

Feb. 28, 1961

A. F. FINO

2,973,113

WEATHER SEAL

Filed Oct. 28, 1958

2 Sheets-Sheet 1

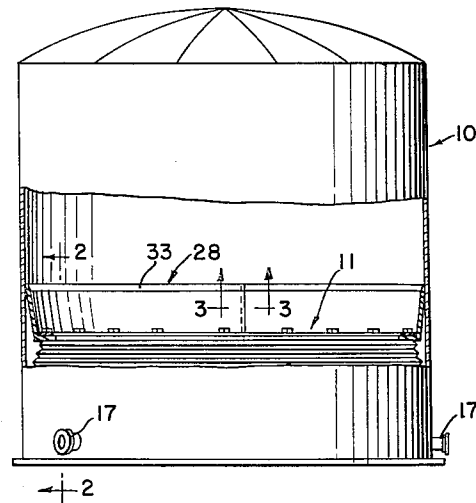


FIG. 1.

FIG. 4.

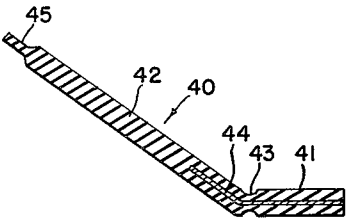


FIG. 2.

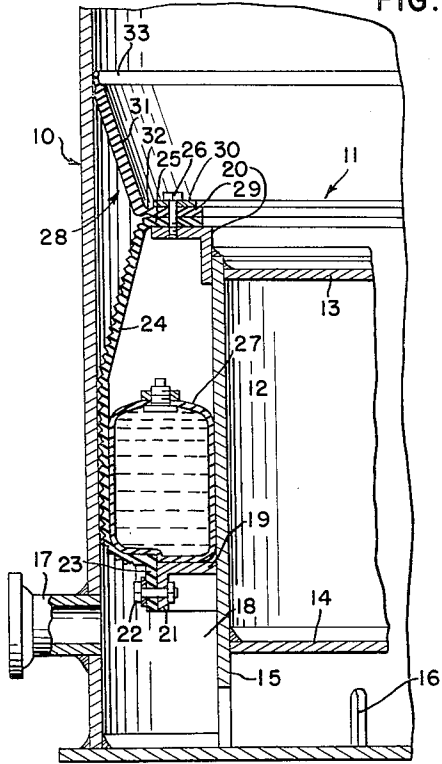


FIG. 5.

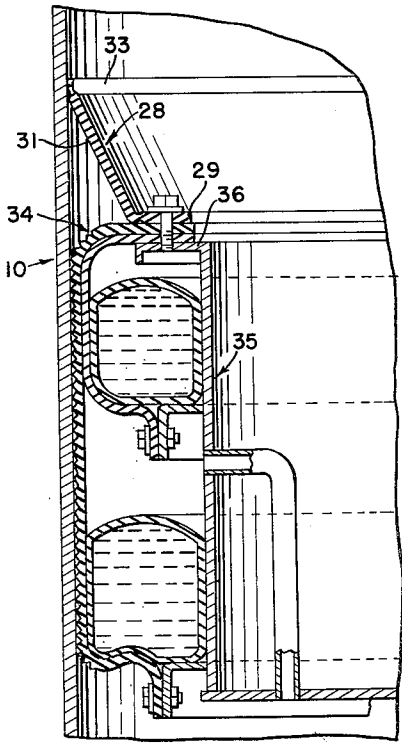
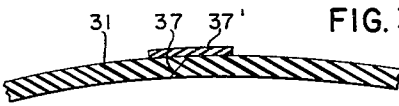


FIG. 3.

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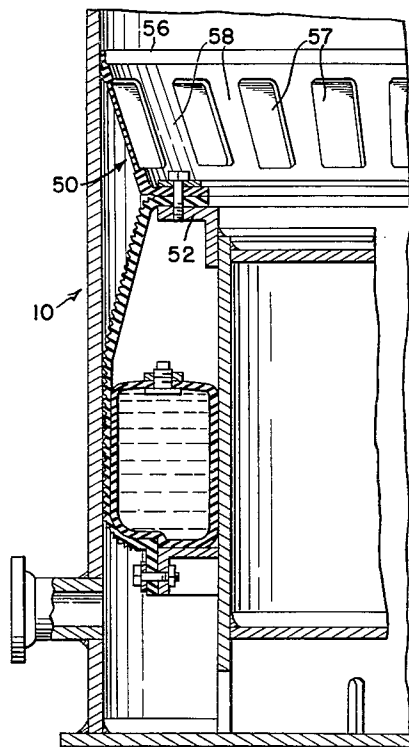


FIG. 6.

FIG. 8.

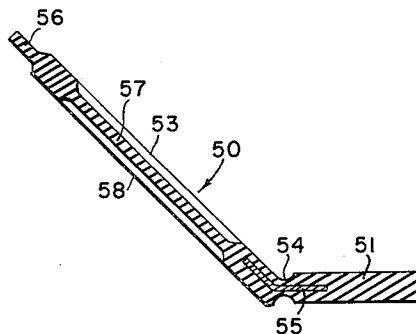
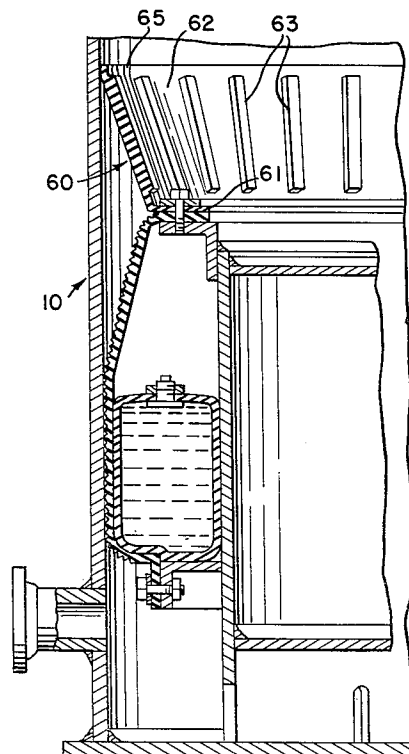
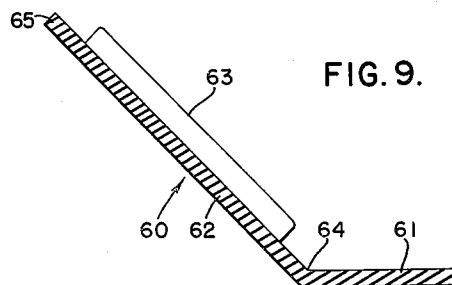


FIG. 7.

FIG. 9.



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2,973,113

WEATHER SEAL

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4 Claims. (Cl. 220—26)

This invention relates to storage tanks for oil and oil products, and the like, of the type having a floating roof or covering that floats on the liquid stored in the tank so that it rises and falls with the liquid level.

In tanks of this sort, a problem is encountered in providing and maintaining an effective seal and although this has largely been overcome by the construction illustrated in Patent 2,735,573, difficulty is encountered under some circumstances due to the fact that the entrance of foreign material between the sealing member and the inner wall of the tank will cause abrading and glazing of the sealing member so that the same will be ineffective to provide the proper and desired seal. It is therefore of primary concern in connection with this invention to provide an attachment for the sealing means for floating roofs of liquid storage tanks which will be effective to maintain the sealing member isolated from foreign material which might cause abrading or glazing thereof destroying the seal obtained thereby and consequently permitting contamination of the stored product by foreign material such as rain water.

Another object of this invention is to provide improvements in floating roofs for liquid storage tanks for storing oil and oil products and the like which incorporates a circumferential flap or sealing strip which is connected to the floating roof and which extends upwardly therefrom for marginal edge contact with the inner surface of the storage tank along a line above the seal utilized in conjunction with the roof itself and so as to prevent the entry of foreign material and the like into the space between the sealing member and the tank.

Still another object of this invention is to provide a protective strip or flap of the character above described which is in the form of an annular strip of flexible material having the inner marginal edge thereof securely fastened to the floating roof structure and with the outer and main body portion thereof extending upwardly therefrom to define a frusto-conical surface terminating in an edge portion engaging against the inner surface of the associated liquid storage tank so as to cooperate with the sealing means associated with the floating roof and thereby protect the sealing means against the entry of foreign material between the sealing means and the inner surface of the tank.

A further object of this invention is to provide a sealing strip of the character described wherein the annular inner marginal edge thereof is joined to the outer or main body portion in a hinge section of reduced thickness to facilitate flexing of the strip at this point to achieve the proper angle between the inner and outer portions of the strip and wherein, further, there is provided a reinforcing strip defining an obtuse angle serving to retain the angulated disposition between the inner and outer sections.

A further object of this invention is to provide a protective strip of the character described wherein the outer marginal edge thereof which is adapted to contact the inner surface of the storage tank is of reduced thickness

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so as to achieve thereby a greater flexibility and resiliency within that portion of such reduced thickness than the remainder of the body so as to permit such edge to readily conform and seal against the inner surface of the associated storage tank.

A further object of this invention is to provide a protective strip of the character described wherein the annular inner marginal edge of the strip which is utilized to anchor the same to the floating roof is of a substantially uniform thickness throughout with the upper angulated main body portion of the strip being provided with generally radially extending reinforcing portions of greater thickness than the major portion thereof so as to rigidify the strip in a radial direction while permitting circumferential flexing thereof for conformity with the associated storage tank inner wall surface.

In the drawings:

Fig. 1 is an elevational view, partly broken away, illustrating a conventional type of liquid storage tank having a floating roof associated therewith and illustrating the disposition of the instant invention in association therewith;

Fig. 2 is an enlarged vertical section taken substantially along the plane of section line 2—2 in Fig. 1 illustrating details of the sealing means as well as the protective strip associated therewith;

Fig. 3 is an enlarged horizontal section taken along the plane of section line 3—3 in Fig. 1 illustrating the manner in which the ends of the protective strip are overlapped;

Fig. 4 is an enlarged transverse sectional view taken through one form of the protective strip in accordance with this invention and illustrating the reinforcing strip associated therewith;

Fig. 5 is a view similar to Fig. 2 but illustrating a modified form of sealing means;

Fig. 6 is a view similar to Figs. 2 and 5 and illustrating a modified form of protective strip;

Fig. 7 is a view similar to Figs. 2, 5 and 6 but illustrating a further modified form of protective strip;

Fig. 8 is an enlarged transverse section taken through the modified form of protective strip illustrated in Fig. 6; and

Fig. 9 is an enlarged transverse sectional view taken through the modified form of protective strip illustrated in Fig. 7.

Referring at this time more particularly to Figs. 1 and 2, the reference numeral 10 indicates in general a liquid storage tank of conventional construction and such as is of the type utilized to store oil or oil products therein. Disposed in the tank and indicated generally by the reference character 11 therein is a floating roof structure which is adapted to float upon the liquid level within the tank and to rise and fall therewith to prevent the formation of a gaseous head space above the liquid and to prevent the entry of contaminants into the liquid stored within the tank.

The floating roof includes a peripheral wall 12, an upper deck 13 and a lower deck 14 and a depending skirt portion 15 below the lower deck 14 provided with openings such as those indicated by the reference character 16 so that when the roof is wholly lowered within the tank, such as indicated in Fig. 2, liquid entering through one or more of the lines 17 may fill the space beneath the lower deck 14.

Between the roof and the inner periphery of the tank shell is an annular space 18 and from the periphery of the floating roof there extends outwardly a lower shelf or flange 19 and similarly provided at the upper edge of the roof is an upper flange 20.

The lower flange 19 is provided with a depending skirt portion 21 which has secured thereto as by suitable

fasteners 22 the lower marginal edge 23 of a sealing band 24, the upper marginal edge 25 being secured as by fasteners 26 to the upper flange 20 substantially as is illustrated in Fig. 2. This is in accordance with my previous patent 2,735,573.

Located within the space produced between the band 24 and the wall 12 of the roof, is a liquid containing deformable tube 27, the purpose of which is to firmly engage the band 24 against the inner surface of the shell of the tank and thereby prevent the entry of moisture, contaminants and the like into the liquid disposed within the tank and below the roof structure.

In accordance with this invention, there is provided in association with the assembly above described, a protective strip or flap indicated generally by the reference character 28 and which, in the form shown in Fig. 2, includes an annular inner marginal edge portion 29 secured to the upper shelf or flange 20 by the same fastening means 26 as is utilized to secure or anchor the upper marginal edge 25 of the scuff band 24, an annular metallic ring 30 being provided beneath the heads of the fasteners 26 to effect a large bearing area for sandwiching these several layers in place between such ring and the flange 20.

The inner marginal edge portion 29 of the protective strip 28 is joined to the major portion or main body 31 thereof by a portion 32 thereof which is of reduced thickness so as to permit the main body portion 31 to assume angularity relative to the inner marginal edge 29 thereof as is shown, the strip or flap being initially of flat form.

The main body portion 31 extends upwardly with respect to the inner marginal edge portion 29 and describes a frusto-conical surface and terminates at its upper end in a free peripheral edge portion 33 of reduced thickness as compared with the thickness of the main body portion 31 proper so that such edge portion 33 is readily deformable to the inner surface of the shell of the tank 10. In this manner water, larger masses of dirt and other foreign substance such as would cause an abrading action on either or both the inner surface of the tank 10 and the scuff band 24 are prevented from entering between these two members and contaminating the stored product. It is to be understood that the protective strip 28 is not intended as a seal but is only intended to provide means whereby rain water is deflected and the larger masses of foreign material are prevented from becoming lodged between the scuff band 24 and the tank 10 which might cause undue wear or glazing of the scuff band such as to ultimately effect its destruction or prevent it from operating in the manner intended, thus permitting contamination of the product stored in the tank 10.

Fig. 5 illustrates the use of the invention shown in Fig. 2 in association with a modified form of sealing mechanism indicated generally by the reference character 34, the details of which are clearly set forth in my copending application, Serial No. 740,748, filed June 9, 1958. In this case the roof structure indicated generally by the reference character 35 is of somewhat modified form but, like the construction shown in Fig. 2, includes an upper flange portion 36 to which the inner marginal edge portion 29 of the protective strip 28 is secured, the main body portion 31 thereof extending angularly outwardly and upwardly to terminate in the marginal edge portion 33 engaging the inner surface of the tank 10.

The strips 28 are preferably formed from a single length of material and, as is shown in Fig. 3, the ends thereof may be beveled as at 37 to be overlapped in a relatively tight joint so as not to destroy the effectiveness of the protective seal itself.

The overlapping ends 37 are reinforced by means of a relatively thin, regulatable strip of reinforcing material 37', which is preferably formed of rubber. It is preferred, also, that this strip be slightly stiffer than the

body of the seal itself so as to achieve a good reinforcing action and prevent undue flexing of the seal at the point of joining the two ends of the seal which might cause premature failure of the seal at this point. The strip 37' is of a length less than the width of the seal portion 32 and, therefore, does not extend all the way to the outer free edge thereof since, of course, it is not desirable for the relatively stiff strip 37' to in any way detract from the inherent flexibility of the free marginal edge of the seal by means of which the effective sealing action is achieved.

In the modification illustrated in Fig. 4, the protective strip 40 indicated generally therein includes an inner marginal portion 41 and an outer or main body portion 42 angulated upwardly with respect thereto and joined to the inner marginal edge portion 41 in the portion 43 of reduced thickness to facilitate initially the angular disposition or hinging as at 43 between the two portions 41 and 42 and embedded within the protective strip in a portion of the main body 42 thereof and the inner marginal edge 41 and extending through the hinge portion 43 of reduced thickness is a hinge-toughening strip 44 which may be formed of Nylon or the like. As before, the outer or upper free edge 45 of the main body portion is of reduced thickness with respect to the thickness of the main body portion so as to permit conformity with the surface of the associated storage tank. It is to be noted that preferably the main body portion 42 is so treated during production as to be of relatively hard rubber characteristics whereas the edge 45 is of relatively soft rubber characteristics enhancing the conformation of the edge 45 to the inner surface of the shell while the relatively hard main body portion assures proper contact of the edge 45 thereagainst and is not of such flexible nature as to sag or permit the edge 45 to be withdrawn from engagement with the shell of the tank.

In the modification illustrated in Figs. 6 and 8, the protective strip indicated generally by the reference character 50 therein will be seen to include an annular inner marginal edge portion 51 for securing to the upper flange 52 of the roof structure and which is joined to the main body portion 53 thereof through the portion 54 of reduced thickness which is reinforced by the strip 55 as is the case in the modification illustrated in Fig. 4.

The main body portion 53 terminates in the soft outer edge 56 engaging the inner surface of the tank 10 and throughout the extent of the main body portion 53 there are provided regions 57 of reduced thickness as can be best seen in Fig. 8, as compared with the intervening region 58 separating the areas or sections 57. Thus the ribs 58 act as radial stiffeners for the main body portion whereas at the same time the existence of the areas 57 permits a circumferential flexing of the strip such as to readily conform to the inner contour of the tank shell.

The same general relationship as is set forth above in regard to Figs. 6 and 8 is prevalent in the modification illustrated in Figs. 7 and 9. In this modification, the sealing strip is indicated generally by the reference character 60 and will be seen to include the inner marginal edge portion 61 joined to the main body portion 62 thereof, both of which may be of generally the same uniform thickness throughout with the exception of the provision of the radial stiffening ribs 63 extending from a point somewhat beyond the juncture 64 between the two sections 61 and 62 to a point short of the marginal edge 65 of the sealing strip, leaving this outer marginal edge 65 free to flex in conformity with the contour of the inner surface of the tank while at the same time the ribs 63 impart the necessary radial rigidity or stiffness to the strip while still permitting the circumferential conformance thereof to the inner contour of the tank. The inner portion of each of the ribs 63 extends substantially normally from the intermediate portion 62 of the sealing strip, and in this manner a shoulder is formed at the

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inner portion of each of the ribs. As is the case with the construction described in connection with Fig. 4, all of the forms of the invention may be so formed as to terminate at their outer marginal edges in relatively soft material, the same holding true for the modifications in Figs. 7 and 9.

It is to be understood that of primary concern in connection with this invention is the provision of means in the form of the above described seal which presents a yielding, deformable sealing edge that will remain in upwardly deflected position during all phases of the float roof movement. The main body portion of the seal is relatively stiffer as compared with the more conformable free marginal edge thereof. This relatively soft or conformable marginal edge effecting a continuation of the main body of the seal not only deforms to act as a seal edge but permits the seal to "creep" over weld joints and other rough edges that may be on the tank interior. Meanwhile, the more rigid main body portion of the seal acts similarly to a spring urging the flexible lip over such obstructions.

By remaining in upwardly projecting position as is illustrated in the drawings, the seal is extremely effective for deflecting rain water and snow that may be blown against the interior walls of the tank shell. Thus, contamination of the liquid within the tank by water is minimized. This is extremely important and, in fact, critical particularly with the storage of jet engine fuels.

The entire construction of the seal is spark proof and corrosion resistant, but possesses the firmness, springiness and electric conductivity of metal, as obtained by the proper selection of rubber compounds.

I claim:

1. In combination with a storage tank having a confining shell and a floating roof disposed therewithin to rise and fall in accordance with the level of the contents of the tank, said roof providing an annular space therearound between the same and said shell and there being a flexible scuff band carried by the roof engaging and sealing against the inner surface of the shell, a protective rubber strip secured to the upper region of said roof and extending therefrom into engagement with the inner surface of the shell above said scuff band, said strip including an inner substantially coplanar annulus fixed to the roof, an intermediate portion integrally joined with said annulus and of frusto-conical configuration extending angularly upwardly and outwardly therefrom toward the inner surface of said shell, the outer periphery of said intermediate portion terminating in closely spaced relationship to said inner surface of the shell, and an outer marginal edge portion integrally joined to said intermediate portion and extending therefrom into engagement with the inner surface of said shell, said intermediate portion being of predetermined thickness sufficient to lend substantial rigidity thereto and being so formed as to be relatively stiff, said outer marginal edge portion being formed substantially softer than the intermediate portion, the normal dimensions of the protective strip being such that the outer marginal edge portion thereof presents a diameter greater than the inner diameter of the shell whereby said relatively stiff intermediate portion springingly urges the soft outer marginal edge portion into deformed contact with the inner surface of the shell to conform accurately to the inner contour of the shell and to creep over weld joints and other rough edges on the inner surface of the tank shell while the more rigid intermediate body portion of the seal springingly urges such outer marginal edge portion over such obstructions, a plurality of radially extending reinforcing ribs formed integrally with said intermediate portion originating in spaced relationship to the juncture of the same and said inner annulus and terminating in spaced relationship to said outer marginal edge portion whereby the reinforcing ribs lend radial stiffness to said intermediate portion without interfering with the flexibility

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of the strip at the juncture between the intermediate portion and the inner annulus or the flexibility of the outer marginal edge portion and while at the same time leaving the strip free from interference by the ribs for circumferential flexing.

2. In combination with a storage tank having a confining shell and a floating roof disposed therein to rise and fall in accordance with the level of the contents of the tank, said roof providing an annular space therearound between the same and said shell and there being a flexible scuff band carried by the roof engaging and sealing against the inner surface of the shell, a protective rubber strip secured to the upper portion of said roof above said scuff band, said strip including an inner substantially coplanar annulus fixed to the roof, an intermediate portion integrally joined with said annulus and extending angularly upwardly and outwardly therefrom toward the inner surface of said shell, said intermediate portion defining a frusto-conical configuration, said intermediate portion being of predetermined thickness sufficient to lend substantial rigidity thereto and being so formed as to be relatively stiff, the outer marginal edge portion of said strip being of reduced thickness with respect to the intermediate portion thereof and being formed of softer material than the intermediate portion, the normal dimensions of the protective strip being such that the outer marginal edge portion thereof presents a diameter greater than the inner diameter of the shell whereby the relatively stiff intermediate portion continuously and resiliently urges the outer marginal edge portion into contact with the inner surface of the shell such that the outer marginal edge portion of reduced thickness is deformed and conforms accurately to the inner contour of the shell, the outer marginal edge of the strip being sufficiently flexible to assume an arcuate configuration whereby the outer end portion of the intermediate portion of the strip is permitted to engage the inner surface of the shell simultaneously with engagement of the outer marginal edge of the strip to thereby positively ensure against the entrance of foreign matter into the tank past the strip, a plurality of radially extending reinforcing ribs formed integrally with said intermediate portion originating in spaced relationship to the juncture of the same and said inner annulus and terminating in spaced relationship to said outer marginal edge portion whereby the reinforcing ribs lend radial stiffness to said intermediate portion without interfering with the flexibility of the strip at the juncture between the intermediate portion and the inner annulus or the flexibility of the outer marginal edge portion and while at the same time leaving the strip free from interference by the ribs for circumferential flexing.

3. In combination with a liquid storage cylindrical tank having a confining shell and a floating roof supported by the liquid in the tank having a diameter less than that of the tank whereby an annular space is left between the periphery of the roof and the tank shell with said roof being adapted to rise and fall with the liquid level in the tank and also being of smaller diameter than the shell to move sometimes into eccentric position in the shell due to wind or other causes, flexible means carried by the roof at its periphery for sealing the space between the roof and the tank shell, and weather shielding means supported from the roof for protecting the annular sealing means from effects of weather which comprise a frusto-conical hollow shield of hard rubber having an inwardly extending horizontal flange section secured to the roof and merging into an upwardly and outwardly inclined section reinforced at the point of emergence with a strip of bendable plastic to form a toughened hinge area thereat, the upper edge of the upwardly and outwardly inclined section of hard rubber terminating in a narrower edge of soft rubber, and reinforcing inwardly extending vertical ribs on the upwardly inclined section, whereby as the roof rises and falls the

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upwardly inclined section bears stiffly against the tank shell and the soft upper edge thereof rubs thereagainst to clean it of contaminations, and as the roof assumes an eccentric position in the tank, the upwardly inclined section pivots about its hinge area normally to bear against the tank shell to persistently bridge the space between the roof and the tank shell.

4. In combination with a liquid storage tank having a confining shell and a floating roof disposed therewithin to rise and fall with the level of liquid within the tank, said roof providing an annular space therearound between the same and said shell and there being a flexible scuff band carried by the roof engaging and sealing against the inner surface of the shell, a protective strip secured to the upper region of said roof and including an inner substantially coplanar annulus fixed to the roof, an intermediate portion integrally joined with said annulus and of frusto-conical configuration extending angularly upwardly and outwardly therefrom toward the inner surface of said shell, the outer periphery of said intermediate portion terminating in closely spaced relationship to said inner surface of the shell, and an outer marginal edge portion integrally joined to said intermediate portion and extending therefrom into engagement with the inner surface of said shell, the normal dimensions of the protective strip being such that the outer marginal edge

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portion thereof presents a diameter greater than the inner diameter of said shell so that said outer marginal edge of the strip is forcefully deformed and sealingly engaged against the inner surface of said shell, said strip being formed of rubber with the outer marginal edge thereof being materially softer than the intermediate portion of said strip, said strip at the juncture between said annulus and the intermediate portion thereof being of reduced thickness to facilitate flexing in this region, and there being a strip of resilient hinge sheet material embedded within the material of the strip joining the annulus and immediately adjacent portions of the intermediate portion so as to pass through the region of reduced thickness, such sheet material being initially deformed to render a preformed shape to the strip.

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