July 3, 1945. J. D. MEIKLE 2,379,735

FLAME ARRESTER

Filed Oct. 9, 1941 4 Sheets-Sheet 1

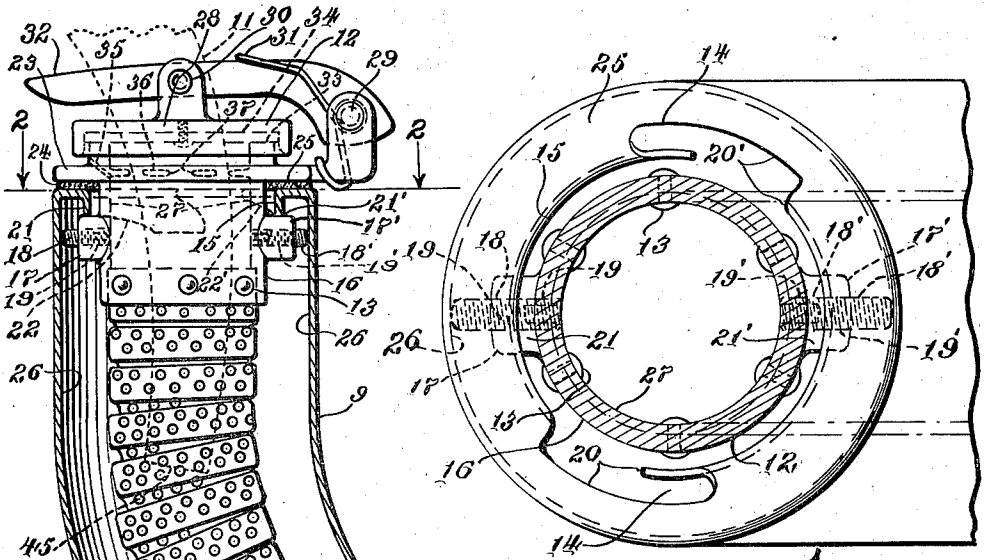


Fig. 2.

Fig. 1.

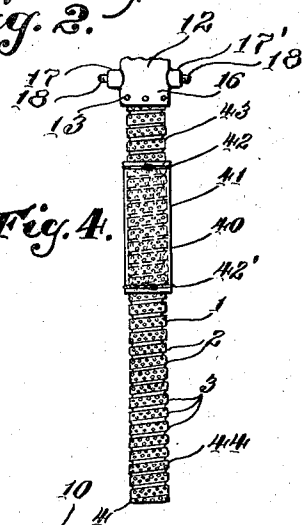


Fig. 4.

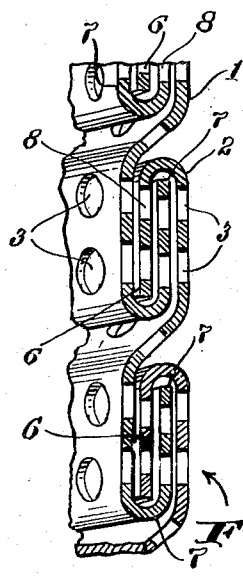


Fig. 3.

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FLAME ARRESTER

Filed Oct. 9, 1941 4 Sheets-Sheet 2

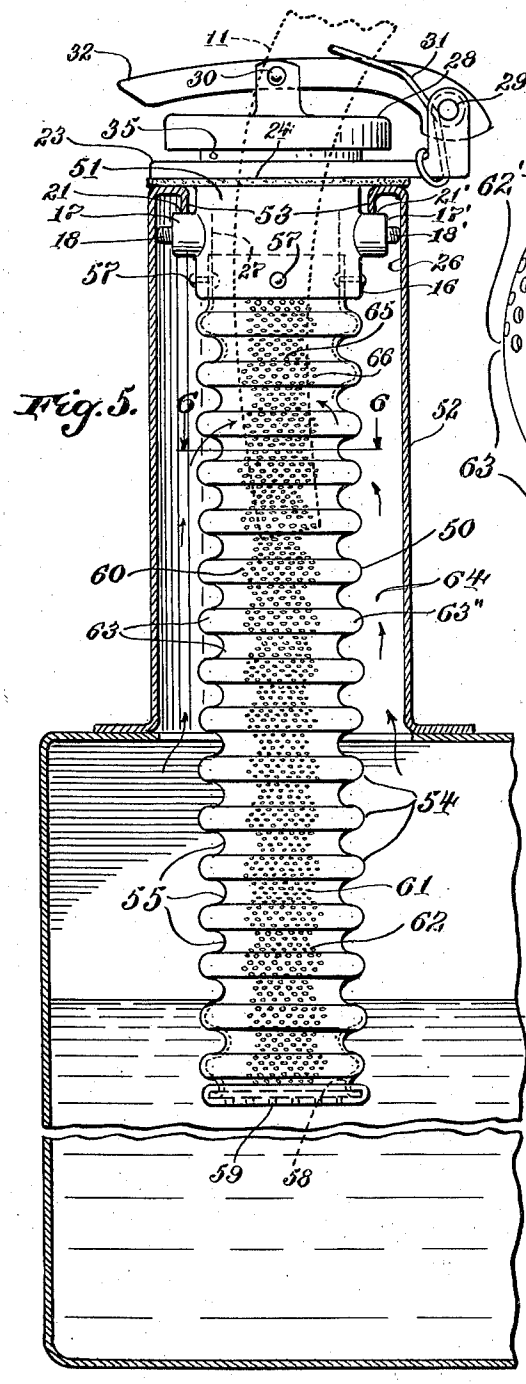


Fig. 5.

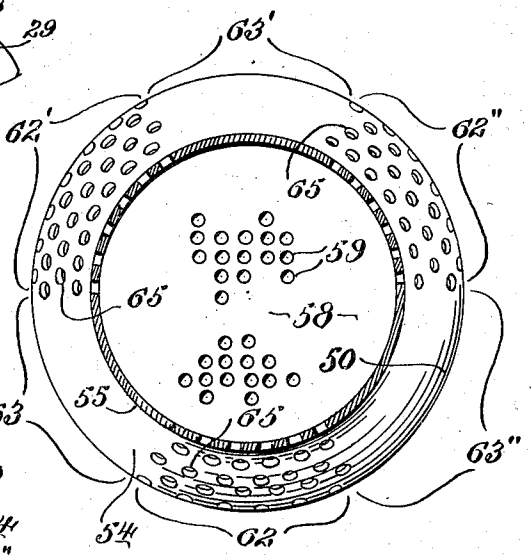


Fig. 6.

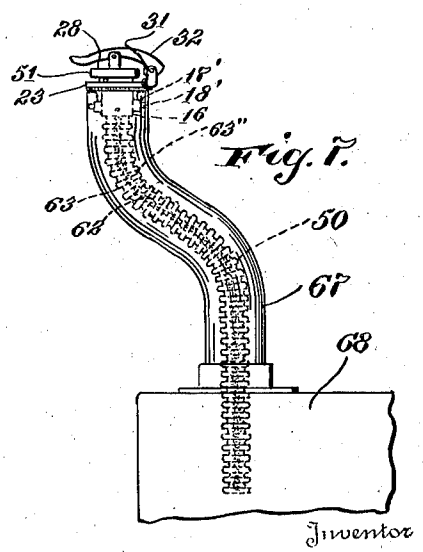


Fig. 7.

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FLAME ARRESTER

Filed Oct. 9, 1941 4 Sheets-Sheet 3

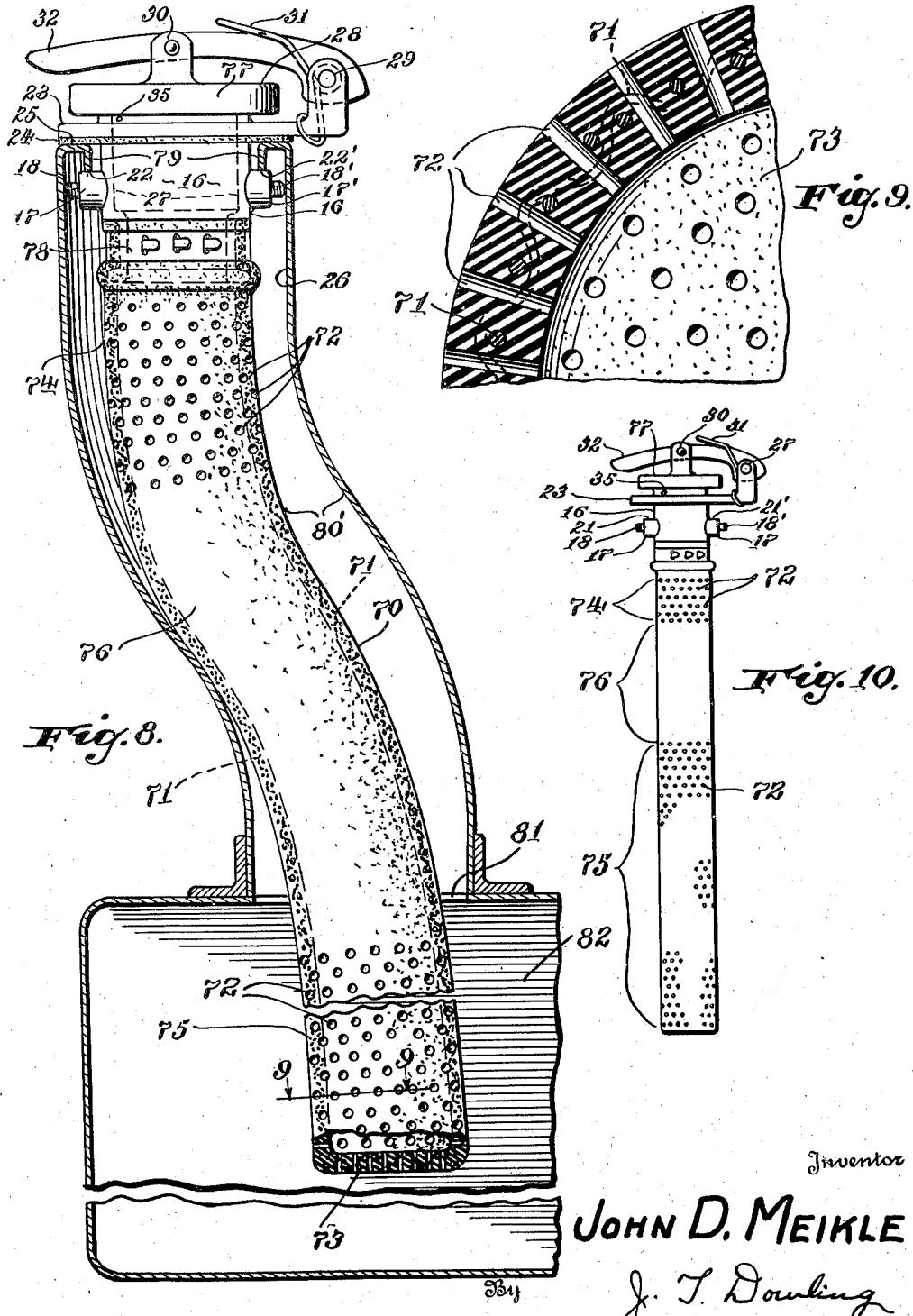


Fig. 8.

Fig. 9.

Fig. 10.

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FLAME ARRESTER

Filed Oct. 9, 1941 4 Sheets-Sheet 4

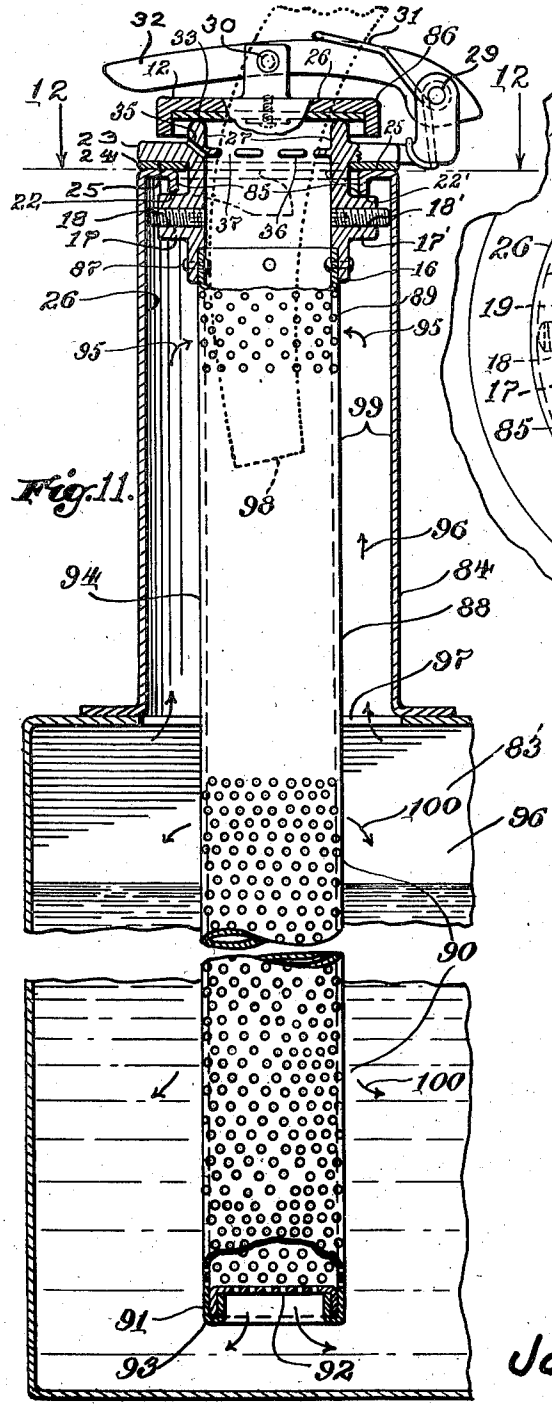


Fig. 11.

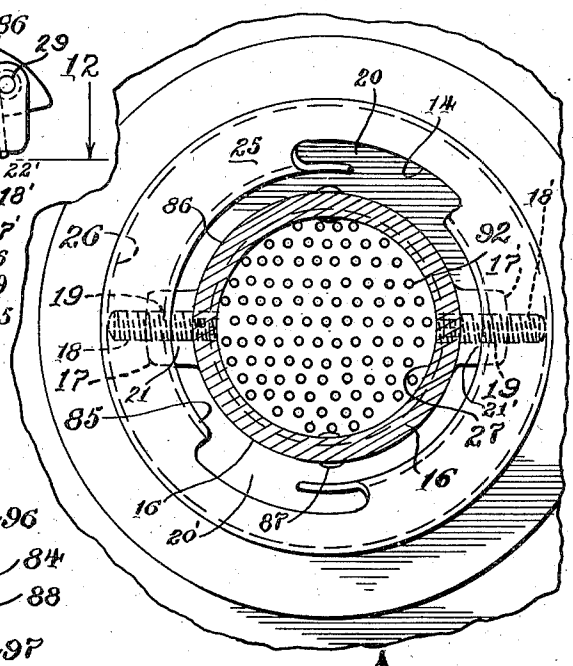


Fig. 12.

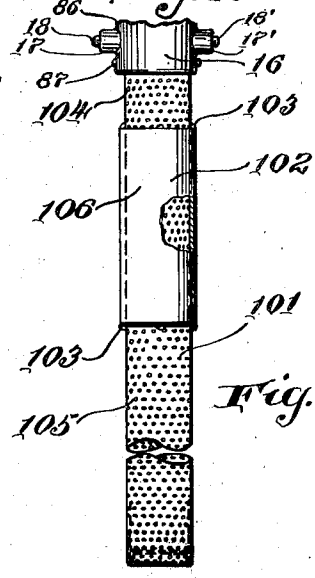


Fig. 13.

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2,379,735

UNITED STATES PATENT OFFICE

2,379,735

FLAME ARRESTER

John D. Meikle, Mount Lebanon, Pa.

Application October 9, 1941, Serial No. 414,308

2 Claims. (Cl. 220—88)

The present invention relates to improvements in safety devices or flame arrester attachments particularly applicable to gasoline tanks and specifically to flame arrester tubing atachments and the novel structural and functional characteristics of the tubing and the means for attaching the same to a tank filler nozzle, particularly of the type usually found in use with gasoline tanks.

For purposes of simplicity, the following descriptive matter and drawings will substantially refer only to the application of the present invention to automobile gasoline tanks and their well known construction, particularly as pertains to their respective filler pipes or tubes, and their respective means for attaching caps thereto. However, it is fully understood the present invention, its novel construction and functions, are not wholly limited to use and adaptation to the filler pipes of gasoline tanks, but may also be equally well adapted for use and attachment to the filler openings in various types of tanks found on boats, or for use with storage and portable vessels or cans, wherever highly volatile liquids having high explosive characteristics are kept in containers of various sorts.

Highly volatile liquids, such as gasoline, tend to constantly give off highly explosive vapors or gases, and these when mixed with a given amount of oxygen will readily ignite and explode in the presence of fire, high heat, or electric sparks of various types.

It is a well known principle if these highly explosive vapors or gases can be kept from freely intermingling with the necessary given quantity of oxygen, they can be prevented from exploding in the presence of fire and flame.

In this respect it is well known in the art that by positioning a piece of foraminous tubing having a closed bottom within the filler pipe of a gasoline tank, the danger of explosion of the gas vapors within the tank, when fire is introduced at the filler opening or even within the foraminous tubing, the gas vapors within the tank will not explode, although any wet gas or vapors within the foraminous tubing will ignite, burn off slowly, and the fire go out, within the foraminous tubing without causing the gases within the tank proper to explode.

The theory or explanation of this phenomena is that the numerous minute openings formed in the foraminous tubing restrict the flow of oxygen and gases between the tube and the tank chamber respectively, thereby preventing the proper proportionate intermingling of these elements for producing explosive characteristics in the presence of fire. Further, the foraminous tubing provides a confining wall and chamber for the fire, preventing the same from entering directly into the tank chamber proper. It would also seem the variation of pressures within the tank proper and that within the heated foraminous tubing would also play a part in preventing full intermingling of these elements.

In view of the present streamlining design of automobiles and the trend towards designing automobiles with concealed gasoline tanks, the manufacturers have been compelled to use gas tank filler piping having different bends, twists, and curved offsets, for purposes of conforming to the various structural elements of the automobile, whereby the filler opening will be exposed at a convenient point at the side of the car body.

In view of the above, it is the purpose of the present invention to provide means for introducing foraminous tubing within said variously bent, curved and shaped filler tubing, the same comprising in the present instance a flexible type of foraminous tubing structure, that is substantially self adaptable to the varying curvatures of gas tank filler piping.

Another important purpose of the present invention is to provide means, comprising a detachable closure for the filler pipe opening, having means for supporting the said foraminous tubing within the said filler pipe, whereby the same is substantially tamper proof against the withdrawal by unauthorized persons without special tools.

With the introduction of foraminous tubing within gas tank filler pipes it has been found during the filling operation of the tank, the foraminous tubing interferes with high pressure feeding of gasoline in the tank, due to the displaced air within the tank proper, in an effort to get out of the tank by way of the filler pipe and foraminous tubing, backing up the inflowing gasoline, whereby the same is caused to flow back out of the filler pipe opening, and overflow the outside of the tank. This, of course, is due to the restricted diameter of the filler pipe, foraminous tubing, and the usual filler nozzle inserted within the tubing during the filling operation.

In view of the above, it is the purpose of the present invention to provide means identified with said foraminous tubing, whereby this displaced air may pass out of the tank by way of the said piping and tubing and past the filler nozzle without substantially retarding the high speed or high pressure feeding of gasoline to a

tank equipped with a flame arrester foraminous tubing unit.

This is indeed an important feature in the fast filling of gas tanks identified with heavy service where gas tanks of unusually large capacity are used, such as those identified with heavy duty trucks, busses, boats, army tanks, transport planes, fighter planes, wherein filling speed is essential.

With these and other objects in view, the invention consists of certain other novel features of construction and combination of parts as will be specifically described in the following description and claims.

In the accompanying drawings, I have illustrated several forms of foraminous tubing structures embodying the various features of my invention in their preferred forms.

Figure 1 is a side elevation of my invention of a flexible type of foraminous tubing and filler closure head shown attached to and positioned within a curved offset type of gasoline tank filler pipe, the pipe and a fragmentary portion of a gasoline tank being shown in section.

Figure 2 is a sectional plan view, taken on the line 2—2 of Figure 1, looking in the direction of the arrows, illustrating particularly the manner of attaching the closure filler head to the bayonette type of slot structure of the filler pipe opening, the view being slightly enlarged in scale in proportion to Figure 1.

Figure 3 is an enlarged fragmentary sectional view, taken on the line 3—3 of Figure 1, looking in the direction of the arrows, illustrating the foraminous structure of the spirally wound flexible tubing and the manner of interlocking the spirals of the tube.

Figure 4 is a small fragmentary view of the flexible foraminous tubing and a portion of the attaching head structure, illustrating a yielding type of sleeve attached to the tubing for purposes of bypassing air.

Figure 5 is a modified form of flexible flame arrester tubing and its respective attaching closure head structure, the same being shown attached to a straight gasoline tank filler pipe, the latter being shown in section for illustrative purposes.

Figure 6 is an enlarged sectional view, taken on the line 6—6 of Figure 5, looking in the direction of the arrows.

Figure 7 is a fragmentary view on a reduced scale of a gasoline tank and a curved offset filler pipe therefor, illustrating my flexible type of foraminous tubing and filler head structure attached thereto, similar to that shown in Figure 5.

Figure 8 is a side elevation of a modified form of my invention of a foraminous tube and filler head structure therefor, disclosing its application to a curved type of offset gasoline tank filler pipe, in this instance the foraminous tubing being composed of a reinforced flexible composition.

Figure 9 is an enlarged sectional view, taken on the line 9—9 of Figure 8.

Figure 10 is a small detailed elevation of the flexible tubing and filler closure head, separated from the tank filler pipe, as shown in Figure 8.

Figure 11 is a fragmentary sectional elevation of a rigid type of foraminous tube, disclosing the details of the filler closure head, the tube member, tank and filler pipe as being partly broken away and partly in section for illustrative purposes.

Figure 12 is a fragmentary sectional plan view, taken on the line 12—12 of Figure 11, illustrating the manner of attaching the closure head for the foraminous tube to the tank filler pipe opening structure.

Figure 13 is a small fragmentary view of a foraminous tube, and its closure head structure, the upper portion of the head structure being broken away, illustrating a modified form of means for preventing the incoming flow of gasoline from interfering with the release of displaced air from a gasoline tank.

Referring to the drawings by reference numerals, each of which represents the same or similar parts throughout the various views, and with reference to Figures 1, 2, 3 and 4, the present invention comprises a flexible foraminous tube 1, comprising a spirally wound and interlocking metallic ribbon 2, having perforations 3, the lower end 4, being closed as indicated preferably by a perforated disc member 5 as indicated.

As shown particularly in Figure 3, the respective upper and inwardly bent or rolled portions 6 of the spiral ribbon 2 interengage as shown with the respective lower and oppositely or outwardly bent portions 7 of the respective spirals in their progressive turn. It will be noted substantially the whole of the spiral ribbon surface, including the bent or rolled interengaging portions 6 and 7 are perforated and foraminous in structure, thereby presenting a substantially continuous foraminous tubular structure, including the overlapping portion 8 of the spiral, comprising in the present instance four thicknesses of the metallic spiral ribbon 2. As may be readily seen, this type of structure provides a flexible spirally wound foraminous tubing ideally suited for the purpose in mind. The ready flexing of the tube 1 provides means whereby the tube is readily adaptable to various and divers curved, bent and offset filler pipes for gasoline tanks.

Figure 1 is a graphic illustration of any invention in this respect shown positioned within a curved offset filler pipe 9 of a fragmentary portion of a gasoline tank 10.

A gasoline dispensing or pump nozzle 11 is indicated in fine dotted lines, shown in normal operative position within the upper portion of the foraminous tubing 1. It may be seen that gasoline, entering the tubing 1 under ordinary filling pressures, may be readily dispensed within the tank through the perforations indicated at 3. In this respect it might be well to mention these openings 3 are shown slightly enlarged for illustrative purposes, and in actual practice slightly closer in proximity.

The upper portion of the tubing 1 may be attached to a supporting closure head structure 12, by rivets 13, or in any suitable manner, and the head 12 attached to the filler pipe opening 15 as shown.

It is the purpose of the present invention to provide a device of the present type that may be readily attached to the average or standard type of filler pipe opening, having a bayonette type of slotted structure 14 at the filler pipe opening 15, adapted to hold the usual type of filler pipe cap thereto.

In the practice of the present invention, the usual cap used for the filler opening is removed and discarded, then the present invention is inserted into the gas tank filler pipe 9, through the filler opening 15. The flexible foraminous tubing readily adapting itself to the curvature of the filler pipe 9. The lower portion 16 of the head structure, comprising radially, oppositely disposed and outwardly extending bosses 17 and 17', said

bosses each being provided with Allen type set screws 18 and 18', respectively, and threadedly engaged to the bosses at 19 and 19'.

When attaching the flame arrester to the filler opening, these Allen set screws are screwed inwardly, i. e., withdrawn for purposes of providing clearance whereby the bosses may clear the respective portions 20 and 20' of the bayonette slot structure of the filler opening 15. Upon the complete insertion of the lower portion 16 of the closure head within the filler opening as shown, the bosses 17 and 17' will be in a position whereby their respective upper surfaces 21 and 21' will engage the respective downwardly directed flange elements of the filler pipe opening 15 and their respective bending cam surfaces 22 and 22'. By turning the closure head in a clockwise manner, the said cam surfaces tend to draw the closure head member downwardly, whereby the concentric shoulder or extension 23, and its fiber washer member 24, are forced downwardly against the upper flat concentric surface 25 formed about the filler opening 15, as shown. After the closure head 12 is turned to a desired tightness of engagement with the bayonette slot, and filler pipe opening structure, the respective Allen set screws 18 and 18' are screwed outwardly until they each become impinged against the inner surface 26 of the filler pipe member 9, as shown in Figures 1 and 2. This is an important feature of the invention in that the closure head may be firmly and tightly engaged to the filler pipe and held in positive clamped fixed relation thereto by the function of the respective bosses and set screws.

An air vent 35 is provided in the closure head whereby the gasoline tank may be supplied with air for the purpose of preventing a vacuum in the tank during the withdrawal of gasoline therefrom.

The closure head is provided with a filler opening 27 and a yieldingly closed floating closure cap member 28, the same being held normally under constant pressure through the respective hinge and cap pivots 29 and 30, the hinge spring 31 and the cap supporting lever arm member 32, thereby providing the additional safety feature of a floating closure cap normally held in closed position under constant spring tension. Also, the cap 28 is loosely held to the lever member 32 by the pivot 30, thereby enabling the cap to "float" in its initial engagement with the upper exposed lip portion 33 of the opening 27, and to "adapt" itself and its washer member 34 to the lip 33 of the opening for proper sealing of the filler opening.

The cap, lever, and spring 31, also provide means whereby any backwash of gasoline in the tank that strikes the cap 34, due to unusual motions of the vehicle, may be prevented from being thrown or splashed from the tank due to the spring tension against the elements of the filler opening closure members.

For purposes of providing means for the free release of displaced tank air during the filling operation by way of the filler opening 27, a plurality of nozzle spacing elements 36, distributed about the filler opening 27, as shown, are provided. These spacing members prevent the gasoline dispensing nozzle 11 from completely blocking off the filler opening 27. The displaced air from the tank passes through the spaces 37 formed between the spacing elements or extensions 36.

Where speed is of the utmost importance in the filling of fuel tanks for aeroplanes, transport planes, busses, armored tanks, and heavy duty self-propelled vehicles, it is necessary to use a much higher pressure for delivery of the fuel from the dispensing nozzle into the fuel tanks. This forceful feeding of gasoline, has presented certain problems, as to the proper and proportionate release of displaced tank air as the tank is being filled and also particularly due to the small size of the filler pipes encountered on standard types of equipment. Under such forceful feeding the inrushing gasoline tends, as it leaves the dispensing nozzle, when positioned inside the filler pipe, to spread out, and thus cause the filler pipe to become more or less choked with gasoline, thereby constantly increasing the air pressure within the tank. This air pressure is soon built up to a point that is sufficient to cause the incoming gasoline choking the filler pipe to be blown back against the pressure and force of the incoming gasoline, thereby causing geyers of gasoline to be forced from the filler opening. This is both dangerous as a fire hazard, unsafe for the operator, and a waste. It also tends to slow up the time for filling the tank.

It is the purpose of the present invention to provide a foraminous filler tube of the class herein described, having means whereby comparatively high pressures may be used in feeding gasoline into a tank provided with the present invention whereby the displaced tank air may readily be released from the filler opening sufficiently to prevent the building up of air pressure in the tank during the filling operation and thereby preventing the backing up and geysering of the gasoline from the filler pipe opening.

To this end the present invention has a portion of its foraminous tubing blanked out, with particular reference to Figure 4, as shown at 40. In the present instance, this blanking out is accomplished by the application of a boot or sleeve member 41, which may be composed of canvas, a rubber impregnated fabric, or in some instances, where flexibility for the entire length of the tubing is not of paramount importance, a light metallic sleeve may be fixed to the tubing by any suitable means such as by soldering or riveting.

In the present instance the flexible sleeve 41 is indicated as being held in place by tightly wound and twisted copper wire at 42 and 42', respectively, at the opposite ends of the sleeve member.

As may be readily noted, the sleeve 41 is so intermediately positioned in respect to the foraminous tubing structure as to leave a small portion 43 of the foraminous tubing exposed at the top, i. e., between the upper end of the sleeve 41 and the lower portion 16 of the closure head. A comparatively larger portion of the foraminous tubing is exposed at 44, below the bottom end of the sleeve 41.

Thus when this form of the invention is positioned in the gas tank filler pipe 9, the open end of the gasoline nozzle, as indicated in fine dotted lines at 45, will be in juxtaposition to the area of the foraminous flexible tube covered by the boot or sleeve member 41. Thereby providing means whereby the emission of gasoline from the filler nozzle 45 will take place in the zone covered by the sleeve member, presenting a blanked out concentric area between the inner wall of the tank pipe 9 and the sleeve member. Thus this portion of the tank piping is kept free of gasoline entering the flexible tube member direct by way of the nozzle. It has been found that by blanking off only a portion of the foraminous

tubing in the manner shown, is sufficient to allow free passage of displaced tank air, during the filling operation, to the outside atmosphere by way of the concentric passage, referred to above, and thence entering the foraminous tubing by way of the perforations at the exposed portion of the tubing at 43, passing the filler nozzle 45 and finally to the atmosphere through the opening 27 of the closure head.

This releasing of displaced tank air will be further discussed hereinafter, as to modified forms of the invention, the function and broad principle being substantially the same in each instance.

It should be understood the flexible type of foraminous tubing, as shown particularly in Figure 1, may be blanked out as to that portion of its spirally wound ribbon structure, whereby the blank or non-foraminous portion of the tubing would appear at the same relative position as the covered portion of the tubing as shown in Figure 4, without the necessity of using a separate boot or sleeve member.

Figures 5, 6 and 7 show a slightly modified form of comparative or semi-flexible foraminous seamless tubing 50. It is understood butt welded tubing may also be used.

The closure head and tube supporting structure 51 is similar to that shown in Figure 1 and hereinbefore described, and also the manner and means for engaging the same to the filler pipe 52 and its respective opening 53.

In the present instance the foraminous tubing 50 is corrugated or accordion shaped, comprising large and small concentric portions 54 and 55, respectively, as shown. The upper portion 56 of the tubing being fixedly engaged to the closure head 51 by rivets 57, as shown, and the bottom opening 58 is closed by a perforated closure cap member 59, and fixed thereto by brazing or rolling the flanged concentric edges together as shown in Figure 5.

It will be noted the foraminous portion 60 is not distributed over the whole surface of the tubing 50 as is the case with the flexible tubing shown in Figure 1. In the present instance, the tubing 50 is provided with a slightly modified form of placement of the holes or perforations 61 comprising the foraminous portions of the tube. As shown in Figures 5 and 6, the tube is provided with three separate foraminous columns or elongated areas 62, 62' and 62'', running substantially parallel with the tube axis but following the general contour of the large and small concentric elements 54 and 55, respectively. This foraminous construction provides a greater number of holes for a given area in proportion to a straight smooth walled tube, i. e., if the tube 50 was straightened out the foraminous columns 62, 62' and 62'' would be much longer than they appear in the contracted tubular structure 50. Thus the lengthwise restricted foraminous portions of the tube are substantially compensated for. Between each foraminous column 62, 62' and 62'', are substantially equally sized elongated bank portions 63, 63' and 63''. Thus providing means in a flame arrester of this type, whereby the inflowing gasoline is emitted from the tube in a somewhat restricted manner from the foraminous columns 62, 62' and 62'', and the displaced tank air is substantially free to move to the atmosphere via the portions of the concentric passage 64 free of incoming gasoline, through the perforations 65 at the upper portion 66 of the intermittently spaced foraminous portions of the tube 50.

For purposes of varying the coefficient of flexibility of the tube 50, the large and small concentric bellows portions 54 and 55, respectively, may be decreased or increased in size as to thickness, thereby increasing or decreasing, respectively, the number of these tube portions for a given length.

Figure 7 illustrates the application of the semi-flexible foraminous tubing and closure head 50 and 51, respectively, to an offset or gooseneck type of bent filler pipe 67, and tank portion 68.

Figures 8, 9 and 10 illustrate another modified form of my invention, in that the foraminous tube member 70 is composed of a reinforced flexible material, having a reinforce of woven wire, as indicated at 71. In this instance, the holes 72, forming the foraminous portion of the tube member are positioned between the interstices of the woven wire reinforce. This particular form of the invention may be molded into an integral structure having an integral foraminous bottom structure 73, upper and lower foraminous portions 74 and 75, respectively, and a non-foraminous or closed wall portion 76, positioned between the said upper and lower portions.

The upper open end of the flexible foraminous tube 70 may be suitably fixed to the lower portion 16 of the closure head member 77 by a conventional clamp strap 78, as shown. The details of the closure member 77, both as to structure, function and application, are similar to those shown and described as to Figure 1.

Also the function, operation and inherent advantages of the closure head 77 and tube 70 are similar to those described and identified with Figures 1, 2, 4, 5 and 6, as to the flame arrester function, the means for filling a gas tank by high pressure injection, and the ready release of displaced tank air.

Referring to Figure 8, the blank or non-foraminous tube portion 76, as well as the upper and lower foraminous portions 74 and 75, respectively, may be raised both as to their individual lengths and relative proportional position to the opening 79 of the tank filler pipe 80 and the opening 81 of the tank member 82. Thus providing means in this respect, adaptable to varying conditions and desired results. This principle is adaptable to the forms of the invention shown and described herein.

With particular reference to lower foraminous section 75 of the flame arrester tube 70, it will be noted the holes 72 of this section begin at a point below the tank opening 81 and that the blank portion 76 of the flame arrester tube as to its lower end, is positioned within the tank chamber, thus providing specific means to prevent gasoline from being fed into the substantially concentric air passage 80' within the tank filler pipe 80, by way of the lower foraminous section 75. The displaced tank air is entirely free to reach the atmosphere by way of the passage 80', foraminous section 74 and open closure head member 77, which of course is always normally open during the tank filling operation.

Referring to Figures 11 and 12, the invention in this instance is shown in operative position and engagement with a gasoline tank 83, and its respective and attached filler pipe 84, the same having a bayonette slot type of opening structure 85, similar to those shown and described in the preceding figures of the drawings in this respect.

In the present instance the invention comprises

a closure head member 86, detachably engaged to the said filler pipe opening structure 85, in the manner as hereinbefore described for this portion of the invention, as shown in Figure 1.

Suitably attached, by rivets 87, to the lower portion 16 of the closure head, is a flame arrester tube 88, comprising upper and lower foraminous end portions 89 and 90, respectively. The bottom opening 91, of the lower portion of the tube is provided with a sunken foraminous closure member 92, the same being held in fixed relation to the tube by the inwardly disposed rolled edge of the tube, as indicated at 93, in Figure 11.

Between the upper and lower foraminous tube sections 89 and 90, respectively, is a closed wall or non-foraminous tube section 94 as shown. The upper foraminous tube section 89 providing means for the free passage of displaced tank air, during the filling of the tank, as indicated by the arrows 95. It will be noted, the lower foraminous tube section 90 is positioned wholly within the gasoline storage chamber 96 of the tank 83, and spaced below the restricted tank opening 97. Thus it may be readily seen, during the filling operation, gasoline entering the flame arrester tube 88 at the non-foraminous section 94, via the gasoline dispensing nozzle 98 will not be emitted into the concentric air passage 99 between the tube 88 and the tank pipe 84, but will leave the flame arrester tube by way of the lower foraminous tube section 90 at a point inside the tank chamber 96 and below the opening 97 of the tank, as indicated by arrows 100. Thereby keeping this opening free of incoming gasoline and permitting the displaced tank air to move in an unobstructed manner via the opening 97, concentric air passage 99, upper foraminous section 89, closure head opening 27 and thence to the outside atmosphere.

This relative location of the respective tube sections 89, 90 and 94, thus provides means whereby the feeding of gasoline into the conventional type of storage tank, through its respective filler pipe may be done at comparatively high speeds and pressures.

Figure 13 discloses a flame arrester tube 101 with a fragmentary portion of the lower part 16 of the closure head shown attached thereto. In this instance the whole surface of the tube is foraminous.

Where the sheet metal used to make the flame arrester tube shown at 101 is perforated for its entire area, thereby making the tube 101 entirely foraminous in this respect, the tube may be readily provided with means for blanking off a portion of the foraminous area of the tube by fixedly engaging a metallic sleeve 102 over that portion of the tube desired to be covered, by spot soldering or the like, as indicated at 103. Thus upper and lower foraminous tube sections 104 and 105, respectively, are provided, as well as a blanked or non-foraminous tube section 106 is provided.

This structure has all the functional advantages, as referred to hereinbefore, with respect to the features of the invention disclosed in Figure 11.

Numerous tests have been made as to the broad principles of design as herein disclosed, and found to be entirely satisfactory, both as to high speed filling and the safety factor of the flame arrester feature. In respect to the tests relating to the latter feature, the closure head cover would be opened and the gasoline vapors ignited with a match, with gasoline in the tank, the vapors igniting immediately, with a blue and partially yellow flame. Upon the vapors being burned out the flames would go out and the gasoline within the tank would be unaffected, and immune from the vapor flames and resultant heat.

I have thus described my invention specifically and in detail in order that its nature, operation and construction may be fully understood; however the specific terms herein are used descriptively rather than in their limiting sense, and the scope of the invention is defined in the claims.

What I claim as new and desire to secure by Letters Patent is:

1. The combination with a liquid fuel storage tank and its respective filler pipe attached thereto, of a flame arrester attachment, comprising a closure head and a flexible tubular member attached at one end to said closure head and covered at its opposite end, means for fixedly engaging said closure head to said tank filler pipe, said tubular member comprising a spirally wound interlocking foraminous ribbon structure, providing means for adapting said tubular member to divers curved and bent tank filler pipes, and also means for restricting the free intermingling and flow of outside oxygen and the explosive gaseous vapors thrown off from liquid fuel within said tank, said flexible tubular member comprising separate foraminous sections, and means for preventing the flow of said liquid introduced into said tubular member at another sectional portion of said tube, said means comprising an adjustable sleeve or cover element attached to the flexible tube member, whereby a predetermined portion of the foraminous area of the said tubular member may be selected to be blocked off and rendered ineffective as to the emitting of said liquid fuel from this covered area.

2. The combination with a liquid fuel storage tank and its respective filler pipe, of a flame arrester, comprising a closure head and a flexible corrugated tubular member attached at one end to said closure head and covered at its opposite end, means for fixedly engaging said closure head to said tank filler pipe, said tubular member comprising alternate parallel ridges and grooves, and also separate isolated foraminous areas, having means for adapting said tubular member to divers curves and bent tank filler pipes and for restricting the free intermingling and flow of outside oxygen and the explosive gaseous vapors thrown off from liquid fuel within said tank, said foraminous areas being separated by non-foraminous areas, said latter areas providing means for substantially unrestricted escape of displaced tank vapors during the filling of the tank through said tubular member.

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