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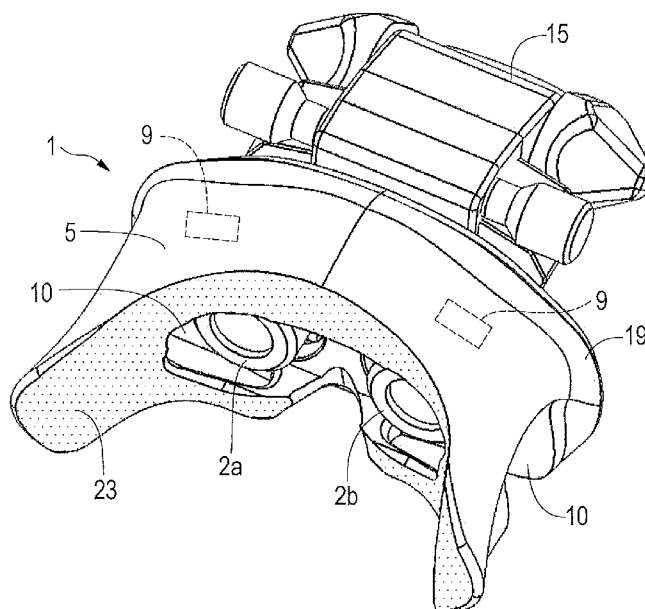


FIG. 4B

(57) Abstract: Disclosed is an attachment for a standalone optical device to alleviate back and neck strain which allows the eyes of the user relative to the eyepieces of the optical device, with embodiments allowing inclusion of preset values such as shape and dimension of the user's face, eye relief distance, pupillary distance. Movement of the eyes is achieved either by a mechanical pivot or by stretching of the mask being comprised of flexible material.



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## **Customized Viewing System for an Optical Device**

### **Statement Regarding Priority**

[001] This application claims priority to and the full benefit of, US patent application number 15/714,505 filed on September 25, 2017 which is a continuation in part of US patent application number 15/274,905 filed on September 23, 2016, to be issued on September 26, 2017. US patent application number 15/274,905 incorporated application number 15/274,905 in its entirety.

### **Background**

[002] Standalone optical devices such as microscopes provide an image or pair of images to a user, and have enough mass or are secured into a position and are able to support the weight of a user's head, neck and back, if a comfortable and workable location for the head to rest were attached to the optical device. Without such a place to lean and rest against, the user often leaned his head, neck and back forward into a position to see through the eyepieces. This leaning often causes short term muscle fatigue and also long term damage to the spine.

[003] For example, the binoculars for a surgical microscope transmit two images, one for each eye, to the user. Binoculars have two eyepieces which normally comprise plastic or metal eyecups which can make contact with the user's eye socket. Although these types of binoculars with eyepieces have been in existence for very long, there are numerous practical difficulties experienced by the users.

[004] The eyepieces of the optical systems are normally configured and attached to the optical system in a manner which does not allow the user's head to rest on them. The user

is often required to view into the eyepieces of binoculars (or a single eyepiece for a monocular device) for extended periods such as during a surgical procedure. With prior art eyepieces, the microscope user can experience neck and back strain from using neck and back muscles and the spine to stabilize the head during long periods of time using the optical system. With prior art binoculars or monoculars with eyepieces, users are unable to lean against the plastic or metal eyepiece cups in an optimum manner. For example, prior art eyepiece cups provide at most, two small points for the user's brow, but the pressure brought by the user at these small areas creates discomfort if the pressure continues long enough. That is, prior art eyepiece cups have not been constructed to support a user's head and back comfortably for long periods of use, such as in surgical procedures. Many optical device users are unable to continue their careers when problems caused by neck and back strain accumulate from years of optical system use, and these kinds of problems can be experienced by any user of optical devices.

[005] The visual images produced for the user by the current eyepieces are not always ideal. That is, the optical environment for the user, comprising pupillary distance (PD), refractive lens correction, and the length of the focal image plane (eye relief), is highly variable from individual to individual. For instance, a user's PD varies depending on the size of the user's face. Also, optical device users often have vision which is corrected by refractive lenses, and adjustable diopters are provided in prior art binoculars with eyepieces, but these can be difficult or impractical to adjust during or even between surgeries. Finally, the distance between the user's cornea and the eyepiece lens (eye relief) affects the user's experience also. The user must hold his head steady in space at several locations in order to find the best image, and this in turn will create neck or back strain as the user attempts to hold her head steady in space in a fixed position. The foregoing conditions mean that achieving the

best optical environment takes a great deal of adjustment and generally leads to neck and back strain.

[006] The column of light exiting the optical device toward the user is called the View Field. When a user rotates his eye(s) while viewing through an optical device, thus moving his eyes relative to the eyepieces of the optical device, the View Field is frequently only partially seen because the center of the user's cornea is no longer centered with the eyepiece lens. With the prior art optical devices, which do not allow movement in relation to the eyepiece(s) of the optical device, eye rotation, which is needed to see the periphery of the view field in the optical device, and actually does not allow the user to visualize the periphery at all.

[007] Thus, there are many practical deficiencies with current optical device binoculars and monoculars with eyepieces which create challenges for delivering the best visual image, and maintaining the health of the user's neck and back.

[008] The present invention provides a number of solutions to these problems, as discussed below.

### **Brief Description of the Drawings**

[009] Fig. 1 is a schematic side view of a user's face contacting the inner contour of the mask and the eyepieces secured to the binocular housing of an optical device. A window covering a cutout is depicted, through which may be seen the eyes positioned toward the lens(es) of the eyepiece(s) at an optimal eye relief distance.

[010] Figs. 2a, 2B and 2C are schematics showing that, for many optical devices, the user's field of view and eyepiece view field are not always optimal.

[011] Fig. 3 is a perspective view of the embodiment of the attached to a standalone optical device (in this example, a surgical microscope).

[012] Fig. 4A is a rear elevational view and Fig. 4B is a rear perspective view of an embodiment of the invention and the binocular housing of the optical device. Pupillary distance between the centers of the lenses is depicted.

[013] Fig. 5a is a rear elevational view and Fig. 5b is a rear perspective view of an embodiment of the invention with the mask in a right and a left half (including a right and a left cover) and the binocular housing of the optical device.

[014] Fig. 6A is a side elevational view of one embodiment of the mask herein and a cover wherein the pivot, here a rail assembly shown in dotted lines, is mounted to the cover and also to the eyepieces. Fig. 6B is a front elevational view of the cover of the mask, without eyepieces in the eyepiece openings.

[015] Fig. 7A is an elevational internal view of the embodiment in 6A-B in which the pivot, here a rail assembly, is mounted to the cover and to the eyepieces. Fig. 7B is the same as 7A, but showing the movement of the mask.

[016] Fig. 8 is a side elevational view of the pivot, herein a dovetail assembly, mounted to the mask and to a plate for mounting to the cover or to the binocular housing.

[017] Fig. 9A is a side elevational view, and Fig. 9B is a perspective view, of the pivot, in an embodiment with a gimbal assembly, mounted to the mask and to a plate for mounting to the eyepiece(s) or to the binocular or monocular housing.

[018] Fig. 10 is a perspective view of the pivot, in an embodiment with a rocker arm assembly, mounted to the mask and to a plate for mounting to the eyepiece(s) or to the binocular or monocular housing.

[019] Fig. 11A is a perspective view of the pivot, in an embodiment with a recessed bearing assembly, mounted to the mask and to a plate for mounting to the eyepiece(s) or to the binocular or monocular housing, and Fig. 11B is a side view of the same.

[020] Fig. 12 is an internal elevational view of the pivot, in an embodiment with a spring mounted assembly, for mounting to the eyepiece(s) or to the binocular or monocular housing.

[021] Fig. 13 is a perspective view of the pivot, in an embodiment with a pad of flexible material, mounted to the mask and to a plate for mounting to the eyepiece(s) or to the binocular or monocular housing.

[022] Fig. 14 is a perspective view of the pivot, in an embodiment with a low friction plate assembly, for mounting to the eyepiece(s) or to the binocular or monocular housing.

[023] Fig. 15 is a side elevational view of mask, here a microscope, mounted to one side of the pivot, here a dovetail assembly, and the other side of the pivot is mounted directly to the binocular housing, showing also that the binocular housing is fixed securely to the eyepiece. This figure shows a slightly extended shape at the upper portion of the mask to allow it to connect to the binocular or monocular housing. Throughout this application, this side of the mask (opposite to the inner contour contacting the face) may take any shape necessary to connect it to the pivot so that the pivot may be located in a convenient location.

[024] Fig. 16 is a rear elevation of the embodiment of the invention with the mask comprising flexible material having been stretched so that the eyes (shown in dotted lines) can look to the right, as shown by the lines from each eye pupil to the center of each lens.

[025] Regarding all the figures with eyepieces, these can either be part of an embodiment of the invention or, alternatively, the eyepieces are part of the optical device and are shown as being connected to the eyepiece openings.

#### Detailed Description

[026] The invention, in one embodiment, is a customized attachment **1** to a standalone optical device, such as a microscope, telescope, sighting system for a weapon, a video game, or a virtual reality device, which is not worn as a head-mounted device. That is the standalone device can support the head, neck and back of a user who leans against it, and the invention provides the location against which the user may lean in order to prevent neck and back strain. The invention also may incorporate preset values obtained from measurements of the user's face which are built into the structure of the system, in order to minimize practical difficulties in using adjustable settings, and to solve other problems described herein.

[027] In one embodiment, the viewing system for attachment to a separate, standalone optical device **15** comprises at least one eyepiece **2a, 2b** secured by a pivot **20**, i.e., any of a number of mechanical means, which is secured to a mask **5** which comprises at least one eyepiece opening **6a, 6b**. In certain embodiments, an eyepiece is secured within the eyepiece opening and, in other embodiments, an eyepiece is not part of the invention but the eyepiece opening of the invention is secured to the eyepiece of the standalone optical device. The inner contour of the mask may be customized to the size and shape of a user's face. An eyepiece comprises at least one rigid sidewall in any practical shape (e.g., round, square, oval and the like) and at least one optical element such as a lens for transmitting light beams from the optical device to the user's eye. Each said eyepiece also comprises a first end **13a, 13b** and a second end **14a, 14b** and each said eyepiece comprises a lens **3a, 3b** located near the second end **14a, 14b** and each said lens **3a, 3b** comprising a center **4a, 4b**, and said center of each said lens may be spaced in relation to the center of the other said lens at a distance similar to a measured pupillary distance (PD) **11** of the user. In one embodiment, each said lens may also be positioned at an optimal eye relief distance **12**, such that the user can rest his or her face against the mask and thereby prevent neck and back strain.



[028] In one embodiment, the lenses **3a**, **3b**, one for each eye, are selected to correspond to the user's prescription lenses or, if no prescription is needed, the eyepieces are set to plano. Each lens **3a**, **3b** has a center **4a**, **4b** upon which the user may center the pupils of the eyes. Each lens is seated or secured near the second end **14a**, **14b** of each eyepiece, which can also be described as the ends of the eyepieces closest to the user. Pupillary distance **11** is the distance between the centers of the user's pupils. The retina has a preferential area for resolving images with small details and, for the best vision, light should be focused on those areas. In order to deliver the optimal image to the user's retina, the image delivered to the eye should be in focus at the user's cornea so that the image may be delivered optimally through each pupil and lens of the eye to the retina. The lenses **3a**, **3b** are also placed at a customized distance from the user's cornea so that the light passing through forms an optimum image on the user's retina, and the image is clearest, as shown in Fig. 1. That is, the invention is customized to place the user's cornea on the same plane as the eye relief **12** produced by each eyepiece. The customized eye relief distance is achieved by shaping the mask to the dimensions and shape of the user's face, as measured from the user himself, particularly the inset of the eyes and their position relative to the rest of the user's face.

[029] In one embodiment, the centers **4a**, **4b** of the lenses **3a**, **3b** in the invention are located relative to one another, that is, they are spaced at a distance which is a particular user's PD as measured from the user, as PD **11** is shown in Figs. 1 and 2. The lenses **3a**, **3b** are also customized to carry the refractive prescription for the user's eyes. The invention further comprises a mask **5** which secures the two eyepieces **2a**, **2b** in eyepiece openings **6a**, **6b** one for each eyepiece.

[030] The mask **5**, in one embodiment is positioned so that the user can rest his or her head completely on the mask, thus eliminating neck and back strain. The mask is not

worn by the user but is attached to the optical device. In one embodiment the mask **5** may not be customized to the shape and dimensions of the user's face, as long as it provides a place for the head to rest during usage. The mask can be made of any material which is strong enough to secure the eyepieces substantially in the same plane, and that material may be relatively inflexible or it may be flexible to allow stretching, as shown in Fig. 16. In one embodiment, the mask may be composed of a polymer which is formed by a 3D printer communicating with a camera enabled to produce 3D images of the face. In another embodiment, the mask can be produced by the older method of taking a plaster mold of the face and then producing a plastic structure therefrom. In one embodiment, a chin rest may also be provided. In another embodiment, padding **17** of relatively soft material such as closed cell foam or rubber is attached to the border **18** of the mask **5** which would contact the user's face. The mask may cover only the upper portion of the face (forehead to nose) or may extend further down towards the chin, as long as allowance may be made to prevent condensation on the eyepieces from the user's exhalation.

[031] The drying of the user's eyes from the air flow typical in a surgical environment is a problem which often requires a user to administer wetting drops to the eyes frequently. Another factor producing dry eyes is that, at certain points, the user might blink the eyes much less frequently to avoid missing any action or developments, and so this retards the eyes' ability to moisten themselves by blinking. In one embodiment, the mask **5** has a cutout **10** on each side so that the user can use peripheral vision. To solve the dry eye problems which might occur in the embodiment with cutouts **10**, the cutouts may be enclosed with a window **16** comprising clear plastic or glass which allows the user peripheral vision and also maintains a closed chamber which is the space between the mask and the user's face. The user's face is pressed against the mask, thereby shielding the eyes from the air flow typical in a surgical environment, and to retain a moister environment for the eyes.

[032] The warm moisture retained between the invention and the user's face, though, can create a problem of condensation on the eyepieces if the environment of use, for example in surgery, is cool. In one embodiment the mask comprises at least one battery or other power source (not shown), optionally housed in a cavity **8** in the mask, for powering circuitry to operate at least one heating or peltier element **9** for heating or cooling the mask and/or the eyepieces. Optionally, a circular cavity **27** for a coil for charging a battery also may be included. Many environments are cool where the invention is used, such as operating rooms, and heating the eyepieces prevents condensation from forming on the eyepiece lenses.

[033] The eyepieces **2a, 2b** may be connected to an optical device such as a microscope through any mechanical means such as threading, clips, screws or also through magnetic force.

[034] In one embodiment, the invention comprises a mask **5** comprising two eyepiece openings **6a, 6b**. The mask may be customized to the size and shape of a user's face, and each said eyepiece opening **6a, 6b** is configured for attachment to an eyepiece of the invention, or the eyepiece incorporated into the standalone optical device. Each said eyepiece and eyepiece opening has a center **4a, 4b**, which is defined by the centers of the user's eyes, and an eyepiece is spaced in relation to the center of the other said eyepiece opening **6a, 6b** at a distance similar to a measured pupillary distance of the user. Each said eyepiece opening is also configured so that a lens **3a, 3b** of an eyepiece of an optical device is at an optimal eye relief distance **12** for the user, that is, the image from the optical device is optimally focused at the user's cornea. As a result of the foregoing, the user can rest his or her face against the mask and thereby prevent neck and back strain. In one embodiment, the eyepieces are not provided and the invention attaches to eyepieces which are part of an optical device. In this embodiment, the center of an eyepiece opening is the point at which a

center of a lens on an eyepiece of the optical device is located when the invention is attached to an optical device.

[035] In another embodiment, the optical device may be one or more screens projecting an image as in a video game or a virtual reality device. In another embodiment the optical device can be the optical components of a weapon or weapon system. In another embodiment, the optical device is a telescope. In another embodiment, the optical device can be monocular such as in certain laboratory microscopes. In such a monocular embodiment, only one eyepiece can be inserted into an eyepiece opening **6a, 6b**. All embodiments of the inventions require that the optical devices are standalone and able to support a user's head, neck and back when she leans against it

[036] The solution for making more of the optical device's exit pupil available to the user is shown in Figs. 2A, 2B and 2C. Fig. 2A shows the eye centered and looking straight into the eyepiece. The user's field of view is coaxial with the eyepiece view field and concentric producing a full circle image. Fig. 2B shows the eye rotated to look to the periphery without the eye moving laterally. The user's field of view and the eyepiece view field do not coincide leaving a clipped or partial view. Fig. 2C shows the eye rotated and moved laterally after the mask 5 has moved, and in this position the eye's field of view is completely contained within the eyepiece view field, yielding a complete and round image. The small movements of the head could fall within a range of 0.1 to 5 millimeters in either direction side to side, depending on the optical device. The structure and skin of the face makes up and down movement feasible without any feature of the present invention. That is, the skin of the face has enough give or play to allow the head to move readily within the range of 0.1 to 5 millimeters in either direction side to side. Side to side movement, however, is not readily available to the user because the skin does not move as readily in that direction, and also the nose is obstructed by the need of the mask to rest on the user's nose. Disclosed

herein, are several means for allowing side movements for the user's head, while the eyepieces (either of the invention when provided as part of the invention or of the optical device when provided by the optical device), remain in a fixed location. The pivot **20**, or multiple pivots, may be configured for movement laterally or vertically.

[037] To allow movement of the mask, and therefore the user's head and eyes, there are several means to do so, as set forth herein.

[038] In one embodiment, the invention comprises an attachment to a standalone optical device **15**, said attachment comprising a mask **5** comprising at least one eyepiece opening **6a, 6b** configured for connection to an eyepiece **2a, 2b** of the standalone optical device, said mask connected to at least one pivot **20** at a first location, said pivot also configured at a second location for connection to an eyepiece of the optical device such that, upon securing the attachment to the optical device, the user can rest his or her face against the mask and thereby prevent neck and back strain, and move the user's eyes by moving the mask in relation to the eyepiece by moving the pivot. The mask may cover the entire upper portion of the user's face, having a center corresponding to a vertical axis at the middle of a user's nose, for example in Figs. 4A-4B. In another embodiment, as for example in Figs. 5A and 5B, the mask **5** further comprises two of said eyepiece openings and two of said pivots **20**, and the mask further comprises a half for a right side of the face **5b** separated from a half for a left side **5a** of the user's face, and each of said right and left halves **5b, 5a** comprises one of the pivots so that each half moves independently of the other half by means of its own pivot. The pivots depicted in Figs. 6-14 may thus be employed to move the entire mask **5** or each separate half of the mask **5a, 5b** and, in such a case, the cover **19** may be separated into two halves **19a, 19b**.

[039] In another embodiment, the invention comprises an attachment to a standalone optical device, said attachment comprising a mask comprising flexible material, which is elastic and allows stretching (as in Fig. 16), and at least one eyepiece opening configured for attachment to an eyepiece of the optical device such that, upon securing the attachment to the optical device, the user can rest his or her face against the mask and thereby prevent neck and back strain, and stretch the mask so that the user's eyes may move in relation to the eyepiece. The flexible material in the mask is selected from a group consisting of rubber, silicone, plastic and plastic foam, and allows the user's head to move without the necessity of a pivot,

such as by stretching in response to pressure exerted by the user's head when she is seeking to view part of the visual field of the optical device. In this embodiment, the mask itself remains anchored in the same location, but the elasticity of the material in the mask stretches and allows the user's eyes to move in relation to the eyepieces.

[040] In another embodiment, the invention comprises an attachment to a standalone optical device, said attachment comprising at least one eyepiece, a mask and at least one pivot, said at least one eyepiece at one location configured for connection to the optical device and comprising a lens, said mask connected to the at least one pivot at a first location and said pivot at a second location connected to the at least one eyepiece such that, upon securing the attachment to the optical device, the user can rest his or her face against the mask and thereby prevent neck and back strain, and move the user's eyes by moving the mask in relation to the at least one eyepiece by moving the pivot. In another embodiment, the invention further comprises two of said eyepieces and two of said pivots, and the mask further comprises a half for a right side of the face separated from a half for a left side of the face, and each of said right and left halves comprises one of the pivots connected to one of the eyepieces. In another embodiment, the mask further comprises a customized inner contour for the user's face, and the customized inner contour positions the eye of a user at an optimal eye relief. The attachment may also comprise at least one lens, and each lens may comprise a refractive prescription for one of the user's eyes. Each of the lenses has a center, and the centers may be spaced at a measured pupillary distance of the user.

[041] In another embodiment, the invention comprises an attachment to a standalone optical device comprising at least one eyepiece, a mask comprising flexible material, said at least one eyepiece at a first position connected to the optical device and comprising a lens, said eyepiece at a second position connected to said mask such that, upon securing the attachment to the optical device, the user can rest his or her face against the mask and thereby prevent neck and back strain, and stretch the mask and move the eyes in relation to the at least one eyepiece, as shown in Fig. 16. The flexible material is selected from a group consisting of rubber, silicone, plastic and plastic foam, and there are many more flexible materials which fit into this group. In this embodiment, the mask itself remains anchored in the same location, but the elasticity of the material in the mask stretches and allows the user's eyes to move in relation to the eyepieces.

[042] In another embodiment, the attachment comprises two of said eyepieces, and the mask further comprises a half for a right side of the face separated from a half for a left side of the face. The mask may further comprise an inner contour customized for the user's face, and the customized inner contour may position the eye of a user at an optimal eye relief. In another embodiment the at least one lens further comprises a refractive prescription for one of the user's eyes, and each of the lenses has a center, and the centers may be spaced at a measured pupillary distance of the user.

[043] The pivot herein is connected at a first position securely to the mask or to the cover securely, so that the user's application of pressure to the mask moves the mask in that direction, as depicted in Figs. 6, 7A-7B, 12 and 14, thus allowing the user's eyes to move in relation to the eyepieces. The pivot is also connected, at a second position, to the eyepiece(s) which do not move in response to pressure from the user. That is, the eyepieces remain stationary under normal usage once they are locked into a position using the optical device's clutches and brakes, or other mechanical methods for fixing the binocular or monocular housing. At the second position the pivot may be "connected to" the eyepiece(s) (1) directly, or (2) indirectly to another portion of the optical device fixed securely to the eyepieces such as the binocular or monocular housing **15**, as depicted in Fig. 15. When the connection between the eyepiece(s) and the pivot is indirect, such as at the binocular housing, a desirable configuration for the pivot may be as shown in Figs. 8-11 and 13.

[044] In another embodiment, the invention may comprise a pivot, and the mask may also be comprised of flexible material to facilitate movement of the eyes of the user by a combination of a pivot and the mask comprising flexible material.

[045] In another embodiment the mask **5**, **5a-b** further comprises a customized inner contour based upon a shape of the user's face, and the customized inner contour may position the eye of the user at an optimal eye relief distance **12** from a lens **3a**, **3b** of the at least one eyepiece of the optical device **15**, which distance is measured by a mold or 3D imaging and subsequent additive manufacturing. The environment for use of the optical device sometimes being challenging, embodiments of the mask may further comprise at least one heater for warming the mask or the eyepiece(s), at least one peltier element for cooling the mask or the eyepiece(s), and/or a fan (not depicted) for ventilation of a chamber formed when the user's face is pressed against the mask. In another embodiment the mask further comprises a cutout

**10** on each side which enables the user to see with peripheral vision, and the cutout may be enclosed with a window **16**.

### Definitions

[046] “Mask” includes the cover **19** when the cover is attached securely to the mask.

[047] “Pivot” includes any mechanical device or assembly enabling linear (vertical or lateral) or rotational movement. The “pivot” may be selected from a group consisting of, a rail assembly, a tongue and groove assembly, a dovetail assembly, a gimbal assembly, a rocker arm assembly, a spring loaded assembly, a low friction plate assembly, a bearing assembly, and a flexible material pad.

[048] “Connected” or “connection” means a direct connection, or an indirect connection which is secure and not subject to bending or flexing during normal use. For example only, an indirect connection the eyepiece(s) includes, without limitation, the structure between the eyepiece(s) and a binocular/monocular housing or other component of a standalone optical device. That is, the housing is substantially fixed in location relative to the eyepiece(s) of the optical device, even though they are not touching directly.

### Additional Discussion re Pivots

[049] Figs. 6, 7A and 7B depict an embodiment of the pivot **20** as a rail assembly. Fig. 7A shows two rails **20a** in parallel and each secured at each end by an anchor **20b**, and two eyepiece housings **21a**, **21b**, each of which is connected directly to an eyepiece **2a**, **2b** and also engaged slidably with each rail **20a** which passes through a tunnel in each of the eyepieces housings. Each eyepiece housing can move in either direction along the rails, for example when the user’s head applies pressure to the mask, and movement of the eyepiece housings here (and movement of the eyepieces themselves) is limited by a stop **26**. In one embodiment the movement of the eyepiece housings is reversed automatically when pressure from the user’s head is removed, by springs **7** placed on each rail between each eyepiece housing and the stop. Movement of the eyepieces and eyepiece housings is demonstrated in Fig. 7B.

[050] Fig. 8 is an embodiment of the pivot **20** as a dovetail assembly comprising a receiver **20c** which is generally female and a sliding insert **20d** which is generally male, each



being sized to fit closely to the other. A dovetail assembly is a more specialized version of a tongue and groove assembly. The sides of **20c** and **20d** which are not joined may be attached to the mask **5** and the binocular housing **15**, or to pivot supports **25a**, **25b** which are attached, respectively to the eyepiece(s) or structures such as the binocular housing, and to the mask **5**.

[051] Figs. 9A and 9B depict a pivot **20** which is a gimbal assembly comprising a rod **20e** threaded through openings in gimbal supports **20f**, at least one attached to the mask **5** or pivot support **25b** attached to the mask, or to the eyepiece **2a**, **2b**, to pivot support **25a** attached to the eyepiece or to another structure such as the binocular housing which is indirectly connected to the eyepiece.

[052] Fig. 10 is an embodiment of a pivot **20** which is a rocker assembly comprising a rocker arm **20g** attached on each of its two ends to brackets **20h** which allow each end of the rocker arm to pivot rotationally. One side of the rocker assembly is attached to the mask or to pivot support **25b**, and the other side is attached to the eyepiece(s), the binocular/monocular housing or other structure, including pivot support **25a**.

[053] Figs. 11A and 11B are views, perspective and side elevational, respectively, of a pivot **20** as one embodiment of a recessed bearing assembly comprising bearings **20i** (shown partially) recessed in bearing housings **20j** which are connected to the mask, or to a pivot support **25b** attached to the mask. The bearings **20i** revolve and allow another pivot support **25a** (or, say, surface of the binocular housing) to move in relation to the mask or pivot support **25b**.

[054] Fig. 12 is an elevational view of a pivot **20** which is one embodiment of a spring loaded assembly comprising springs **20k** each of which is attached on one end to a plate **25** attached to the eyepieces and on the other end to the cover **19** which is secured to the mask **5**.

[055] Fig. 13 is a pivot **20** which is a perspective view of one embodiment of a flexible material pad **20l**, attached to the mask directly or by pivot support **25b**, and attached to the eyepiece(s) directly or to the binocular/monocular housing (or other structure of the optical device) by means of a pivot support **25a**.

[056] Fig. 14 is a perspective view of the pivot **20** in one embodiment of a low friction plate assembly comprising plates **20m** and **20p** which contact each other and are capable of sliding relative the other.

[057] Fig. 15 is a side elevational view of the mask **5** connected to the pivot **20**, for example a dovetail assembly as in Fig. 8, where the pivot is connected to the binocular housing, and the binocular housing is indirectly connected to the eyepieces. The binocular housing is fixed securely to the eyepieces, so movement of the mask at the pivot is movement relative to the eyepieces.

## CLAIMS

We claim:

1. An attachment to a standalone optical device, said attachment comprising a mask comprising at least one eyepiece opening configured for connection to an eyepiece of the standalone optical device, said mask connected to at least one pivot at a first location, said pivot configured for connection at a second location to the eyepiece of the optical device such that, upon securing the attachment to the optical device, the user can rest his or her face against the mask and thereby prevent neck and back strain, and move the mask in relation to the eyepiece by moving the pivot.
2. The attachment as in claim 1, wherein the at least one pivot is selected from a group consisting of, a rail assembly, a tongue and groove assembly, a dovetail assembly, a gimbal assembly, a rocker arm assembly, a spring loaded assembly, a low friction plate assembly, a bearing assembly, and flexible material.
3. The attachment as in claim 1 wherein the mask further comprises two of said eyepiece openings and two of said pivots, and wherein the mask further comprises a half for a right side of the face separated from a half for a left side of the face, and each of said right and left halves comprises one of the pivots.
4. The attachment as in claim 1, wherein the mask further comprises a customized inner contour based upon a shape of the user's face.
5. The attachment as in claim 4, wherein the customized inner contour positions an eye of the user at an optimal eye relief distance from a lens of the eyepiece.
6. An attachment to a standalone optical device, said attachment comprising a mask comprising flexible material and at least one eyepiece opening configured for attachment to an eyepiece of the optical device such that, upon securing the attachment to the optical device, the user can rest his or her face against the mask and thereby prevent neck and back strain, and stretch the mask in relation to the eyepiece.
7. The attachment as in claim 6, wherein the flexible material is selected from a group consisting of rubber, silicone, plastic and plastic foam.

8. The attachment as in claim 6 wherein the mask further comprises two of said eyepieces, and the mask further comprises a half for a right side of the face separated from a half for a left side of the face.
9. The optical device as in claim 6, wherein the mask further comprises a customized inner contour customized for the user's face.
10. The attachment as in claim 9, wherein the customized inner contour positions an eye of the user at an optimal eye relief distance from a lens of the eyepiece.
11. An attachment to a standalone optical device, said attachment comprising at least one eyepiece, a mask and at least one pivot, said at least one eyepiece at one location configured for connection to the optical device and comprising a lens, said mask connected to the at least one pivot and said pivot connected to the at least one eyepiece such that, upon securing the attachment to the optical device, the user can rest his or her face against the mask and thereby prevent neck and back strain, and move the mask in relation to the at least one eyepiece by moving the pivot.
12. The attachment as in claim 11, wherein the at least one pivot is selected from a group consisting of, a rail assembly, a tongue and groove assembly, a dovetail assembly, a gimbal assembly, a rocker arm assembly, a spring loaded assembly, a low friction plate assembly, a bearing assembly, and flexible material.
13. The attachment as in claim 11 further comprising two of said eyepieces and two of said pivots, and the mask further comprises a half for a right side of the face separated from a half for a left side of the face, and each of said right and left halves comprises one of the pivots connected to one of the eyepieces.
14. The attachment as in claim 11, wherein the mask further comprises a customized inner contour for the user's face.
15. The attachment as in claim 14, wherein the customized inner contour positions the eye of a user at an optimal eye relief.
16. The attachment as in claim 11, wherein the at least one lens further comprises a refractive prescription for one of the user's eyes.

17. The optical device as in claim 13, wherein each of the lenses has a center, and the centers are spaced at a measured pupillary distance of the user.
18. An attachment to a standalone optical device comprising at least one eyepiece, a mask comprising flexible material, said at least one eyepiece at a first position connected to the optical device and comprising a lens, said eyepiece at a second position connected to said mask such that, upon securing the attachment to the optical device, the user can rest his or her face against the mask and thereby prevent neck and back strain, and stretch the mask in relation to the at least one eyepiece.
19. The optical device as in claim 18, wherein the flexible material is selected from a group consisting of rubber, silicone, plastic and plastic foam.
20. The optical device as in claim 18 wherein the attachment comprises two of said eyepieces, and the mask further comprises a half for a right side of the face separated from a half for a left side of the face.
21. The optical device as in claim 18, wherein the mask further comprises an inner contour customized for the user's face.
22. The attachment as in claim 21, wherein the customized inner contour positions the eye of a user at an optimal eye relief.
23. The optical device as in claim 18, wherein the at least one lens further comprises a refractive prescription for one of the user's eyes.
24. The optical device as in claim 20, wherein each of the lenses has a center, and the centers are spaced at a measured pupillary distance of the user.

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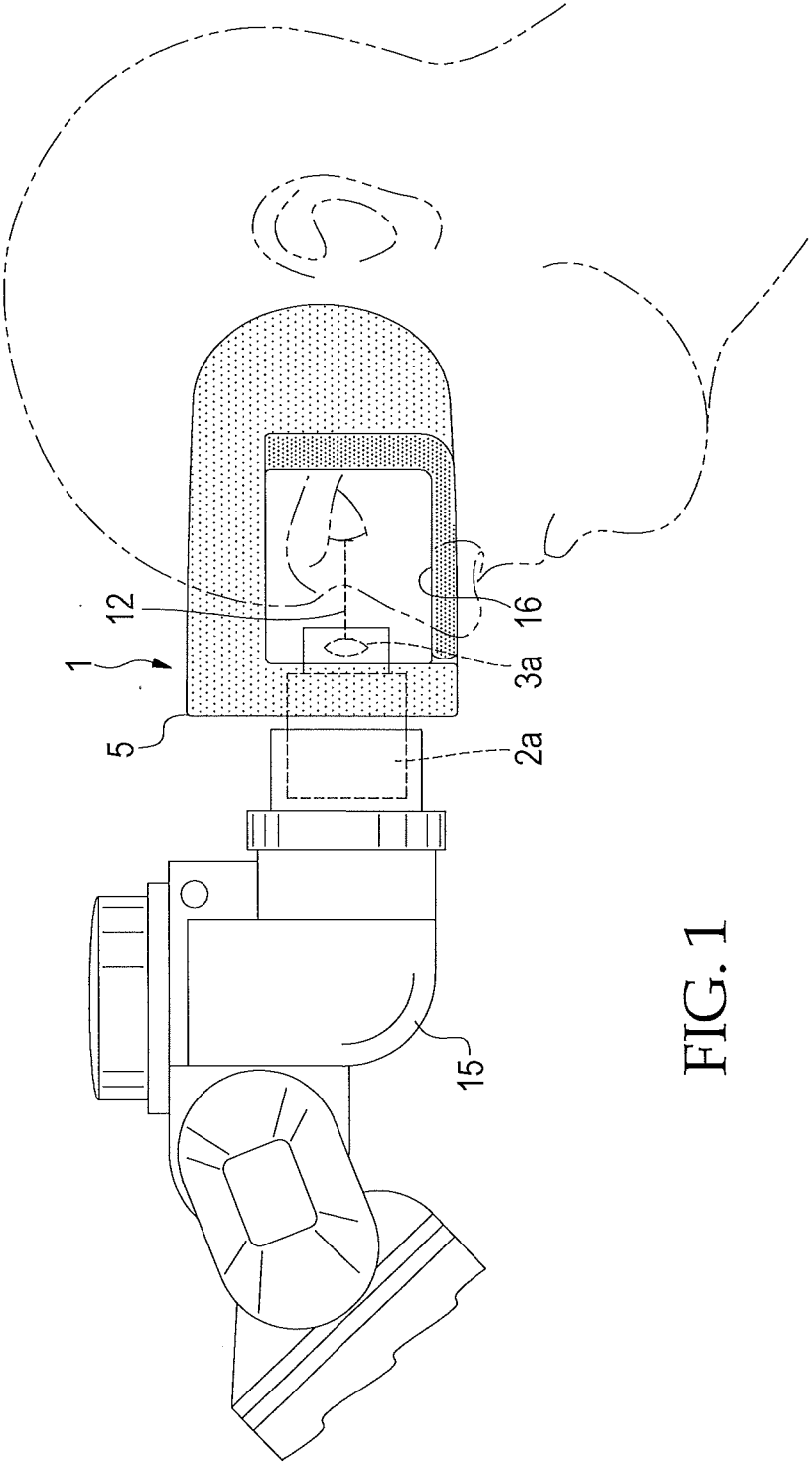


FIG. 1

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FIG. 2A

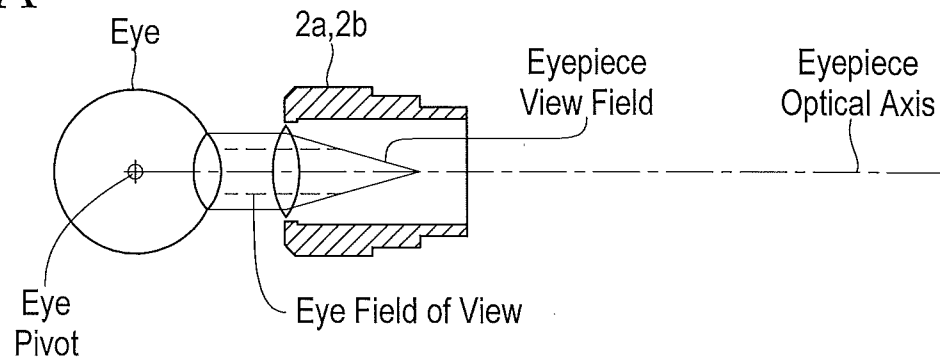


FIG. 2B

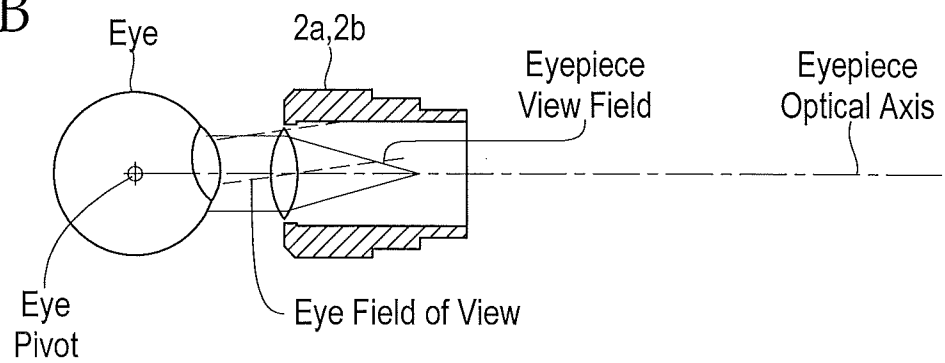
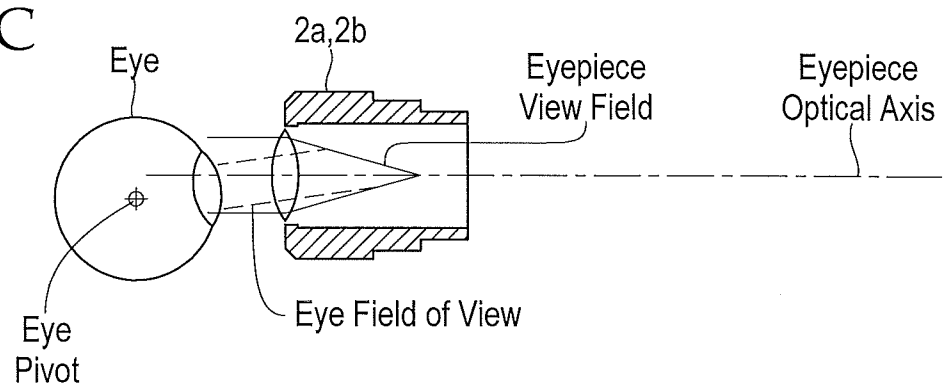


FIG. 2C



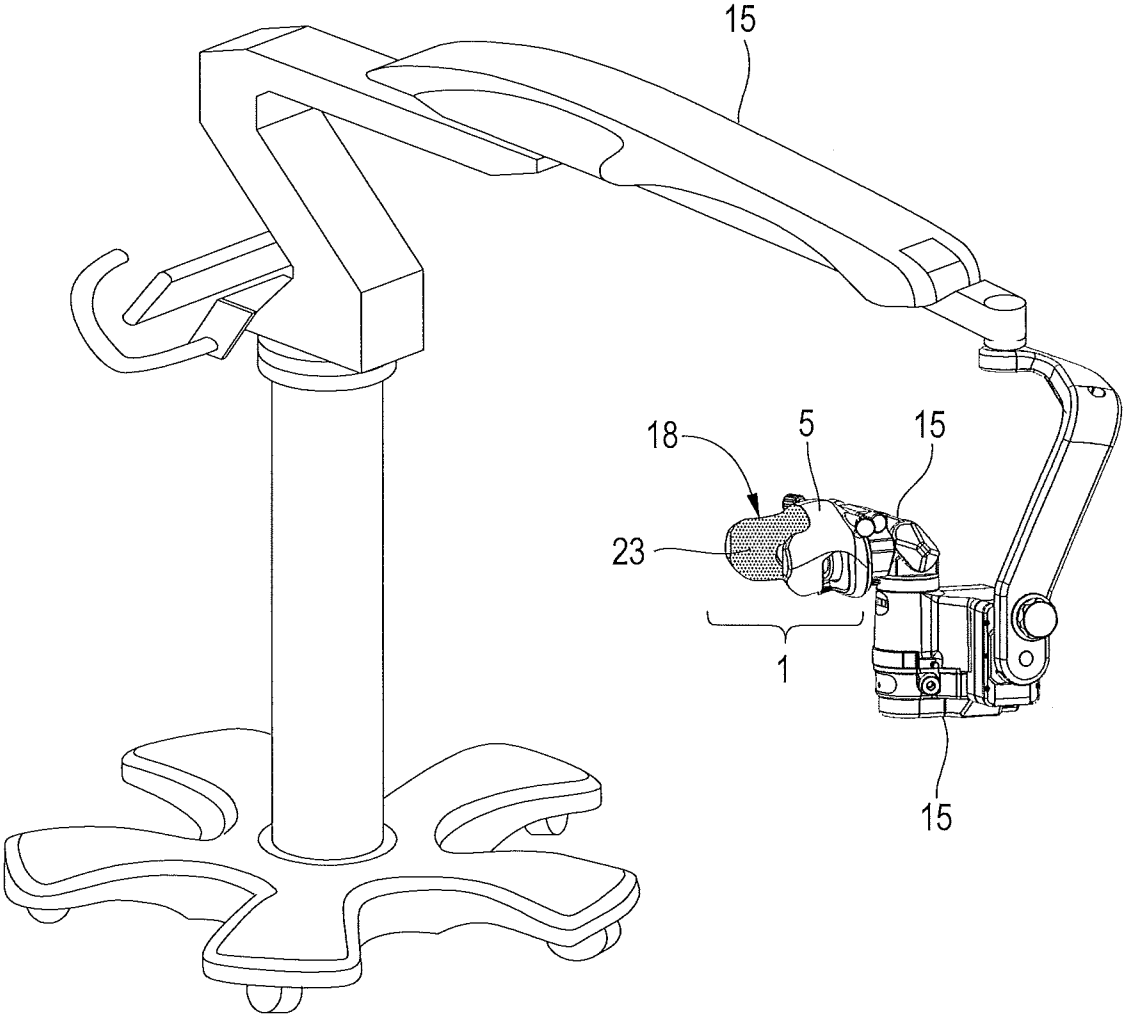


FIG. 3



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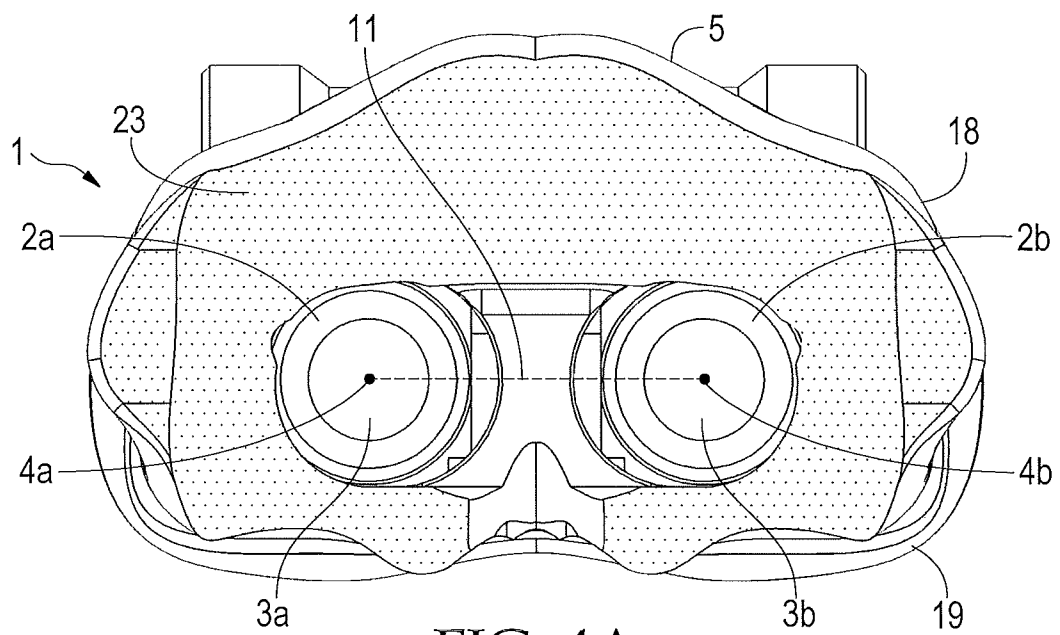


FIG. 4A

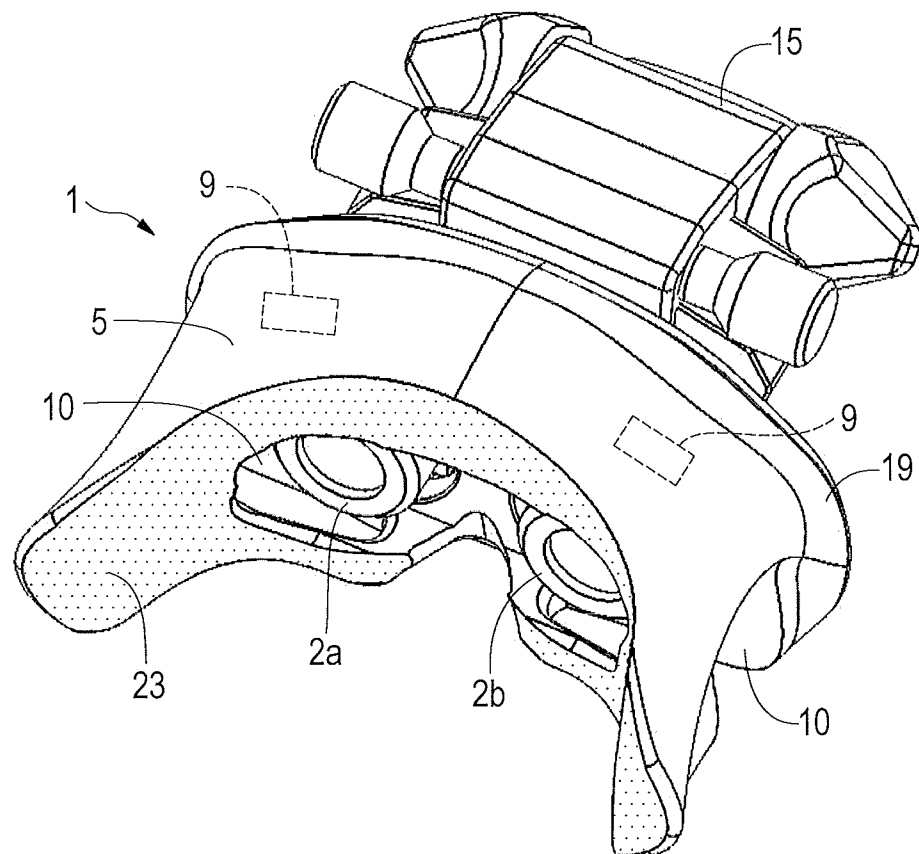
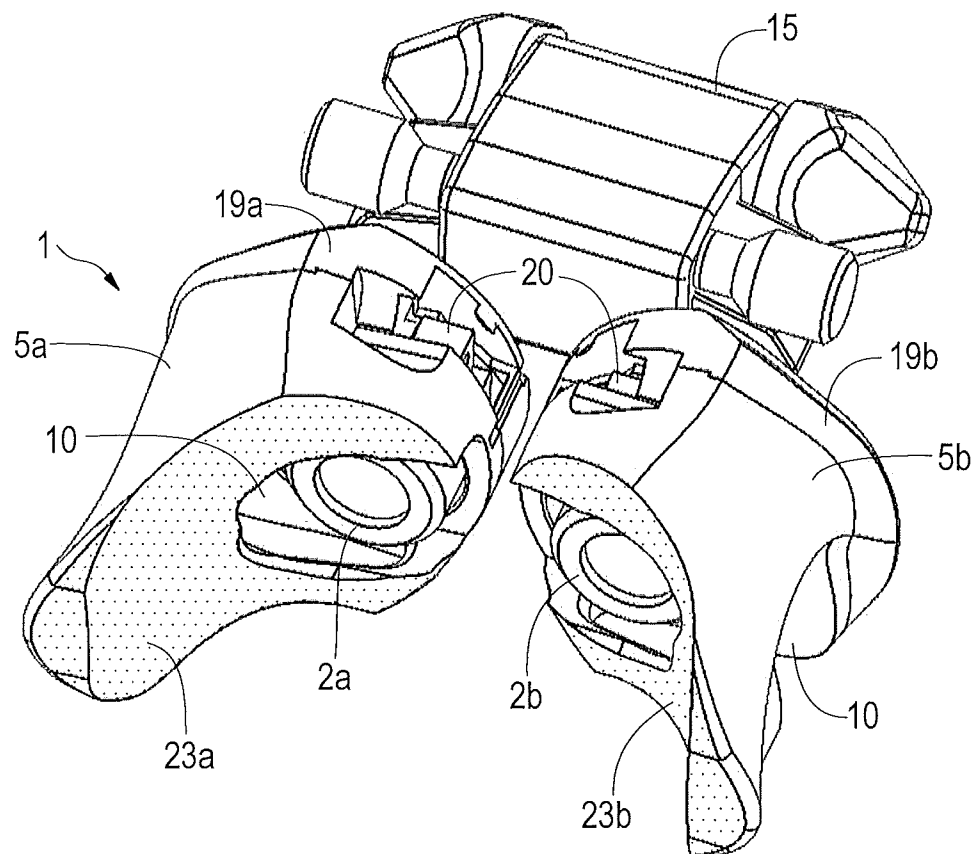
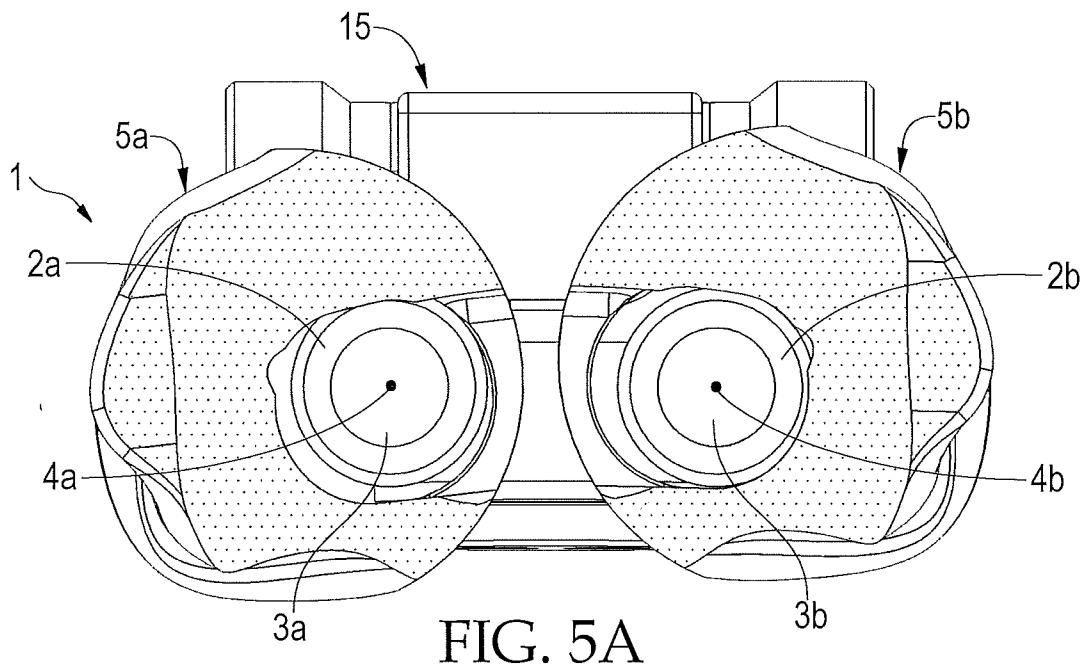


FIG. 4B

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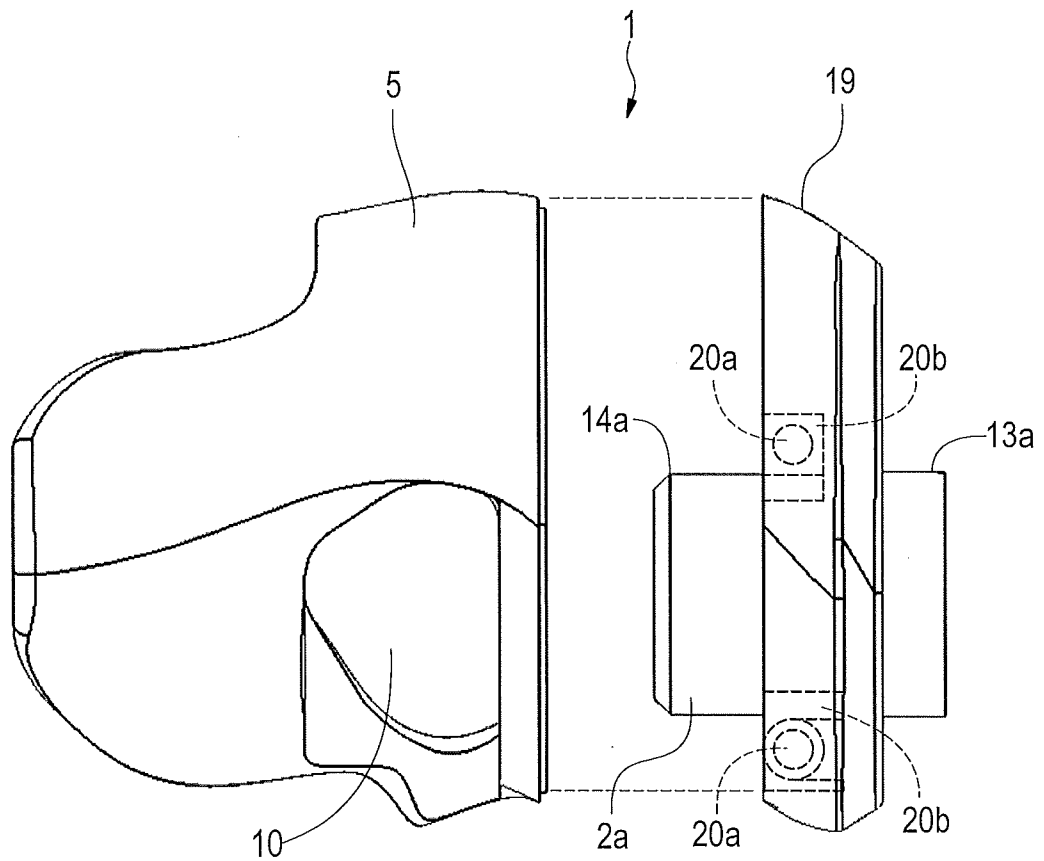


FIG. 6A

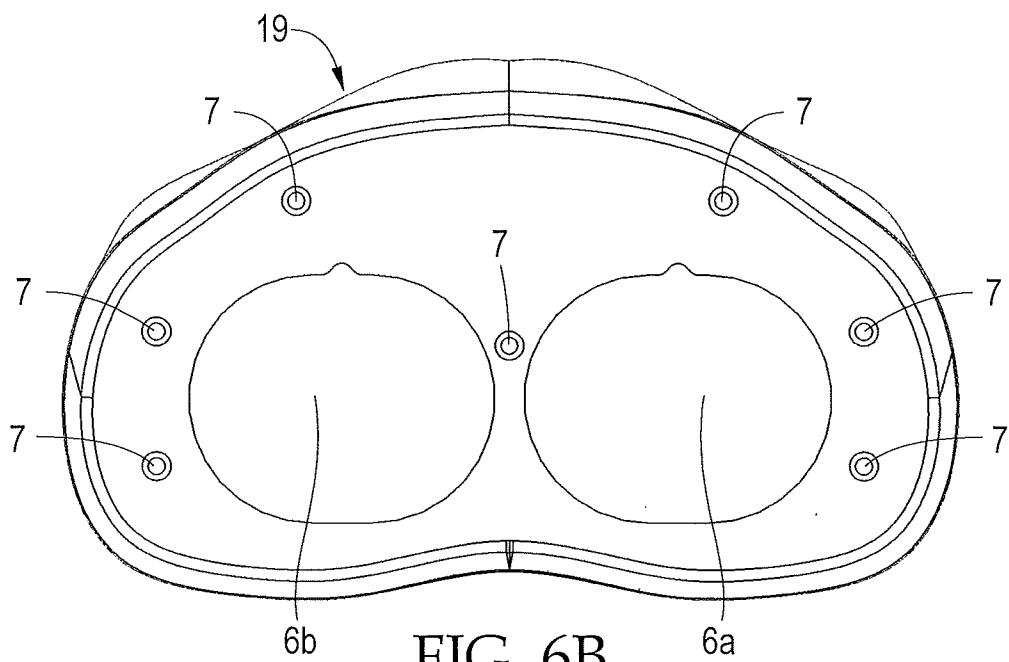


FIG. 6B

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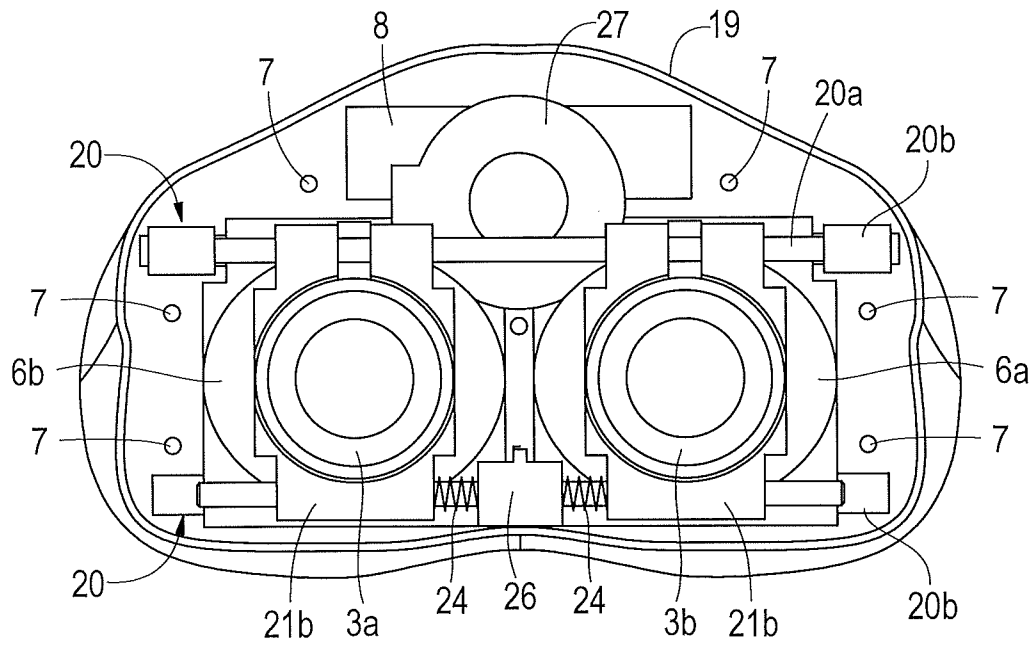


FIG. 7A

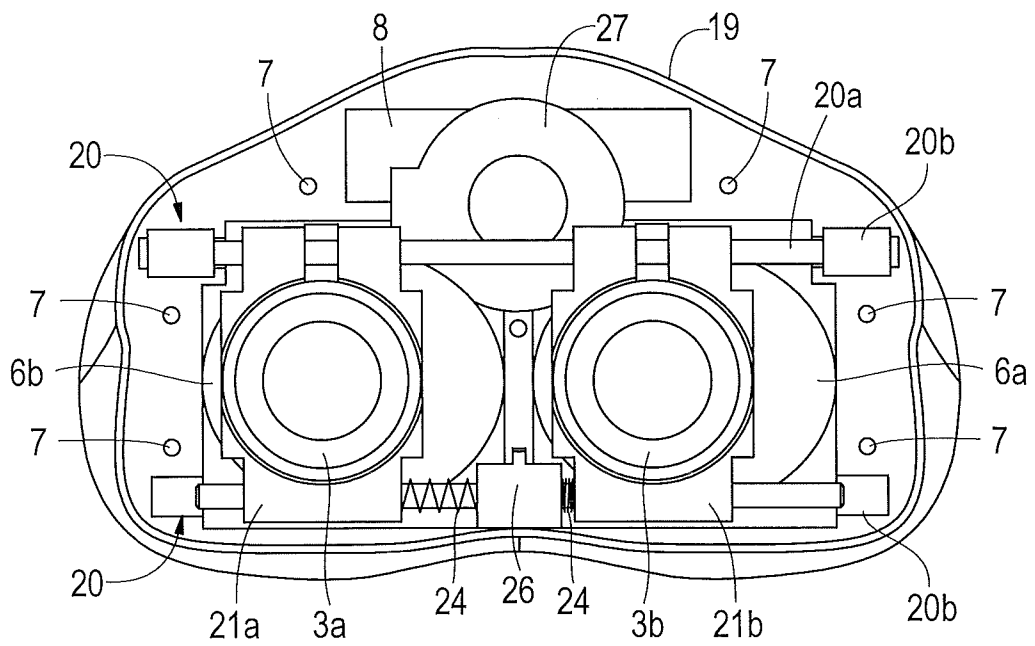


FIG. 7B

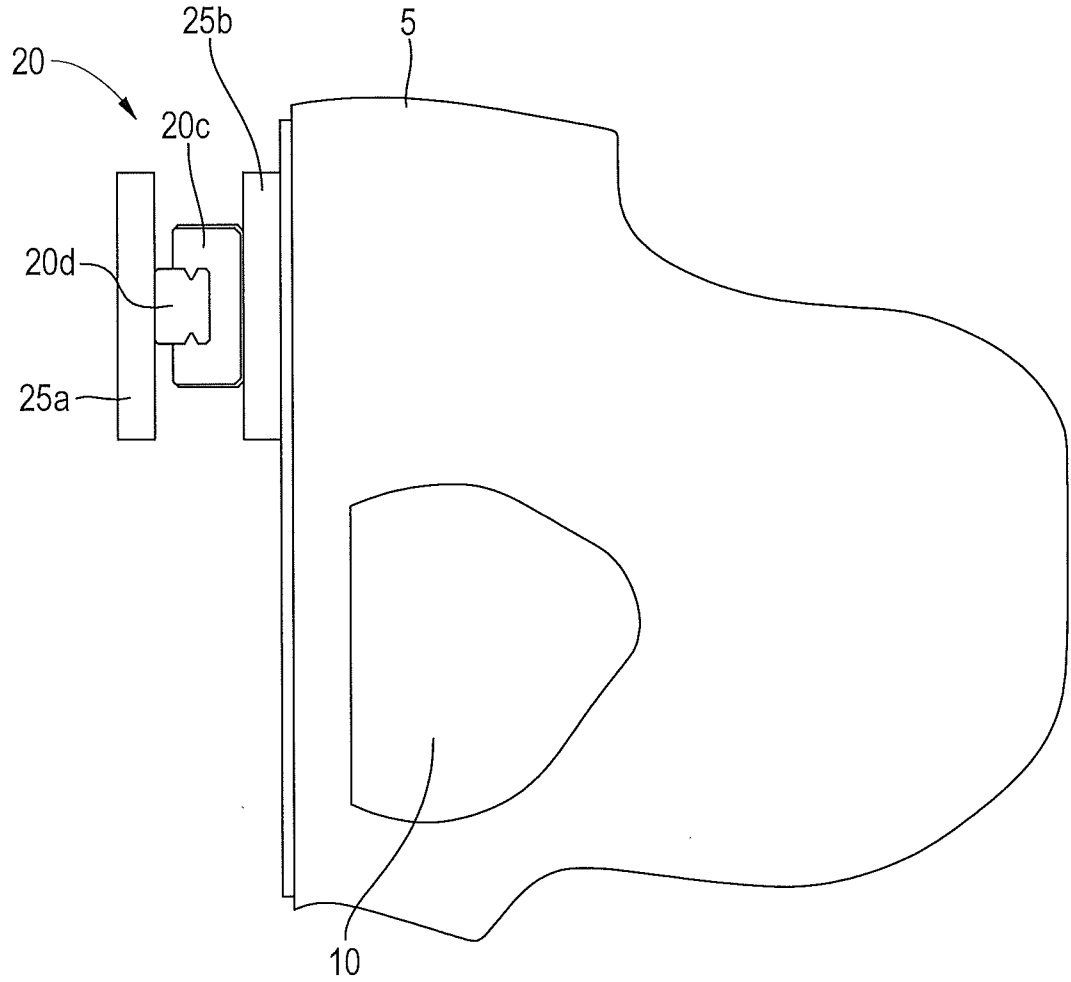


FIG. 8

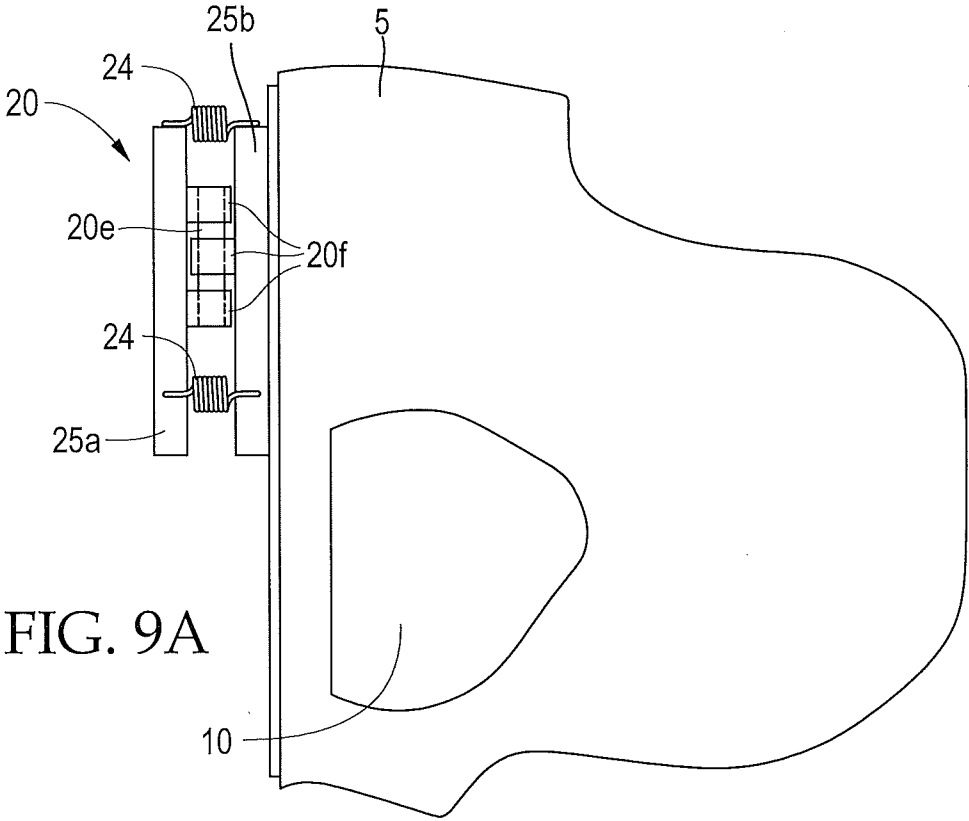


FIG. 9A

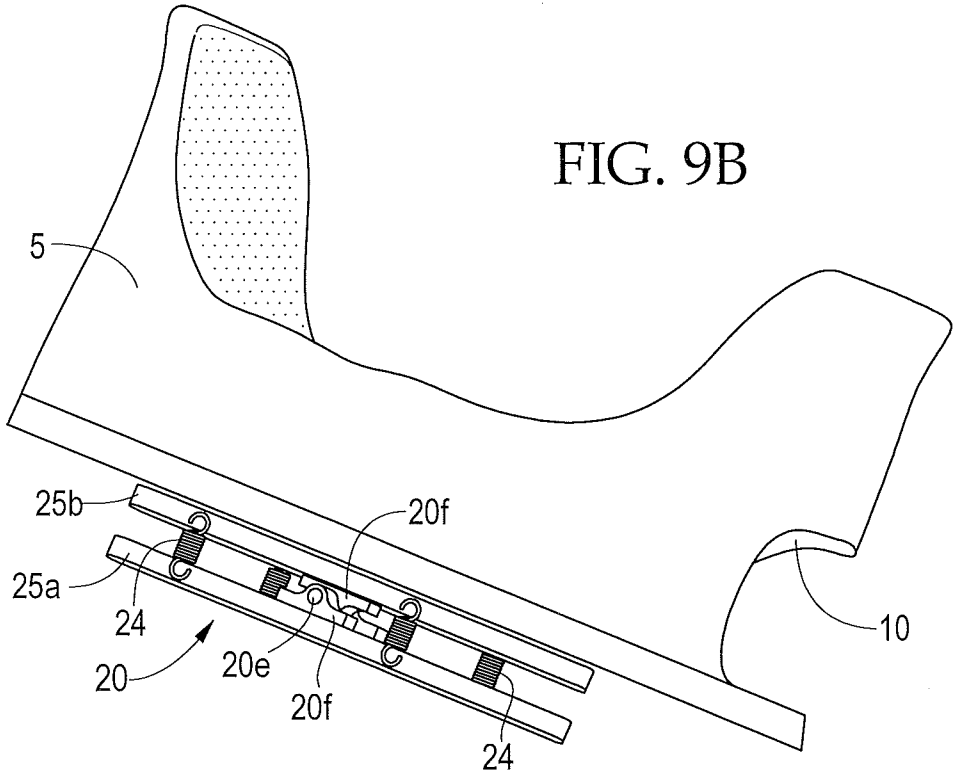


FIG. 9B

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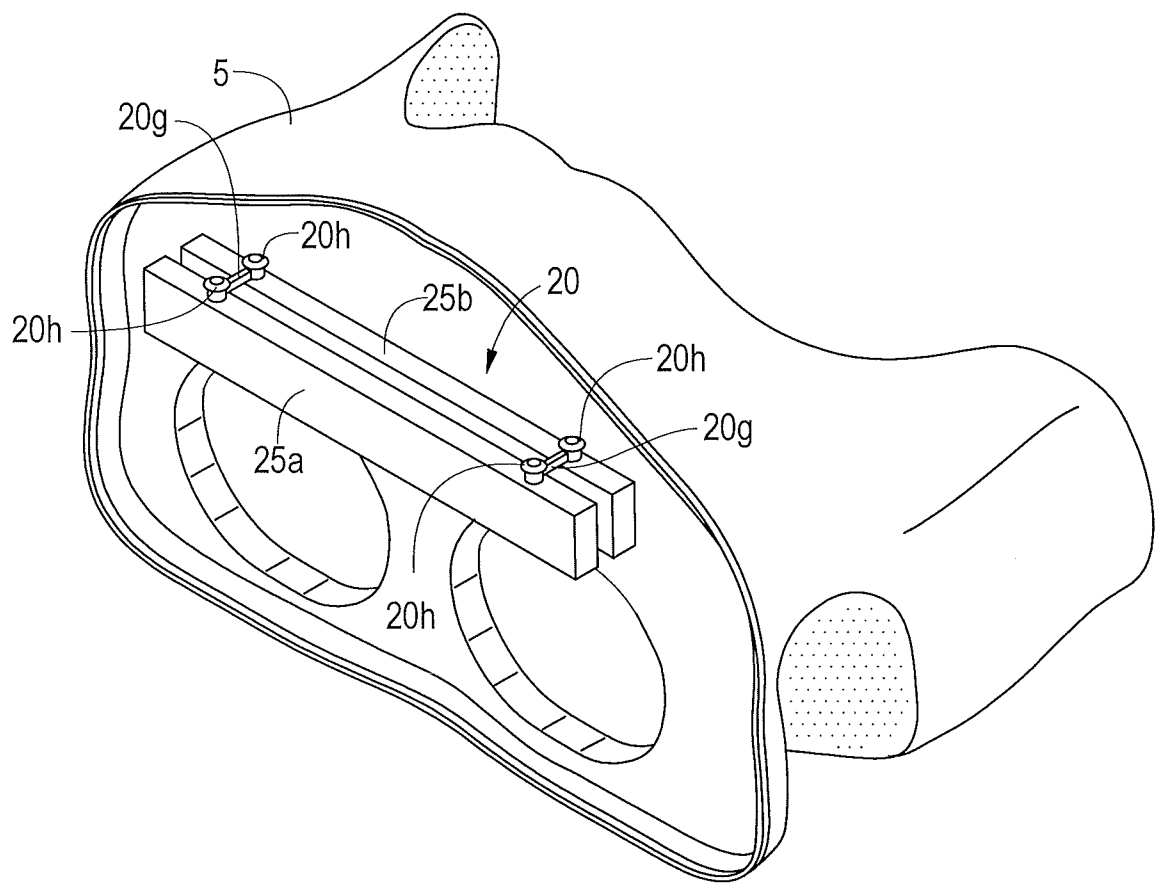


FIG. 10

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FIG. 11A

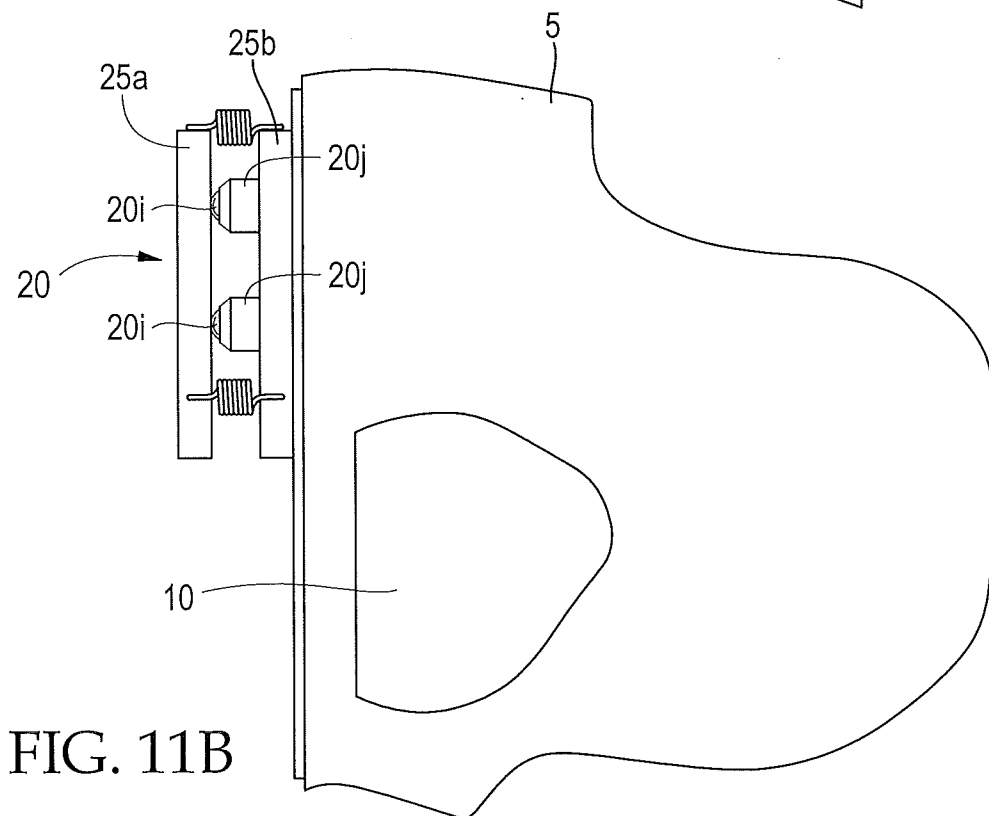
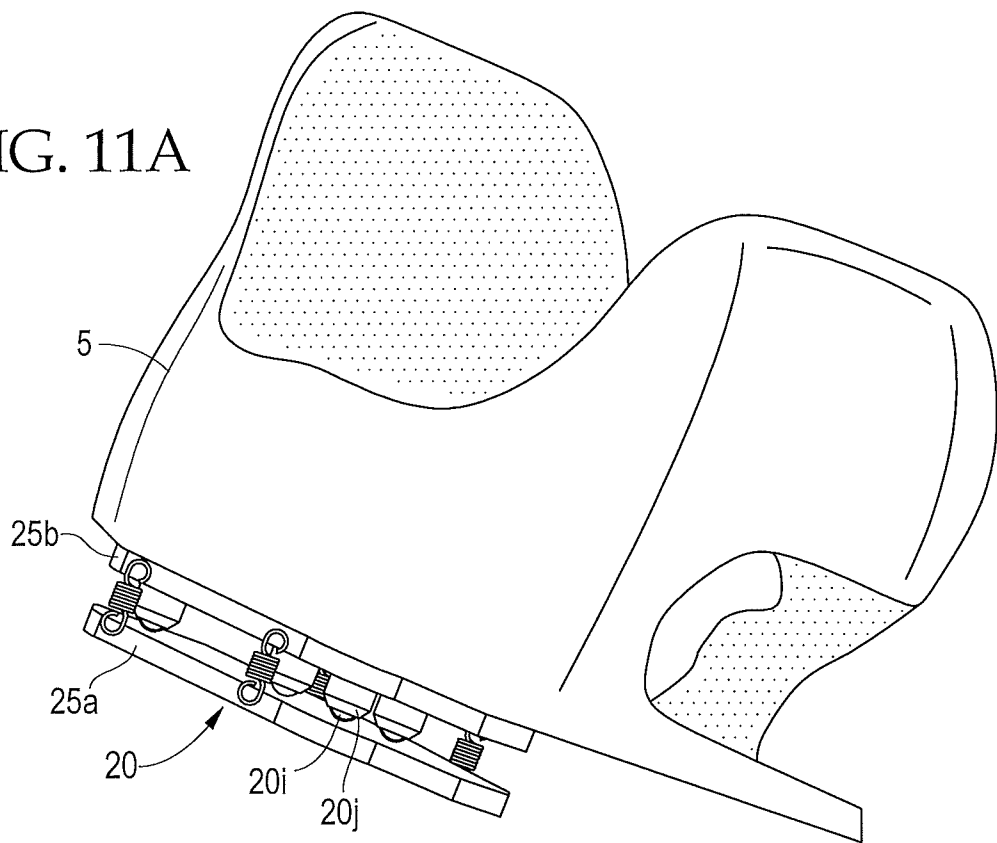


FIG. 11B



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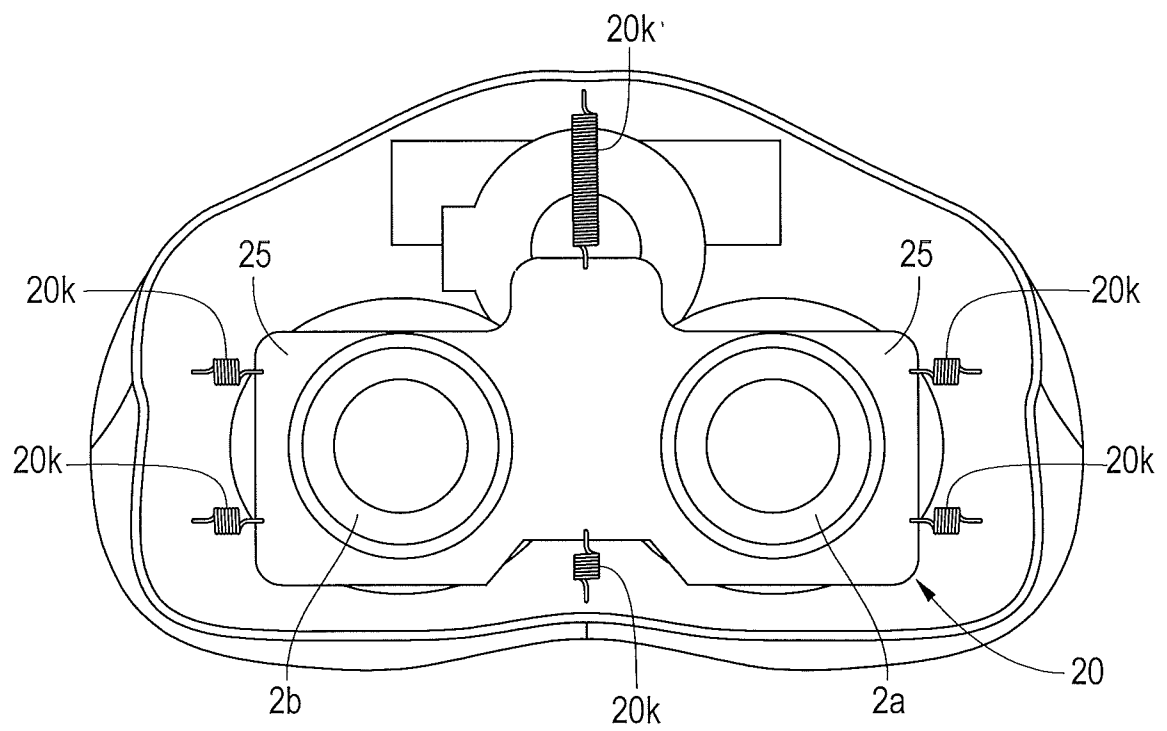


FIG. 12

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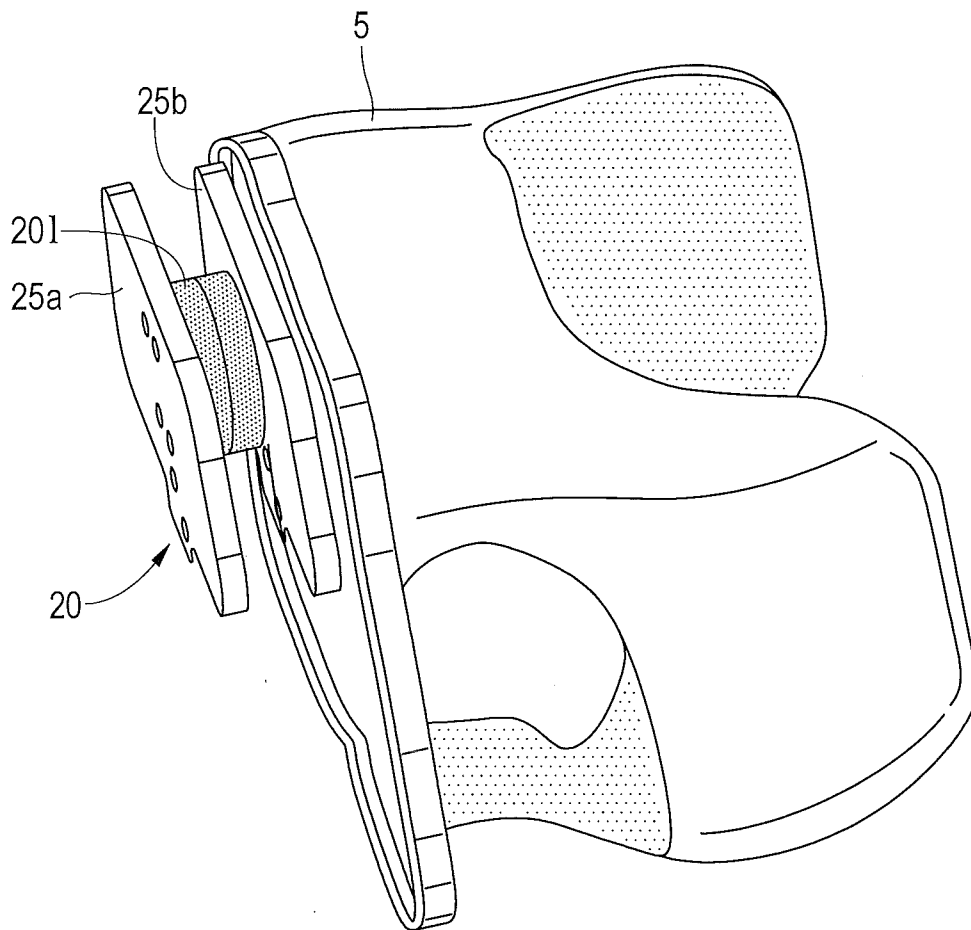


FIG. 13

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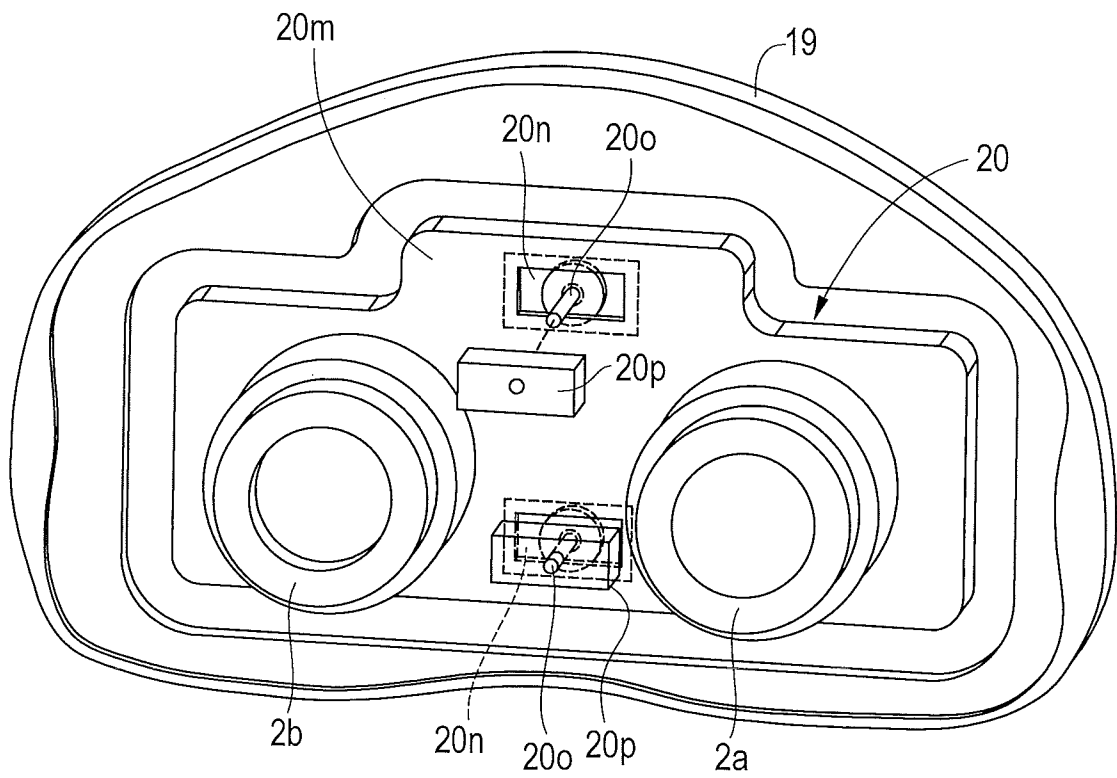


FIG. 14

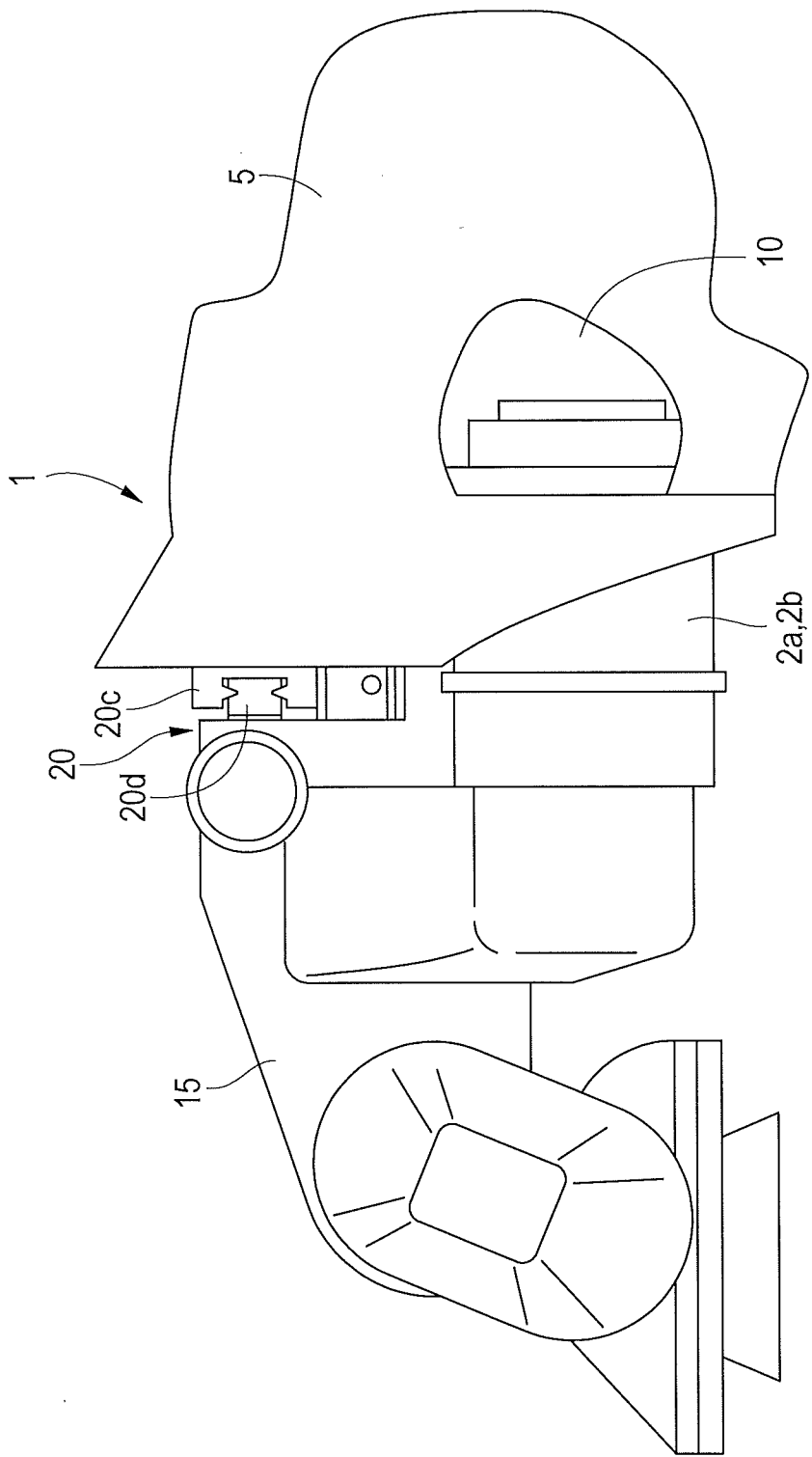


FIG. 15

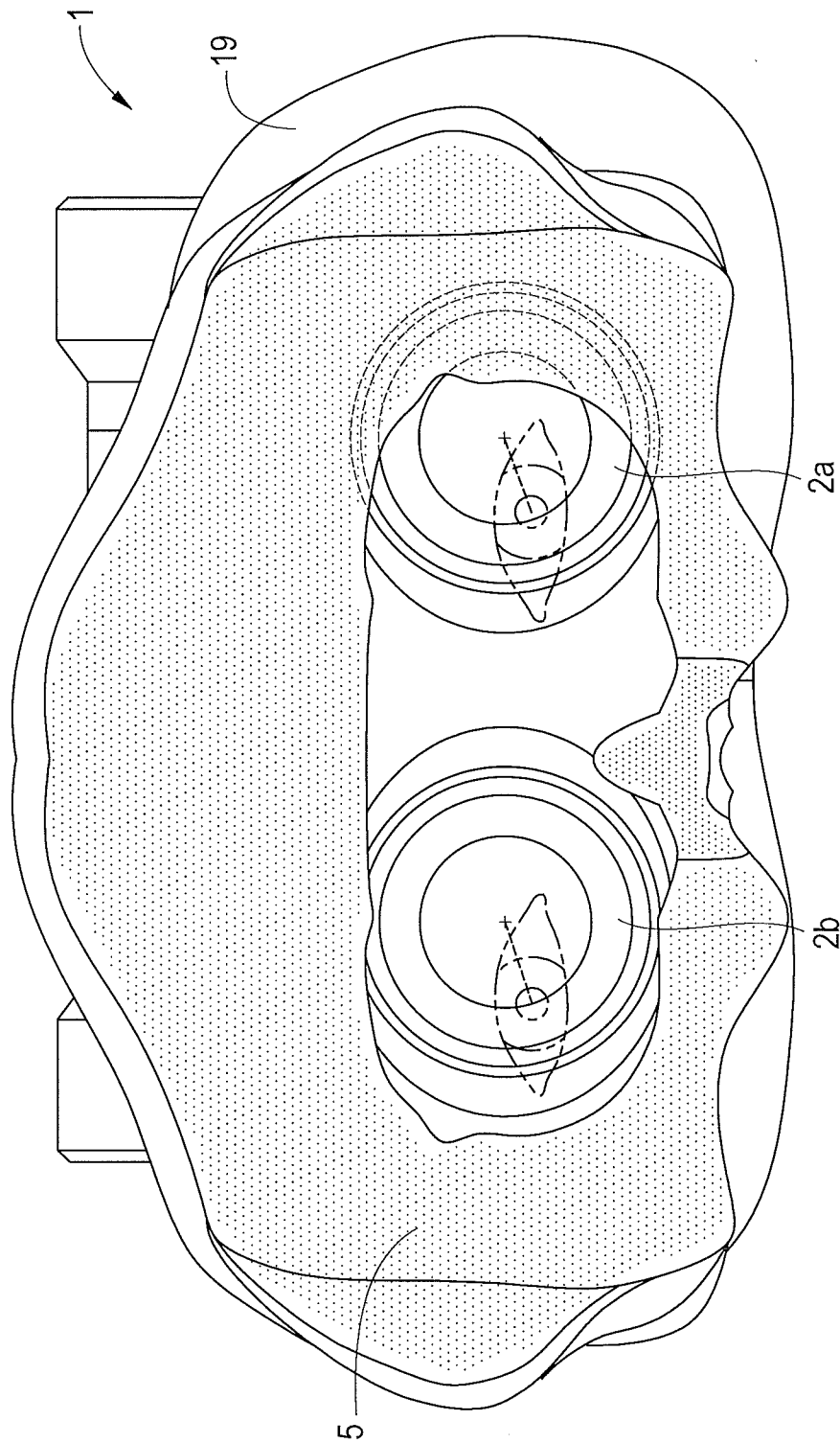


FIG. 16

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US17/53283

## A. CLASSIFICATION OF SUBJECT MATTER

IPC - G02B 25/00, 27/02; G02C 1/00, 11/00 (2017.01)

CPC - G02B 25/001, 27/022, 27/028; G02C 11/00

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)

See Search History document

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

See Search History document

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

See Search History document

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 489 758 A (SPOONER, A) October 26, 1977; page 3, lines 9-20, 28-50, 66-70 & 73-75, figures 1 & 2	1-2, 6, 11-12 & 18
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Y		4-5, 7, 9-10, 14-16, 19 & 21-23
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A		3, 8, 13, 17, 20 & 24
Y	US 2004/0226563 A1 (XU, Z et al.) November 18, 2014; abstract, paragraphs [0062] & [0075]	4-5, 7, 9-10, 14-15, 19 & 21-22
Y	US 2013/0141690 A1 (TAYLOR, R et al.) June 6, 2013; paragraph [0013]	16 & 23

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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Date of the actual completion of the international search

08 November 2017 (08.11.2017)

Date of mailing of the international search report

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