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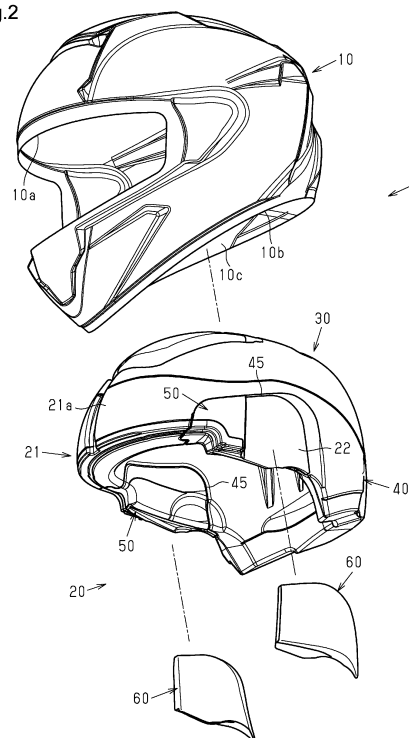
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(54) **HELMET AND METHOD FOR MANUFACTURING HELMET**

(57) A helmet (1) comprises a helmet body (10) and a shock absorbing material (20) which is disposed inside the helmet body (10). The shock absorbing material (20) comprises: a main body (21) which has a hemispherical shape and which has, on an outer surface (21a) of the main body (21), an insertion recess (22) that defines, between the outer surface (21a) of the main body (21) and an inner surface (10c) of the helmet body (10), an insertion space (10d) opening toward an insertion opening (10b) of the helmet body (10); and an insertion member (60) which is press-fitted into the insertion space (10d).

Fig.2



Description

TECHNICAL FIELD

[0001] The present disclosure relates to a helmet and a method for manufacturing a helmet.

BACKGROUND ART

[0002] A motorcycle helmet includes an impact absorber at the inner side of a helmet shell. For example, Patent Document 1 describes a liner made of resin foam as an example of an impact absorber. The liner has a hemispherical shape in conformance with the inner surface of the helmet shell and is configured to cover the entire head of a wearer. The liner protects the head of the wearer by absorbing impact applied to the helmet.

CITATION LIST

Patent Literature

[0003] Patent Literature 1: Japanese Laid-Open Patent Publication No. 2019-85663

SUMMARY OF INVENTION

Technical Problem

[0004] The lateral dimension of the inner surface of the helmet shell gradually increases from a location covering the top of the head of the wearer toward a location covering the sides of the head and then decreases from the location covering the side of the head toward a fitting opening into which the head of the wearer is fitted. Thus, when attaching the liner to the inner side of the helmet shell, the liner needs to be deformed to be reduced in size in the lateral direction so that the portion of the liner having the maximum dimension in the lateral direction can enter the fitting opening. As a result, the shape of the inner surface of the helmet shell will not match the shape of the outer surface of the liner, and the deformation of the liner will form a gap between the inner surface of the helmet shell and the outer surface of the liner.

[0005] In addition, if a portion that interferes with the liner when the liner is attached to the helmet shell is cut away or if the lateral width of the liner is reduced, a gap may be formed between the inner surface of the helmet shell and the outer surface of the liner. Further, if the thickness of the helmet shell is not constant or the inner surface of the helmet shell is uneven because of steps or inner projections used to attach parts, gaps may be formed between the inner surface of the helmet shell and the outer surface of the liner.

[0006] When a gap is formed between the inner surface of the helmet shell and the outer surface of the liner, the area of contact will be reduced between the helmet shell and the liner. This will lower the impact absorbing

capability of the liner. Thus, in the related art, the helmet shell or the liner is increased in thickness to ensure that the impact absorbing capability is sufficient even when a gap is formed between the helmet shell and the liner. However, when the thickness of the helmet shell or the liner is increased, the helmet will be increased in weight and the helmet shell will be enlarged thereby increasing the air resistance. This will increase the load on the wearer. The direction in which the liner is deformed so that the liner can enter the helmet shell from the fitting opening of the helmet shell is not limited to the lateral direction. In other words, a gap between the inner surface of the helmet shell and the outer surface of the liner such as that described above may be formed in a direction other than the lateral direction.

Solution to Problem

[0007] In one aspect of the present disclosure, a helmet includes a helmet shell and an impact absorber arranged at an inner side of the helmet shell. The impact absorber includes: a hemispherical main body including an insertion recess in an outer surface of the main body, the insertion recess defining an insertion space between the outer surface of the main body and an inner surface of the helmet shell, the insertion space being open toward a fitting opening of the helmet shell; and an inserted member that is press-fitted into the insertion space.

[0008] With the above structure, the inserted member is press-fitted into the insertion space so that the inserted member fills the insertion space, formed by the outer surface of the main body and the inner surface of the helmet shell. Thus, contact between the helmet shell and the impact absorber is increased. This improves the impact absorbing capability of the impact absorber.

[0009] In the above helmet, preferably, the main body includes the insertion recess at a location covering a side of a head of a wearer. The lateral dimension of the inner surface of the helmet shell is the maximum at the location covering the sides of the head of the wearer. In this case, the lateral dimension of the outer surface of the impact absorber also needs to be the maximum at the location covering the sides of the head of the wearer. However, when attaching the impact absorber to the inner side of the helmet shell, the impact absorber will have to be deformed to reduce the maximum dimension as described above. Thus, contact between the helmet shell and the impact absorber will be decreased at the location covering the sides of the head of the wearer. With respect to this, after the main body is attached to the inner side of the helmet shell, the inserted member is press-fitted into the insertion space defined at locations corresponding to the sides of the head of the wearer thereby effectively increasing the contact between the impact absorber and the helmet shell. This improves the impact absorbing capability of the impact absorber.

[0010] In the above helmet, preferably, the main body and the inserted member are molded products of the

same resin foam, and a portion of the main body where the insertion space is defined has an expansion ratio equal to that of the inserted member. With the above structure, the portion of the main body where the insertion space is defined has the expansion ratio equal to that of the inserted member. This allows an impact applied to the helmet to be uniformly dispersed and absorbed by the entire impact absorber. Accordingly, the impact absorbing capability of the impact absorber is further improved.

[0011] In the above helmet, preferably, the inserted member has a thickness of 3 mm or greater and 30 mm or less. With the above structure, the thickness of the inserted member is 3 mm or greater to increase the mechanical strength of the inserted member. This avoids breakage of the inserted member when the inserted member is press-fitted into the insertion space. Further, the thickness of the inserted member is 30 mm or less so that the inserted member can be readily press-fitted into the insertion space.

[0012] In the above helmet, preferably, the inserted member is removable from the insertion space. With the above structure, since the inserted member is removable from the insertion space, when the impact absorber attached to the helmet shell is removed, the main body can be readily taken out of the fitting opening by first removing the press-fitted inserted member from the insertion space and then removing the main body.

[0013] In the above helmet, preferably, the main body includes: a first member located at a position corresponding to a top of a head; a second member having an annular shape and arranged entirely around the head at a lower side of the first member; two third members located at positions corresponding to right and left sides of the head at a lower side of the second member; two fourth members located at positions corresponding to right and left cheeks of the head at lower sides of the third members; and a fifth member located at a position corresponding to a mouth and a chin of the head and connecting ends of the fourth members, each of the third members is a member defining the insertion space that receives the inserted member between the inner surface of the helmet shell and an outer surface of the third member, and the impact absorber includes a total of nine components. With the above structure, the nine components can be each made of a foamed material having density suitable for the corresponding locations.

[0014] In the above helmet, preferably, among the total of nine components, the first member has a density that is the lowest and the second member has a density that is second to the lowest. With the above structure, the first member absorbs impact directly applied to the second member. The first member further absorbs impact, through the second member, applied to any one or more of the third members, the inserted member, the fourth members, and the fifth member.

[0015] In the above helmet, preferably, the second member has a density lower than that of the third mem-

bers and lower than or equal to that of the inserted member. With the above structure, the third members and the inserted member are harder than the second member to protect the temples from impact. Impact applied to the third members is absorbed by the second member and the first member.

[0016] In the above helmet, preferably, the third members have a density higher than or equal to that of the inserted member. With the above structure, impact applied to the helmet is dispersed and absorbed by the third members and the inserted member. Further, the inserted member is press-fitted into the insertion recess.

[0017] In the above helmet, preferably, the third members have a density lower than or equal to that of the fourth members, and the inserted member has a density lower than that of the fourth members. With the above structure, the fourth members that protect the cheeks are harder than the third members and the inserted members to protect the cheeks from impact. Further, impact applied to the fourth members is dispersed and absorbed by the third members, the inserted members, the second member, and the first member.

[0018] In the above helmet, preferably, the fifth member has a density higher than or equal to that of the fourth members, and the density of the fifth member is the highest. With the above structure, the fifth member is the hardest in a liner and protects the mouth and the chin. Impact applied to the fifth member is dispersed and absorbed by the fourth members, the third members, the inserted members, the second member, and the first member.

[0019] In the above helmet, preferably, the second member has a vertical width between the first member and the third members that is less than a vertical width of other regions. With the above structure, in the second member, the upper side of the recess to which the third member is attached is narrow so that impact from the third member and the inserted member is readily transmitted to holes of the first member.

[0020] Preferably, in the second member, a vertical width of a portion corresponding to a back of the head is greater than a vertical width between the first member and the third members and a vertical width of a portion corresponding to a front of the head.

[0021] In the above helmet, preferably, at least one of the first member, the second member, the third members, the fourth members, the fifth member, and the inserted member includes a blind hole. With the above structure, the member of the main body effectively absorbs impact with the blind hole.

[0022] In the above helmet, preferably, the blind hole includes: a hole extending through one member selected from a group of components consisting of the first member, the second member, the third members, the fourth members, the fifth member, and the inserted member, the hole including a first end in an outer surface of the one member and a second end in a first abutting surface of the one member, the first abutting surface abutting a second abutting surface of another member selected

from the group or components to abut the one member; and a closing portion included in the second abutting surface and closing the second end of the hole. With the above structure, the one member abutting the other member effectively absorbs impact from the other member. In one example, preferably, the hole is included in the first member and the closing portion is included in the second member.

[0023] In another aspect of the present disclosure, a method for manufacturing a helmet is provided. The helmet includes a helmet shell and an impact absorber arranged at an inner side of the helmet shell. The method includes attaching the impact absorber to the inner side of the helmet shell. The impact absorber includes a hemispherical main body, the main body including an insertion recess in an outer surface of the main body, the insertion recess defining an insertion space between the outer surface of the main body and an inner surface of the helmet shell, the insertion space being open toward a fitting opening of the helmet shell. During the attaching, after the main body is attached to the inner side of the helmet shell, an inserted member is press-fitted into the insertion recess.

Advantageous Effects of Invention

[0024] With the above structure, the impact absorbing capability of the impact absorber is improved.

BRIEF DESCRIPTION OF DRAWINGS

[0025]

Fig. 1 is a side view of a helmet according to a first embodiment.

Fig. 2 is an exploded perspective view of the helmet of Fig. 1.

Fig. 3 is a perspective view of a first member and a second member serving as elements of a main body of a liner of the helmet of Fig. 1.

Fig. 4 is a perspective view of the second member serving as an element of the main body of the liner of the helmet of Fig. 1.

Fig. 5 is a perspective view of two third members serving as elements of the main body of the liner of the helmet of Fig. 1.

Fig. 6 is a perspective view of two inserted members serving as elements of the liner of the helmet of Fig. 1.

Fig. 7 is a side view of the main body of the helmet of Fig. 1 before the inserted member is attached.

Fig. 8 is a cross-sectional view of the helmet taken along line 8-8 in Fig. 7.

Fig. 9 is a cross-sectional view of the helmet taken along line 9-9 in Fig. 1.

Fig. 10 is a perspective view of a helmet according to a second embodiment.

Fig. 11 is an exploded perspective view of a liner for the helmet of Fig. 10.

Fig. 12 is a lower perspective view of the first member of the helmet of Fig. 10.

Fig. 13 is a perspective view of the helmet of Fig. 10 when the first member, the second member, the third members, and the inserted members are combined. Fig. 14 is a perspective view showing the third member, the inserted member, and a fourth member attached to the helmet of Fig. 10.

Fig. 15 is a perspective view showing the fourth member and a fifth member attached to the helmet of Fig. 10.

Fig. 16 is a table showing the density of each member of the helmet of Fig. 10.

DESCRIPTION OF EMBODIMENTS

[0026] A helmet according to one embodiment will now be described with reference to Figs. 1 to 9. In Figs. 1 to 9, the frame of reference for the forward, rearward, leftward, rightward, upward, and downward directions will be based on directions as viewed from a wearer of the helmet.

First Embodiment

Helmet

[0027] As shown in Fig. 1, a helmet 1 according to a first embodiment is a full-face helmet. The helmet 1 includes a helmet shell 10 and a liner 20, which is an example of an impact absorber.

[0028] The helmet shell 10 forms the outer shell of the helmet 1. The helmet shell 10 is a hemispherical plastic member. The helmet shell 10 is made of a material selected from, for example, a thermoplastic resin such as acrylonitrile-butadiene-styrene copolymers (ABS) or polycarbonate (PC), and a fiber reinforced plastic impregnated with a thermosetting resin.

[0029] The helmet shell 10 includes an opening 10a that is open toward the front. The opening 10a provides a field of view for a wearer. The opening 10a may include a shield 11 serving as a light-transmissive plate member. The shield 11 prevents foreign matter, rain, wind, and the like from entering the front of the helmet 1 and improves the visibility of the wearer.

[0030] The helmet shell 10 includes a fitting opening 10b that is open downward. The wearer inserts his or her head into the fitting opening 10b. The lateral dimension of an inner surface 10c (refer to Fig. 2) of the helmet shell 10 gradually increases from a location covering the top of the head of the wearer toward a lower side. The lateral dimension of the inner surface 10c of the helmet shell 10 becomes the maximum at a location covering the sides of the head and then decreases toward the fitting opening 10b.

[0031] The liner 20 is arranged at the inner side of the helmet shell 10. The liner 20 has a hemispherical shape in its entirety in conformance with the inner surface 10c

of the helmet shell 10. The liner 20 covers the top of the head of the wearer, the front of the head, the back of the head, and the sides of the head to protect the head of the wearer by absorbing impact applied to the helmet 1. In addition to the liner 20, the helmet shell 10 may include an impact absorber that protects the cheeks of the wearer at locations corresponding to the cheeks of the wearer.

[0032] As shown in Fig. 2, the liner 20 includes a main body 21 and right and left inserted members 60. The main body 21 includes a first member 30, a second member 40, and right and left third members 50. Although details are not described here, the main body 21 further includes two fourth members 70 and a fifth member 80. The fourth members 70 are located at the lower sides of the third members 50 in correspondence with the right and left cheeks. The fifth member 80 connects the ends of the fourth members 70 and is located at a position corresponding to the mouth (see Fig. 1). In one example, the first member 30, the second member 40, the right and left third members 50, and the right and left inserted members 60 are formed by molded products made of resin foam such as styrene foam.

[0033] The first member 30 is arranged at the uppermost portion of the main body 21. The first member 30 protects the top of the head of the wearer. The second member 40 is arranged at the lower side of the first member 30. The second member 40 is an attachment base member to which the first member 30 and the third members 50 are attached. The second member 40 protects the front of the head of the wearer, the back of the head, and the sides of the head. The second member 40 includes recesses 45 at the right and left sides corresponding to the sides of the head of the wearer. The third members 50 are arranged in the recesses 45. The third members 50 and the inserted members 60 protect the sides of the head of the wearer.

[0034] The main body 21 includes insertion recesses 22 at the right and left sides corresponding to the sides of the head of the wearer in an outer surface 21a of the main body 21. The insertion recesses 22 are each formed by the second member 40 and the corresponding third member 50. The insertion recess 22 and the inner surface 10c of the helmet shell 10 define an insertion space 10d (refer to Fig. 8) when the main body 21 is arranged inside the helmet shell 10. The insertion recess 22 is recessed in the outer surface 21a of the liner 20 and extends continuously from an intermediate portion of the liner 20 in the vertical direction to the lower end of the liner 20. The insertion space 10d is open at the lower end of the liner 20. Each inserted member 60 is press-fitted into the corresponding insertion space 10d.

[0035] As shown in Fig. 3, with regard to the first member 30, an outer surface 30a of the first member 30 is shaped in conformance with the inner surface 10c of the helmet shell 10. Further, the first member 30 includes an inner surface 30b with a cavity 35 at a location corresponding to the top of the head of the wearer. An interior pad or the like for increasing contact between the head

of the wearer and the helmet 1 is arranged in the cavity 35. The first member 30 may include ventilation holes or the like that extends through the first member 30 in the thickness direction, specifically, from the outer surface 30a to the inner surface 30b.

[0036] The first member 30 includes a bottom surface 31 with a lower edge having a predetermined width. The first member 30 also includes a fitting recess 32 in a region extending along the bottom surface 31 and recessed upward from the bottom surface 31. The second member 40 includes a fitting projection 42 that is inserted into the fitting recess 32.

[0037] The first member 30 includes engaging projections 33a and 33b that are cylindrical projections projecting downward from the fitting recess 32. The engaging projections 33a and 33b extend over the bottom surface 31 and the fitting recess 32 at the front end of the fitting recess 32. The engaging projections 33a and 33b engage engaging recesses 43a and 43b of the second member 40.

[0038] The first member 30 includes engaging recesses 34a and 34b that are cylindrical recesses recessed upward from the bottom surface 31. The engaging recesses 34a and 34b extend over the bottom surface 31 and the fitting recess 32 at the rear end of the fitting recess 32. The engaging recesses 34a and 34b engage engaging projections 44a and 44b of the second member 40.

[0039] The second member 40 is annular and includes a central space into which the head of the wearer is fitted. The second member 40 includes an outer surface 40a that is continuous with the outer surface 30a of the first member 30 and shaped in conformance with the inner surface 10c of the helmet shell 10. Further, the second member 40 includes an inner surface 40b that is shaped continuously with the inner surface 30b of the first member 30.

[0040] The front end of the second member 40 is located at a position corresponding to the front of the head of the wearer when the liner 20 is arranged inside the helmet shell 10. The lower edge of the front end of the second member 40 forms the upper edge of the opening 10a. The rear end of the second member 40 covers the back of the head of the wearer when the liner 20 is arranged inside the helmet shell 10. The sides of the second member 40 cover the sides of the head, for example, the temples. The rear lower edge of the second member 40 forms part of the fitting opening 10b.

[0041] The second member 40 includes an upper surface 41 with an upper edge having a predetermined width. The second member 40 also includes the fitting projection 42 that is a region extending along the upper surface 41 and projecting upward from the upper surface 41. When the fitting projection 42 is inserted into the fitting recess 32, the upper surface 41 abuts the bottom surface 31 so that the first member 30 is fitted into the second member 40.

[0042] The second member 40 includes the engaging recesses 43a and 43b, which are cylindrical recesses

recessed downward from the fitting projection 42. The engaging recesses 43a and 43b extend over the upper surface 41 and the fitting projection 42 at the front end of the fitting projection 42. The engaging recesses 43a and 43b engage the engaging projections 33a and 33b of the first member 30.

[0043] The second member 40 includes the engaging projections 44a and 44b, which are cylindrical projections projecting toward the upper surface 41 from the fitting projection 42. The engaging projections 44a and 44b extend over the upper surface 41 and the fitting projection 42 at a rear portion of the second member 40. The engaging projections 44a and 44b engage the engaging recesses 34a and 34b of the first member 30.

[0044] Engagement of the engaging projections 33a and 33b with the engaging recesses 43a and 43b and engagement of the engaging recesses 34a and 34b with the engaging projections 44a and 44b results in engagement of the first member 30 with the second member 40 to restrict separation of the first member 30 and the second member 40 that are fitted together.

[0045] As shown in Fig. 4, the second member 40 includes recesses 45 at the right and left sides covering the sides of the head of the wearer. Each recess 45 is a region where the bottom surface of the second member 40 is recessed upward. In the second member 40, a portion at the upper side of the recess 45 connects a portion that protects the front of the head to a portion that protects the back of the head. The corresponding third member 50 is fitted into the recess 45 so that the recess 45 forms the insertion recess 22 into which the inserted member 60 is inserted.

[0046] The region of the recess 45 located toward the inner surface 40b in the thickness direction of the second member 40 includes a first step 45a projecting from the inward surface of the recess 45. Further, the recess 45 includes an engagement groove 45b extending in the vertical direction at the middle of the first step 45a in the front-rear direction. The engagement groove 45b engages an engaging projection 55 of the corresponding third member 50. The recess 45 includes a first sloped surface 45c in the outer surface 40a at a region located in a corner rearward from the recess 45. The first sloped surface 45c abuts a second sloped surface 61 of the corresponding inserted member 60.

[0047] In the second member 40, the vertical width W1 of the portion where the recess 45 is located is less than the vertical widths of other regions, for example, the vertical width W2 of the portion corresponding to the front of the head and the vertical width W3 of the portion corresponding to the back of the head. In addition, the vertical width W3 of the portion corresponding to the back of the head is greater than the vertical width W1 of the portion where the recess 45 is located and the vertical width W2 of the portion corresponding to the front of the head.

[0048] The upper side of the recess 45 of the second member 40 is an element required to connect portions

at the front and back of the head. In the second member 40, the region at the upper side of the recess 45 is narrower than the regions at the front and the back of the head. In the present embodiment, the region at the upper side of the recess 45 is the narrowest so that impact from the corresponding third member 50 and the inserted member 60 is readily transmitted to the first member 30.

[0049] As shown in Fig. 5, the right and left third members 50 are plane-symmetrical to each other with respect to a plane orthogonal to the lateral direction. Each third member 50 includes a front region 51 at the front side of the third member 50 and a rear region 52 at the rear side of the front region 51.

[0050] The front region 51 has a thickness that is continuous with the second member 40. Specifically, an inner surface 50a of each third member 50 is shaped so that the inner surface of the front region 51 is continuous with the inner surface of the rear region 52 and so that the inner surface 50a is continuous with the inner surface 40b of the second member 40. Further, an outer surface 51a of the front region 51 is continuous with the outer surface 40a of the second member 40 and shaped in conformance with the inner surface 10c of the helmet shell 10.

[0051] The rear region 52 is an example of a thin portion that is thinner than other regions of the main body 21. Specifically, the rear region 52 includes an outer surface 52a located closer to the inner surface 50a of the third member 50 than the outer surface 51a of the front region 51 in the thickness direction of the third member 50. Thus, when the liner 20 is arranged inside the helmet shell 10, the outer surface 52a of the rear region 52 is spaced apart from the inner surface 10c of the helmet shell 10.

[0052] Each third member 50 includes a first inclined surface 53 at the boundary between the front region 51 and the rear region 52. The first inclined surface 53 is part of the outer surface of the third member 50 and is inclined downward toward the front from the upper end of the third member 50. The first inclined surface 53, the corresponding recess 45, and the outer surface 52a of the rear region 52 form the corresponding insertion recess 22 of the main body 21. The first inclined surface 53, which is an example of a guide surface, is a smooth surface for smoothly guiding press-fitting of the inserted member 60 into the insertion space 10d.

[0053] In the upper surface and the front and rear surfaces of the third member 50, a second step 54 is formed in a region of the third member 50 at the side where the inner surface 50a of the third member 50 is located in the thickness direction of the third member 50. The second step 54 is recessed in conformance with the corresponding first step 45a. When fitting the third member 50 to the recess 45, the second step 54 is fitted into and positioned by the first step 45a.

[0054] Further, the third member 50 includes the engaging projection 55 on the upper surface of the third member 50 projecting upward from the second step 54.

Engagement of the engaging projection 55 with the engagement groove 45b holds the third member 50 in a state fitted into the recess 45.

[0055] As shown in Fig. 6, the right and left inserted members 60 are plane-symmetrical to each other with respect to a plane orthogonal to the lateral direction. When each inserted member 60 is arranged inside the helmet shell 10, an outer surface 60a of the inserted member 60 faces the inner surface 10c of the helmet shell 10. An inner surface 60b of the inserted member 60 faces the outer surface 52a of the corresponding third member 50. A second inclined surface 60c, which is a front surface of the inserted member 60, will face the first inclined surface 53 of the third member 50.

[0056] Each inserted member 60 is slightly larger than the corresponding insertion space 10d, which is defined by the inner surface 10c of the helmet shell 10 and the insertion recess 22, and is sized to be press-fittable into the insertion space 10d. Specifically, the outer surface 60a of the inserted member 60 extends continuously with the outer surface 40a of the second member 40 and the outer surface 51a of the front region 51 and shaped in conformance with the inner surface 10c of the helmet shell 10. The inner surface 60b of the inserted member 60 is shaped in conformance with the outer surface 52a of the rear region 52.

[0057] The inner surface 60b of the inserted member 60 includes a second sloped surface 61 at the rear end of the inserted member 60. The second sloped surface 61 abuts the corresponding first sloped surface 45c of the second member 40. Further, the second inclined surface 60c is shaped in conformance with the first inclined surface 53 of the corresponding third member 50. That is, the second inclined surface 60c is inclined downward toward the front from the upper end of the inserted member 60.

[0058] The inserted member 60 has a thickness increasing from the upper end toward the lower end to facilitate press-fitting of the inserted member 60 into the corresponding insertion space 10d. Specifically, the inserted member 60 has a thickness allowing the insertion space 10d to be filled with the inserted member 60. The thickness T of the inserted member 60 at the upper end is preferably 3 mm or greater and 30 mm or less. The thickness T of 3 mm or greater will increase the mechanical strength of the inserted member 60 and avoid breakage of the inserted member 60 when press-fitted into the insertion space 10d. The thickness T of 30 mm or less will facilitate press-fitting of the inserted member 60 into the insertion space 10d.

[0059] Further, to uniformly disperse and absorb impact applied to the helmet 1 with the entire liner 20, it is preferred that the inserted member 60 have the same expansion ratio as the resin foam forming each member of the main body 21. The expansion ratio in this case is, for example, a value obtained by dividing the density of a resin foam prior to foaming by the apparent density of the resin foam subsequent to foaming.

[0060] Any of the first member 30, the second member 40, the third members 50, and the inserted members 60 may be made of resin foam having, for example, a higher expansion ratio than the other members or a lower expansion ratio than the other members. Further, any of the first member 30, the second member 40, the third members 50, and the inserted members 60 may be made of a material differing from the other members. This will allow the mechanical characteristics of the liner 20, such as strength or elasticity, to be changed in part.

Operation of First Embodiment

[0061] The operation of the helmet 1 will now be described with reference to Figs. 7 to 9. Specifically, the procedure for attaching the main body 21, which includes the first member 30, the second member 40, and the right and left third members 50, and the right and left inserted members 60 to the helmet shell 10 will now be described.

[0062] As shown in Fig. 8, the main body 21 is first fitted into the helmet shell 10 through the fitting opening 10b. Then the main body 21 is held in contact with the inner surface 10c of the helmet shell 10 and fitted and fixed to the inner surface 10c. When the main body 21 is attached to the helmet shell 10, the insertion spaces 10d are formed between the insertion recesses 22 of the main body 21 and the inner surface 10c of the helmet shell 10. The insertion spaces 10d are open toward the fitting opening 10b of the helmet shell 10.

[0063] The lateral dimension of the inner surface 10c of the helmet shell 10 is the maximum at the location covering the sides of the head of the wearer. In this case, the lateral dimension of the outer surface of the liner 20 also needs to be the maximum at the location covering the sides of the head of the wearer. Thus, in the related art, when attaching the liner 20 to the helmet shell 10 in a state in which the main body 21 is integrated with the inserted members 60, the liner 20 will have to be deformed to reduce the maximum dimension to allow for passage through the fitting opening 10b. Further, when attaching the liner 20 to the helmet shell 10 in the state in which the main body 21 is integrated with the inserted members 60, interference will easily occur between the liner 20 and the fitting opening 10b. This will lower efficiency for attaching the liner 20.

[0064] In this respect, the liner 20 is divided into the main body 21 and the inserted members 60. Further, the main body 21 includes the insertion recesses 22 at locations corresponding to the sides of the head of the wearer. Thus, interference is reduced between the main body 21 and the fitting opening 10b. This improves the efficiency for attaching the liner 20. Further, when the main body 21 is inserted through the fitting opening 10b, the main body 21 can be fitted into the helmet shell 10 through the fitting opening 10b without being greatly deformed. This will avoid a decrease in the contact between the outer surface 21a of the main body 21 and the inner surface 10c of the helmet shell 10. Thus, the impact absorbing

capability of the liner 20 will be improved.

[0065] The main body 21 is attached to the inner side of the helmet shell 10 with the first member 30, the second member 40, and the right and left third members 50 in a combined state. The first member 30, the second member 40, and the right and left third members 50 may also be attached to the inner side of the helmet shell 10 in this order.

[0066] Then, the inserted members 60 are press-fitted into the insertion spaces 10d formed at the inner side of the helmet shell 10. The inserted members 60 are inserted into the innermost portions of the insertion spaces 10d where the inserted members 60 abut the inward surfaces of the recesses 45 of the second member 40.

[0067] As shown in Fig. 7, when each inserted member 60 is press-fitted into the corresponding insertion space 10d, the second inclined surface 60c abuts the first inclined surface 53 to guide the inserted member 60 in an insertion direction. In addition, the first sloped surface 45c of the second member 40 and the second sloped surface 61 of the inserted member 60 reduce resistance when the inserted member 60 is press-fitted.

[0068] As shown in Fig. 9, the inserted members 60 are press-fitted into the insertion spaces 10d. This fills the insertion spaces 10d with the inserted members 60. Thus, the inserted members 60 are fixed and held between the helmet shell 10 and the main body 21.

[0069] The liner 20 is attached to the helmet shell 10 through the above procedures. After the liner 20 is attached to the helmet shell 10, impact absorbers may be arranged in the helmet shell 10 at locations corresponding to the cheeks of the wearer to protect the cheeks of the wearer.

[0070] When the inserted members 60 are press-fitted into the insertion spaces 10d, the outer surfaces 60a of the inserted members 60 contact the inner surface 10c of the helmet shell 10, and the inner surfaces 60b of the inserted members 60 contact the insertion recesses 22 of the main body 21. Thus, the helmet shell 10 and the main body 21 are in contact through the inserted members 60, which are press-fitted into the insertion spaces 10d. This improves the impact absorbing capability of the liner 20. Further, displacement of the liner 20 arranged at the inner side of the helmet shell 10 will be limited.

[0071] Thus, even if the main body 21 is plastically deformed when, for example, inserted through the fitting opening 10b, the liner 20 can be held in contact with the helmet shell 10. Further, even if part of the outer surface of each member forming the liner 20 has a draft angle to facilitate removal from a mold during manufacture, the liner 20 can be held in contact with the helmet shell 10.

[0072] In the related art, the helmet shell 10 or the liner 20 needs to have an increased thickness to obtain the impact absorbing capability required for the entire helmet 1 when a gap forms between the helmet shell 10 and the liner 20. The increased thickness of the helmet shell 10 or the liner 20 will increase the weight or enlarge the helmet 1 thereby increasing air resistance. In this re-

spect, the helmet shell 10 and the main body 21 are held in contact by the inserted members 60 in the present embodiment. This obtains the impact absorbing capability required for the entire helmet 1 without increasing the thickness of the helmet shell 10 or the liner 20 like in the related art. This allows the helmet 1 to be smaller and lighter than conventional helmets. As a result, the air resistance will be reduced when traveling on a vehicle. Further, the fatigue of the wearer will decrease and the concentration of the wearer will be improved.

[0073] In a state press-fitted into the insertion spaces 10d, the inserted members 60 may be removable from the insertion spaces 10d. In this case, the main body 21 can be readily taken out of the fitting opening 10b by removing the inserted members 60 from the insertion spaces 10d. This facilitates disassembly of the helmet 1 and replacement of the liner 20 or the like.

Advantages of First Embodiment

[0074] The above embodiment has the following advantages.

(1-1) The main body 21 includes the insertion recesses 22, and the inserted members 60 are press-fitted into the insertion spaces 10d so that the inserted members 60 fills the insertion spaces 10d, each formed by the corresponding insertion recess 22 and the inner surface 10c of the helmet shell 10. The inserted members 60 increases contact between the helmet shell 10 and the main body 21. This improves the impact absorbing capability of the liner 20. Further, displacement of the liner 20 is restricted at the inner side of the helmet shell 10.

(1-2) The main body 21 includes the insertion recesses 22 at locations corresponding to the sides of the head of the wearer. This allows interference to be reduced between the main body 21 and the fitting opening 10b. This improves efficiency for attaching the liner 20. Further, when the main body 21 is inserted through the fitting opening 10b, the main body 21 can be fitted into the helmet shell 10 through the fitting opening 10b without being greatly deformed. This avoids a decrease in the contact between the outer surface 21a of the main body 21 and the inner surface 10c of the helmet shell 10 is limited. Accordingly, the impact absorbing capability of the liner 20 is improved.

(1-3) The inserted members 60 and each member of the main body 21 are made of the same resin foam and have the same expansion ratio. This allows an impact applied to the helmet 1 to be uniformly dispersed and absorbed by the entire liner 20. Accordingly, the impact absorbing capability of the liner 20 is further improved.

(1-4) The liner 20 includes multiple members. Thus, any of the members of the liner 20 can be made of a material differing from the other members to

change the mechanical characteristics, such as strength or elasticity, in part of the liner 20.

(1-5) The thickness T of each inserted member 60 is 3 mm or greater to increase the mechanical strength of the inserted member 60. This avoids breakage of the inserted member 60 when the inserted member 60 is press-fitted into the corresponding insertion space 10d. Further, the thickness T of the inserted member 60 is 30 mm or less so that the inserted member 60 can be readily press-fitted into the insertion space 10d.

(1-6) In a state press-fitted into the insertion spaces 10d, when the inserted members 60 are removable from the insertion spaces 10d, the main body 21 can be readily taken out of the fitting opening 10b by removing the inserted members 60 from the insertion spaces 10d. This facilitates disassembly of the helmet 1 and replacement of the liner 20 or the like.

Second Embodiment

[0075] As shown in Fig. 10, a helmet 100 according to a second embodiment is a full-face helmet and includes the helmet shell 10 and the liner 20, which is an example of an impact absorber. The same reference numerals are given to those members or portions that are the same as the corresponding components or portions of the first embodiment and detailed explanations are omitted.

[0076] As shown in Fig. 11, the liner 20 arranged at the inner side of the helmet shell 10 includes the main body 21 and the right and left inserted members 60. The main body 21 includes the first member 30, the second member 40, and the right and left third members 50. Further, the main body 21 includes the two fourth members 70, located at the lower sides of the third members 50, and the fifth member 80 at a location corresponding to the mouth and the chin and connecting the ends of the fourth members 70. The fourth members 70 are located at positions corresponding to the right and left cheeks. Further, each fourth member 70 is connected to the corresponding third member and the corresponding inserted member 60 overlapping each other in the thickness direction. The fifth member 80 is arranged between the ends of the right and left fourth members 70 to cover the mouth and the chin. In one example, the first member 30, the second member 40, the right and left third members 50, the right and left fourth members 70, the fifth member 80, and the right and left inserted members 60 are formed by molded products made of resin foam such as styrene foam.

[0077] The liner 20 includes a total of nine components, specifically, one first member 30, one second member 40, two third members 50, two inserted members 60, two fourth members 70, and one fifth member 80. The nine components are each made of a foamed material having density suitable for the corresponding location. The members become harder when the foamed material has a higher density. Alternatively, the nine components are

each made of a foamed material having an expansion ratio suitable for the corresponding location. The members become harder when the foamed material has a lower expansion ratio. The structures of each of the nine components will now be described.

[0078] The first member 30 is made of a foamed material having the lowest density among the nine components (see Fig. 16). In Fig. 16, "1" to "8" represent the density, and a smaller value indicates a lower density. The first member 30 absorbs impact applied to the top of the head or the like. The first member 30 also absorbs impact from the second member 40.

[0079] Holes 37a extend through the first member 30 in the vertical direction at positions located upward from the right and left sides of the head. In other words, the holes 37a extend straight in the vertical direction through the first member 30 at a position corresponding to the upper region of the temples. Three holes 37a are lined in the front-rear direction at the right side and the left side.

The number of holes 37a formed at the right side and the left side is not limited to three and is determined in accordance with required strength. For example, the number of holes 37a may be two or less or four or more.

[0080] Each hole 37a includes one end (first end) in the outer surface 30a. As shown in Fig. 12, each hole 37a includes another end (second end) located at a position adjacent to a vertical wall 32a that forms the fitting recess 32. The fitting recess 32 is included in the bottom surface 31 that abuts the upper surface 41 of the second member 40. The portion where the holes 37a are located is softer than the other portions of the first member 30, which is the softest among the total nine components. The bottom surface 31 including the fitting recess 32 is a first abutting surface that abuts the upper surface 41 of the second member 40.

[0081] The second member 40 is made of a foamed material having a density that is second to the lowest density of the first member 30 (see Fig. 16). The second member 40 is the attachment base member to which the first member 30, the third members 50, the inserted members 60, and the fourth members 70 are attached. In the second member 40, the upper side of the recess 45 is an element required to connect the portion that protects the front of the head and the portion that protects the back of the head. The second member 40 reduces impact from the third members 50 and the inserted members 60 and disperses the impact by transmitting the impact to the first member 30.

[0082] As shown in Fig. 13, the upper surface 41 of the second member 40 includes a fitting projection 42 projecting upward. When the fitting projection 42 is inserted into the fitting recess 32, the upper surface 41 abuts the bottom surface 31, and the first member 30 is fitted into the second member 40. The upper surface 41 including the fitting projection 42 is a second abutting surface that abuts the bottom surface 31 (first abutting surface) of the first member 30. A portion in the upper surface 41 including the fitting projection 42 that closes the other end of

each hole 37a is a closing portion.

[0083] In the main body 21, the holes 37a formed in the first member 30 and the closing portions arranged on the upper surface 41 of the second member 40 define blind holes 37. The blind holes 37 extend in the vertical direction between the outer surface 30a and the bottom surface 31 (first abutting surface) of the first member 30 at the upper side of the second member 40. Three blind holes 37 are arranged next to each other in the front-rear direction at the right side and the left side. As will be described in detail later, the blind holes 37 adjust the hardness or softness of the liner 20 and deform prior to other portions to absorb a large impact applied at a high speed or a low speed.

[0084] Specifically, the blind holes 37 are located above where the third member 50 and the inserted members 60 are arranged. The portion where the blind holes 37 are located is softer and weaker than the second member 40 and other regions of the first member 30. The third members 50 and the inserted members 60 protect the temples and the like from impact, and the portion of the first member 30 where the blind holes 37 are located absorbs impact applied to the third members 50 and the inserted members 60 at the upper side of the recess 45 of the second member 40.

[0085] In the second member 40, the vertical width W1 of the portion where the recess 45 is located is less than the vertical widths of other regions, for example, the vertical width W2 of the portion corresponding to the front of the head and the vertical width W3 of the portion corresponding to the back of the head (Fig. 11). In addition, the vertical width W3 of the portion corresponding to the back of the head is greater than the vertical width W1 of the portion where the recess 45 is located and the vertical width W2 of the portion corresponding to the front of the head.

[0086] The second member 40 is the attachment base member to which the first member 30, the third members 50, the inserted members 60, and the fourth members 70 are attached. The upper side of the recess 45 is an element required to connect the portion that protects the front of the head and the portion that protects the back of the head. In the second member 40, the region at the upper side of the recess 45 is narrower than the region at the front of the head and the back of the head. In the present embodiment, the region at the upper side of the recess 45 is the narrowest so that impact from the third members 50 and the inserted members 60 and impact from the fourth members 70 are readily transmitted by the second member 40 to the region of the first member 30 where the holes 37a are located.

[0087] The third member 50 is fitted into the recess 45 to form the insertion recess 22 (refer to Fig. 11) into which the corresponding inserted member 60 is inserted. The right and left third members 50 each include the front region 51 at the front of the third member 50 and the rear region 52 at the rear side of the front region 51. The inner surface 50a of the third member 50 is shaped so that the

inner surface of the front region 51 is continuous with the inner surface of the rear region 52 and so that the inner surface 50a is continuous with the inner surface 40b of the second member 40. Further, the outer surface 51a of the front region 51 is continuous with the outer surface 40a of the second member 40 and shaped in conformance with the inner surface 10c of the helmet shell 10. The rear region 52 is a thin portion that is thinner than other regions of the main body 21. When the liner 20 is arranged inside the helmet shell 10, the outer surface 52a of the rear region 52 is spaced apart from the inner surface 10c of the helmet shell 10. The space defines the insertion recess 22 that accommodates the corresponding inserted member 60.

[0088] As shown in Fig. 14, the third member 50 includes a lower surface 56 extending over the front region 51 and the rear region 52. The lower surface 56, extending over the front region 51 and the rear region 52, includes a flat surface 56a, located toward the front region 51, and a recessed surface 56b, recessed toward the second member 40.

[0089] As shown in Fig. 13, when each inserted member 60 is arranged inside the helmet shell 10, the outer surface 60a of the inserted member 60 faces the inner surface 10c of the helmet shell 10. The inner surface 60b of the inserted member 60 faces the outer surface 52a of the corresponding third member 50. The inserted member 60 includes a lower surface 62. The lower surface 62 is continuous with the lower surface 56 of the third member 50 when the inserted member 60 is inserted into the insertion recess 22. The lower surface 62 includes a first engagement wall 63 projecting downward from the lower surface 62.

[0090] The density of the second member 40 is lower than the density of the third members 50 and lower than or equal to the density of the inserted members 60 (refer to Fig. 16). The third members 50 and the inserted members 60 are harder than the second members 40 to protect the temples from impact. Impact applied to the third members 50 is absorbed by the second member 40 and the first member 30. The density of the third members 50 is higher than or equal to the density of the inserted members 60. Thus, impact applied to the helmet 1 is dispersed and absorbed by the third members 50 and the inserted members 60.

[0091] The fourth members 70 are located at the lower sides of the corresponding third members 50. The fourth members 70 are located at positions corresponding to the right and left cheeks and curved to extend from the cheeks toward the chin. The density of the third members 50 is lower than or equal to the density of the fourth members 70, and the density of the inserted members 60 is lower than the density of the fourth members 70 (see Fig. 16). The fourth members 70 that protect the cheeks are harder than the third members 50 and the inserted members 60 to protect the cheeks from impact. Further, impact applied to the fourth members 70 is dispersed and absorbed by the third members 50, the inserted members

60, the second member 40, and the first member 30.

[0092] Each fourth member 70 includes an outer surface 70a continuous with the outer surface 60a of the corresponding inserted member 60 and the outer surface 51a of the front region 51 of the third member 50. The fourth member 70 includes an inner surface 70b continuous with the inner surface 50a of the third member 50.

[0093] A first end surface 71 at the upper end of each fourth member 70 abuts the lower surface 56 of the corresponding third member 50 and the lower surface 62 of the corresponding inserted member 60. The first end surface 71 includes a second engagement wall 72 continuous with the outer surface 70a. When the first end surface 71 abuts the lower surfaces 56 and 62, the first engagement wall 63 is located at the inner side, and the second engagement wall 72 is located at the outer side. This positions the first end surface 71 of the fourth member 70 with respect to the lower surface 56 of the third member 50 and the lower surface 62 of the inserted member 60. The first end surface 71 also abuts the flat surface 56a of the lower surface 56 of the third member 50 and the lower surface 62 of the inserted member 60. The first end surface 71 also includes a curved surface 73 that abuts the recessed surface 56b of the third member 50.

[0094] As shown in Fig. 15, each fourth member 70 includes a lower end defining a second end surface 75 connected to one of two connection surfaces 81 defined by the two ends of the fifth member 80. The upper edge of the fourth member 70 forms the lower edge of the opening 10a. The lower edge of the fourth member 70 forms part of the fitting opening 10b below the side of the head.

[0095] The fifth member 80 is located between the ends of the right and left fourth members 70 to cover the mouth and the chin. The upper edge of the fifth member 80 is the middle of the lower edge of the opening 10a. The lower edge of the fifth member 80 forms part of the fitting opening 10b underneath the chin. The fifth member 80 includes an outer surface 80a continuous with the outer surfaces 70a of the fourth members 70. The fifth member 80 includes an inner surface 80b continuous with the inner surfaces 70b of the fourth members 70.

[0096] The right and left ends of the fifth member 80 include the connection surfaces 81 for the fourth members 70. The fifth member 80 is positioned and attached between the second end surfaces 75 of the right and left fourth members 70.

[0097] The density of the fifth member 80 is higher than or equal to the density of the fourth members 70, and the fifth member 80 has the highest density (see Fig. 16). The fifth member 80 is the hardest in the liner 20 and protects the mouth and the chin. Impact applied to the fifth member 80 is dispersed and absorbed by the fourth members 70, the third members 50, the inserted members 60, the second member 40, and the first member 30.

[0098] The liner 20 described above includes nine components in total, specifically, one first member 30, one second member 40, two third members 50, two in-

serted members 60, two fourth members 70, and one fifth member 80. The liner 20 includes the nine components so that the density, or hardness, is changed in accordance with location of the head to provide impact protection tuned in accordance with the characteristics of each part of the head.

[0099] Fig. 16 shows the densities of the first member 30, the second member 40, the third members 50, the inserted members 60, the fourth member 70, and the fifth member 80 for each size (S, M, L, XL). In Fig. 16, "1" to "8" represent density and smaller values indicate lower density. In one example, "1" indicates a density of about 0.01 to 0.0125 (g/cm³), and "2" indicates a density of about 0.0111 to 0.0143 (g/cm³). Further, "3" indicates a density of about 0.0125 to 0.0167 (g/cm³), and "4" indicates a density of about 0.0143 to 0.020 (g/cm³). Further, "5" indicates a density of about 0.0167 to 0.025 (g/cm³), and "6" indicates a density of about 0.020 to 0.033 (g/cm³). Further, "7" indicates a density of about 0.025 to 0.050 (g/cm³), and "8" indicates a density of about 0.033 to 0.1 (g/cm³).

[0100] When the helmet is assembled, the main body 21 is first fitted into the helmet shell 10 through the fitting opening 10b. Then the main body 21 is held in contact with the inner surface 10c of the helmet shell 10 and fitted and fixed to the inner surface 10c. When the main body 21 is attached to the helmet shell 10, the insertion spaces 10d are formed between the insertion recesses 22 of the main body 21 and the inner surface 10c of the helmet shell 10. The insertion spaces 10d are open toward the fitting opening 10b of the helmet shell 10. Then, the inserted members 60 are press-fitted into the insertion spaces 10d formed at the inner side of the helmet shell 10. The inserted members 60 are inserted into the innermost portions of the insertion spaces 10d where the inserted members 60 abut the inward surfaces of the recesses 45 of the second member 40.

Advantages of Second Embodiment

[0101]

(2-1) The liner 20 includes nine components in total, specifically, one first member 30, one second member 40, two third members 50, two inserted members 60, two fourth members 70, and one fifth member 80. Thus, the nine components can be each made of a foamed material having density suitable for the corresponding locations.

(2-2) The first member 30 has the lowest density, and the density of the second member 40 is second to the lowest density. Thus, the first member 30 absorbs impact directly applied to the second member 40. The first member 30 further absorbs impact, through the second member 40, applied to any one or more of the third member 50, the inserted member 60, the fourth member 70, and the fifth member 80.

(2-3) The density of the second member 40 is lower

than the density of the third members 50 and lower than or equal to the density of the inserted members 60. The third members 50 and the inserted members 60 are harder than the second member 40 to protect the temples from impact. Impact applied to the third members 50 is absorbed by the second member 40 and the first member 30.

(2-4) The density of the third members 50 is higher than or equal to the density of the inserted members 60. Thus, impact applied to the helmet 1 is dispersed and absorbed by the third member 50 and the inserted member 60. Further, the inserted member 60 is press-fitted into the insertion recess 22.

(2-5) The density of the third members 50 is lower than or equal to the density of the fourth members 70, and the density of the inserted members 60 is lower than the density of the fourth members 70. The fourth members 70 that protect the cheeks are harder than the third members 50 and the inserted members 60 to protect the cheeks from impact. Further, impact applied to the fourth members 70 is dispersed and absorbed by the third members 50, the inserted members 60, the second member 40, and the first member 30.

(2-6) The density of the fifth member 80 is higher than or equal to the density of the fourth members 70, and the fifth member has the highest density. The fifth member 80 is the hardest in the liner 20 and protects the mouth and the chin. Impact applied to the fifth member 80 is dispersed and absorbed by the fourth members 70, the third members 50, the inserted members 60, the second member 40, and the first member 30.

(2-7) In the second member 40, the vertical width W1 of the portion where the recess 45 is located is less than the vertical widths of the other regions, for example, the vertical width W2 of the portion corresponding to the front of the head and the vertical width W3 of the portion corresponding to the back of the head (Fig. 11). In the second member 40, the region at the upper side of the recess 45 is narrower in the vertical direction than the regions at the front of the head and the back of the head so that impact from the third member 50 and the inserted member 60 is readily transmitted to the holes 37a of the first member 30.

(2-8) The blind holes 37 are located above where the third member 50 and the inserted members 60 are arranged. Where the blind holes 37 are arranged is softer and weaker than the first member 30 and the second member 40. The blind holes 37 effectively absorb impact applied to the third member 50 and the inserted member 60.

(2-9) The blind holes 37 are arranged by forming the holes 37a in the first member 30 with a drill or the like and closing the ends of the holes 37a with the second member 40. Thus, the processing for the blind holes 37 is simplified.

[0102] The first embodiment and the second embodiment may be modified as follows.

[0103] In the second embodiment, the blind holes 37 may be formed in the front of the helmet 100, specifically, at the upper side of the opening 10a. In this case, the blind holes 37 are arranged by forming the holes 37a, extending in the vertical direction, in the first member 30 at the upper side of the opening 10a, and closing the holes 37a with the upper surface 41 of the second member 40. When impact is applied to the second member 40 at the upper side of the opening 10a, the impact is absorbed by the blind holes 37. The blind holes 37 may be located at the upper sides of the third members 50 and the inserted members 60 and/or the upper side of the opening 10a.

[0104] In the second embodiment, the blind holes 37 do not need to include the holes 37a formed in the first member 30. In one example, the blind holes 37 may be arranged by forming the holes 37a, extending in the vertical direction, in the second member 40 at the upper side of the third member 50 and the inserted member 60, and closing the holes 37a with at least one of the third member 50 and the inserted member 60.

[0105] The blind holes 37 do not need to be formed by holes extending through one member selected from the first member 30, the second member 40, and the like and a closing portion of another member, closing the holes, selected from the first member 30, the second member 40, and the like. For example, the blind holes 37 may extend from one of the outer surface and the inner surface to an intermediate portion toward the other surface in one member selected from the first member 30, the second member 40, and the like. In this case, the blind holes 37 may each include an open end in the outer surface of the member and extend from the outer surface toward the center of the helmet. Alternatively, the blind hole 37 may include an open end in the inner surface of the member and extend inward in the member.

[0106] The blind holes 37 do not need to be formed by two members. Instead, the blind holes 37 may be formed by one member. That is, the blind holes 37 may be formed solely by the first member 30 or the second member 40. Furthermore, the blind holes 37 may be formed solely by the third member 50 or the inserted member 60. Furthermore, the blind holes 37 may be formed solely by the fourth member 70 or the fifth member 80.

[0107] The blind holes 37 may be formed after being molded in a subsequent process with a tool or the like or may be formed by a mold when being molded.

[0108] In the second member 40, the vertical width W1 of the portion where the recess 45 is located may be greater than or equal to the vertical width W2 of the portion corresponding to the front of the head and the vertical width W3 of the portion corresponding to the back of the head.

[0109] In the second embodiment, the fifth member 80 does not need to have the highest density among the nine components.

[0110] In the second embodiment, the density of the fourth members 70 may be higher than the density of the fifth member 80.

[0111] In the second embodiment, the density of the third members 50 may be higher than the density of the fourth members 70. Further, the density of the inserted members 60 may be higher than or equal to the density of the fourth members 70.

[0112] In the second embodiment, the density of the third members 50 may be lower than the density of the inserted members 60.

[0113] In the second embodiment, the density of the second member 40 may be higher than or equal to the density of the third members 50. The density of the second member 40 may be higher than the density of the inserted members 60.

[0114] In the second embodiment, the first member 30 does not need to have the lowest density.

[0115] In the second embodiment, the liner 20 may include more than or less than nine components.

[0116] In the first embodiment and the second embodiment, the thickness T of the inserted member 60 is not limited if the inserted member 60 can be smoothly press-fitted into the insertion space 10d and has sufficient strength for press-fitting. The thickness T may be determined in accordance with the size, the shape, and the like of the insertion space 10d and the material, the shape, and the like of the inserted member 60. For example, the thickness T of the inserted member 60 may be greater than 30 mm or less than 3 mm. Further, the inserted member 60 may be configured by bonding or overlapping multiple members so that the thicknesses T is 3 mm or greater and 30 mm or less.

[0117] In the first embodiment, the main body 21 includes the insertion recesses 22 at locations covering the sides of the head of the wearer. This is not a limitation, and in the first embodiment, the main body 21 may include the insertion recesses 22 at any portion. For example, the main body 21 may include the insertion recess 22 at a location covering the back of the head of the wearer. Further, the main body 21 may include the insertion recesses 22 at locations covering the sides of the head of the wearer and the location covering the back of the head of the wearer.

[0118] In the first embodiment, the main body 21 is formed by the first member 30, the second member 40, and the third members 50. Instead, the main body 21 may be formed by, for example, a single member. Further, the first member 30 and the second member 40 may be a single member. Further, for example, any one of the first member 30, the second member 40, and the third member 50 may be formed by separate members.

[0119] In the first embodiment, one inserted member 60 is press-fitted into one insertion space 10d. Alternatively, in the first embodiment, for example, multiple inserted members 60 may be press-fitted into one insertion space 10d.

[0120] In the first embodiment, the inserted members

60 do not need to be press-fitted into the innermost portions of the insertion spaces 10d if the outer surfaces 60a of the inserted members 60 contact the inner surface 10c of the helmet shell 10, and the inner surfaces 60b of the inserted members 60 contact the insertion recesses 22 of the main body 21. That is, if the main body 21 contacts the helmet shell 10 through the inserted members 60, the upper surface or the front and rear side surfaces of the inserted member 60 may be spaced apart from the insertion recess 22.

[0121] In the first embodiment and the second embodiment, the second member 40 may be divided into four pieces in total. In one example, the second member 40 may include a portion corresponding to the front of the head, a portion corresponding to the back of the head, and portions connecting the two portions and corresponding to the sides of the head.

[0122] In the first embodiment and the second embodiment, the helmets 1 and 100 do not need to be full-face helmets. The helmets 1 and 100 may be flip-up helmets with a chin portion that can be raised, open face helmets, helmets with a removable chin portion, or convertible helmets with a chin portion that is pivoted and fixed to the back of the helmet.

REFERENCE SIGNS LIST

[0123]

- T) thickness
- 1) helmet
- 10) helmet shell
- 10b) fitting opening
- 10c) inner surface
- 10d) insertion space
- 20) liner
- 21) main body
- 21a) outer surface
- 22) insertion recess
- 30) first member
- 40) second member
- 45) recess
- 45c) first sloped surface
- 50) third member
- 60) inserted member
- 61) second sloped surface

Claims

1. A helmet, comprising:

a helmet shell; and
an impact absorber arranged at an inner side of the helmet shell, wherein
the impact absorber includes:

a hemispherical main body including an in-

- sertion recess in an outer surface of the main body, the insertion recess defining an insertion space between the outer surface of the main body and an inner surface of the helmet shell, the insertion space being open toward a fitting opening of the helmet shell; and
an inserted member that is press-fitted into the insertion space.
2. The helmet according to claim 1, wherein the main body includes the insertion recess at a location covering a side of a head of a wearer.
3. The helmet according to claim 1 or 2, wherein
the main body and the inserted member are molded products of a same resin foam, and a portion of the main body where the insertion space is defined has an expansion ratio equal to that of the inserted member.
4. The helmet according to any one of claims 1 to 3, wherein the inserted member has a thickness of 3 mm or greater and 30 mm or less.
5. The helmet according to any one of claims 1 to 4, wherein the inserted member is removable from the insertion space.
6. The helmet according to any one of claims 1 to 5, wherein
the main body includes:
a first member located at a position corresponding to a top of a head;
a second member having an annular shape and arranged entirely around the head at a lower side of the first member;
two third members located at positions corresponding to right and left sides of the head at a lower side of the second member;
two fourth members located at positions corresponding to right and left cheeks of the head at lower sides of the third members; and
a fifth member located at a position corresponding to a mouth and a chin of the head and connecting ends of the fourth members,
each of the third members is a member defining the insertion space that receives the inserted member between the inner surface of the helmet shell and an outer surface of the third member, and
the impact absorber includes a total of nine components.
7. The helmet according to claim 6, wherein among the total of nine components, the first member has a density that is the lowest and the second member has a density that is second to the lowest.
8. The helmet according to claim 6 or 7, wherein the second member has a density lower than that of the third members and lower than or equal to that of the inserted member.
9. The helmet according to any one of claims 6 to 8, wherein the third members have a density higher than or equal to that of the inserted member.
10. The helmet according to any one of claims 6 to 9, wherein
the third members have a density lower than or equal to that of the fourth members, and the inserted member has a density lower than that of the fourth members.
11. The helmet according to any one of claims 6 to 10, wherein
the fifth member has a density higher than or equal to that of the fourth members, and the density of the fifth member is the highest.
12. The helmet according to any one of claims 6 to 11, wherein the second member has a vertical width between the first member and the third members that is less than a vertical width of other regions.
13. The helmet according to any one of claims 6 to 12, wherein in the second member, a vertical width of a portion corresponding to a back of the head is greater than a vertical width between the first member and the third members and a vertical width of a portion corresponding to a front of the head.
14. The helmet according to any one of claims 6 to 13, wherein at least one of the first member, the second member, the third members, the fourth members, the fifth member, and the inserted member includes a blind hole.
15. The helmet according to claim 14, wherein the blind hole includes:
a hole extending through one member selected from a group of components consisting of the first member, the second member, the third members, the fourth members, the fifth member, and the inserted member, the hole including a first end in an outer surface of the one member and a second end in a first abutting surface of the one member, the first abutting surface abut-

ting a second abutting surface of another member selected from the group or components to abut the one member; and
a closing portion included in the second abutting surface and closing the second end of the hole. 5

16. The helmet according to claim 15, wherein the hole is included in the first member and the closing portion is included in the second member. 10

17. The helmet according to any one of claims 1 to 5, wherein the main body includes the blind hole.

18. A method for manufacturing a helmet, the helmet including a helmet shell and an impact absorber arranged at an inner side of the helmet shell, the method comprising: 15

attaching the impact absorber to the inner side of the helmet shell, wherein 20
the impact absorber includes a hemispherical main body, the main body including an insertion recess in an outer surface of the main body, the insertion recess defining an insertion space between the outer surface of the main body and 25
an inner surface of the helmet shell, the insertion space being open toward a fitting opening of the helmet shell, and
during the attaching, after the main body is attached to the inner side of the helmet shell, an 30
inserted member is press-fitted into the insertion recess.

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Fig.1

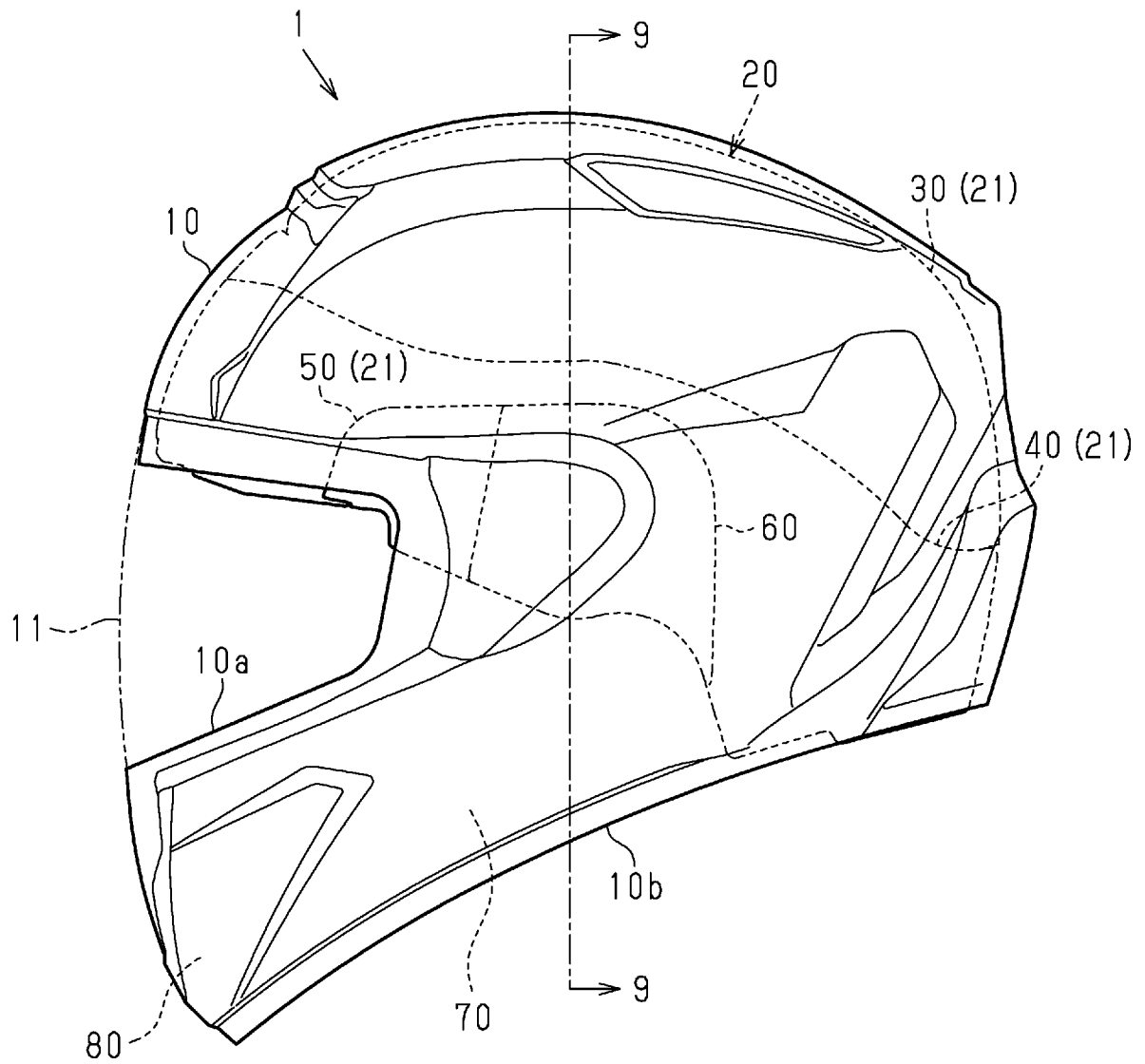


Fig.2

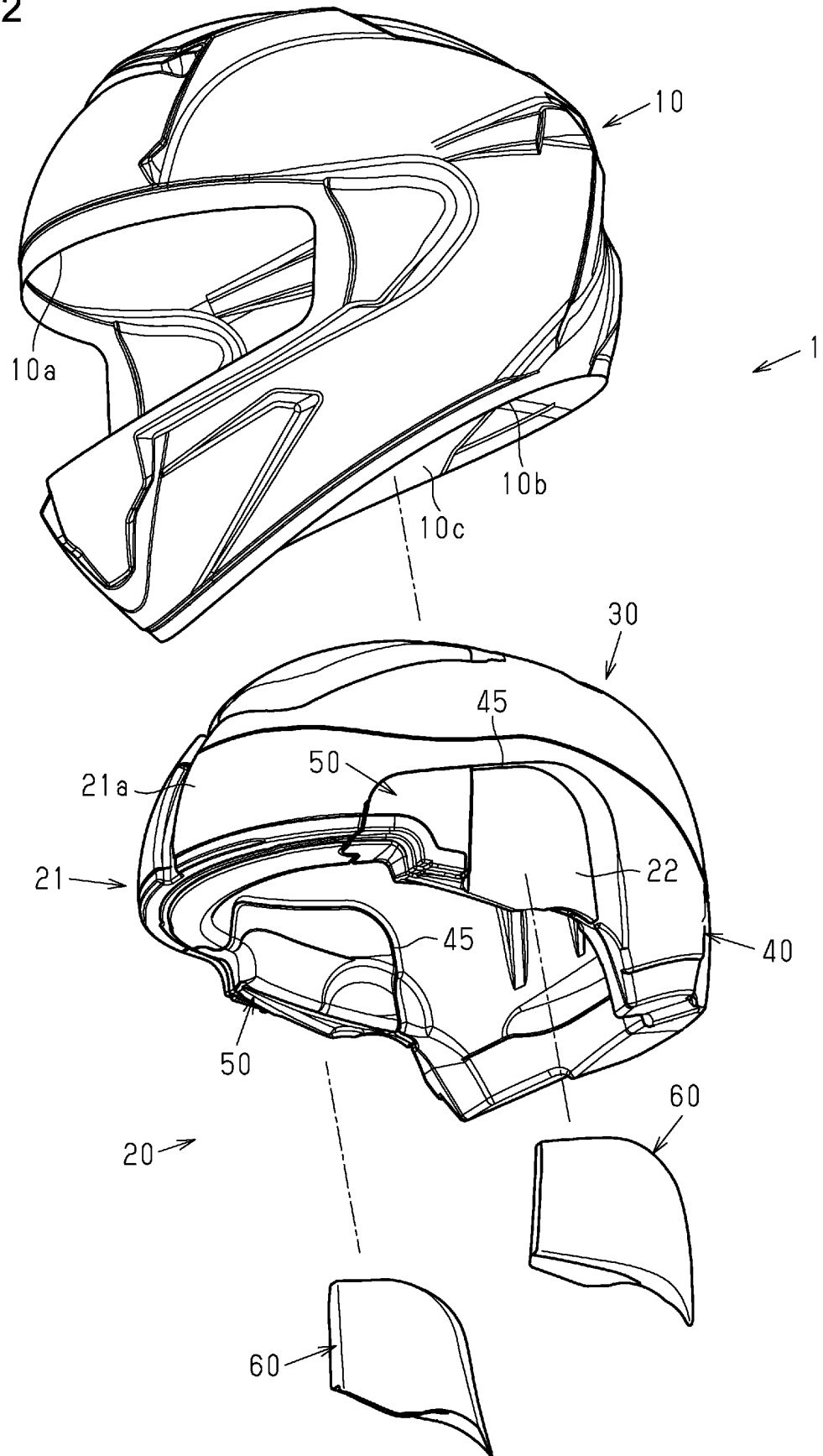


Fig.3

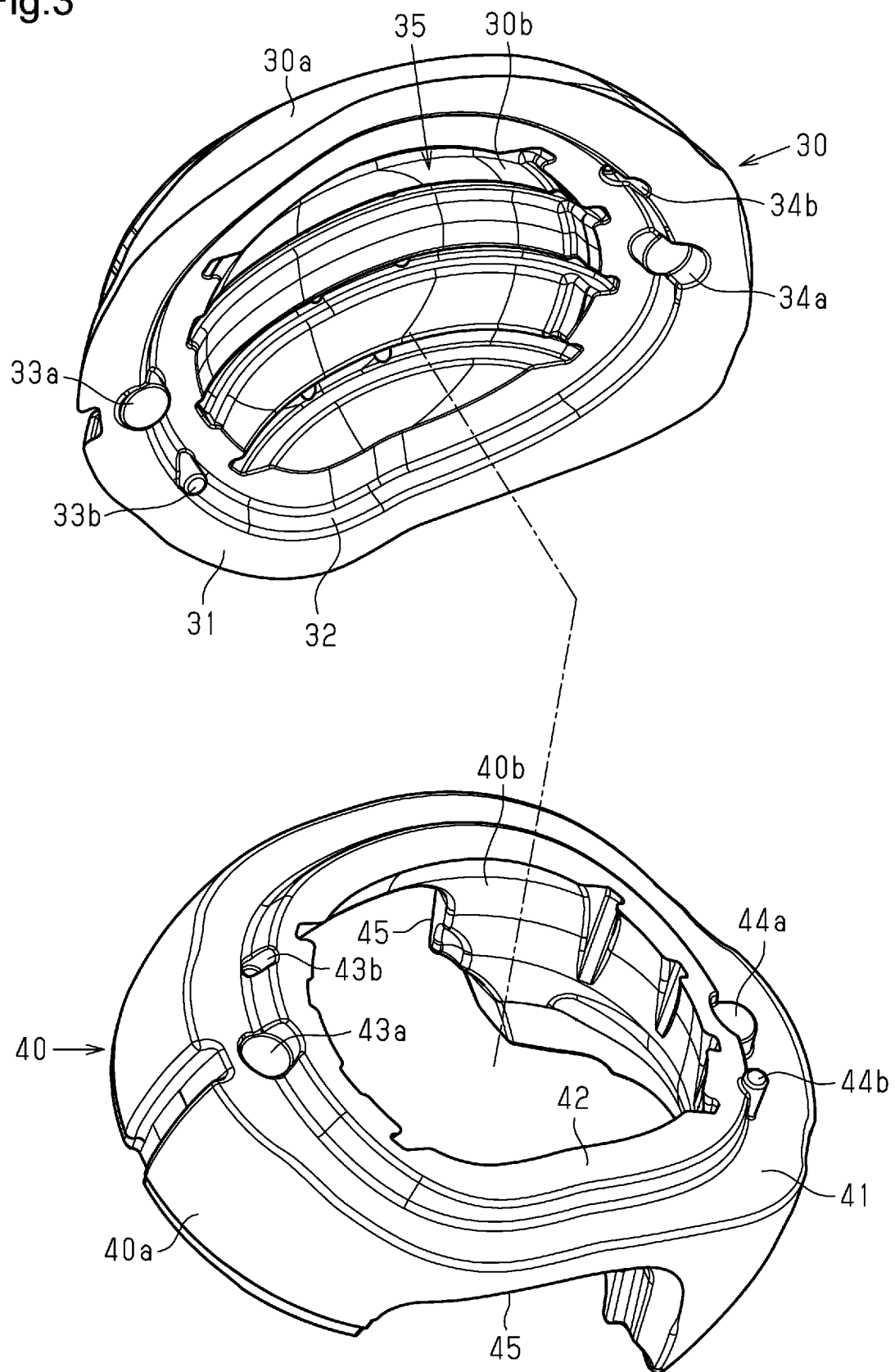


Fig.4

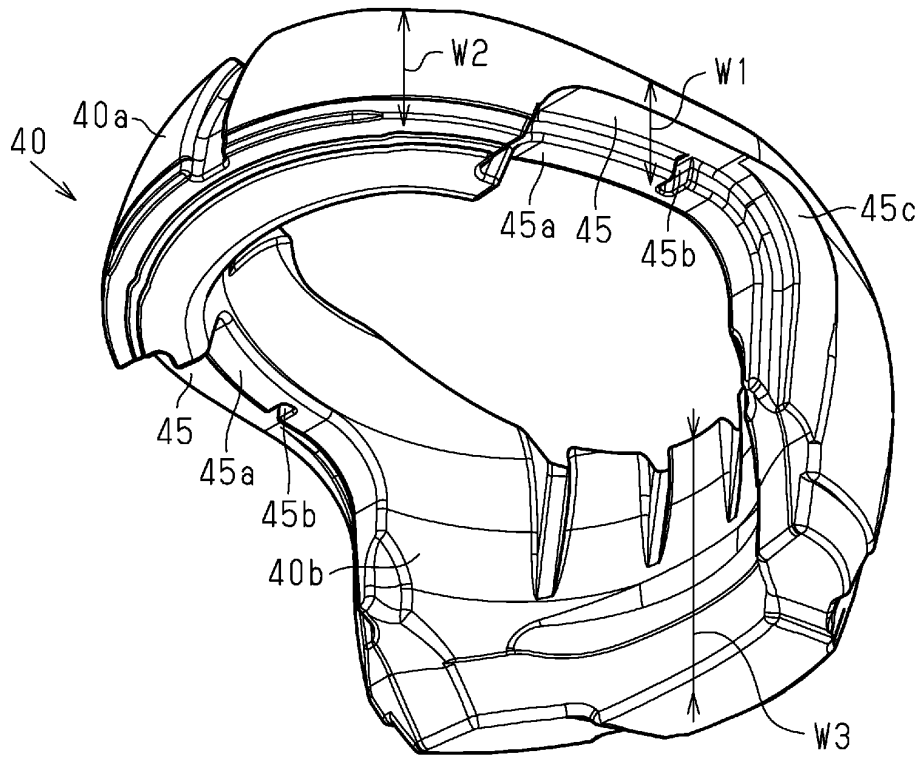


Fig.5

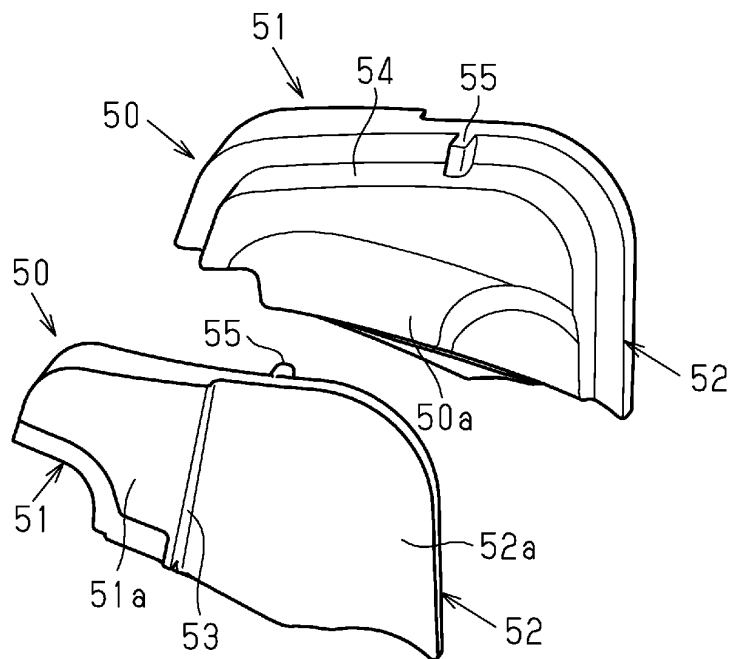


Fig.6

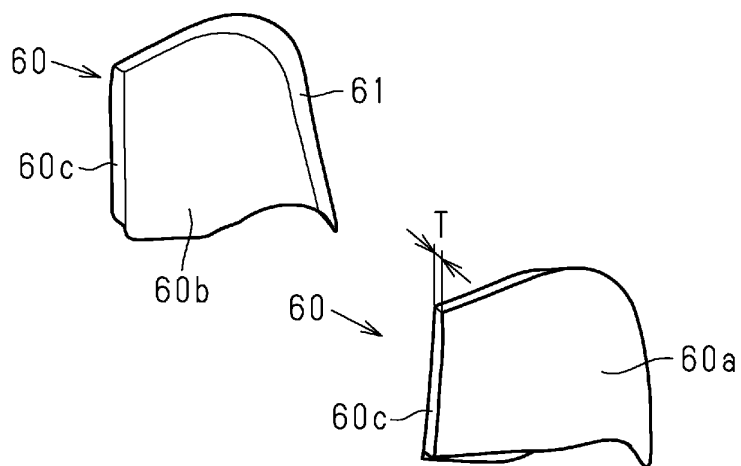


Fig.7

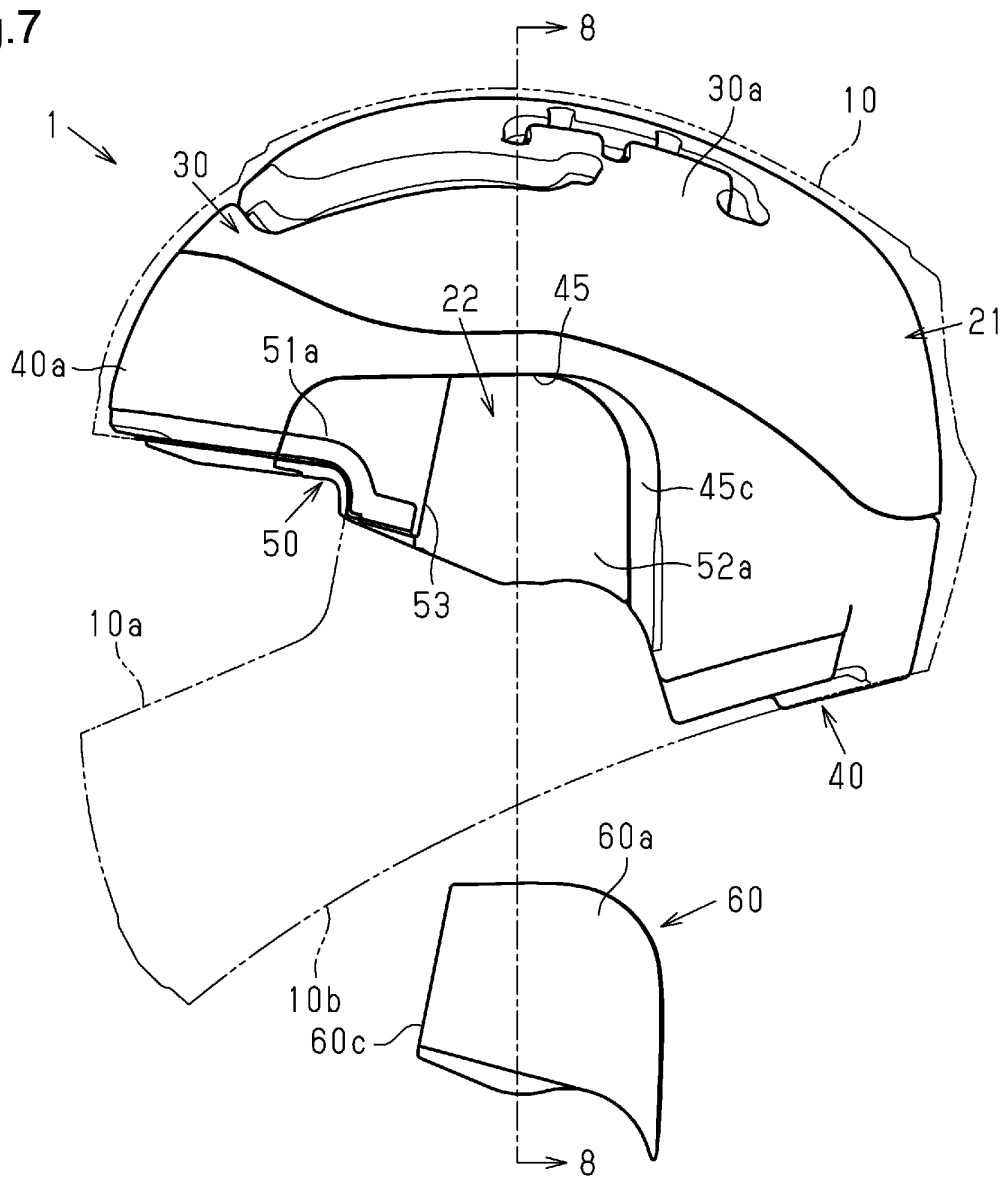


Fig.8

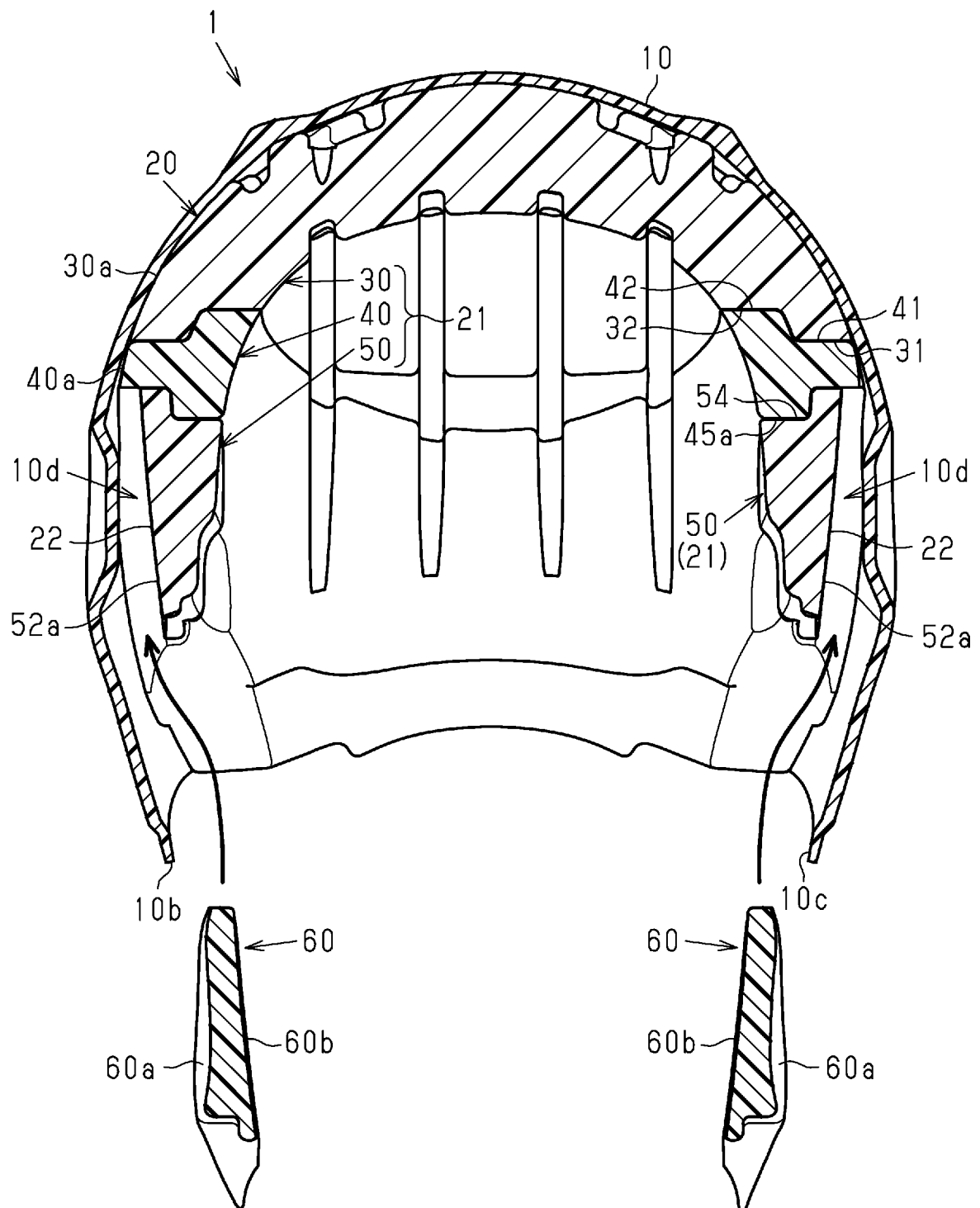


Fig.9

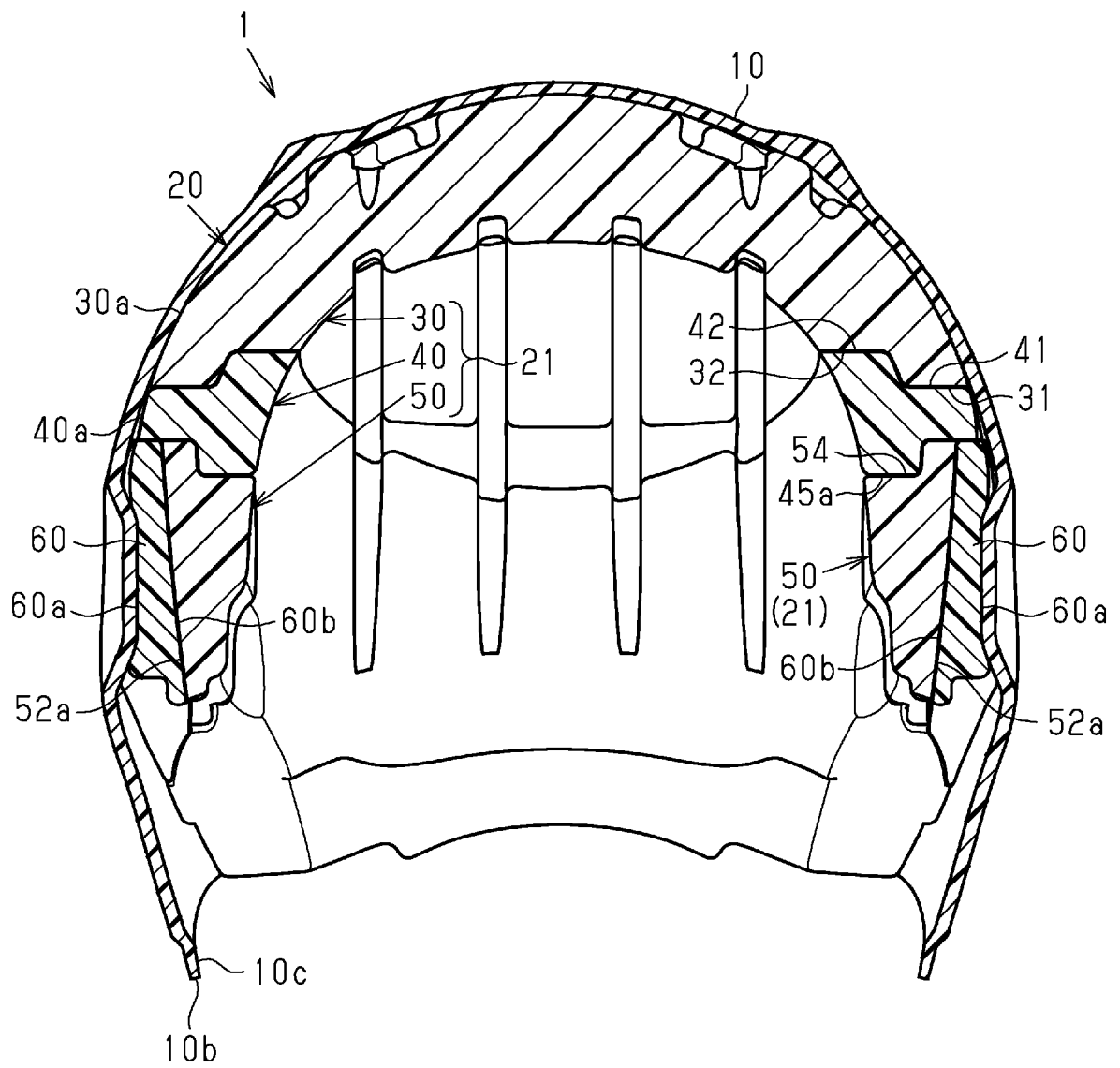


Fig.10

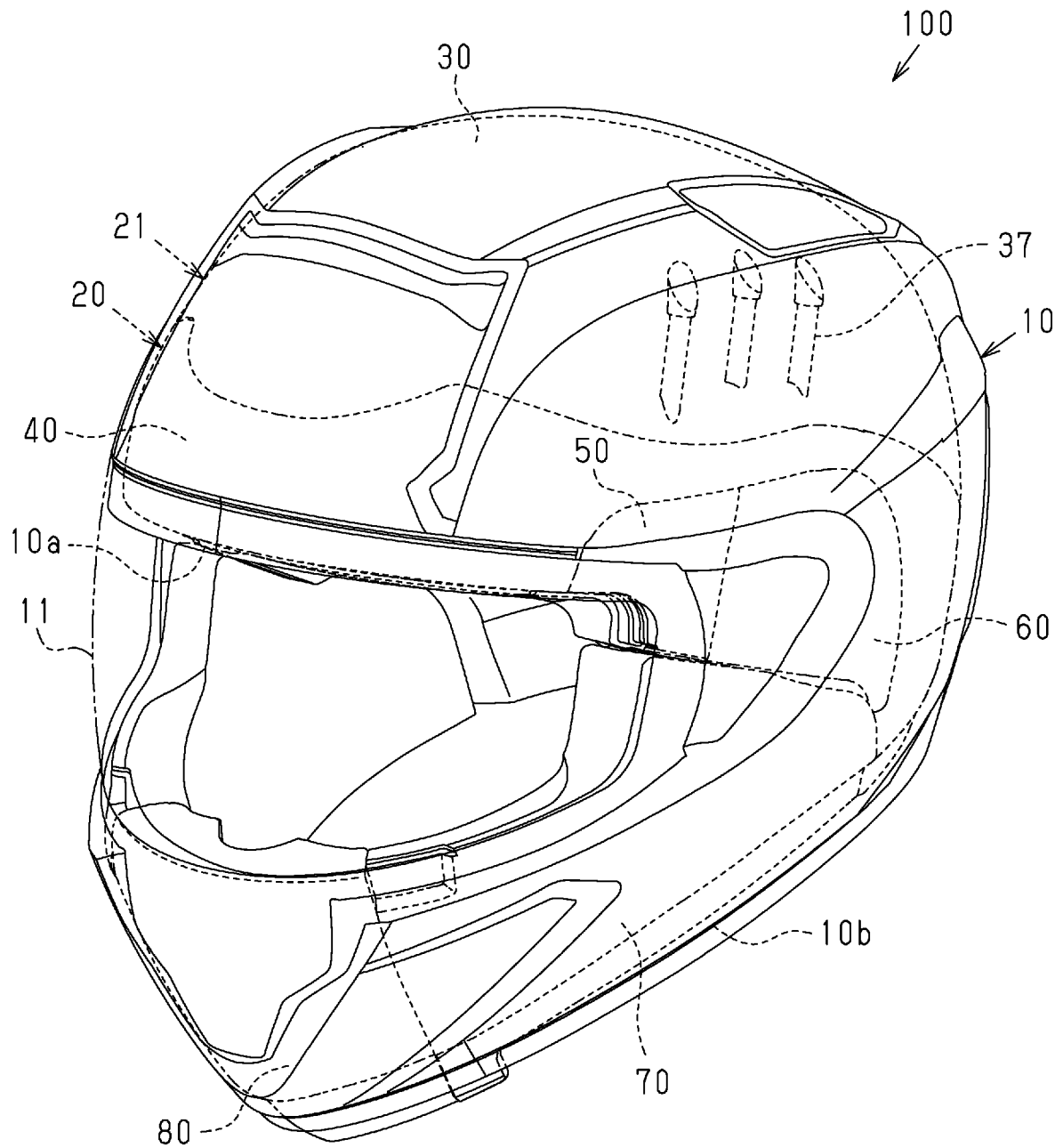


Fig.11

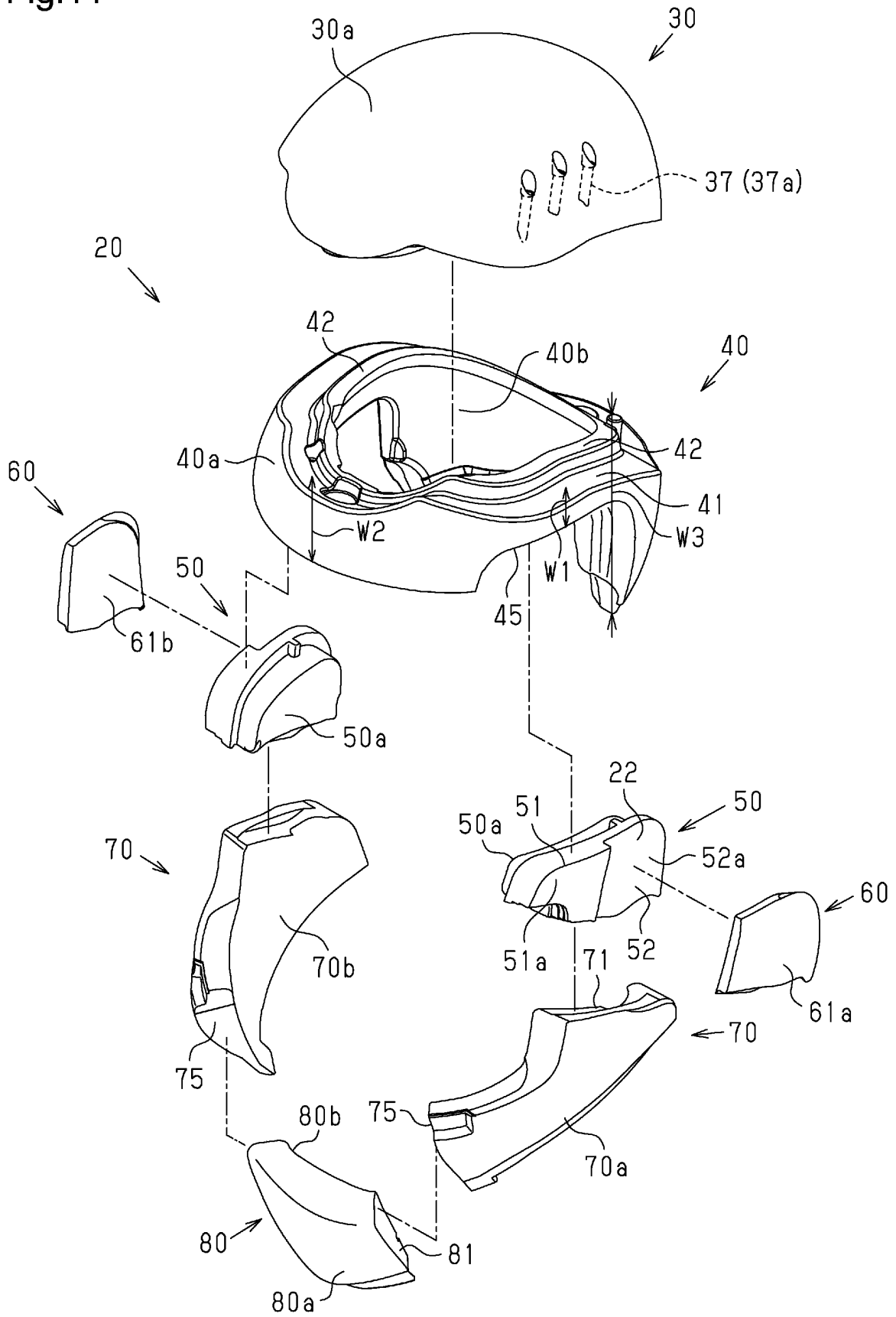


Fig.12

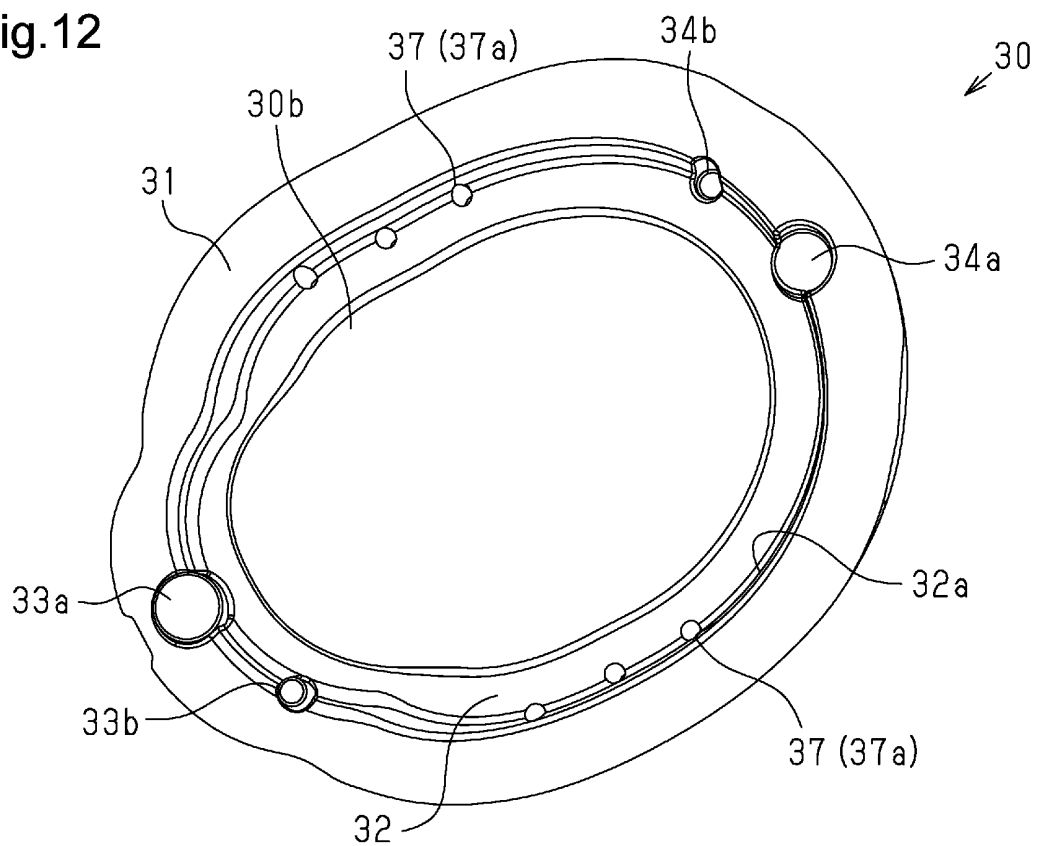


Fig.13

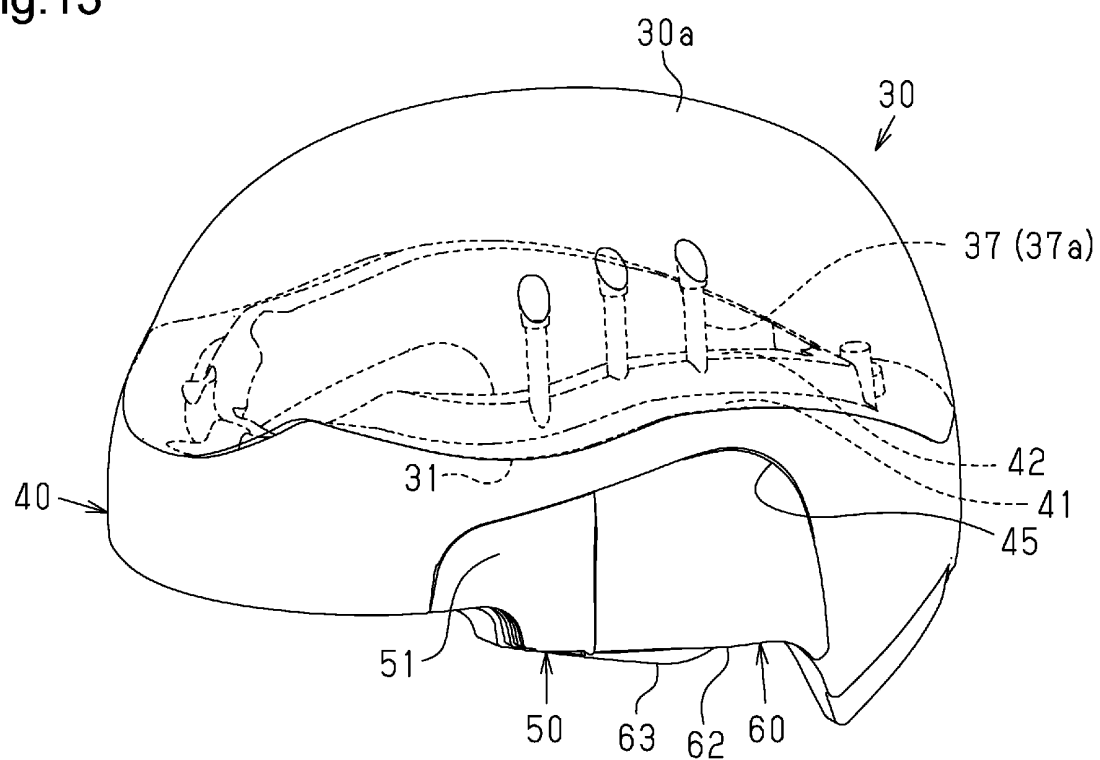


Fig.14

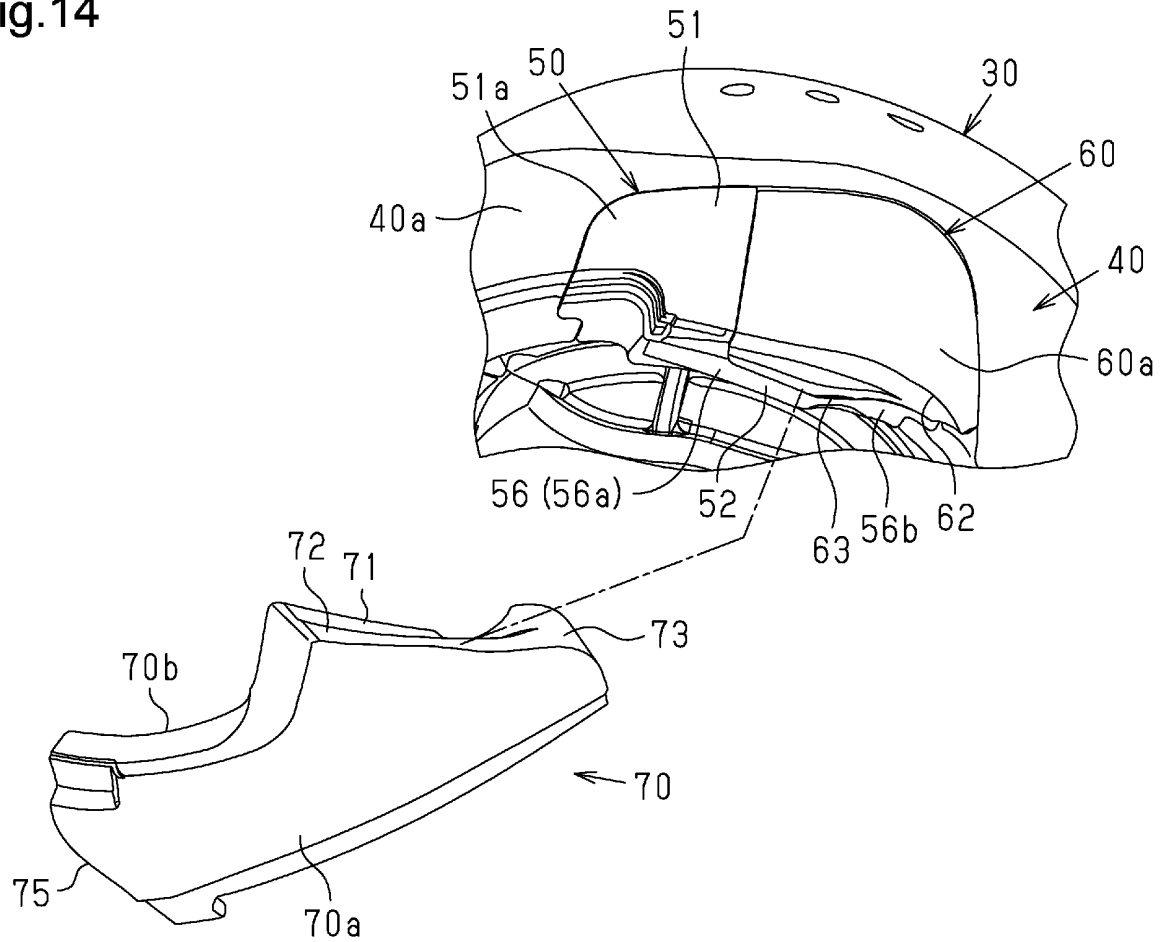


Fig.15

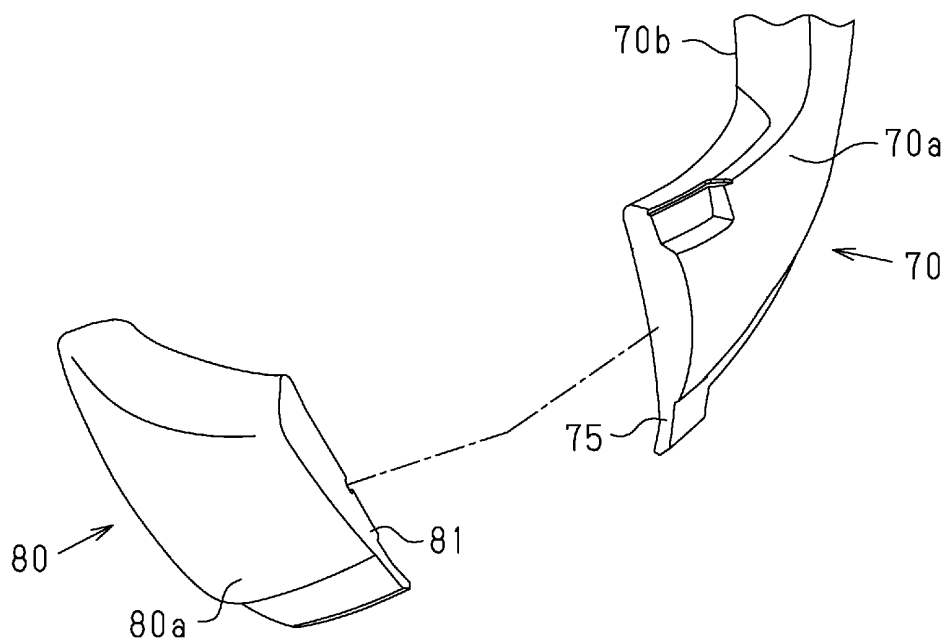


Fig.16

Size	First Member 30	Second Member 40	Third Member 50	Inserted Member 60	Fourth Member 70	Fifth Member 80
S	1	3	5	5	6	6
M	2	3	6	5	6	7
L	2	4	6	5	7	8
XL	3	5	7	5	7	8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2021/035640

A. CLASSIFICATION OF SUBJECT MATTER <i>A42B 3/12</i> (2006.01)i FI: A42B3/12 According to International Patent Classification (IPC) or to both national classification and IPC																											
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) A42B3/12 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2021 Registered utility model specifications of Japan 1996-2021 Published registered utility model applications of Japan 1994-2021 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)																											
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>JP 2000-080514 A (HONDA ACCESS CORP.) 21 March 2000 (2000-03-21) paragraph [0029], fig. 1-7</td> <td>1-2, 4-5, 18</td> </tr> <tr> <td>Y</td> <td></td> <td>17</td> </tr> <tr> <td>A</td> <td></td> <td>3, 6-16</td> </tr> <tr> <td>Y</td> <td>JP 2001-295129 A (HONDA MOTOR CO., LTD.) 26 October 2001 (2001-10-26) paragraph [0031], fig. 9</td> <td>17</td> </tr> <tr> <td>A</td> <td></td> <td>1-16, 18</td> </tr> <tr> <td>A</td> <td>JP 62-069811 A (YAMAHA MOTOR CO., LTD.) 31 March 1987 (1987-03-31) entire text, all drawings</td> <td>1-18</td> </tr> <tr> <td>A</td> <td>JP 2009-209502 A (ARAI HELMET LTD.) 17 September 2009 (2009-09-17) entire text, all drawings</td> <td>1-18</td> </tr> <tr> <td>A</td> <td>US 2020/0060374 A1 (GLOVER et al.) 27 February 2020 (2020-02-27) entire text, all drawings</td> <td>1-18</td> </tr> </tbody> </table>	Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	JP 2000-080514 A (HONDA ACCESS CORP.) 21 March 2000 (2000-03-21) paragraph [0029], fig. 1-7	1-2, 4-5, 18	Y		17	A		3, 6-16	Y	JP 2001-295129 A (HONDA MOTOR CO., LTD.) 26 October 2001 (2001-10-26) paragraph [0031], fig. 9	17	A		1-16, 18	A	JP 62-069811 A (YAMAHA MOTOR CO., LTD.) 31 March 1987 (1987-03-31) entire text, all drawings	1-18	A	JP 2009-209502 A (ARAI HELMET LTD.) 17 September 2009 (2009-09-17) entire text, all drawings	1-18	A	US 2020/0060374 A1 (GLOVER et al.) 27 February 2020 (2020-02-27) entire text, all drawings	1-18
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Date of the actual completion of the international search 28 October 2021	Date of mailing of the international search report 14 December 2021																										
Name and mailing address of the ISA/JP Japan Patent Office (ISA/JP) 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915 Japan	Authorized officer Telephone No.																										

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/JP2021/035640

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2000-080514 A	21 March 2000	(Family: none)	
JP 2001-295129 A	26 October 2001	US 2001/0032351 A1 paragraph [0041], fig. 9	
JP 62-069811 A	31 March 1987	(Family: none)	
JP 2009-209502 A	17 September 2009	US 2009/0222977 A1 entire text, all drawings	
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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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