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Vehicle Fender Structure

ABSTRACT

By fastening a bolt (38) to a nut (40), a sloping wall portion (14B) of a fender (14) and a sloping wall portion (26F) of an apron upper member upper (26) are sandwiched between a bottom piece portion (36A) and a top piece portion (36B) of a nut plate (36), resulting in the sloping wall portion (14B) of the fender (14) being fixed at the top portion (32B) of a hole (32) to the sloping wall portion (26F) of an apron upper member upper (26). Therefore, the fender (14) and both the nut plate (36) and bolt (38) are moved substantially downward by an impact load from a substantially upward direction relative to the apron upper member (24), as is shown by the double dot chain line.



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ORIGINAL

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Invention Title:	Vehicle Fender Structure

The following statement is a full description of this invention, including the best method of performing it known to me/us:-

VEHICLE FENDER STRUCTURE

BACKGROUND OF THE INVENTION

1. Field of the Invention

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The invention relates to the structure of a fender portion of a vehicle and, in particular, to the structure of a fender portion of a vehicle in which a fender is attached to a structural member of a vehicle such as an automobile.

2. Description of the Related Art

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An example of a structure for a vehicle fender in which the fender is attached to a structural member of a vehicle such as an automobile is given in Japanese Utility Model Laid-Open Publication No. 6-27449.

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As is shown in Fig. 47, in this vehicle fender structure, a plurality of angular holes 404 are punched in a step portion 402 formed in a wall portion 400A on the inner side in the vehicle transverse direction of a front fender 400 and angular portions 404A of the angular holes 404 are matched at break line portions 402A of the step portion 402. Therefore, in this front fender 400, the break line portions 402A are easily deformed due to the forming of the angular portions 404A and, as is shown by the double dot chain line in Fig. 47, there is a large amount of deformation in a vertex 406 of the front fender 400 which corresponds to the angular holes 404. As a result, in this vehicle fender structure even if a colliding body impacts on the vertex 406 of the front fender 400, which corresponds to the angular holes 404, it is possible for the impact energy to be

reliably absorbed.

5 However, this type of vehicle fender structure is structured so that, if a colliding body (impactor) impacts or strikes on the vertex 406 of the front fender 400 which corresponds to the angular holes 404, or if a colliding body impacts on the vertex 406 of the front fender 400 which does not correspond to the angular holes 404, the wall portion 400A on the inner side in the vehicle transverse direction of a front fender 400 is deformed by buckling in the vertical direction thereby absorbing the impact energy. As a result of this, there is a large amount of buckling deformation in the vertical direction in the wall portion on the inner side in the transverse direction of the vehicle generated by the impact load substantially from above (i.e. from the direction shown by the arrow F in Fig. 47). Because, however, there is a limit on the amount of buckling deformation in the vertical direction in the wall portion 400A on the inner side in the vehicle transverse direction of the front fender 400, it is easy for the impact load to exceed this amount of buckling deformation in the vertical direction in the inner wall portion 400A, and the load increase in the moments when the buckling deformation of the inner wall portion 400A is about to end. Accordingly, in this vehicle fender structure, when the impact load substantially from above is great, it is possible that the performance to mitigate the impact force is lowered.

OBJECT OF THE INVENTION

25 It is an object of this invention to provide a fender structure for a vehicle in which the performance to mitigate the impact force is improved, or at least to provide a useful alternative to existing vehicle fender structures.



The invention provides a fender portion structure of a vehicle comprising:

a structural member of said vehicle;

a mounting member, and

a fender mounted on said structural member by way of said mounting member, wherein said mounting member is displaceable relative to one of said structural member and said fender upon application of an impact load to said fender in a substantially downward direction so as to move said fender relative to said structural member.

Therefore,

because a portion of the impact energy can be absorbed by this movement, it is possible to reduce the amount of buckling deformation in the fender generated by the impact load. As a result, because it is possible to absorb the impact energy within the range in which buckling deformation is possible in the fender, a low deformation load is obtained until the end of the deformation and the performance to mitigate the impact force can be improved.

In the above aspect, it is possible for the mounting member to comprise a nut plate and a fastening bolt, and for a hole to be formed in the structural member such that the mounting member is capable of being moved by an impact load from a substantially upward direction.

If this structure is employed, when an impact load is applied from a substantially upward direction, the fastening bolt and the nut plate serving as mounting members are moved easily via the



hole formed in the structural member in the shearing direction of the fastened portion, relative to the structural member.

5 In the above aspect, it is possible for the mounting member to comprise a nut that is fixed to the structural member and a fastening bolt, and for a hole to be formed in the fender such that the fender is capable of being moved relative to the mounting member by an impact load from a substantially upward direction.

10 If this structure is employed, when an impact load is applied substantially from an upward direction, the fender nut is able to move easily in the shearing direction of the fastened portion relative to the nut fixed to the structural member and the fastening bolt via the hole formed in the fender.

15 A second structure disclosed is a structure for a fender portion of a vehicle in which a fender is mounted on a structural member of a vehicle, wherein the fender portion structure is provided with a first deforming portion in the fender that is deformed by an impact load from a substantially upward direction, a second deforming portion in the structural member that is deformed by an impact load from a substantially upward direction, and a deformation suppressing means that suppresses a deformation of the first deforming portion and the second deforming portion at a predetermined load or less.

20 Accordingly, because it is possible to absorb a portion of the impact energy caused by an impact load from a substantially upward direction through deformation of both the first deforming portion in the fender and the second deforming portion in the structural member, it is possible to reduce the amount of buckling



deformation in the fender generated by the impact load. As a result, because it is possible to absorb the impact energy within the range in which buckling deformation is possible in the fender, a low deformation load is obtained until the end of the deformation and the performance to mitigate the impact force can be improved. Moreover, because it is possible to suppress both the deformation of the first deforming portion and the second deforming portion through the deformation suppressing portion at a predetermined load or less, it is possible to secure a predetermined rigidity.

In the above second structure, it is possible for the first deforming portion to be a tongue shaped piece in the fender and the second deforming portion to be a tongue shaped piece in the structural member, and the deformation suppressing means to be a supporting piece provided below the tongue shape piece in the structural member.

If this structure is employed, the structure is simple and therefore easily manufactured.

Further, it is possible for the tongue shaped piece in the structural member to be provided with a weakened portion that acts as a trigger for deformation.

If this structure is employed, because it is possible for the deformation of the tongue shaped piece to be further accelerated by the weakened portion, the performance to mitigate the impact force can be further improved.

A third structure disclosed is a structure for a fender portion of a vehicle in which a fender is mounted on a structural



member of a vehicle, wherein the fender portion structure is provided with a weakened portion on an outside surface in the vehicle transverse direction of the fender that becomes the base point of deformation caused by an impact load from a substantially upward direction, and with a linking member that links the vicinity of the weakened portion with the structural member.

Accordingly, the fender is deformed by an impact load from a substantially upward direction with the weakened portion in the vehicle outer side surface as a base point. At this time, because the linking member linking the vicinity of the weakened portion with the structural member becomes a support pillar and the weakened portion of the fender definitely becomes the base point of the deformation, it is possible to reduce the amount of buckling deformation of the fender generated by the impact load.

As a result, because it is possible to absorb the impact energy within the range in which buckling deformation is possible of the fender, it is possible to obtain a low deformation load until the end of the deformation and the performance to mitigate the impact force is improved.

In the above third structure, it is possible for the weakened portion to be a concave groove extending in the longitudinal direction of the vehicle.

If this structure is employed, it is possible to improve the performance to mitigate the impact force across the entire longitudinal length of the vehicle through the concave groove provided extending in the vehicle longitudinal direction.

Further, it is possible for an ornamental molding to be attached



to the concave groove.

If this structure is employed, the concave groove can double as a concave groove for attaching the ornamental molding and as the weakened portion which becomes the base point of the deformation of the fender.

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A fourth structure disclosed is a structure for a fender portion of a vehicle in which a fender is mounted on a structural member of a vehicle, wherein a height in the vertical direction of the vehicle where the mounting portion of the fender is mounted on the structural member is set lower than a height in the vertical direction of the vehicle of a top surface of the structural member, and a portion that is thinner in the vertical direction of the vehicle than a framework of a hood is provided above the top surface of the structural member.

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Accordingly, even if the cross section of the vehicle structural member or the cross section of the framework portion of the hood are enlarged and the rigidities thereof ensured, there is no interference between the structural member and the framework of the hood when an impact load is applied from a substantially upward direction. Also, it is possible to receive an impact load in the hood that is fixed to the vehicle body by the left and right side hinges placed toward the rear of the vehicle body and the lock portion placed in the center of the hood toward the front of the vehicle, and that is elastically deformable around the fulcrums of the hinges and lock. Namely, it is possible to increase the range of dependency centered solely on the ability of the hood to soften impact regardless of the ability of the fender

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to soften the impact, thereby enabling the performance to mitigate the impact force to be improved.

In the above fourth structure, it is possible for rigidity ensuring means to be provided in an area of the hood facing the mounting portion of the fender.

If this structure is employed, it is possible to ensure the rigidity for holding the shape necessary in the endpoint on the vehicle outer side of the hood by the rigidity ensuring means.

In the above structure, it is possible for the rigidity ensuring means to be a flange portion that hangs down and is formed at an endpoint on the vehicle outer side of the hood.

If this structure is employed, by forming the rigidity ensuring means from the flange portions that are formed hanging down from the endpoints on the vehicle outer side of the hood, the structure is simplified.

Further, it is possible for the rigidity ensuring means to be a hood auxiliary framework that is formed at an outer side in the transverse direction of the vehicle of the thinly formed hood portion and whose thickness in the vertical direction of the vehicle is thicker than the thinly formed hood portion.

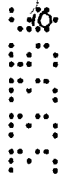
If this structure is employed, by forming the rigidity ensuring means as a hood auxiliary framework that is formed at the vehicle outer side of the thinly formed hood portion and whose thickness in the vertical direction of the vehicle is thicker than the thinly formed hood portion, it is possible to secure sufficient rigidity of the endpoints on the vehicle outer side of the hood.

In the above fourth structure, it is possible for the fender to be



provided with a sloping surface in an inner wall portion in the transverse direction of the vehicle that slopes from the outer side of the vehicle at the top to the inner side of the vehicle at the bottom.

5 If this structure is employed, because only the endpoints of the hood interfere with the sloping surface of the fender and are deformed when an impact load is received from a substantially upward direction, a further reduction in the impact load is achieved.



In the above fourth structure, it is also possible for the fender to be provided with a substantially triangular shaped convex rib in an inner wall portion in the transverse direction of the vehicle that runs toward an inner side in the vehicle transverse direction.

15 If this structure is employed, because only the endpoints of the hood interfere with the substantially triangular convex ribs, which are formed in the inner wall portion in the vehicle transverse direction of the fender running toward the vehicle inner side, and are deformed when an impact load is received from a substantially upward direction, a further reduction in the impact load is achieved.



25 A fifth structure disclosed is a structure for a fender portion of a vehicle in which a fender is mounted on a structural member of a vehicle, wherein the structure is provided with component force generating means for separating force input into a fender from a substantially upward direction into plurality of component forces that are offset in the transverse direction of



the vehicle and thus controlling the directions in which the fender is crushed.

Accordingly, by using a component force generating means to separate the input into the fender from a substantially upward direction into a plurality of component forces that are offset in the vehicle transverse direction, it is possible to control the directions in which the fender is crushed. As a result, if the vehicle body is constructed such that, upon an input from a substantially upward direction being received by the fender, the hood and the fender interfere with each other and the deformation load increases, the direction in which the fender is crushed is controlled so as to be a direction in which the hood and the fender do not interfere with each other. Therefore, it is possible to suppress any increase in the deformation load and to

improve the performance to mitigate the impact force. If, however, the vehicle body is constructed such that deformation load in the fender increases when the amount of deformation of the fender increases, then the direction in which the fender is crushed is controlled so as to be a direction in which the fender deformation load does not increase. Therefore, it is possible to suppress any increase in the deformation load and to improve the performance to mitigate the impact force.

In the above fifth structure, it is possible for the component force generating means to comprise at least two linking wall portions that face each other in the transverse direction of the vehicle.

If this structure is employed, it is possible to improve the



performance to mitigate the impact force easily by adjusting the deformation shape of at least two linking wall portions that face each other in the transverse direction of the vehicle.

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It is also possible for the linking wall portions to be integral with the fender.

If this structure is employed, by forming the linking wall portions integrally with the fender, the number of parts can be decreased and the ease of assembly thereby improved.

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In the above aspect, it is also possible for at least one of the linking wall portions not to be formed rectilinearly as seen from the front of the vehicle.

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If this structure is employed, it is possible to make the fender deform in a predetermined direction by causing the linking wall portion which is not rectilinear as seen from the front of the vehicle to deform with a bend point as a base point and to thereby easily adjust the direction of the deformation.

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In the above aspect, it is also possible for, in the linking wall portions, two facing linking wall portions not to be formed rectilinearly as seen from the front of the vehicle.

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If this structure is employed, it is possible to make the fender deform in a predetermined direction by causing the two facing linking wall portions which are not rectilinear as seen from the front of the vehicle to deform with the bend point of each as a base point and to thereby easily adjust the direction of the deformation.

Furthermore, it is possible, in the linking wall portions, for the positions in the vertical direction of respective bend points

of two facing linking wall portions to be different from each other.

5 If this structure is employed, by setting the positions in the vertical direction of respective bend points of two facing linking wall portions to be different from each other while considering the load generated by the interference between the hood and the fender and the load generated by the deformation of the fender, it is possible to easily adjust the deformation configuration of the linking wall portions.

10. Moreover, in the above structure, it is possible, in the linking wall portions, to set the respective bending directions of the two facing linking wall portions to be different from each other in the transverse direction of the vehicle.

15 If this structure is employed, by setting the respective bending directions of the respective bend points of the two facing linking wall portions to be different directions from each other in the transverse direction of the vehicle while considering the load generated by the interference between the hood and the fender and the load generated by the deformation of the fender, it is possible to easily adjust the deformation configuration of the linking wall portions.

25 A sixth structure disclosed is a structure for a fender portion of a vehicle in which a fender is mounted on a structural member of a vehicle, wherein the structure is provided with: a general surface between the structural member and a parting portion between the hood that is formed as a sloping wall portion that slopes downward toward the inner side in the vehicle



transverse direction; a fender panel whose attachment portion where the fender panel attaches to the structural member is substantially horizontal; and, between the sloping wall portion and the mounting portion, with a folding portion that is folded by a load from a substantially upward direction and a hole that is contracted when the folding portion is folded.

Accordingly, because the portion for mounting on the structural member is not provided on a sloping wall portion as in the conventional structure, the engine room is not made any smaller by protruding of the mounting portion of the fender panel toward the inner side in the vehicle transverse direction. Moreover, when a load is applied from a substantially upward direction, the folding portion between the sloping wall portion and the mounting portion is folded and the hole portion is contracted, resulting in the deformation load being reduced. Therefore, the ability to absorb impact is improved.

In the above sixth aspect, it is also possible for the folding portions to be provided at least to the front and rear in the longitudinal direction of the vehicle of the mounting portion, and for the hole portion to be provided at an outer side in the vehicle transverse direction of the mounting portion.

If this structure is employed, because the portion for mounting on the structural member is not provided on a sloping wall portion as in the conventional structure, the engine room is not made any smaller by protruding of the mounting portion of the fender panel toward the inner side in the vehicle transverse direction. Moreover, when an impact load is applied from a substantially

upward direction, the folding portions provided at least to the front and rear sides of the mounting portion are folded and absorb the impact and the hole portion provided at the outer side in the vehicle transverse direction of the mounting portion is contracted, resulting in the deformation load being reduced. Therefore, the ability to absorb impact is improved.

In the above aspect, it is also possible for the length of a straight line between a bottom end and a top end of the folding portion before it is folded to be substantially equal to that of a straight line between a bottom end and a top end of the folding portion after it is folded.

If this structure is employed, when the folding portion is folded, the deformation load can be reliably reduced without any new bent portion being created.

In the above aspect, it is also possible for a recessed portion to be provided in an area opposing the folding portion of the structural member.

If this structure is employed, because a portion of the folding portion enters, when it is folded, the recessed portion, a portion of the folding portion abuts against the structural member and any further bending is prevented, therefore, the deformation load is further reduced.

In the above sixth aspect, it is also possible for the folding portion to be provided at an outer side in the vehicle transverse direction of the mounting portion, and the for hole portions to be provided to the front and rear in the longitudinal direction of the vehicle of the mounting portion.

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If this structure is employed, because the portion for mounting on the structural member is not provided on a sloping wall portion as in the conventional structure, the engine room is not made any smaller by protruding of the mounting portion of the fender panel toward the inner side in the vehicle transverse direction.

Moreover, when an impact load is applied from a substantially upward direction, the folding portion provided at least to the outer side in the vehicle transverse direction of the mounting portion is folded and absorbs the impact and the hole portion provided to the front and rear sides of the mounting portion is contracted, resulting in the deformation load being reduced. Therefore, the ability to absorb impact is improved.

Furthermore, it is possible for the folding portion to be formed separately from the fender panel.

By employing the above structure, the shape of the folding portion can be set without having to consider the formability of the fender panel.

BRIEF DESCRIPTION OF THE DRAWINGS

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Fig. 1 is a cross sectional view along the line I - I in Fig. 3;

Fig. 2 is an enlarged perspective view of a portion of the vehicle fender structure according to the first embodiment of the invention;

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Fig. 3 is a perspective view showing a vehicle to which the vehicle fender structure according to the first embodiment of the invention has been applied;

Fig. 4 is a cross sectional view corresponding to Fig. 1 showing the vehicle fender structure according to the second embodiment of the invention;

5 Fig. 5 is an enlarged perspective view of a portion of the vehicle fender structure according to the second embodiment of the invention;

Fig. 6 is a cross sectional view corresponding to Fig. 1 showing the vehicle fender structure according to the third embodiment of the invention;

10 Fig. 7 is an enlarged perspective view of a portion of the vehicle fender structure according to the third embodiment of the invention;

15 Fig. 8 is an enlarged perspective view of a portion of the vehicle fender structure according to a modified example of the third embodiment of the invention;

20 Fig. 9 is a cross sectional view corresponding to Fig. 1 showing the vehicle fender structure according to the fourth embodiment of the invention;

25 Fig. 10 is an enlarged perspective view of a portion of the vehicle fender structure according to the fourth embodiment of the invention;

Fig. 11 is a cross sectional view along the line XI - XI in Fig. 13;

30 Fig. 12 is an enlarged perspective view of a portion of the vehicle fender structure according to the fifth embodiment of the invention;

Fig. 13 is a perspective view showing a vehicle to which the

vehicle fender structure according to the fifth embodiment of the invention has been applied;

Fig. 14 is a cross sectional view corresponding to Fig. 11 showing the vehicle fender structure according to the sixth embodiment of the invention;

Fig. 15 is an enlarged perspective view of a portion of the vehicle fender structure according to the sixth embodiment of the invention;

Fig. 16 is a cross sectional view corresponding to Fig. 11 showing the vehicle fender structure according to the seventh embodiment of the invention;

Fig. 17 is a cross sectional view corresponding to Fig. 11 showing the vehicle fender structure according to a variant example of the seventh embodiment of the invention;

Fig. 18 is a cross sectional view along the line XVIII - XVIII in Fig. 21;

Fig. 19 is a cross sectional view showing a modified state of the vehicle fender structure according to the eighth embodiment of the invention;

Fig. 20 is an enlarged perspective view showing a portion of the vehicle fender structure according to the eighth embodiment of the invention;

Fig. 21 is a perspective view showing a vehicle to which the vehicle fender structure according to the eighth embodiment of the invention has been applied;

Fig. 22 is a cross sectional view corresponding to Fig. 18 showing the vehicle fender structure according to the ninth

embodiment of the invention;

Fig. 23 is a cross sectional view showing a modified state of the vehicle fender structure according to the ninth embodiment of the invention;

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Fig. 24 is a cross sectional view corresponding to Fig. 18 showing the vehicle fender structure according to the tenth embodiment of the invention;

Fig. 25 is a cross sectional view showing a modified state of the vehicle fender structure according to the tenth embodiment of the invention;

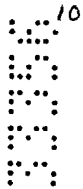
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Fig. 26 is an enlarged perspective view showing a portion of the vehicle fender structure according to the tenth embodiment of the invention;

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Fig. 27 is a cross sectional view corresponding to Fig. 18 showing the vehicle fender structure according to the eleventh embodiment of the invention;

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Fig. 28 is a cross sectional view showing a modified state of the vehicle fender structure according to the eleventh embodiment of the invention;

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Fig. 29 is an enlarged perspective view showing a portion of the vehicle fender structure according to another embodiment of the invention;

Fig. 30 is a cross sectional view corresponding to Fig. 18 showing the vehicle fender structure according to another embodiment of the invention;

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Fig. 31 is a cross sectional view corresponding to Fig. 18 showing the vehicle fender structure according to another

embodiment of the invention;

Fig. 32 is a cross sectional view corresponding to Fig. 18 showing the vehicle fender structure according to another embodiment of the invention;

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Fig. 33 is a cross sectional view corresponding to Fig. 18 showing the vehicle fender structure according to another embodiment of the invention;

Fig. 34 is a cross sectional view corresponding to Fig. 18 showing the vehicle fender structure according to another embodiment of the invention;

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Fig. 35 is a cross sectional view corresponding to Fig. 18 showing the vehicle fender structure according to another embodiment of the invention;

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Fig. 36 is a cross sectional view corresponding to Fig. 18 showing the vehicle fender structure according to another embodiment of the invention;

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Fig. 37 is an enlarged perspective view showing the vehicle fender structure according to another embodiment of the invention;

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Fig. 38 is a perspective view seen from a point diagonally to the front of and from the inner side of a vehicle showing the vehicle fender structure according the twelfth embodiment of the invention;

Fig. 39 is a cross sectional view along the line XXXIX - XXXIX in Fig. 42;

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Fig. 40 is an enlarged cross sectional view along the line XL - XL in Fig. 39;

Fig. 41 is an operation explanatory diagram of the vehicle

fender structure according the twelfth embodiment of the invention;

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Fig. 42 is a perspective view showing a vehicle to which the vehicle fender structure according to the twelfth embodiment of the invention has been applied;

Fig. 43 is a perspective view seen from a point diagonally to the front of and from the inner side of a vehicle showing the vehicle fender structure according the thirteenth embodiment of the invention;

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Fig. 44 is a perspective view seen from a point diagonally to the front of and from the inner side of a vehicle showing the vehicle fender structure according the fourteenth embodiment of the invention;

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Fig. 45 is a perspective view seen from a point diagonally to the front of and from the inner side of a vehicle showing the vehicle fender structure according the fourteenth embodiment of the invention;

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Fig. 46 is an enlarged cross sectional view along the line XLVI - XLVI in Fig. 45; and

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Fig. 47 is a side view showing a vehicle fender structure.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A first embodiment of the vehicle fender structure of the invention will now be described in accordance with Figs. 1 to 3.

Note that, in the diagrams, the arrow FR shows the direction of

the front of the vehicle, the arrow UP shows the direction of the top of the vehicle, and the arrow IN shows the direction of the inside of the vehicle.

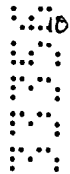
5 As is shown in Fig. 3, in this embodiment, a boundary 16 between a hood panel 12 and a fender 14 of a vehicle body 10 extends in the longitudinal direction of the vehicle at both end portions in the transverse direction of the vehicle of a front hood 18.

10 As is shown in Fig. 1, a hood inner panel 20 is provided extending in the vehicle longitudinal direction at the bottom surface side of the outer side portions in the vehicle transverse direction of the hood panel (also known as the hood outer panel) 12. The cross sectional configuration of the hood inner panel 20 as seen from the vehicle longitudinal direction is formed
15 generally in a hat shape with the open portion thereof facing upward. An inner flange 20A formed protruding outward at the inner side in the vehicle transverse direction of the open portion is joined to a bottom surface 12A of the hood panel 12 by an adhesive 13. An outer peripheral edge 12B of the hood panel 12 in the vehicle transverse direction is fixed by a hemming process to an outer flange 20B formed protruding outward at the outer side in the vehicle transverse direction of the open portion of the hood inner panel 20. A closed cross section portion 21 formed from the hood panel 12 and the hood inner panel 20 forms the framework of
20 the hood panel 12 and is also provided with load monodeformation characteristics capable of absorbing sufficient impact even if a colliding body S collides with only the hood panel 12.

An apron upper member 24 which serves as a structural member of

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the vehicle body 10 in the vehicle longitudinal direction is provided below the boundary 16 between the hood panel 12 and the fender 14. The apron upper member 24 is formed from an apron upper member upper 26, which forms the top portion of the apron upper member 24, and an apron upper member lower 28, which forms the bottom portion of the apron upper member 24.

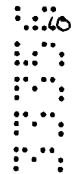


The apron upper member upper 26 is formed with a trapezoid shaped cross section whose open portion faces downward and a flange 26B, which is directed toward the outer side in the vehicle transverse direction, is formed at the bottom end portion of the outer wall portion 26A in the vehicle transverse direction. The apron upper member lower 28 is formed with an L shaped cross section and a horizontal wall portion 28B, which is directed toward the outer side in the vehicle transverse direction, is formed at the top end portion of a vertical wall portion 28A. The flange 26B of the apron upper member upper 26 and a distal end portion 28C of the horizontal wall portion 28B of the apron upper member lower 28 are welded together. A bottom end edge portion 26D of an inner wall portion 26C in the vehicle transverse direction of the apron upper member upper 26 is welded to an inner surface 28D in the vehicle transverse direction of the top end edge portion of the vertical wall portion 28A of the apron upper member lower 28.

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Accordingly, the apron upper member 24 forms a closed cross sectional portion 30 that extends in the vehicle longitudinal direction through the apron upper member upper 26 and the apron upper member lower 28.

5 As is shown in Fig. 2, the top end portion of the inner wall portion 26C in the vehicle transverse direction and the inner end portion in the vehicle transverse direction of a top wall portion 26E of the apron upper member upper 26 are joined by a sloping wall portion 26F. Holes 32 are formed at predetermined intervals in the vehicle longitudinal direction in the sloping wall portion 26F. A bottom portion 32A of these holes 32 is formed in a rectangular shape with the bottom portion of the bottom portion 32A punched out of the top end portion of the inner side wall portion 26C in the vehicle transverse direction. The top portion 32B of the holes 32 is formed in a slit shape extending vertically from the center portion in the longitudinal direction of the bottom portion 32A.



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15 As is shown in Fig. 1, the inner edge portion 14A in the vehicle transverse direction of the fender 14 facing the outer edge portion 12B in the vehicle transverse direction of the hood panel 12 is curved in an arc shape, and a sloping wall portion 14B is provided extending from an inner edge portion 14A in the vehicle transverse direction toward the sloping wall portion 26F of the apron upper member upper 26.

25 As is shown in Fig. 2, mounting holes 34 are punched at predetermined intervals in the vehicle longitudinal direction in the vicinity of the lower end portion of the sloping wall portion 14B in the fender 14. Nut plates 36 serving as mounting members are fixed by bolts 38 serving as mounting members to the mounting holes 34.

As is shown in Fig. 1, nuts 40 are fixed to a bottom piece 36A

of the nut plate 36. By fastening the bolts 38 from a top piece 36B of the nut plate 36 to the nuts 40, the sloping wall portion 14B of the fender 14 and the sloping wall portion 26F of the apron upper member upper 26 are sandwiched between the top piece 36B and the bottom piece 36A of the nut plate 36. This results in the sloping wall portion 14B of the fender 14 being fixed to the sloping wall portion 26F of the apron upper member upper 26.

The operation of this embodiment will now be described.

As is shown by the solid line in Fig. 1, in a normal state, by sandwiching the sloping wall portion 14B of the fender 14 and the sloping wall portion 26F of the apron upper member upper 26 between the top piece 36B and the bottom piece 36A of the nut plate 36, the sloping wall portion 14B of the fender 14 is fixed to the sloping wall portion 26F of the apron upper member upper 26, therefore, the fender can be reliably supported.

If, however, a colliding body S collides with the boundary 16 between the hood panel 12 and the fender 14 and the load acts substantially from an upward direction in substantially a downward direction (i.e. in the direction shown by the arrow A in Fig. 1), the area in the vicinity of the boundary 16 of the hood panel 12 and the area in the vicinity of the boundary 16 of the fender 14 is deformed downward, as is shown by the double dot chain line in Fig. 1.

At this time, in the vehicle fender structure of this embodiment, both the fender 14 and the mounting member comprising the bolt 38 and nut plate 36 are moved by the impact load from a substantially upward direction substantially downward, as is shown by the double

dot chain line in Fig. 1, relative to the apron upper member 24 serving as a structural member. Therefore, because it is possible by this movement to absorb a portion of the impact energy, it is possible to reduce the amount of deformation of a buckling deformation area 14C of the fender 14 generated by the impact load. As a result, because it is possible to absorb the impact energy within the range in which buckling deformation is possible of the fender 14, it is possible to obtain a low deformation load until the end of the deformation and the performance to mitigate the impact force is improved.

Furthermore, in this embodiment, when an impact load acts substantially from an upward direction, the nut plate 36 and bolt 38 serving as mounting members are able to move easily in the shearing direction of the fastened portion (i.e. the direction indicated by the arrow B in Fig. 1) through the hole 32 formed in the apron upper member 24 serving as a structural member.

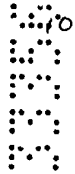
Note that, because the force by which the bolt 38 is fastened is controlled such that the nut plate 36 and bolt 38 are able to be easily moved in the direction in which the fastened portion is sloping by an impact load substantially from above, the bolt 38 is fastened with a predetermined torque and, if necessary, a shoulder bolt is used.

Next, a second embodiment of the vehicle fender structure of the invention will be described in accordance with Figs. 4 and 5.

Note that those members that are the same as in the first embodiment are given the same reference symbols and a description thereof is omitted.

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As is shown in Fig. 5, in this embodiment, mounting holes 44 are formed at predetermined intervals in the vehicle longitudinal direction on the top portion of the sloping wall portion 26F of the apron upper member upper 26, and nuts 46 serving as mounting members are fixed coaxially with the mounting holes 44 to the bottom surface of the sloping wall portion 26F.



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A vertical wall portion 14D is formed at the center portion in the vertical direction of the sloping wall portion 14B of the fender 14, and holes 48 are formed at predetermined intervals in the vehicle longitudinal direction in the vertical wall portion 14D. A top portion 48A of each hole 48 is formed in a rectangular shape in the vertical wall portion 14D while a bottom portion 48B is formed in the bottom end portion 14E of the sloping wall portion 14B in a slit shape that extends downward from the center portion in the longitudinal direction of the top portion 48A.

As is shown in Fig. 4, by inserting a bolt 50 serving as a mounting member in the bottom portion 48B of the hole 48 and meshing this bolt 50 with the nut 46, the bottom end portion 14E of the sloping wall 14B of the fender 14 is sandwiched between the bolt 50 and the sloping wall portion 26F of the apron upper member upper 26, thereby fixing the fender 14 to the sloping wall portion 26F of the apron upper member upper 26.

Next, the operation of this embodiment will be described.

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As is shown in Fig. 4, in a normal state, because the bottom end portion 14E of the sloping wall portion 14B of the fender 14 is sandwiched between the bolt 50 and the sloping wall portion 26F of the apron upper member upper 26 thereby fixing the fender 14 to

the sloping wall portion 26F of the apron upper member upper 26, the fender 14 can be reliably supported.

If, however, a load acts substantially from an upward direction in substantially a downward direction (i.e. in the direction shown by the arrow A in Fig. 4) on the boundary 16 between the hood panel 12 and the fender 14, the area in the vicinity of the boundary 16 of the hood panel 12 and the area in the vicinity of the boundary 16 of the fender 14 is deformed downward, as is shown by the double dot chain line in Fig. 4.

At this time, in the vehicle fender structure of this embodiment, the fender 14 is moved by the impact load from a substantially upward direction substantially downward, as is shown by the double dot chain line in Fig. 4, relative to the apron upper member 24 serving as a structural member. Therefore, because it is possible by this movement to absorb a portion of the impact energy, it is possible to reduce the amount of deformation of the buckling deformation area 14C of the fender 14 generated by the impact load. As a result, because it is possible to absorb the impact energy within the range in which buckling deformation is possible of the fender 14, it is possible to obtain a low deformation load until the end of the deformation and the performance to mitigate the impact force is improved.

Furthermore, in this embodiment, when an impact load acts substantially from an upward direction, the fender 14 is able to move easily via the hole 48 formed in the fender 14 in the shearing direction of the fastened portion (i.e. the direction indicated by the arrow B in Fig. 4), relative to the nut 46 and

the bolt 50.

Next, a third embodiment of the vehicle fender structure of the invention will be described in accordance with Figs. 6 and 7.

Note that those members that are the same as in the first embodiment are given the same reference symbols and a description thereof is omitted.

As is shown in Fig. 7, in this embodiment, the apron upper member upper 26 is formed with a U shaped cross section whose open portion faces downward, and tongue shaped pieces 54 serving as second deforming portions are formed at predetermined intervals in the vehicle longitudinal direction in the top wall portion 26E of the apron upper member upper 26. Mounting holes 56 are formed in the vicinity of a base portion 54A of the tongue piece 54, which is the inner side in the vehicle transverse direction. Nuts 58 serving as mounting members are fixed coaxially with the mounting holes 56 to the bottom surface of the tongue shaped pieces 54.

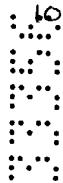
Notches 60 cut in a V shape from both the front and rear directions of the vehicle are formed in the center portion in the vehicle transverse direction of the tongue shaped pieces 54, thereby forming weakened portions 54B. In addition, the end portions on the outer side in the vehicle transverse direction of the tongue shaped pieces 54 are supported from below by supporting pieces 62 serving as deformation control portions. The supporting pieces 62 are formed by being cut and then folded inside notches 64 formed in the outer wall portion 26A in the vehicle transverse direction of the apron upper member upper 26

Tongue shaped pieces 66 serving as first deforming members are

also formed protruding at predetermined intervals in the vehicle longitudinal direction in the sloping wall portion 14B of the fender 14. A mounting hole 68 is formed in a bottom end portion 66A of the tongue shaped pieces 66.

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As is shown in Fig. 6, by inserting a bolt 70 serving as a mounting member into the mounting hole 68 of each tongue shaped piece 66 in the fender 14 and by meshing this bolt 70 with the nut 58, the bottom end portion 66A of each tongue shaped piece 66 in the fender 14 is fixed to the tongue shaped piece 54 of each apron upper member upper 26 by the bolt 70 and nut 58.



Note that, as is shown in Fig. 7, in this embodiment, the vertical width H of the sloping wall portion 14B of the fender 14 is narrowed in areas other than the tongue shaped pieces 66 so that there is hardly any interference thereby with the apron upper member 24.

The operation of this embodiment will now be described.

As is shown in Fig. 6, in a normal state, the bottom end portion 66A of the tongue shaped piece 66 of the fender 14 is fixed to the tongue shaped piece 54 of the apron upper member upper 26 by the nut 58 and bolt 70 and the outer end portion in the vehicle transverse direction of the tongue shaped piece 54 is supported from below by the supporting piece 62 serving as a deformation control member. As a result, the fender 14 can be reliably supported.

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If, however, a load above a predetermined value acts substantially from an upward direction in substantially a downward direction (i.e. in the direction shown by the arrow A in Fig. 6)

on the boundary 16 between the hood panel 12 and the fender 14, the area in the vicinity of the boundary 16 of the hood panel 12 and the area in the vicinity of the boundary 16 of the fender 14 is deformed downward, as is shown by the double dot chain line in Fig. 6.

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At this time, in the vehicle fender structure of this embodiment, the tongue shaped piece 54 serving as the second deforming portion of the apron upper member 24 buckles in a V shape with the weakened portion 54 B in which the V shaped notch 60 is formed as a base point and is deformed downward away from the supporting piece 62. The tongue shaped piece 66 serving as the first deforming portion of the fender 14 is also buckled. Therefore, because it is possible by the deformation of both the tongue shaped piece 54 and the tongue shaped piece 66 to absorb the impact energy, it is possible to reduce the amount of buckling deformation of the fender 14 generated by the impact load. As a result, because it is possible to absorb the impact energy within the range in which buckling deformation is possible of the fender 14, it is possible to obtain a low deformation load until the end of the deformation and the performance to mitigate the impact force is improved.



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Moreover, in this embodiment, because the weakened portion 54B which acts as a trigger allowing the tongue shaped piece 54 to be deformed is provided, the deformation of the tongue shaped piece 54 can be further accelerated and the performance to mitigate the impact force is further improved.

Moreover, in this embodiment, because both the tongue shaped

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piece 54 and the tongue shaped piece 66 are deformed inside the closed cross section portion 30, it is possible to prevent the deformed tongue shaped piece 54 and the deformed tongue shaped piece 66 from interfering with adjacent members and the overall structure can be made more compact.

Further, in this embodiment, because the first deforming portion is formed from the tongue shaped piece 66 and the second deforming portion is formed from the tongue shaped piece 54, and because the deformation control portion is formed from the supporting piece 62 provided beneath the tongue shaped piece 54, the structure is simple and easily manufactured.

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Note that, in this embodiment, the tongue shaped piece 66 serving as the first deforming member is formed integrally with the fender 14, however, instead of this, as is shown in Fig. 8, it is also possible to fix a tongue shaped piece 66 that has been formed as a separate member to the fender 14. In addition, in this embodiment, the weakened portion 54B is formed using a V shaped notch 60, however, instead of the V shaped notch, it is also possible to form the weakened portion 54B by another weakened portion forming means, such as by using a thinned portion or the like.

Next, a fourth embodiment of the vehicle fender structure of the invention will be described in accordance with Figs. 9 and 10

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Note that those members that are the same as in the first embodiment are given the same reference symbols and a description thereof is omitted.

As is shown in Fig. 10, in this embodiment, a concave groove 80,

serving as a weakened portion that becomes the base point of deformation due to an impact load from substantially an upward direction on the vehicle outer surface 14F of the fender 14, is provided extending in the vehicle longitudinal direction. An
 5 ornamental molding 82 is attached to the concave groove 80. Flanges 84A and 84b of a bracket 84 serving as a connecting member are fixed to a bottom portion 80A of the concave groove 80. The bracket 84 is provided extending toward the inner side in the vehicle transverse direction and mounting holes 86 are punched in the inner end portion 84C in the vehicle transverse direction of the bracket 84.

Note that a notch 88 is formed in the sloping wall portion 14B of the fender 14 so that it does not interfere with the bracket 84.

Mounting holes 90 are formed at predetermined intervals in the vehicle longitudinal direction in the top wall portion 26E of the apron upper member upper 26, and nuts 92 serving as mounting members are fixed coaxially with the mounting holes 90 to the bottom surface of the top wall portion 26E.

As is shown in Fig. 9, by inserting a bolt 94 serving as a mounting member in the mounting hole 86 of the bracket 84 and meshing this bolt 94 with the nut 92, the bottom portion 80A of the concave groove 80 of the fender 14 is fixed via the bracket 84 to the top wall portion 26E of the apron upper member upper 26.

Next, the operation of this embodiment will be described.

25 As is shown in Fig. 9, in a normal state, the bottom portion 80A of the concave groove 80 of the fender 14 is fixed via the bracket 84 to the top wall portion 26E of the apron upper member upper 26.

Therefore, the fender 14 can be reliably supported.

If, however, a load of a predetermined value or more acts substantially from an upward direction in substantially a downward direction (i.e. in the direction shown by the arrow A in Fig. 9) on the boundary 16 between the hood panel 12 and the fender 14, the area in the vicinity of the boundary 16 of the hood panel 12 and the area in the vicinity of the boundary 16 of the fender 14 are deformed downward, as is shown by the double dot chain line in Fig. 9.

At this time, in the vehicle fender structure of this embodiment, the fender 14 is deformed with the concave groove 80 serving as the weakened portion in the vehicle outer surface 14F as a base point, and the bottom end portion of the sloping wall 14B of the fender 14 slides over the top of the top wall portion 26E of the apron upper member upper 26 toward the inner side in the vehicle transverse direction. At this time, because the bracket 84 serving as a connecting member becomes a support pillar and the concave groove 80 of the fender 14 definitely becomes the base point of the deformation, it is possible to reduce the amount of buckling deformation of the fender 14 generated by the impact load. As a result, because it is possible to absorb the impact energy within the range in which buckling deformation is possible of the fender 14, it is possible to obtain a low deformation load until the end of the deformation and the performance to mitigate the impact force is improved.

Moreover, in this embodiment, because the concave groove 80 which becomes the base point of the deformation of the fender 14

extends in the vehicle longitudinal direction, it is possible to improve the performance to mitigate the impact force across the entire longitudinal length of the vehicle.

Moreover, in this embodiment, because the ornamental molding 82 is attached to the concave groove 80, the concave groove 80 can double as a concave groove 80 for attaching the ornamental molding 82 and as the weakened portion which becomes the base point of the deformation of the fender 14.

A fifth embodiment of the vehicle fender structure of the invention will now be described in accordance with Figs. 11 to 13.

Note that, in the diagrams, the arrow FR shows the direction of the front of the vehicle, the arrow UP shows the direction of the top of the vehicle, and the arrow IN shows the direction of the inside of the vehicle.

As is shown in Fig. 13, in this embodiment, the boundary 116 between a hood panel 112 and a fender 114 of a vehicle body 110 extends in the longitudinal direction of the vehicle at both end portions in the transverse direction of the vehicle of a front hood 118. Note that, in this embodiment, the boundary 116 is set at the outer side in the vehicle transverse direction and, as is shown in Fig. 11, is structured so that it is difficult for a colliding body S to collide with the fender 114. Moreover, the hood 118 is fixed to the vehicle body by left and right side hinges placed toward the rear of the vehicle body and a lock portion placed in the center of the hood 118 toward the front of the vehicle, and the hood 118 is elastically deformable around the fulcrums of the hinges and lock.

As is shown in Fig. 11, a hood inner panel 120 is provided extending in the vehicle longitudinal direction at the bottom surface side of the outer side portions in the vehicle transverse direction of the hood panel (also known as the hood outer panel) 112. The cross sectional configuration of the hood inner panel 120 as seen from the vehicle longitudinal direction is formed generally in a hat shape with the open portion thereof facing upward. An inner flange 120A formed protruding outward at the inner side in the vehicle transverse direction of the open portion is joined to a bottom surface 112A of the hood panel 112 by an adhesive 113. A flange portion 120B is formed hanging downward at the outer end portion in the vehicle transverse direction of the open portion of the hood inner panel 120. This flange portion 120B is joined to a flange portion 112B formed hanging downward at the outer edge portion in the vehicle transverse direction of the hood panel 112, and the joined flange portions 120B and 112B form a rigidity ensuring means.

In a closed cross section portion 121 formed from the hood panel 112 and the hood inner panel 120, a thickness T1 of the outer portion 121A in the vehicle transverse direction is thinner than a thickness T2 of the inner portion 121B in the vehicle transverse direction forming the framework portion of the hood 118. An apron upper member 124 which serves as a structural member of the vehicle body 110 in the vehicle longitudinal direction is provided below the outer portion 121A in the vehicle transverse direction of the closed cross section portion 121. The apron upper member 124 is formed from an apron upper member upper 126, which forms

the top portion of the apron upper member 124, and an apron upper member lower 128, which forms the bottom portion of the apron upper member 124.

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The apron upper member upper 126 is formed with a trapezoid shaped cross section whose open portion faces downward and the outer wall portion 126A in the vehicle transverse direction is formed as a sloping surface that slopes from the vehicle inner side at the top to the vehicle outer side at the bottom. A flange 126B is formed toward the outer side in the vehicle transverse direction at the bottom end portion of the outer wall portion 126A in the vehicle transverse direction. The apron upper member lower 128 is formed with an L shaped cross section and a flange 128B, which is directed toward the outer side in the vehicle transverse direction, is formed at the top end portion of the vertical wall portion 128A. The flange 126B of the apron upper member upper 126 and the flange 128B of the apron upper member lower 128 are welded together. A horizontal wall portion 128C is formed toward the inner side in the vehicle transverse direction at the top end portion of the vertical wall portion 128A of the apron upper member lower 28, and a flange 128D is formed downward at the inner end portion in the vehicle transverse direction of the horizontal wall portion 128C. The bottom end edge portion 126D of the inner wall portion 126C in the vehicle transverse direction of the apron upper member upper 126 is welded to the flange 128D.

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Accordingly, the apron upper member 124 forms a closed cross section portion 130 that extends in the vehicle longitudinal direction through the apron upper member upper 126 and the apron

upper member lower 128.

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As is shown in Fig. 12, mounting holes 132 are formed at predetermined intervals in the vehicle longitudinal direction in the joint portion of the flange 126B of the apron upper member upper 126 and the flange 128B of the apron upper member lower 128. Nuts 134 are fixed coaxially with the mounting holes 132 to the bottom surface of the flange 128B of the apron upper member lower 128.

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As is shown in Fig. 11, the inner edge portion 114A in the vehicle transverse direction of the fender 114 facing an outer edge portion 112C in the vehicle transverse direction of the hood panel 112 is bent downward, and a vertical wall portion 114B is formed extending substantially in parallel with the flange portion 112B of the hood panel 112. A flange 114C is formed toward the inner side in the vehicle transverse direction at the bottom end portion of the vertical wall portion 114B.

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As is shown in Fig. 12, mounting holes 136 are punched at predetermined intervals in the vehicle longitudinal direction in the flange 114C of the fender 114.

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As is shown in Fig. 11, a bolt 138 is inserted from above into each mounting hole 136 in the fender 114 and each mounting hole 132 in the apron upper member 124 and by fastening the bolt 138 to the nut 134, the flange 114C of the fender 114 is fixed to the flange 126B of the apron upper member upper 126 and the flange 128B of the apron upper member lower 128.

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A height H1 in the vertical direction of the vehicle of the flange 114C which becomes the mounting portion where the fender

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114 is mounted on the apron upper member 124 is lower than a height H2 in the vehicle vertical direction of the top surface of the top wall portion 126E of the apron upper member upper 126. The outer portion 121A (i.e. the hood portion that is thinner in the vehicle vertical direction than the inner side portion 121B in the vehicle transverse direction that forms the framework portion of the hood 118) in the vehicle transverse direction of the closed cross section portion 121 which is formed from the hood panel 112 and the hood inner panel 120 is provided above the top wall portion 126E of the apron upper member upper 126.

Next, the operation of this embodiment will be described.

In this embodiment, when a colliding body S collides with the boundary 116 between the hood 118 and the fender 114, namely, with the vicinity of the endpoint on the outer side of the vehicle of the hood 118 and a load acts thereon from a substantially upward direction in a substantially downward direction (i.e. in the direction indicated by the arrow A in Fig. 11), the endpoint vicinity on the vehicle outer side of the hood 118 is deformed downward as is shown by the double dot chain line in Fig. 11.

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At this time, in the vehicle fender structure of this embodiment, the height H1 in the vertical direction of the vehicle of the flange 114C of the fender 114 is lower than the height H2 in the vehicle vertical direction of the top surface of the top wall portion 126E of the apron upper member upper 126, and the outer portion 121A in the vehicle transverse direction of the closed cross section portion 121 that is formed with a thin thickness is provided above the top wall portion 126E of the apron upper member

upper 126. Consequently, even if the closed cross section portion 130 of the apron upper member 124 or the inner side portion 121B in the vehicle transverse direction of the closed cross section portion 121 that forms the framework portion of the fender 118 are enlarged to ensure rigidity, there is no interference between the apron upper member 124 and the inner side portion 121B in the vehicle transverse direction of the closed cross section portion 121. As a result, it is possible to receive an impact load in the hood 118 that is fixed to the vehicle body by the left and right side hinges placed toward the rear of the vehicle body and the lock portion placed in the center of the hood 118 toward the front of the vehicle, and that is elastically deformable around the fulcrums of the hinges and lock. Namely, it is possible to increase the range or area of dependency centered solely on the ability of the hood 118 to soften impact regardless of the ability of the fender 114 to soften the impact, thereby enabling the performance to mitigate the impact force to be improved.

In this embodiment, it is possible to ensure the rigidity for holding the shape necessary in the endpoint on the vehicle outer side of the hood 118 by the flange portions 112B and 120B, which serve as rigidity ensuring means, that are formed at the endpoint on the vehicle outer side of the hood 118. In addition, in this embodiment, by forming the rigidity ensuring means from the flange portions 112B and 120B that are formed hanging down from the endpoints on the vehicle outer side of the hood 118, the structure is simplified.

Next, the sixth embodiment of the vehicle fender structure of

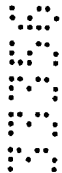
the invention will be described in accordance with Figs. 14 and 15.

Note that those members that are the same as in the fifth embodiment are given the same reference symbols and a description thereof is omitted.

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As is shown in Fig. 15, in this embodiment convex ribs 150 protruding toward the inner side of the vehicle are formed at predetermined intervals in the vehicle longitudinal direction in the vertical wall portion 114B, which is the inner side wall portion in the vehicle transverse direction of the fender 114, at positions other than the area where bolts 138 are inserted.

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As is shown in Fig. 14, the convex ribs 150 are formed substantially in a triangle shape as seen from the vehicle longitudinal direction, and an upper sloping surfaces 150A thereof are positioned below the flange portions 112B and 120B that are formed hanging down from the endpoints on the vehicle outer side of the hood 118.



In this embodiment, the concave groove 152 serving as a weakened portion that becomes the base point for deformation at a vehicle outer side surface 114D of the fender 114 is provided extending in the vehicle longitudinal direction and ornamental moldings 154 are attached to the concave grooves 152.

Next, the operation of this embodiment will be described.

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In this embodiment, when a colliding body S collides with the vicinity of the endpoint on the outer side of the vehicle of the hood 118 and a load acts thereon from a substantially upward direction in a substantially downward direction (i.e. in the direction indicated by the arrow A in Fig. 14), the area in the

vicinity of the boundary 116 of the hood 118 is deformed downward as is shown by the double dot chain line in Fig. 14.

At this time, in the vehicle fender structure of this embodiment, in the same way as in the fifth embodiment, the height H1 in the vertical direction of the vehicle of the flange 114C of the fender 114 is lower than the height H2 in the vehicle vertical direction of the top surface of the top wall portion 126E of the apron upper member upper 126. Also, the outer portion 121A in the vehicle transverse direction of the closed cross section portion 121 that is formed with a thin thickness is provided above the top wall portion 126E of the apron upper member upper 126. Consequently, even if the closed cross section portion 130 of the apron upper member 124 or the inner side portion 121B in the vehicle transverse direction of the closed cross section portion 121 that forms the framework portion of the fender 118 are enlarged to ensure rigidity, there is no interference between the apron upper member 124 and the inner side portion 121B in the vehicle transverse direction of the closed cross section portion 121. As a result, it is possible to receive an impact load in the hood 118 that is fixed to the vehicle body by the left and right side hinges placed toward the rear of the vehicle body and the lock portion placed in the center of the hood 118 toward the front of the vehicle, and that is elastically deformable around the fulcrums of the hinges and lock. Namely, it is possible to increase the range of dependency centered solely on the ability of the hood 118 to soften impact regardless of the ability of the fender 114 to soften the impact, thereby enabling the performance

to mitigate the impact force to be improved.

Furthermore, in this embodiment, when the endpoint in the vehicle outer side direction of the hood 118 is moved downward by a predetermined value or more, as is shown by the chain line, the flanges 112B and 120B abut against the sloping surfaces 150A on the top side of the convex ribs 150 formed in the vertical wall portion 114B of the fender 114. As a result, the vertical wall portion 114B of the fender 114 is pushed toward the outer side of the vehicle (i.e. in the direction shown by the arrow B in Fig. 14). Therefore, the fender 114 is deformed toward the outer side of the vehicle with the concave groove 152 as a base point, as is shown by the single dot chain line in Fig. 14. Accordingly, in this embodiment, even if there is a large downward deformation of the hood 118, it is possible to avoid the colliding body S and the fender 114 from interfering and a further reduction in the impact load is achieved.

Note that, if the angle of the slope θ of the sloping surface 150A of the convex ribs 150 is made small, it is possible to lessen the effects on the deformation load of the hood 118 from the hood 118 abutting against the fender 114 because of the relationship between the component force in the horizontal direction and the component force in the vertical direction. In addition, because the transverse width W1 of the hood 118 is large in this embodiment, it is possible to make the transverse width W2 of the fender 114 relatively smaller. Therefore, for this reason as well, the fender 114 is able to deform easily in the vehicle outer side direction as is shown by the chain line in Fig. 14.

Next, a seventh embodiment of the vehicle fender structure of the invention will be described in accordance with Fig. 16.

Note that those members that are the same as in the fifth embodiment are given the same reference symbols and a description thereof is omitted.

As is shown in Fig. 16, in this embodiment, an auxiliary framework portion 121C whose thickness T3 in the vehicle vertical direction is thicker than the thickness T1 of the outer portion 121A in the vehicle transverse direction is formed at the vehicle outer side of the outer portion 121A in the vehicle transverse direction of the closed cross section portion 121 that is formed from the hood panel 112 and the hood inner panel 120. This auxiliary framework portion 121C forms a rigidity ensuring means. Note that, the outer peripheral edge 112D in the vehicle transverse direction of the hood panel 112 is fixed by a hemming process to an outer flange 120C formed protruding outward at the outer side in the vehicle transverse direction of the open portion of the hood inner panel 120, and a hemmed portion 118A is formed running around the outline of the hood 118.

In this embodiment, a sloping surface 114E that slopes from the vehicle outer side at the top to the vehicle inner side at the bottom is formed in the area between the vertical wall portion 114B and the inner edge portion 114A in the vehicle transverse direction, which becomes the inner wall portion in the vehicle transverse direction of the fender 114. The position of the vertical wall portion 114b is shifted by a distance S toward the vehicle outer side relative to the auxiliary framework 121C.

Accordingly, when the fender 114 is moved downward, the hemmed portion 118A is made to abut against the sloping surface 114E.

Next, the operation of this embodiment will be described.

5 In this embodiment, when a colliding body S collides with the boundary 116 between the hood 118 and the fender 114, and a load acts thereon from a substantially upward direction in a substantially downward direction (i.e. in the direction indicated by the arrow A in Fig. 16), the area in the vicinity of the boundary 116 of the hood 118 is deformed downward as is shown by the double dot chain line in Fig. 16.

10 At this time, in the vehicle fender structure of this embodiment, in the same way as in the fifth embodiment, the height H1 in the vertical direction of the vehicle of the flange 114C of the fender 114 is lower than the height H2 in the vehicle vertical direction of the top surface of the top wall portion 126E of the apron upper member upper 126. Also, the outer portion 121A in the vehicle transverse direction of the closed cross section portion 121 that is formed with a thin thickness is provided above the top wall portion 126E of the apron upper member upper 126. Consequently, even if the closed cross section portion 130 of the apron upper member 124 or the inner side portion 121B in the vehicle transverse direction of the closed cross section portion 121 that forms the framework portion of the fender 118 are enlarged to ensure rigidity, there is no interference between the apron upper member 124 and the inner side portion 121B in the vehicle transverse direction of the closed cross section portion 121. As a result, it is possible to receive an impact load in the hood 118

that is fixed to the vehicle body by the left and right side hinges placed toward the rear of the vehicle body and the lock portion placed in the center of the hood 118 toward the front of the vehicle, and that is elastically deformable around the fulcrums of the hinges and lock. Namely, it is possible to increase the range of dependency centered solely on the ability of the hood 118 to soften impact regardless of the ability of the fender 114 to soften the impact, thereby enabling the performance to mitigate the impact force to be improved.

Moreover, in this embodiment, by forming an auxiliary framework portion 121C whose thickness T3 in the vehicle vertical direction is thicker than the thickness T1 of the outer portion 121A in the vehicle transverse direction of the closed cross section portion 121 at the endpoint of the hood 118 in the direction of the vehicle outer side, it is possible to ensure the rigidity for holding the shape necessary in the endpoint of the hood 118 in the direction of the vehicle outer side.

Furthermore, in this embodiment, when the endpoint of the hood 118 in the direction of the vehicle outer side is moved in a downward direction by a predetermined value or more, the hemmed portion 118A of the hood 118 abuts against the sloping surface 114E of the fender 114 and the hemmed portion 118A is easily deformed in the manner shown by the double dot chain line in Fig. 16. Accordingly, in this embodiment, it is possible to achieve a further reduction in the impact load through the deformation of the hemmed portion 118A.

Note that, in this embodiment, the sloping surface 114E that

5 slopes from the vehicle outer side at the top to the vehicle inner side at the bottom is formed between the vertical wall portion 114B and the inner edge portion 114A in the vehicle transverse direction of the fender 114 in consideration of the constraints of the molding shape and the like in the manufacturing process.

However, as is shown in Fig. 17, instead of the sloping surface 114E, it is also possible to use a structure in which a step portion 114F is formed between the vertical wall portion 114B and the inner edge portion 114A in the vehicle transverse direction of the fender 114, and the hemmed portion 118A of the hood 118 is deformed when it abuts against this step portion 114F.

An eighth embodiment of the vehicle fender structure of the invention will now be described in accordance with Figs. 18 to 21.

Note that, in the diagrams, the arrow FR shows the direction of the front of the vehicle, the arrow UP shows the direction of the top of the vehicle, and the arrow IN shows the direction of the inside of the vehicle.

As is shown in Fig. 21, in this embodiment, a boundary 216 between a hood panel 212 and the fender of a vehicle body 210 extends in the longitudinal direction of the vehicle at both end portions in the transverse direction of the vehicle of a hood 218.

25 As is shown in Fig. 18, a hood inner panel 220 is provided extending in the vehicle longitudinal direction at the bottom surface of the outer portions in the vehicle transverse direction of the hood panel (also known as the hood outer panel) 212. The cross sectional shape of the hood inner panel 220 as seen from the vehicle longitudinal direction is formed substantially in a hat

shape with the open portion thereof facing upward. An inner flange (not illustrated) formed protruding outward at the inner side in the vehicle transverse direction of the open portion is joined to the bottom surface 212A of the hood panel 212. An outer peripheral edge 212B of the hood panel 212 in the vehicle transverse direction is fixed by a hemming process to an outer flange 220A formed protruding outward at the outer side in the vehicle transverse direction of the open portion of the hood inner panel 220. A closed cross section portion 221 formed from the hood panel 212 and the hood inner panel 220 forms the framework of the hood panel 212.

An apron upper member 224 which serves as a structural member of the vehicle body 210 is provided in the vehicle longitudinal direction below the hemmed portion 218A of the hood 218. An apron upper member 224 is formed from an apron upper member upper 226, which forms the top portion of the apron upper member 224, and an apron upper member lower 228, which forms the bottom portion of the apron upper member 224.

The apron upper member upper 226 is formed with a trapezoid shaped cross section whose open portion faces downward and the top portion of the outer wall portion in the vehicle transverse direction is formed as a sloping wall portion 226A that slopes from the vehicle inner side at the top to the vehicle outer side at the bottom. The bottom portion of the outer wall portion in the vehicle transverse direction of the apron upper member upper 226 is formed as a vertical wall portion 226B. A flange 226C, which is directed toward the outer side in the vehicle transverse

direction, is formed at the bottom end portion of the vertical wall portion 226B. The apron upper member lower 228 is formed with an L shaped cross section and an outer end portion 228B in the vehicle transverse direction of a horizontal wall portion 228A and the flange 226C of the apron upper member upper 226 are welded together. A vertical wall portion 228C is formed downward at the inner end portion in the vehicle transverse direction of the horizontal wall portion 228A of the apron upper member lower 228. A bottom end edge portion 226E of the inner wall portion 226D in the vehicle transverse direction of the apron upper member upper 226 is welded to the vertical wall portion 228C.

Accordingly, the apron upper member 224 forms a closed cross sectional portion 230 that extends in the vehicle longitudinal direction through the apron upper member upper 226 and the apron upper member lower 228.

As is shown in Fig. 20, brackets 232 serving as component force generating means are provided at predetermined intervals in the vehicle longitudinal direction on the apron upper member upper 226. The fender 214 is fixed to the apron upper member upper 226 via the brackets 232.

As is shown in Fig. 18, the brackets 232 are formed with a substantially hexagonal cross section whose open portion faces downward when seen from the front of the vehicle (i.e. in front elevational view) and are provided with two linking wall portions 232A and 232B that face each other in the vehicle transverse direction (are offset in the vehicle transverse direction). The linking wall portion 232A on the outer side in the vehicle

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transverse direction (referred to hereafter as the outer linking wall portion) is bent in a V shape protruding toward the outer side in the vehicle transverse direction when seen from the front of the vehicle. The bend point P1 thereof is set above the center L in the vertical direction of the outer linking wall portion 232A. On the other hand, the linking wall portion 232B on the inner side in the vehicle transverse direction (referred to hereafter as the inner linking wall portion) is bent in a V shape protruding toward the inner side in the vehicle transverse direction when seen from the front of the vehicle. The bend point P2 thereof is set below the center L in the vertical direction of the inner linking wall portion 232B.



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A flange 232C is formed at the bottom end portion of the outer linking wall portion 232A of the bracket 232 and this flange 232C is welded to the sloping wall portion 226A of the apron upper member upper 226. In addition, a flange 232D is formed at the bottom end portion of the inner linking wall portion 232B of the bracket 232 and this flange 232D is welded to the top end edge portion 226F of the inner wall portion 226D in the vehicle transverse direction of the apron upper member upper 226.

The top end portion of the outer linking wall portion 232A of the bracket 232 is linked by the top wall portion 232E to the top end portion of the inner linking wall portion 232B. Mounting holes 234 are punched in the center portion of this top wall portion 232E and weld nuts 236 are provided coaxially with the mounting holes 234 on the bottom surface of the top wall portion 232E.

An inner edge portion 214A in the vehicle transverse direction of the fender 214 that faces a hemmed portion 218A of the hood 218 is bent downward thereby forming a vertical wall portion 214B that extends in a vertical direction. A flange 214C is formed facing inward in the vehicle transverse direction at the bottom end portion of this vertical wall portion 214B and mounting holes 238 are punched at predetermined intervals in the vehicle longitudinal direction in the flange 214C.

Bolts 240 are inserted from above into the mounting holes 234 of the bracket 232 and the mounting holes 238 of the fender 214. By fastening these bolts 240 with nuts 236, the flange 214C of the fender 214 is fixed to the top wall portion 232E of the bracket 232.

In this embodiment, a concave groove 242 is formed extending in the vehicle longitudinal direction in a vehicle outer side surface 214D of the fender 214 and an ornamental molding 244 is attached to the concave groove 242. Accordingly, as is shown in Fig. 19, the vehicle body is structured such that when a colliding body S collides with the boundary 216 between the hood 218 and the fender 214, and a load acts from a substantially upward direction in a substantially downward direction (i.e. in the direction indicated by the arrow A in Fig. 19), then even if there is a large amount of deformation of the fender 214, the vehicle outer side surface 214D of the fender 214 easily deforms using the concave groove 242 as the base point and it is difficult for the deformation load to become large. Note that, even if the concave groove 242 is not formed in the vehicle outer side surface 214D of the fender 214,

it is still possible to structure the vehicle body such that when a colliding body S collides with the boundary 216 between the hood 218 and the fender 214, and a load acts from a substantially upward direction in a substantially downward direction (i.e. in the direction indicated by the arrow A in Fig. 19), due to other factors such as the material used to construct the fender 214, the configuration (i.e. curvature or inclination) of the vehicle outer side surface 214D, the way the fender 214 is mounted, and the like, the fender 214 easily deforms and it is difficult for the deformation load to increase when there is a large amount of deformation of the fender 214.

The operation of this embodiment will now be described.

In this embodiment, when a colliding body S collides with the boundary 216 between the hood 218 and the fender 214, and a load acts thereon from a substantially upward direction in a substantially downward direction (i.e. in the direction indicated by the arrow A in Fig. 19), the area in the vicinity of the boundary 216 of the hood panel 212 and the area in the vicinity of the boundary 216 of the fender 214 are deformed downward as is shown in Fig. 2.

At this time, in this embodiment, the outer linking wall portion 232A of the bracket 232 that fixes the fender 214 to the apron upper member upper 226 is bent in a V shape protruding toward the outer side in the vehicle transverse direction when seen from front of the vehicle. The bend point P1 thereof is set above the center L in the vertical direction of the outer linking wall portion 232A, while the inner linking wall portion 232B is bent in

a V shape protruding toward the inner side in the vehicle
 transverse direction when seen from front of the vehicle. The
 bend point P2 thereof is set below the center L in the vertical
 direction of the inner linking wall portion 232B. Therefore, as
 5 is shown in Fig. 19, the outer linking wall portion 232A and the
 inner linking wall portion 232B are each deformed by the component
 forces distributed to the outer linking wall portion 232A and the
 inner linking wall portion 232B. As a result, the top wall
 portion 232E of the bracket 232 together with the flange 214C of
 10 the fender 214 is crushed in a downward direction toward the outer
 side in the vehicle transverse direction (i.e. in the direction
 shown by the arrow B in Fig. 19). Accordingly, it is possible
 using a simple structure to avoid interference between the hemmed
 portion 218A of the hood 218 which deforms toward the outer
 15 downward side in the vehicle transverse direction (i.e. in the
 direction shown by the arrow C in Fig. 19) and the vertical wall
 portion 214B of the fender 214. As a result, it is possible to
 suppress increases in the deformation load and to improve the
 performance to mitigate the impact force.

Moreover, in this embodiment, it is possible to adjust the
 deformation configuration easily by changing the position in the
 vertical direction of each of the bend points P1 and P2 of the
 outer linking wall portion 232A and the inner linking wall portion
 232B of the brackets 232 that face each other in the vehicle
 25 transverse direction.

A ninth embodiment of the vehicle fender structure of the
 invention will now be described in accordance with Figs. 22 and 23.

Note that those members that are the same as in the eighth embodiment are given the same reference symbols and a description thereof is omitted.

5 As is shown in Fig. 22, in this embodiment, the outer linking wall portion 232A of the bracket 232 is bent in a V shape protruding toward the outer side in the vehicle transverse direction when seen from the front of the vehicle. The bend point P1 thereof is set below the center L in the vertical direction of the outer linking wall portion 232A. On the other hand, the inner linking wall portion 232B is bent in a V shape protruding toward the inner side in the vehicle transverse direction when seen from the front of the vehicle. The bend point P2 thereof is set above the center L in the vertical direction of the inner linking wall portion 232B.

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In this embodiment, there is no concave groove of the fifth embodiment (see Fig. 18) formed in the vehicle outer side surface 214D of the fender 214. The vehicle body is structured such that when a load acts from a substantially upward direction in a substantially downward direction (i.e. in the direction shown by the arrow B in Fig. 19), and if there is a large amount of deformation in the fender 214, it is easy that the deformation load increases. Note that, if the concave groove is formed in the vehicle outer side surface 214D of the fender 214, it is still possible to structure the vehicle body such that when a colliding body S collides with the boundary 216 between the hood 218 and the fender 214, and a load acts from a substantially upward direction in a substantially downward direction (i.e. in the direction

indicated by the arrow A in Fig. 23), due to other factors such as the material used to construct the fender 214, the configuration (i.e. curvature or inclination) of the vehicle outer side surface 214D, the way the fender 214 is mounted, and the like, it is easy for the deformation load to decrease when there is a large amount of deformation of the fender 214.

The operation of this embodiment will now be described.

In this embodiment, when a colliding body S collides with the boundary 216 between the hood 218 and the fender 214, and a load acts thereon from a substantially upward direction in a substantially downward direction (i.e. in the direction indicated by the arrow A in Fig. 23), the area in the vicinity of the boundary 216 of the hood panel 212 and the area in the vicinity of the boundary 216 of the fender 214 are deformed downward as is shown in Fig. 23.

At this time, in this embodiment, the outer linking wall portion 232A of the bracket 232 that fixes the fender 214 to the apron upper member upper 226 is bent in a V shape protruding toward the outer side in the vehicle transverse direction when seen from the front of the vehicle and the bend point P1 thereof is set below the center L in the vertical direction of the outer linking wall portion 232A, while the inner linking wall portion 232B is bent in a V shape protruding toward the inner side in the vehicle transverse direction when seen from the front of the vehicle. The bend point P2 thereof is set above the center L in the vertical direction of the inner linking wall portion 232B. Therefore, as is shown in Fig. 23, the outer linking wall portion 232A and the

inner linking wall portion 232B are each deformed by the component forces distributed to the outer linking wall portion 232A and the inner linking wall portion 232B. As a result, the top wall portion 232E of the bracket 232 together with the flange 214C of the fender 214 is crushed in a downward direction toward the inner side in the vehicle transverse direction (i.e. in the direction shown by the arrow D in Fig. 23). Accordingly, although the hemmed portion 218A of the hood 218 which deforms toward the outer downward side in the vehicle transverse direction interferes with the fender 214, using a simple structure it is possible to prevent curvature deformation of the vehicle outer side surface 214D of the fender 214 in the same manner as in the fifth embodiment (see Fig. 19). Namely, because the vehicle outer side surface 214D of the fender 214 that has a large deformation load is not allowed to deform, it is possible to suppress increases in the deformation load of the fender 214 and to improve the performance to mitigate the impact force.

Moreover, in this embodiment, it is possible to adjust the deformation configuration easily by changing the position in the vertical direction of each of the bend points P1 and P2 of the outer linking wall portion 232A and the inner linking wall portion 232B of the brackets 232 that face each other in the vehicle transverse direction.

A tenth embodiment of the vehicle fender structure of the invention will now be described in accordance with Figs. 24 to 26.

Note that those members that are the same as in the eighth embodiment are given the same reference symbols and a description

thereof is omitted.

As is shown in Fig. 24, in this embodiment, the fender 214 is formed from a resin material and two linking wall portions 214E and 214F that serve as component force generating means are formed integrally with the fender 214 facing each other in the vehicle transverse direction. The linking wall portion 214E on the outer side in the vehicle transverse direction (referred to hereafter as the outer linking wall portion) is bent in a V shape protruding toward the outer side in the vehicle transverse direction when seen from the front of the vehicle and the bend point P1 thereof is set above the center L in the vertical direction of the outer linking wall portion. On the other hand, the linking wall portion 214F on the inner side in the vehicle transverse direction (referred to hereafter as the inner linking wall portion) is bent in a V shape protruding toward the inner side in the vehicle transverse direction when seen from the front of the vehicle and the bend point P2 thereof is set below the center L in the vertical direction of the inner linking wall portion 214F.

The top portion of the outer linking wall portion 214E of the fender 214 is linked to the bottom end portion of the vertical wall portion 214B, while the top end portion of the inner linking wall portion 214F is linked to the inner end portion in the vehicle transverse direction of the top wall portion 214G extending inward in the vehicle transverse direction from the bottom end portion of the vertical wall portion 214B. In addition, the bottom end portion of the outer linking wall portion 214E and the bottom end portion of the inner linking wall portion 214F are

linked by a bottom wall portion 214H.

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As is shown in Fig. 26, the bottom wall portion 214H, the inner linking wall portion 214F, and the outer linking wall portion 214E of the fender 214 are formed at predetermined intervals in the vehicle longitudinal direction. Moreover, the bottom wall portion 214H of the fender 214 is provided extending in the vehicle longitudinal direction forming the mounting portion 214J.

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As is shown in Fig. 24, in this embodiment, mounting holes 250 are punched at predetermined intervals toward the front of the vehicle longitudinal direction in a top wall portion 226G of the apron upper member upper 226 and weld nuts 252 are provided coaxially with the mounting holes on the bottom surface of the top wall portion 226G. In addition, mounting holes 254 are punched in the center portion of the mounting portion 214J of the fender 214. By inserting bolts 256 from the top into the mounting holes 250 in the apron upper member upper and the mounting holes 254 in the fender 214 and fastening the bolts 256 to the nuts 252, the mounting portion 214J of the fender 214 is fixed to the top wall portion 226G of the apron upper member upper 226.

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In this embodiment, in the same way as in the eighth embodiment, as is shown in Fig. 25, the vehicle body is structured such that when a colliding body S collides with the boundary 216 of the hood 218 and the fender 214 and a load acts substantially from an upward direction in substantially a downward direction (i.e. in the direction shown by the arrow A in Fig. 25), even if the amount of deformation of the fender 214 is great, it is difficult for the deformation load to increase.

The operation of this embodiment will now be described.

In this embodiment, when a colliding body S collides with the boundary 216 of the hood 218 and the fender 214 and a load acts substantially from an upward direction in substantially a downward direction (i.e. in the direction shown by the arrow A in Fig. 25), the area in the vicinity of the boundary 216 of the hood panel 212 and the area in the vicinity of the boundary 216 of the fender 214 is deformed downward as is shown in Fig. 25.

At this time, in this embodiment, the outer linking wall portion 214E formed integrally with the fender 214 that fixes the fender 214 to the apron upper member upper 226 is bent in a V shape protruding toward the outer side in the vehicle transverse direction when seen from the front of the vehicle and the bend point P1 thereof is set above the center L in the vertical direction of the outer linking wall portion 214E, while the inner linking wall portion 214F is bent in a V shape protruding toward the inner side in the vehicle transverse direction when seen from the front of the vehicle and the bend point P2 thereof is set below the center in the vertical direction of the inner linking wall portion 214F. Therefore, as is shown in Fig. 25, the outer linking wall portion 214E and the inner linking wall portion 214F are each deformed by the component forces distributed to the outer linking wall portion 214E and the inner linking wall portion 214F. As a result, the bottom end portion of the vertical wall portion 214B of the fender 214 is crushed in a downward direction toward the outer side in the vehicle transverse direction (i.e. in the direction shown by the arrow B in Fig. 25). Accordingly, it is

possible using a simple structure to avoid interference between the hemmed portion 218A of the hood 218 which deforms toward the outer downward side in the vehicle transverse direction (i.e. in the direction shown by the arrow C in Fig. 25) and the vertical wall portion 214B of the fender 214. As a result, it is possible to suppress increases in the deformation load and to improve the performance to mitigate the impact force.

Moreover, in this embodiment, it is possible to adjust the deformation configuration easily by changing the position in the vertical direction of each of the bend points P1 and P2 of the outer linking wall portion 214E and the inner linking wall portion 214F of the fender 214 that face each other in the vehicle transverse direction.

Further, in this embodiment, by forming the outer linking wall portion 214E and the inner linking wall portion 214F integrally with the fender, the number of parts can be decreased and the ease of assembly thereby improved.

An eleventh embodiment of the vehicle fender structure of the invention will now be described in accordance with Figs. 27 and 28.

Note that those members that are the same as in the tenth embodiment are given the same reference symbols and a description thereof is omitted.

As is shown in Fig. 27, in this embodiment, the fender 214 is formed from a resin material and two linking wall portions 214E and 214F that serve as component force generating means are formed integrally facing each other in the vehicle transverse direction. The outer linking wall portion 214E is bent in a V shape

protruding toward the outer side in the vehicle transverse direction when seen from the front of the vehicle and the bend point P1 thereof is set below the center L in the vertical direction of the outer linking wall portion. On the other hand, the inner linking wall portion 214F is bent in a V shape protruding toward the inner side in the vehicle transverse direction when seen from the front of the vehicle and the bend point P2 thereof is set above the center L in the vertical direction of the inner linking wall portion 214F.

The operation of this embodiment will now be described.

In this embodiment, when a colliding body S collides with the boundary 216 between the hood 218 and the fender 214, and a load acts thereon from a substantially upward direction in a substantially downward direction (i.e. in the direction indicated by the arrow A in Fig. 28), the area in the vicinity of the boundary 216 of the hood panel 212 and the area in the vicinity of the boundary 216 of the fender 214 are deformed downward as is shown in Fig. 28.

At this time, in this embodiment, the outer linking wall portion 214E formed integrally with the fender 214 that fixes the fender 214 to the apron upper member upper 226 is bent in a V shape protruding toward the outer side in the vehicle transverse direction when seen from the front of the vehicle and the bend point P1 thereof is set below the center L in the vertical direction of the outer linking wall portion 214E, while the inner linking wall portion 214F is bent in a V shape protruding toward the inner side in the vehicle transverse direction when seen from

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the front of the vehicle and the bend point P2 thereof is set above the center in the vertical direction of the inner linking wall portion 214F. Therefore, as is shown in Fig. 28, the outer linking wall portion 214E and the inner linking wall portion 214F are each deformed by the component forces distributed to the outer linking wall portion 214E and the inner linking wall portion 214F. As a result, the bottom end portion of the vertical wall portion 214B of the fender 214 is crushed in a downward direction toward the inner side in the vehicle transverse direction (i.e. in the direction shown by the arrow D in Fig. 28). Accordingly, although the hemmed portion 218A of the hood 218 which deforms toward the outer downward side in the vehicle transverse direction interferes with the fender 214, using a simple structure it is possible to prevent curvature deformation of the vehicle outer side surface 214D of the fender 214 that occurs in the tenth embodiment (see Fig. 25). Namely, because the vehicle outer side surface 214D of the fender 214 that has a large deformation load is not allowed to deform, it is possible to suppress increases in the deformation load of the fender 214 and to improve the performance to mitigate the impact force.

Moreover, in this embodiment, it is possible to adjust the deformation configuration easily by changing the position in the vertical direction of each of the bend points P1 and P2 of the outer linking wall portion 214E and the inner linking wall portion 214F of the fender 214 that face each other in the vehicle transverse direction in the same way as in the tenth embodiment.

Further, in this embodiment, by forming the outer linking wall

portion 214E and the inner linking wall portion 214F integrally with the fender, the number of parts can be decreased and the ease of assembly thereby improved in the same way as in the tenth embodiment.

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Note that, in the above tenth and eleventh embodiments, the fender 214 is formed from a resin material and two linking wall portions 214E and 214F that serve as component force generating means are formed integrally with the fender 214, however, instead of this, it is also possible to form the fender 214 from another material such as a metal cast using a light alloy such as aluminum and to form the linking wall portions 214E and 214F that serve as component force generating means integrally with the fender 214.



In the above, a detailed description has been given of specific embodiments of the invention, however, the invention is not limited to these embodiments and it will be evident to one skilled in the art that various other embodiments are possible within the scope of the invention. For example, as is shown in Fig. 29, it is also possible to form a bending accelerating means such as the slits 260, thin portions, or the like in the bend point P1 in the outer linking wall portion 232A and the bend point P2 in the inner linking wall portion 232B of the bracket 232 in the eighth and ninth embodiments. Moreover, as is shown in Fig. 30, it is also possible to form bending accelerating means such as notches 262 in the surfaces of each of the bend points P1 and P2 that face each other in the outer linking wall portion 214E and the inner linking wall portion 214F of the fender 214 in the tenth and eleventh embodiments.

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Moreover, in each of the above embodiments, the outer linking wall portion and the inner linking wall portion that face each other are both formed in a V shape, however, instead of this, as is shown in Fig. 31, it is also possible to form just one of the outer linking wall portion 232A and the inner linking wall portion 232B bent in a V shape (in Fig. 31, this is the inner linking wall portion 232B).

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Moreover, in each of the above embodiments, the outer linking wall portion is bent in a V shape protruding toward the outer side in the vehicle transverse direction as seen from the front of the vehicle, and the inner linking wall portion is bent in a V shape protruding toward the inner side in the vehicle transverse direction as seen from the front of the vehicle. However, instead of this, as is shown in Figs. 32 and 33, it is possible to employ a structure in which the outer linking wall portion 232A is bent in a V shape protruding toward the inner side in the vehicle transverse direction as seen from the front of the vehicle and the inner linking wall portion 232B is bent in a V shape protruding toward the outer side in the vehicle transverse direction as seen from the front of the vehicle.

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Moreover, in each of the above embodiments, the outer linking wall portion is bent in a V shape protruding toward the outer side in the vehicle transverse direction as seen from the front of the vehicle, and the inner linking wall portion is bent in a V shape protruding toward the inner side in the vehicle transverse direction as seen from the front of the vehicle. However, instead of this, as is shown in Figs. 34, it is also possible to employ a

structure in which both the inner linking wall portion 232B and the outer linking wall portion 232A are bent in a V shape protruding in the same direction as seen from the front of the vehicle (in Fig. 34, this is toward the outer side in the vehicle transverse direction). Note that, in this case, the direction in which the fender 214 crushes (i.e. the direction indicated by the arrow B in Fig. 34) can be adjusted by the direction of the V shaped bend (in Fig. 34, this is the outward direction in the vehicle transverse direction).

Moreover, in each of the above embodiments, at least one of the inner linking wall portion and the outer linking wall portion is bent in a V shape at one bend point in the vertical direction, however, instead of this, as is shown in Fig. 35, it is also possible to employ a structure in which at least one of the outer linking wall 232A and the inner linking wall 232B is bent at a plurality of bend points P1 and P3 as well as P2 and P4 in the vertical direction.

Moreover, in each of the above embodiments, at least one of the outer linking wall portion and the inner linking wall portion is bent at a bend point. However, instead of this, as is shown in Fig. 36, it is also possible to employ a structure in which at least a top portion of the outer linking wall portion 232A and the inner linking wall portion 232B is curved outward (i.e. is bent in an arc shape) at the bend points P1 and P2.

Moreover, in the tenth and eleventh embodiments, as is shown in Fig. 26, the bottom wall portion 214H of the fender 214 is formed as the mounting portion 214J extending in the vehicle forward

direction, however, instead of this, as is shown in Fig. 37, it is also possible to employ a structure in which the bottom wall portion 214H of the fender 214 is held by a press plate 270 formed as a separate member and fixed by the bolt 256 to the top wall portion 226G of the apron upper member upper 226.

Moreover, in each of the above embodiments, the component force generating means is formed from the two outer linking wall portions 232A and 214E and inner linking wall portions 232B and 214F that face each other in the vehicle transverse direction. However, instead of this, it is also possible to form the component force generating means from three or more linking wall portions that are offset in the vehicle transverse direction.

A twelfth embodiment of the vehicle fender structure of the invention will now be described in accordance with Figs. 38 to 42.

Note that, in the diagrams, the arrow FR shows the direction of the front of the vehicle, the arrow UP shows the direction of the top of the vehicle, and the arrow IN shows the direction of the inside of the vehicle.

As is shown in Fig. 42, in this embodiment, a boundary 316 between a hood 312 of a vehicle body 310 and a fender panel 314 that is formed from metal or resin extends in the longitudinal direction of the vehicle at both end portions in the transverse direction of the vehicle of a front hood 318.

As is shown in Fig. 39, a hood inner panel 320 is provided extending in the vehicle longitudinal direction at the bottom surface of the outer portions in the vehicle transverse direction of the hood panel (also known as the hood outer panel) 312. The

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cross sectional configuration of the hood inner panel 320 as seen from the vehicle longitudinal direction is formed generally in a hat shape with the open portion thereof facing upward. An inner flange 320A formed protruding outward at the inner side in the vehicle transverse direction of the open portion is joined with adhesive to a bottom surface 312A of the hood panel 312. An outer peripheral edge 312B in the vehicle transverse direction of the hood panel 312 is fixed by a hemming process to an outer flange 320B formed protruding outward at the outer side in the vehicle transverse direction of the open portion of the hood inner panel 320. A closed cross section portion 321 formed from the hood panel 312 and the hood inner panel 320 forms the framework of the hood panel 312, and is also provided with load monodeformation characteristics capable of absorbing sufficient impact even if a colliding body S collides with only the hood panel 312.

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An apron upper member 324 which serves as a structural member of the vehicle body 310 is provided in the vehicle longitudinal direction below the boundary 316 of the hood panel 312 and the fender panel 314. The apron upper member 324 is formed from an apron upper member upper 326, which forms the top portion of the apron upper member 324, and an apron upper member lower 328, which forms the bottom portion of the apron upper member 324.

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The apron upper member upper 326 is formed with a U shaped cross section whose open portion faces downward and a flange 326B, which is directed toward the outer side in the vehicle transverse direction, is formed at the bottom end portion of the outer wall portion 326A in the vehicle transverse direction. The apron upper

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member lower 328 is formed with an L shaped cross section and a horizontal wall portion 328B, which is directed to the outer side in the vehicle transverse direction, is formed at the top end portion of the vertical wall portion 328A. The flange 326B of the apron upper member upper 326 and a distal end portion 328C of the horizontal wall portion 328B of the apron upper member lower 328 are welded together. The bottom end edge portion 326D of the inner wall portion 326C in the vehicle transverse direction of the apron upper member upper 326 is welded to the inner surface 328D in the vehicle transverse direction of the top end edge portion of the vertical wall portion 328A of the apron upper member lower 328.

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Accordingly, the apron upper member 324 forms a closed cross sectional portion 330 that extends in the vehicle longitudinal direction through the apron upper member upper 326 and the apron upper member lower 328.



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As is shown in Fig. 38, mounting holes 332 are formed spaced at predetermined intervals in the vehicle longitudinal direction in a top wall portion 326E of the apron upper member upper 326.

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As is shown in Fig. 39, an inner edge portion 314A in the vehicle transverse direction of the fender panel 314 that faces an outer edge portion 312B in the vehicle transverse direction of the hood panel 312 is formed as a parting portion of the fender panel 314. The inner edge portion 314A in the vehicle transverse direction curves downward and a narrow step portion 314F is formed facing the vehicle inner side at the bottom of this curved portion. A sloping wall portion 314B is provided extending in the vehicle transverse direction from the inner end P1 in the vehicle

transverse direction of the step portion 314F toward the vicinity of the top wall portion 326E of the apron upper member upper 326 that is on the inner side in the vehicle transverse direction. A substantially horizontal flange portion 314C is formed extending inward in the vehicle transverse direction from the bottom end portion P2 of the sloping wall portion 314B. The flange portion 314C abuts against the top wall portion 326E of the apron upper member upper 326.

As is shown in Fig. 38, mounting portions 314D of the fender panel 314 where the fender panel 314 is mounted to the apron upper member upper 326 are formed at predetermined intervals in the vehicle longitudinal direction and each mounting portion 314D is formed substantially horizontally. Mounting holes 334 are punched in the center portion of each mounting portion 314D and bolts 336 are inserted from the top into the mounting holes 334 and the mounting holes 332 in the apron upper member upper 326.

As is shown in Fig. 39, the fender panel 314 is fixed to the apron upper member upper 326 by these bolts 336 and weld nuts 338 that are fixed to the bottom surface of the top wall portion 326E of the apron upper member upper 326.

As is shown in Fig. 38, folding portions 340, 342, and 344, which are folded by a load substantially from above, are formed between the mounting portions 314D and the sloping wall portions 314B of the fender panel 314.

As is shown in Fig. 39, the folding portion 340 is provided at the outer side in the vehicle transverse direction of the mounting portion 314D and a bent portion P3 is formed protruding inward in

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the vehicle transverse direction in the center portion in the vertical direction of the folding portion 340. The cross section of the folding portion 340 is shaped in a V shape bending inward in the vehicle transverse direction when looked at from the vehicle longitudinal direction. The boundary between the mounting portion 314D and the bottom end portion of the folding portion 340 forms a bent portion P4. If the lengths between the various portions are set as: S1 between P1 and P2; S2 between P1 and P3; S3 between P3 and P4; and S4 between P4 and P2, then these lengths have the relationship: $S1 \div S2 - S3 + S4$. In the folding portion 340, the distance in a direct line between the top end P1 and the bottom end P2 after folding is set so as to be substantially the same as the distance in a straight line between the top end P1 and the bottom end P2 before folding.

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An elongated hole portion 346 that cuts through the bent portion P3 is formed extending in the vehicle vertical direction in the center portion in the vehicle longitudinal direction of the folding portion 340. This hole portion 346 is designed so as to be compressed in the manner shown by the double dot chain line in Figs. 38 and 40 when the folding portion 340 becomes folded.

25

As is shown in Fig. 38, the folding portion 342 is provided toward the vehicle rear on the mounting portion 314D and, when looked at in plan view, extends from the rear end of the folding portion 340 rearwards and inward in the vehicle transverse direction. Moreover, a bent portion P5 is formed protruding toward the inner forward side of the vehicle at the center portion in the vertical direction of the folding portion 342, and the

cross section of the folding portion 342, as seen from the transverse direction of the vehicle, is formed in a V shape bent toward the front of the vehicle.

5 A folding portion 344 is provided toward the vehicle front on the mounting portion 314D and, when looked at in plan view, extends from the front end of the folding portion 340 forwards and inward in the vehicle transverse direction. Moreover, a bent portion P6 is formed protruding toward the inner rearward side of the vehicle at the center portion in the vertical direction of the
10 folding portion 344, and the cross section of the folding portion 344, as seen from the transverse direction of the vehicle, is formed in a V shape bent toward the rear of the vehicle.

As seen in Fig. 39, a recessed portion 348 is formed in the area opposing the folding portions 340, 342, and 344 in the top wall
15 portion 326E of the apron upper member upper 326. As is shown in Fig. 41, when the folding portion 340 becomes folded, a portion of the folding portion 340 enters the recessed portion 348.

The operation of the embodiment will now be described.

In this embodiment, as is shown in Fig. 38, the mounting portion 314D of the fender panel 314 is fixed to the top wall portion 326E of the apron upper member upper 326. Therefore, because the
20 portion for mounting on the apron upper member upper 326 is not provided on a sloping wall portion as in the conventional structure, the engine room 371 is not made any smaller by protruding of the mounting portion 314D of the fender panel 314 toward the inner side in the vehicle transverse direction.

If, however, a colliding body S collides with the boundary 16

between the hood panel 12 and the fender 14 and the load acts substantially from an upward direction in substantially a downward direction (i.e. in the direction shown by the arrow A in Fig. 38), the area in the vicinity of the boundary 16 of the hood panel 12 and the area in the vicinity of the boundary 16 of the fender 14 is deformed downward, as is shown by the double dot chain line in Fig. 41.

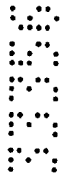
At this time, in the vehicle fender structure of this embodiment, the folding portions 340, 342, and 344 of the fender panel 314 are folded by an impact load from a substantially upward direction, for example, as is shown in Fig. 41, with the top end P1 of the folding portion 340 rotating toward the vehicle outer side about the bottom end P2 and the folding portion 340 thereby being folded resulting in the deformation load being reduced. In addition, the hole portion 346 provided in the folding portion 340, which is on the outer side in the vehicle transverse direction of the mounting portion 314D, as is shown by the double dot chain line in Fig. 40, is deformed in the direction in which the angle θ of the angle portion of the hat shape increases, namely, in the direction in which the hole portion 346 contracts. Therefore, although it would be necessary for portions other than the angle portion to be deformed if the hole portion 346 was not formed and the deformation load would thus increase, because this can be eliminated using the hole portion 346, the deformation load is reduced. As a result, the ability to absorb impact is improved.

In this embodiment, if the lengths in the folding portion 340 between the various portions are set as: S1 between P1 and P2; S2

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between P1 and P3; S3 between P3 and P4; and S4 between P4 and P2, then these lengths have the relationship: $S1 \div S2 - S3 + S4$. In the folding portion 340, the distance in a direct line between the top end P1 and the bottom end P2 after folding is set so as to be substantially the same as the distance in a straight line between the top end P1 and the bottom end P2 before folding. Therefore, when the folding portion 340 is folded, no new bent portion is created and the deformation load can be reliably reduced. Moreover, after the folding, it is possible to prevent the bent portion P4 from protruding downward too much.

10



In this embodiment, as is shown in Fig. 41, when the folding portion 340 is folded, a portion (i.e. the bent portion P4) of the folding portion 340 enters the recessed portion 348. Accordingly, a portion of the folding portion 340 abuts against the apron upper member upper 326 and any further bending is prevented, therefore, the deformation load is further reduced.

Next, a thirteenth embodiment of the vehicle fender structure of the invention will be described in accordance with Figs. 43 and 44.

Note that those members that are the same as in the twelfth embodiment are given the same reference symbols and a description thereof is omitted.

25

In this embodiment, instead of the folding portion 340 of the twelfth embodiment, as is shown in Figs. 43 and 44, a large hole portion 360 is formed on the outer side in the vehicle transverse direction of the mounting portion 314D of the fender panel 314, and folding portions 342 and 344 are formed respectively in the vehicle rear side and vehicle front side of the hole portion 360,

in the same way as in the twelfth embodiment.

Next, the operation of this embodiment will be described.

5

In this embodiment, as is shown in Fig. 43, the mounting portion 314D of the fender panel 314 is fixed to the top wall portion 326E of the apron upper member upper 326. Therefore, because the portion for mounting on the apron upper member upper 326 is not provided on a sloping wall portion as in the conventional structure, the engine room 371 is not made any smaller by protruding of the mounting portion 314D of the fender panel 314 toward the inner side in the vehicle transverse direction.

10



In contrast, when the area in the vicinity of the inner edge portion 314A in the vehicle transverse direction of the fender panel 314 is deformed downward, the folding portions 342 and 344 of the fender panel 314 are folded by the impact load from a substantially upward direction and absorb the impact. The deformation load is also reduced by the hole portion 360 being contracted. Therefore, the ability to absorb impact is improved.



20

Next, a fourteenth embodiment of the vehicle fender structure of the invention will be described in accordance with Figs. 45 and 46.

Note that those members that are the same as in the twelfth embodiment are given the same reference symbols and a description thereof is omitted.

25

In this embodiment, instead of the folding portions 340, 342, and 344 of the twelfth embodiment, as is shown in Fig. 45, a large hole portion 364 is formed in the fender panel 314 and the mounting portion of the fender panel 314 is a mounting portion 366A of a bracket 366 which is a separate body. Namely, a

mounting hole 332 for mounting on the apron upper member upper 326 is formed in the mounting portion 336A of the bracket 336, and the inner end portion 366B in the vehicle transverse direction of the mounting portion 366A is joined to the bottom surface of a joining portion 314E formed continuously with the flange 314C of the hood panel 314.

Moreover, a flange portion 366C is formed at the top end portion of the bracket 366 and the rear surface of the sloping wall portion 314B is joined to the flange portion 366C. Note that the flange portion 366C extends in the vehicle longitudinal direction and widened portions 366D are formed at both ends of the flange portion 366C in the vehicle longitudinal direction.

As is shown in Fig. 46, the size of the hole 364 is set such that a jig for fastening the bolt 336 can be inserted therein, and a folding portion 368 that is folded by a load from a substantially upward direction is formed between the mounting portion 366A of the bracket 366 and the flange portion 366C of the bracket 366. Namely, the folding portion 368 is provided at the outer side in the vehicle transverse direction of the mounting portion 366A, and a bent portion P7 that protrudes outward in the vehicle transverse direction is formed at the center portion in the vertical direction of the folding portion 368. The cross section of the folding portion 368 as seen from the vehicle longitudinal direction is formed as a V shape bent outward in the vehicle transverse direction. As a result, as is shown in Fig. 45, a hole portion 372 and a hole portion 374 are formed respectively at the vehicle front side and vehicle rear side of the folding

portion 368.

The operation of this embodiment will now be described.

5 In this embodiment, as is shown in Fig. 45, the flange 314C of the fender panel 314 is fixed to the top wall portion 326E of the apron upper member upper 326. Therefore, because the portion for mounting on the apron upper member upper 326 is not provided on a sloping wall portion as in the conventional structure, the engine room 371 is not made any smaller by protruding of the mounting portion of the fender panel 314 toward the inner side in the vehicle transverse direction.

10 In contrast, when the area in the vicinity of the inner edge portion 314A in the vehicle transverse direction of the fender panel 314 is deformed downward, the folding portions 368 of the fender panel 314 is folded by the impact load from a substantially upward direction and absorbs the impact. The deformation load is also reduced by the hole portions 372 and 374 being contracted. Therefore, the ability to absorb impact is improved.

15 Moreover, in this embodiment, because the folding portion 368 and the mounting portion 366A are formed in the bracket 366 that is formed separately from the fender panel 314, it is possible to set the shape of the folding portion 368 without having to consider the formability of the fender panel 314. A result of this is that, for example, the degree of freedom in the design of the fender panel 314 is improved.

20 In the above, a detailed description has been given of specific embodiments of the invention, however, the invention is not limited to these embodiments and it will be evident to one skilled

in the art that various other embodiments are possible within the scope of the invention. For example, the shape of the cross section of the folding portions 340, 342, 344, and 368 is not limited to a V and it is also possible to use a Z shape or the like.

In the above, a detailed description has been given of specific embodiments of the invention, however, the invention is not limited to these embodiments and it will be evident to one skilled in the art that various other embodiments are possible within the scope of the invention.

The claims defining the invention are as follows:

1. A fender portion structure of a vehicle comprising:
a structural member of said vehicle;
a mounting member, and
5 a fender mounted on said structural member by way of said
mounting member, wherein said mounting member is displaceable
relative to one of said structural member and said fender upon
application of an impact load to said fender in a substantially
downward direction so as to move said fender relative to said
10 structural member.

2. The fender portion structure of claim 1, wherein
said mounting
member comprises a nut plate and a fastening bolt, and a hole is
15 formed in said structural member, said hole being configured to
enable displacement of said mounting member relative to said
structural member upon said application of said impact load.

3. The fender portion structure of claim 1, wherein
20 said mounting
member comprises a nut that is fixed to said structural member
and a fastening bolt, and a hole is formed in said fender, said
hole being configured to enable displacement of said mounting
member relative to said fender upon said application of said
25 impact load.

4. A fender portion structure for a vehicle, said
structure being substantially as hereinbefore described with
reference to figures 1 to 5 of the accompanying drawings.

30

Dated 16 December, 2002

Toyota Jidosha Kabushiki Kaisha

Patent Attorneys for the Applicant/Nominated Person

SPRUSON & FERGUSON



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The image shows four 5x5 dot patterns arranged vertically. The first pattern represents the digit '1', the second '2', the third '3', and the fourth '4'. Each pattern is composed of black dots on a white background.

FIG. 1

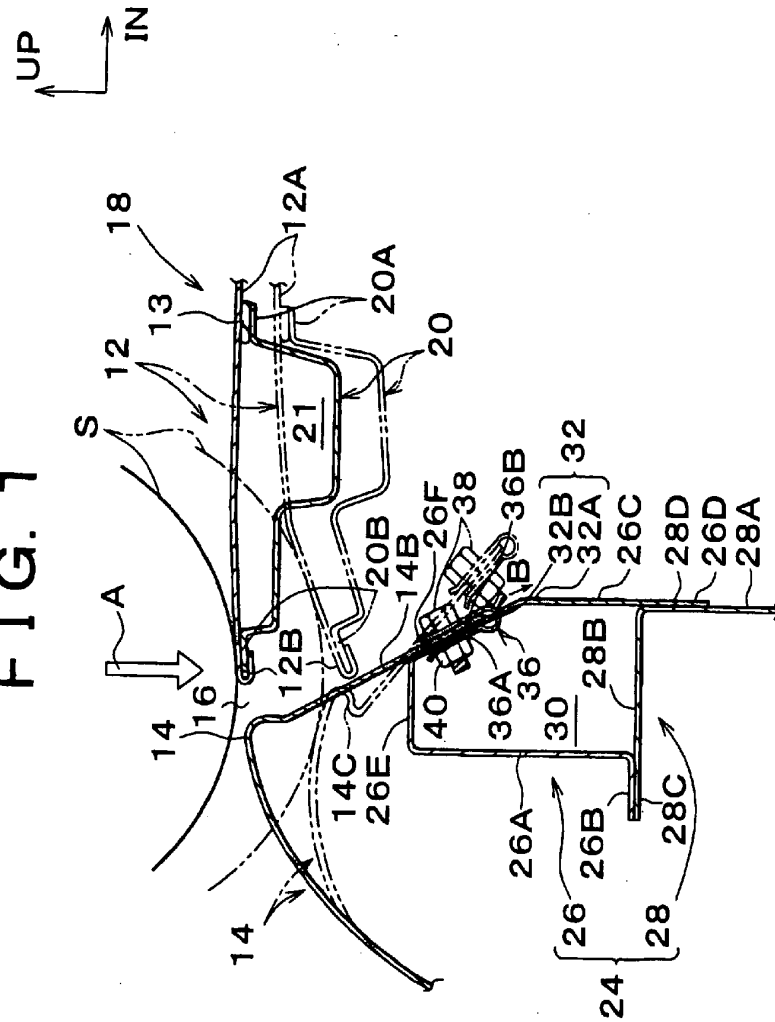


FIG. 2

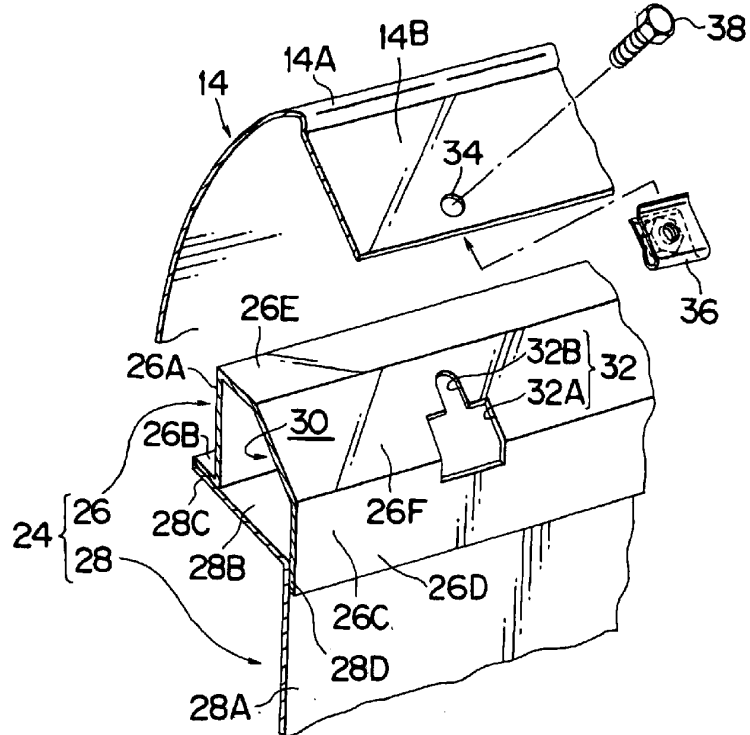
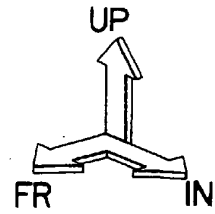


FIG. 3

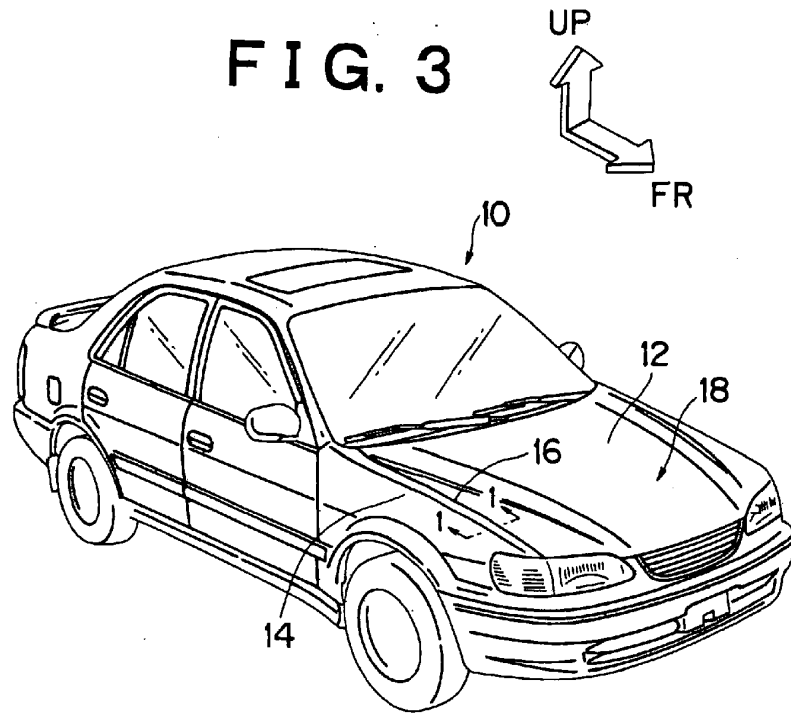


FIG. 3

FIG. 4

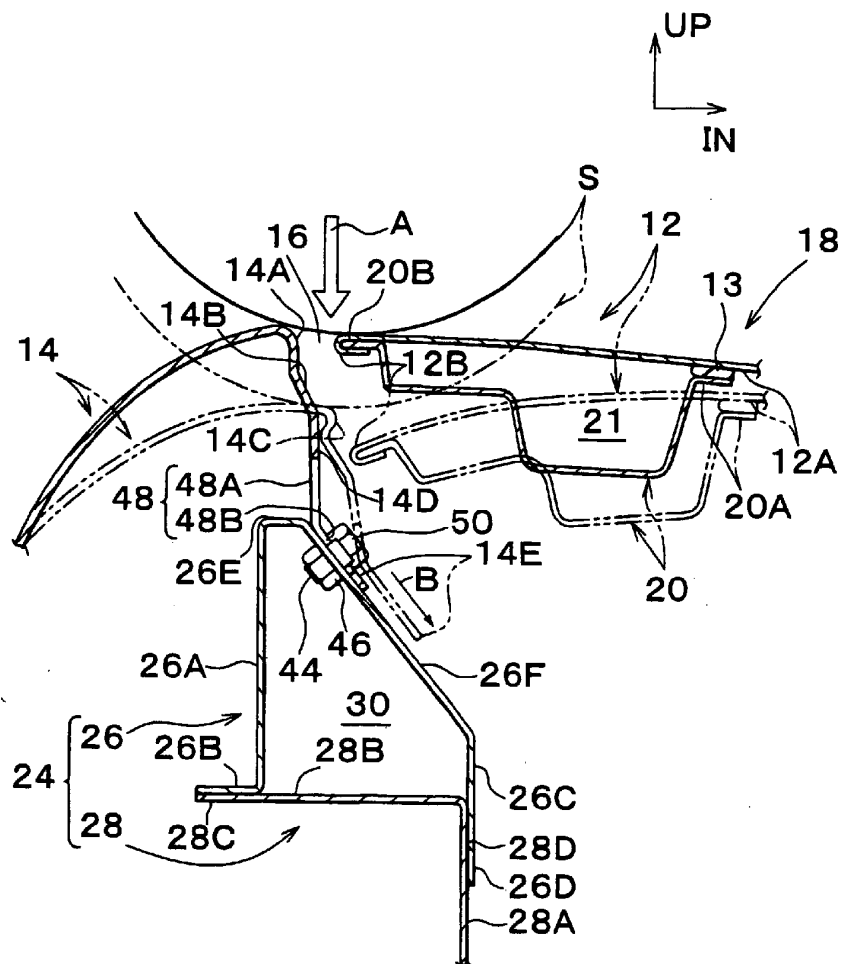


FIG. 5

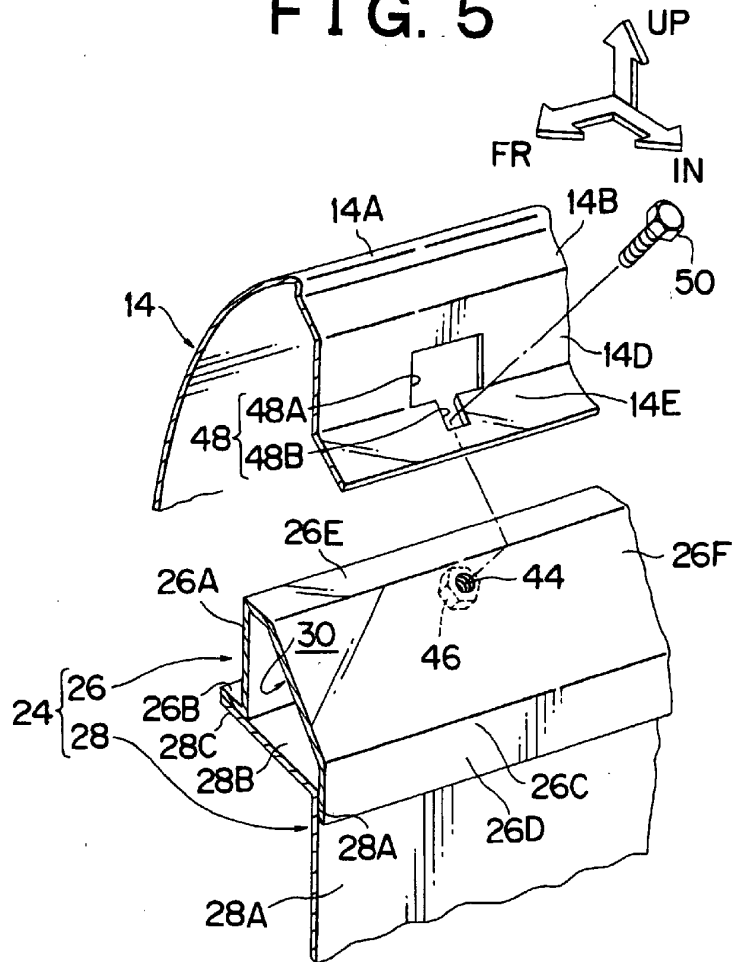


FIG. 6

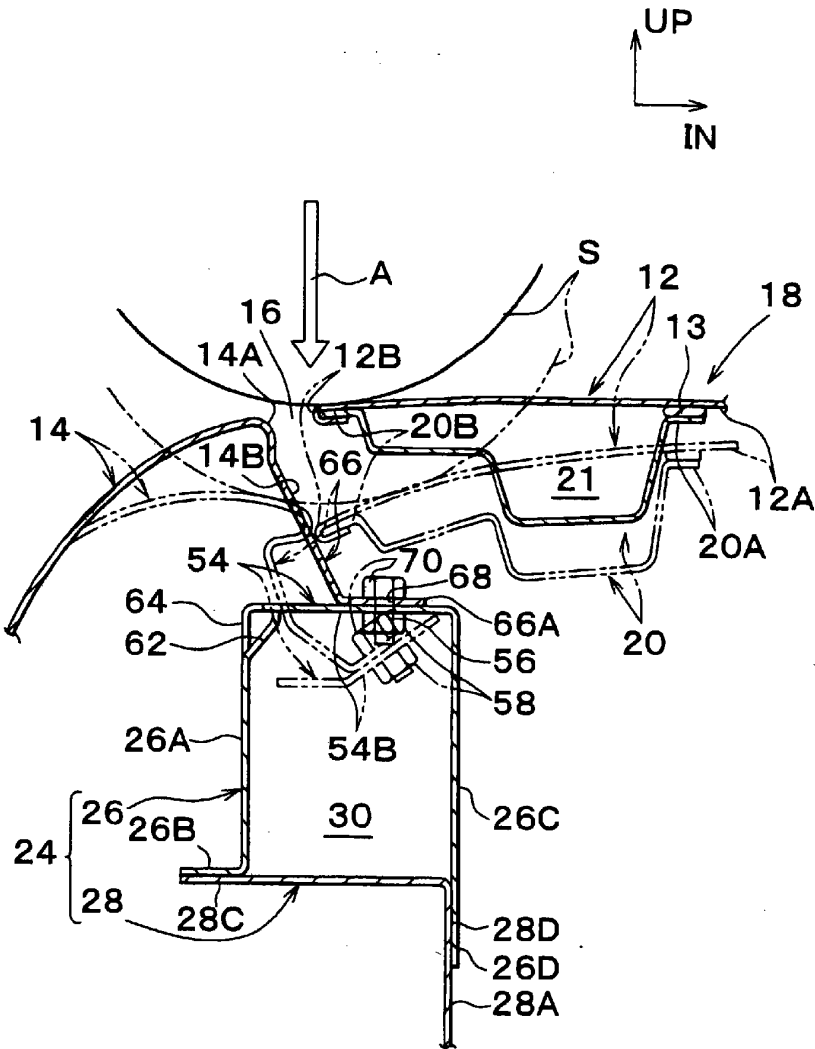


FIG. 7

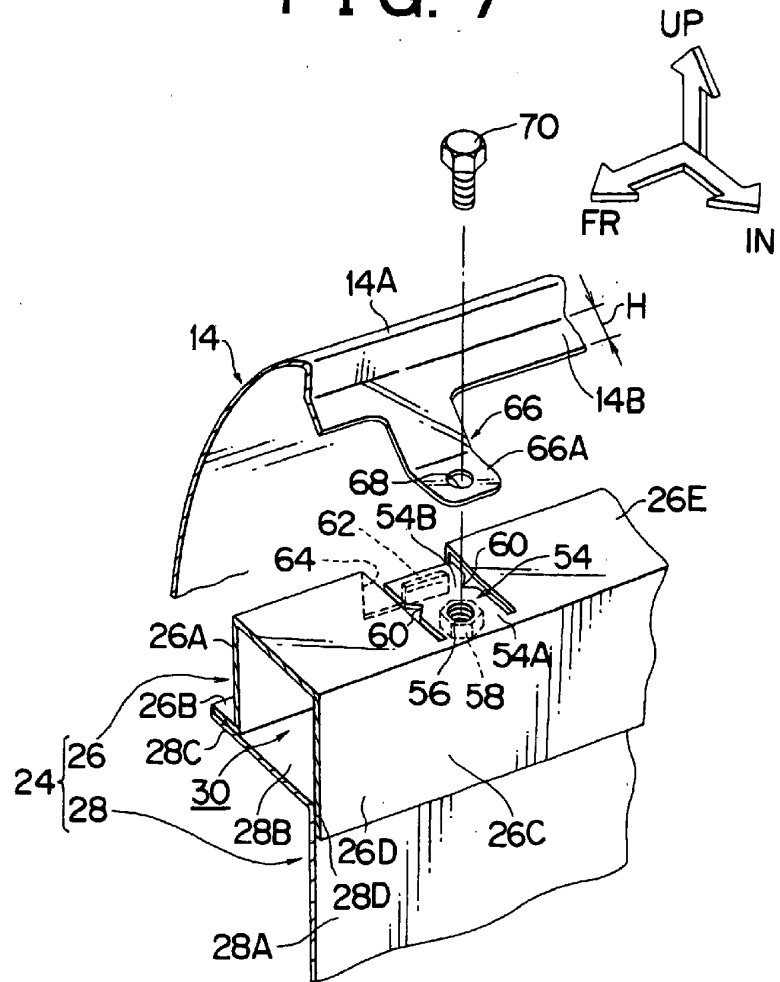


FIG. 8

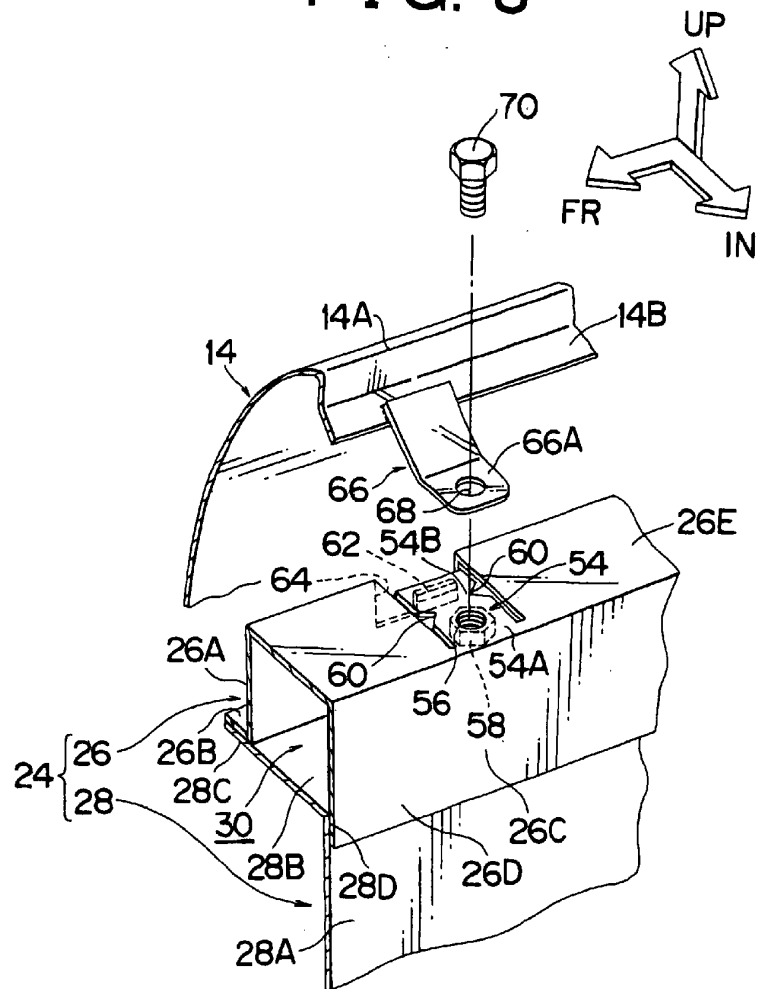


FIG. 9



FIG. 10

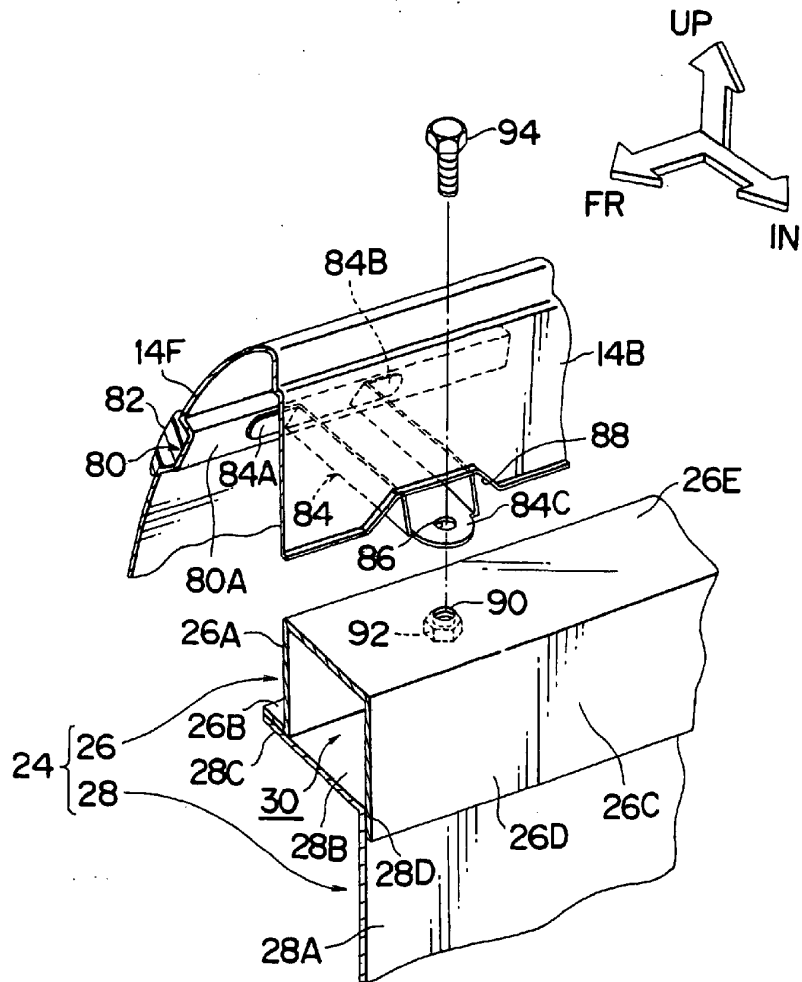


FIG. 11

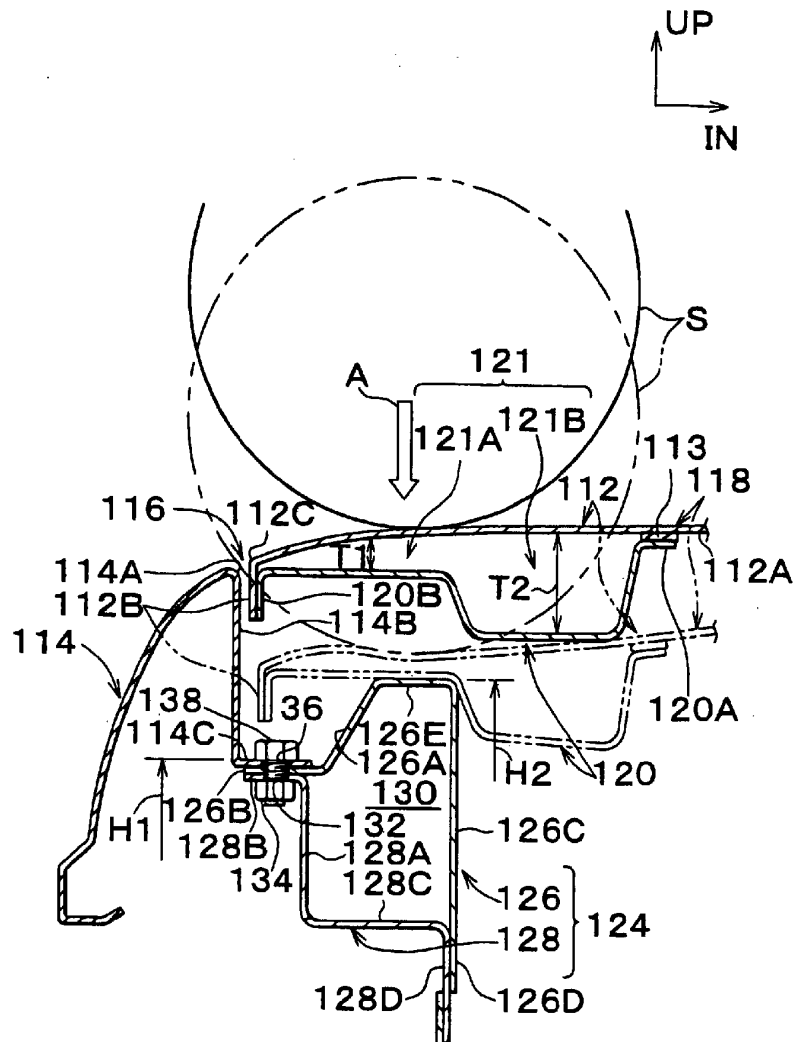


FIG. 13

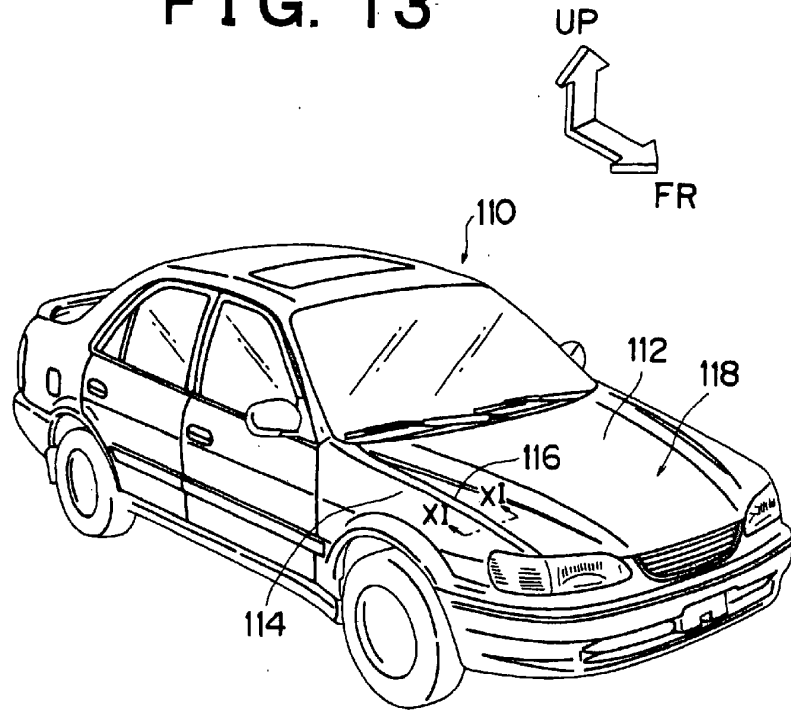


FIG. 13

FIG. 14

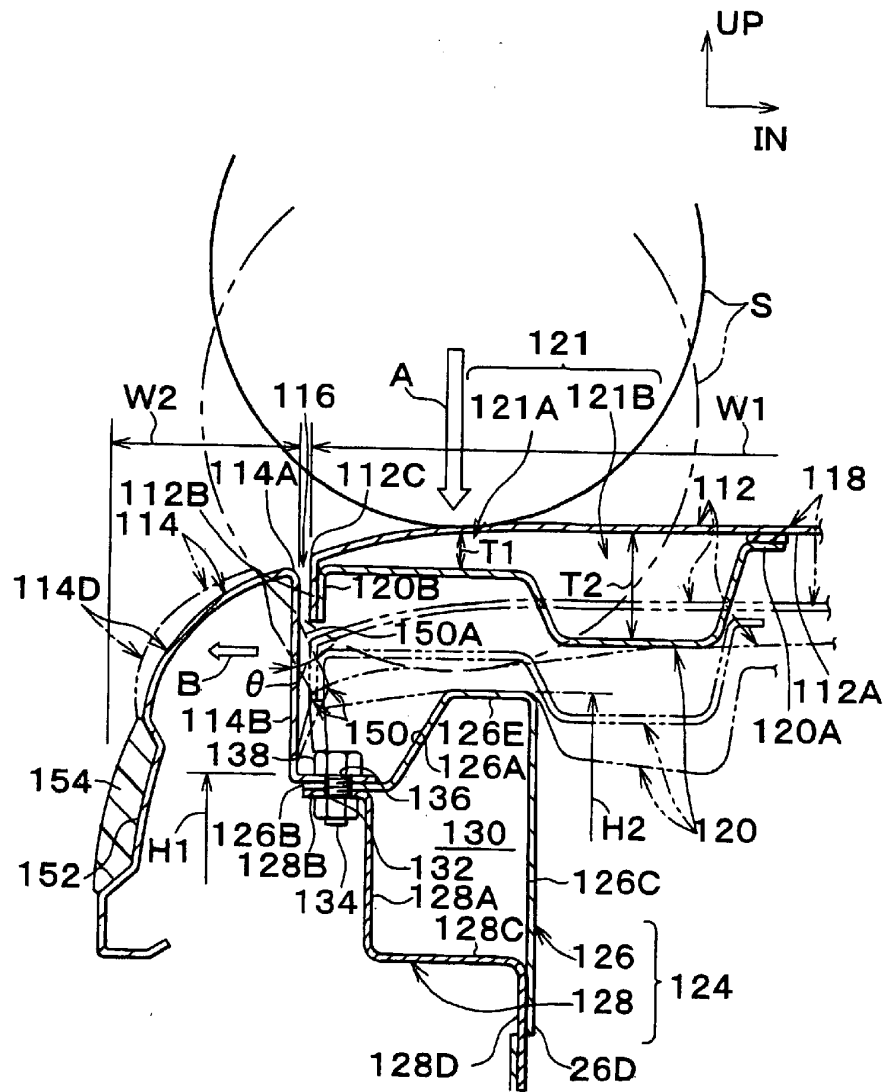
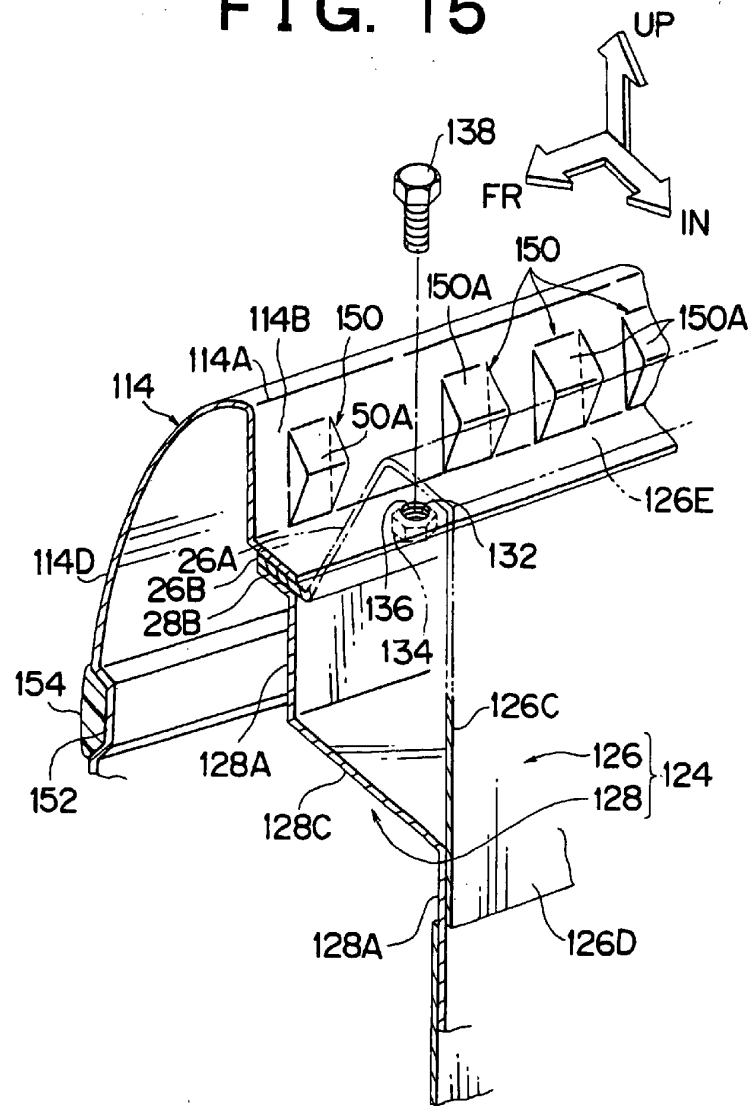


FIG. 15



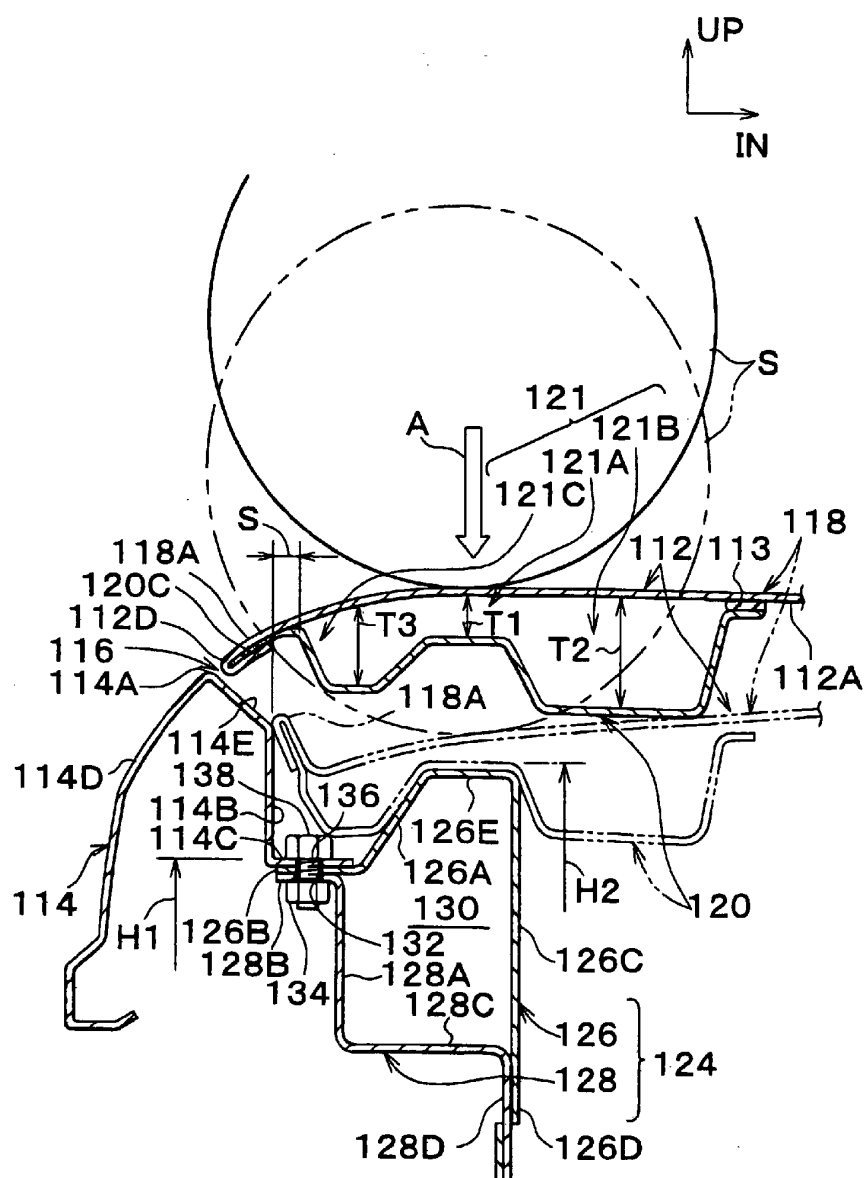


FIG. 17

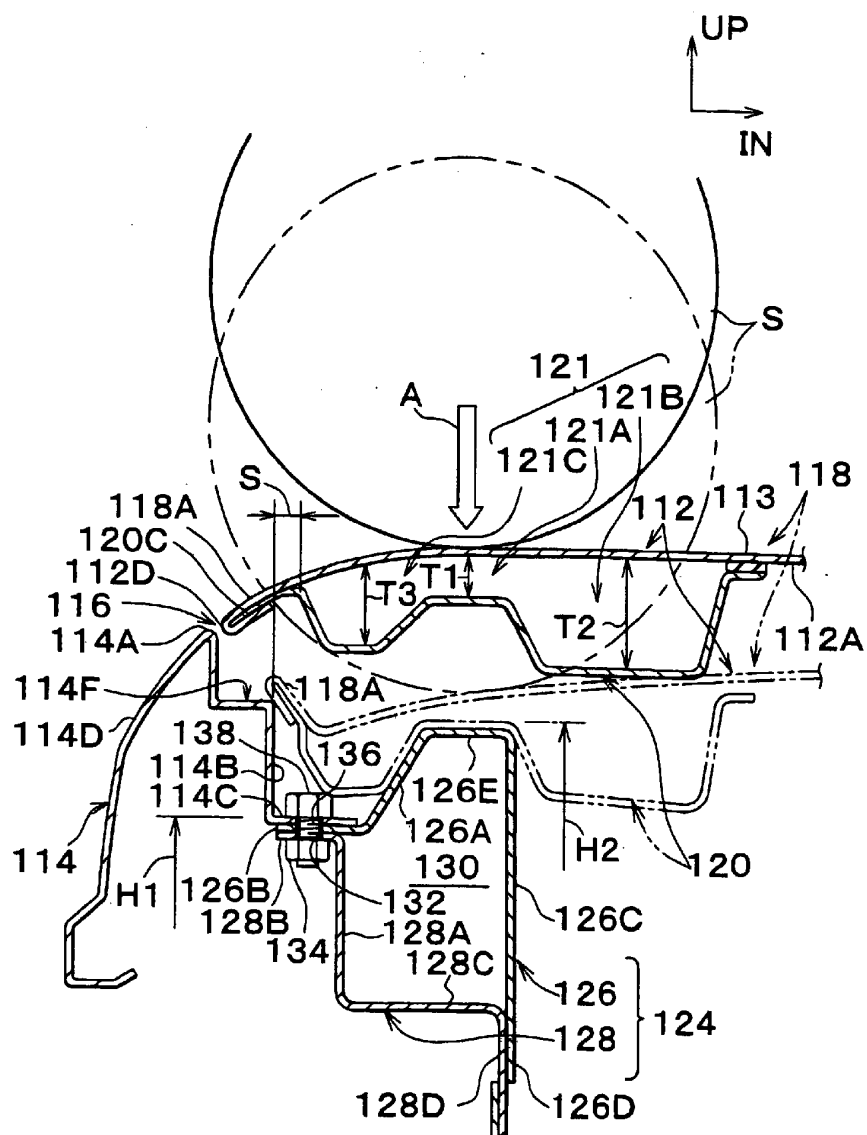


FIG. 18

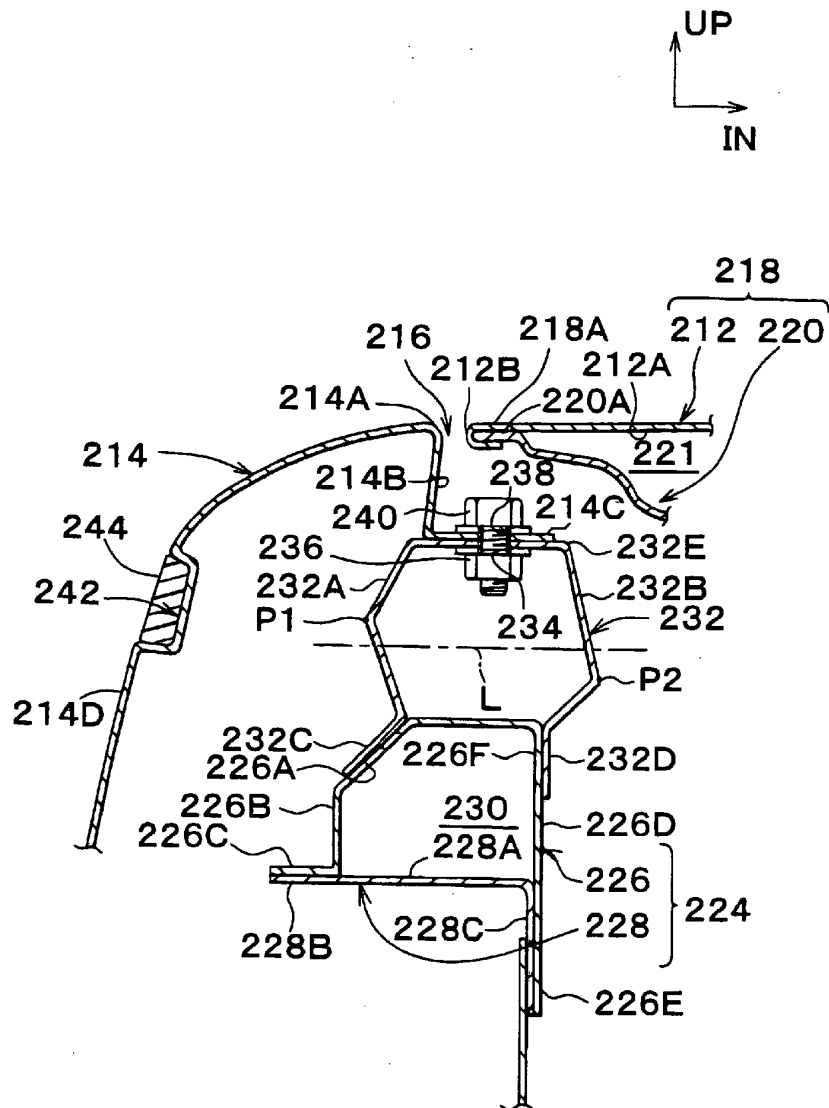
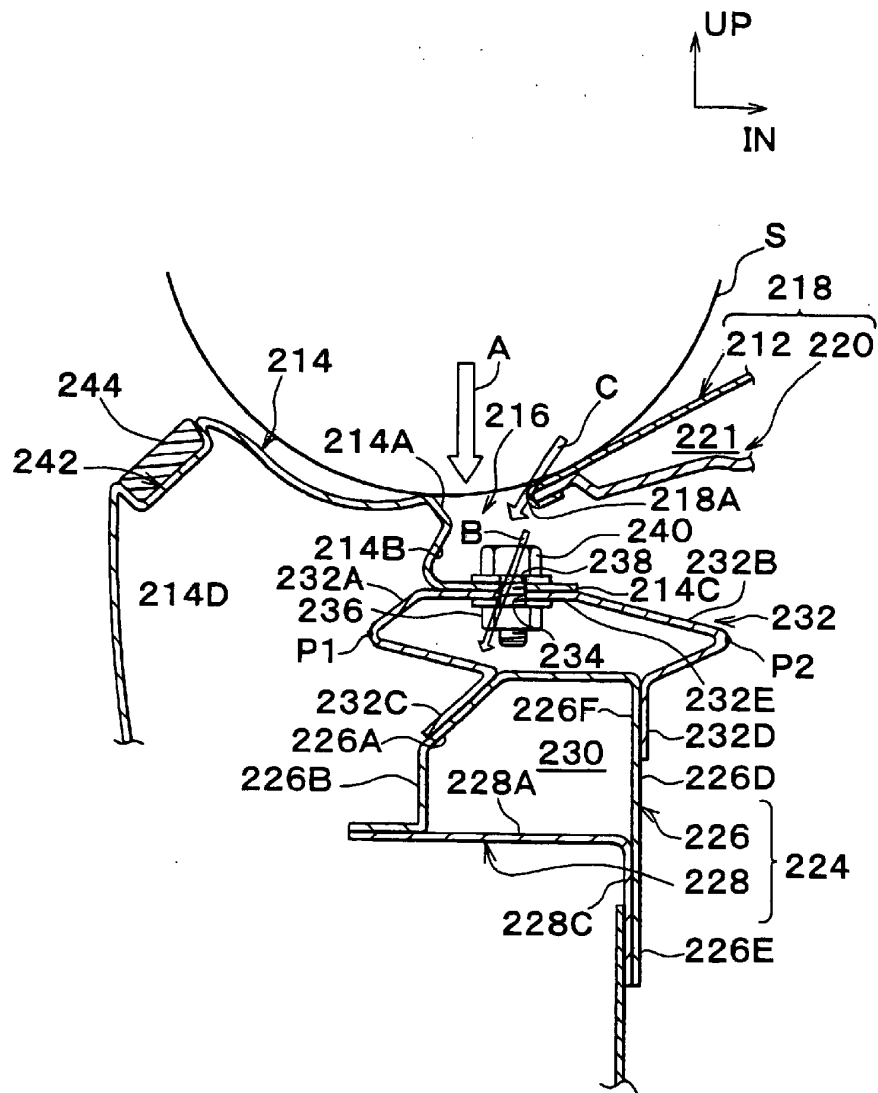


FIG. 19



30 03 01 33356

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FIG. 20

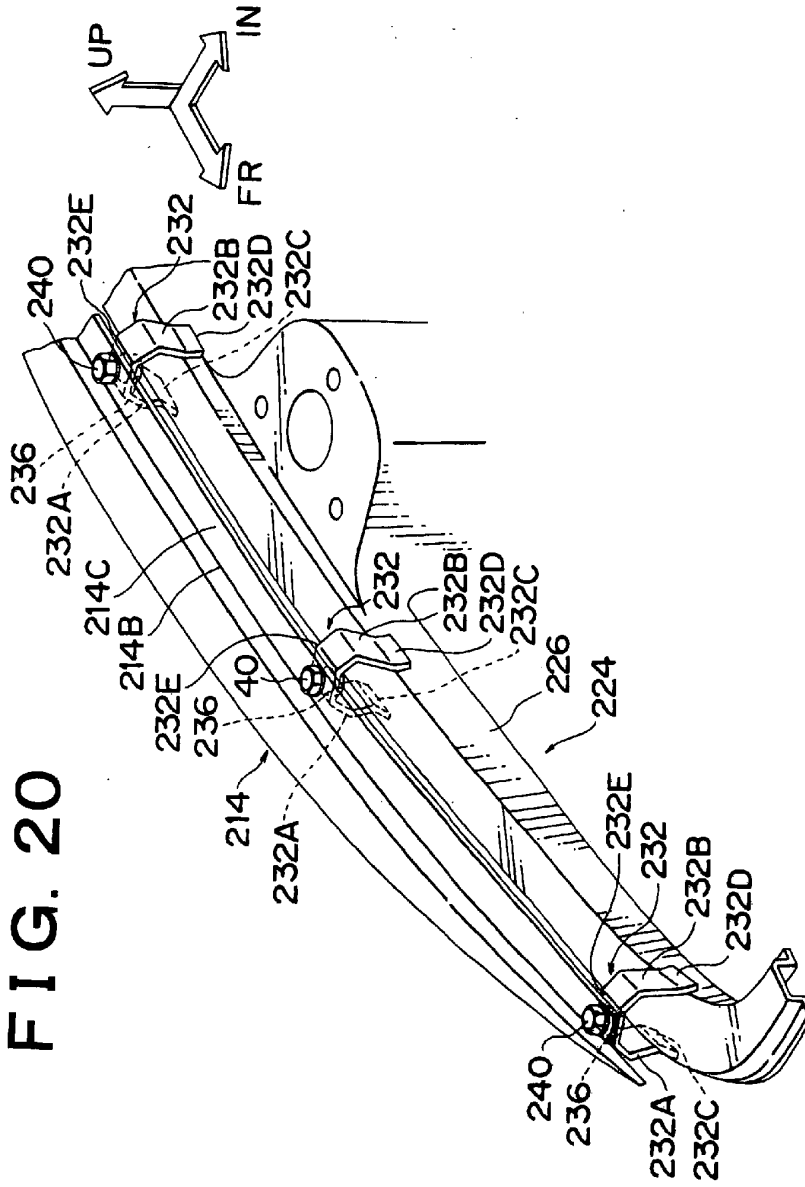
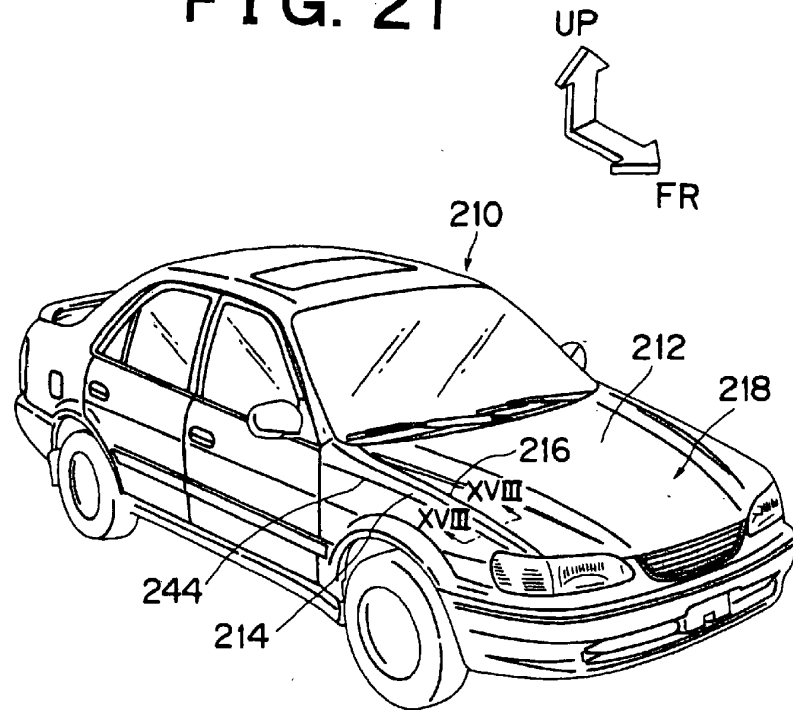


FIG. 21



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FIG. 22

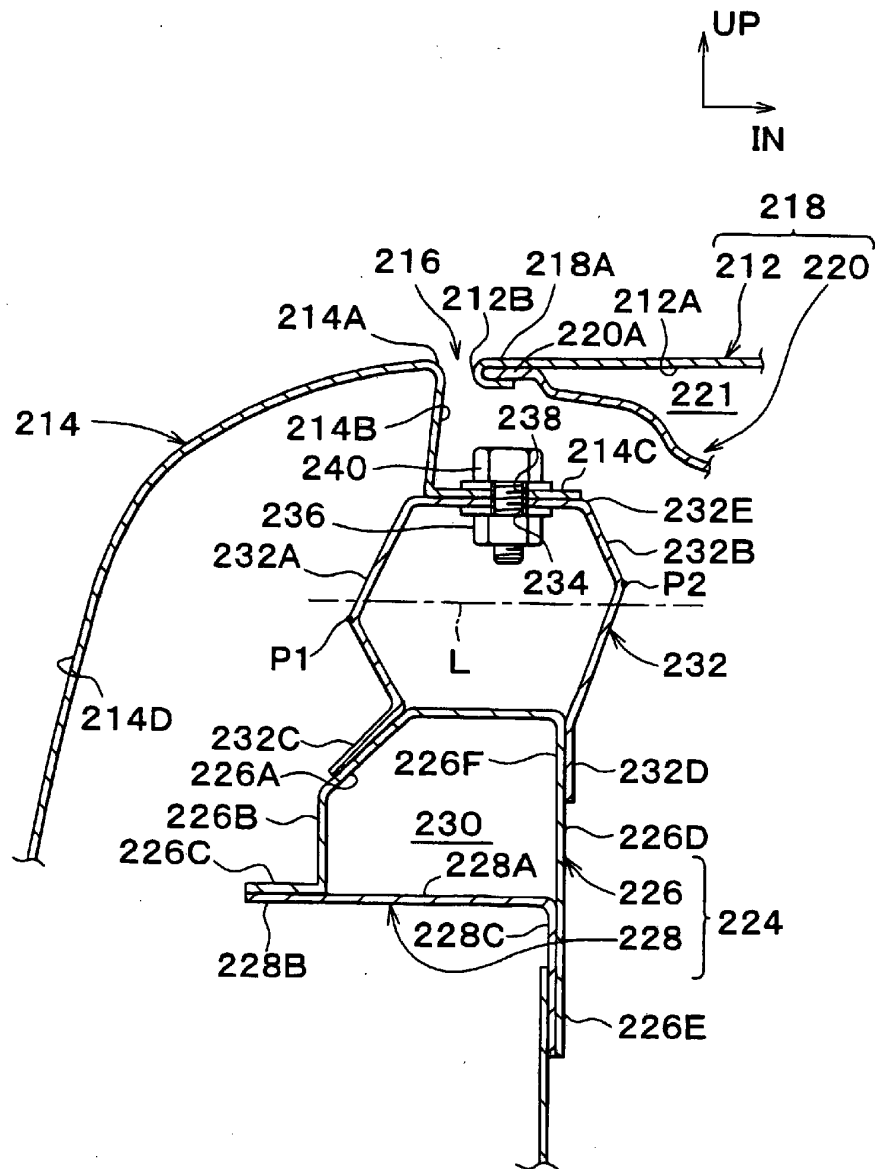


FIG. 23

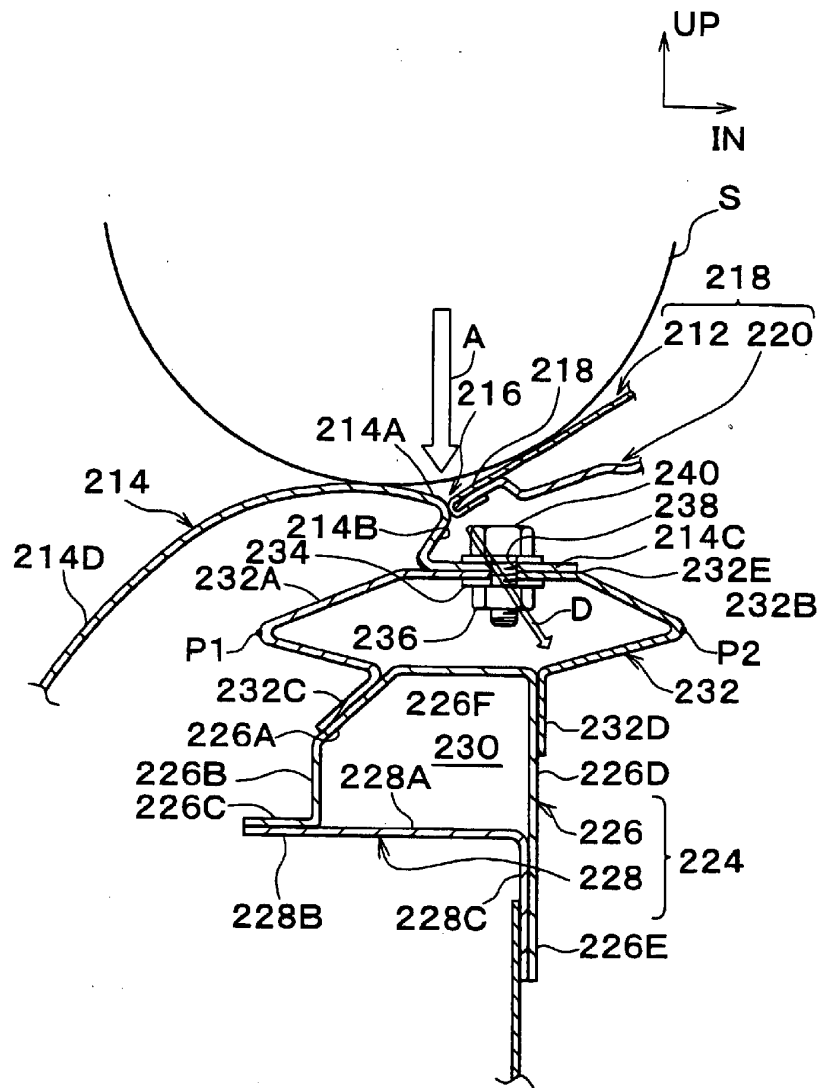


FIG. 24

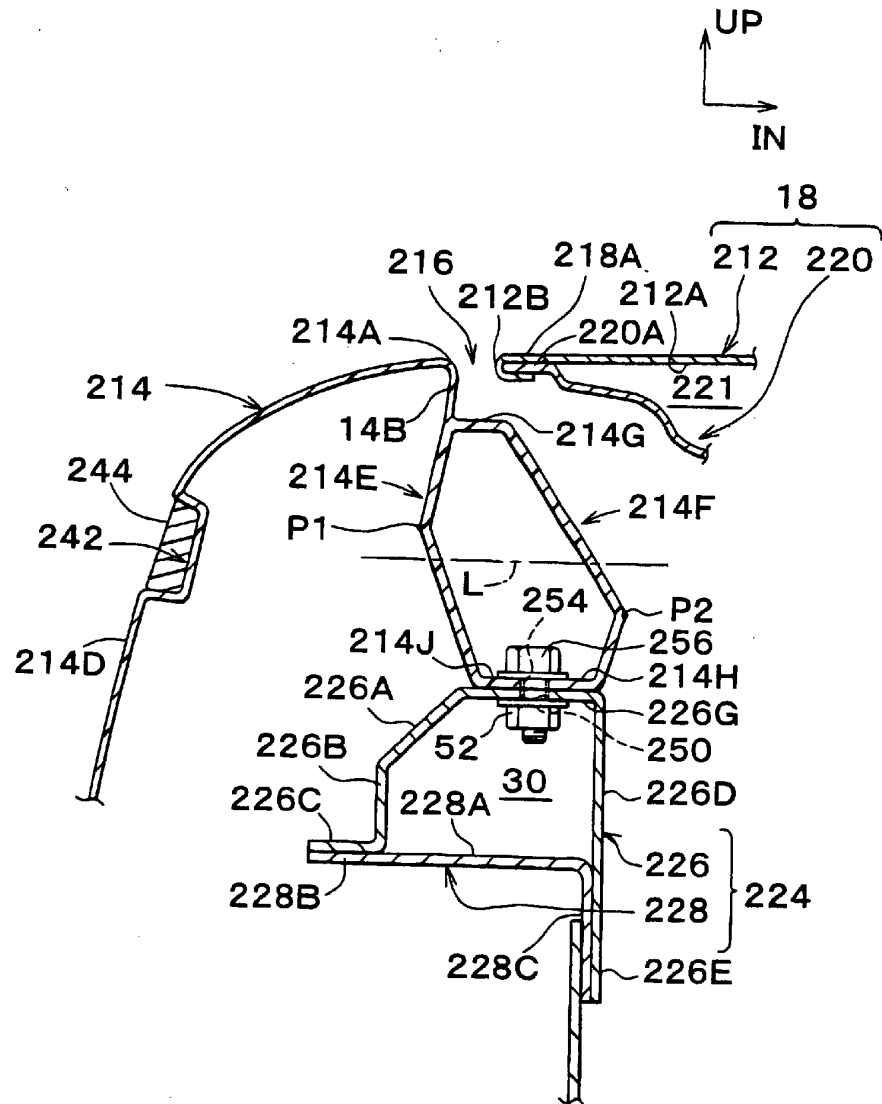
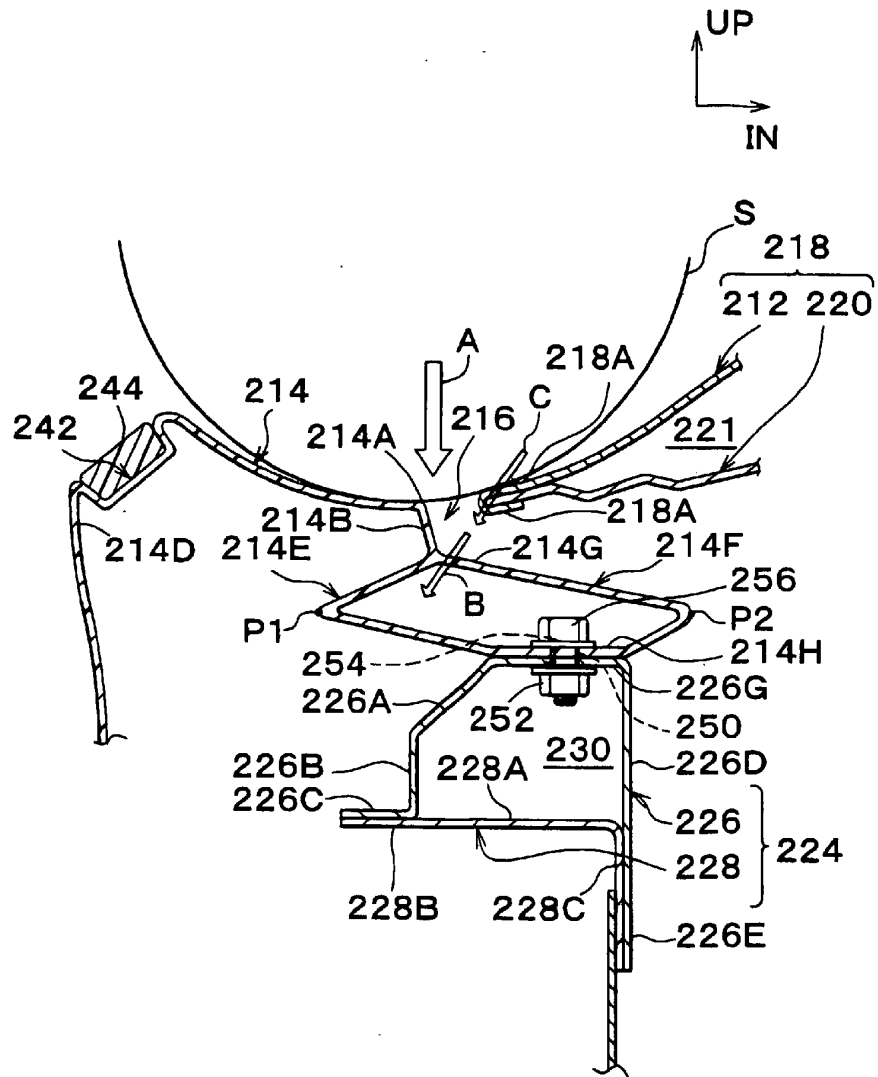


FIG. 25



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FIG. 26

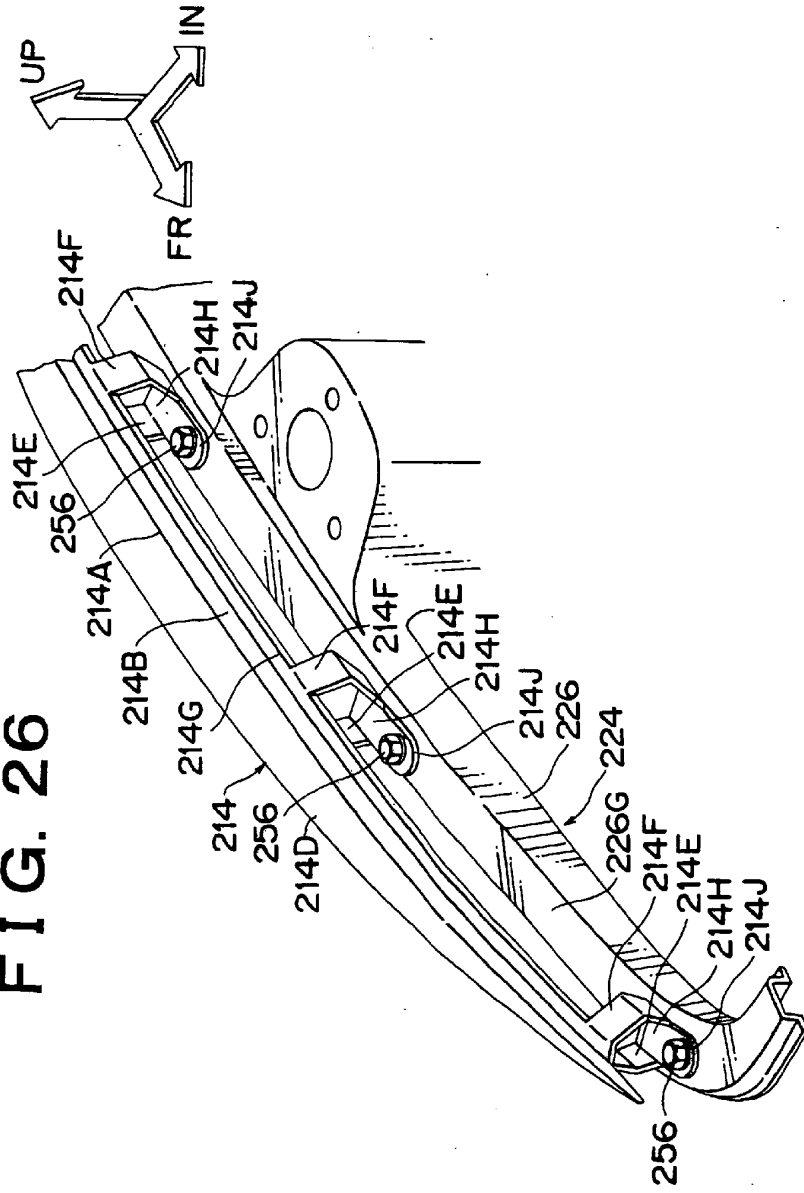


FIG. 27

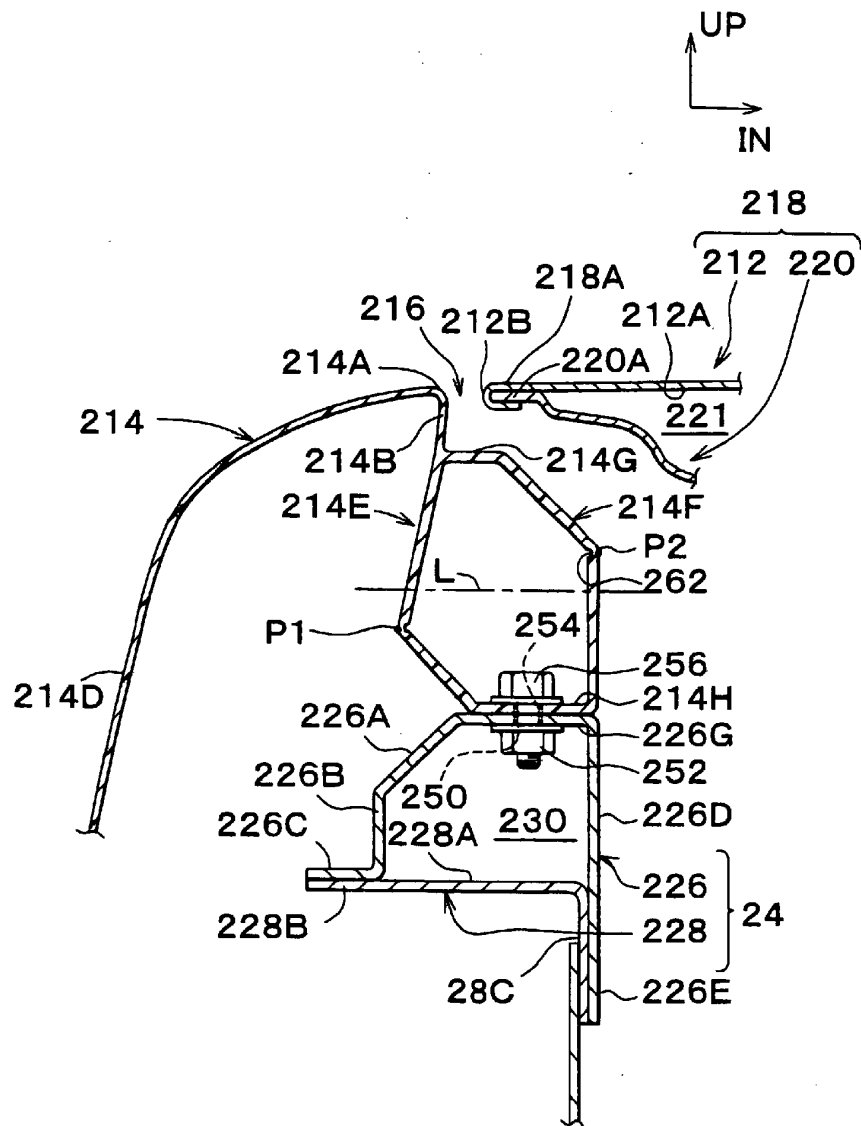


FIG. 28

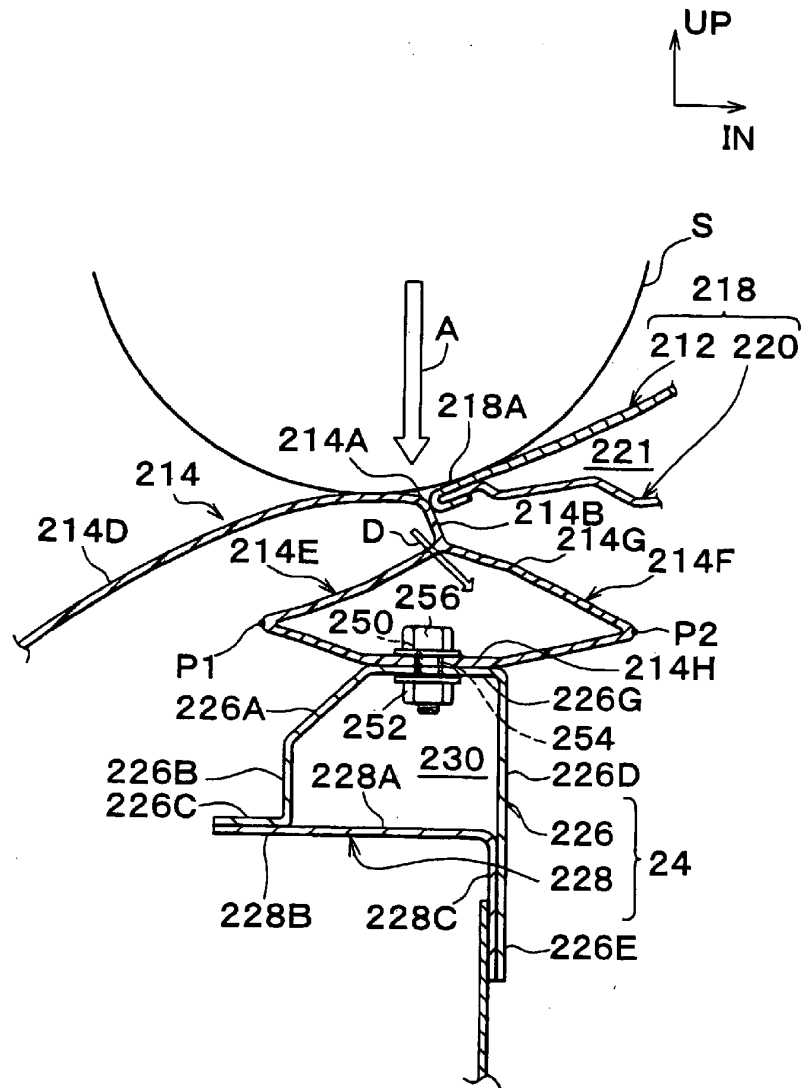


FIG. 29

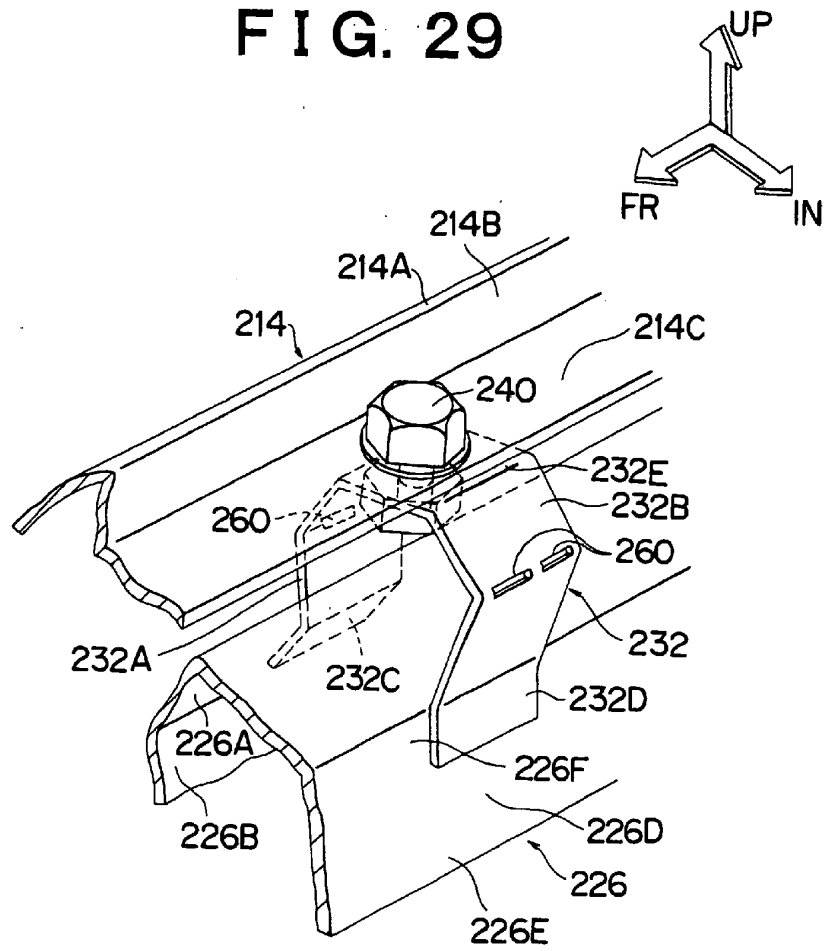


FIG. 30

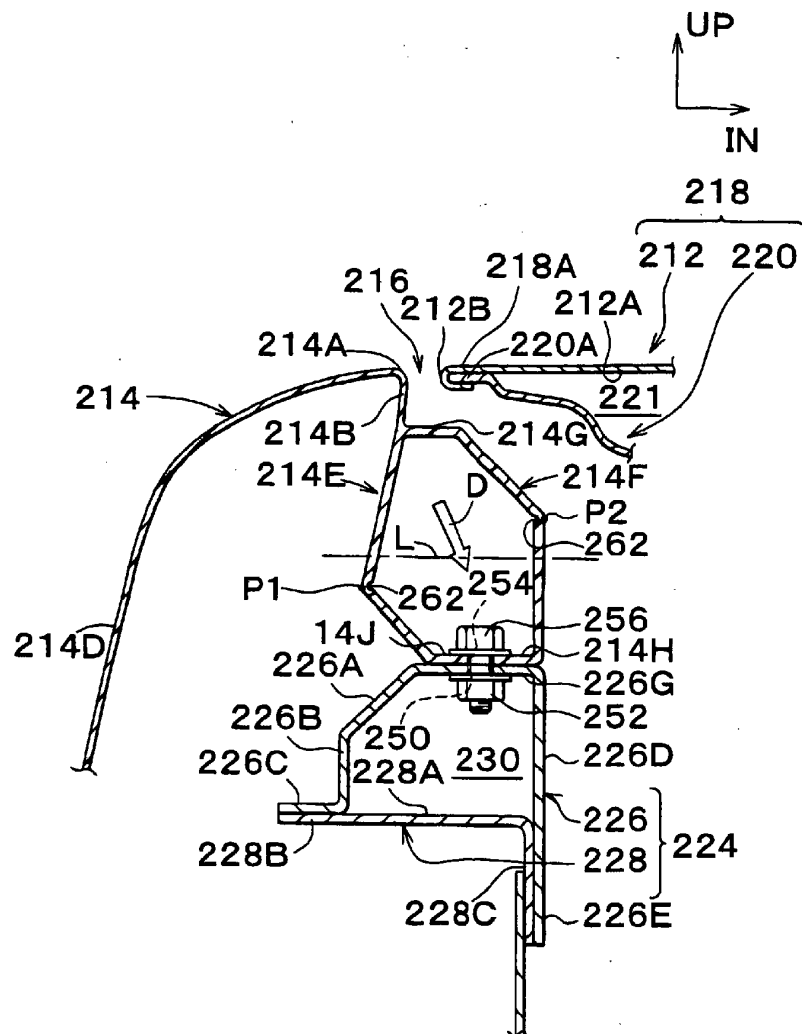


FIG. 31

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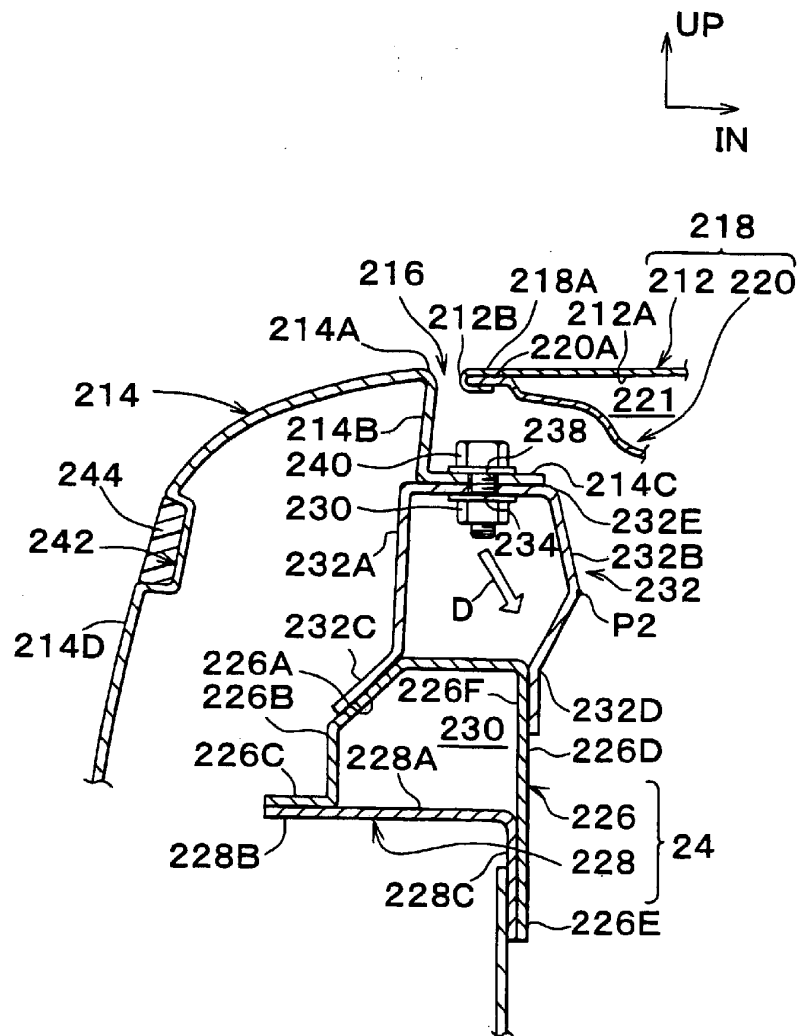


FIG. 32

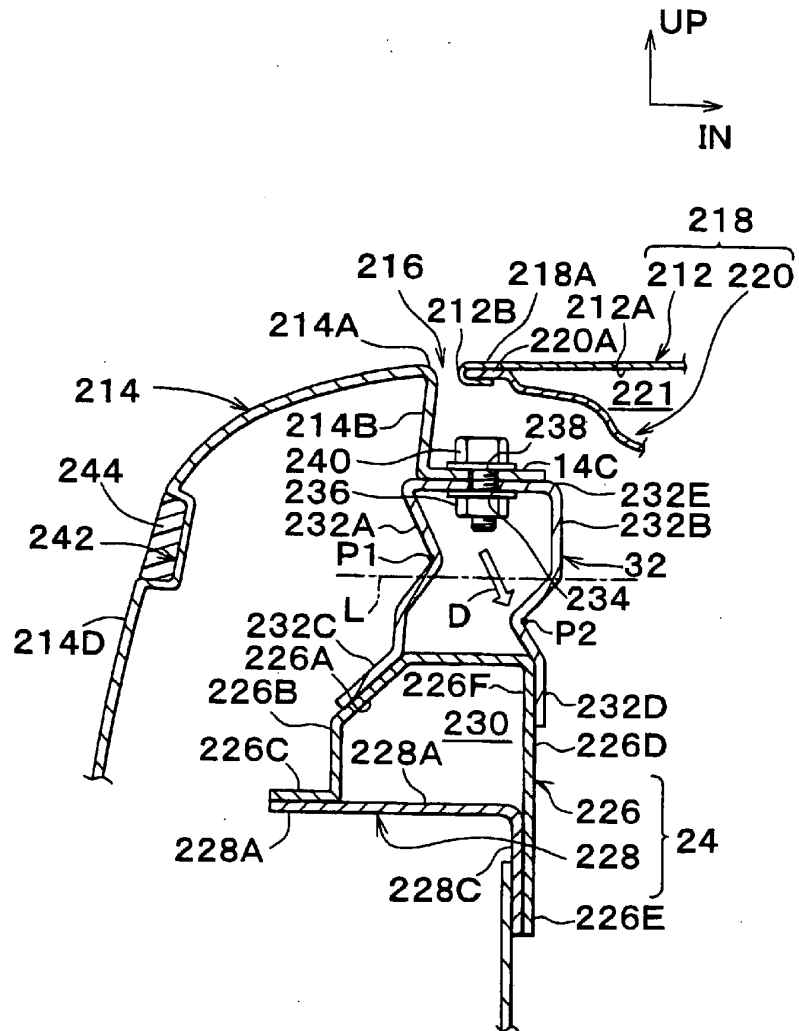


FIG. 33

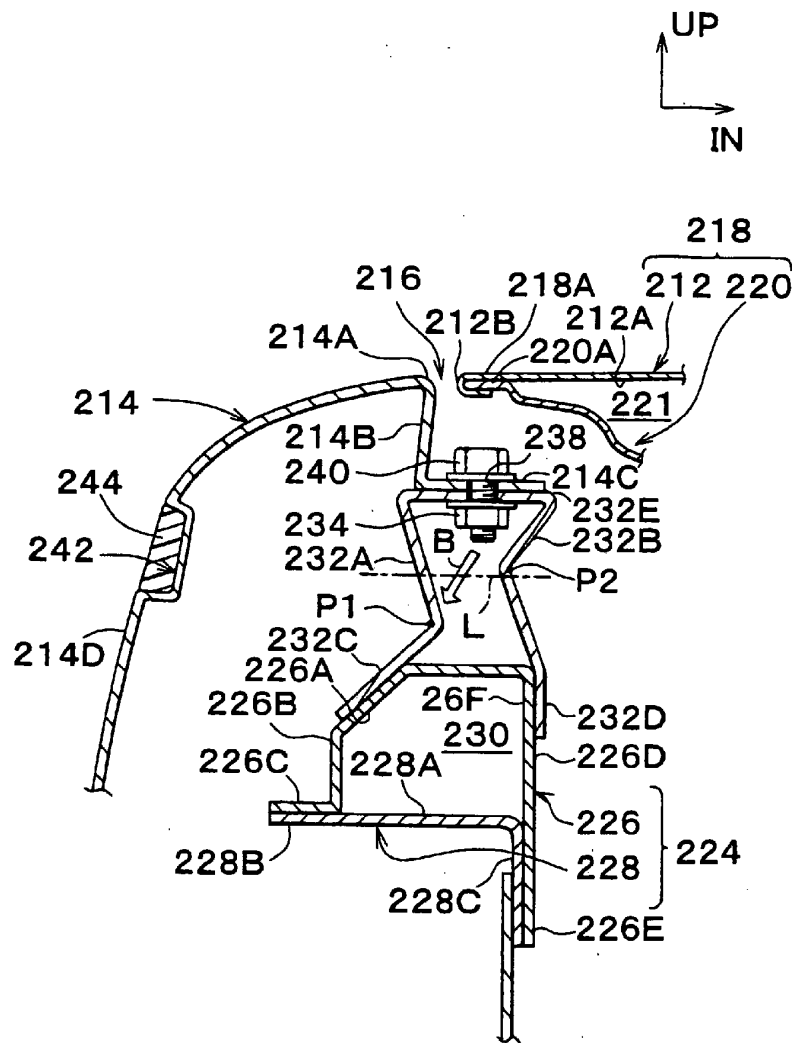


FIG. 34

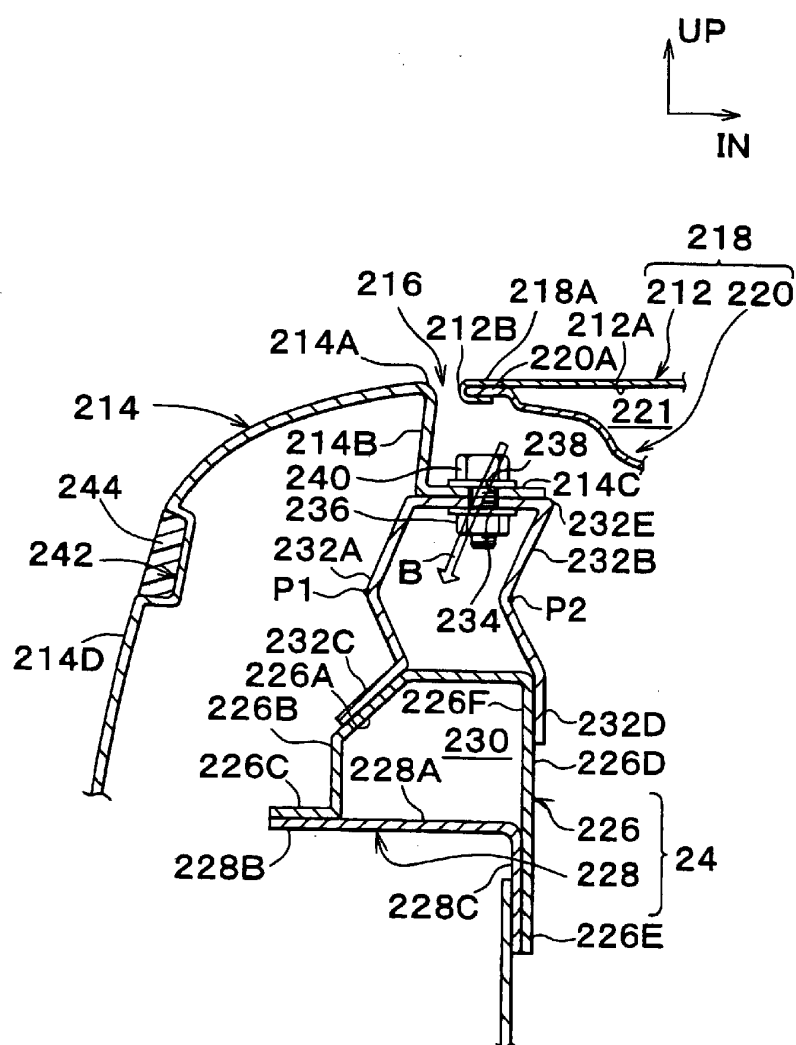


FIG. 35

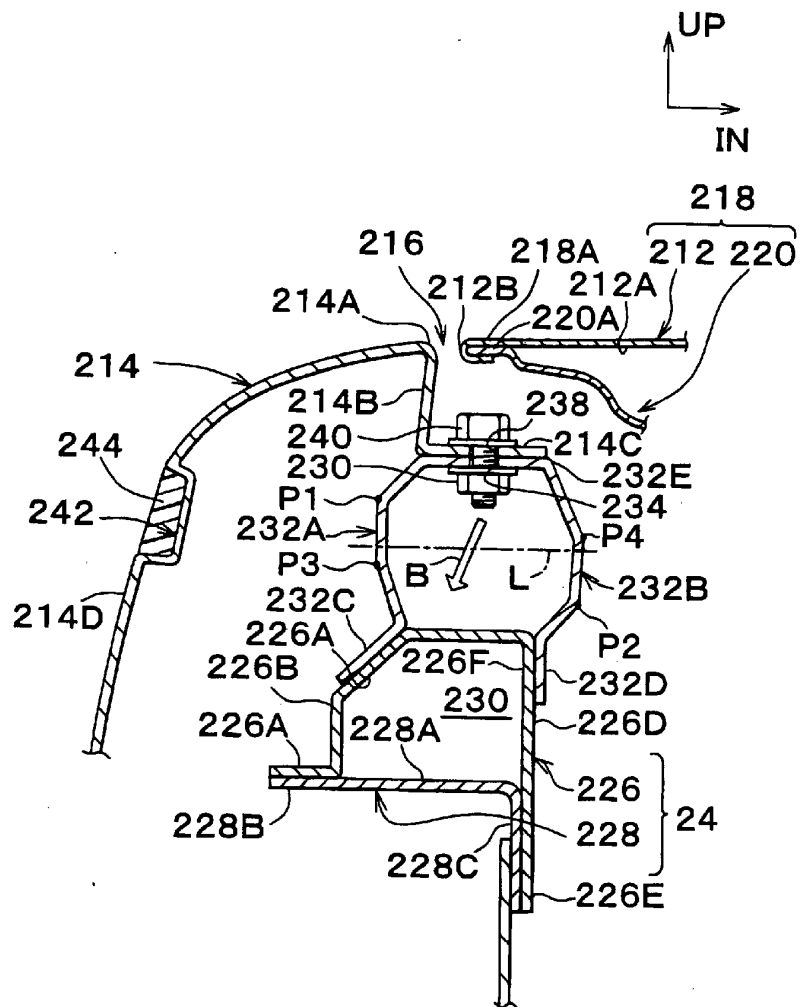
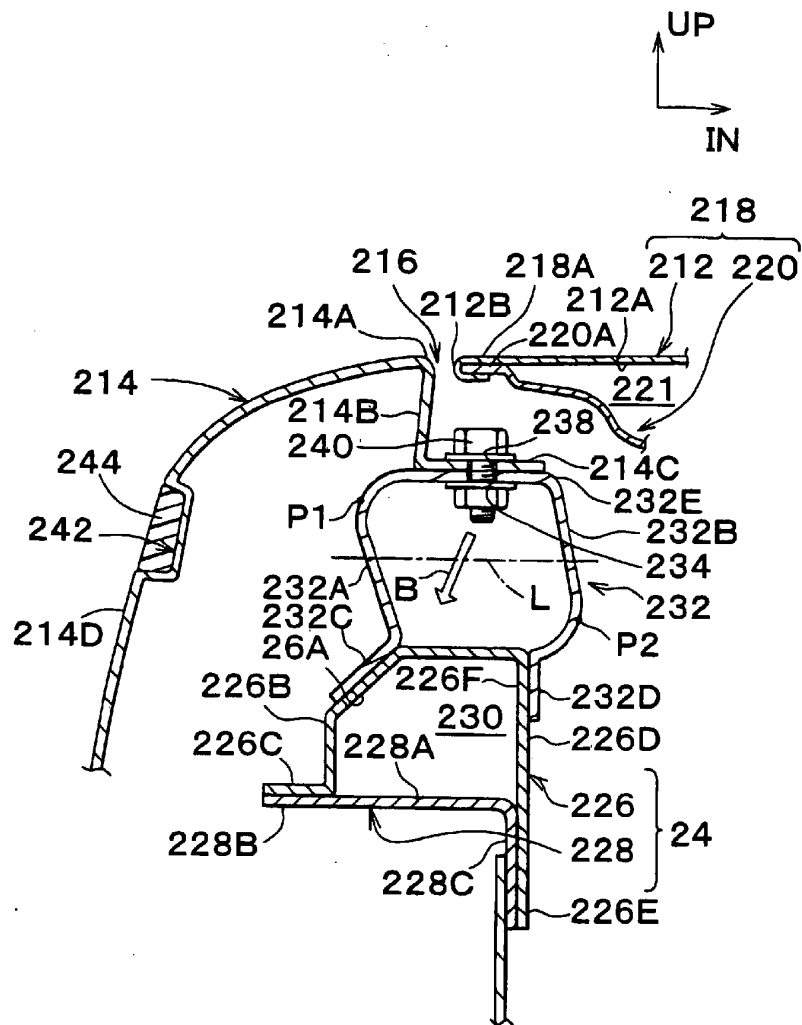


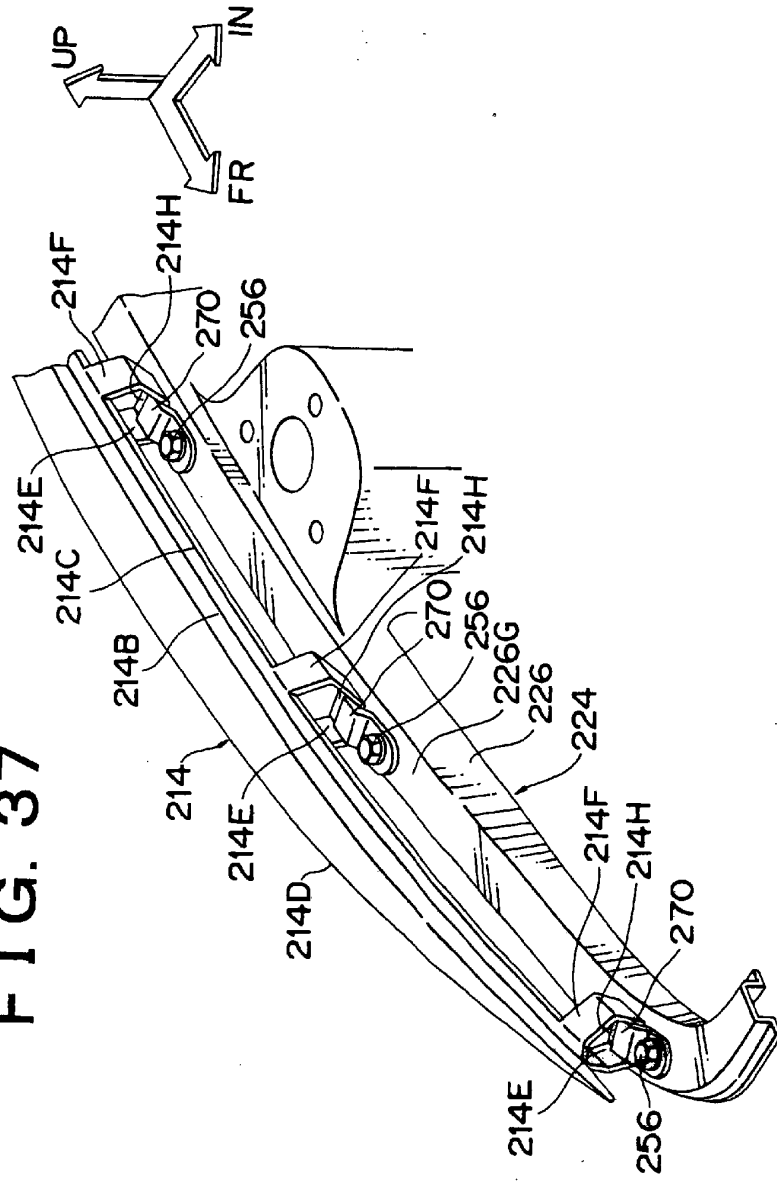
FIG. 36



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FIG. 37



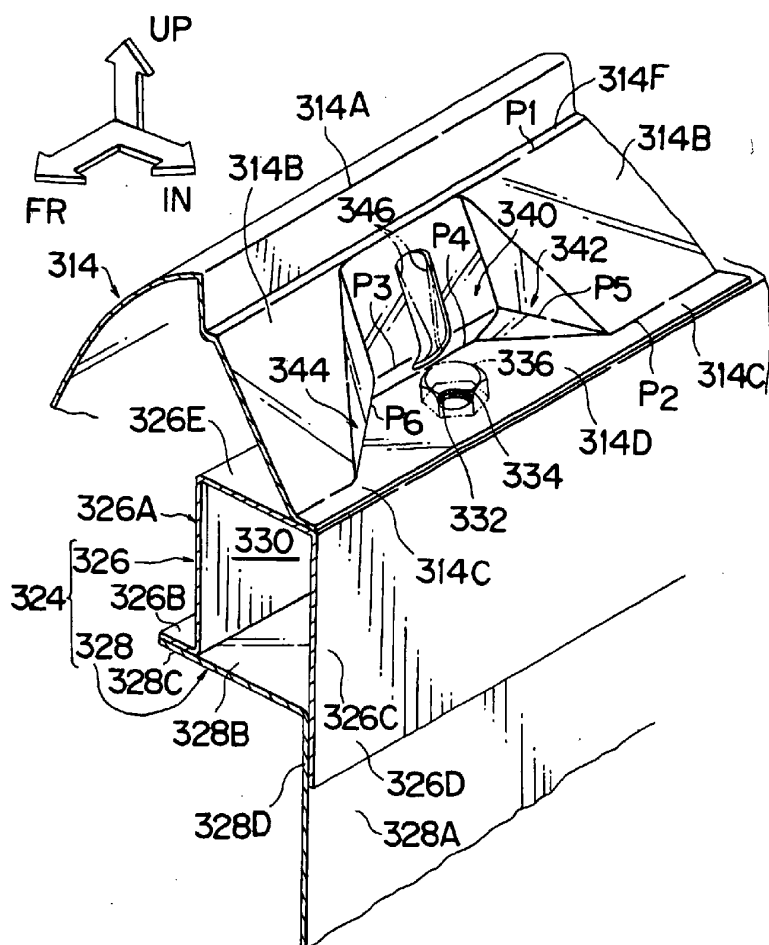


FIG. 39

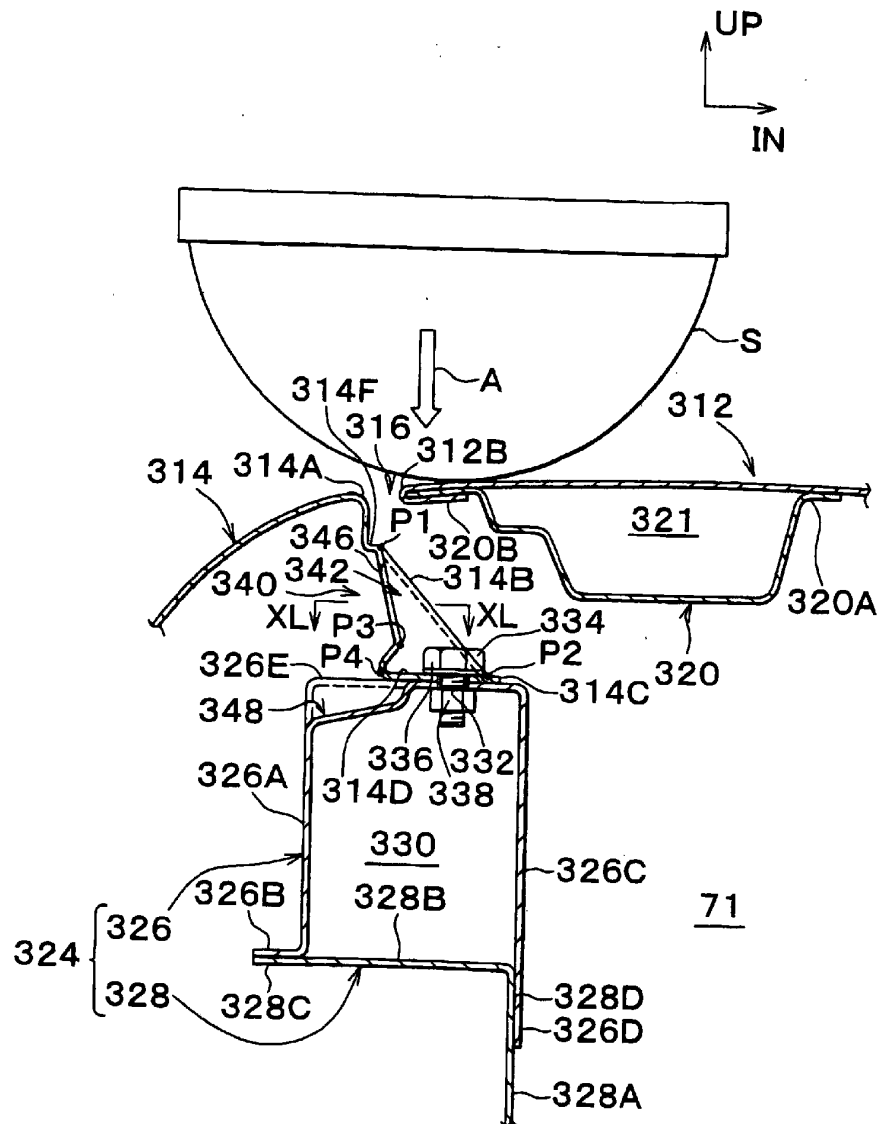


FIG. 40

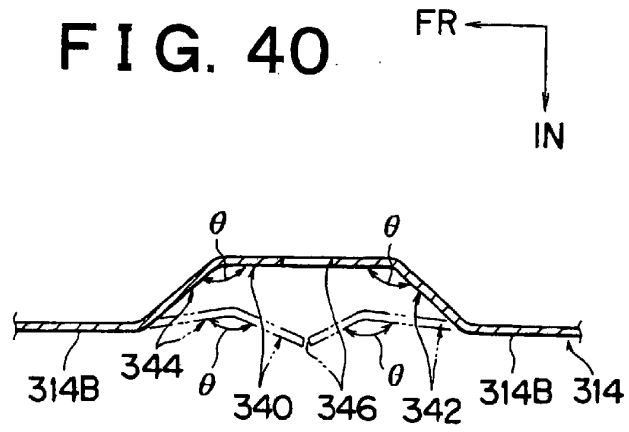


FIG. 41

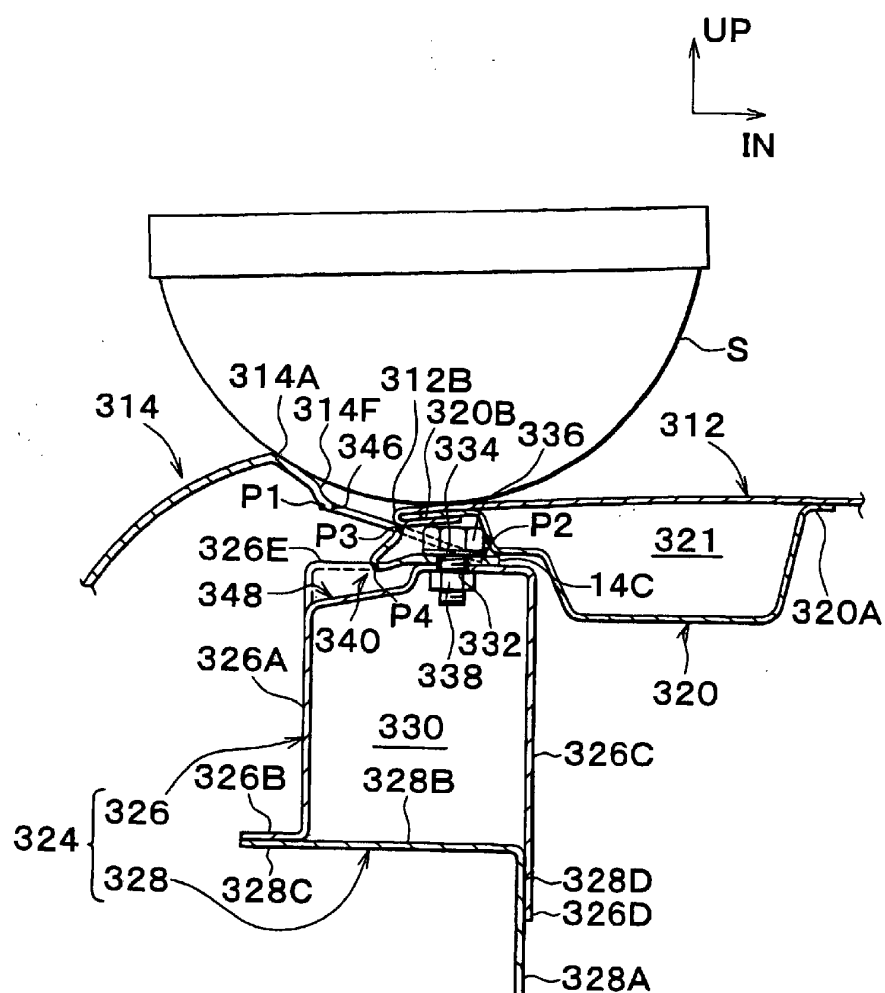
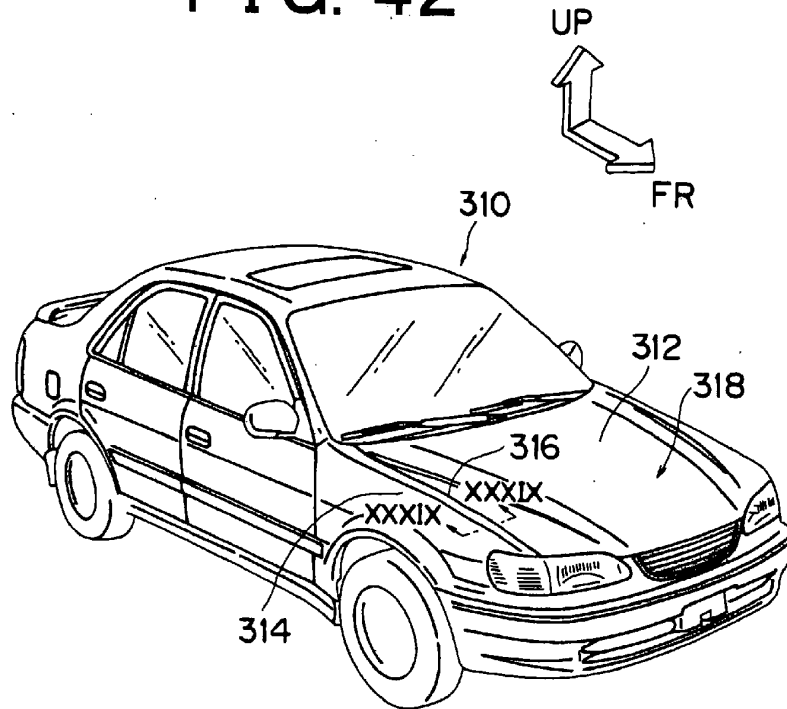


FIG. 42



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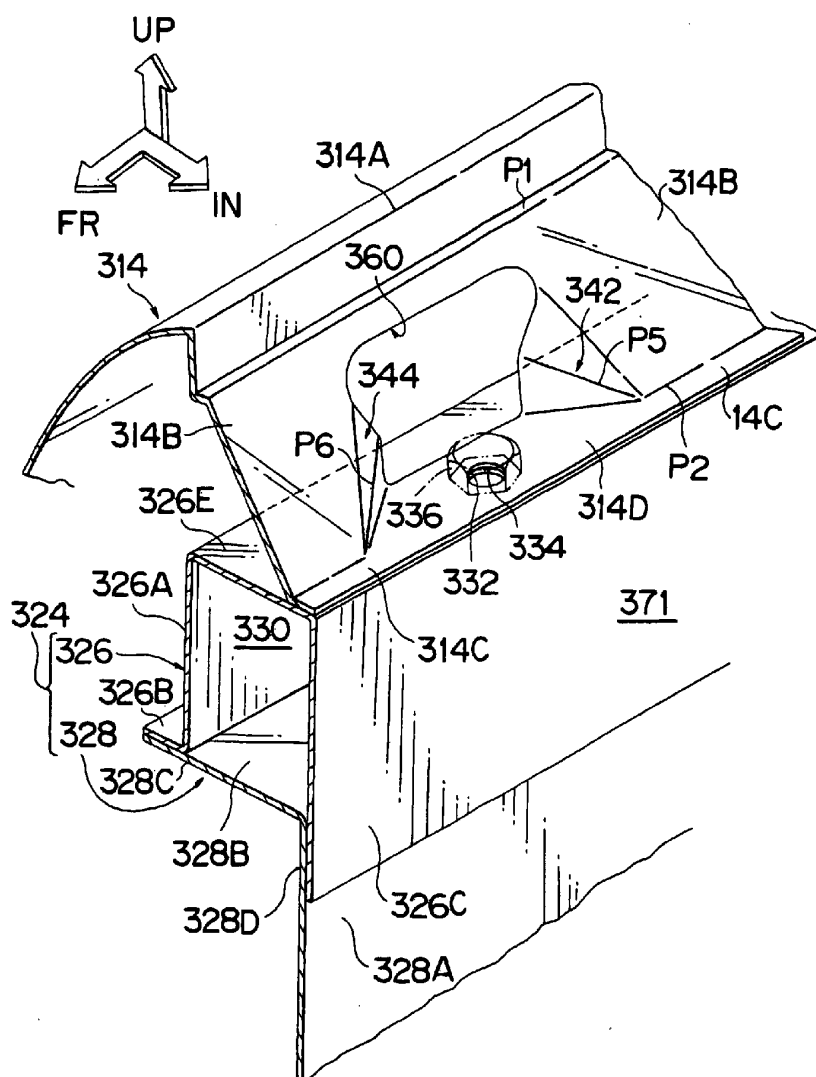


FIG. 44

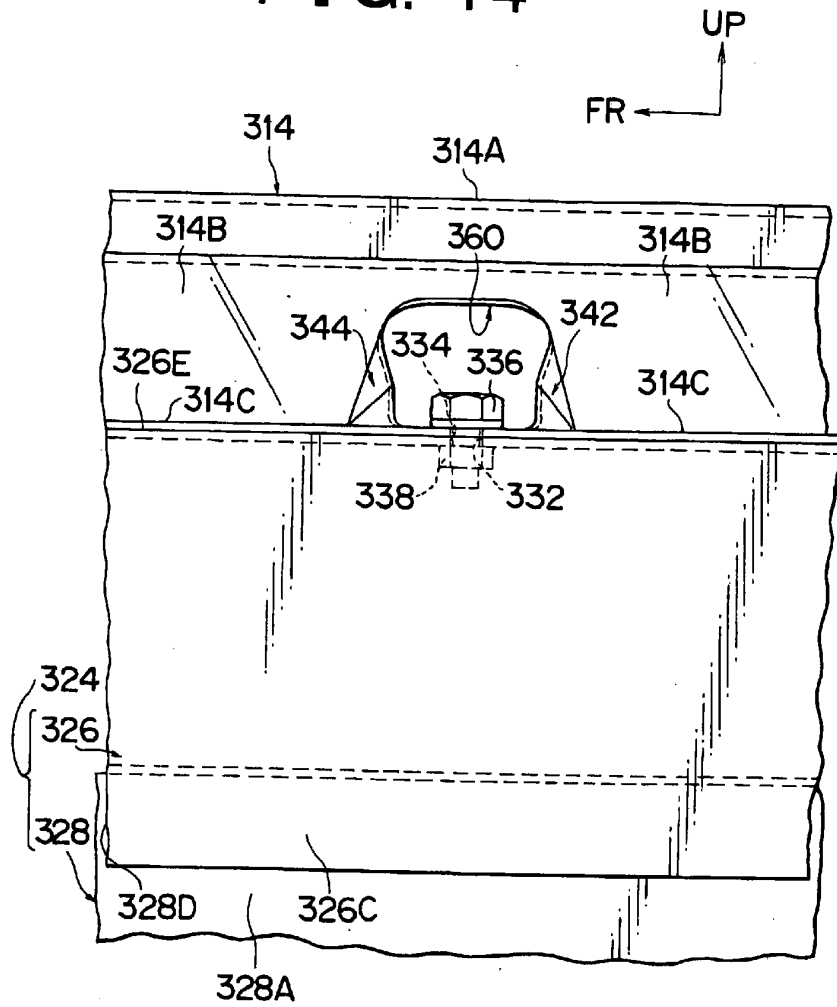


FIG. 45

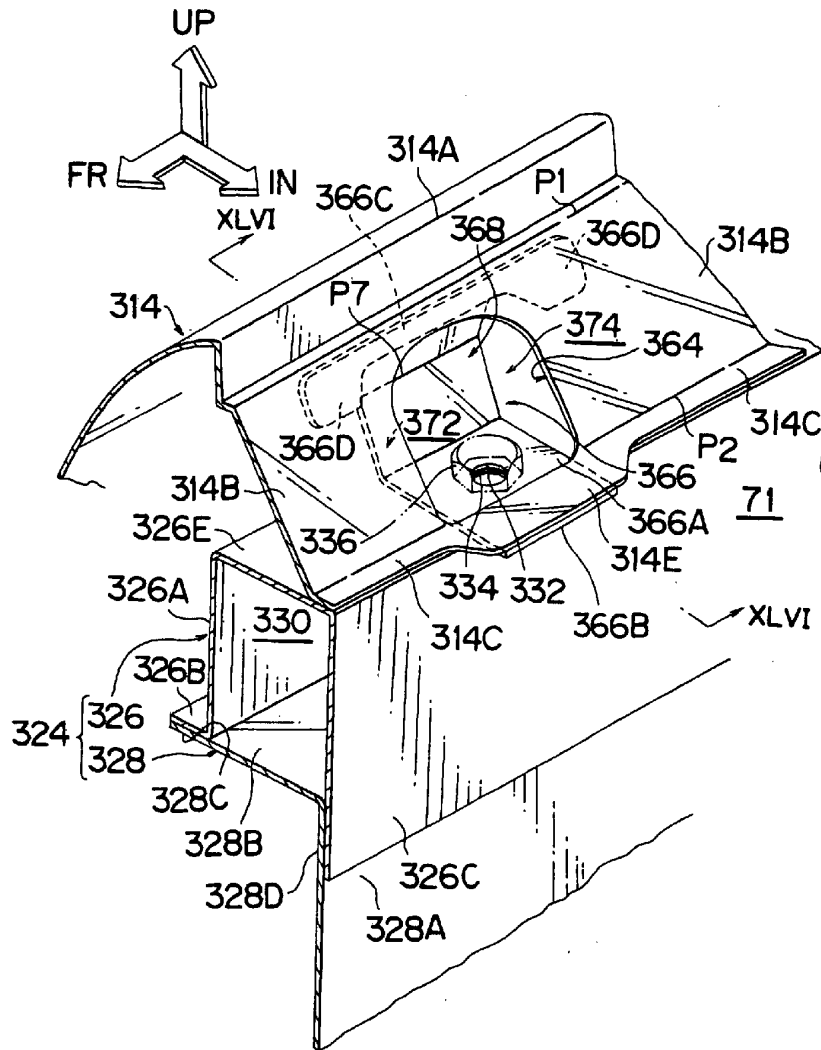
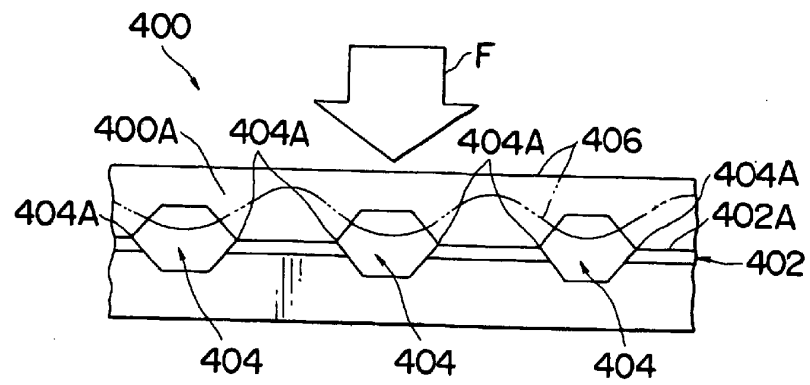


FIG. 46



FIG. 47



400A
404A
404
402A
402