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(54) **HEAD-MOUNTED APPARATUS**

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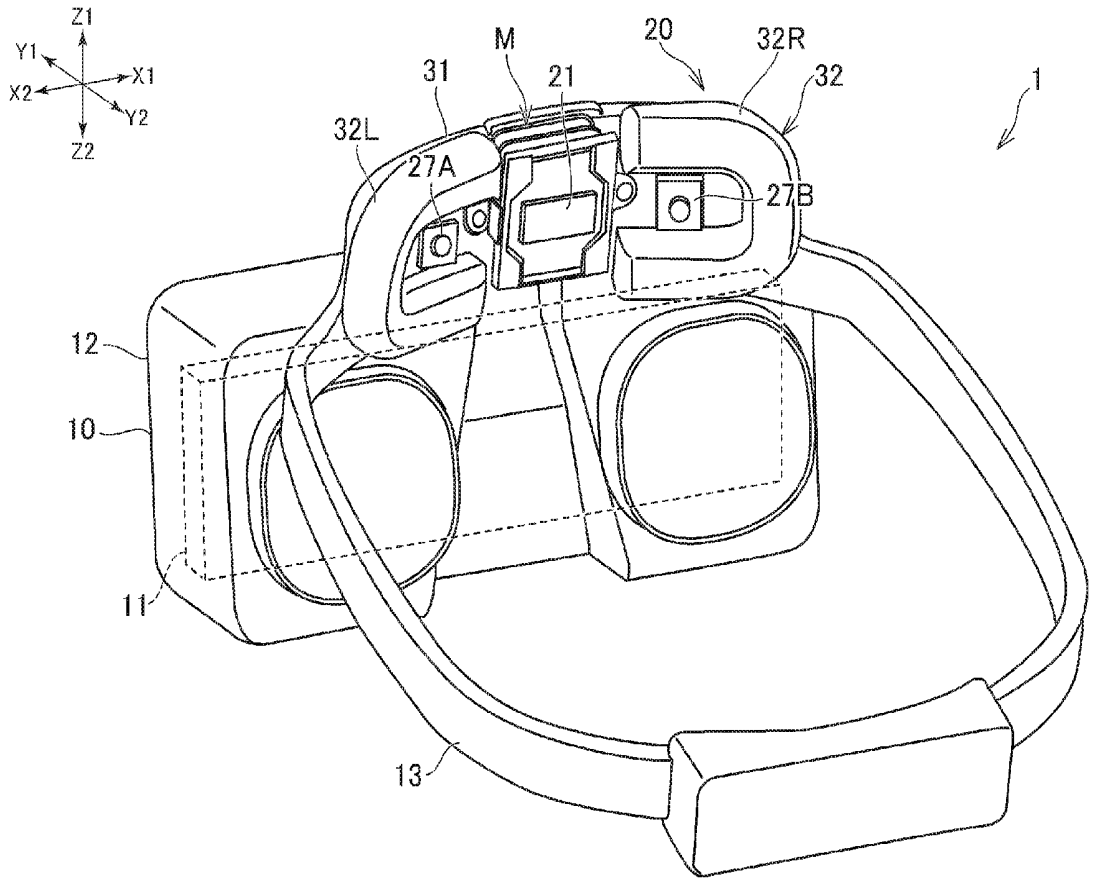
(57) **ABSTRACT**

Disclosed herein is a head-mounted apparatus, including: an optical sensor having a contact face for contacting with the head of a user; a supporting unit disposed around the optical sensor and configured to contact with the head of the user; and a sensor supporting mechanism configured to support the optical sensor so as to permit a movement of the optical sensor in a contact direction that is a direction perpendicular to the contact face.



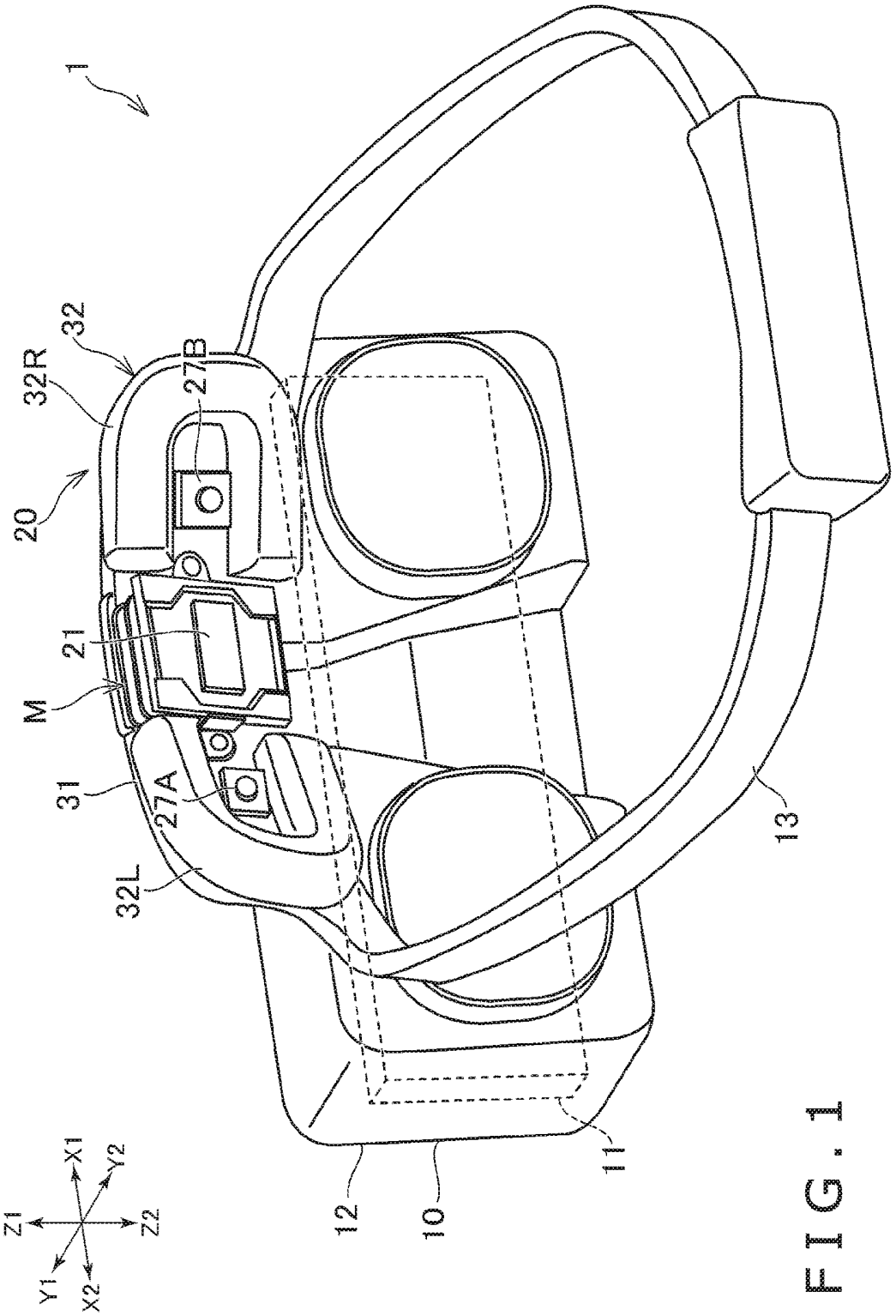
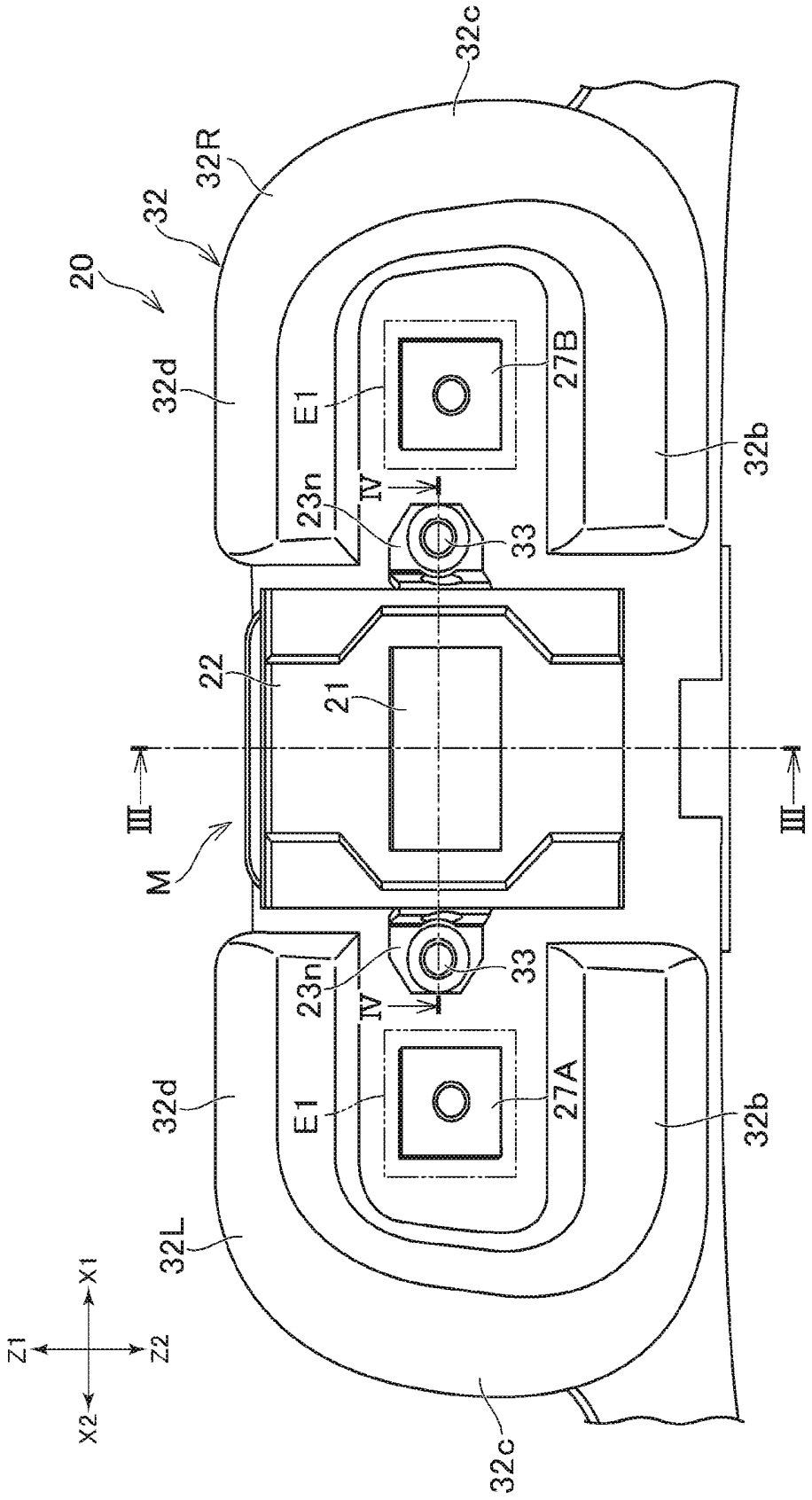


FIG. 1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32d
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IV
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22
21
III
M
III
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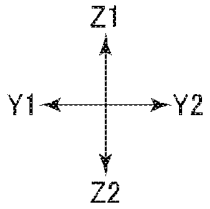
IV
32d
E1
27A
32b
32L
32c
Z1
Z2
X1
X2

FIG. 2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Y1
Y2
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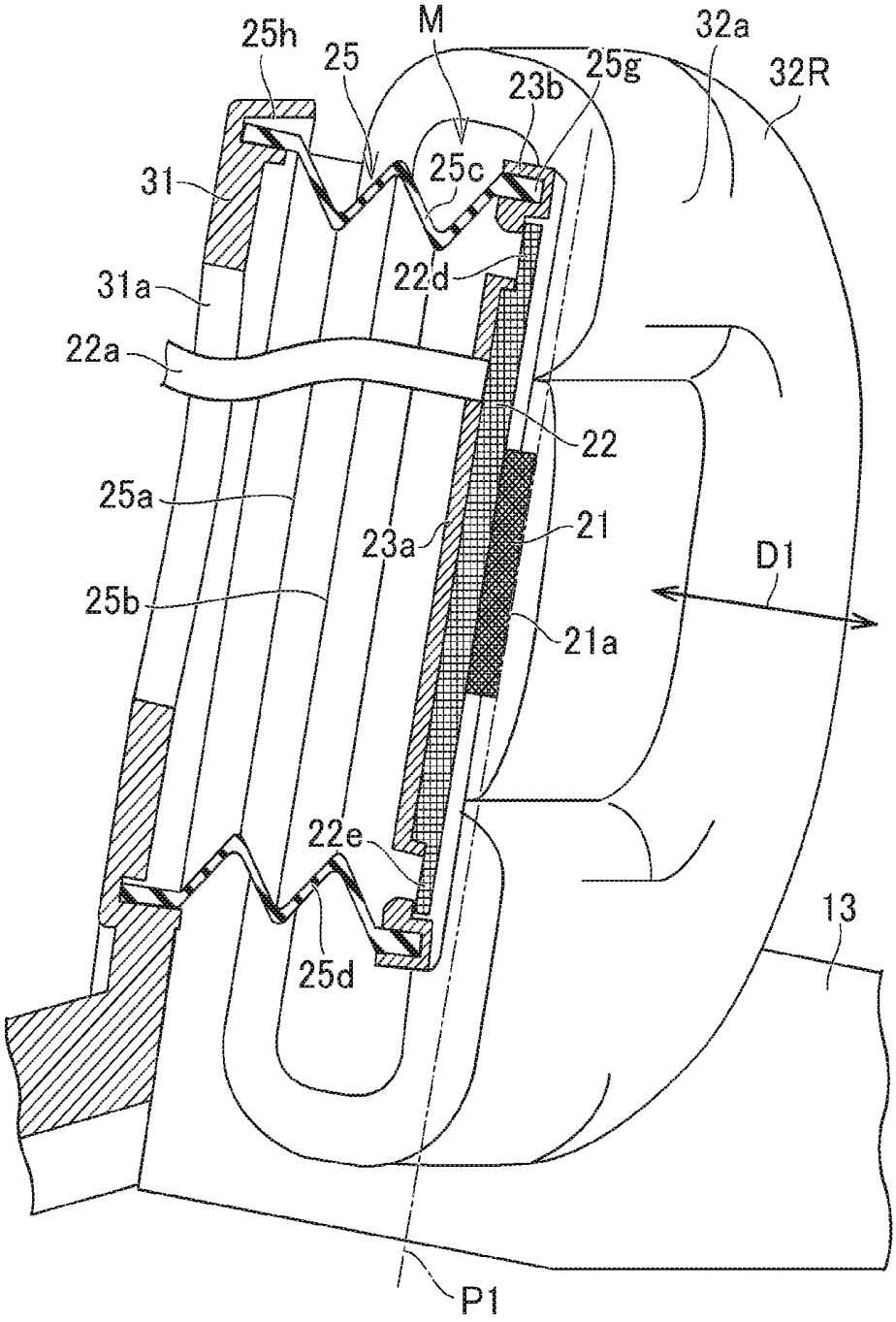
FIG. 3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25
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32R
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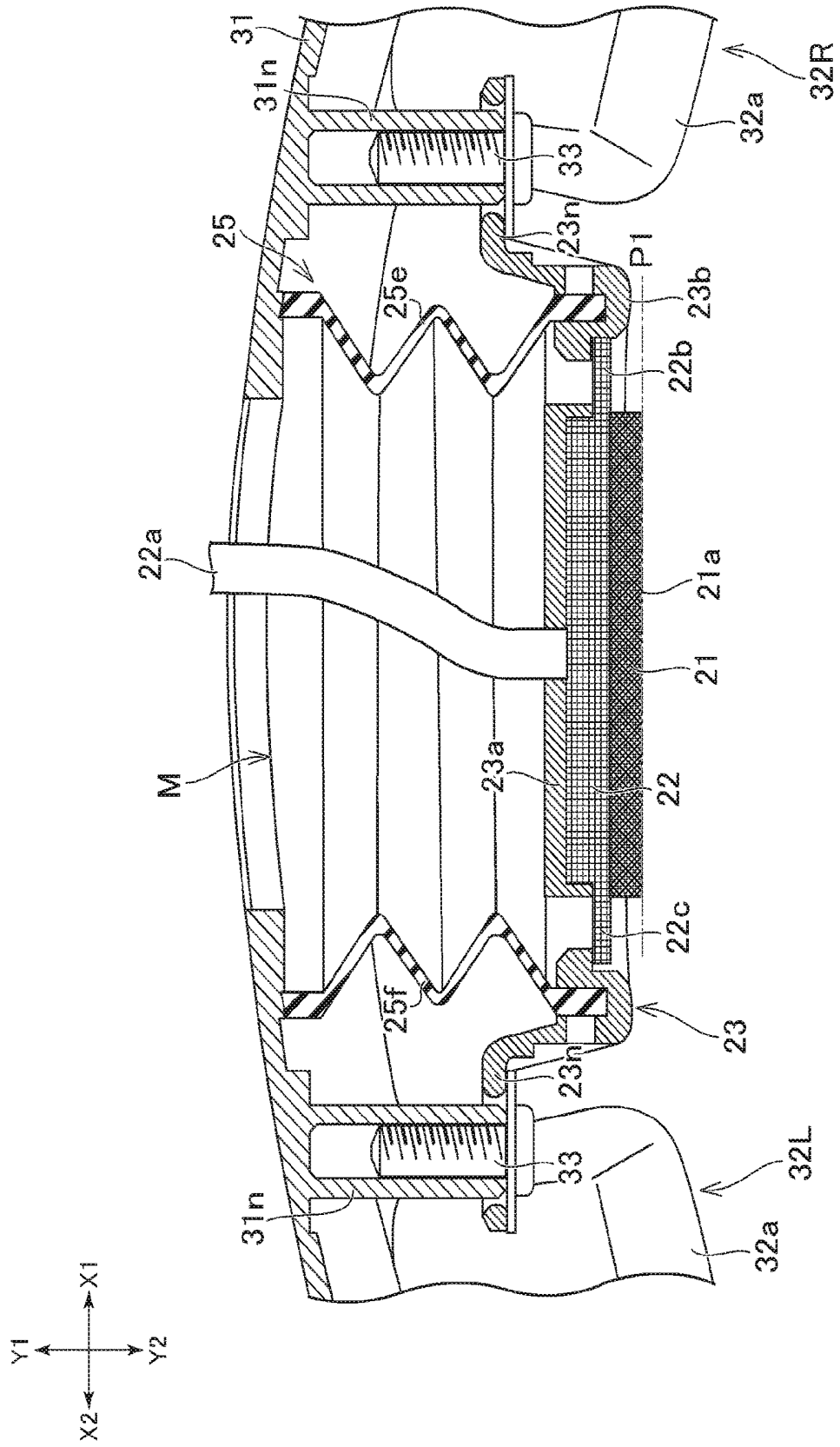
P1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22c
25f
23
23n
33
31n
32L
32a
X1
Y1
Y2
X2

FIG. 4

HEAD-MOUNTED APPARATUS

BACKGROUND

[0001] The technology discussed herein relates to a head-mounted apparatus.

[0002] In related art, development of an apparatus for detecting biological information such as an electroencephalogram or a blood flow amount has been and is being underway. Japanese Patent Laid-Open No. 2013-146371 discloses a sensor that uses light to detect a blood flow. Some of such sensors for detecting biological information are used in a state in which they contact closely with the skin of a subject.

[0003] Further, a head-mounted apparatus that is mounted on the head of a user is known. For example, PCT Patent Publication No. WO2015/137165 discloses a head-mounted display for appreciating a video or for a like purpose. The head-mounted display receives video data generated by a video generation apparatus such as a game apparatus or an audio-visual apparatus and displays the received video data on a display apparatus disposed in front of the user's eyes.

SUMMARY

[0004] It is being studied to incorporate a sensor for detecting biological information into a head-mounted apparatus. If it is tried to stably mount a head-mounted apparatus on the head of a user, then some degree of force works between the head-mounted apparatus and the head. If this increases the contact pressure between the sensor and the skin, then the detection accuracy of biological information sometimes degrades. For example, in the case where the blood flow amount is to be detected as biological information, the high contact pressure influences on the blood flow, resulting in a problem that the detection accuracy of the blood flow amount degrades.

[0005] The head-mounted apparatus proposed herein includes an optical sensor having a contact face for contacting with the head of a user, a supporting unit disposed around the optical sensor and configured to contact with the head of the user, and a sensor supporting mechanism configured to support the optical sensor so as to permit a movement of the optical sensor in a contact direction that is a direction perpendicular to the contact face. With the head-mounted apparatus, the contact face of the optical sensor can be closely contacted with a moderate contact pressure with the head of a user, and the detection accuracy of biological information can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** is a perspective view depicting a head-mounted display that is an example of an embodiment of the present disclosure;

[0007] FIG. **2** is a rear elevational view of a portion of the head-mounted display at which a blood flow sensor is disposed;

[0008] FIG. **3** is a cross sectional view taken along line III-III of FIG. **2**; and

[0009] FIG. **4** is a cross sectional view taken along line IV-IV of FIG. **2**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0010] In the following, an embodiment of the present disclosure is described. In the present specification, a head-mounted display as an example of the embodiment of the present disclosure is described. The present disclosure may be applied to an apparatus that is different from the head-mounted display, for example, a head-mounted apparatus that does not include a display and detects a brain movement.

[0011] In the following description, the directions indicated by arrow marks Y1 and Y2 of FIG. **1** are referred to as forward direction and rearward direction, respectively, and the directions indicated by arrow marks Z1 and Z2 of FIG. **1** are denoted as upward direction and downward direction, respectively. Further, the directions indicated by arrow marks X1 and X2 of FIG. **2** are denoted as rightward direction and leftward direction, respectively. Further, in the following direction, the head-mounted display is referred to as HMD.

[0012] As depicted in FIG. **1**, the HMD **1** includes an apparatus main body **10** that has a display apparatus **11** built therein. Although the display apparatus **11** is, for example, a liquid crystal display apparatus or an organic electroluminescence display apparatus, the kind of it is not restricted specifically. When the HMD **1** is used, the apparatus main body **10** covers the front of the eyes of the user. The apparatus main body **10** includes a housing **12** in which the display apparatus **11** is accommodated.

[0013] As depicted in FIG. **1**, the HMD **1** has a mounting unit **20** at a front portion thereof. In the mounting unit **20**, a blood flow sensor **21** hereinafter described for detecting the blood flow amount of the forehead of the user and electroencephalogram sensors **27**A and **27**B for detecting an electroencephalogram are provided. The mounting unit **20** is positioned on the upper side of the apparatus main body **10** and is connected to the apparatus main body **10**. When the HMD **1** is used, the mounting unit **20** is applied to the forehead of the user. The mounting unit **20** (more particularly, a frame **31** of the mounting unit **20**) is curved so as to conform to the shape of the forehead of a person.

[0014] As depicted in FIG. **1**, the HMD **1** has a mounting belt **13** that is to be wrapped around the head of the user. In the example of the HMD **1**, the mounting belt **13** is connected to the right side and the left side of the mounting unit **20**. Further, the mounting belt **13** and the mounting unit **20** have an annular shape surrounding the head as viewed in plan. The mounting belt **13** may be configured such that it has an adjustable length. The attachment position of the mounting belt **13** is not limited to the example of the HMD **1**. For example, the mounting belt **13** may otherwise be connected not to the mounting unit **20** but to the apparatus main body **10**.

[0015] As depicted in FIG. **3**, the mounting unit **20** includes a blood flow sensor **21** and a sensor supporting mechanism M for supporting the blood flow sensor **21**. Further, the mounting unit **20** has a supporting unit **32** disposed around the blood flow sensor **21** and a frame **31** (in the following description, the frame **31** is referred to as "front side frame").

[0016] The blood flow sensor **21** is an optical sensor that measures the blood flow amount. The blood flow sensor **21** irradiates light (for example, a laser beam) upon the forehead and measures the cerebral blood flow from reflected

light of the same. The blood flow sensor **21** includes a light emitting element (for example, a laser diode) and a light receiving element (for example, a photodiode). Thus, the blood flow sensor **21** irradiates, for example, infrared rays on the forehead and detects the scattered light by the light receiving element. The blood flow sensor **21** measures a variation of the blood flow amount in the proximity of the surface of the cerebrum from the light detected by the light receiving element. The blood flow sensor **21** may have a plurality of light receiving elements. Further, the blood flow sensor **21** may have a plurality of light emitting elements.

[0017] The HMD **1** is connected by wireless connection or wired connection to a video generation apparatus such as, for example, a game apparatus, an audio-visual apparatus or a personal computer. Thus, the HMD **1** receives video data from the video generation apparatus and displays the video data on the display apparatus **11**. Further, the HMD **1** transmits information of the blood flow amount detected by the blood flow sensor **21** to the video generation apparatus. The video generation apparatus reflects the information of the blood flow amount received from the HMD **1** on the video data to be generated by the video generation apparatus. In other words, the video generation apparatus generates (including correction) video data to be transmitted to the HMD **1** on the basis of the data of the blood flow amount received from the HMD **1**.

[0018] As depicted in FIG. **2**, in the example of the HMD **1**, the blood flow sensor **21** is disposed at a central location of the mounting unit **20** in the leftward and rightward direction. As hereinafter described, the sensor supporting mechanism M supports the blood flow sensor **21** so as to permit a variation of the position and the posture of the blood flow sensor **21**. The disposition of the blood flow sensor **21** is not limited to that of the example of the HMD **1**. For example, the position of the blood flow sensor **21** may be displaced in the rightward direction or the leftward direction from the center of the mounting unit **20** in the leftward and rightward direction. The HMD **1** may have a plurality of blood flow sensors **21**. In this case, the plurality of blood flow sensors **21** may be lined up in the leftward and rightward direction or in the upward and downward direction.

[0019] The front side frame **31** has, for example, a form of a plate. As depicted in FIG. **1**, parts configuring the mounting unit **20** such as the supporting unit **32** and the sensor supporting mechanism M are attached to the front side frame **31**. The mounting belt **13** described hereinabove is connected, for example, to the front side frame **31**. The front side frame **31** is curved so as to conform to the shape of the forehead of a person. The front side frame **31** is formed, for example, from plastics. The front side frame **31** may be one member formed integrally or may be configured from a plurality of members individually formed integrally. For example, a portion (first portion) to which the sensor supporting mechanism M is attached and another portion (second portion) to which the supporting unit **32** is attached may be formed separately from each other, and the first portion may be attached to the second portion.

[0020] As depicted in FIG. **1**, the supporting unit **32** is attached to a rear face of the front side frame **31**. The surface (rear face) **32***a* of the supporting unit **32** (refer to FIG. **3**) contacts with the forehead of the user when the HMD **1** is used. Therefore, the supporting unit **32** can function as a spacer for assuring a distance between the front side frame **31** and the forehead of the user. Since the supporting unit **32** contacts with the forehead of the user, the blood flow sensor **21** can be prevented from being pressed strongly against the forehead of the user. For example, in the case where the mounting unit **20** is pressed against the forehead of the user because the length of the mounting belt **13** is decreased by the user, the pressing force acts upon the supporting unit **32** while high force does not act upon the blood flow sensor **21**. The supporting unit **32** has elasticity for urging the surface **32***a* of the supporting unit **32** toward the forehead of the user. In other words, the supporting unit **32** is formed from a maternal having a cushioning property. The supporting unit **32** can be formed, for example, from rubber or a foamed material.

[0021] As depicted in FIG. **2**, in the example of the HMD **1**, the supporting unit **32** has two portions **32**R and **32**L positioned on the opposite sides to each other across the blood flow sensor **21** (in other words, across the sensor supporting mechanism M) (in the following description, each of the portions **32**R and **32**L is referred to as "half"). In the example of the HMD **1**, the supporting unit **32** has a right half **32**R disposed on the right side with respect to the blood flow sensor **21** and a left half **32**L disposed on the left side with respect to the blood flow sensor **21**. The halves **32**R and **32**L have, for example, a substantially U shape open toward the blood flow sensor **21**. In particular, each of the halves **32**R and **32**L has an upper horizontal portion **32***d* extending in the leftward and rightward direction at an upper portion of the mounting unit **20**, a lower horizontal portion **32***b* extending in the leftward and rightward direction at a lower portion of the mounting unit **20**, and a vertical portion **32***c* that connects the upper horizontal portion **32***d* and the lower horizontal portion **32***b* to each other. Other parts such as, for example, electroencephalogram sensors **27**A and **27**B hereinafter described, a circuit board and a battery may be disposed in a region E**1** on the inner side of each of the halves **32**R and **32**L.

[0022] The shape or disposition of the supporting unit **32** is not limited to that of the example of the HMD **1**. For example, the supporting unit **32** may include a portion positioned on the upper side with respect to the blood flow sensor **21** and/or a portion positioned on the lower side with respect to the blood flow sensor **21**. In another example, the supporting unit **32** may have a quadrangular shape or a circular shape. In this case, the supporting unit **32** may include or may not include the regions E**1** in which other parts are disposed. In a further example, the halves **32**R and **32**L may each include the vertical portion **32***c* that connects the upper horizontal portion **32***d* and the lower horizontal portion **32***b*.

[0023] The blood flow sensor **21** has a contact face **21***a* (refer to FIG. **3**) for contacting with the forehead of the user. A light emitting element and a light receiving element are provided on the contact face **21***a*. If a gap exists between the contact face **21***a* and the skin of the forehead, then external light enters the gap and the blood flow amount cannot be detected appropriately. Therefore, it is necessary for the contact face **21***a* to closely contact with the skin. However, if the contact pressure between the contact face **21***a* and the skin is high, then the high contact pressure influences on the blood flow amount, resulting in degradation of the detection accuracy of the blood flow amount. Therefore, it is necessary

for the contact face **21***a* to closely contact with the skin with an appropriate contact pressure (comparatively low contact pressure).

[0024] Therefore, in the example of the HMD **1**, the supporting unit **32** is disposed around the blood flow sensor **21**. Further, the sensor supporting mechanism M supports the blood flow sensor **21** so as to permit a movement of the blood flow sensor **21** in a direction (Dl direction in FIG. **3**) perpendicular to the contact face **21***a* (in the following description, the Dl direction is referred to as "contact direction." In the present specification, the "contact direction" is a direction orthogonal to the contact face **21***a* when the blood flow sensor **21** is at its initial position). According to this structure, the contact face **21***a* can closely contact with the skin with an appropriate contact pressure.

[0025] As depicted in FIG. **3**, the sensor supporting mechanism M has an expansion and contraction unit **25** that is expandable and contractible in the contact direction and supports the blood flow sensor **21** through the expansion and contraction unit **25**. In particular, the sensor supporting mechanism M supports the blood flow sensor **21** in a floating manner in the contact direction, and the expansion and contraction unit **25** functions as a floating spring. The expansion and contraction unit **25** includes, for example, bellows. In particular, the expansion and contraction unit **25** has a plurality of folds **25***a* and **25***b* such that the valley folds **25***a* and the mountain folds **25***b* are lined up alternately in the contact direction. If bellows are used as the expansion and contraction unit **25** in this manner, then the variation of the contact pressure caused by displacement of the blood flow sensor **21** can be reduced in comparison with that in an alternative case in which, for example, a spring is used as the expansion and contraction unit **25**. Therefore, even in the case where the tightening of the mounting belt **13** is increased, the contact pressure can be kept fixed.

[0026] The expansion and contraction unit **25** is formed from rubber (for example, silicone rubber, urethane rubber, acrylic rubber or the like). Further, the expansion and contraction unit **25** has a shape of a tube extending in the contact direction and is hollow in the inside thereof. In particular, the expansion and contraction unit **25** has an upper face portion **25***c* (refer to FIG. **3**), a lower face portion **25***d* (refer to FIG. **3**), a right side face portion **25***e* (refer to FIG. **4**) and a left side face portion **25***f* (refer to FIG. **4**), and a space is formed in the inner side of them.

[0027] The expansion and contraction unit **25** has elasticity for urging the blood flow sensor **21** toward the forehead of the user. Consequently, the contact face **21***a* can closely contact with the forehead of the user. Preferably, the expansion and contraction unit **25** has a low elastic modulus. If the expansion and contraction unit **25** has a low elastic modulus, then the load (contact pressure) acting from the blood flow sensor **21** upon the forehead of the user can be suppressed from being changed by the shape of the forehead of the user or by the degree of tightening of the mounting belt **13** (in other words, the length of the mounting belt **13**). For example, even in the case where the supporting unit **32** is pressed against the forehead of the user with comparatively strong force because the mounting belt **13** is shortened, the blood flow sensor **21** can contact with the forehead of the user with moderate force. The expansion and contraction unit **25** has an elastic modulus, for example, lower than that of the supporting unit **32**.

[0028] It is to be noted that the expansion and contraction unit **25** may not be bellows. For example, the expansion and contraction unit **25** may have only one fold in place of the plurality of folds **25***a* and **25***b* lined up alternately in the contact direction. Further, the sensor supporting mechanism M may have one or a plurality of springs as the expansion and contraction unit **25**. In this case, preferably a spring having a comparatively low elastic modulus is used as the expansion and contraction unit **25**.

[0029] Preferably, the blood flow sensor **21** is designed such that it contacts with the forehead irrespective of the shape of the forehead of the user. In particular, the blood flow sensor **21** is disposed such that the contact face **21***a* thereof is positioned, for example, on the forehead side of the user with respect to an imaginary curved plane formed from the surface (rear face) **32***a* of the supporting unit **32**. In other words, the contact face **21***a* of the blood flow sensor **21** is positioned rearwardly with respect to the curved plane formed from the surface **32***a* of the supporting unit **32**.

[0030] As depicted in FIG. **3**, the blood flow sensor **21** is mounted on a board **22** (in the following description, the board **22** is referred to as "sensor board"). A driving circuit for the blood flow sensor **21** may be mounted on the sensor board **22**. Further, to the sensor board **22**, an electrical wire **22***a* that connects the driving circuit for the blood flow sensor **21** and a different circuit or part the HMD **1** has to each other may be connected. In the example of the HMD **1**, the sensor board **22** passes the inner side of the tubular expansion and contraction unit **25** and extends forwardly. The sensor supporting mechanism M has a sensor frame **23** to which the sensor board **22** is attached. The sensor board **22** is attached to a central portion **23***a* of the sensor frame **23**.

[0031] As depicted in FIG. **3**, the sensor frame **23** has an outer peripheral portion **23***b* to which a rear edge **25***g* of the tubular expansion and contraction unit **25** is connected. As described hereinabove, the tubular expansion and contraction unit **25** has a tubular shape having the upper face portion **25***c*, lower face portion **25***d*, right side face portion **25***e* and left side face portion **25***f*. The outer peripheral portion **23***b* has a rectangular shape, and the upper face portion **25***c*, lower face portion **25***d*, right side face portion **25***e* and left side face portion **25***f* are connected at the rear edge **25***g* thereof to the outer peripheral portion **23***b*. By the configuration, the sensor frame **23** and the sensor board **22** can move together with each other in the contact direction.

[0032] As depicted in FIG. **3**, a front edge **25***h* of the expansion and contraction unit **25** is connected to the front side frame **31**. The front side frame **31** has an opening **31***a* formed therein so as to be positioned in front of the expansion and contraction unit **25**. The inside space of the expansion and contraction unit **25** is communicated with the outside through the opening **31***a*. When the expansion and contraction unit **25** expands or contracts, the air can go into and out of the inside of the expansion and contraction unit **25** through the opening **31***a*. As a result, the expansion and contraction unit **25** can expand and contract smoothly. The electrical wire **22***a* connected to the sensor board **22** extends through the opening **31***a* of the front side frame **31**.

[0033] The sensor supporting mechanism M supports the blood flow sensor **21** such that it permits tilting of the contact face **21***a* of the blood flow sensor **21**. Here, the "tilting of the contact face **21***a*" is tilting of the contact face **21***a* with respect to a plane P1 depicted in FIGS. **3** and **4**. The plane P1 is a plane parallel to the contact face **21***a* when the

blood flow sensor **21** is at its initial position (position of the blood flow sensor **21** depicted in FIGS. **3** and **4**). According to this structure, the posture of the blood flow sensor **21** can be changed in conformity with the shape of the forehead of the user. As a result, the close contact property between the contact face **21***a* and the forehead of the user can be improved.

[0034] The front side frame **31** has a guide portion **31***n* for guiding the sensor frame **23** such that the sensor frame **23** can move in the contact direction. In the example of the HMD **1**, the front side frame **31** has guide portions **31***n* at two locations positioned on the opposite sides to each other across the sensor supporting mechanism M. As depicted in FIG. **4**, the guide portions **31***n* are provided on the right side and the left side with respect to the sensor supporting mechanism M. The guide portions **31***n* extend in the contact direction from the front side frame **31**. More particularly, the guide portions **31***n* are bosses projecting from the front side frame **31**. Meanwhile, the sensor frame **23** has two guided portions **23***n* individually movable along the two guide portions **31***n*. In the example of the HMD **1**, the guided portions **23***n* are formed on a right edge and a left edge of the outer peripheral portion **23***b* of the sensor frame **23**.

[0035] As depicted in FIG. **4**, an opening is formed in each of the guided portions **23***n*. The guide portions **31***n* are fitted in the openings. Consequently, the sensor frame **23** is supported by the guide portions **31***n*. In particular, the movement of the sensor frame **23** with respect to the guide portions **31***n* in the upward and downward direction and the leftward and rightward direction is restricted. Further, the guided portions **23***n* are movable in the contact direction along the guide portions **31***n*. Each of the guide portions **31***n* has at an end portion thereof a stopper member **33** for restricting the guided portion **23***n* from the guide portion **31***n* so as not to be pulled off. For example, a screw can be used as the stopper member **33**. As described hereinabove, the expansion and contraction unit **25** has elasticity and urges the blood flow sensor **21** in the contact direction (rearward direction). When the left and right guided portions **23***n* contact with the stopper members **33** of the left and right guide portions **31***n*, respectively, the blood flow sensor **21** is disposed at its initial position.

[0036] The two guided portions **23***n* formed on the sensor frame **23** can move separately from each other along the guide portions **31***n*. Accordingly, a right edge **22***b* (refer to FIG. **4**) and a left edge **22***c* (refer to FIG. **4**) of the sensor board **22** can move separately from each other in the contact direction. As a result, the contact face **21***a* of the blood flow sensor **21** can be tilted in the rightward direction or in the leftward direction.

[0037] The opening of each of the guided portions **23***n* has a diameter greater than that of the guide portions **31***n*, and each guided portion **23***n* can tilt with respect to the guide portion **31***n*. As a result, an upper edge **22***d* (refer to FIG. **3**) and a lower edge **22***e* (refer to FIG. **3**) of the sensor board **22** can move separately from each other in the contact direction. As a result, the contact face **21***a* of the blood flow sensor **21** can be tilted in the upward direction or in the downward direction.

[0038] It is to be noted that the supporting structure for the sensor board **22** is not necessarily limited to that of the example depicted in FIG. **4** only if tilting of the sensor board **22** is permitted. For example, the positions of the guide portions **31***n* formed on the front side frame **31** may be positions on the upper side and the lower side of the sensor supporting mechanism M. Further, in another example, the guide portions **31***n* and the guided portions **23***n* are formed on the inner side of the expansion and contraction unit **25**. In a further example, the number of guide portions **31***n* is not limited to two but may be three or four.

[0039] As depicted in FIG. **2**, the mounting unit **20** has the electroencephalogram sensors **27**A and **27**B. The electroencephalogram sensors **27**A and **27**B are, for example, electrodes and detect a variation of a potential difference generated between two points of the surface of the head of the user as an electroencephalogram. The HMD **1** transmits information of the electroencephalogram to a video generation apparatus such as a game apparatus. The video generation apparatus reflects the information of the electroencephalogram received from the HMD **1** on video data to be generated by the video generation apparatus. In other words, the video generation apparatus generates (corrects) video data to be transmitted to the HMD **1** on the basis of the information of the electroencephalogram received from the HMD **1**.

[0040] In the example of the HMD **1**, the electroencephalogram sensors **27**A and **27**B are disposed on the right side and the left side with respect to the blood flow sensor **21**, respectively. When the HMD **1** is used, the electroencephalogram sensors **27**A and **27**B contact with the upper side with respect to the eyebrows of the user. By disposing the electroencephalogram sensors **27**A and **27**B at the positions just described, when the HMD **1** is used, the electroencephalogram sensors **27**A and **27**B are permitted to be pressed sufficiently against the forehead of the user. As a result, the detection accuracy of the electroencephalogram can be improved. It is to be noted that, when the HMD **1** is used, the contact pressure between the blood flow sensor **21** and the forehead of the user is lower than the contact pressure between the electroencephalogram sensors **27**A and **27**B and the forehead of the user.

[0041] As described hereinabove, each of the left and right halves **32**R and **32**L the supporting unit **32** has has a region E**1** on the inner side thereof. In the example of the HMD **1**, the electroencephalogram sensors **27**A and **27**B are disposed in the regions E**1** and are surrounded by the halves **32**R and **32**L, respectively. In this manner, in the example of the HMD **1**, the regions E**1** on the inner side of the supporting unit **32** are utilized effectively to dispose the electroencephalogram sensors **27**A and **27**B, and the size of the mounting unit **20** can be reduced thereby.

[0042] The disposition of the electroencephalogram sensors **27**A and **27**B is not limited to that of the example of the HMD **1** but may be changed suitably. For example, the electroencephalogram sensors **27**A and **27**B may be disposed on the upper side with respect to the sensor supporting mechanism M or may be disposed on the lower side with respect to the sensor supporting mechanism M. Further, while, in the example of FIG. **2**, the mounting unit **20** has the two electroencephalogram sensors **27**A and **27**B, the number of the electroencephalogram sensors **27**A and **27**B may be greater than 2.

[0043] As described above, the HMD **1** includes a blood flow sensor **21** having a contact face **21***a* for contacting with the head of a user, a supporting unit **32** disposed around the blood flow sensor **21** and configured to contact with the head of the user, and a sensor supporting mechanism M that supports the blood flow sensor **21** so as to permit a move-

ment of the blood flow sensor **21** in a contact direction that is a direction perpendicular to the contact face **21***a*. With the apparatus just described, the contact face **21***a* can closely contact with the forehead of the user with a moderate contact pressure, and the detection accuracy of the blood flow amount can be improved.

[0044] It is to be noted that the present disclosure is not limited to the HMD **1** described above but may be changed suitably. For example, the present disclosure may be applied to a head-mounted apparatus that does not include the display apparatus **11** although it includes the blood flow sensor **21**. As another example, the head-mounted apparatus may include a sensor configured to use light to detect biological information other than the blood flow amount and supported by the sensor supporting mechanism M.

[0045] The present disclosure contains subject matter related to that disclosed in Japanese Priority Patent Application JP 2017-184645 filed in the Japan Patent Office on Sep. 26, 2017, the entire contents of which are hereby incorporated by reference.

[0046] It should be understood by those skilled in the art that various modifications, combinations, sub-combinations and alterations may occur depending on design requirements and other factors insofar as they are within the scope of the appended claims or the equivalents thereof.

What is claimed is:

1. A head-mounted apparatus, comprising:
- an optical sensor having a contact face for contacting with the head of a user;
- a supporting unit disposed around the optical sensor and configured to contact with the head of the user; and
- a sensor supporting mechanism configured to support the optical sensor so as to permit a movement of the optical sensor in a contact direction that is a direction perpendicular to the contact face.

2. The head-mounted apparatus according to claim **1**, wherein
- the sensor supporting mechanism has an expansion and contraction unit capable of being expanded and contracted in the contact direction and supports the optical sensor through the expansion and contraction unit; and
- the expansion and contraction unit includes bellows.

3. The head-mounted apparatus according to claim **1**, wherein
- the sensor supporting mechanism has an expansion and contraction unit capable of being expanded and contracted in the contact direction and supports the optical sensor through the expansion and contraction unit; and
- the expansion and contraction unit is formed from rubber and is a hollow member.

4. The head-mounted apparatus according to claim **1**, wherein
- the sensor supporting mechanism has an expansion and contraction unit capable of being expanded and contracted in the contact direction and supports the optical sensor through the expansion and contraction unit;
- the expansion and contraction unit has elasticity that urges the optical sensor toward the head;
- the supporting unit has elasticity that urges a face of the supporting unit toward the head; and
- the expansion and contraction unit has an elastic modulus lower than that of the supporting unit.

5. The head-mounted apparatus according to claim **1**, wherein
- the sensor supporting mechanism supports the optical sensor so as to permit tilting of the contact face.

6. The head-mounted apparatus according to claim **1**, wherein
- the optical sensor is attached to a board; and
- the sensor supporting mechanism supports the board such that a right edge and a left edge of the board can move separately from each other in the contact direction.

7. The head-mounted apparatus according to claim **1**, wherein
- the optical sensor is attached to a board; and
- the sensor supporting mechanism supports the board such that an upper edge and a lower edge of the board can move separately from each other in the contact direction.

8. The head-mounted apparatus according to claim **1**, further comprising:
- an electroencephalogram sensor surrounded by the supporting unit.

9. The head-mounted apparatus according to claim **1**, further comprising:
- at least two electroencephalogram sensors disposed on the right side and the left side with respect to the optical sensor.

10. The head-mounted apparatus according to claim **1**, wherein
- the optical sensor is a blood flow sensor.

* * * * *

专利名称(译)	头戴式设备		
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摘要(译)

本发明公开了一种头戴式装置，包括：光学传感器，具有用于与使用者的头部接触的接触面;支撑单元，设置在光学传感器周围，并配置成与用户的头部接触;传感器支撑机构，被配置为支撑光学传感器，以允许光学传感器在作为垂直于接触面的方向的接触方向上移动。