US 20250266020A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2025/0266020 A1

Kobayashi (43) Pub. Date: Aug. 21, 2025

(54) **PERCUSSION INSTRUMENT AND FORMATION METHOD OF HIT SURFACE**

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(21) Appl. No.: **19/007,558**

(22) Filed: **Jan. 2, 2025**

(30) **Foreign Application Priority Data**

Feb. 21, 2024 (JP) 2024-024565

Publication Classification

(51) **Int. Cl.**

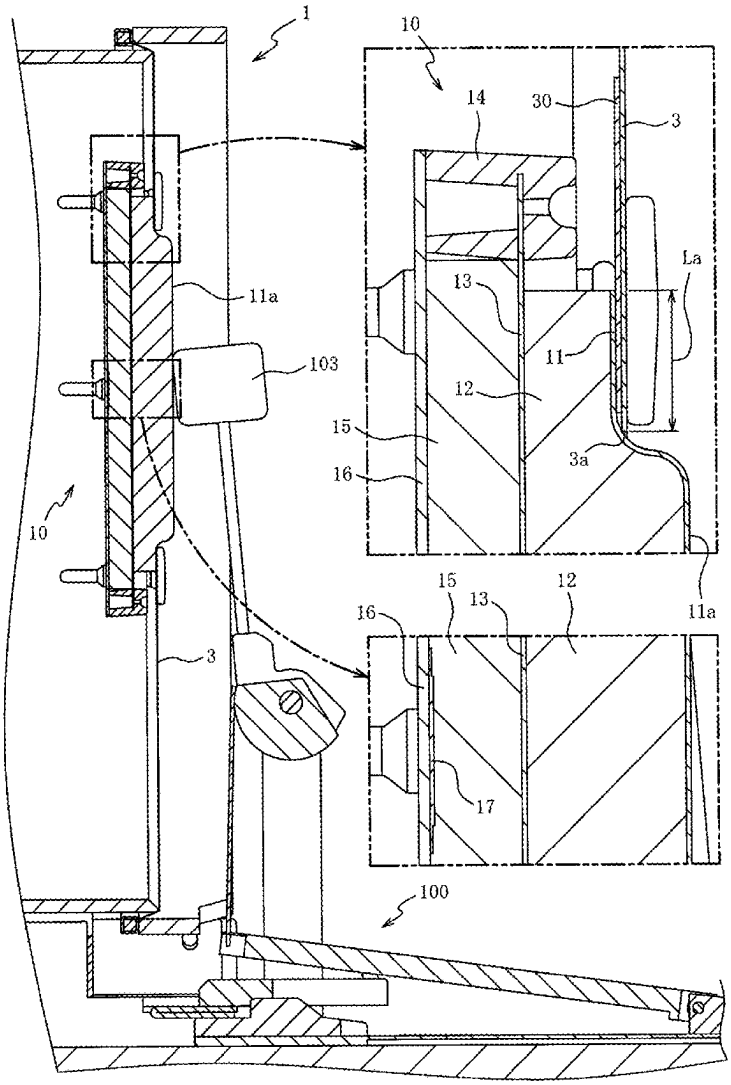
G10D 13/20 (2020.01)
G10D 13/02 (2020.01)
G10D 13/11 (2020.01)
G10D 13/24 (2020.01)

(52) **U.S. Cl.**

CPC ***G10D 13/20*** (2020.02); ***G10D 13/02*** (2013.01); ***G10D 13/11*** (2020.02); ***G10D 13/24*** (2020.02)

(57) **ABSTRACT**

Provided are a percussion instrument and a formation method of hit surface. The percussion instrument includes: a first cushion; a membrane-like membrane member joined to a front surface of the first cushion to form a hit surface; and a regulation device configured at a position overlapping with outer edges of the first cushion and the membrane member in a thickness direction of the membrane member. When the membrane member is hit, the regulation device regulates deformation that increases a thickness of an outer edge of the first cushion. The formation method of hit surface in the percussion instrument includes forming a hit surface by a part of the membrane member located on an inner peripheral side of the regulation device.



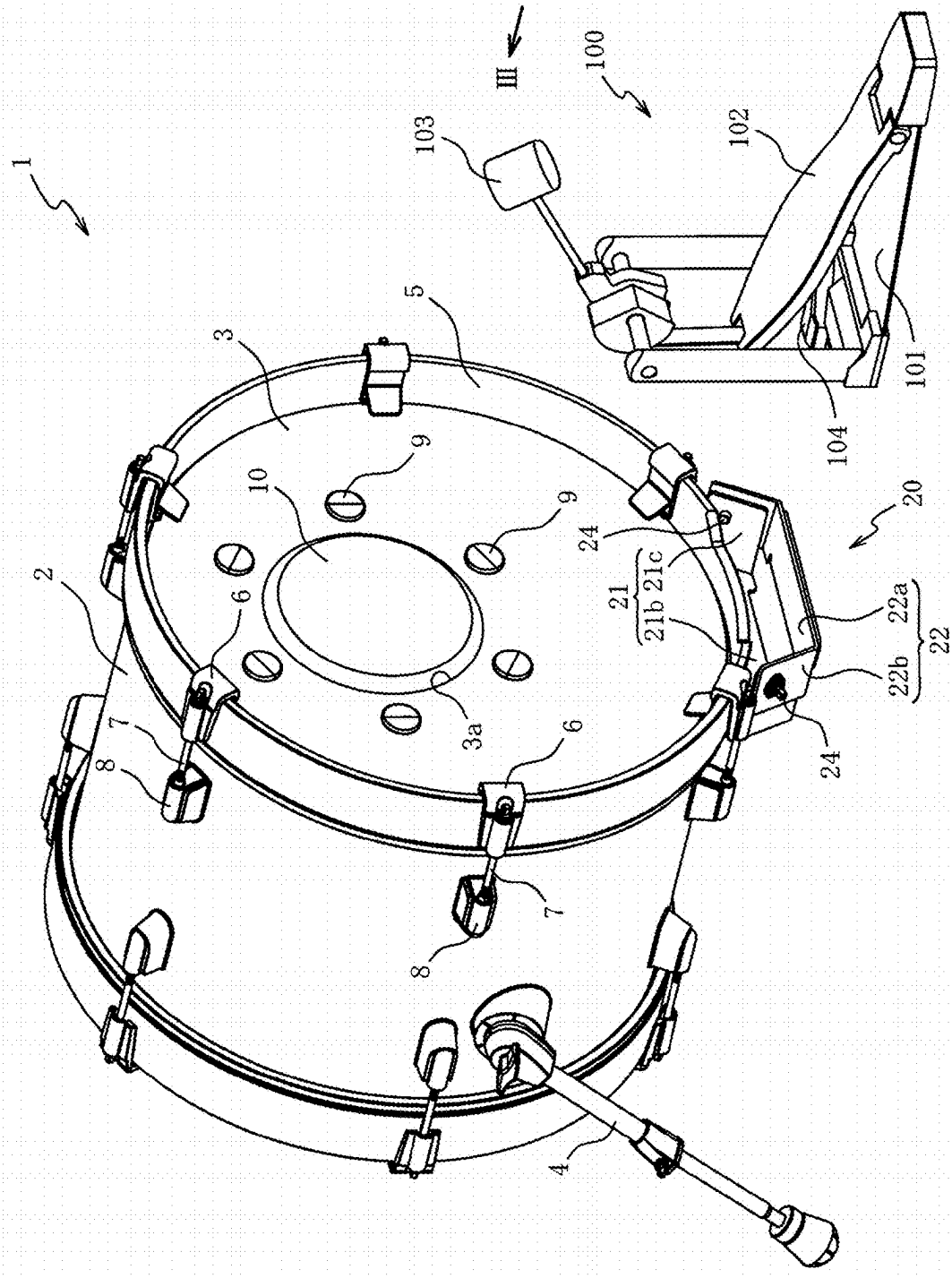

1
2
3
4
5
6
7
8
9
10
3a
20
21
21b
21c
22
22a
22b
24
100
101
102
103
104
III

FIG. 1

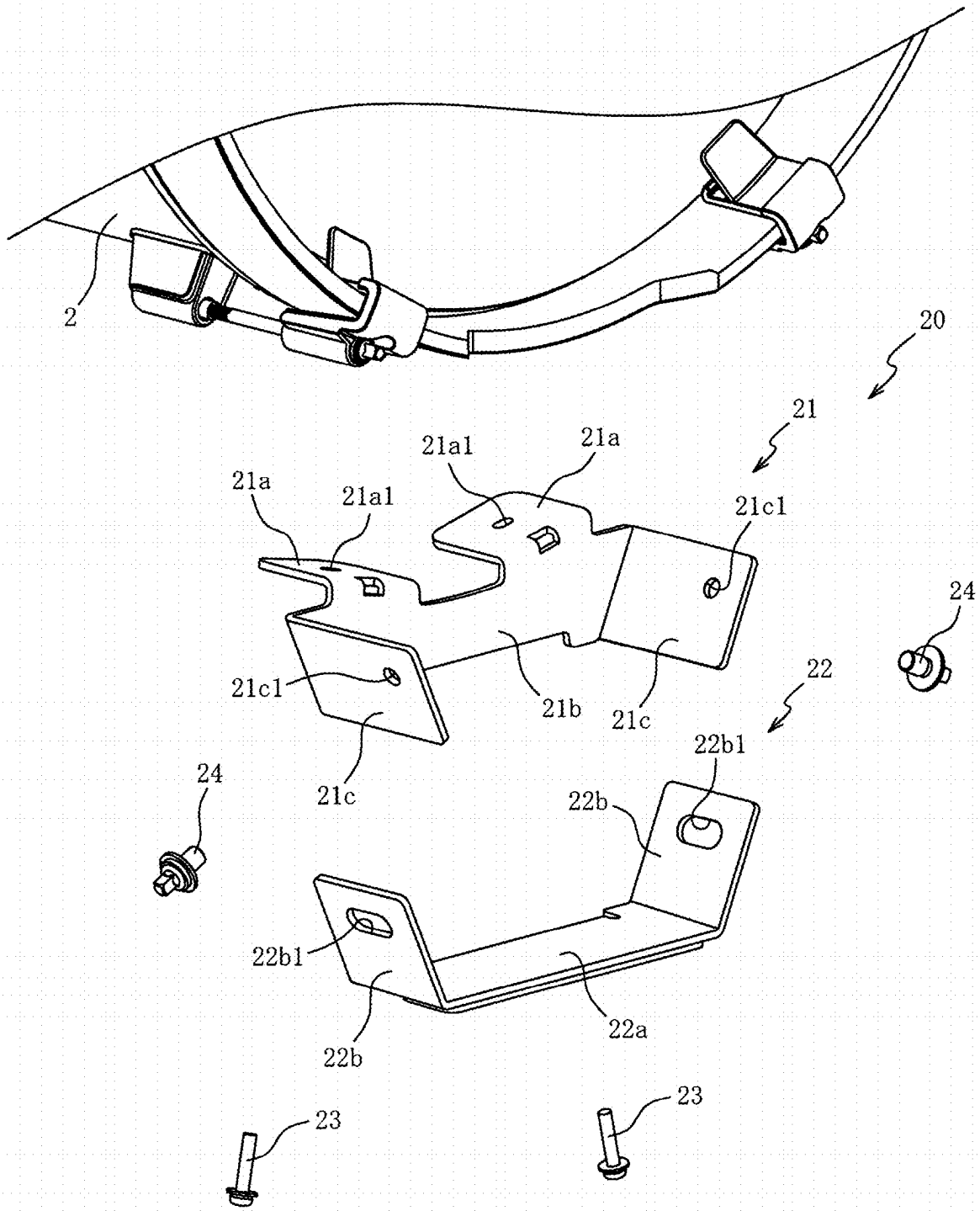

2
20
21
21a1
21a
21a
21a1
21c1
24
21c1
21b
21c
22
22b1
24
21c
22b
22b1
22a
22b
23
23

FIG. 2

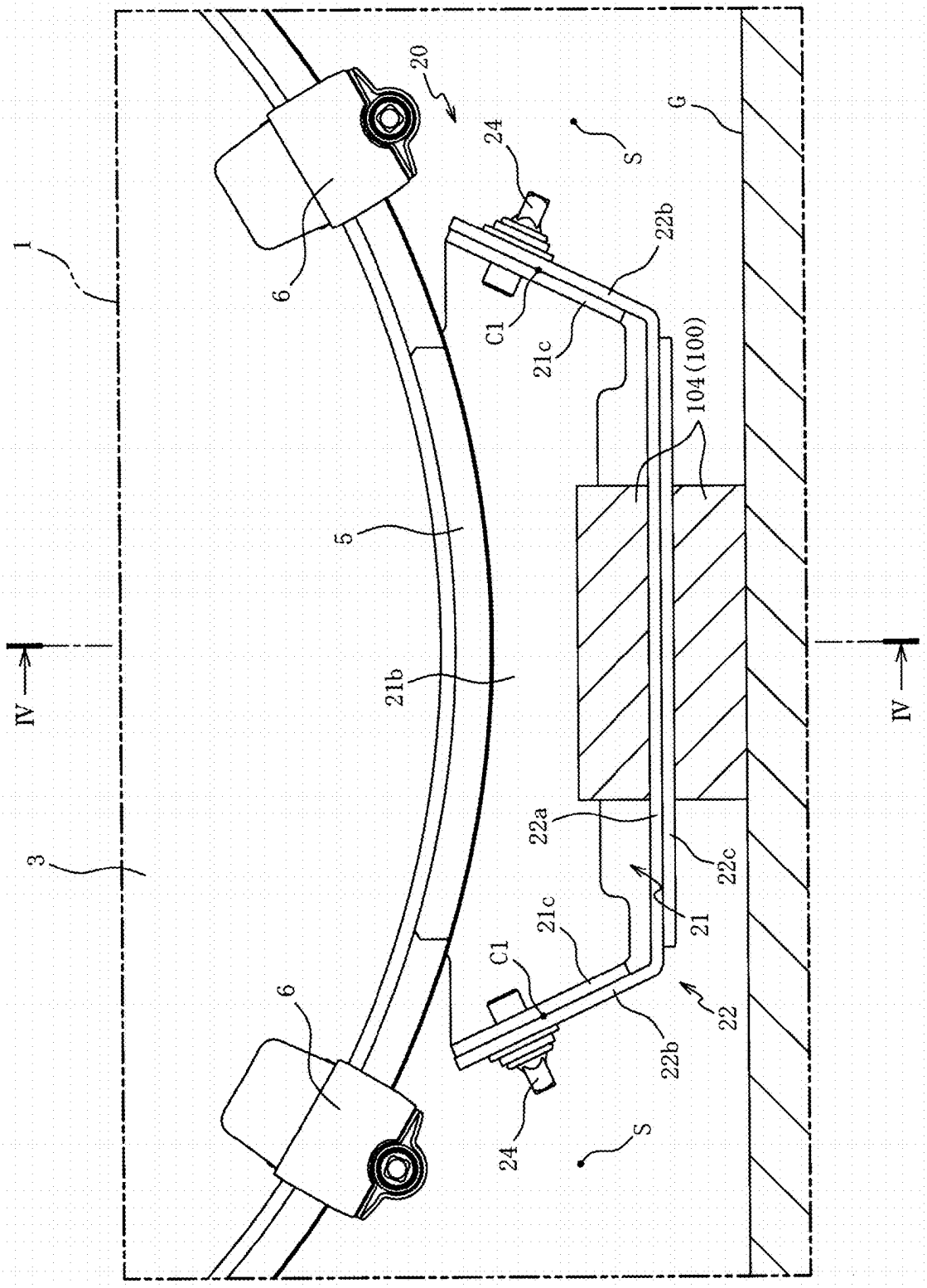

1
3
5
6
6
20
21
21b
21c
21c
22
22a
22b
22b
22c
24
24
104(100)
C1
C1
G
S
S
IV
IV

FIG. 3

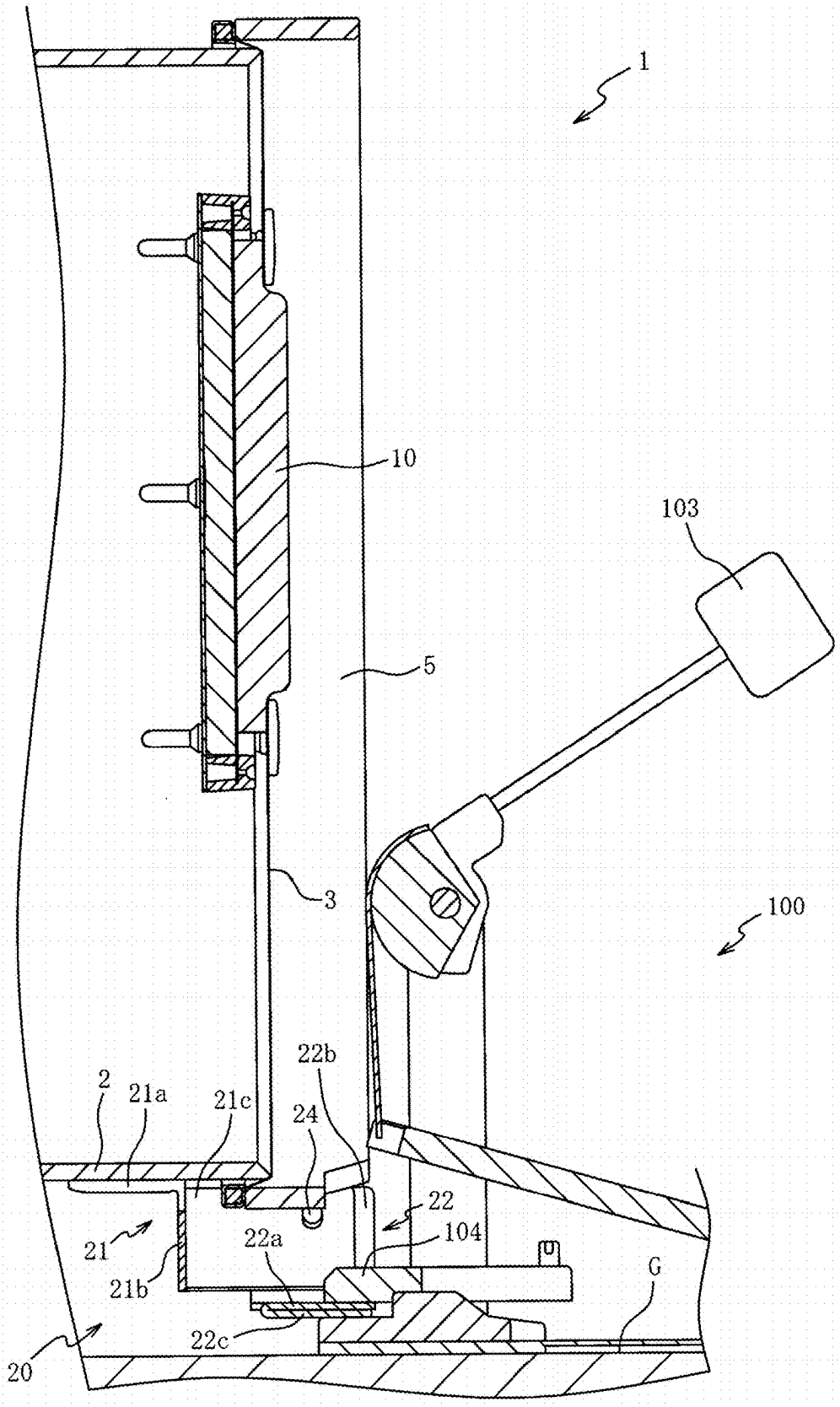


FIG. 4

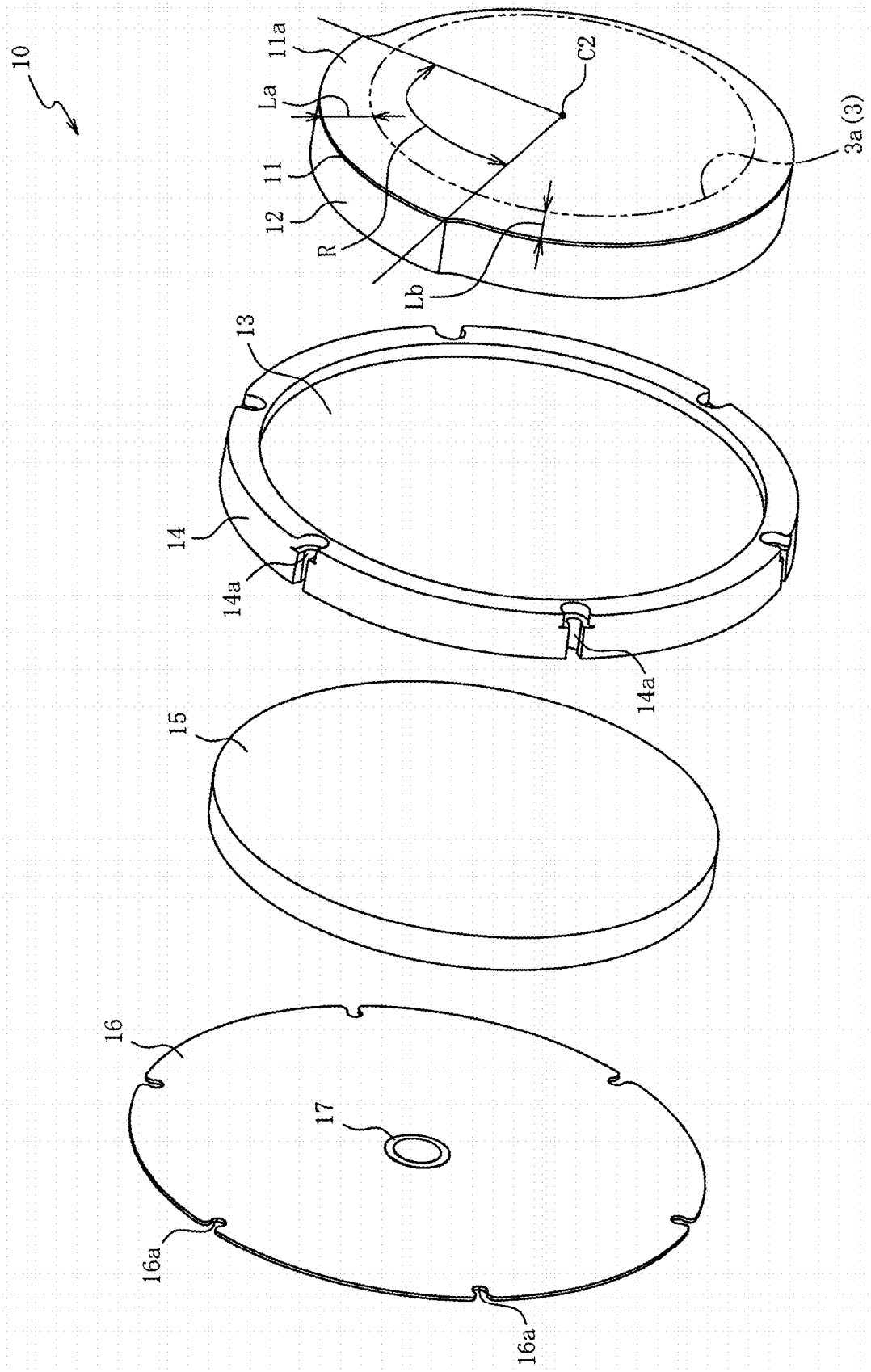


FIG. 5

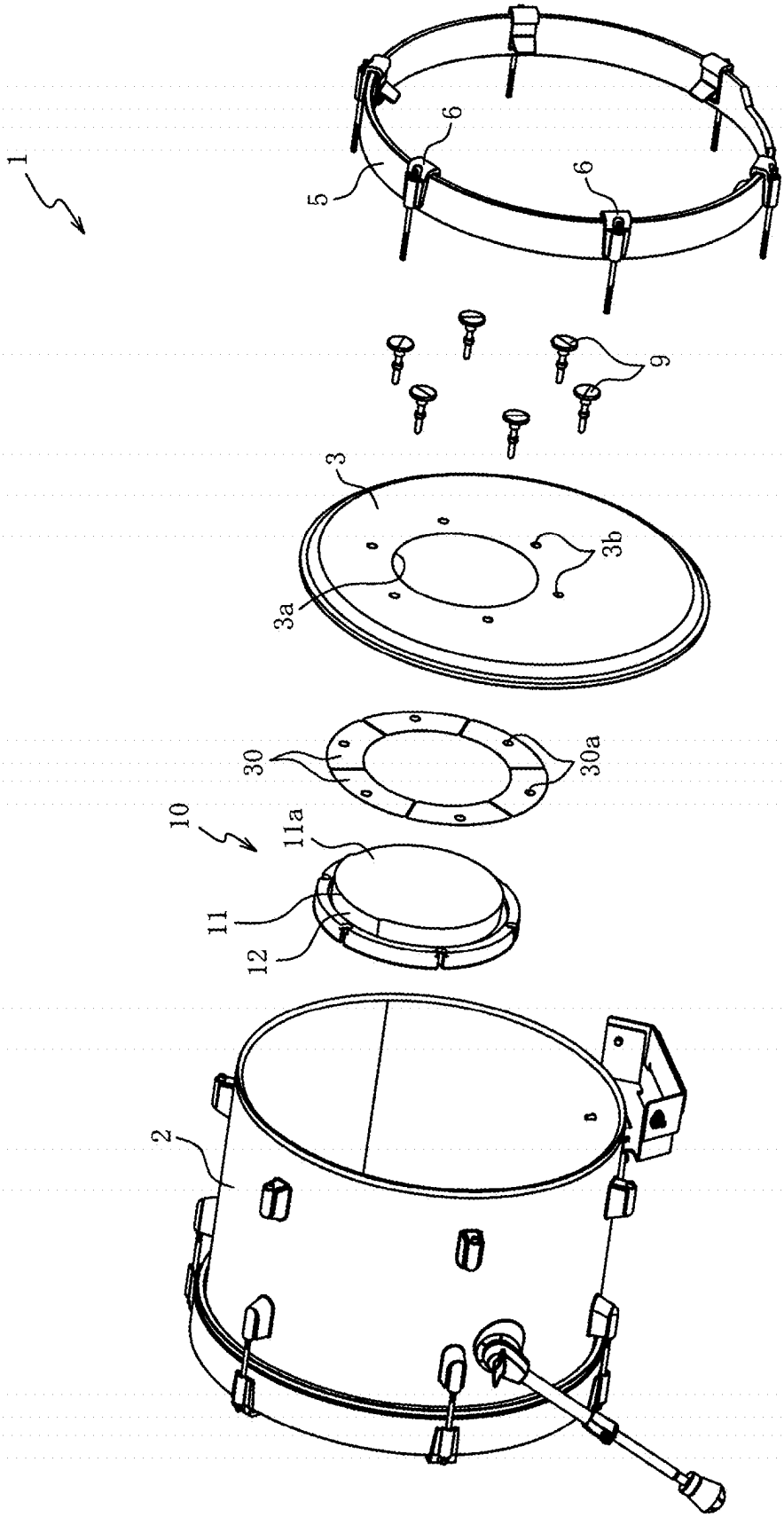


FIG. 6

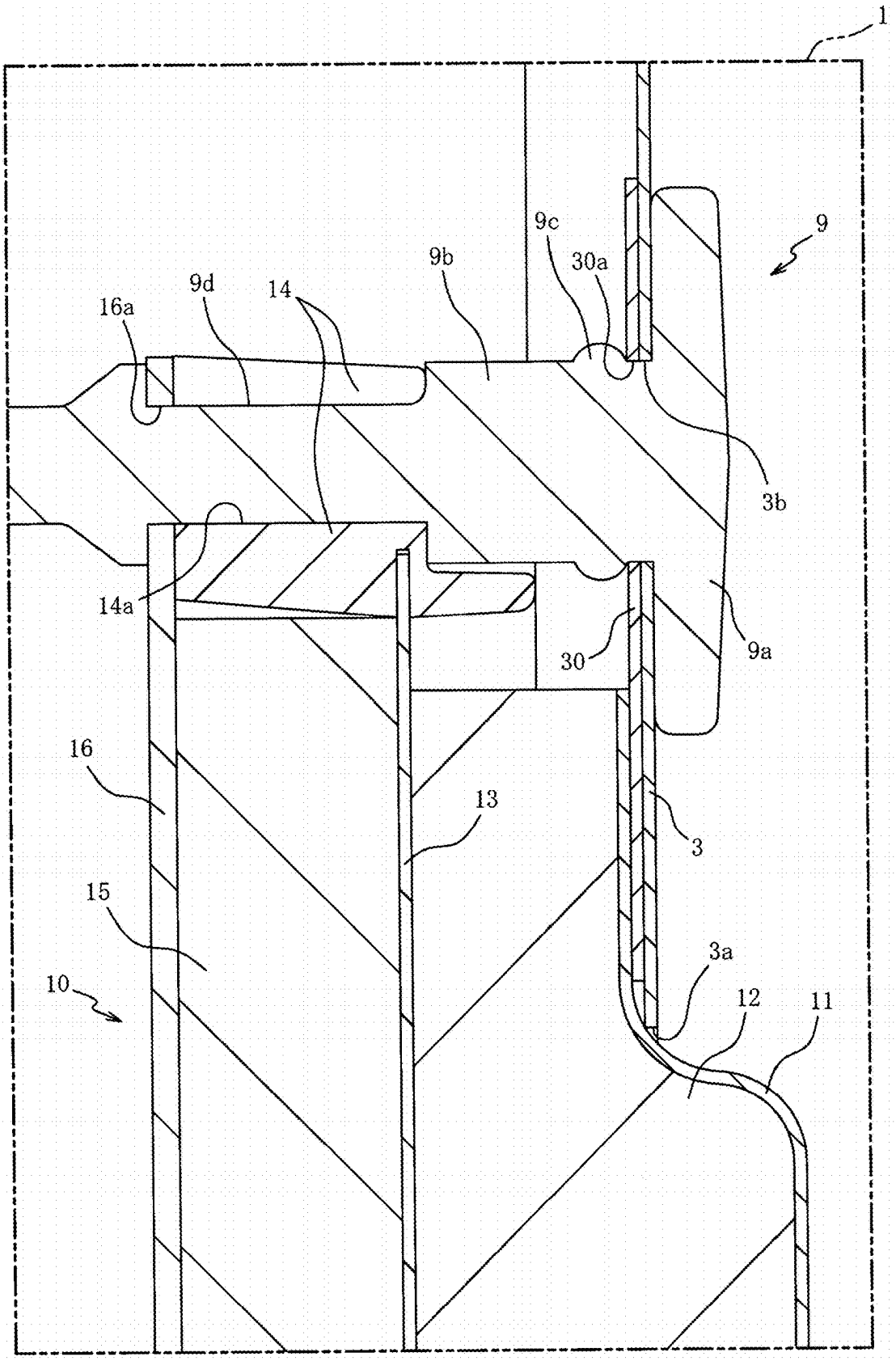


FIG. 7

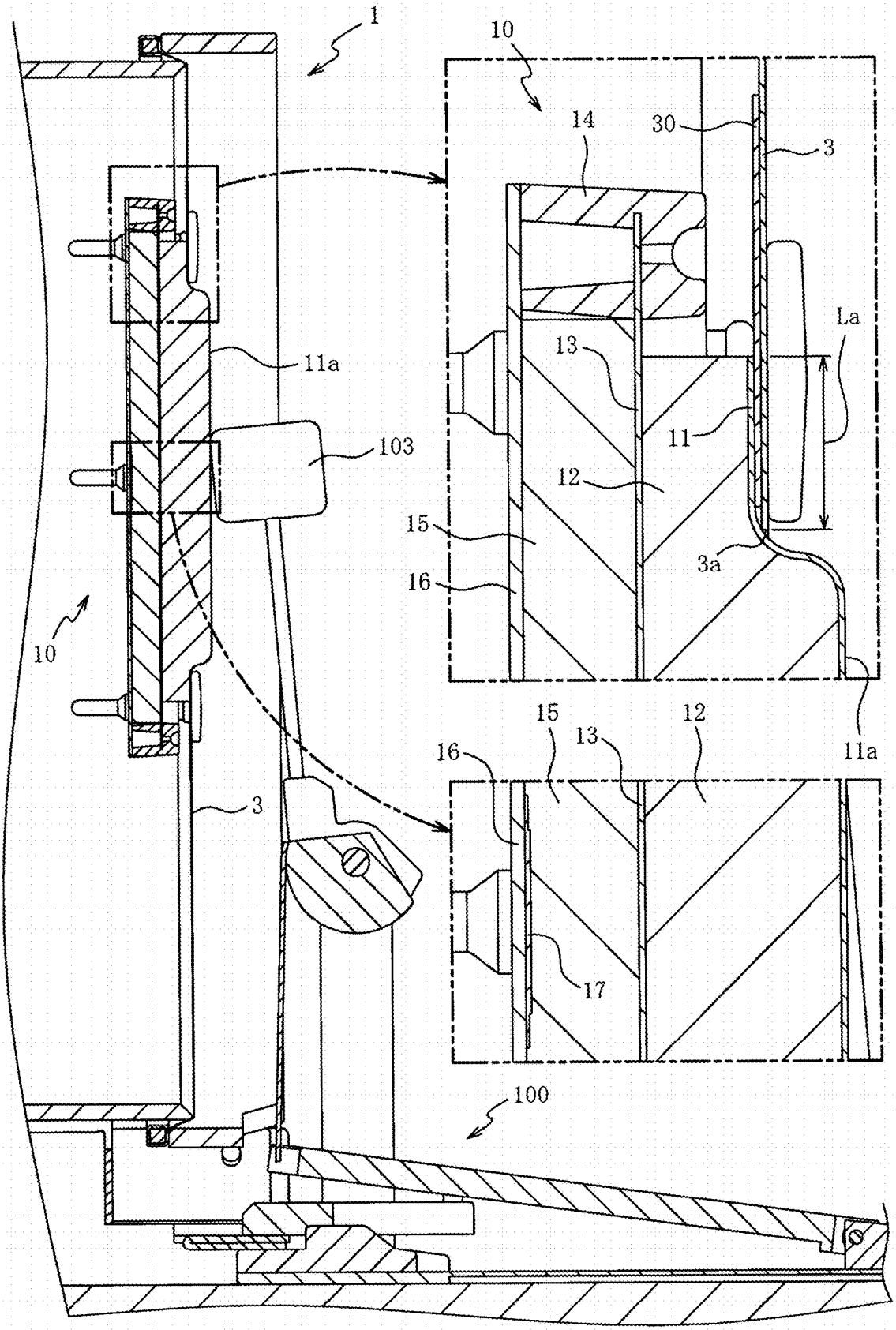


FIG. 8

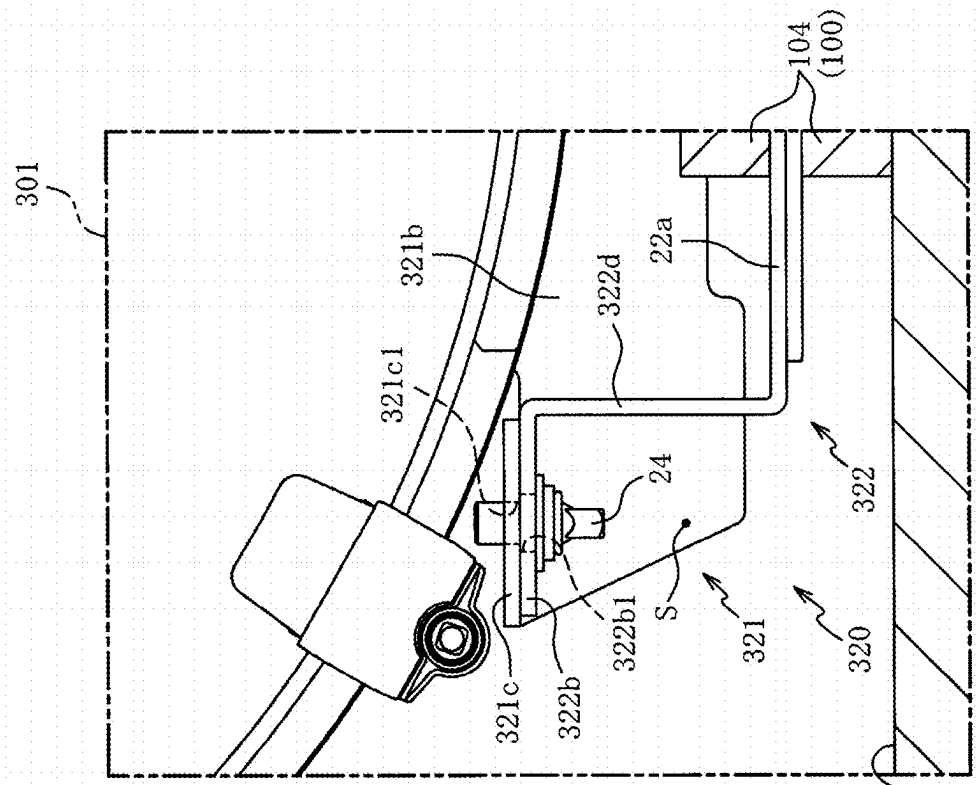

301
321b
321c1
322d
22a
104
(100)
24
322
321c
322b
322b1
S
321
320
G

FIG. 9B

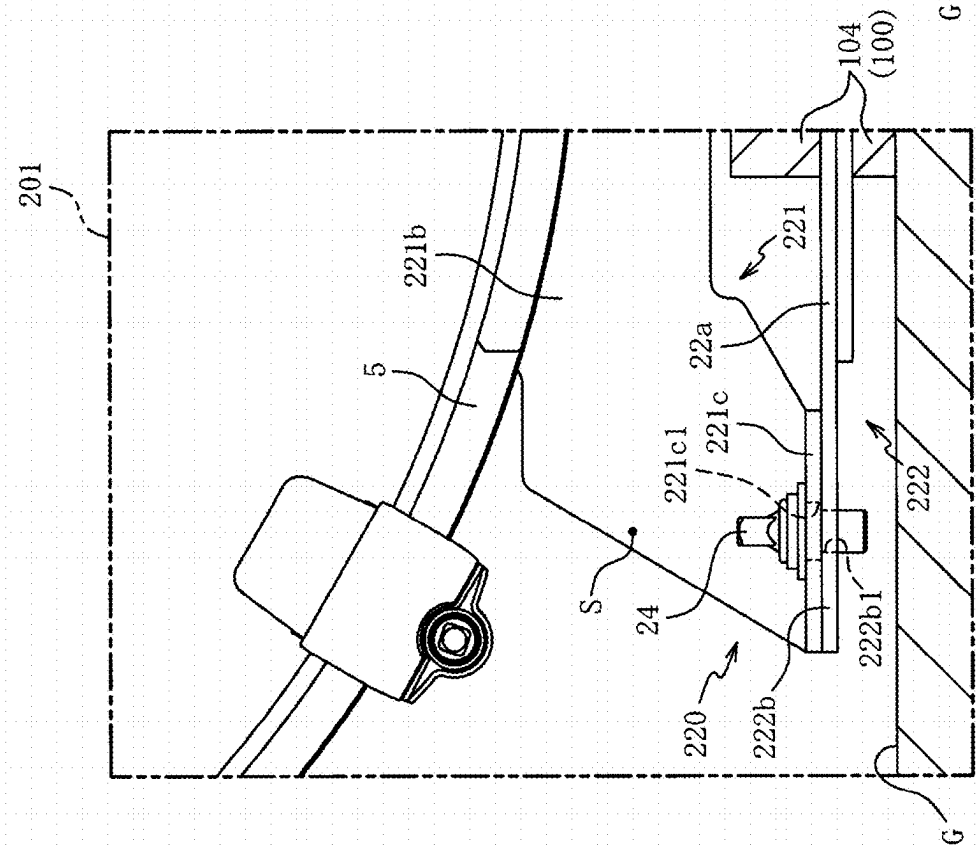

201
221b
5
104
(100)
221
22a
221c1
221c
222
S
24
222b1
220
222b
G

FIG. 9A

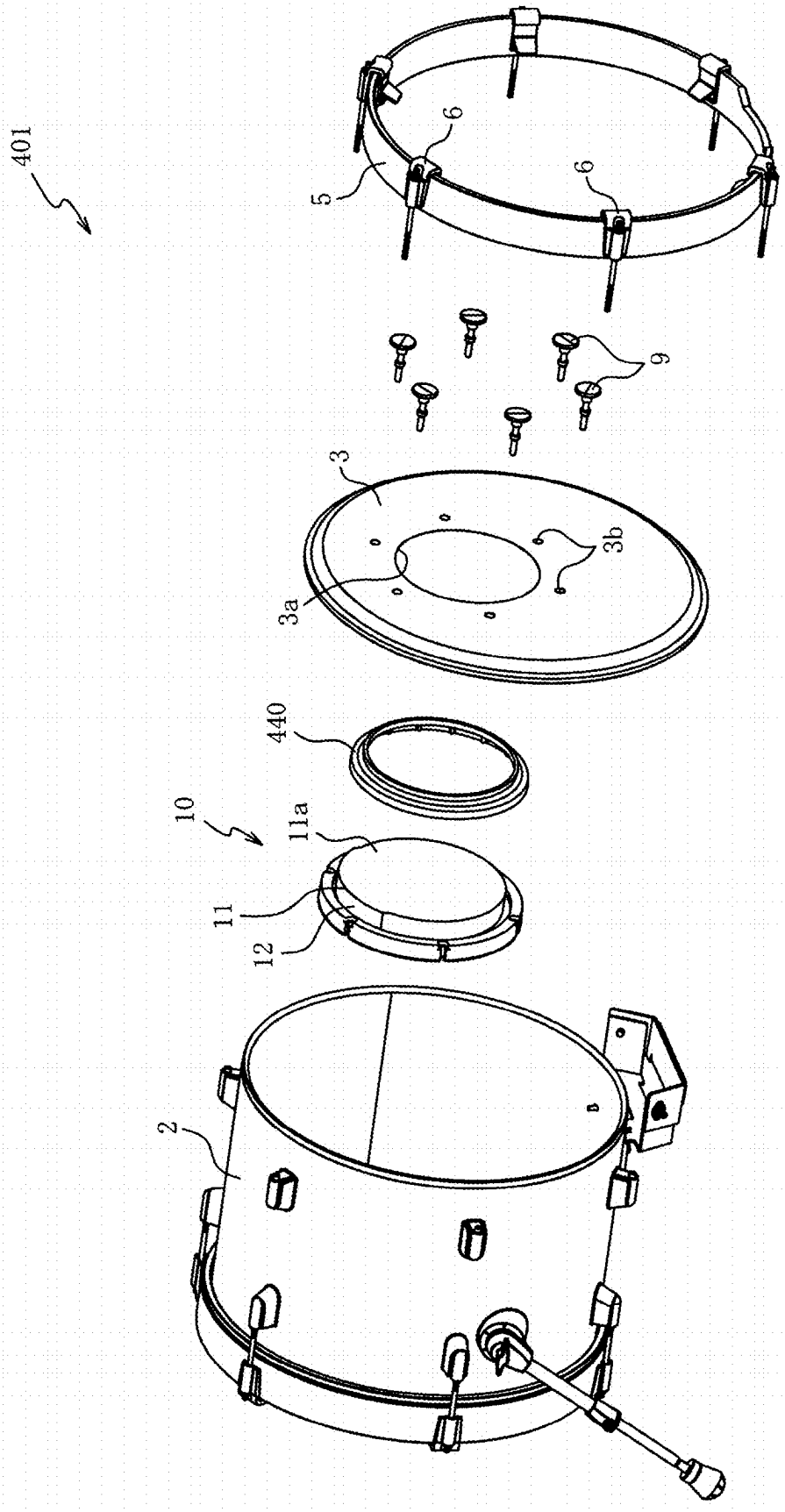


FIG. 10

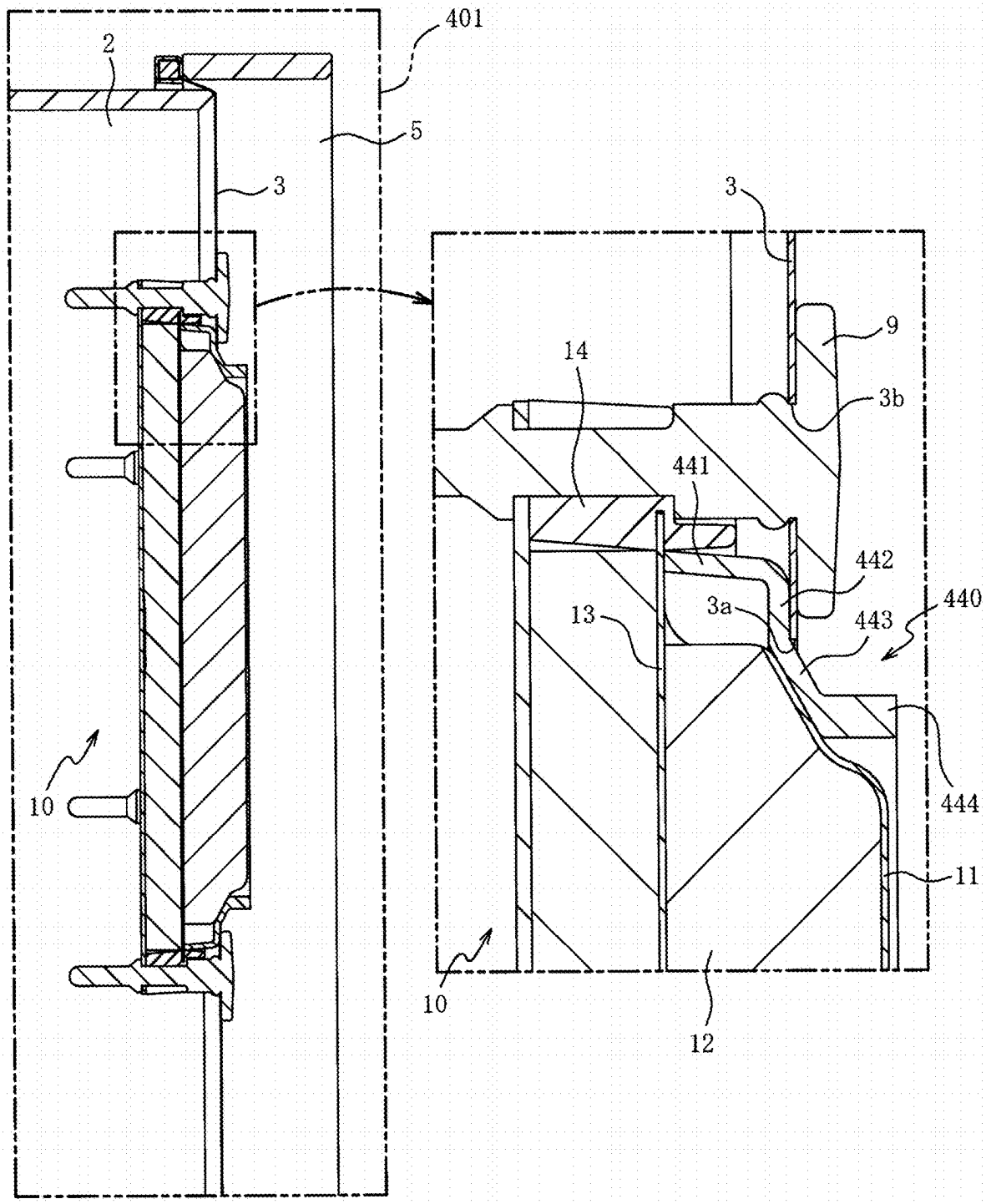


FIG. 11

PERCUSSION INSTRUMENT AND FORMATION METHOD OF HIT SURFACE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the priority benefit of Japan application serial no. 2024-024565, filed on Feb. 21, 2024. The entirety of the above-mentioned patent application is hereby incorporated by reference herein and made a part of this specification.

BACKGROUND

Technical Field

[0002] The disclosure relates to a percussion instrument and a formation method of hit surface, and particularly relates to a percussion instrument and a formation method of hit surface that may improve the durability of the hit surface.

Description of Related Art

[0003] For example, Patent Document 1 (International Publication No. WO 2017/038226 (e.g., paragraphs 0066 and 0067, FIG. 5 and FIG. 6)) describes a technology for forming a hit surface by adhering a cushion portion 47 (first cushion) to the rear surface of a hard body 48 (membrane member) such as woven fabric. According to this technology, the impact when hitting the hard body 48 may be absorbed by the cushion portion 47, thereby reducing the hitting sound generated during such hitting.

[0004] In the above-mentioned conventional technology, when the hard body 48 is hit, while the central side of the cushion portion 47 is compressed, a deformation occurs on the outer edge side of the cushion portion 47 that increases the thickness thereof. Due to this deformation of the outer edge part of the cushion portion 47, peeling is likely to occur in the adhesive part between the hard body 48 and the cushion portion 47, or cracks are likely to occur on the outer peripheral surface of the cushion portion 47. Thus, there is a problem that the durability of the hit surface is low.

[0005] The disclosure provides a percussion instrument and a formation method of hit surface that may improve the durability of the hit surface.

SUMMARY

[0006] The percussion instrument of the disclosure includes a first cushion; a membrane-like membrane member joined to a front surface of the first cushion to form a hit surface; and a regulation device configured at a position overlapping with outer edges of the first cushion and the membrane member in a thickness direction of the membrane member. When the membrane member is hit, the regulation device regulates deformation that increases a thickness of an outer edge of the first cushion.

[0007] In a formation method of hit surface in a percussion instrument of the disclosure, the percussion instrument includes a first cushion; a membrane-like membrane member joined to a front surface of the first cushion; and a regulation device configured at a position overlapping with outer edges of the first cushion and the membrane member in a thickness direction of the membrane member. The formation method of hit surface includes forming a hit surface by a part of the membrane member located on an inner peripheral side of the regulation device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a perspective view of the percussion instrument according to the first embodiment.

[0009] FIG. **2** is a perspective view of the percussion instrument showing the lifter in a disassembled state.

[0010] FIG. **3** is a partially enlarged front view of the percussion instrument as viewed in the direction of arrow III in FIG. **1**.

[0011] FIG. **4** is a partially enlarged cross-sectional view of the percussion instrument along the line IV-IV in FIG. **3**.

[0012] FIG. **5** is an exploded perspective view of the attachment.

[0013] FIG. **6** is an exploded perspective view of the percussion instrument.

[0014] FIG. **7** is a partially enlarged cross-sectional view of the percussion instrument.

[0015] FIG. **8** is a partially enlarged cross-sectional view of the percussion instrument showing the state where the hit surface of the attachment is hit by the beater from the state shown in FIG. **4**.

[0016] FIG. **9**A is a partially enlarged front view of the percussion instrument according to the second embodiment, and FIG. **9**B is a partially enlarged front view of the percussion instrument according to the third embodiment.

[0017] FIG. **10** is an exploded perspective view of the percussion instrument according to the fourth embodiment.

[0018] FIG. **11** is a partially enlarged cross-sectional view of the percussion instrument.

DESCRIPTION OF THE EMBODIMENTS

[0019] The following describes embodiments with reference to the drawings. First, with reference to FIG. **1**, the overall configuration of the percussion instrument **1** according to the first embodiment is described. FIG. **1** is a perspective view of the percussion instrument **1** according to the first embodiment.

[0020] It is noted that, in the following description, the side of the percussion instrument **1** closer to the performer when viewed from the performer's side is referred to as the front (front side) of the percussion instrument **1**, and the opposite side is referred to as the rear of the percussion instrument **1**. Further, the left side when viewed from the performer's side is referred to as the left side of the percussion instrument **1**, and the opposite side is referred to as the right side of the percussion instrument **1**.

[0021] As shown in FIG. **1**, the percussion instrument **1** is a bass drum in which the opening part at the front end (axial end portion) of the cylindrical shell **2** is covered with the head **3**. A rod-shaped stand **4** that inclines downward toward the rear side of the shell **2** is attached to the outer peripheral surface of the shell **2** (body portion). The stand **4** is provided as a pair on both the left and right side surfaces of the shell **2**, and this pair of stands **4** supports the rear end portion of the shell **2** on the installation surface.

[0022] The head **3** is formed into a disc shape using a synthetic resin film and is attached to the shell **2** by an annular hoop **5**. U-shaped attaching parts **6** are hooked onto the hoop **5** at multiple locations in the circumferential direction. Through holes (not shown) are formed in the parts of the attaching parts **6** located on the outer peripheral side of the hoop **5**, and tension bolts **7** are inserted into these through holes. Multiple lugs **8** are provided on the outer peripheral surface of the shell **2**, arranged in the circumfer-

ential direction, and with the outer edge of the head **3** hooked onto the hoop **5**, tension is applied to the head **3** by screwing the tension bolts **7** into the lugs **8**.

[0023] The attachment **10** is fixed to the head **3** by multiple fixing parts **9**. The detailed configuration of this fixing structure using the fixing parts **9** and the attachment **10** is described later, but the attachment **10** is fitted into a circular through hole **3***a* formed in the head **3**, and this attachment **10** is hit by the foot pedal **100**.

[0024] The foot pedal **100** includes a base plate **101** that is installed on the installation surface, and a foot board **102** is pivotally supported at the base end part (the end on the performer's side) of this base plate **101**. When the performer steps on the foot board **102**, the beater **103** rotates to hit the attachment **10** (performing the percussion instrument **1**). A clamp **104** is provided at the front end side of the base plate **101**, and in response to performing the percussion instrument **1**, this clamp **104** is attached to the lifter **20** of the percussion instrument **1**.

[0025] Next, the detailed configuration of the lifter **20** is described with reference to FIG. **1** and FIG. **2**. FIG. **2** is a perspective view of the percussion instrument **1** showing the lifter **20** in a disassembled state.

[0026] As shown in FIG. **1** and FIG. **2**, the lifter **20** includes a fixing member **21** that is fixed to the shell **2**, and an attaching member **22** that is attached to the fixing member **21**. Each of the fixing member **21** and the attaching member **22** (lifter **20**) has a left-right symmetrical shape.

[0027] The fixing member **21** includes a pair of fixing portions **21***a* (refer to FIG. **2**) spaced apart in the left and right direction (circumferential direction of the outer peripheral surface of the shell **2**). The fixing portion **21***a* is formed in a rectangular flat plate shape, and a through hole **21***a***1** is formed in the center of the fixing portion **21***a*. The fixing member **21** (a pair of fixing portions **21***a*) is attached to the shell **2** by fastening bolts **23** inserted into the through holes **21***a***1** to the shell **2**. It is noted that although not shown in the figure, a resin spacer is sandwiched between the fixing portion **21***a* and the outer peripheral surface of the shell **2**.

[0028] From the front end side (the end portion on the performer's side) of the pair of fixing portions **21***a*, hanging portion **21***b* hang downward, and from both left and right ends of the hanging portions **21***b*, bent portions **21***c* are bent toward the front side. Female screw holes **21***c***1** are formed on the front end side (more toward the front side than the center in the front and rear direction) of the bent portions **21***c*, and the attaching member **22** is attached to the fixing member **21** by bolts **24** fastened to these female screw holes **21***c***1** (refer to FIG. **1** for this attached state).

[0029] The attaching member **22** includes an attaching portion **22***a* extending in the horizontal direction, and a pair of fastening portions **22***b* bent upward from both left and right ends of the attaching portion **22***a*. Elongated holes **22***b***1** (refer to FIG. **2**) extending in the front and rear direction are formed in the fastening portions **22***b*, and the attaching member **22** is fixed to the fixing member **21** by fastening bolts **24** inserted into these elongated holes **22***b***1** to the female screw holes **21***c***1** of the fixing member **21**. On the other hand, in a state where the bolts **24** are loosened, the fastening position of the fastening portions **22***b* relative to the bent portions **21***c* may be adjusted in the front and rear direction by sliding the fastening portions **22***b* (attaching member **22**) along the elongated holes **22***b***1**.

[0030] Next, the case where the foot pedal **100** is attached to the lifter **20** is described with reference to FIG. **3** and FIG. **4**. FIG. **3** is a partially enlarged front view of the percussion instrument **1** as viewed in the direction of arrow III in FIG. **1**, and FIG. **4** is a partially enlarged cross-sectional view of the percussion instrument **1** along the line IV-IV in FIG. **3**.

[0031] It is noted that in FIG. **3**, the shape of the clamp **104** of the foot pedal **100** that grips the attaching member **22** (attaching portion **22***a*) is schematically illustrated and shown with hatching. Further, in FIG. **4**, the illustration of the attaching parts **6** (refer to FIG. **3**) of the hoop **5** is omitted.

[0032] As shown in FIG. **3** and FIG. **4**, in the case of attaching the foot pedal **100** to the percussion instrument **1**, the attaching portion **22***a* is sandwiched from above and below by the clamp **104**. In the state where the foot pedal **100** is attached to the attaching portion **22***a*, the front end portion of the percussion instrument **1** is supported on an installation surface G such as a floor through the foot pedal **100**. It is noted that as mentioned above, the rear end side of the percussion instrument **1** is supported on the installation surface G by the stand **4** (refer to FIG. **1**).

[0033] In response to attaching the foot pedal **100** to the attaching portion **22***a*, there may be cases where the foot pedal **100** interferes with the percussion instrument **1** (head **3** or hoop **5**), or the hitting position of the beater **103** (refer to FIG. **4**) is not appropriate. In such cases, an operation is performed to adjust the relative position between the percussion instrument **1** and the foot pedal **100** in the front and rear direction by loosening the bolts **24** and sliding the fastening portions **22***b* back and forth relative to the bent portions **21***c*.

[0034] As a conventional technology for this type of percussion instrument **1**, a technique of fastening bolts from the lower surface side of an attaching member to which a foot pedal is attached (for example, the drum connecting member 23 in Japanese Patent Application Laid-Open Publication No. 2014-071196) is known. However, in this conventional technology, in response to performing the bolt fastening operation, it is necessary to insert a hand (or tool) into the narrow space between the installation surface and the lifter, or to invert the percussion instrument upside down. Thus, adjusting the relative position between the percussion instrument and the foot pedal requires considerable effort.

[0035] In contrast, in this embodiment, fastening portions **22***b* are provided on two sides in the left and right direction of the attaching portion **22***a* to which the foot pedal **100** is attached, and these fastening portions **22***b* are fastened to the fixing member **21** (bent portion **21***c*) by bolts **24**. As a result, even in the state where the percussion instrument **1** is installed on the installation surface G, the fastening operation of the bolts **24** may be performed utilizing the relatively wide spaces S (refer to FIG. **3**) formed on both left and right sides of the attaching portion **22***a* (lateral side of the lifter **20**). In other words, the relative position between the percussion instrument **1** and the foot pedal **100** may be easily adjusted without inverting the percussion instrument **1** upside down.

[0036] In the state where the fixing member **21** and the attaching member **22** are fastened by the bolts **24**, the side surface of the bent portion **21***c* facing the outer side in the left and right direction contacts the side surface of the fastening portion **22***b* facing the inner side in the left and right direction. Hereinafter, each of these side surfaces are

referred to as a "fastening surface", and the fastening surface of the bent portion **21***c* and the fastening portion **22***b* on the left side of the lifter **20** and the fastening surface of the bent portion **21***c* and the fastening portion **22***b* on the right side are collectively referred to as the "left and right fastening surfaces", etc.

[0037] In this embodiment, the left and right fastening surfaces are inclined with respect to the vertical direction, but, for example, even if the left and right fastening surfaces are planes along the vertical direction, it is possible to perform the fastening operation of the bolts **24** utilizing the wide spaces S on the left and right sides of the lifter **20** (refer to FIG. **3**).

[0038] However, in a configuration where the left and right fastening surfaces of the lifter **20** are planes along the vertical direction (the left and right fastening surfaces face each other in parallel), the center axes of the left and right bolts **24** align (line up in a straight line). As a result, the attaching member **22** may rotate around the bolts **24** due to vibrations generated in response to stepping on the foot pedal **100**.

[0039] In the case where the attaching member **22** rotates around the bolts **24** as an axis, the relative position between the percussion instrument **1** and the foot pedal **100** may shift during performance, resulting in a decrease in the playability of the percussion instrument **1**. Further, in response to the attaching member **22** rotating around the bolts **24** as an axis, loosening of the bolts **24** may occur, making it easier for the attaching member **22** to rattle relative to the fixing member **21**. This also leads to a decrease in the playability of the percussion instrument **1**.

[0040] To suppress such rotation of the attaching member **22**, it may be considered to fasten each of the left and right fastening surfaces with two bolts **24** (providing a total of four bolts **24** on the left and right fastening surfaces). However, in a configuration where multiple bolts **24** are provided on the left and right fastening surfaces, the fastening operation of the bolts **24** becomes time-consuming, and the lifter **20** becomes larger in size.

[0041] In contrast, in this embodiment, the left and right fastening surfaces of the lifter **20** are non-parallel to the vertical direction, and the left and right bolts **24** fasten the fastening portion **22***b* at positions where their center axes do not align. In other words, it is a configuration where the center axes of the bolts **24**, provided one each on the left and right fastening surfaces, do not line up in a straight line.

[0042] As a result, the rotation of the attaching member **22** relative to the fixing member **21** (rotation of the attaching member **22** around the bolts **24** as an axis) may be regulated by the engagement between the bolts **24** and the fastening portion **22***b*, or by the engagement between the left and right fastening surfaces (the bent portion **21***c* and the fastening portion **22***b*). Thus, the relative position between the percussion instrument **1** and the foot pedal **100** may be prevented from shifting during performance, thus improving the playability of the percussion instrument **1**.

[0043] Further, since the attaching member **22** does not rotate around the bolts **24** as an axis, it is possible to suppress the loosening of the bolts **24** due to such rotation. Thus, as it becomes difficult for the attaching member **22** to rattle relative to the fixing member **21** (bent portion **21***c*), the playability of the percussion instrument **1** may be improved.

[0044] Here, as alternative examples of configurations that may facilitate the fastening operation of the bolts **24**, the percussion instruments **201** and **301** of the second and third embodiments to be described later (refer to FIG. **9**A and **9**B) are illustrated. Details are described later, but in the percussion instrument **201** of the second embodiment (refer to FIG. **9**A), the fastening operation of the bolts **24** is performed utilizing the space S between the hoop **5** and the bent portion **221***c*, and in the percussion instrument **301** of the third embodiment (refer to FIG. **9**B), the fastening operation of the bolts **24** is performed utilizing the space S between the fastening portion **322***b* and the installation surface G.

[0045] However, in configurations where the bolts **24** are fastened in the up and down direction, as in the percussion instruments **201** and **301** of the second and third embodiments, the hoop **5** or the installation surface G may interfere with the hand or tool performing the fastening operation of the bolts **24**.

[0046] In contrast, in this embodiment, since the left and right fastening surfaces (fastening portion **22***b*) of the lifter **20** are inclined upward from the attaching portion **22***a* towards the left and right direction outer side (refer to FIG. **3**), the bolts **24** may be fastened from the lateral side of the fastening portion **22***b*. As a result, compared to the percussion instruments **201** and **301** of the second and third embodiments, it becomes less likely for the hoop **5** or the installation surface G to interfere with the hand or tool performing the fastening operation of the bolts **24**. Thus, the workability of the fastening operation of the bolts **24** may be improved.

[0047] Further, the axis of the bolts **24** is positioned above the up and down direction center C**1** of the left and right fastening surfaces. In other words, since the bolts **24** fasten the fixing member **21** (bent portion **21***c*) and the fastening portion **22***b* at a position above the up and down direction center C**1** of the fastening surfaces, compared to a case where the bolts **24** are provided below the up and down direction center C**1** of the fastening surfaces, it becomes less likely for the installation surface to interfere with the hand or tool performing the fastening operation of the bolts **24**. This also contributes to improving the workability of the fastening operation of the bolts **24**.

[0048] It is noted that in this embodiment, the inclination angle of the left and right fastening surfaces (bent portion **21***c* and fastening portion **22***b*) with respect to the vertical direction is 25°, but it is preferable that this inclination angle of the fastening surfaces is between 5° and 40°. Within this range of angles, interference of the percussion instrument **1** or the installation surface with the hand or tool performing the fastening operation of the bolts **24** may be suppressed. Further, it is more preferable that the inclination angle of the left and right fastening surfaces is between 15° and 30°. Within this range of angles, interference of the percussion instrument **1** or the installation surface with the hand or tool performing the fastening operation of the bolts **24** may be suppressed more effectively.

[0049] After fastening the fixing member **21** and the attaching member **22** with the bolts **24**, the performance of the percussion instrument **1** is carried out by stepping on the foot pedal **100**, but during this performance, the attaching portion **22***a* to which the foot pedal **100** is attached is prone to experiencing loads (vibrations) in the up and down direction. When these loads during performance repeatedly act on the attaching portion **22***a*, the bolts **24** may become loose.

[0050] In other words, as described above, although the lifter **20** of this embodiment is configured to generally prevent the rotation of the attaching member **22** around the axis of the bolts **24**, when the loads during performance repeatedly act on the attaching portion **22***a* (attaching member **22**), the bolts **24** may gradually become loose.

[0051] In response to this, in this embodiment, the bent portion **21***c* (fixing member **21**) is fastened to the inner side in the left and right direction of the fastening portion **22***b*. Thus, even if loosening or detachment of the bolts **24** occurs, the bent portion **21***c* (fixing member **21**) may be retained on the inner side of the left and right fastening portions **22***b*. In other words, even if detachment of the bolts **24** occurs during performance, the state in which the fixing member **21** is supported from below by the attaching member **22** may be maintained, allowing the performance of the percussion instrument **1** to continue.

[0052] Further, since the loads during performance are likely to act on the attaching portion **22***a*, in this embodiment, the rigidity of the attaching portion **22***a* is ensured by overlapping (joining) the reinforcement portion **22***c* on the lower surface of the attaching portion **22***a*. The attaching portion **22***a* and the reinforcement portion **22***c* are integrally formed by bending one metal plate (as shown in FIG. **4**, the reinforcement portion **22***c* is folded back from the rear end portion of the attaching portion **22***a* to the lower surface side of the attaching portion **22***a*). Similarly, the attaching portion **22***a* and the fastening portion **22***b* are also integrally formed by bending a metal plate, so that the attaching member **22** including these portions **22***a* to **22***c* may be easily formed from one metal plate.

[0053] Further, the loads during performance also act on the fixing member **21** through the attaching member **22**. In this case, as in the percussion instruments **201** and **301** of the second and third embodiments to be described later (refer to FIG. **9**A and **9**B), in the case where the structure is such that the bent portions **221***c* and **321***c* are bent from the lower end portion or upper end portion of the hanging portions **221***b* and **321***b*, the load from stepping on the foot pedal **100** acts in the plate thickness direction of the bent portions **221***c* and **321***c*. As a result, deflection is likely to occur in the bent portions **221***c* and **321***c*, or bending is likely to occur in the bending parts between the hanging portions **221***b* and **321***b* and the bent portions **221***c* and **321***c*.

[0054] In other words, in the configurations of the second and third embodiments to be described later, the rigidity of the fixing members **221** and **321** against the loads acting from the foot pedal **100** decreases, making it easier for the relative position between the percussion instrument **1** and the foot pedal **100** to shift during performance.

[0055] In response to this, in this embodiment, since the fastening portions **22***b* are fastened to the bent portions **21***c* that bend forward from both left and right ends of the hanging portion **21***b* (the plate surfaces of the bent portions **21***c* are directed left and right), it is possible to suppress the up and down direction loads during performance from acting in the plate thickness direction (the bending direction of the bent portions **21***c* relative to the hanging portion **21***b*) of the bent portions **21***c*. This may suppress the occurrence of bending in the bent portions **21***c* or deformation in the bending parts between the hanging portion **21***b* and the bent portions **21***c*. In other words, the rigidity of the fixing member **21** against the loads acting from the foot pedal **100** may be improved, making it difficult for the relative position between the percussion instrument **1** and the foot pedal **100** to change during performance. As a result, the playability of the percussion instrument **1** may be improved.

[0056] Further, since the fixing portions **21***a*, hanging portion **21***b*, and bent portions **21***c* constituting the fixing member **21** are integrally formed by bending a metal plate, the fixing member **21** may be easily formed from one metal plate.

[0057] Next, referring to FIG. **5**, the configuration of the attachment **10** that is hit by the beater **103** (refer to FIG. **4**) during performance of the percussion instrument **1** is described. FIG. **5** is an exploded perspective view of the attachment **10**.

[0058] As shown in FIG. **5**, the attachment **10** includes a disc-shaped membrane member **11** whose front surface serves as a hit surface **11***a*, and a cushion **12** is adhered to the rear surface of the membrane member **11** to absorb the impact of hits on the hit surface **11***a*.

[0059] The membrane member **11** is formed into a membrane shape using a mesh material made by weaving synthetic fibers, but the material of the membrane member **11** may be any material that is harder (has a higher hardness) than the cushion **12**. Thus, for example, the membrane member **11** may be formed using a synthetic resin film. The cushion **12** is formed into a disc shape thicker than the membrane member **11**, and the diameters of the membrane member **11** and the cushion **12** are the same. In other words, the outer shapes (shapes in the front and rear direction view) of the membrane member **11** and the cushion **12** are identical to each other.

[0060] The cushion **12** is formed using polyurethane foam, which is a foamed synthetic resin. However, the cushion **12** may be formed using a resin such as rubber or elastomer (synthetic resin), or a foam material using such a resin (hereinafter referred to as an "elastic material") as long as it has a predetermined degree of flexibility.

[0061] The rear surface of the cushion **12** is supported by a supporting membrane **13**. The supporting membrane **13** is formed into a disc shape using a mesh of woven synthetic fibers or a synthetic resin film, and an annular frame **14** is fixed to the outer edge of the supporting membrane **13**. The frame **14** is formed using a resin material, and the supporting membrane **13** and the frame **14** are integrally formed by mold forming. Alternatively, the frame **14** may be formed using a material other than resin (for example, metals such as aluminum or iron) and joined to the supporting membrane **13** by adhesion or other means.

[0062] Multiple (in this embodiment, six) press-fit holes **14***a* are formed at equal intervals in the circumferential direction on the outer edge of the frame **14**. These press-fit holes **14***a* are holes into which the fixing parts **9** (refer to FIG. **6**) described later are fitted.

[0063] A disc-shaped cushion **15** formed using an elastic material is stacked on the rear surface of the supporting membrane **13**, and an attaching plate **16** is stacked on the rear surface of the cushion **15**. The attaching plate **16** is formed into a disc shape using resin or metal material, and a disc-shaped sensor **17** (piezoelectric element) is attached to the center of the attaching plate **16** using double-sided tape with cushioning properties.

[0064] Multiple press-fit holes **16***a* are formed on the outer edge of the attaching plate **16** in positions corresponding to the press-fit holes **14***a* of the frame **14**. The attachment **10** is

attached to the head **3** by the fixing parts **9** (refer to FIG. **6**) that are press-fitted into these press-fit holes **14***a* and **16***a*.

[0065] The attachment structure of this attachment **10** is described with reference to FIG. **6** and FIG. **7**. FIG. **6** is an exploded perspective view of the percussion instrument **1**, and FIG. **7** is a partially enlarged cross-sectional view of the percussion instrument **1**. It is noted that in FIG. **7**, a cross-section cut along a plane including the axis of the fixing parts **9** is illustrated.

[0066] As shown in FIG. **6**, the head **3** of the percussion instrument **1** is attached to the shell **2** by the hoop **5** and the attaching parts **6** as described above, and a through hole **3***a* is formed in the head **3** for fitting the membrane member **11** and the cushion **12** of the attachment **10**.

[0067] Multiple (in this embodiment, six) press-fit holes **3***b* are formed at equal intervals in the circumferential direction around the through hole **3***a*, and the fixing parts **9** are press-fitted into these press-fit holes **3***b*. The fixing parts **9** are pins made of elastomer or rubber.

[0068] Further, multiple (in this embodiment, six) plates **30** made of resin are joined to the rear surface of the head **3** to reinforce the area around the through hole **3***a*. The multiple plates **30** are formed by equally dividing an annular film in the circumferential direction. In other words, each of the multiple plates **30** is formed into a sector shape, and the through hole **3***a* is surrounded entirely by these multiple sector-shaped plates **30**. Press-fit holes **30***a* are formed in the plates **30** for press-fitting the fixing parts **9**.

[0069] As shown in FIG. **7**, the fixing parts **9** include a disc-shaped head portion **9***a* and a shaft portion **9***b* protruding in the thickness direction (toward the rear side) of the head portion **9***a*. The diameter of the head portion **9***a* is formed larger than the diameter of the press-fit hole **3***b* of the head **3**.

[0070] The shaft portion **9***b* is formed with a protrusion **9***c* for hooking the head **3** and the plate **30**, and a groove **9***d* for hooking the press-fit holes **14***a* and **16***a* of the frame **14** and the attaching plate **16**. The protrusion **9***c* is an annular protrusion extending in the circumferential direction of the shaft portion **9***b*. An interval corresponding to the membrane thickness of the head **3** and the plate **30** is formed between the head portion **9***a* and the protrusion **9***c*, and the outer diameter of the protrusion **9***c* is formed slightly larger than the diameter of the press-fit holes **3***b* and **30***a* of the head **3** and the plate **30**. Thus, by press-fitting the protrusion **9***c* into the press-fit holes **3***b* and **30***a*, the head **3** and the plate **30** are hooked between the head portion **9***a* and the protrusion **9***c*.

[0071] The groove **9***d* is an annular recess extending in the circumferential direction of the shaft portion **9***b*, and in the region where the groove **9***d* is formed, the diameter of the shaft portion **9***b* is formed to be the same as the inner diameter of the press-fit holes **14***a* and **16***a* of the frame **14** and the attaching plate **16**. Thus, by press-fitting the shaft portion **9***b* into the press-fit holes **14***a* and **16***a*, the frame **14** and the attaching plate **16** are hooked into the groove **9***d*. As a result, the attachment **10** is attached to the rear surface of the head **3** by the fixing parts **9**.

[0072] In this attached state of the attachment **10**, the supporting membrane **13**, the frame **14**, the cushion **15**, and the attaching plate **16** constitute a supporting body that supports the membrane member **11** and the cushion **12** on the rear surface side of the head **3**. Then, the membrane member **11** and the cushion **12**, which are interposed between this supporting body and the head **3**, are pressed against the peripheral edge portion of the through hole **3***a* of the head **3** via the plate **30**. This configuration improves the durability of the membrane member **11** and the cushion **12**.

[0073] The detailed configuration of this attachment **10** is described with reference to FIG. **8**. FIG. **8** is a partially enlarged cross-sectional view of the percussion instrument **1** showing the state where the hit surface **11***a* of the attachment **10** is hit by the beater **103** from the state shown in FIG. **4**.

[0074] As shown in FIG. **8**, the membrane member **11** (hit surface **11***a*) of the attachment **10** is hit by the beater **103** of the foot pedal **100**, and the impact at the time of this hitting is absorbed by the cushion **12**. Thus, the hitting sound generated when the membrane member **11** is hit may be reduced.

[0075] In the conventional technology of this type of percussion instrument **1** (for example, International Publication No. 2017/038226), in the case where the membrane member **11** is hit, deformation occurs such that the outer edge part of the cushion **12** expands (increases in thickness). As a result, there were problems such as peeling occurring in the adhesive part between the membrane member **11** and the cushion **12**, or cracks occurring on the outer peripheral surface of the cushion **12**.

[0076] In contrast, in this embodiment, in the front and rear direction, the outer edge parts of the membrane member **11** and cushion **12** are arranged to overlap with the peripheral edge portion of the through hole **3***a* of the head **3** (the hit surface **11***a* is formed by the part of the membrane member **11** located on the inner peripheral side of the through hole **3***a* of the head **3**). As a result, in the case where the membrane member **11** is hit by the beater **103**, the expansion deformation of the outer edge of the cushion **12** may be regulated by the head **3**. Thus, peeling in the adhesive part between the membrane member **11** and cushion **12**, or cracks occurring on the outer peripheral surface of the cushion **12** may be suppressed. Thus, the durability of the hit surface **11***a* (the hit body consisting of the membrane member **11** and the cushion **12**) may be improved.

[0077] Moreover, in the state where the attachment **10** is attached to the head **3**, the interval between the head **3** (plate **30**) and the supporting membrane **13** is formed to be smaller than the thickness of the membrane member **11** and the cushion **12**. Thus, in the state before the hit surface **11***a* is hit, the outer edge part of the cushion **12** is compressed by the head **3**. This effectively suppresses the expansion deformation of the outer edge part of the cushion **12**, thereby improving the durability of the membrane member **11** and the cushion **12**.

[0078] Further, since the outer edge part of the cushion **12** is compressed by the head **3**, the head **3** may be given the function of regulating the expansion of the outer edge of the cushion **12**, in addition to the function of attaching the attachment **10**.

[0079] Further, multiple plates **30** that are harder (have higher hardness) than the head **3** (membrane member **11**) are sandwiched between the head **3** and the membrane member **11**. These multiple plates **30** are arranged in an annular shape around the through hole **3***a*, so the expansion deformation of the outer edge of the cushion **12** may be uniformly regulated around the entire circumference of the cushion **12**. Thus, the durability of the membrane member **11** and cushion **12** may be improved. Furthermore, the compression amount of the cushion **12** may be adjusted by changing the thickness of the plates **30**.

[0080] Moreover, since multiple plates **30** are attached around the through hole **3***a* of the head **3**, the rigidity of the head **3** may be increased by the plates **30**. This may suppress damage to the head **3** that presses down on the membrane member **11** and the cushion **12**, and the expansion deformation of the outer edge of the cushion **12** may be effectively regulated by the head **3** and the plates **30**. Thus, the durability of the head **3**, the membrane member **11**, and the cushion **12** may be improved.

[0081] In this way, in the case of aiming to increase the rigidity around the through hole **3***a* by the plates **30**, for example, it is also possible to integrally form multiple plates **30** and attach one annular-shaped plate **30** around the through hole **3***a* of the head **3**. However, in such a configuration, the plate **30** is prone to bending, making it difficult to properly attach the plate **30** to the head **3**.

[0082] Further, in a configuration where one annular-shaped plate **30** is cut out from a resin plate as the material, the number of plates **30** that may be cut out from the resin plate decreases (all the resin plate cut out from the inner peripheral side of the annular-shaped plate **30** becomes waste material). Thus, the manufacturing cost of the plate **30** increases.

[0083] In contrast, in this embodiment, multiple (annular sector) plates **30** are arranged in an annular shape around the through hole **3***a*. As a result, compared to the case where the plate **30** is formed as one annular shape as described above, the bending of the plates **30** may be suppressed, so the plates **30** may be properly attached to the head **3**. Thus, the workability of the attaching operation of the plates **30** may be improved.

[0084] Furthermore, when cutting out multiple (annular sector) plates **30** from a resin plate as the material, compared to the case of cutting out one annular-shaped plate **30** as described above, a larger number of plates **30** may be cut out from the resin plate (the amount of resin plate that becomes waste material may be reduced). Thus, the manufacturing cost of the plates **30** may be reduced.

[0085] The vibration when the membrane member **11** (hit surface **11***a*) is hit is detected by the sensor **17** attached to the attaching plate **16**, and a musical sound signal based on the detection result is generated by a sound source (not shown). By outputting the musical sound signal generated by the sound source to an amplifier and speaker (both not shown), an electronic musical sound is emitted from the speaker.

[0086] In this way, in the case of detecting the hitting of the hit surface **11***a* with the sensor **17**, the conventional technology described above (for example, International Publication No. 2017/038226) has the following problems because there is no member that compresses the outer edge of the cushion **12** as in this embodiment.

[0087] Specifically, in a configuration where the outer edge of the cushion **12** is not compressed, compared to the central area of the cushion **12**, deformation is more likely to occur (the impact absorption capacity is larger) at the outer edge side of the cushion **12**. Thus, in the case where the outer peripheral side of the hit surface **11***a* (membrane member **11**) is hit, the output value of the sensor **17** tends to be smaller compared to the case where the central area of the hit surface **11***a* is hit. In other words, the sensitivity distribution of the sensor **17** to the hitting of the hit surface **11***a* becomes non-uniform.

[0088] When the sensitivity distribution of the sensor **17** is non-uniform, in the case of hitting the hit surface **11***a* with a twin-pedal type foot pedal **100**, different musical sounds (for example, sounds with different volumes) are likely to be generated when hit by the left and right beaters **103**. To resolve such a malfunction in musical sound generation, it is necessary to finely adjust the attaching position of the foot pedal **100** to the percussion instrument **1** in the left and right direction so that the center of the hit surface **11***a* (sensor **17**) is positioned between the left and right beaters **103**. Thus, there is a problem that the attaching operation of the foot pedal **100** required extra effort.

[0089] In contrast, in this embodiment, because the outer edge of the cushion **12** is compressed, the difference in ease of deformation (impact absorption capacity) between the central area and the outer edge side of the cushion **12** is less likely to occur. This allows for a uniform sensitivity distribution of the sensor **17** to the hitting of the hit surface **11***a* (membrane member **11**). Thus, for example, when using a twin-pedal type foot pedal **100**, even if the attaching position of the foot pedal **100** (hitting positions of the left and right beaters **103**) is offset to the left or right from the center of the hit surface **11***a*, appropriate musical sounds are more likely to be generated. In other words, there is no need to finely adjust the attaching position of the foot pedal **100** to the percussion instrument **1** in the left and right direction, thus making the attaching operation of the foot pedal **100** easier.

[0090] In this way, in the case of detecting the hitting of the membrane member **11** with the sensor **17** attached to the attaching plate **16**, it is possible to omit the cushion **15**, for example. In other words, the attachment **10** of this embodiment includes a membrane-like supporting membrane **13** that overlaps the rear surface side of the cushion **12**, and a frame **14** connected to the outer edge of the supporting membrane **13**, and the attaching plate **16** is attached to this frame **14**. Thus, for example, even in the case where the cushion **15** is omitted, the vibration when the membrane member **11** is hit may be transmitted to the sensor **17** through the cushion **12**, the supporting membrane **13**, the frame **14**, and the attaching plate **16**.

[0091] However, in the case where the cushion **15** is omitted, in the case where the attaching plate **16** itself vibrates due to vibrations transmitted from the frame **14**, it is not possible to attenuate the vibration of the attaching plate **16** at an early stage. In the case where the attenuation of the vibration of the attaching plate **16** is slow, there is a possibility that the vibration may be erroneously detected by the sensor **17**, making it unable to accurately detect the hitting of the membrane member **11** by the sensor **17**.

[0092] In contrast, in this embodiment, by having the cushion **15** sandwiched between the supporting membrane **13** and the attaching plate **16**, the vibration of the attaching plate **16** may be attenuated at an early stage by the cushion **15**. As a result, the hitting of the membrane member **11** may be accurately detected by the sensor **17**.

[0093] In this way, while the cushion **15** is required to have the function of absorbing the vibration of the attaching plate **16**, the cushion **12** needs to have not only the function of absorbing the impact during the hitting of the membrane member **11** but also the function of providing the hitting feel (similar to that of an acoustic drum) during the hitting of the membrane member **11**. Thus, in this embodiment, the cushion **12** is formed using a foam material with a higher density (higher hardness) than the cushion **15**. As a result, while absorbing the impact during the hitting of the membrane

member **11** by the cushion **12**, the hitting feel during the hitting of the membrane member **11** may be improved.

[0094] On the other hand, since the hitting feel during the hitting of the membrane member **11** may be generally ensured by the cushion **12** and the supporting membrane **13**, the cushion **15** is not required to have the function of providing the hitting feel, but mainly only the function of attenuating the vibration of the attaching plate **16**. Thus, by forming the cushion **15** from a low-density foam material, it is possible to reduce the cost (and weight) of the cushion **15** while providing the necessary function (attenuating the vibration of the attaching plate **16**) to the cushion **15**.

[0095] Further, because the sensor **17** is sandwiched between the cushion **15** and the attaching plate **16**, the sensitivity of the sensor **17** to the hitting of the membrane member **11** may be improved (the maximum value of the sensor **17** output may be increased) compared to the case where the sensor **17** is attached to the rear surface of the attaching plate **16**. This is considered to be because a part of the vibration during the hitting of the membrane member **11** is transmitted to the sensor **17** through the cushion **12**, the supporting membrane **13**, and the cushion **15**. As a result, the hitting of the membrane member **11** may be accurately detected by the sensor **17**.

[0096] In this case, the direction of hitting by the beater **103** is often in a downward inclined direction towards the rear lower side of the percussion instrument **1** (direction towards the lower left in FIG. **8**), and when the membrane member **11** is hit in such a direction, the membrane member **11** and the cushion **12** are pushed down (pulled) downward. For this reason, if the overlap amount La between the membrane member **11** and the head **3** on the upper end side is small, the outer edge of the membrane member **11** and the cushion **12** tends to be exposed (protrude) to the inner peripheral side of the through hole **3***a* of the head **3** during the hitting by the beater **103**.

[0097] In contrast, this embodiment has a configuration that may suppress such exposure of the membrane member **11** and the cushion **12**. This configuration is described with reference back to FIG. **5**. It is noted that in FIG. **5**, a circle corresponding to the through hole **3***a* of the head **3** is illustrated by a two-dot chain line.

[0098] As shown in FIG. **5**, the radial dimension of the membrane member **11** and the cushion **12** with respect to the center C**2** of the through hole **3***a* is formed to be the largest in the region R on the upper end side of the membrane member **11** and the cushion **12**. In other words, the overlap amount La between the head **3** and the membrane member **11** (cushion **12**) in the region R including the upper edge of the membrane member **11** is formed to be larger than the overlap amount Lb in other regions. These overlap amounts La and Lb indicate the range where the peripheral edge portion of the through hole **3***a* of the head **3** overlaps with the membrane member **11** and the cushion **12** in the front and rear direction view (thickness direction view of the membrane member **11**).

[0099] By increasing the overlap amount La with the head **3** in the region R including the upper edge of the membrane member **11** (cushion **12**) in this way, even if the membrane member **11** and the cushion **12** are pushed down by the hitting of the beater **103** (refer to FIG. **8**), the exposure (protrusion) of the outer edge of the membrane member **11** and the cushion **12** to the inner peripheral side of the through hole **3***a* may be suppressed. By suppressing such exposure of the membrane member **11** and the cushion **12**, interference with the performance of the percussion instrument **1** may be suppressed (for example, the operation of reattaching the attachment **10** to the head **3** may be eliminated).

[0100] It is noted that the dimension of the overlap amount La between the head **3** and the membrane member **11** (cushion **12**), and the range in the circumferential direction of the region R where the overlap amount La is relatively large, may be appropriately set to the extent that the membrane member **11** and the cushion **12** do not expose to the inner peripheral side of the through hole **3***a* during the hitting by the beater **103**.

[0101] Next, with reference to FIG. **9**A and **9**B, the percussion instruments **201** and **301** of the second and third embodiments are described. In the aforementioned first embodiment, a case where bent portions **21***c* are formed on both left and right ends of the hanging portion **21***b* of the lifter **20** is described. In the second and third embodiments, cases where bent portions **221***c* and **321***c* are formed on both upper and lower end sides of the hanging portions **221***b* and **321***b* are described. It is noted that the same parts as those in the above-mentioned first embodiment are denoted by the same reference numerals, and the description thereof is omitted.

[0102] FIG. **9**A is a partially enlarged front view of the percussion instrument **201** of the second embodiment, and FIG. **9**B is a partially enlarged front view of the percussion instrument **301** of the third embodiment.

[0103] As shown in FIG. **9**A, the lifter **220** of the percussion instrument **201** of the second embodiment includes a fixing member **221** fixed to the shell **2** (refer to FIG. **1**), and an attaching member **222** attached to the fixing member **221**. Each of the fixing member **221** and the attaching member **222** (lifter **220**) has a left-right symmetrical shape.

[0104] The hanging portion **221***b* of the fixing member **221** has the same configuration as the hanging portion **21***b* (refer to FIG. **3**) of the first embodiment, except that both left and right ends (for example, the left end in FIG. **9**A) are extended to incline downward toward the left and right direction outer side.

[0105] From the lower end portion of the hanging portion **221***b* positioned on the left and right direction outer side of the attaching portion **22***a*, the bent portion **221***c* is bent toward the front side. An elongated hole **221***c***1** extending in the front and rear direction is formed in the bent portion **221***c*, and a bolt **24** is inserted from above into this elongated hole **221***c***1**.

[0106] The attaching member **222** has the same configuration as the attaching member **22** (refer to FIG. **3**) of the first embodiment, except that both left and right ends of the attaching portion **22***a* (for example, the left end in FIG. **9**A) are extended in the left and right direction outer side to form the fastening portion **222***b*. A female screw hole **222***b***1** is formed in the fastening portion **222***b*, and the attaching member **222** is fixed to the fixing member **221** by fastening the bolt **24** inserted into the elongated hole **221***c***1** of the fixing member **221** to the female screw hole **222***b***1**.

[0107] In this embodiment as well, the fastening portions **222***b* are provided on two sides in the left and right direction of the attaching portion **22***a* to which the clamp **104** (foot pedal **100**) is attached, and these fastening portions **222***b* are fastened to the fixing member **221** (bent portion **221***c*) by the bolts **24**. As a result, even in the state where the percussion instrument **201** is installed on the installation surface G, the

fastening operation of the bolts **24** may be performed utilizing the relatively wide space S formed on both left and right sides of the attaching portion **22***a* (between the bent portion **221***c* and the hoop **5**). In other words, the relative position between the percussion instrument **201** and the foot pedal **100** may be easily adjusted without inverting the percussion instrument **201** upside down.

[0108] Further, the fastening surfaces between the bent portion **221***c* and the fastening portion **222***b* extend in the horizontal direction as flat surfaces, and although not shown in the figure, the left and right pair of bolts **24** fasten the fastening portion **222***b* at positions where their central axes do not coincide. As a result, even if vibrations from the foot pedal **100** being stepped act on the attaching member **222**, rotation of the attaching member **222** around the bolts **24** as an axis may be suppressed. Thus, the relative position between the percussion instrument **201** and the foot pedal **100** may be prevented from shifting during performance, thus improving the playability of the percussion instrument **201**. Further, since the attaching member **222** does not rotate around the bolts **24** as an axis, loosening of the bolts **24** may be suppressed. Thus, as it becomes difficult for rattling to occur between the fixing member **221** and the attaching member **222**, the playability of the percussion instrument **201** may be improved.

[0109] As shown in FIG. **9**B, the lifter **320** of the percussion instrument **301** of the third embodiment includes a fixing member **321** fixed to the shell **2** (refer to FIG. **1**), and an attaching member **322** attached to the fixing member **321**. Each of the fixing member **321** and the attaching member **322** (lifter **320**) has a left-right symmetrical shape.

[0110] The hanging portion **321***b* of the fixing member **321** has the same configuration as the hanging portion **21***b* (refer to FIG. **3**) of the first embodiment, except that both left and right ends (for example, the left end in FIG. **9**B) are extended in the left and right direction outer side.

[0111] From the upper end portion of the hanging portion **321***b* positioned on the left and right direction outer side of the attaching portion **22***a,* the bent portion **321***c* is bent toward the front side. A female screw hole **321***c***1** is formed in the bent portion **321***c,* and the bolt **24** is fastened from below to this female screw hole **321***c***1**.

[0112] The attaching member **322** has the same configuration as the attaching member **22** (refer to FIG. **3**) of the first embodiment, except that it includes bent portions **322***d* that bend upward from both left and right ends of the attaching portion **22***a* (for example, the left end in FIG. **9**A), and fastening portions **322***b* that bend in the left and right direction outer side from the upper end of the bent portions **322***d.*

[0113] An elongated hole **322***b***1** extending in the front and rear direction is formed in the fastening portion **322***b,* and the attaching member **322** is fixed to the fixing member **321** by fastening the bolt **24** inserted into this elongated hole **322***b***1** to the female screw hole **321***c***1** of the fixing member **321**.

[0114] In this embodiment as well, the fastening portions **322***b* are provided on two sides in the left and right direction of the attaching portion **22***a* to which the clamp **104** (foot pedal **100**) is attached, and these fastening portions **322***b* are fastened to the fixing member **321** (bent portion **321***c*) by the bolts **24**. As a result, even in the state where the percussion instrument **301** is installed on the installation surface G, the fastening operation of the bolts **24** may be performed utilizing the relatively wide space S formed on both left and right sides of the attaching portion **22***a* (between the fastening portion **322***b* and the installation surface G). In other words, the relative position between the percussion instrument **301** and the foot pedal **100** may be easily adjusted without inverting the percussion instrument **301** upside down.

[0115] Further, the fastening surfaces between the bent portion **321***c* and the fastening portion **322***b* extend in the horizontal direction as flat surfaces, and although not shown in the figure, the left and right pair of bolts **24** fasten the fastening portion **322***b* at positions where their central axes do not coincide. As a result, even if vibrations from the foot pedal **100** being stepped act on the attaching member **322**, rotation of the attaching member **322** around the bolts **24** as an axis may be suppressed. Thus, the relative position between the percussion instrument **301** and the foot pedal **100** may be prevented from shifting during performance, thus improving the playability of the percussion instrument **301**. Further, since the attaching member **322** does not rotate around the bolts **24** as an axis, loosening of the bolts **24** may be suppressed. Thus, as it becomes difficult for rattling to occur between the fixing member **321** and the attaching member **322**, the playability of the percussion instrument **301** may be improved.

[0116] Next, referring to FIG. **10** and FIG. **11**, the percussion instrument **401** of the fourth embodiment is described. In the aforementioned first embodiment, a case where the outer edge part of the membrane member **11** and the cushion **12** (hit surface **11***a*) of the attachment **10** is compressed by the head **3** and the plate **30** is described. In contrast, in the fourth embodiment, a case where the outer edge part of the membrane member **11** and the cushion **12** (hit surface **11***a*) is compressed by the head **3** and an annular member **440** is described.

[0117] FIG. **10** is an exploded perspective view of the percussion instrument **401** according to the fourth embodiment, and FIG. **11** is a partially enlarged cross-sectional view of the percussion instrument **401**. It is noted that in FIG. **11**, a cross-section cut along a plane including the axis of the fixing parts **9** is illustrated, and the illustration of the attaching parts **6** (refer to FIG. **10**) is omitted.

[0118] As shown in FIG. **10** and FIG. **11**, the percussion instrument **401** of the fourth embodiment has the same configuration as the percussion instrument **1** of the first embodiment, except that an annular member **440** is provided instead of the plate **30** (refer to FIG. **6**). Thus, similar to the first embodiment, the head **3** of the percussion instrument **401** is attached to the shell **2** by the hoop **5** and the attaching parts **6**, and the attachment **10** is attached to the head **3** by the fixing parts **9** which are press-fitted into the press-fit hole **3***b* of the head **3**.

[0119] In the state where the attachment **10** is attached to the head **3**, the annular member **440** is sandwiched between the head **3** and the attachment **10**. The inner diameter of the annular member **440** is formed to be smaller than the diameter of the through hole **3***a* of the head **3**, while the outer diameter of the annular member **440** is formed to be larger than the diameter of the through hole **3***a.*

[0120] As shown in FIG. **11**, the annular member **440** includes an outer peripheral portion **441** that overlaps the front surface of the supporting membrane **13** on the outer peripheral side of the cushion **12**. The outer diameter of the outer peripheral portion **441** (annular member **440**) is

formed to be the same as (or slightly smaller than) the inner diameter of the frame **14**. The outer peripheral portion **441** extends forward from the supporting membrane **13** toward the head **3**, and from the front end of the outer peripheral portion **441**, a bent portion **442** is bent toward the inner peripheral side of the annular member **440**. The bent portion **442** is a portion that extends approximately parallel to the head **3**, and from the inner edge of the bent portion **442**, an inclined portion **443** extends toward the inner peripheral side of the annular member **440**.

[0121] The inclined portion **443** is inclined away from the supporting membrane **13** toward the inner peripheral side of the annular member **440**, and the portion on the inner edge side of the inclined portion **443** protrudes to the front surface side of the head **3** through the through hole **3***a*. From the inner edge of the inclined portion **443**, a protruding portion **444** protrudes toward the front side, and these parts **441** to **444** constituting the annular member **440** are integrally formed using a resin material.

[0122] In the state where the attachment **10** is attached to the head **3**, the outer edge part of the cushion **12** is compressed by the head **3** and the annular member **440**. The annular member **440** is formed annularly using a material harder than the head **3** (membrane member **11**), so it may uniformly regulate the expansion deformation of the outer edge of the cushion **12** around its entire circumference. Thus, the durability of the membrane member **11** and cushion **12** may be improved.

[0123] Further, the annular member **440** is formed with an inclined portion **443** that is inclined away from the supporting membrane **13** toward its inner peripheral side, and this inclined portion **443** presses down on the outer edge part of the membrane member **11** and the cushion **12**. As a result, the compression amount of the cushion **12** by the annular member **440** (inclined portion **443**) may be made larger at the outer edge side of the cushion **12** while gradually decreasing toward the inner peripheral side of the cushion **12**.

[0124] Thus, in the region on the outer edge side of the cushion **12**, the expansion deformation of the cushion **12** may be effectively suppressed, while the compression amount of the cushion **12** may be reduced in the area further inward. In the region where the compression amount of the cushion **12** is small, the elastic force of the cushion **12** is less likely to weaken, thus improving the durability of the cushion **12**.

[0125] The above description has been given based on the above embodiment, but the disclosure is not limited to the above embodiments, and it may be easily inferred that various improvements and modifications are possible within the range that does not deviate from the spirit of the disclosure.

[0126] In the above embodiments, the cases where the percussion instruments **1**, **201**, **301**, and **401** include a sensor **17** and are electronic percussion instruments (electronic drums) are described, but the disclosure is not necessarily limited thereto. For example, the percussion instruments **1**, **201**, **301**, and **401** may be percussion instruments that do not include a sensor **17**. Further, in the above embodiments, the structure of the lifters **20**, **220**, and **320** in the percussion instruments **1**, **201**, **301**, and **401** where the attachment **10** is attached to the head **3** is described, but such structure of the lifters **20**, **220**, and **320** may also be applied to acoustic bass drums.

[0127] In the above embodiments, the case where the lifters **20**, **220**, and **320** (fixing members **21**, **221**, and **321**) are fixed to the outer peripheral surface of the shell **2** is described, but the disclosure is not necessarily limited thereto. For example, the lifters **20**, **220**, and **320** may be fixed to the hoop **5**. In other words, the fixing position of the lifters **20**, **220**, and **320** relative to the percussion instruments **1**, **201**, **301**, and **401** (housing) may be changed as appropriate.

[0128] In the above embodiments, the case where the shape of the lifters **20**, **220**, and **320** is symmetrical in the left and right direction is described, but the disclosure is not necessarily limited thereto. For example, the shape of the lifters **20**, **220**, and **320** may be asymmetrical in the left and right direction, and the specific shape of the lifters **20**, **220**, and **320** is not limited to the above-mentioned forms. In other words, as long as the configuration allows the fastening portions **22***b*, **222***b*, and **322***b* to be provided on both sides of the attaching portion **22***a* in the left and right direction, and the fastening portions **22***b*, **222***b*, and **322***b* may be fastened at positions where the center axes of the left and right bolts **24** do not coincide, the shape of the lifters **20**, **220**, and **320** may be changed as appropriate.

[0129] In the above embodiments, the case where each part of the fixing members **21**, **221**, and **321** or the attaching members **22**, **222**, and **322** is integrally formed by bending a metal plate is described, but a part of the fixing members **21**, **221**, and **321** or the attaching members **22**, **222**, and **322** may be formed separately from other parts.

[0130] In the above embodiments, the case where the membrane member **11** and the cushion **12** (i.e., the hit body forming the hit surface **11***a*) are disc-shaped is described, but the disclosure is not necessarily limited thereto. The membrane member **11** and the cushion **12** may be polygonal (for example, rectangular), and in this case, the shape of the through hole **3***a* of the head **3**, the supporting body (such as the supporting membrane **13**, frame **14**, cushion **15**, and attaching plate **16**), and the annular member **440** may be formed in a shape corresponding to the membrane member **11** and the cushion **12**.

[0131] In the above embodiments, the case where the outer edge part of the cushion **12** is compressed by the head **3** (plate **30** and annular member **440**) in the state before the hit surface **11***a* is hit is described, but the disclosure is not necessarily limited thereto. For example, in the state before the hit surface **11***a* is hit, as long as the configuration is such that the head **3** (plate **30** and annular member **440**) is in contact with at least the membrane member **11**, the expansion deformation of the outer edge of the cushion **12** may be regulated by the head **3** (plate **30** and annular member **440**).

[0132] In the above embodiments, the case where the plate **30** or the annular member **440**, which is harder than the head **3** (membrane member **11**), is provided between the head **3** and the membrane member **11** is described, but the disclosure is not necessarily limited thereto. For example, the plate **30** and the annular member **440** may be omitted, or a configuration using both the plate **30** and the annular member **440** (with the plate **30** interposed between the head **3** and the annular member **440**) may be employed. Further, the plate **30** may be attached to the front surface of the head **3**.

[0133] In the above embodiments, the configuration where the attachment **10** is attached to the head **3**, that is, the configuration where the expansion deformation of the outer

edge part of the cushion **12** is regulated by the head **3** is described, but the disclosure is not necessarily limited thereto.

[0134] For example, a member equivalent to the annular member **440** (one that may hold down the outer edge of the membrane member **11** and the cushion **12**) may be attached to the frame **14**, or may be integrally formed with the frame **14**. In such a configuration, while enabling the use of the attachment **10** itself as a percussion instrument when detached from the head **3** (or the use of the attachment **10** with the sensor **17** removed as a practice pad), the expansion deformation of the outer edge of the cushion **12** may be regulated by the member equivalent to the annular member **440**.

[0135] In the above embodiments, the case where multiple (annular sector) plates **30** are arranged in an annular shape, or the case where the annular member **440** is formed in an annular shape is described, but the disclosure is not necessarily limited thereto. For example, multiple plates **30** may be integrally formed into one annular-shaped plate **30**, or the annular member **440** may be divided into multiple parts in the circumferential direction.

[0136] Further, the shape of the multiple plates **30** or the annular member **440** is not limited to an annular shape, and the shape of the plates **30** or the annular member **440** may be appropriately changed as long as it may surround the through hole **3***a*. Thus, for example, a configuration where one annular plate **30** is formed (or divided into multiple parts) by cutting out the center of a polygonal (e.g., rectangular) resin plate in a circular shape, or a configuration where rectangular plates **30** are arranged in an annular shape, may be employed.

[0137] In the above embodiments, the case where the cushion **15** is sandwiched between the supporting membrane **13** and the attaching plate **16**, or the case where the sensor **17** is sandwiched between the cushion **15** and the attaching plate **16** is described, but the disclosure is not necessarily limited thereto. For example, the cushion **15** may be omitted, or the sensor **17** may be attached to the rear surface of the attaching plate **16**.

[0138] In the above embodiments, the case where the cushion **12** is formed using a foam material with a higher density than the cushion **15** is described, but the disclosure is not necessarily limited thereto. For example, the density of cushions **12** and **15** may be the same, or the cushion **12** may be formed using a foam material with a lower density than the cushion **15**.

[0139] In the above embodiments, the case where the overlap amount La between the head **3** and the region R including the upper edge of the membrane member **11** is formed larger than the overlap amount Lb between the head **3** and other regions is described, but the disclosure is not necessarily limited thereto. For example, the overlap amount La in the region R including the upper edge of the membrane member **11** may be smaller than the overlap amount Lb in other regions, or these overlap amounts La and Lb may be of the same dimension.

[0140] In the first embodiment described above, the case where the left and right fastening surfaces of the lifter **20** are fastened by one bolt **24** each is described, but the disclosure is not necessarily limited thereto. For example, the left and right fastening surfaces may be fastened by multiple bolts **24** each.

[0141] In the first embodiment described above, the case where the bent portion **21***c* and the fastening portion **22***b* are fastened by the bolt **24** on the upper side of the center C**1** in the up and down direction of the left and right fastening surfaces of the lifter **20** is described, but the disclosure is not necessarily limited thereto. For example, the bolt **24** may be provided at the center C**1** in the up and down direction of the fastening surface or on the lower side thereof.

[0142] In the first embodiment described above, the case where the bent portion **21***c* (fixing member **21**) is fastened to the inner side in the left and right direction of the fastening portion **22***b* is described, but the disclosure is not necessarily limited thereto. For example, the fastening portion **22***b* (attaching member **22**) may be fastened to the inner side in the left and right direction of the bent portion **21***c*. In this case, by forming the elongated hole **22***b***1** (refer to FIG. **2**) in the bent portion **21***c* while forming the female screw hole **21***c***1** (refer to FIG. **2**) in the fastening portion **22***b*, it is possible to fasten the bolt **24** from the lateral side of the bent portion **21***c* and the fastening portion **22***b*, while allowing adjustment of the fixed position of the attaching member **22** relative to the fixing member **21** in the front and rear direction.

What is claimed is:

1. A percussion instrument, comprising:

a first cushion; a membrane-like membrane member joined to a front surface of the first cushion to form a hit surface; and a regulation device configured at a position overlapping with outer edges of the first cushion and the membrane member in a thickness direction of the membrane member,

wherein when the membrane member is hit, the regulation device regulates deformation that increases a thickness of an outer edge of the first cushion.

2. The percussion instrument according to claim **1**, wherein in a state before the hit surface is hit, an outer edge part of the first cushion is compressed by the regulation device.

3. The percussion instrument according to claim **1**, further comprising: a cylindrical body portion; a head covering an opening of the body portion and in which a through hole is formed; and a supporting body attached to a rear surface side of the head and supporting the membrane member and the first cushion in a region where the through hole is formed,

wherein a peripheral edge portion of the through hole of the head is configured as the regulation device.

4. The percussion instrument according to claim **3**, further comprising an annular hard body sandwiched between the membrane member and the head, and the hard body being formed harder than the head.

5. The percussion instrument according to claim **4**, wherein the hard body is a plate attached to a peripheral edge portion of the through hole of the head.

6. The percussion instrument according to claim **3**, wherein the supporting body comprises: a supporting membrane supporting a rear surface of the first cushion; an annular frame connected to an outer edge of the supporting membrane and attached to a rear surface of the head; an attaching plate overlapped on a rear surface side of the frame and to which a sensor is attached; and a second cushion sandwiched between the attaching plate and the supporting membrane.

7. The percussion instrument according to claim 6, wherein the sensor is sandwiched between the attaching plate and the second cushion.

8. The percussion instrument according to claim 6, wherein the first cushion is harder than the second cushion.

9. The percussion instrument according to claim 1, wherein the percussion instrument is a bass drum in which the hit surface is hit by a beater of a foot pedal, and

an overlap amount between the membrane member and the regulation device in a region including an upper edge of the membrane member is formed larger than an overlap amount between the membrane member and the regulation device in other regions.

10. The percussion instrument according to claim 1, wherein a material of the membrane member is harder than the cushion.

11. A formation method of hit surface in a percussion instrument, the percussion instrument comprising: a first cushion; a membrane-like membrane member joined to a front surface of the first cushion; and a regulation device configured at a position overlapping with outer edges of the first cushion and the membrane member in a thickness direction of the membrane member, the formation method of hit surface comprising:

forming a hit surface by a part of the membrane member located on an inner peripheral side of the regulation device.

12. The formation method of hit surface according to claim 11, wherein in a state before the hit surface is hit, an outer edge part of the first cushion is compressed by the regulation device.

13. The formation method of hit surface according to claim 11, further comprising: a cylindrical body portion; a head covering an opening of the body portion and in which a through hole is formed; and a supporting body attached to a rear surface side of the head and supporting the membrane member and the first cushion in a region where the through hole is formed,

wherein a peripheral edge portion of the through hole of the head is configured as the regulation device.

14. The formation method of hit surface according to claim 13, further comprising an annular hard body sandwiched between the membrane member and the head, and the hard body being formed harder than the head.

15. The formation method of hit surface according to claim 14, wherein the hard body is a plate attached to a peripheral edge portion of the through hole of the head.

16. The formation method of hit surface according to claim 13, wherein the supporting body comprises: a supporting membrane supporting a rear surface of the first cushion; an annular frame connected to an outer edge of the supporting membrane and attached to a rear surface of the head; an attaching plate overlapped on a rear surface side of the frame and to which a sensor is attached; and a second cushion sandwiched between the attaching plate and the supporting membrane.

17. The formation method of hit surface according to claim 16, wherein the sensor is sandwiched between the attaching plate and the second cushion.

18. The formation method of hit surface according to claim 16, wherein the first cushion is harder than the second cushion.

19. The formation method of hit surface according to claim 11, wherein the percussion instrument is a bass drum in which the hit surface is hit by a beater of a foot pedal, and

an overlap amount between the membrane member and the regulation device in a region including an upper edge of the membrane member is formed larger than an overlap amount between the membrane member and the regulation device in other regions.

20. The formation method of hit surface according to claim 11, wherein a material of the membrane member is harder than the cushion.

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