May 4, 1943. E. EGER 2,318,301

BULLET RESISTING ARMOR

Filed March 15, 1939 2 Sheets-Sheet 1

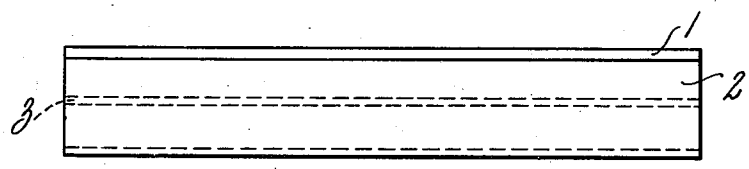


Fig. 1

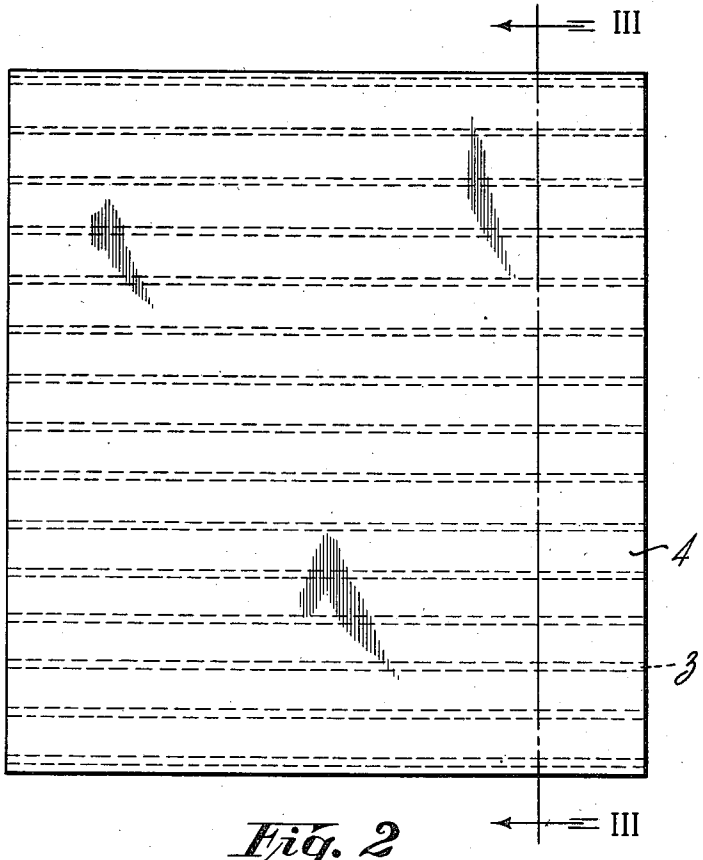


Fig. 2

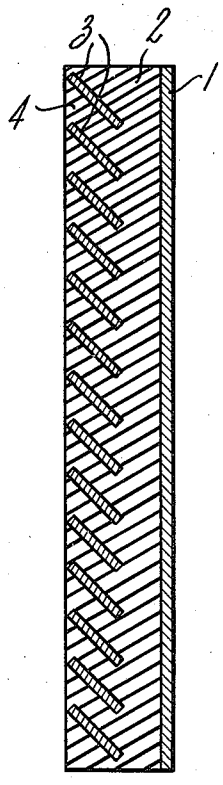


Fig. 3

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BULLET RESISTING ARMOR

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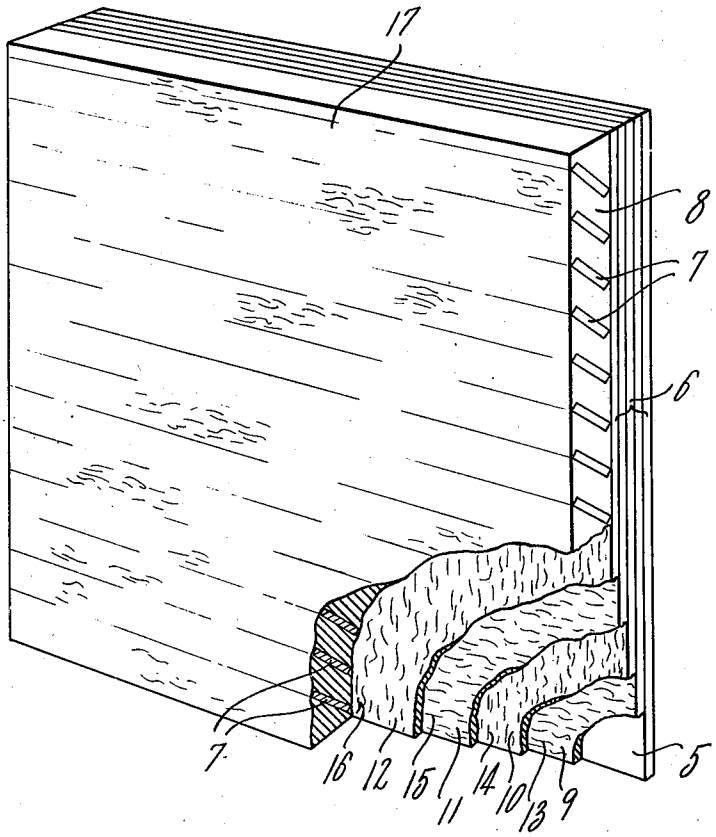


Fig. 4

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UNITED STATES PATENT OFFICE

2,318,301

BULLET RESISTING ARMOR

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Application March 15, 1939, Serial No. 261,881

9 Claims. (Cl. 109—81)

This invention relates to a bullet resisting armor, and in particular it relates to a protective or defense combination of materials for bringing to rest projectiles or fragmentary portions thereof.

In general, the invention comprises a plurality of metal strips embedded in overlapping relation in a rubber composition, each strip lying at an angle of approximately 45 degrees to the exposed face of the armor, and including a cushion of rubber composition lying at the back of the plurality of strips, and also including a metal base plate bonded to the cushion of rubber composition.

Bullet resisting armor of a predetermined strength or resistance, depending upon the type or size projectile it is to resist, can be obtained by merely providing a conventional steel armor plate of a proper and sufficient thickness. However, considerable difficulty has been encountered in attempting to use such conventional armor plate in places where the weight of the armor is also an important factor. For example, on critical parts of motor vehicles, tanks, ships and aircraft, it is highly desirable to use an armor having the proper bullet resisting qualities desired and yet decrease the weight thereof to a minimum.

It has also been found that indirect damage often results while using conventional armor plate since projectiles or fragmentary portions thereof may be deflected from the exposed surface of the plate and strike nearby objects before coming to a state of rest.

In accordance with the practice of my invention, I provide a combination and arrangement of materials which, in comparison with conventional armor plate, has equal bullet resisting characteristics and at the same time has a weight materially less than said armor plate. The bullet resisting armor of my invention has the additional property of tending to prevent projectiles or portions thereof from being deflected from the exposed surface of the armor but allowing a limited penetration of the projectile and then tending to retain same embedded in the armor.

Among the objects of my invention are, to provide bullet resisting material of relatively light weight; to provide a bullet resisting material having certain structural innovations; and to provide a bullet resisting material which is reasonably economical of manufacture and which requires no difficult manufacturing processes. These and other objects and advantages will appear more fully in the following detailed description, when considered in connection with the accompanying drawings, in which:

Fig. 1 is a plan view of a bullet resisting armor embodying features of my invention;

Fig. 2 is a front elevational view thereof;

Fig. 3 is an end view, in section, of the bullet resisting armor taken along section line III—III of Fig. 2; and,

Fig. 4 is a perspective view, partly broken away and partly in section, of a modified form of bullet resisting armor.

Referring to the drawings and in particular to Figs. 1, 2, and 3, I show by way of example an embodiment of my invention in the form of a base plate 1, a cushion of vulcanized rubber composition 2 bonded to the base plate 1, and a plurality of unconnected metal plates or strips 3 spaced in overlapping relation and solely supported and separated by portions of rubber composition 4 so that plates 3 may have independent movement in the vulcanized rubber. Preferably, the metal strips 3 are positioned so that the faces thereof lie at an angle of approximately 45 degrees relative to the principal or exposed face of the bullet resisting armor. Each strip 3 overlaps its adjacent strip by an amount at least sufficient to avoid a direct horizontal path through the vertically positioned armor without piercing one or more of the plates 3. Preferably, the distance between the strips 3 should be less than the diameter of the projectile which the armor is intended to resist.

The rubber composition which forms the cushion 2 and the spacer portions 4 is of relatively tough stock, having a hardness of 90 according to Shore durometer reading. While the hardness of the rubber composition may vary, it is important that the composition be not less than 80 durometer hardness.

While the plates 1 and 3 may be composed of relatively tough metal, I prefer that they be formed of conventional armor plate stock. Such armor plate comprises steel having extreme hardness and toughness. The Brinell hardness readings for such steel generally range between 380 and 430 when tested with a 10 millimeter tungsten carbide ball applied under a load of 3000 kilograms for a period of 30 seconds. These metal portions 1 and 3 are treated by brass plating or other means for insuring a proper bond between the rubber composition and the metal plates.

In operation, bullets or projectiles which strike the armor are deflected by the metal strips 3 which, being mounted in the rubber composition,

are permitted slight cushioning movement, thus absorbing much of the energy of the projectile. In addition, the toughness of the rubber composition 4 causes a resisting action over a relatively wide area of composition, thereby increasing the property of dispelling the energy of the projectile. The plate 1 functions as a catch plate to further obstruct and deflect the travel of projectile and for retaining the projectile or parts thereof if same should pass by the metal strips 3 or the cushion 2. The plate 1 may also be used as a structural part of a vehicle or other equipment of which the armor forms a part.

Actual experiments in which .30 and .50 caliber projectiles have been employed demonstrated that armor formed in accordance with my invention having bullet resisting characteristics at least equal to armor plate also has the added advantage of between 20 to 40 percent less weight than the armor plate.

In Fig. 4, I show a modification of my invention constituting a base plate 5, cushion of rubber composition 6, metal strips 7, and rubber composition 8 for filling the spaces between the metal strips 7. The general arrangement of the metal parts and rubber composition is similar to that in the embodiment illustrated by Figs. 1, 2, and 3. The compositions 6 and 8 are formed of a vulcanized rubber having fibers intermixed therewith. While various materials may be employed for reinforcing the rubber composition, I have obtained good results with a composition containing about 20 to 30 percent cotton fibers relative to the weight of the rubber composition. The cotton fibers are in their natural condition, and are of approximately ⅞ inch staple.

The cushion of rubber composition 6 may be formed of a layer of single thickness, or it may be formed of a plurality of sheets 9, 10, 11, and 12. When the cushion is formed of a plurality of sheets, it is preferable to alternate the direction in which the cotton fibers thereof extend. That is, in the sheet 9 the greater portion of the cotton fibers 13 extend in a horizontal direction; in sheet 10 cotton fibers 14 extend in a vertical direction; in sheet 11 cotton fibers 15 extend in a horizontal direction; and in sheet 12 cotton fibers 16 extend in a vertical direction. In the rubber composition 8 the greater portion of cotton fibers 17 extend in a horizontal direction parallel with the strips 7. By this cross lamination of rubber composition having cotton fibers extending alternately in 90 degree directions, the toughness of the rubber composition is increased so that a greater reactionary area is provided for absorbing the energy of projectiles. A resulting advantage of the arrangement and compositions forming this embodiment of my invention is that projectiles or fragmentary portions thereof are retained by the armor, thus preventing indirect damage due to deflection of a projectile or parts thereof from the surface armor.

While I have shown and described a preferred embodiment of my invention, it is to be understood that it may be otherwise embodied, such as by arranging the armor in a form having curved surfaces, and it is intended that the invention includes such modifications within the scope of the appended claims.

Having thus described my invention, what I claim and desire to protect by Letters Patent is:

1. A bullet resisting armor comprising a plurality of unconnected metal strips positioned in spaced and substantially parallel relation, a vulcanized yieldable rubber composition bonded to and forming an embedment and the sole supporting means for the strips and forming an exposed surface for the armor, the faces of said strips forming an angle of approximately 45 degrees with the normally exposed face of the assembled armor, said strips being spaced in a manner to provide overlapping of one strip relative to its adjacent strips in the direction of bullet resistance, and fibers interspersed in the rubber composition to the extent of at least 20 percent of the weight of the rubber composition.

2. A bullet resisting armor comprising a plurality of unconnected metal strips positioned in spaced and substantially parallel relation, a vulcanized yieldable rubber composition bonded to and forming an embedment and the sole support for the strips, the faces of said strips forming an angle of approximately 45 degrees with the normally exposed face of the assembled armor, said strips being spaced in a manner to provide overlapping of one strip relative to its adjacent strips in the direction of bullet resistance, and a layer of rubber composition forming a cushion at the back of said strips.

3. A bullet resisting armor comprising a plurality of unconnected metal strips positioned in spaced and substantially parallel relation, a vulcanized yieldable rubber composition bonded to and forming an embedment for the strips, the faces of said strips forming an angle of approximately 45 degrees with the normally exposed face of the assembled armor, said strips being spaced in a manner to provide overlapping of one strip relative to an adjacent strip in the direction of bullet resistance, a layer of rubber composition secured directly to said embedment and forming a cushion at the back of said strips, and a metal plate bonded to the back of the layer of rubber, said rubber compositions having a hardness of at least 80 durometer.

4. A bullet resisting armor comprising a plurality of unconnected metal strips positioned in spaced and substantially parallel relation, a vulcanized yieldable rubber composition bonded to and forming an embedment for the strips, the faces of said strips forming an angle of approximately 45 degrees with the normally exposed face of the assembled armor, said strips being spaced in a manner to provide overlapping of one strip relative to an adjacent strip in the direction of bullet resistance, a layer of rubber composition forming a cushion at the back of said strips for the strips and embedment and also forming the sole supporting means therefor, a metal plate bonded to the back of the layer of rubber, and fibers interspersed in the rubber compositions to the extent of at least 20 percent of the weight of the rubber composition.

5. A bullet resisting armor comprising a plurality of unconnected metal strips positioned in spaced and substantially parallel relation, a vulcanized yieldable rubber composition bonded to and forming an embedment for the strips, the faces of said strips forming an angle of approximately 45 degrees with the normally exposed face of the assembled armor, said strips being spaced in a manner to provide overlapping of one strip relative to an adjacent strip in the direction of bullet resistance, a layer of rubber composition secured to the back of said embedment and forming a cushion at the back of said strips, a metal plate bonded to the back of the layer of rubber composition, said rubber compositions having a hardness of at least 80 durometer, and fibers interspersed in the rubber compositions to

the extent of at least 20 percent of the weight of the rubber composition.

6. A bullet resisting armor comprising a plurality of unconnected metal strips positioned in spaced and substantially parallel relation, a vulcanized yieldable rubber composition bonded to and forming an embedment for the strips, the faces of said strips forming an angle of approximately 45 degrees with the normally exposed face of the assembled armor, said strips being spaced in a manner to provide overlapping of one strip relative to its adjacent strip in the direction of bullet resistance, a layer of rubber composition bonded to and forming a cushion at the back of said strips, and a metal plate bonded to the back of the layer of rubber, said layer of rubber composition being formed of a plurality of sheets of rubber composition.

7. A bullet resisting armor comprising a plurality of unconnected metal strips positioned in spaced and substantially parallel relation, a vulcanized yieldable rubber composition bonded to and forming an embedment for the strips, the faces of said strips forming an angle of approximately 45 degrees with the normally exposed face of the assembled armor, said strips being spaced in a manner to provide overlapping of one strip relative to its adjacent strips in the direction of bullet resistance, a plurality of sheets of rubber composition, having fibers interspersed therein to the extent of at least 20 percent of the weight of the rubber composition, secured to the back of said embedment and forming a cushion for said strips, and a metal base plate secured to the cushion.

8. A bullet resisting armor comprising a plurality of unconnected metal strips positioned in spaced and substantially parallel relation, a vulcanized rubber composition bonded to and forming an embedment for yieldably supporting the strips, the face of said strips forming an angle of approximately 45 degrees with the normally exposed face of the embedment, said strips being spaced in a manner to provide overlapping of one strip relative to its adjacent strip in the direction of bullet resistance, a layer of rubber composition bonded to the back of said embedment for forming a cushion for said strips, said layer of rubber composition being formed of a plurality of sheets of rubber composition with fibers interspersed therein to the extent of at least 20 percent of the weight of the rubber composition, the length of the greater portion of said fibers in each sheet lying in a direction approximately 90 degrees relative to the direction of the length of the greater portion of the fibers in the adjacent sheet, and a metal plate bonded to the back of said layer.

9. A bullet resisting armor comprising a plurality of unconnected metal strips positioned in spaced and substantially parallel relation, a vulcanized rubber composition bonded to and forming a yieldable embedment for the strips, the faces of said strips forming an angle of approximately 45 degrees with the normally exposed face of the assembled armor, said strips being spaced in a manner to provide bullet resisting overlapping of one strip relative to its adjacent strip, fibers interspersed in the rubber composition to the extent of at least 20 percent of the weight of the rubber composition, the length of the greater portion of said fibers lying in a direction substantially parallel with the length of the strips, a layer of rubber composition secured directly to the back of said embedment for forming a cushion for said strips, and a metal plate bonded to the back of the layer of rubber.

ERNST EGER.