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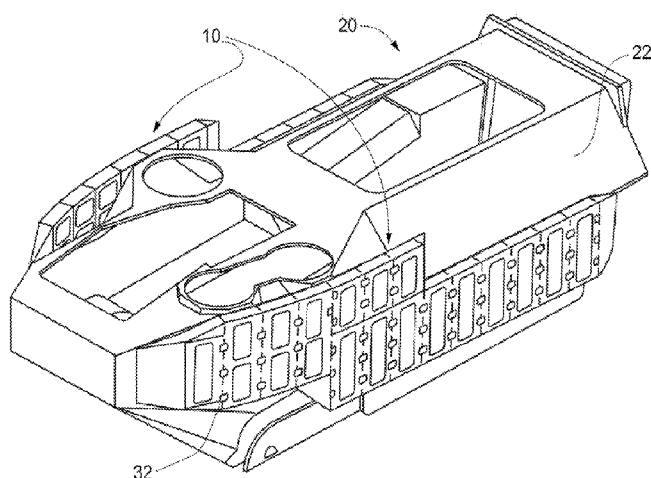
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[Continued on next page]

(54) Title: BUOYANT ARMOR APPLIQUE SYSTEM

Fig. 4



(57) Abstract: An armor applique system for sup-
plementing the integrated armor of an amphibious
vehicle without increasing the effective weight of
the vehicle in water. A plurality of armored mod-
ules individually are affixed to the hull of an am-
phibious vehicle, each module having an armor ele-
ment and a buoyant element sized to offset at least
the weight of the armor element when the module is
submerged in water. The modules can be arranged
to align with the armor elements of neighboring
modules and create a nearly continuous armor layer
over a layer of buoyant elements and the hull. The
modules can be provided in a plurality of different
shapes and sizes such that the armor layer can be
customized approximate to shape and size of the
portion of the hull to prove protected.



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BUOYANT ARMOR APPLIQUÉ SYSTEM

RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application No.
5 61/61/642,115, entitled BUOYANT ARMOR APPLIQUE SYSTEM, and filed May 3, 2012,
said applications being fully incorporated herein by reference.

FIELD OF THE INVENTION

The present invention is directed to an armor appliqué system affixable to the exterior
10 hull of an armored vehicle for supplementing the integrated armor of the vehicle. Specifically,
the present invention is directed to a modular armor appliqué system having a plurality of
interchangeable armored modules with integrated buoyancy elements for offsetting the additional
armor weight.

15 BACKGROUND OF THE INVENTION

Armored vehicles are often fitted with additional ballistic armor or blast armor attached
to the armored hull of the vehicle to counter specific threats. Specifically, armor appliqués are
often fixed to the exterior of the hull to provide an additional armor layer supplementing the
integrated vehicle armor. In particular, the increased use of asymmetric improvised explosive
20 devices (IEDs) has required retrofitting of otherwise adequately armored vehicles with additional
armor especially along the sides and undercarriage of the vehicle. While attaching additional
armor improves the survivability of the armored vehicle against IED threats, the additional armor
also increases the weight of the vehicle. The additional weight can affect the overall performance

of the vehicle. In particular, the additional weight can significantly impact the swimming ability and cargo capacity of amphibious vehicles.

Armored amphibious vehicles are commonly tasked as armored personnel carriers capable of transporting personnel and equipment from ship to shore or across bodies of water in addition to across dry land. Unlike purely land or water vehicles, the weight of the vehicle must be taken into consideration for both water and land operation. Moreover, changes in vehicle weight may unequally affect the performance of the vehicle on land and in the water. The increased vehicle weight from armor appliqué can minimally affect the operation of the vehicle on land. However, the same weight increase can significantly compromise the ability of the vehicle to safely travel through the water. Accordingly, the additional armor weight is typically offset by reducing the maximum cargo capacity of the vehicle. The tradeoff between increased protection and reduced cargo capacity creates a need for improving the protection of the vehicle while minimizing the effect on the aquatic performance of the vehicle.

SUMMARY OF THE INVENTION

The present invention is directed to an armor appliqué system for supplementing the integrated armor of an amphibious vehicle without increasing the effective weight of the vehicle in water. The system can comprise a plurality of armored modules individually affixed to the hull of an amphibious vehicle. Each module can comprise a passive or active armor element and a buoyant element sized to offset at least the weight of the armor element when the module is submerged in water. The modules can be individually affixed to the hull such that modules can be individually replaced if damaged or deployed. The individually affixed modules can be arranged end-to-end on the hull of the vehicle to align the armor elements of neighboring

modules and create a nearly continuous armor layer over a layer of buoyant elements and the hull. The modules can be provided in a plurality of different shapes and sizes such that the armor layer can be customized approximate to shape and size of the portion of the hull to prove protected. The modules can also be arranged on the hull to provide an armor layer having a shape and size independent of the contours of the underlying hull portion.

An armored module, according to an embodiment of the present invention, can comprise an armor element, a buoyant element and a module casing having at least one engagement feature for securing the module to a hull of a vehicle. The armor and buoyant elements can be arranged within the module casing such that the buoyant element is positioned between the armor element and the hull when the module is affixed to the vehicle. The armor element can be generally planar and oriented parallel to the hull to shield the buoyant element and the hull from ballistic threats travelling transverse to the plane of the hull. Positioning the armor element on the exterior side of the buoyant element allows for the use of active armor without the risk of damaging the buoyant element and comprising the performance of the buoyant element.

In one aspect, the buoyant element of each module can be sized to provide a buoyancy force offsetting only the weight of the corresponding armor element. In another aspect, the buoyant element can have a larger size to provide a buoyancy force greater than necessary to offset the weight of the armor element of that module. In this configuration, the surplus buoyancy force generated by the buoyant element partially offsets the overall weight of the vehicle. The size of the buoyant element can be selected according to the intended mounting location on the hull of the particular module. Modules having smaller buoyant elements can be positioned on portions of the hull where space is limited, such as on the undercarriage of the

vehicle. Similarly, modules having larger buoyant elements can be positioned on portions of the hull where space is less of a premium, such as on the sides of the hull.

In one aspect, the armor elements can be generally planar such that positioning a plurality of armored modules end-to-end on the hull aligns the horizontal and/or vertical edges of the armor elements to create a nearly continuous armor layer. Similarly, aligning the armor elements can also align the buoyant elements to create a nearly continuous buoyant layer between the armor layer and the hull. In this configuration, the armor appliqué system can further comprise an adjustable mounting assembly for adjusting the horizontal position of the armored modules to minimize ballistic gaps between the armor elements.

A method of supplementing the integrated armor of an amphibious vehicle having an exterior hull can comprise providing a plurality of armored modules that each have an armor element and a buoyant element. The method can further comprise positioning each of the armored modules on the hull such that the buoyant element is positioned between the armor element and the hull. The method can also comprise positioning the modules end-to-end to align the armor elements and create a generally continuous armor layer over a generally continuous buoyant layer and the hull. In one aspect, the method can further comprise independently separating and replacing at least one of the armored modules from the hull.

The above summary of the various representative embodiments of the invention is not intended to describe each illustrated embodiment or every implementation of the invention. Rather, the embodiments are chosen and described so that others skilled in the art can appreciate and understand the principles and practices of the invention. The figures in the detailed description that follow more particularly exemplify these embodiments.

BRIEF DESCRIPTION OF THE CLAIMS

The invention can be completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

5 Figure 1 is a side cross sectional view of an armored module according to an embodiment of the present invention.

 Figure 2 is a perspective front view of an armored module according to an embodiment of the present invention.

10 Figure 3 is a representative cross-sectional side view of armored modules affixed to a vehicle hull according to an embodiment of the present invention.

 Figure 4 is a side perspective view of a vehicle having an armored appliqué system mounted according to an embodiment of the present invention.

 Figure 5 is a partial top perspective view of a vehicle having an armored appliqué system mounted according to an embodiment of the present invention.

15 Figure 6 is a partial perspective view of a mounting assembly for armored modules according to an embodiment of the present invention.

 While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the invention to the particular
20 embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION

As shown in FIGS. 1-2, an armor appliqué system 10, according to an embodiment of the present invention comprises at least one armored module 12 having an armor element 14, a buoyant element 16 and a module casing 18. The armor element 14 can have a generally planar shape and comprise active, passive, bar, net or other forms of types or armor. The buoyant element 16 can comprise water absorption resistant materials, such as close celled foams, to provide the necessary buoyancy. The buoyant element 16 is sized to provide a predetermined buoyant force when submerged in water. In one aspect, the buoyant element 16 is sized to provide a buoyant force offsetting the weight of the armor element 14 such that the net effective weight of armored module 12 in water is about zero. In another aspect, the buoyant element 16 can have a bigger size to provide a buoyant force greater than necessary to offset the weight of the armor element 14. The casing 18 can comprise a lightweight material that can supplement the armor element 14 including, but not limited to steel, aluminum, titanium, fiber reinforced plastic, fiber reinforced glass and combinations thereof.

As shown in FIGS. 3-5, the armor appliqué system 10 can be mounted on an armored amphibious vehicle 20. The amphibious vehicle 20 can further comprise an exterior hull 22 on which the armored modules 12 can be mounted. The exterior hull 22 can comprise integrated armor plating or can be unarmored. The description of the amphibious vehicle 20 is not intended to be limiting, but to assist in the description of the appliqué system 10.

As shown in FIGS. 3-5, in one embodiment of the present invention, a plurality of armored modules 12 can be arranged on the hull 22 of the vehicle 20 in an end-to-end vertical and/or horizontal configuration. In this configuration, the armor elements 14 of the neighboring armored modules 12 are aligned to create a nearly continuous armor layer 24 separated by small

ballistic gaps 26 as depicted in FIG. 5. Similarly, the arrangement aligns the buoyant elements 16 to create a nearly continuous buoyant layer 28 also separated by the ballistic gaps 26. As shown in FIGS. 3-4, in one aspect, the appliqué system 10 can comprise modules 12 having different shapes and sizes that can be combined to form an armor layer 24 approximating the contours of the hull 22 covered by the appliqué system 10. In another aspect, the armored modules 12 can be arranged to form an armor layer 24 having a shape and size independent of the shape of the hull 22 covered by the appliqué system 10. The armor layer 24 can be shaped to enhance the protection provided of the armor elements 14.

As shown in FIGS. 2-4, in an embodiment of the present invention, each armored module 12 can further comprise a locking member 30 positioned at the edge of the module casing 18. The appliqué system 10 can further comprise at least one locking clip 32 for securing the locking members 30 of neighboring armored modules 12 to fix the relative positions of the neighboring armored modules 12. In one aspect, clipping the armored modules 12 together can reinforce the appliqué system 10 enhancing the protection provided by the appliqué system.

As shown in FIGS. 5-6, in an embodiment of the present invention, the appliqué system 12 further comprises an adjustable mounting assembly 34. The mounting assembly 34 comprises a hull plate 36 and an adjustable plate 38 having an integrated angle portion 40. The hull plate 36 defines at least one first bore hole 42 and can be integrated into or affixed to the hull 22. Similarly, the adjustable plate 38 defines at least one second bore hole 44 corresponding to the first bore hole 42 such that a fastener can be threaded through the first and second bore holes 42, 44 to affix the adjustable plate 38 and integrated angle portion 40 to the hull 22.

As shown in FIGS. 5-6, the angle portion 40 extends outwardly at an angle perpendicular transverse to the plane of the hull 22 and defines a plurality of third bore holes 46 defining an

axis parallel to the plane of the hull 22. In this configuration, each armored module 12 further comprises a locking pin 48 receivable within the third bore hole 46 to secure the armored module 12 to the hull 22. The armored module 12 can be positioned at a plurality of positions along a horizontal axis by inserting the locking pin 48 into a different third bore hole 46. The adjustable mounting assembly 34 allows the armored modules 12 to be adjustably positioned relative to each other to minimize the size of the ballistic gaps 26.

According to an embodiment of the present invention, a method of supplementing the integrated armor of an amphibious vehicle 20 having an exterior hull 22 can comprise providing a plurality of armored modules 12 that each having an armor element 14 and a buoyant element 16. The method can further comprise positioning each of the armored modules 12 on the hull 22 such that the buoyant element 16 is positioned between the armor element 14 and the hull 22. The method can also comprise positioning the modules 12 end-to-end to align the armor elements 14 and create a generally continuous armor layer 24 over a generally continuous buoyant layer 26 and the hull 22. In one aspect, the method can further comprise independently separating and replacing at least one of the armored modules 12 from the hull 22.

While the invention is amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and described in detail. It is understood, however, that the intention is not to limit the invention to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

CLAIMS

1. An armored appliqué system for an amphibious vehicle as substantially described herein.
2. An armored module for an amphibious vehicle as substantially described herein.
3. A method of supplementing the integrated armor of an amphibious vehicle as substantially described herein.

Fig. 1

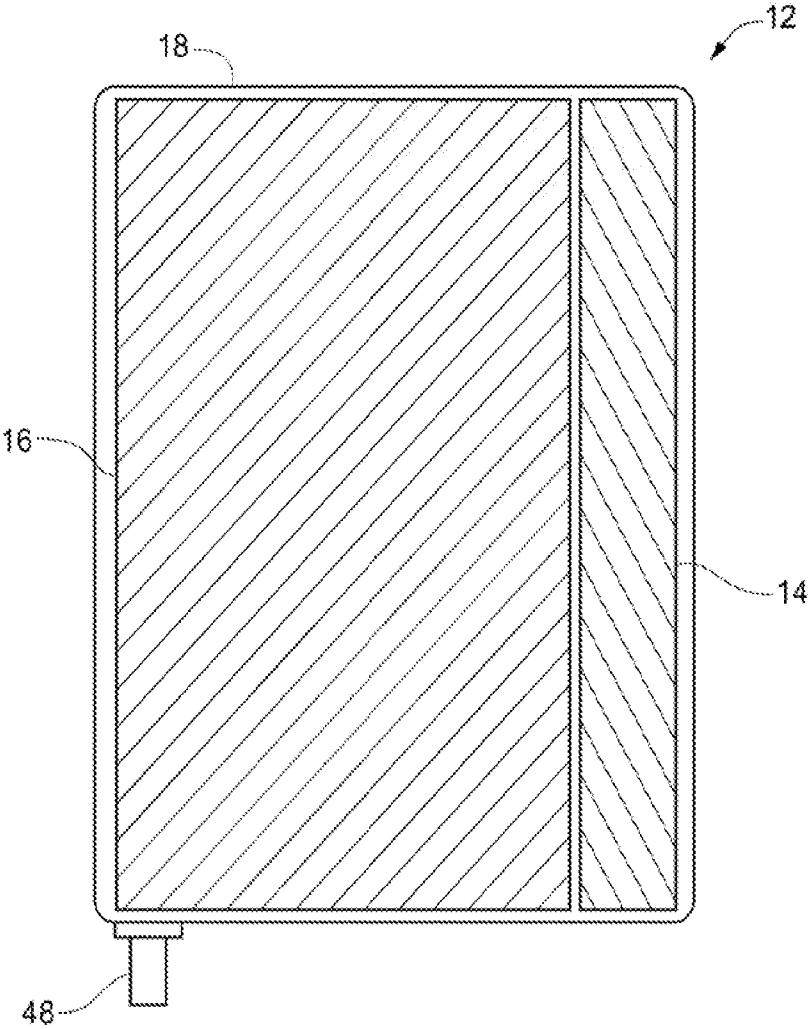


Fig. 2

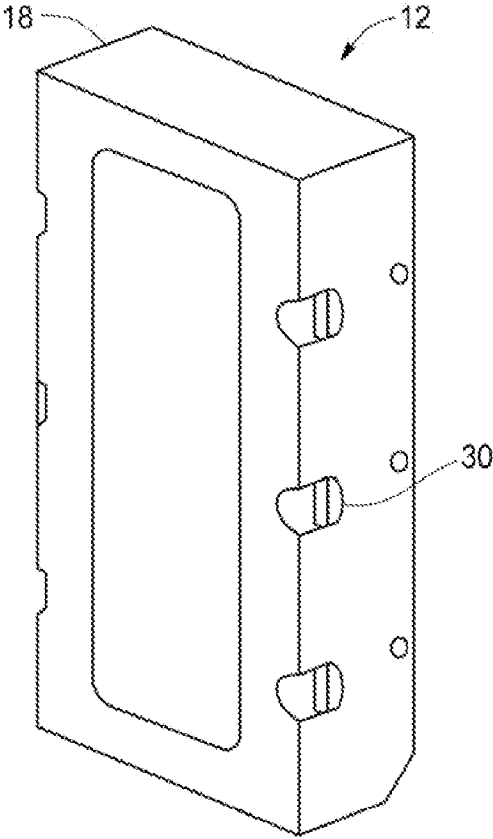


Fig. 3

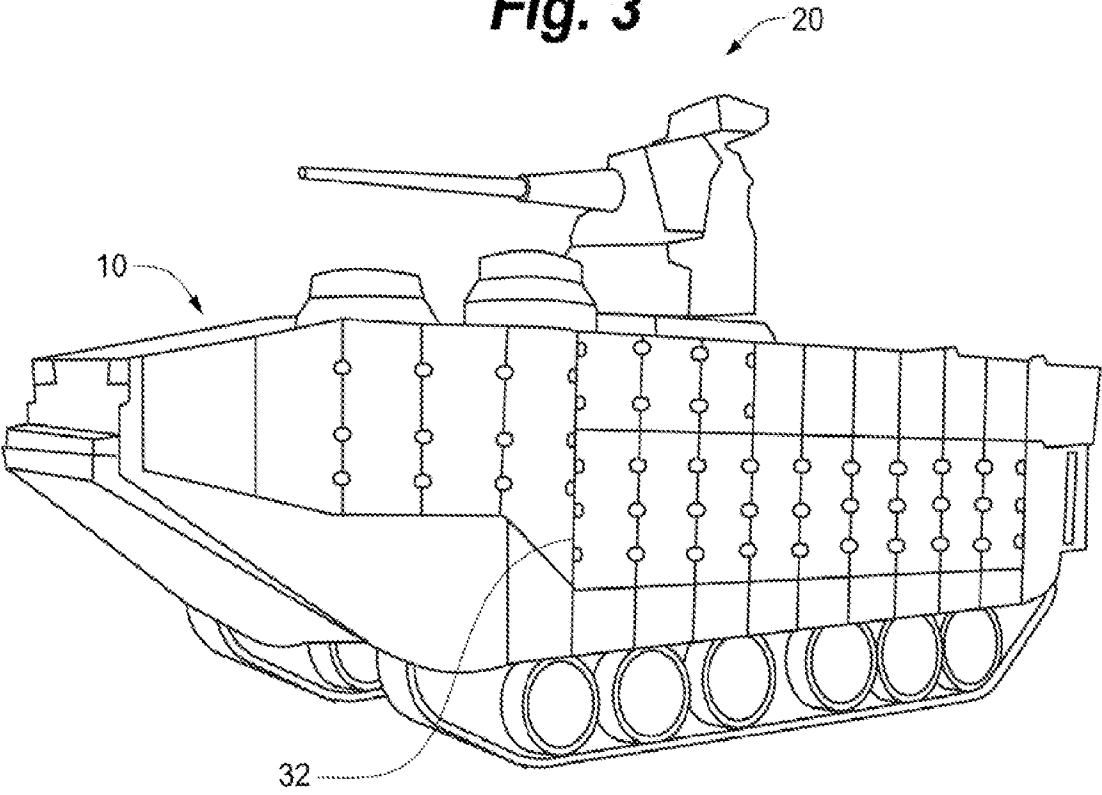


Fig. 4

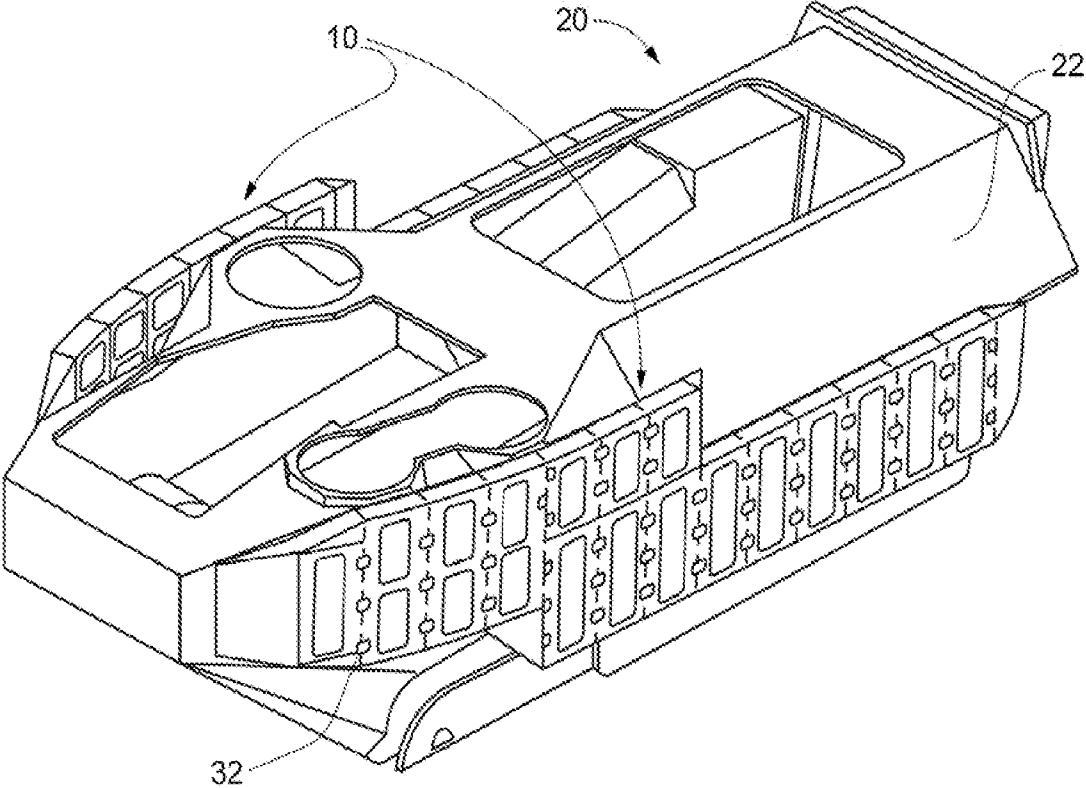


Fig. 5

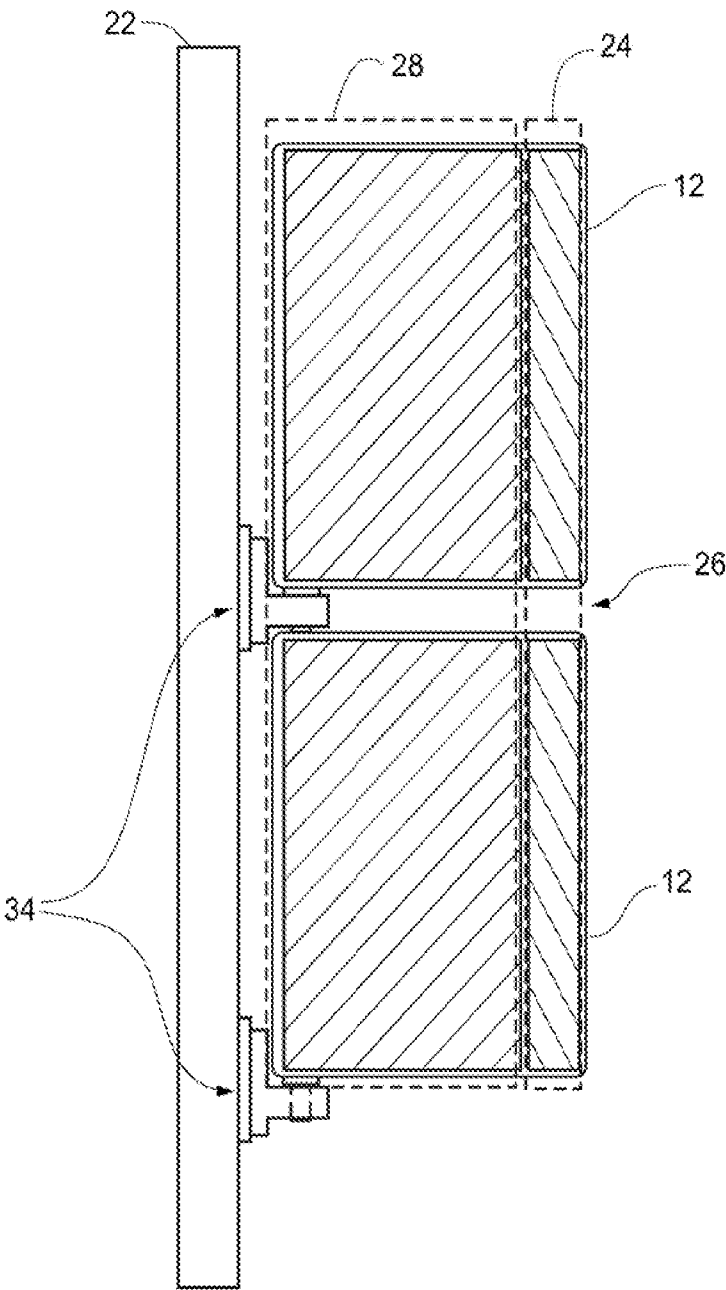


Fig. 6

