Sept. 10, 1946. D. ROBERTS 2,407,515

SELF-SEALING TANK

Filed Oct. 9, 1940

FIG.1

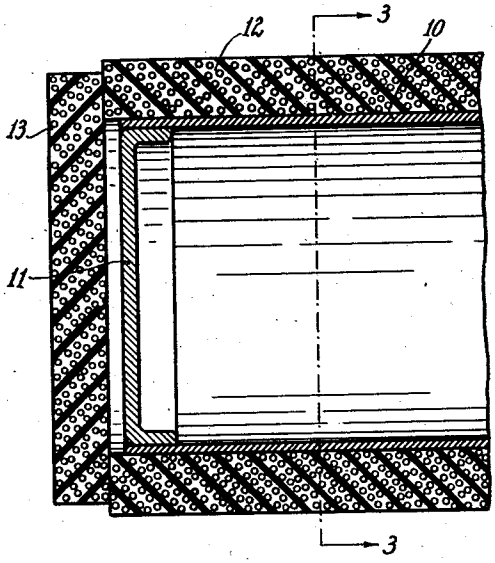



FIG.2

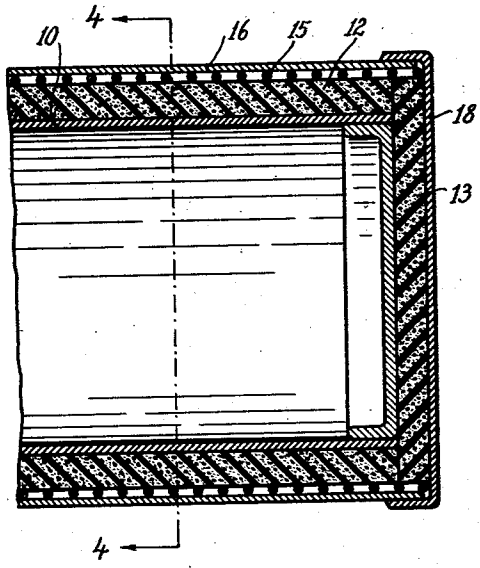



FIG.3

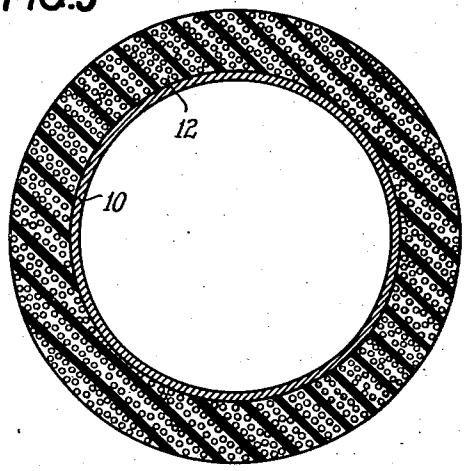
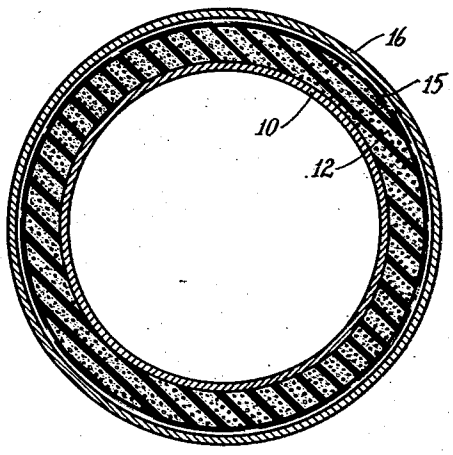



FIG.4



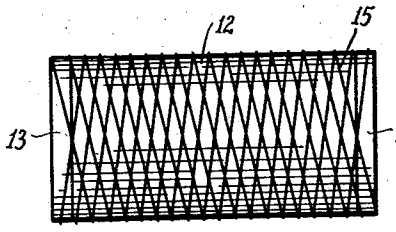




FIG.5

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2,407,515

# UNITED STATES PATENT OFFICE

2,407,515

## SELF-SEALING TANK

Dudley Roberts, deceased, late of New York, N. Y., by Dudley Roberts, Jr., executor, New York, N. Y., assignor to Rubatex Products, Inc., New York, N. Y., a corporation of Delaware

Application October 9, 1940, Serial No. 360,396

4 Claims. (Cl. 154—43.5)

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The invention relates to a novel construction for protecting and sealing fuel tanks against bullet or shell fire and more particularly the invention relates to a self-sealing gasoline tank to protect said tank and prevent leakage therefrom in the event of penetration by bullet or shell fragment.

In military and in naval airplanes the gasoline tank represents one of the most vulnerable points for disabling and destroying a plane. It is preeminently desirable that such gasoline tanks be protected against penetration by anti-aircraft shell fragments and, if such penetration does result, that the gasoline therein be prevented from flowing out from the pierced tank so as to prevent the possibility of fire developing.

A novel construction by means of which gasoline tanks are protected by covering the tank with closed cell gas expanded rubber of a flexible and resilient nature. It is a particular feature of the invention that such flexible and resilient closed cell gas expanded rubber be placed over the fuel tank and confined so as to be maintained under compression. The compression referred to is primarily in a direction in the plane of the resilient closed cell rubber but also in the direction normal thereto tending to compress the resilient closed cell rubber in the plane of its largest dimensions. By means of this covering comprising a compressed sheet of closed cell gas expanded rubber, it has been found that greatly increased protection is afforded. In the first place, the resilient closed cell rubber is flexible and absorbent of blows and hence when surrounded by a hard and tough shell-like cover, glancing blows of shell fragments can be rendered innocuous inasmuch as closed cell rubber has a great elasticity and recedes or gives with the blow.

A further and more important feature of the invention lies in the fact that when a direct hit is scored and a bullet or shell fragment has impacted against the covering with sufficient force to penetrate the same and pierce through into the gasoline tank, because of the nature of the covering provided gasoline is prevented from flowing out in substantial quantity and accordingly the damage of fire and loss of fuel is diminished. More specifically upon the covered tank being pierced by a bullet or shell fragment, the pierced soft and resilient closed cell gas expanded rubber, because of the inwardly directed compressive force thereupon, tends to move to fill up the space torn away by the bullet or shell fragment and cause a physical sealing or blocking action to take place. The slight leakage of gasoline into and through this breach exerts a sealing action thereon so that little flow of gasoline to the outside is possible.

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Accordingly, it is the object of the invention to provide a novel construction for the protection of fuel tanks.

It is a further object of the invention to provide a novel construction whereby a self-sealing effect is obtained upon penetration of the cover and gasoline tank by a bullet or shell fragment.

It is a further object of the invention to provide novel method for resiliently resisting glancing impacts of bullets or shell fragments.

It is a further object of the invention to provide a covering for a fuel tank comprising a sheet of soft and resilient closed cell gas expanded rubber maintained under a compressive force, compression being directed inwardly in the plane of the sheet of closed cell rubber.

These and further objects of the invention will be apparent from a consideration of the description which follows taken in connection with the drawing, in which

Figure 1 is a cross-section of the construction of the invention in which closed cell rubber is disposed over a gas tank.

Figure 2 is a cross section of a gas tank of the invention in which the closed cell rubber disposed over the gas tank is compressed and guarded by a suitable shell-like cover.

Figure 3 is a cross section taken along line 3—3 of Figure 1.

Figure 4 is a cross section taken along line 4—4 of Figure 2.

Figure 5 is a side elevation of the construction of the invention showing a compressing network superimposed over the closed cell rubber disposed on a gas tank.

Referring now more specifically to the drawing:

In Figure 1 is shown a gasoline tank comprising a side wall, 10, and an endpiece, 11, and disposed over this gas tank is closed cell gas expanded rubber, 12 and 13. This closed cell gas expanded rubber is formed by injecting nitrogen gas under pressure in the order of three thousand pounds per square inch into rubber, and so treating the rubber as by partial vulcanization, so that the gas is entrapped in the rubber in the form of closed cells. Closed cell rubber may also be formed by mixing with the rubber suitable chemicals adapted to compose and develop nitrogen gas under heat. Methods of forming closed cell rubber are more fully set forth in Patent No.

2,086,513, issued July 6, 1937, and application Serial No. 159,706, filed August 18, 1937.

The closed cell rubber, 12 and 13, is disposed over a gas tank to which it may be suitably secured as by means of adhesive areas, although to obtain free movement of the closed cell rubber, it is preferable that no adhesive be employed between the closed cell rubber and the tank's surface. Over the sheet, 12, of closed cell gas expanded rubber, there is placed a compressive spring-like member, 15, which is tightened so as to compress the closed cell rubber in a direction normal to the plane of the sheet. Over this compressing spring member is disposed a hard shell-like member, 16, which may for example be armor plate or some suitable metal.

In order to provide desirable inward compression an end member, 18, is found disposed over the end sheet, 13, so as to compress the same which moves against the end of the sheet, 12, causing that to be inwardly compressed. This end member, 18, is also formed of a shock-resistant hard armor plate, and hence, a full superficial protection against glancing blows of projectiles or shell fragments is afforded. Because the closed cell rubber sheet, 12, is compressed both downwardly and inwardly, it is well adapted to recede and give with any blows directed thereto, and in case of a direct hit secured by a projectile with sufficient force to pass through the armor plate, 16, the closed cell rubber, 12, and the gas tank wall, 10, then the closed cell rubber, 12, under compression tends to move inwardly to close the openings formed by the projectile. Thus a physical self-sealing action is effected. Similarly, since the gasoline exerts a solvent or flowing action on the torn portion of the closed cell rubber it tends to seal the opening formed therein.

In Figures 3 and 4 are shown cross sections based upon Figures 1 and 2, as indicated, and in these Figures 3 and 4 is indicated the relative compression and means of compression for the closed cell rubber.

Closed cell rubber contains enclosed cells of gas, homogeneously distributed throughout its mass, and when compressed, these cells are also compressed but not ruptured. Closed cell rubber is impervious to the flow of liquids, extremely resilient and at the same time light in weight because of the presence of the gas therein.

Various modifications in the invention may be employed, but of primary importance is the fact



that the closed cell gas expanded rubber is employed as a shield by the gas tank and that there may be exerted such compression on this closed cell rubber so that it has increased resilience to shock, and upon displacement of a material portion therein, will move to fill up the displaced portion. Compression of the closed cell rubber is inwardly in the plane of the rubber, and an additional downward compression may or may not be employed.

Additionally, the armor plate to repel glancing blows is disposed as a shell-like exterior in the construction.

Although it has been found that rubber is most suitable in the closed cell gas expanded material, it is in the purview of the invention to use combinations of rubber or substitute other elastic materials for the rubber base.

It is claimed:

1. A tank and a layer of closed cell gas expanded rubber positioned over said tank, means for inwardly compressing said closed cell rubber in the plane of said layer of closed cell rubber, and a shock resistant protective layer positioned over said closed cell rubber.

2. A tank and a layer of closed cell gas expanded rubber positioned over said tank, means for inwardly and downwardly compressing said closed cell rubber in the plane of said layer of closed cell rubber, and a shock resistant protective layer positioned over said closed cell rubber.

3. In combination with a tank, a sealed cellular gas expanded rubber sheet covering said tank surface, said rubber being mounted to permit freedom of movement of said cellular structure, a compressive spring-like means for maintaining said rubber under compression in a direction normal to the plane of said rubber sheet, and a hard shell-like member disposed over said spring-like member.

4. In combination with a tank, a sealed cellular gas expanded rubber sheet covering said tank surface, said rubber being mounted to permit freedom of movement of said cellular structure, a compressive spring-like means for maintaining said rubber under compression in a direction normal to the plane of said rubber sheet, a hard shell-like member disposed over said spring-like member, and end members disposed over the ends of said sheet for pressing said rubber inwardly.

DUDLEY ROBERTS, JR.,
*Executor of the Last Will and Testament of Dudley Roberts, Deceased.*