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(54) **MUD FLAP**

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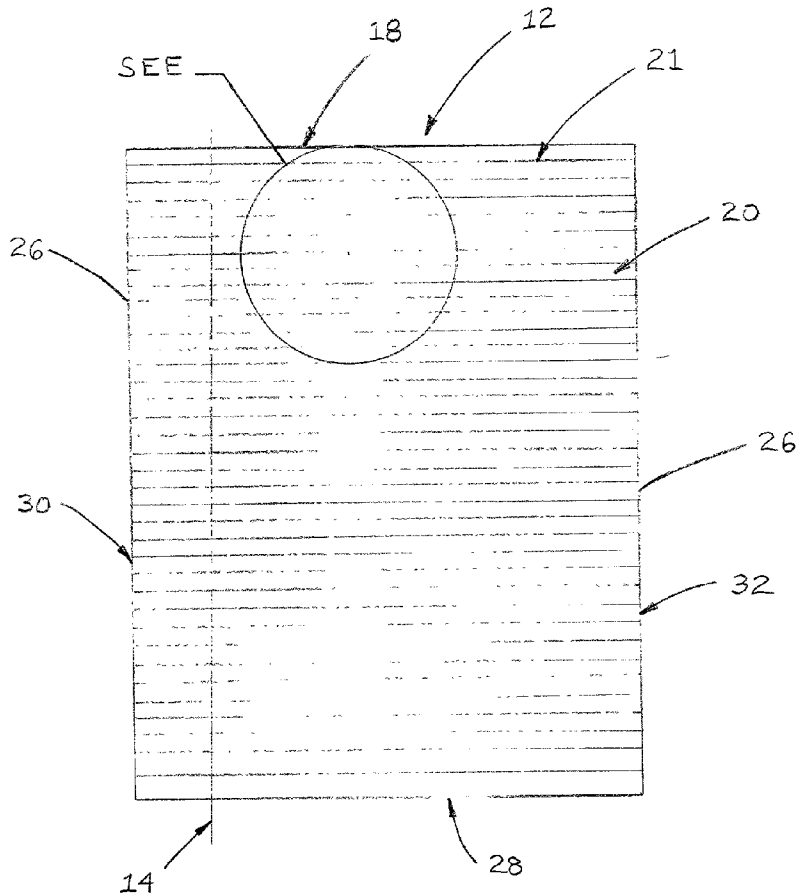
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(57) **ABSTRACT**

The invention comprises a mud flap for deflecting water and roadway debris, which is adapted to be attached to a vehicle behind a wheel of the vehicle. According to the invention,

the mud flap comprises a deflecting panel having a longitudinal axis, a front face, a top edge, and a plurality of openings in the deflecting panel. Each of the openings is defined by a pair of horizontal members and a pair of vertical members. Each horizontal member has an upper side and a lower side. Each horizontal member is substantially parallel to the top edge, and each vertical member is substantially perpendicular to the top edge. The upper side and lower side of each horizontal member is preferably substantially planar. Each vertical member is also preferably substantially planar. The sum of the areas of the plurality of openings represents at least about 75% of the total surface area of the front face of the deflecting panel. In a preferred embodiment of the invention, the deflecting panel has a thickness of no more than about 1/4 (0.25) inch, the lower side of each horizontal member is disposed rearwardly and downwardly at an angle of about 80° from the longitudinal axis, the total area of the openings is about 85% of the surface area of the front face of the deflecting panel, the opposing vertical members are at least about 10 inches apart, and the lower side of each horizontal member is spaced no more than about 1/8 (0.125) inch away from the lower side of the adjacent horizontal member.



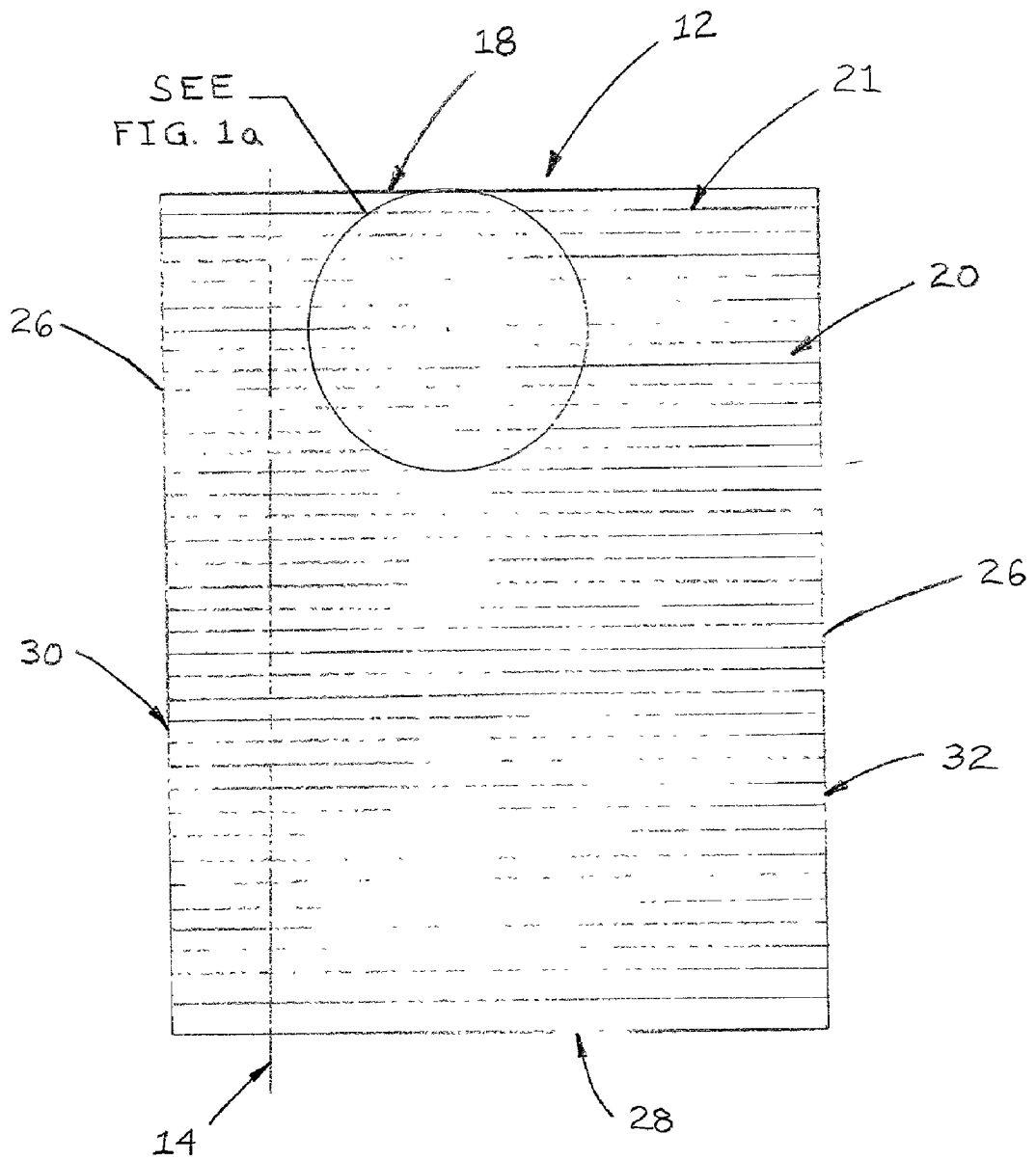


FIGURE 1

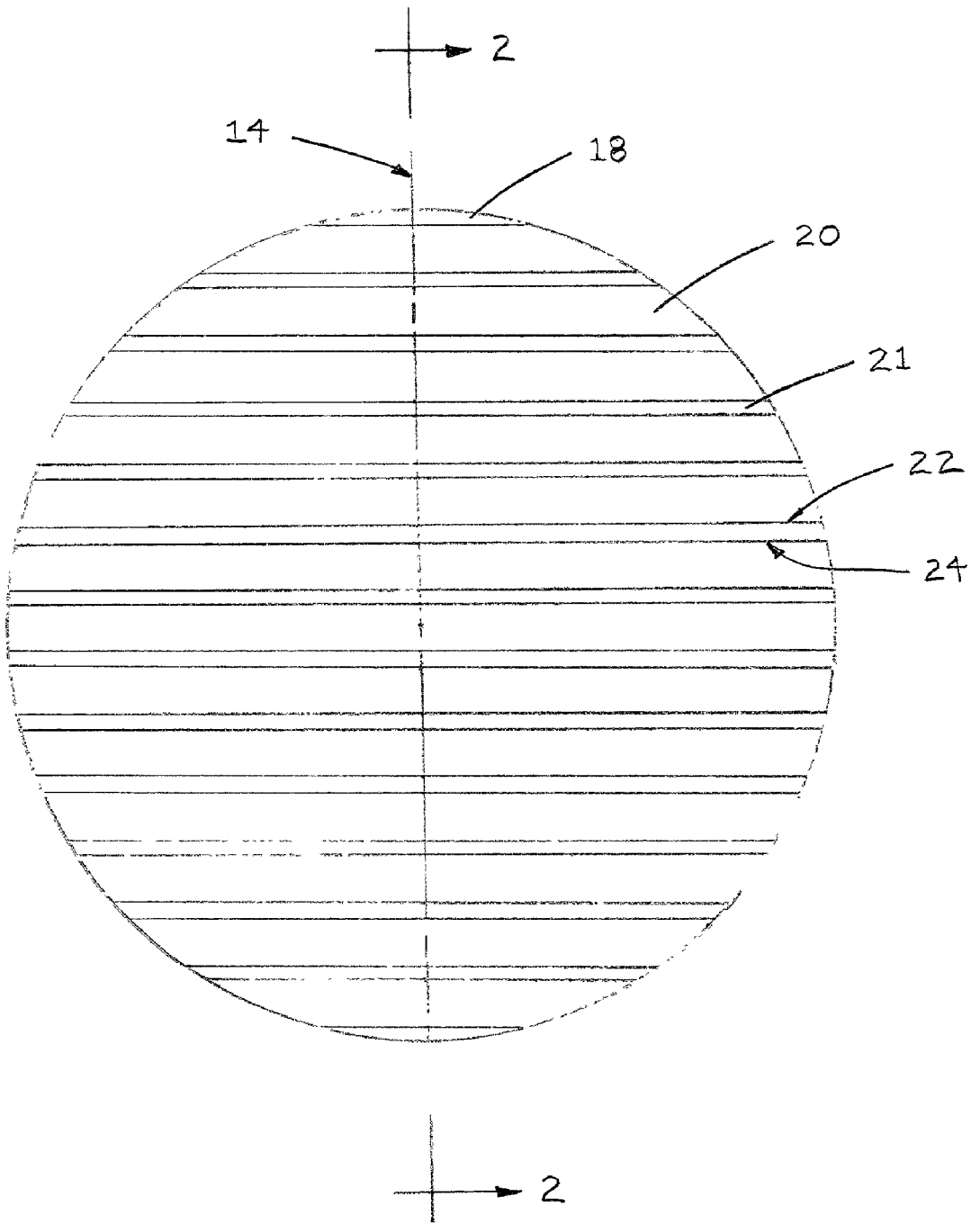


FIGURE 1a

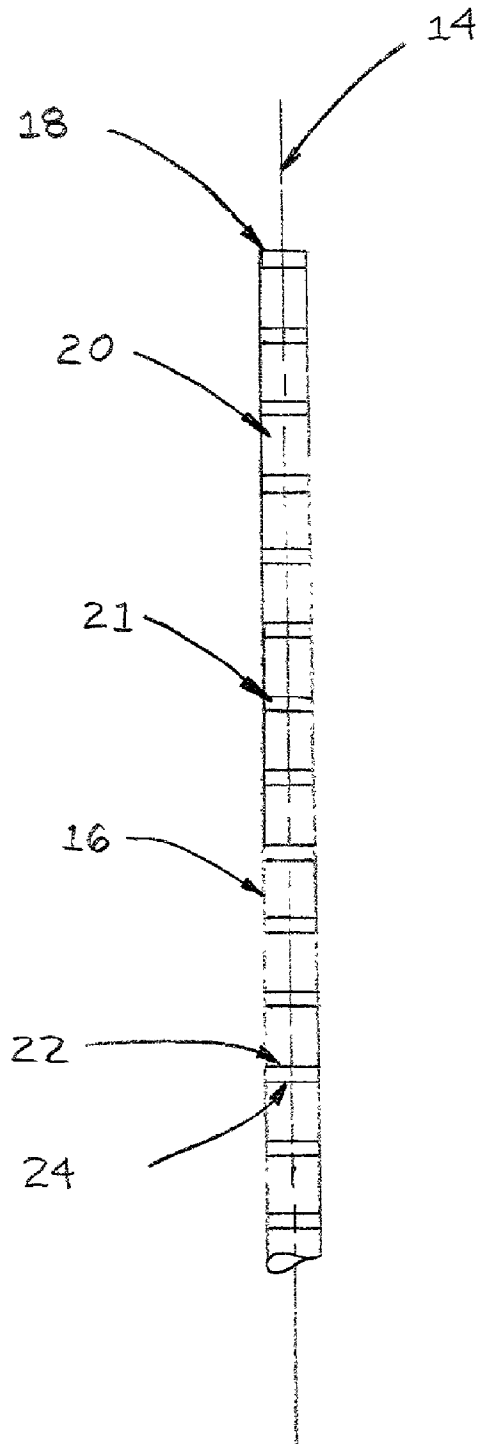


FIGURE 2

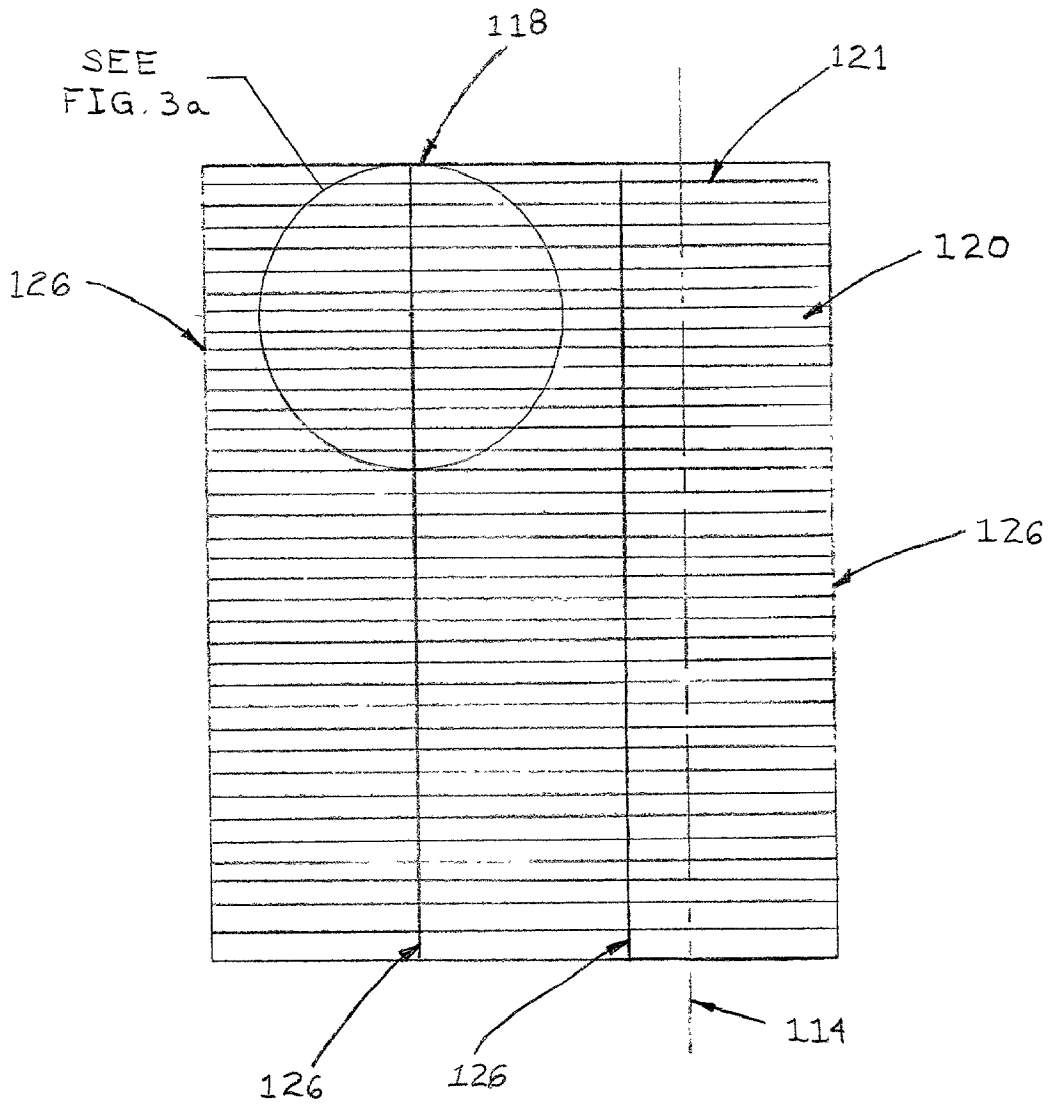


FIGURE 3

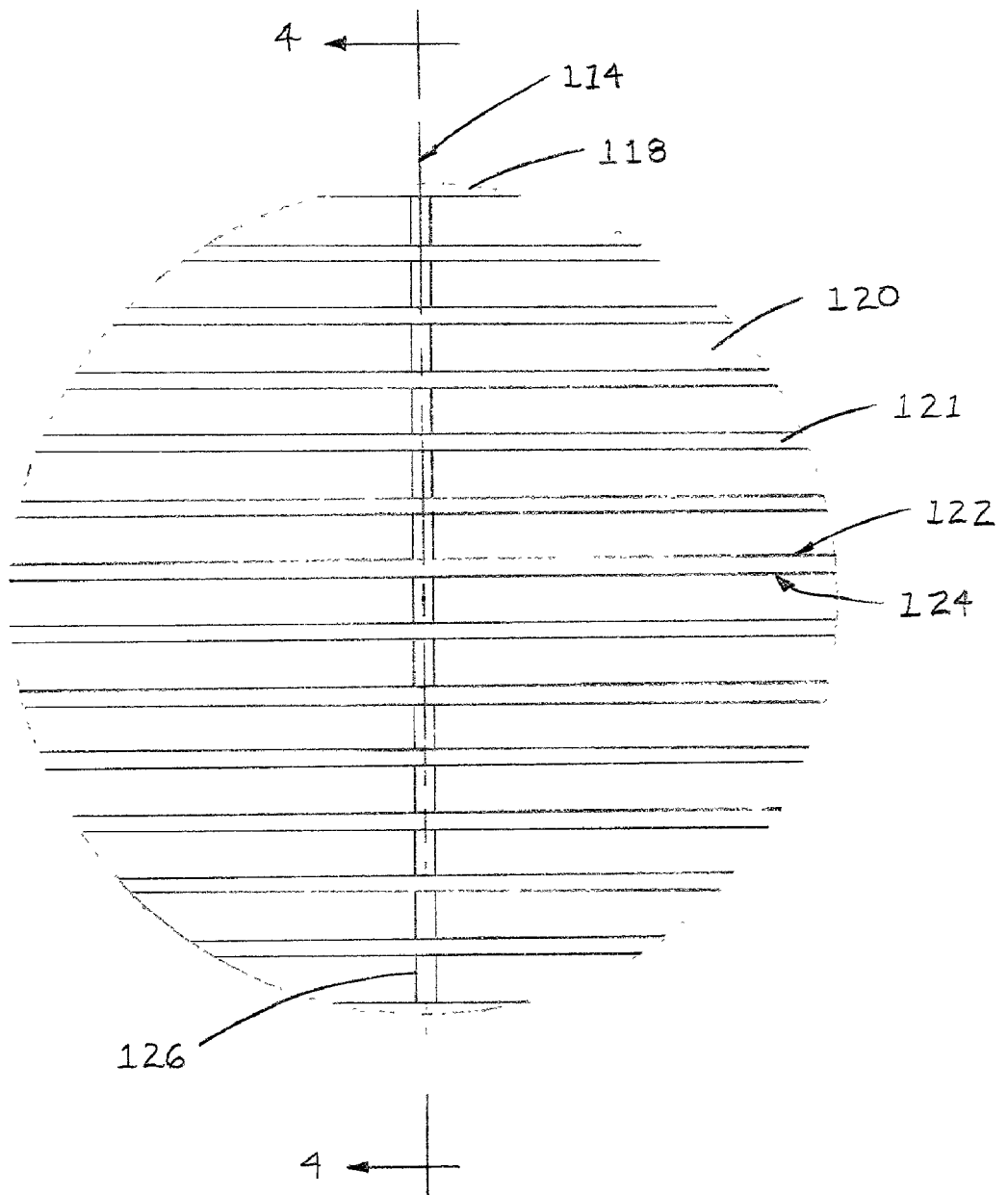


FIGURE 3a

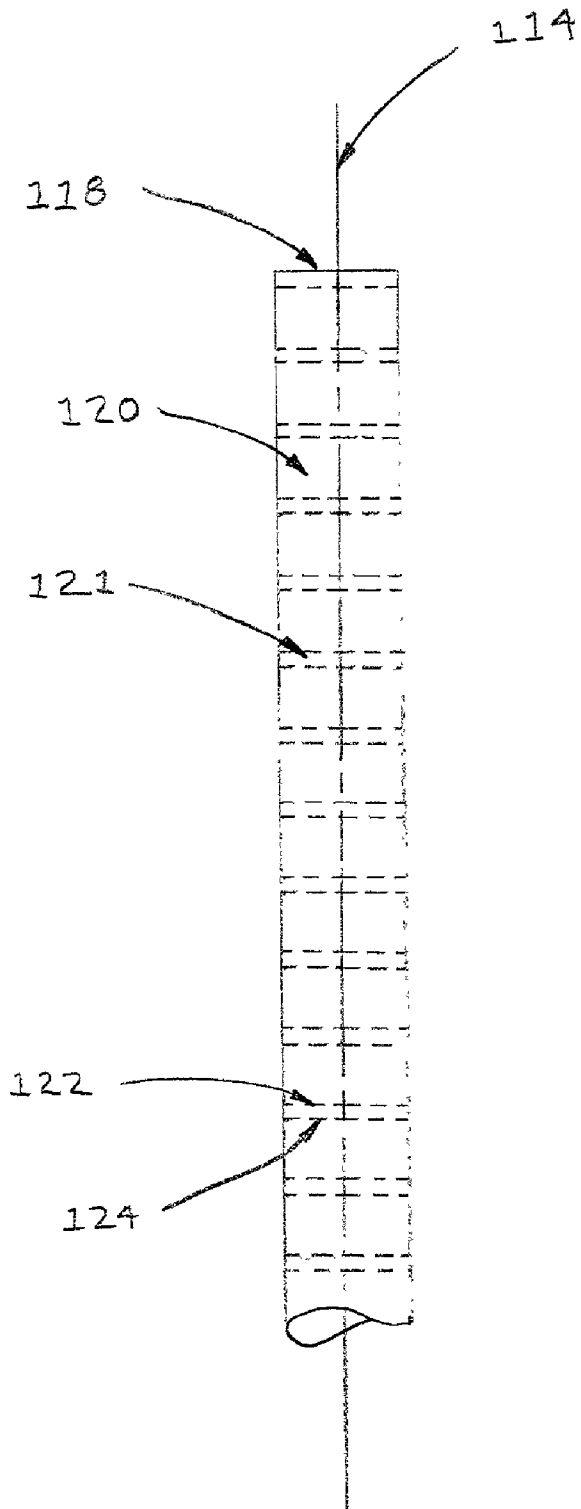


FIGURE 4

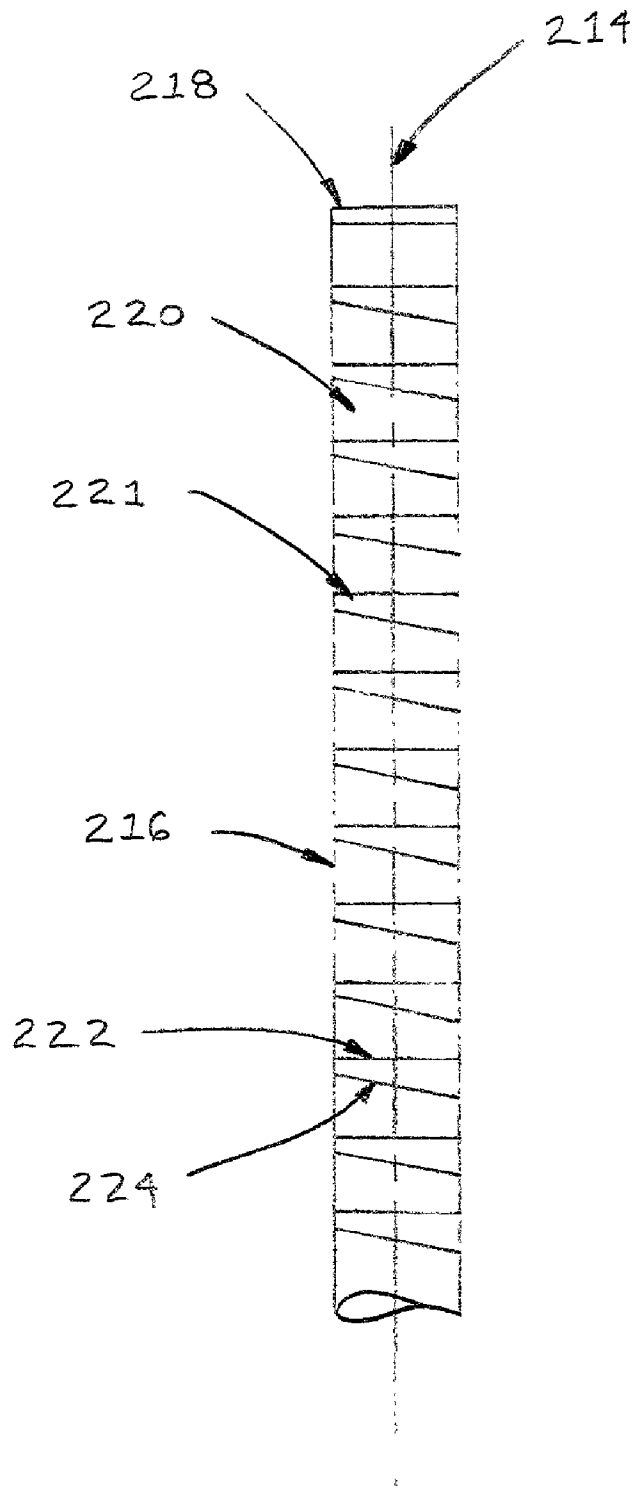


FIGURE 5

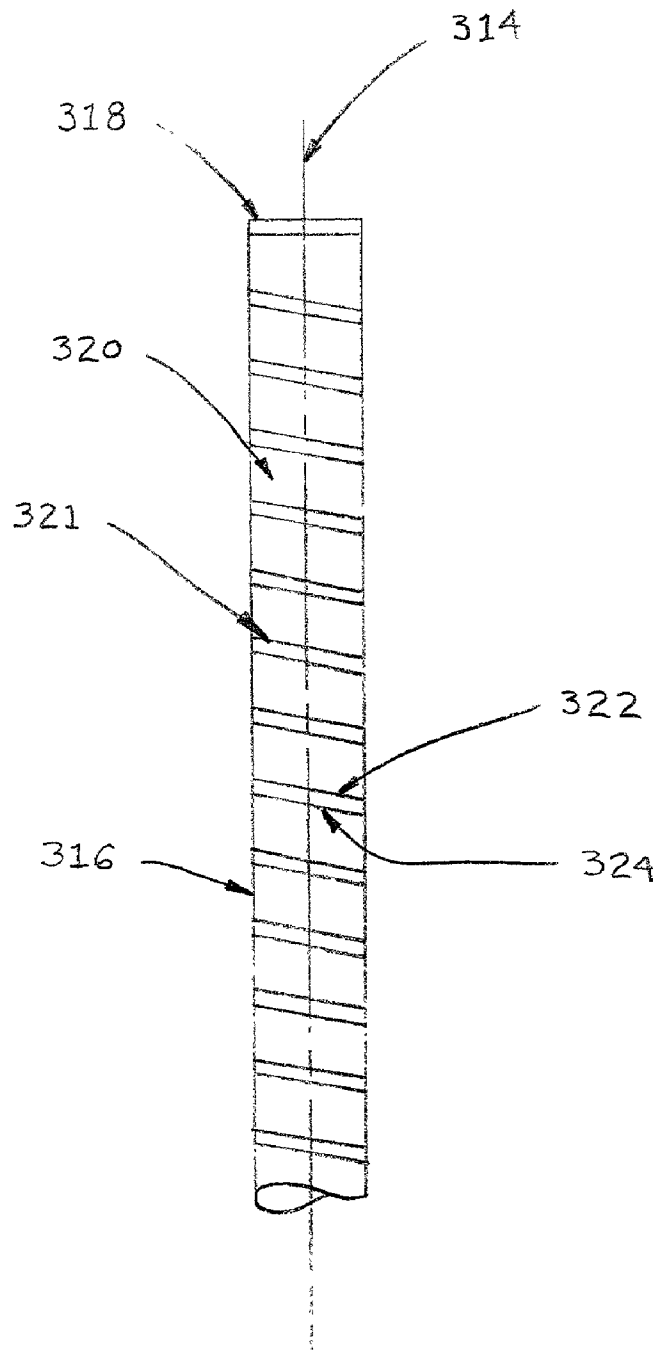


FIGURE 6

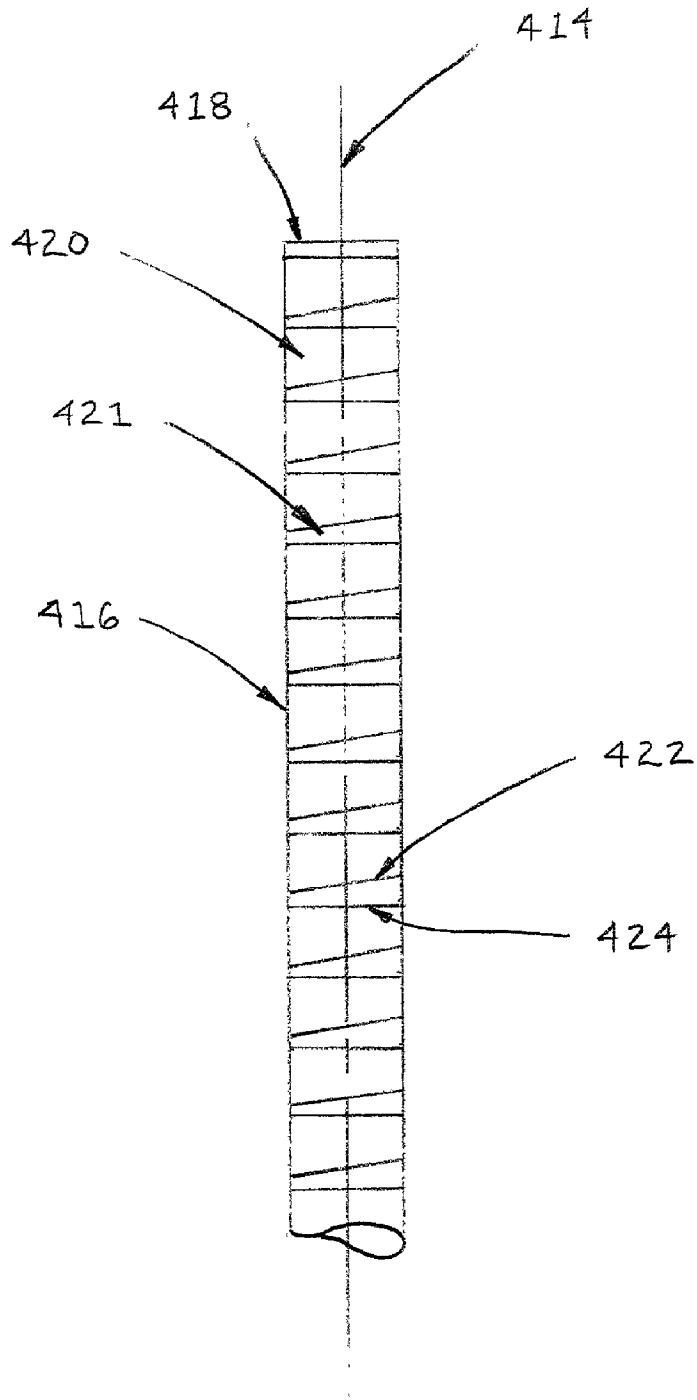


FIGURE 7

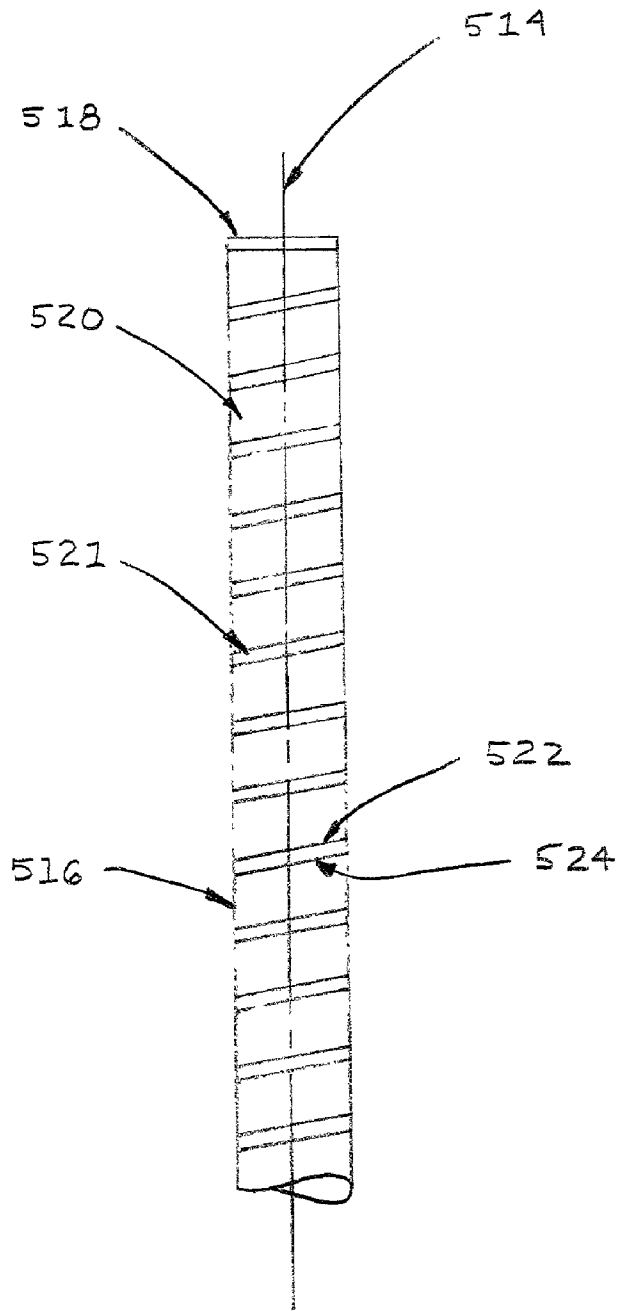


FIGURE 8

MUD FLAP

FIELD OF THE INVENTION

[0001] This invention relates generally to mud flaps adapted for use on wheeled vehicles. More particularly, the invention relates to a mud flap having a plurality of openings that are adapted to allow air and small amounts of water and roadway debris to pass therethrough while the flap deflects larger objects away from following traffic.

BACKGROUND AND DESCRIPTION OF THE PRIOR ART

[0002] Many types of mud flaps have been used for preventing water, mud, rocks and other road debris from being directed rearwardly from a moving wheeled vehicle into the path of following traffic. Typically, mud flaps are substantially rectangular in shape and have a solid deflecting panel. The top edge of each mud flap is conventionally mounted behind a wheel of a vehicle such that the bottom of the mud flap hangs freely near the roadway surface.

[0003] While conventional solid mud flaps are effective in deflecting water and roadway debris, they suffer from several disadvantages. First, the solid design of the mud flap prevents any water or other road debris encountered by the mud flap from passing through the mud flap. As a result, a large proportion of the water and other road debris is projected off the sides and the bottom of the mud flap and into the path of other vehicles. In addition, the solid design of the mud flap prevents air from passing through it, thereby increasing the drag created by the mud flap and decreasing fuel economy. Similarly, the solid mud flap is heavy and, therefore, decreases fuel economy and payload capacity. Also, the bottom of a solid mud flap may be displaced rearwardly at high rates of speed, thereby reducing the amount of debris the mud flap deflects. Finally, the solid mud flap increases the temperature in the area of the tire of the vehicle because air is not permitted to flow through the mud flap. Increased temperature in the area of the tire increases the risk of tire failure.

[0004] Several modifications have been made to the conventional solid mud flap to address the disadvantages identified above. For example, mud flaps have been provided with openings to permit some air, water and other debris to pass through the mud flap. Typically, the openings are defined, at least in part, by rearwardly and downwardly extending louvers or flaps. For example, U.S. Pat. No. 3,350,114 of Salisbury describes a mud flap having a plurality of flexible flaps adapted to be opened by a stream of water and capable of deflecting said stream downwardly. Absent a stream of water, however, the flexible hinged flaps remain substantially closed over the apertures with which each is associated. As a result, the mud flap does little to reduce the drag created by the mud flap, the weight of the mud flap, the rearward displacement of the bottom of the mud flap at high speeds, or increased temperatures in the area of the tire.

[0005] Several patents describe mud flaps having louvers. See, e.g. U.S. Pat. No. 3,088,751; No. 4,660,846; and No. 4,921,276. U.S. Pat. No. 5,366,247 of Fischer describes a vehicle splashguard having louvers adapted to deflect water and other debris downwardly rather than sidewardly or rearwardly into the path of following traffic. The louvers

extend generally horizontally across substantially the entire width of the splashguard. Similarly, U.S. Pat. No. 5,564,750 of Bajorek et al. describes a mud flap having louvers that extend horizontally across substantially the entire width of the mud flap. In addition, the mud flap includes a vertical rib member midway between the ends of each louver to provide vertical support to the louvers. The louvers of this mud flap, however, do little to reduce the drag forces created by air resistance because the surface area of the openings is small relative to the surface area of the mud flap panel, and the louvers are angled only slightly from the vertical axis. The louvers of this mud flap are also likely to break or crack with extended use, thereby increasing the cost of the mud flap and the amount of repair and replacement required. In addition, the louvers of this mud flap increase the depth of the conventional solid mud flap, which may not be desirable on certain types of vehicles. Further, the design of this mud flap is complicated, and the cost of manufacturing is high.

[0006] Other attempts to overcome the disadvantages of the conventional solid mud flap have been made. U.S. Pat. No. 5,273,318 of Nakayama describes a vehicle mudguard having multiple screens and draining ribs. U.S. Pat. No. 5,582,430 of Bauer et al. describes a spray protection device having an inlet layer and a spacer layer which creates a void therebetween. Such screens and layers, however, are typically made from metal which tends to rust with use and increases the weight of the mud flap. In addition, the complex air flow design of the screens and layers tends to become clogged with use. U.S. Pat. No. 4,964,655 of Tucker describes a heavy duty mud flap made from metal segments connected by rods which contain a plurality of alternating rubber discs and spacers. This mud flap is also heavy and complex, thereby increasing fuel consumption and manufacturing cost.

[0007] It would be desirable, therefore, if a mud flap could be provided which reduces the amount of water and other road debris that is projected off the sides and bottom of the mud flap. It would also be desirable if a mud flap could be provided which causes water and other road debris passing through its openings to be directed downwardly toward the roadway. It would also be desirable if a mud flap could be provided which reduces the weight and drag created by the mud flap, thereby increasing fuel economy, payload capacity, and the amount of debris the mud flap deflects. It would also be desirable if a mud flap could be provided which does not contribute to increasing the temperature in the area of the tire of a vehicle. It would also be desirable if a mud flap could be provided which is less complicated and costly to manufacture and maintain. It would also be desirable if a mud flap could be provided which is not likely to become clogged with use and is suitable for use on substantially all types of vehicles.

ADVANTAGES OF THE INVENTION

[0008] Accordingly, it is an advantage of the invention claimed herein to provide a mud flap which reduces the amount of water and other road debris that is projected off the sides and bottom of the mud flap. It is also an advantage of the invention to provide a mud flap which causes water and other road debris passing through its openings to be directed downwardly toward the roadway. It is another advantage of the invention to provide a mud flap which reduces the weight and drag created by the mud flap, thereby increasing fuel

economy, payload capacity, and the amount of debris the mud flap deflects. It is still another advantage of the invention to provide a mud flap which does not contribute to increasing the temperature in the area of the tire of a vehicle. It is another advantage of the invention to provide a mud flap which is less complicated and costly to manufacture and maintain. It is yet another advantage of the invention to provide a mud flap which is not likely to become clogged with use and is suitable for use on substantially all types of vehicles.

[0009] Additional advantages of this invention will become apparent from an examination of the drawings and the ensuing description.

SUMMARY OF THE INVENTION

[0010] The invention comprises a mud flap for deflecting water and roadway debris, which is adapted to be attached to a vehicle behind a wheel of the vehicle. According to the invention, the mud flap comprises a deflecting panel having a longitudinal axis, a front face, a top edge, and a plurality of openings in the deflecting panel. Each of the openings is defined by a pair of horizontal members and a pair of vertical members. Each horizontal member has an upper side and a lower side. Each horizontal member is substantially parallel to the top edge, and each vertical member is substantially perpendicular to the top edge. The upper side and lower side of each horizontal member is preferably substantially planar. Each vertical member is also preferably substantially planar. The sum of the areas of the plurality of openings represents at least about 75% of the total surface area of the front face of the deflecting panel. In a preferred embodiment of the invention, the deflecting panel has a thickness of no more than about $\frac{1}{4}$ (0.25) inch, the lower side of each horizontal member is disposed rearwardly and downwardly at an angle of about 80° from the longitudinal axis, the total area of the openings is about 85% of the surface area of the front face of the deflecting panel, the opposing vertical members are at least about 10 inches apart, and the lower side of each horizontal member is spaced no more than about $\frac{1}{8}$ (0.125) inch away from the lower side of the adjacent horizontal member.

[0011] In order to facilitate an understanding of the invention, the preferred embodiments of the invention are illustrated in the drawings, and a detailed description thereof follows. It is not intended, however, that the invention be limited to the particular embodiments described or to use in connection with the apparatus illustrated herein. Various modifications and alternative embodiments such as would ordinarily occur to one skilled in the art to which the invention relates are also contemplated and included within the scope of the invention described and claimed herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The presently preferred embodiments of the invention are illustrated in the accompanying drawings, in which like reference numerals represent like parts throughout, and in which:

[0013] **FIG. 1** is a front view of a preferred embodiment of the invention. **FIG. 1a** is an enlarged front view of a portion of the preferred embodiment of the invention illustrated in **FIG. 1**.

[0014] **FIG. 2** is an enlarged side view of a portion of the preferred embodiment of the invention taken along line 2-2 of **FIG. 1a**.

[0015] **FIG. 3** is a front view of an alternative embodiment of the invention having additional vertical members.

[0016] **FIG. 3a** is an enlarged front view of a portion of the embodiment of the invention illustrated in **FIG. 3**.

[0017] **FIG. 4** is a side view of the embodiment of a portion of the invention illustrated in **FIG. 3a** taken along line 4-4.

[0018] **FIG. 5** is a side view of an alternative embodiment of the invention having rearwardly and downwardly disposed lower sides.

[0019] **FIG. 6** is a side view of an alternative embodiment of the invention having rearwardly and downwardly disposed upper and lower sides.

[0020] **FIG. 7** is a side view of an alternative embodiment of the invention having rearwardly and upwardly disposed upper sides.

[0021] **FIG. 8** is a side view of an alternative embodiment of the invention having rearwardly and upwardly disposed upper and lower sides.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

[0022] Referring now to the drawings, the apparatus of the invention is illustrated by **FIGS. 1 through 8**. The preferred embodiment of the invention is illustrated in **FIGS. 1 and 2**. As shown in **FIGS. 1 and 2**, the invention comprises a mud flap for deflecting water and roadway debris propelled by the rotating tires of a moving motor vehicle. The mud flap comprises deflecting panel **12** which may be manufactured using any suitable material conventionally used to make mud flaps such as polypropylene or some other elastomeric or polymeric material. It is also contemplated within the scope of the invention that the deflecting panel may be made from metal. Preferred deflecting panel **12** is preferably manufactured using current plastic molding technology. In the preferred embodiment of the invention, the elastomeric material used to make panel **12** is heated until it becomes a liquid. The liquid may then be introduced into a mold where it is allowed to cool and solidify.

[0023] As illustrated in **FIG. 1**, preferred panel **12** is generally rectangular in shape, but it is also contemplated within the scope of the invention that the panel may be any suitable shape for deflecting water and roadway debris propelled by the tires of a motor vehicle. In a preferred embodiment of the invention, panel **12** has a thickness of no more than about $\frac{1}{4}$ (0.25) inch.

[0024] As best shown in **FIG. 2**, deflecting panel **12** is adapted to be attached behind a wheel of a vehicle such that it hangs freely from top edge **18** with longitudinal axis **14** substantially perpendicular to the road surface and front face **16** facing the wheel of the vehicle behind which the mud flap is attached. Panel **12** may be attached to the vehicle using any suitable fasteners conventionally used to attach mud flaps to vehicles such as rivets, threaded fasteners and the like.

[0025] As illustrated in **FIG. 1**, deflecting panel **12** comprises openings **20**, each of which is defined by a pair of

horizontal members 21 and a pair of vertical members 26. Each horizontal member 21 is substantially parallel to top edge 18, and each vertical member 26 is substantially perpendicular to top edge 18. Openings 20 are substantially rectangular in shape. The surface area of the front face 16 of deflecting panel 12 is the area contained within top edge 18, lower edge 28, left side 30 and right side 32. The sum of the areas of openings 20 represents at least about 75% of the total surface area of front face 16 of deflecting panel 12. In a preferred embodiment of the invention, the sum of the areas of openings 20 represents about 85% of the total surface area of the front face of the deflecting panel. While preferred openings 20 are formed by a mold that is used to define the shape of panel 12, the openings may be made using any suitable conventional means for making openings such as a punch press or the like. It is also contemplated that horizontal members 21 (including top edge 18) and vertical members 26 may be attached together using any suitable conventional adhesive such as glue, or any suitable conventional fastening device such as threaded fasteners, rivets and the like. It is also contemplated that the horizontal members (including the top edge) and vertical members may be attached using a plurality of interlocking channels in the members or a plurality of mating slots and tabs in the members.

[0026] FIG. 1a illustrates an enlarged front view of a portion of the embodiment of the invention illustrated in FIG. 1. As shown in FIG. 1a, each horizontal member 21 has upper side 22 and lower side 24. Upper side 22 and lower side 24 are substantially perpendicular to vertical axis 14, substantially parallel to top edge 18, and preferably substantially planar. Openings 20 are defined in part by upper side 22 and lower side 24. Openings 20 are substantially rectangular.

[0027] FIG. 2 is an enlarged side view of a portion of deflecting panel 12 taken along line 2-2 of FIG. 1a. As best illustrated in FIG. 2, the cross-sectional shape of each horizontal member 21 is substantially rectangular. It is also contemplated, however, that the cross-sectional shape of each horizontal member may be circular, square or any other suitable shape. In a preferred embodiment of the invention, upper side 22 of each horizontal member 21 is spaced no more than about $\frac{1}{8}$ (0.125) inch from lower side 24 of the adjacent horizontal member.

[0028] FIG. 3 illustrates an alternative embodiment of the invention. As shown in FIG. 3, a total of four vertical members 126 are provided on deflecting panel 112. The additional vertical members are intended to provide support for horizontal members 121. While FIG. 3 illustrates four vertical members 126, it is also contemplated within the scope of the invention that a total of three, five, or more vertical members 126 may be provided to improve the strength and stability of deflecting panel 112. Openings 120 are defined by a pair of horizontal members 121 and a pair of vertical members 126. It is preferred that the vertical members are spaced at least about 5 inches apart, and more preferably, at least about 10 inches apart.

[0029] FIG. 3a illustrates an enlarged front view of a portion of the embodiment of the invention illustrated in FIG. 3. As shown in FIG. 3a, each horizontal member 121 has upper side 122 and lower side 124. Upper side 122 and lower side 124 are substantially perpendicular to vertical

axis 114 and vertical member 126, substantially parallel to top edge 118, and preferably substantially planar. Openings 120 are defined in part by upper side 122, lower side 124 and vertical member 126. Openings 120 are substantially rectangular. FIG. 3a also shows that vertical member 126 is substantially parallel to longitudinal axis 114, substantially perpendicular to top edge 118, and substantially planar.

[0030] FIG. 4 illustrates an enlarged side view of a portion of deflecting panel 112 taken along line 4-4 of FIG. 3a. As shown in FIG. 4, deflecting panel 112 is thicker than the panel illustrated in FIG. 2. While the preferred panel has a thickness of no more than about $\frac{1}{4}$ (0.25) inch, it is also contemplated that the panel may be thicker than $\frac{1}{4}$ (0.25) inch. It is also contemplated, however, that vertical members 126 may be substantially cylindrical or any other suitable configuration. In the embodiment shown in FIG. 4, upper sides 122 and lower sides 124 of horizontal members 121 are substantially perpendicular to longitudinal axis 114 and substantially parallel to top edge 118. The cross-sectional shape of horizontal members 121 is substantially rectangular.

[0031] FIG. 5 illustrates another preferred embodiment of the mud flap. As shown in FIG. 5, the lower side 222 of each horizontal member 221 is disposed rearwardly and downwardly from front face 216 at an angle of about 80° from longitudinal axis 214. The upper side 224 of each horizontal member 221 is substantially parallel to top edge 218 and perpendicular to longitudinal axis 214. Each opening 220 is defined by the upper side of a horizontal member, the lower side of the adjacent horizontal member, and a pair of opposing vertical members. Top edge 218 is substantially perpendicular to longitudinal axis 214. In this embodiment of the invention, the rearwardly and downwardly disposed lower side 222 deflects water and road debris passing through opening 220 downwardly towards the roadway surface and away from following traffic.

[0032] FIG. 6 illustrates another preferred embodiment of the mud flap. As shown in FIG. 6, both upper side 322 and lower side 324 of horizontal members 321 are disposed rearwardly and downwardly from front face 316 at an angle of about 80° from longitudinal axis 314. Openings 320 are defined by upper side 322 of horizontal member 321, lower side 324 of the adjacent horizontal member, and a pair of vertical members. Top edge 318 is substantially perpendicular to longitudinal axis 314. In this embodiment of the invention, the rearwardly and downwardly disposed lower sides of horizontal members 321 deflect water and other debris downwardly towards the roadway and away from following traffic. In addition, the rearwardly and downwardly disposed upper sides of horizontal member 321 improve air flow through the panel.

[0033] FIG. 7 illustrates another preferred embodiment of the mud flap. As shown in FIG. 7, upper side 422 of each horizontal member 421 is disposed rearwardly and upwardly from front face 416 at an angle of about 80° from longitudinal axis 414. Lower side 424 is substantially parallel to top edge 418 and perpendicular to longitudinal axis 414. Openings 420 are defined by upper side 422 of each horizontal member 421, lower side 424 of the adjacent horizontal member, and a pair of vertical members. Top edge 418 is substantially perpendicular to longitudinal axis 414. In this embodiment of the invention, air flow through the panel is

increased by the rearwardly and upwardly displaced upper sides of the horizontal members.

[0034] FIG. 8 illustrates another preferred embodiment of the mud flap. As shown in FIG. 8, both upper side 522 and lower side 524 of horizontal members 521 are rearwardly and upwardly disposed from front face 516 at an angle of about 80° from longitudinal axis 514. Openings 520 are defined by upper side 522 of horizontal member 521, lower side 524 of the adjacent horizontal member, and a pair of vertical members. Top edge 518 is substantially perpendicular to longitudinal axis 514. In this embodiment of the invention, air flow through the panel is increased by the rearwardly and upwardly displaced upper and lower sides of the horizontal members.

[0035] In operation, the various embodiments of the deflecting panel demonstrate the numerous advantages of the invention claimed herein. The relatively large area of the front face of the deflecting panel that is comprised of the openings permits a significant amount of air, water and debris to flow through the panel with minimal rearward displacement of the panel. As a result, the panel remains disposed in a position substantially perpendicular to the roadway even when the vehicle is travelling at high speeds. When the panel is disposed in such a position, it is capable of deflecting a greater amount of water and roadway debris away from following traffic. In addition, the increased amount of air flow through the panel reduces the drag forces created by the mud flap, thereby increasing fuel efficiency.

[0036] Similarly, the relatively large area of the openings in the panel reduces the overall weight of the panel, thereby increasing fuel efficiency and payload capacity. The large area of the openings in the panel also permits a substantial amount of water and roadway debris to pass through the panel rather than deflect off the sides or bottom of the panel and into following traffic. Finally, the large area of the openings in the panel and the resulting air flow do not allow the mud flap to contribute significantly to an increase in the temperature in the vicinity of the tire.

[0037] The various embodiments of the openings in the deflecting panel demonstrate additional advantages of the invention. In certain preferred embodiments of the invention, the horizontal members of the panel are angled rearwardly and downwardly from the tire to increase the amount of water and roadway debris deflected downwardly by the panel. As a result, less water and roadway debris will be propelled into following traffic. In other preferred embodiments, the horizontal members of the panel are angled rearwardly and upwardly from the tire to increase the amount of water and roadway debris that may flow through the panel rather than off the sides or the bottom of the panel.

[0038] Finally, the simplicity of the design and method of manufacture of the mud flap demonstrates the advantages of the mud flap claimed herein over existing mud flaps. The minimal thickness of the panel makes it suitable for use on almost all motor vehicles and reduces the problem of clogging in the openings of the panel. The mud flap of the invention may be manufactured inexpensively using current molding technology, and it is inexpensive to replace, repair and maintain.

[0039] Although this description contains many specifics, these should not be construed as limiting the scope of the

invention but as merely providing illustrations of some of the presently preferred embodiments thereof, as well as the best mode contemplated by the inventor of carrying out the invention. The invention, as described herein, is susceptible to various modifications and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is:

1. A mud flap that is adapted to be attached to a vehicle behind a wheel thereof, said mud flap comprising a deflecting panel having a longitudinal axis, a front face, a top edge, and a plurality of openings therethrough, with each of said openings being defined by:

- (a) a pair of horizontal members each having an upper side and a lower side, said upper side and said lower side being substantially parallel to the top edge;
- (b) a pair of opposing vertical members, each of which is substantially perpendicular to the top edge;

wherein the sum of the areas of the openings represents at least about 75% of the total surface area of the front face of the deflecting panel.

2. The mud flap of claim 1 wherein the deflecting panel has a thickness of no more than about ¼ (0.25) inch.

3. The mud flap of claim 1 wherein the opposing vertical members are at least about 5 inches apart.

4. The mud flap of claim 1 wherein the deflecting panel is made from a polymeric material.

5. The mud flap of claim 1 wherein the lower side of each horizontal member is disposed rearwardly and downwardly from the front face at an angle of about 80° from the longitudinal axis.

6. The mud flap of claim 1 wherein the lower side and the upper side of each horizontal member is disposed rearwardly and downwardly from the front face at an angle of about 80° from the longitudinal axis.

7. The mud flap of claim 1 wherein the sum of the areas of the openings represents at least about 85% of the total surface area of the front face of the deflecting panel.

8. The mud flap of claim 1 wherein the upper side of each horizontal member is spaced no more than about ⅙ (0.125) inch away from the lower side of the adjacent horizontal member.

9. The mud flap of claim 1 wherein the upper side of each horizontal member is disposed rearwardly and upwardly from the front face at an angle of about 80° from the longitudinal axis.

10. The mud flap of claim 1 wherein the upper side and the lower side of each horizontal member is disposed rearwardly and upwardly from the front face at an angle of about 80° from the longitudinal axis.

11. The mud flap of claim 1 wherein the opposing vertical members are no less than about 10 inches apart.

12. The mud flap of claim 1 wherein the upper side is substantially planar.

13. The mud flap of claim 1 wherein the lower side is substantially planar.

14. The mud flap of claim 1 wherein the upper side and the lower side are substantially planar.

15. The mud flap of claim 1 wherein the vertical members are substantially planar.

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