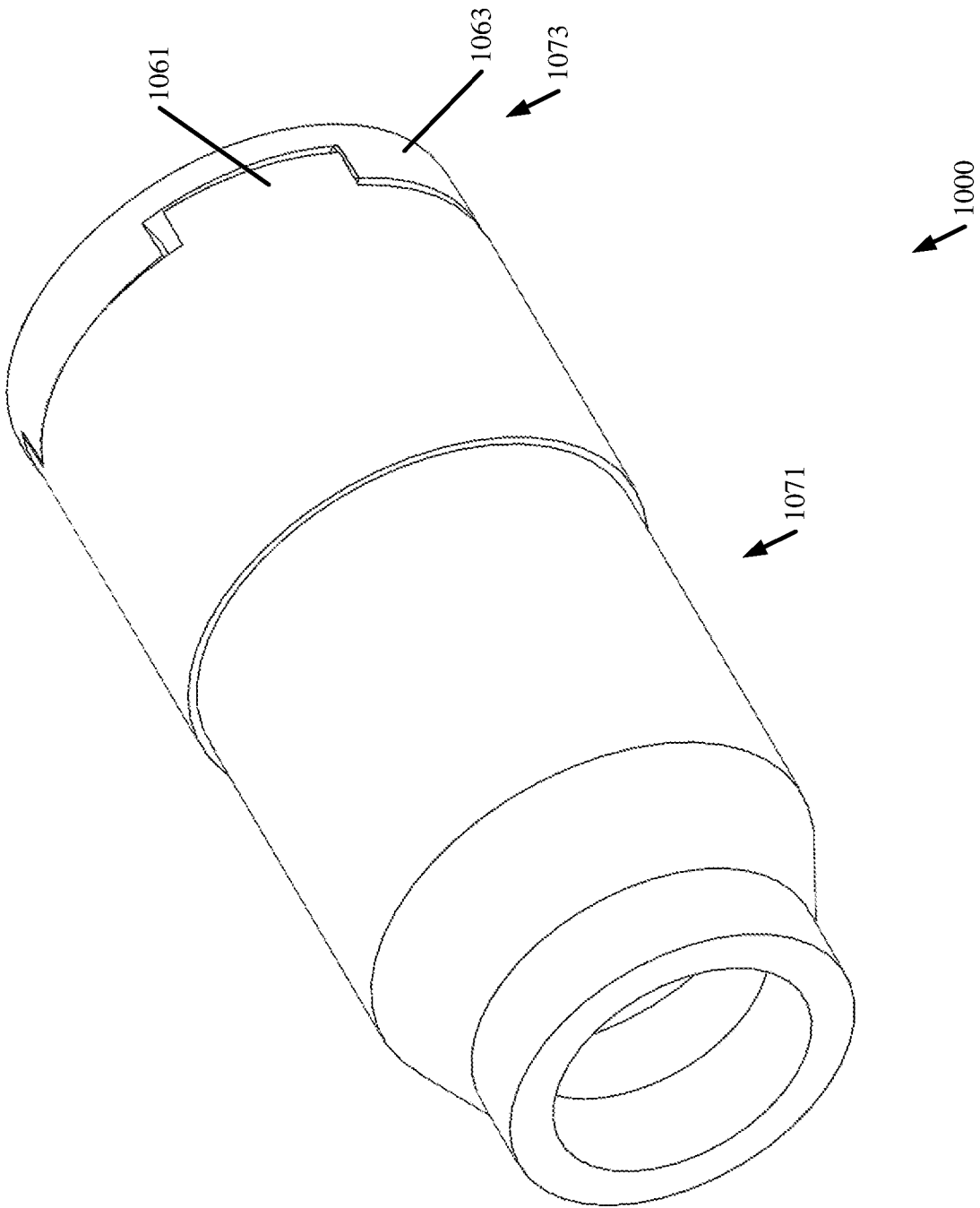


Fig. 10C

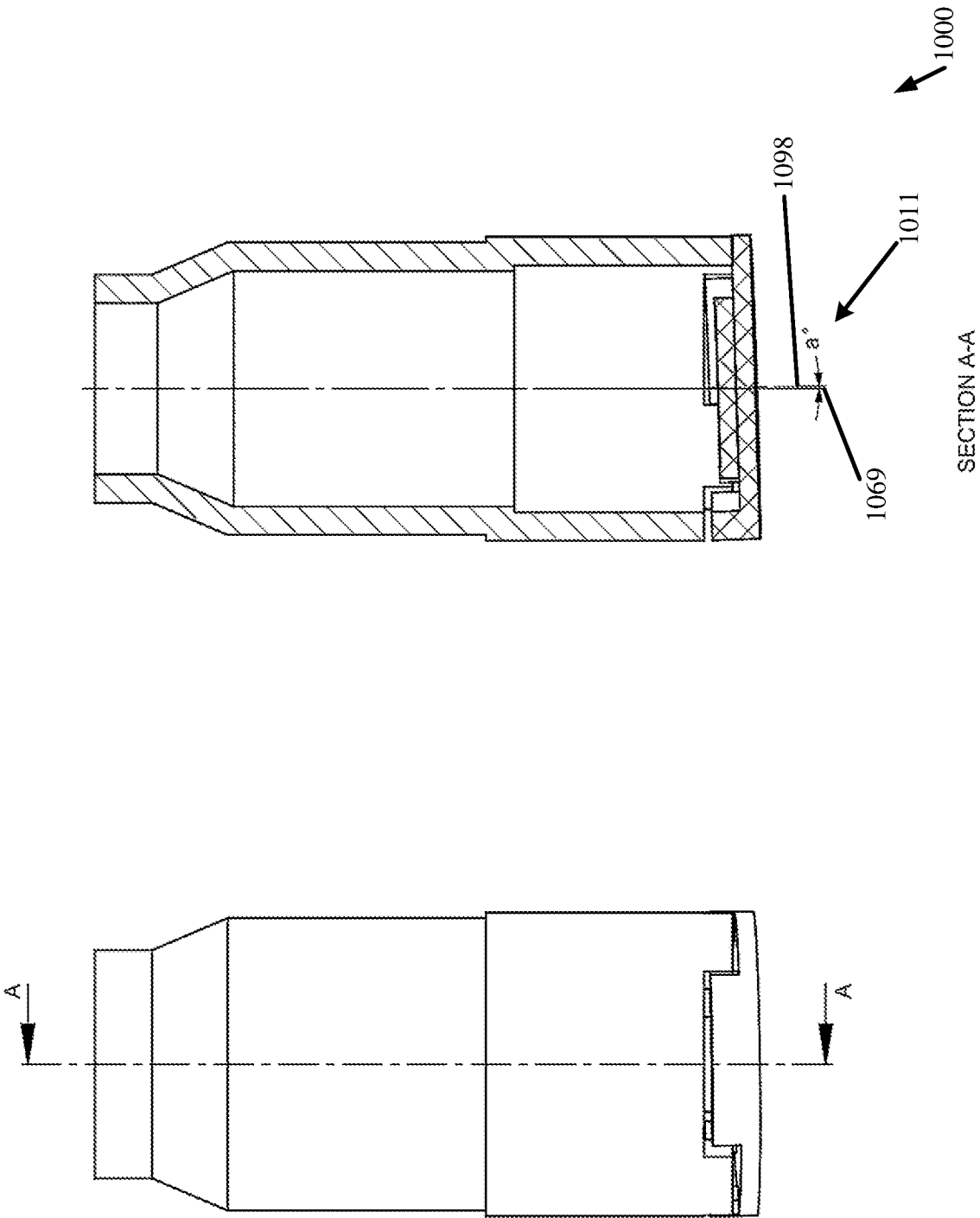


Fig. 10D

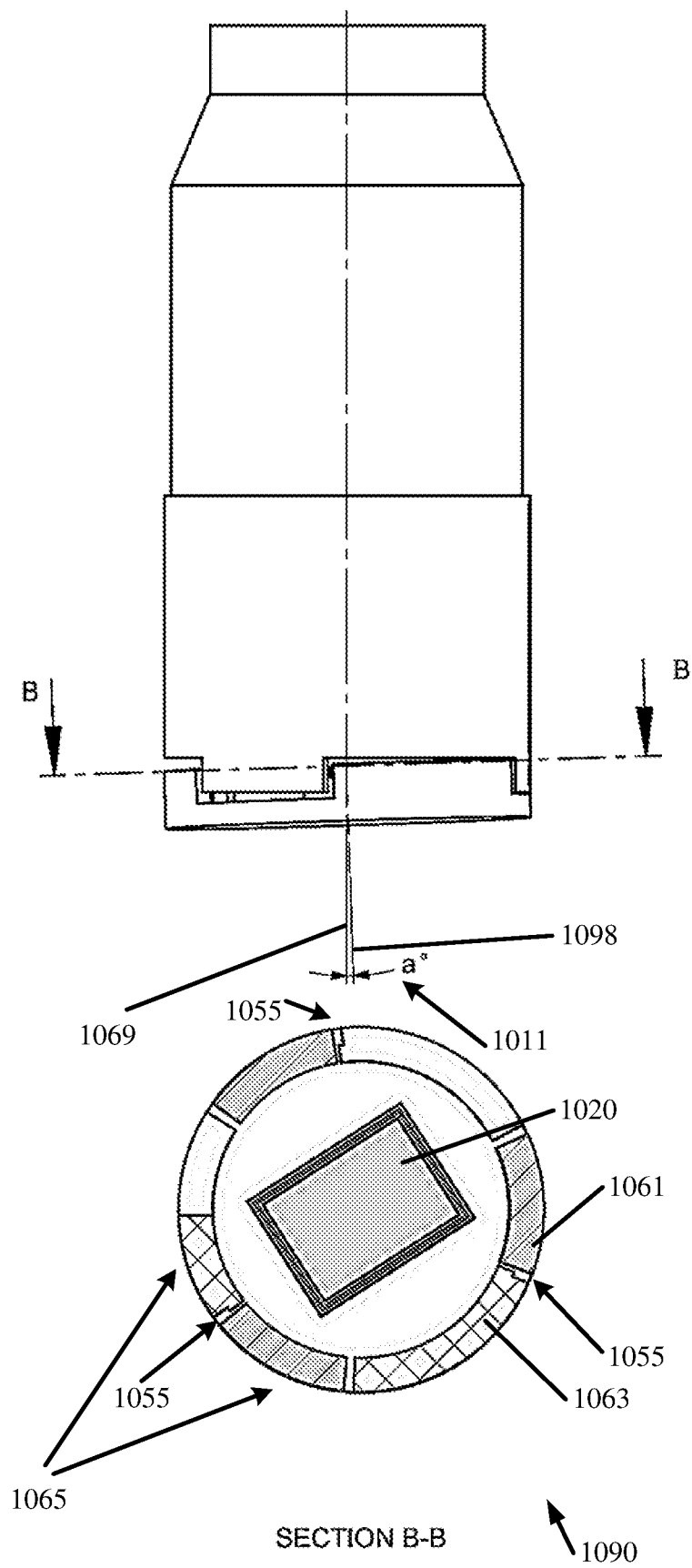


Fig. 10E

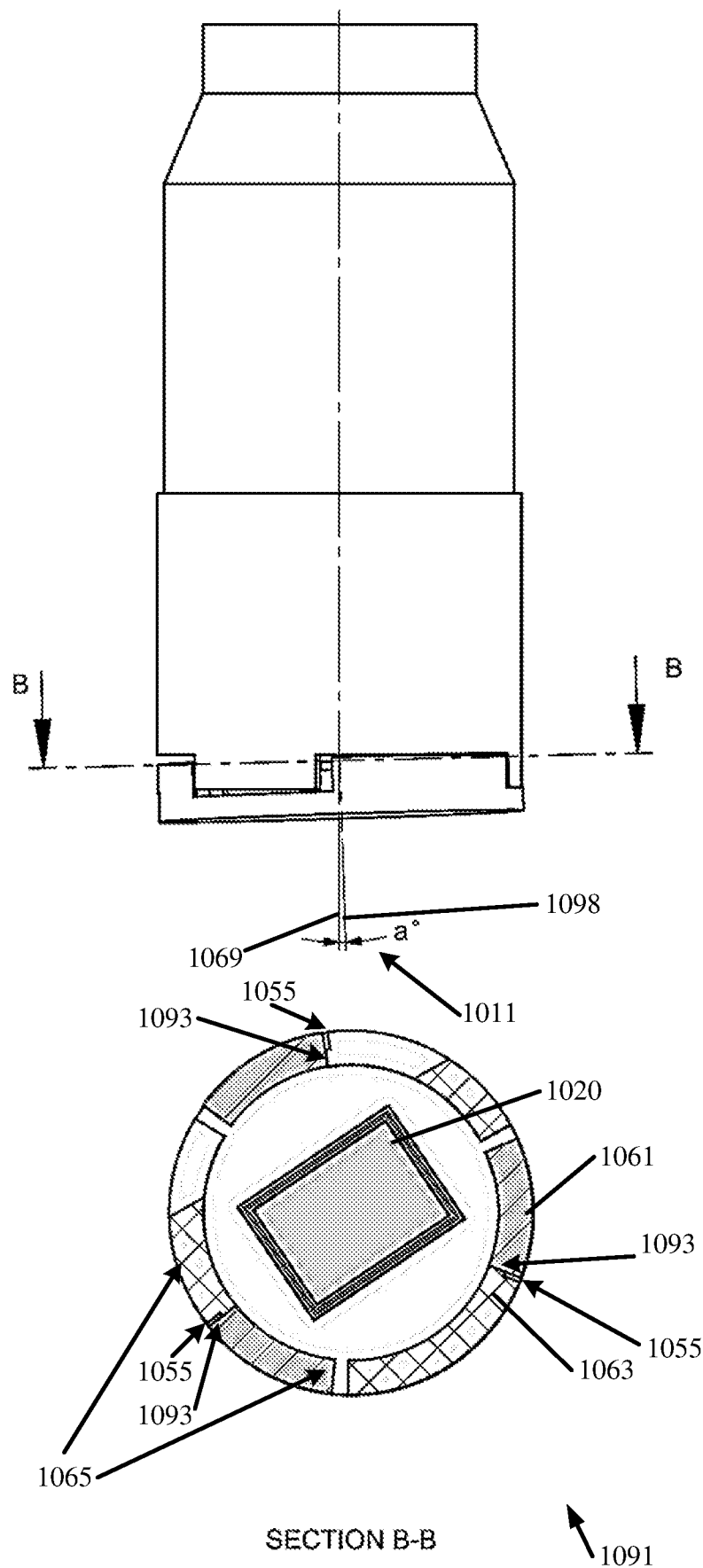
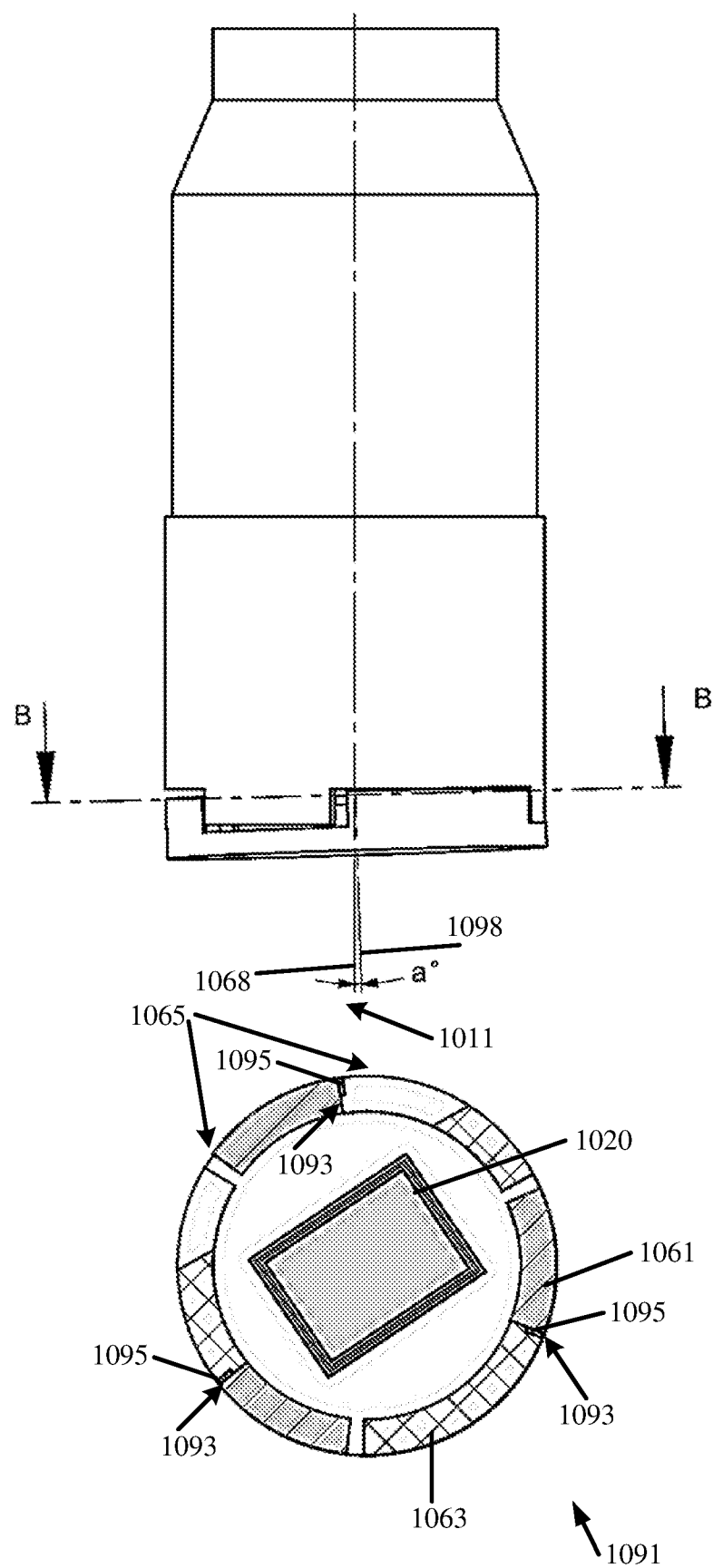


Fig. 10F



SECTION B-B

Fig. 10G

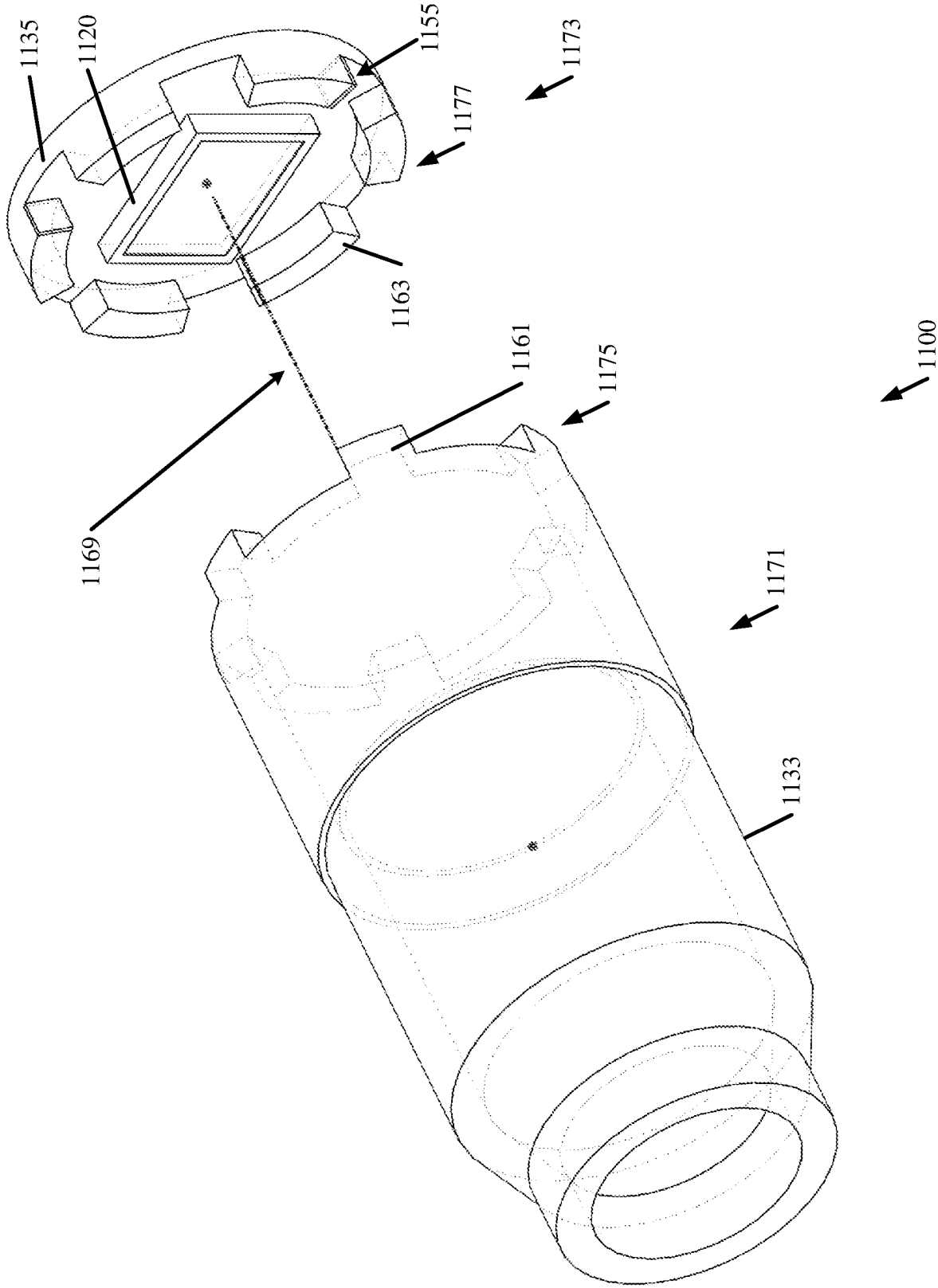


Fig. 11A

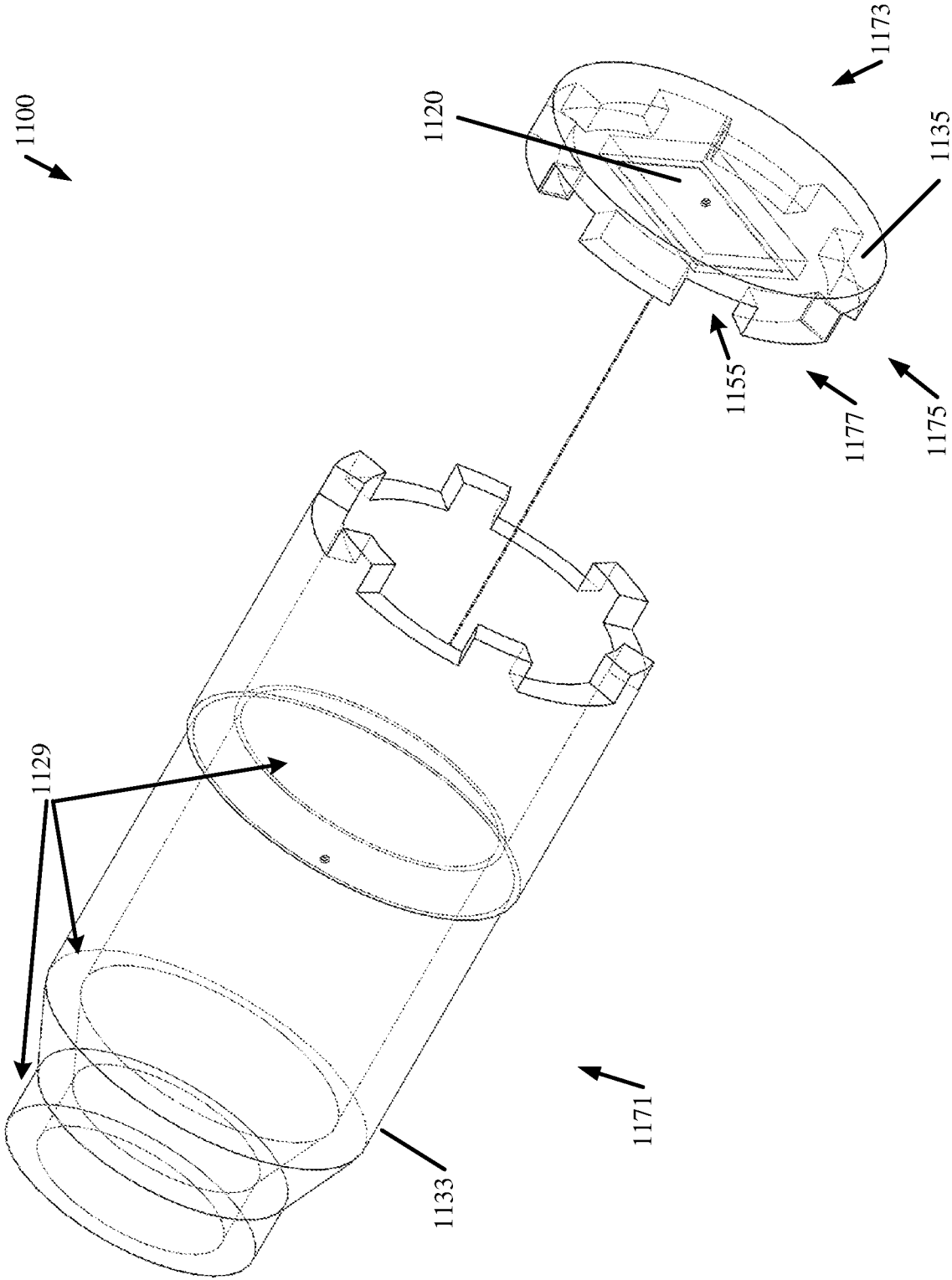


Fig. 11B

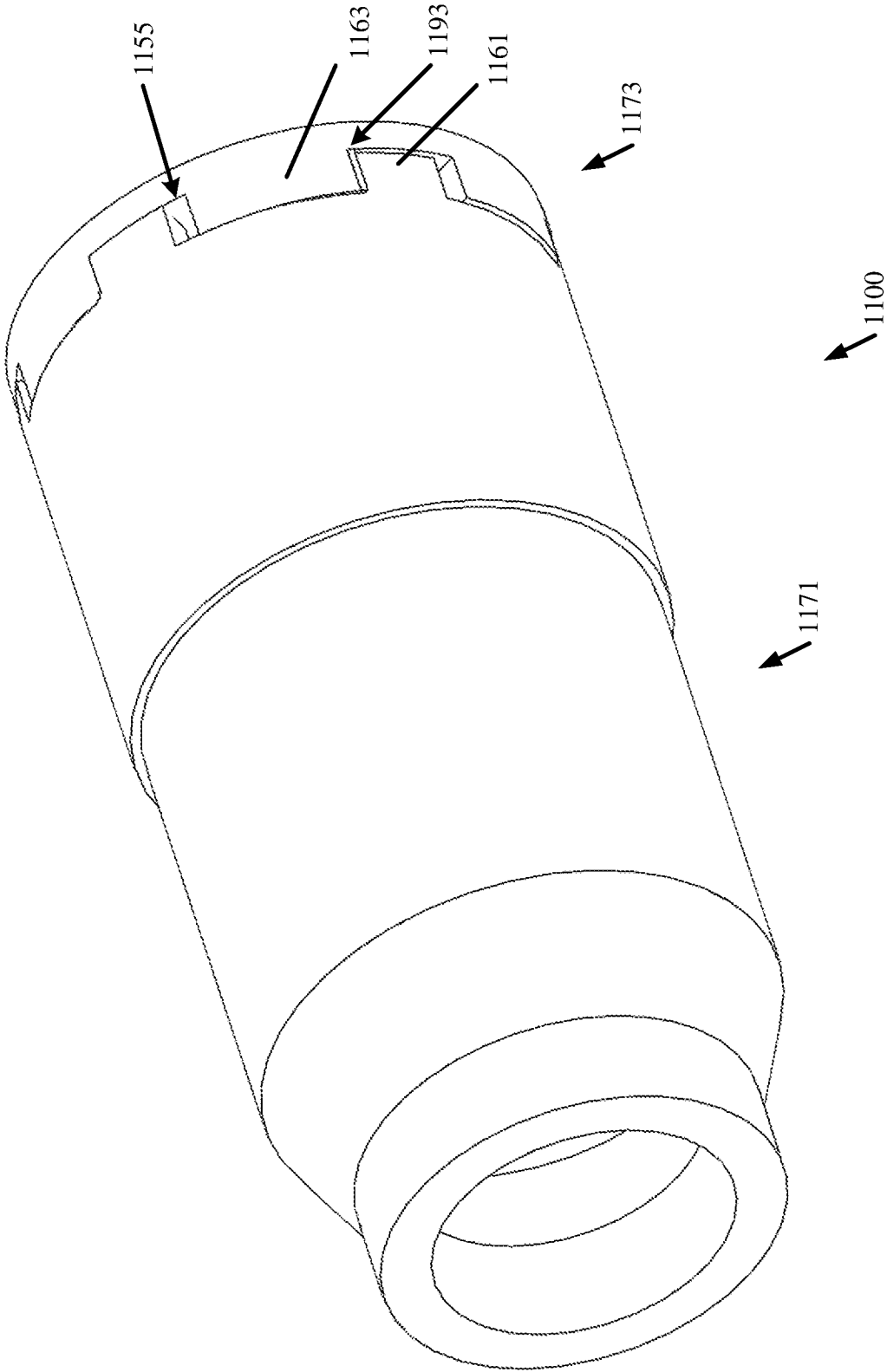


Fig. 11C

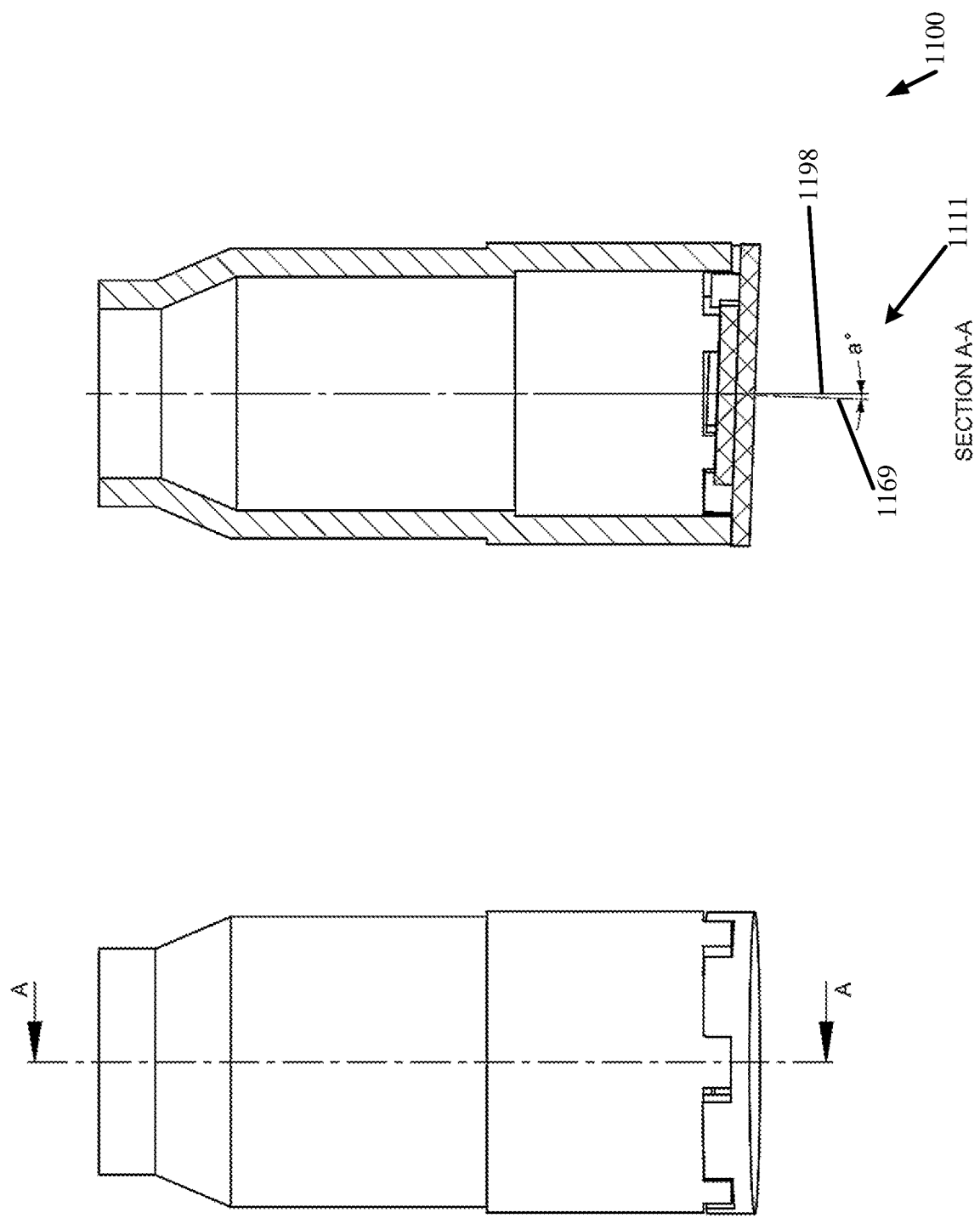


Fig. 11D

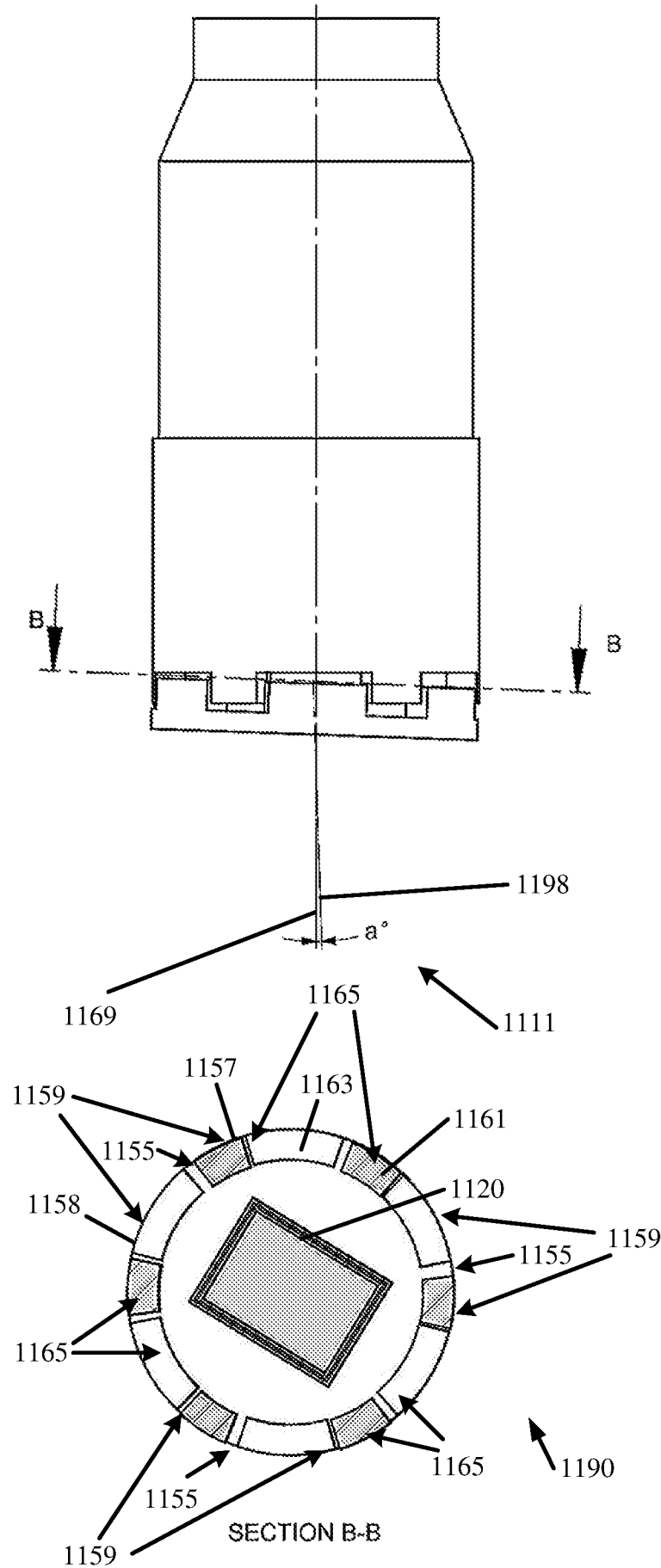


Fig. 11E

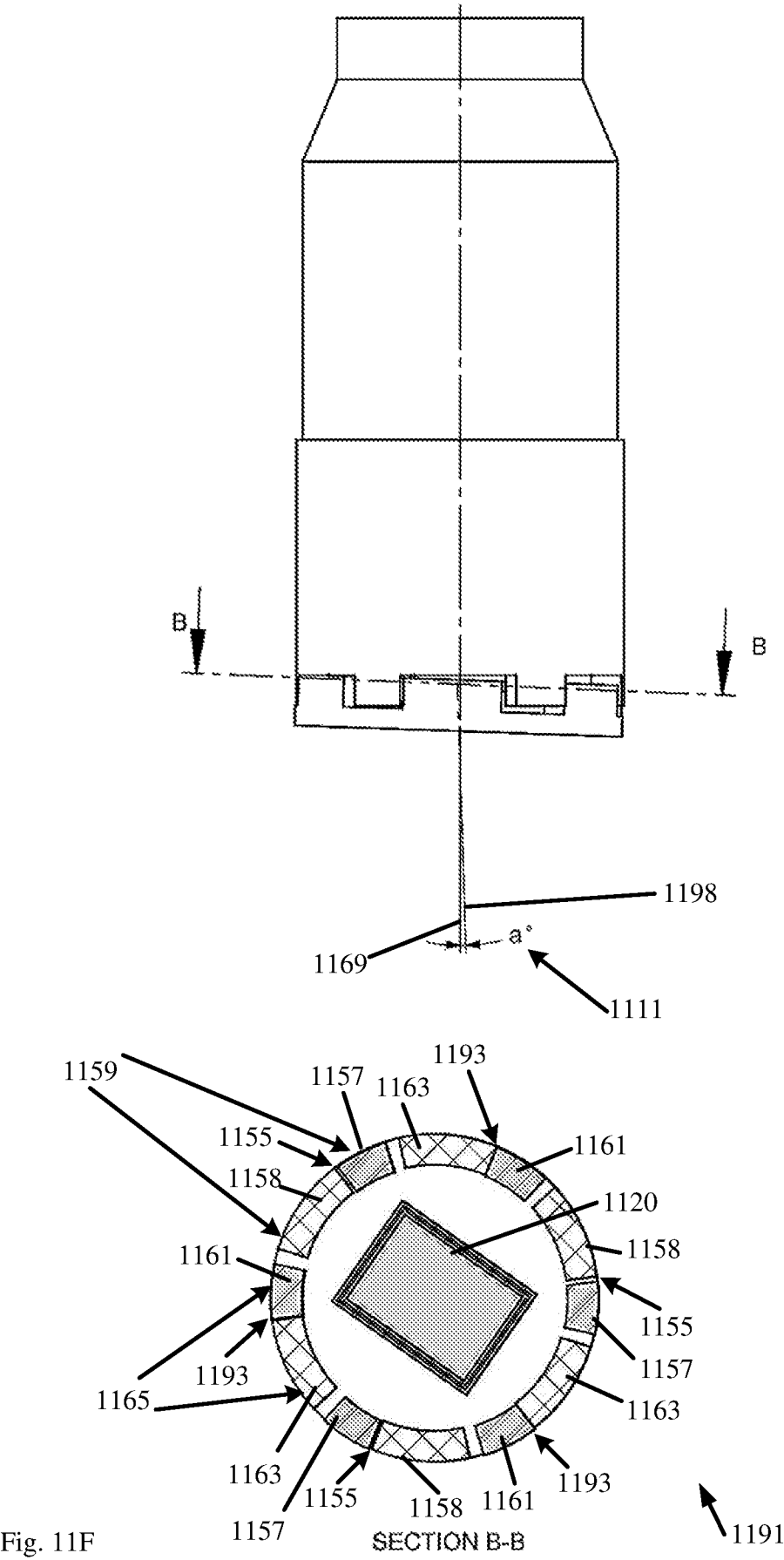


Fig. 11F

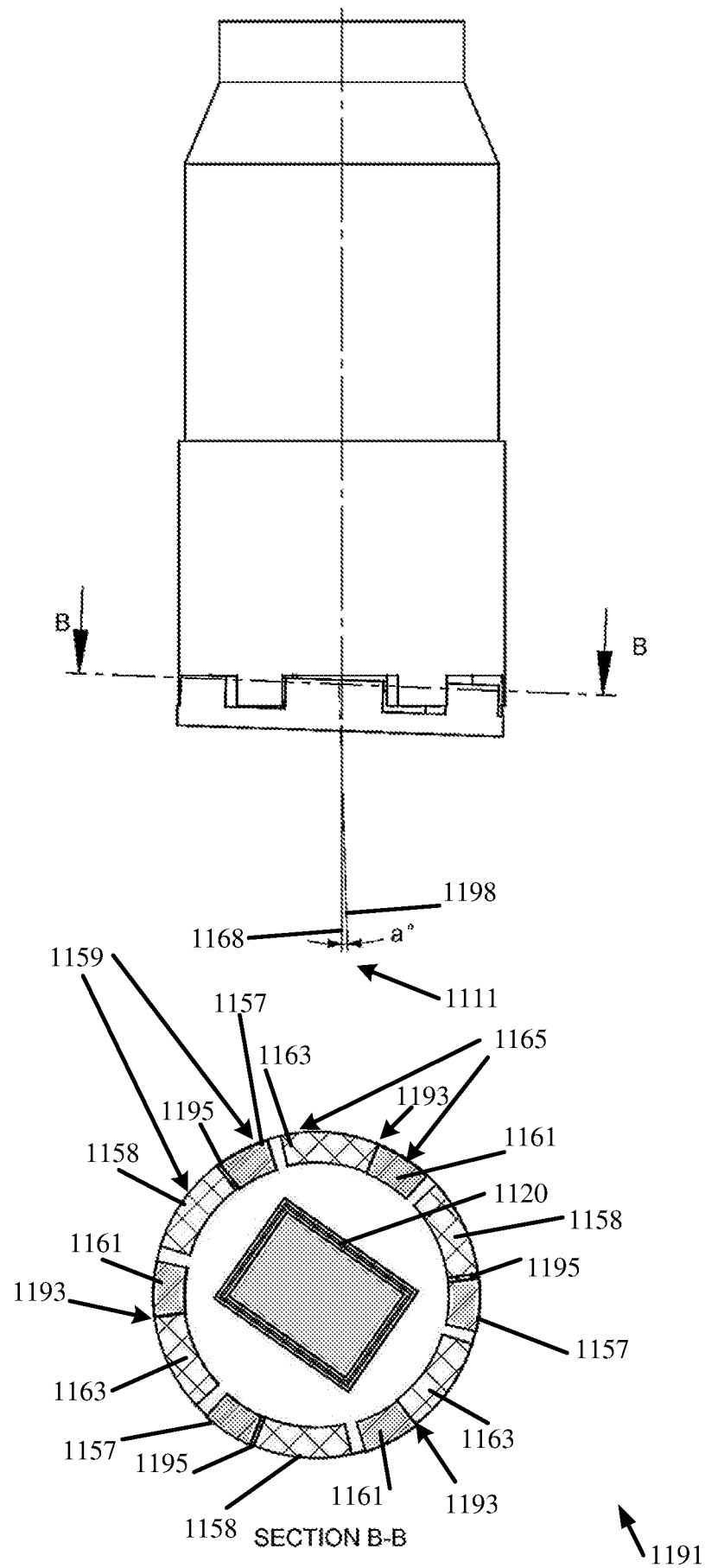


Fig. 11G

INTERNATIONAL SEARCH REPORT

International application No

PCT/IB2024/051679

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04N23/55 G02B7/00

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04N G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/168846 A1 (YE ZHIJIN [JP] ET AL) 4 August 2005 (2005-08-04) paragraphs [0068] - [0070], [0100], [0105] - [0108], [0138]; figures 3A, 3B -----	1-4, 6-14, 16-20, 23-29
X	US 2018/364441 A1 (HUBERT AURELIEN R [US] ET AL) 20 December 2018 (2018-12-20) paragraphs [0052], [0062], [0099] - [0104]; figures 1, 10, 11 ----- -/--	1-9, 12, 13, 15-24, 26-29



Further documents are listed in the continuation of Box C.



See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search

13 May 2024

Date of mailing of the international search report

24/05/2024

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Fax: (+31-70) 340-3016

Authorized officer

Rolet, Etienne

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2024/051679

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2021/103119 A1 (RECKKER MARTIN J [US] ET AL) 8 April 2021 (2021-04-08) paragraphs [0029], [0038], [0040]; figure 9 -----	1-9, 12, 13, 15-24, 26-29
X	US 2022/382070 A1 (WU BING [CN] ET AL) 1 December 2022 (2022-12-01) paragraphs [0128], [0132]; figure 2A -----	1-11, 13, 15-18, 21-29
A	US 2021/382375 A1 (SESTI MATTHEW C [US] ET AL) 9 December 2021 (2021-12-09) paragraph [0005] -----	1-29

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2024/051679

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005168846 A1	04-08-2005	NONE	
US 2018364441 A1	20-12-2018	US 2018364441 A1	20-12-2018
		US 2020124818 A1	23-04-2020
		US 2021199913 A1	01-07-2021
US 2021103119 A1	08-04-2021	US 2021103119 A1	08-04-2021
		US 2023194828 A1	22-06-2023
US 2022382070 A1	01-12-2022	CN 114731359 A	08-07-2022
		EP 4044576 A1	17-08-2022
		US 2022382070 A1	01-12-2022
		WO 2021082708 A1	06-05-2021
US 2021382375 A1	09-12-2021	US 2021382375 A1	09-12-2021
		US 2023259007 A1	17-08-2023