R. D. SMITH.

HUMIDIFIER APPARATUS.

APPLICATION FILED JULY 29, 1918.

1,305,944.

Patented June 3, 1919.

Fig. 1

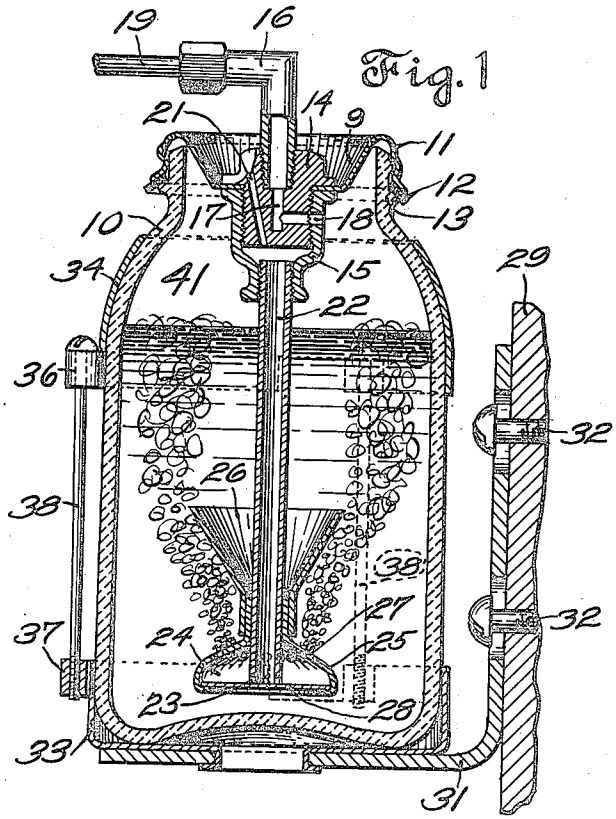


Fig. 2

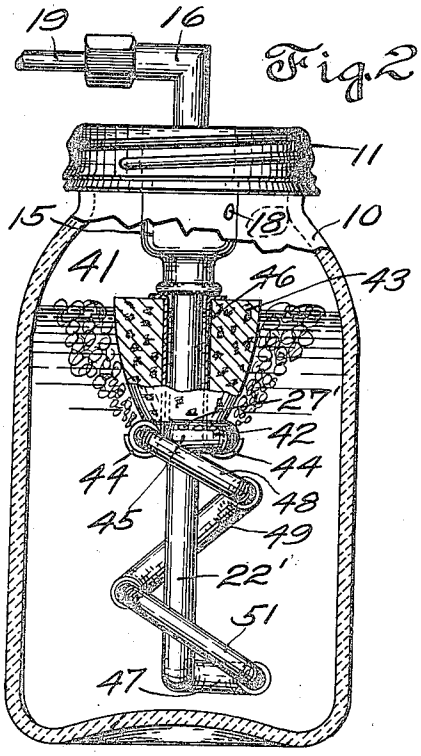


Fig. 3

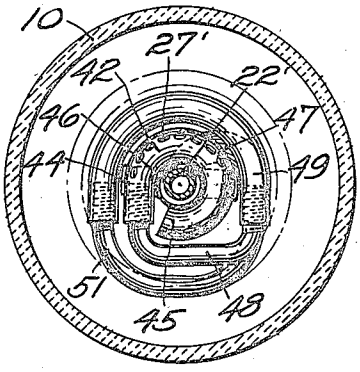


Fig. 4

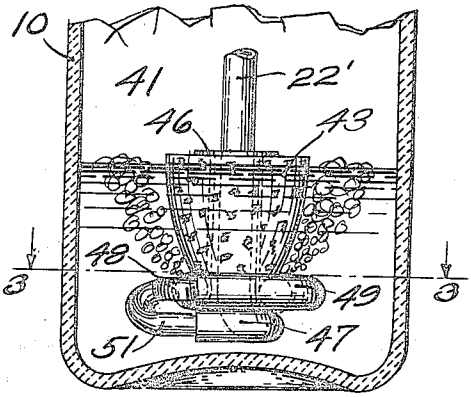
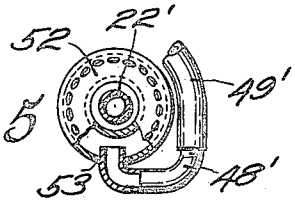


Fig. 5



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UNITED STATES PATENT OFFICE.

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HUMIDIFIER APPARATUS.

1,305,944. Specification of Letters Patent. Patented June 3, 1919.

Application filed July 29, 1918. Serial No. 247,211.

To all whom it may concern:

Be it known that I, RAYMOND D. SMITH, a citizen of the United States, residing at Arlington, in the county of Middlesex and Commonwealth of Massachusetts, have invented certain new and useful Improvements in Humidifier Apparatus, of which the following is a specification.

My invention relates, in general, to an improved apparatus for leading a gas to a point below the surface of a body of liquid and thereat liberating or spraying such gas into the liquid so that it may rise in small bubbles therethrough. My present improvement is of particular use in a type of bubbling humidifier which for certain purposes may embody a closed and operatively air-tight liquid container or tank having an air outlet connected above the designed level of the contained liquid, and provided with means in the form of a separate air inlet duct arranged to receive air at a point above said level,—said duct then terminating at an orifice below said level;—whereby, upon application of a suction force to said outlet, or of a pressure force to said inlet, air is indrawn through said duct, is released under the surface of and rises through the liquid, and is taken out and discharged through said outlet in a humified condition and for any desired use. In such apparatus, the submerged orifice for releasing the air under water is generally and preferably upwardly directive and as such is preferably, but not necessarily, arranged as a rose or sprayer, in order more effectively to humidify the air by causing it to rise in many small and separate bubbles through the water.

One object of my present improvement is to provide such type of apparatus in a form of extreme simplicity and of resulting low cost of manufacture and maintenance, while at the same time in a form providing desired durability in operation and affording maximum convenience and efficiency in operation.

To this end I may advantageously employ as the liquid container above mentioned (which in practice is rigidly held and supported) a simple vessel made of vitreous material, and, if desired, of transparent glass to render visible the interior of the humidifier; but it will be understood that my invention is by no means restricted to the use of a container of this nature.

It is an object of the present improvement to provide, as a closing or sealing member for the container, a cover or cap which, with certain fixedly mounted parts carried thereby, constitutes in a single assembled structure means to introduce air below the surface of the contained liquid; a suction outlet adapted for piping connection with, say, the intake passage of an automobile engine; and also a means to facilitate pouring of water into the container without removing the cover therefrom.

A further object of my invention is to provide such a closing and sealing cap, especially in combination with a fixedly held vitreous container, so formed relative thereto and mounted thereon that said cap, while carrying and supporting piping connections for the inlet orifice, has (to as great an extent as is practicable) a resilient, diaphragmatic disposition across the cap sealed opening in the container; the relatively yielding nature of which effectively protects the container against fracture resulting from piping or other strains imposed during installation, or in operation, upon the cap.

A further and important object of my invention is to provide in such apparatus, whether so organized or of radically different form, simple and efficient means whereby the air rose, or other form of sprayer employed, will be automatically maintained at substantially a constant depth of submergence below the surface of the water thereby to subject the air taken through the apparatus to passage through substantially a constant height of liquid irrespective of the varying total depth of the liquid in the container.

These and other objects and features of my invention will be made clear by the following description and claims in conjunction with the annexed drawings, in which latter:

Figure 1 is a view taken in central vertical section through a simple form of my improved humidifier and also shows a suitable construction for mounting the same.

Fig. 2 is a similar sectional view of a modified form of the humidifier wherein the submerged air sprayer is vertically movable and buoyed by a float.

Fig. 3 is a section taken on the horizontal plane 3—3 in Fig. 4.

Fig. 4 is a view looking at the right of Fig. 2 but showing the sprayer, together

with its jointed, air-supplying conduit in lowest or collapsed position.

Fig. 5 is a fragmentary view showing a different form of swiveled connection between the sprayer and its movable delivery conduit.

Each reference numeral, when appearing in more than one figure of the drawing, designates the same or corresponding views of the same element.

In Fig. 1, I have shown, as the liquid container employed, merely a glass jar 10 of common form,—this type of jar being universally obtainable on the market in substantially standard size and proportion; and thereby readily replaceable in case of breakage.

I have shown this jar 10 as sealed at the top by means of threaded metallic cap 11 which cap when screwed down to place clamps a rubber washer 12 between its outer edge and a circumferential ledge 13 about the neck of jar 10; and thus insures an air-tight seal in a simple and approved manner. As shown in Fig. 1, the cap 11 is entirely clear of contact with the jar 10 at all points between its center portion and its threaded portion and thereby provides a resiliency protecting the jar 10 from breakage through strain applied to the central portion of cap 11.

The cap 11 has a central cup-formation 9 which at the bottom is securely clamped between the hexagonally headed screw plug 14, protruding downwardly therethrough, and a reducing nipple 15 screwed upwardly onto said plug as a nut beneath the cap 11. The assemblage of plug 14, nipple 15 and the cap 11 greatly reinforces the latter which, in itself, is simply a light, sheet metal structure but in use of the humidifier must be subjected to more or less strain by piping connection thereto.

The plug 14 receives a connector elbow 16 centrally in its hexagonal head, said elbow thus communicating with a blind vertical hole 17 in the plug 14 and thence through a laterally drilled hole 18 with the interior of jar 10, so that an elbow-connected tube such as 19 running, say, to the intake passage of an automobile engine (not shown) may establish communication between such intake passage and the top interior of the jar.

Also drilled in the plug 14 is a separate and through port 21, which opens outwardly at a low point within the inclosure of the cup-formation in cap 11 and which, therefore, is served by said cup-formation as a funnel to facilitate pouring of water into the jar 10 through the duct 21.

Extending downwardly from the lower and smaller end of the nipple 15 is a vertical pipe 22 closed except at the lower extremity thereof, whereat openings 23 establish communication between the interior of pipe 22 and an outer sprayer or rose chamber 24 that is inclosed by the punched metal part or rose 25. The rose 25 is supported on the pipe 22, which also carries thereabove an inverted conical spreader 26 for further separating the air issuing upwardly through the air outlets 27 in the rose as such air rises in bubbles through the water. The bottoms of both rose 25 and pipe 22 are closed by a flat disk 28 that may be spun into the piece 25.

Exterior of the jar 10 suitable parts are shown for mounting the humidifier securely on the dash-board 29 or other appropriate part of an automobile. The parts comprise a shelf-bracket 31 fastened adjustably to the dash by screws 32 and carrying horizontally the cup base 33 fixed thereto to receive the jar 10.

For holding the jar 10 within this cup base 33 any suitable means may be employed, those which I have shown comprising a sheet-metal collar or band 34 conforming to the shoulder portion of jar 10. The collar 34 may have struck outwardly from the lower edge thereof three or more lug ears such as that shown at 36 which may register with corresponding lug ears 37 formed in a similar manner from the cup base 33,—each of the latter ears being threaded to receive an upright tie-bolt 38 so that the jar 10 may be securely drawn down by such bolts against the base 33 and yet readily removable therefrom.

The operation of this simple form of my humidifier is as follows:

Suction created by the movement of the intake charge to the cylinders of the automobile engine (not shown) creates through the tube 19 a partial vacuum in the space 41 above the water in jar 10. This partial vacuum will suffice to draw air through the port 21, down the pipe 22, through the openings 23 at the bottom thereof, into the rose chamber 24, whence it will be liberated through the rose openings 27 and thus caused to bubble upwardly to the surface of the water. Upon reaching the space 41 above the water level, the now humidified air is drawn through the ports 18 and 17, through the elbow 16, and tube 19 to supplement the intake charge of the explosive engine with humidified air. Escape of the air from the channels of movement just outlined is effectively prevented by the employment of simple threaded connections which in practice have been shown to constitute a satisfactorily tight seal.

The simple form of my device shown in Fig. 1 is, however, open to the objection that greatly varying rates of water consumption are effected, with a given suction applied at tube 19, when the tank is full of water and when the tank is nearly

emptied. The cause of this, obviously, is that a given amount of air bubbling through a comparatively great depth of water absorbs more moisture and thereby consumes more water than the same amount of air bubbling through comparatively shallow water. As the type of container I herein employ is so shaped and proportioned as to have a content of small horizontal cross section as compared with its height it will be appreciated that the objection above mentioned becomes magnified.

To remedy this condition and to produce, as well as may be done, a constant rate of water consumption irrespective of the water level in the jar, I have devised the simple means of a float-buoyed sprayer shown in Figs. 2, 3 and 4. In the modified form of my invention shown in the latter figures all parts may be supposed similar to those pictured in Fig. 1 with the exception of the pipe 22′ and the air conducting and delivery elements carried thereby. These elements in Figs. 2, 3 and 4 comprise a tubular linkage system connected at one end to the curved lower terminal 47 of pipe 22′, and at the other end with the vertically movable sprayer 42. This sprayer as shown in Fig. 3, is merely a circularly bent tube provided, circumferentially, with ports 27′ encircling the pipe 22′ and plugged airtight at its blind end 45. As plainly shown in Fig. 2, the sprayer 42 is connected to the superposed float 43 by hook formations 44 extended from a metallic lining sleeve 46 for the float 43, said sleeve being of such diameter as enables the combined float and sprayer structures to be loosely slidable upwardly and downwardly on the pipe 22′ as a guide.

Following the movements of sprayer 42 and forming an extensible conduit for connecting the same with the lower terminal 47 of pipe 22′ is a jointed tubular linkage system comprising upper, intermediate and lower curved tubes 48, 49 and 51, respectively, which are loosely threaded into one another, end to end, and also into the sprayer 42 and end 47 of pipe 22′. The relation of curvatures in this construction, as clearly shown in Fig. 3, is such that sprayer 42 may nestle down to be surrounded by tubular links 48 and 49, so that in the collapsed position of parts shown in Fig. 4, the air outlet ports 27′ may occupy the lowest possible position in the jar 10. The dot-dash circles in Fig. 3 indicate the compass of the neck of jar 10 as viewed in plan, and from this figure it is clear that the entire jointed conduit is so compact in collapsed position as to be readily removable through such neck. I have found that a threaded swivel connection, such as that between the tubular links 48, 49 and 51, may be very loose and yet constitute a sufficiently air-tight seal to prevent escape of the conduit-guided air while the water seal afforded by the complete submergence of all these parts, as shown, adds still further to the air-tightness of such a jointed conduit.

Relief is thus had from requirement for nicety of mechanical construction at the threaded swiveled joints between the tubular links and such joints may be made sufficiently loose to give as free motion as desired for the relative swinging movement of the links.

It will be understood that when that form of my invention shown in Figs. 2, 3 and 4 is not in use,—that is, when no suction head is created in the space 41,—then the liquid in the container rises to an equal height in the air entrance duct and linked-pipe system 45, 48, 49, 51, 47 and 22′. When, however, the suction head is created in the space 41,— as by connecting the suction outlet 16, 19 to the intake of an explosive engine,—then the small cross section of the air entrance duct and linked-pipe system is such that that suction head sucks or withdraws the water, so that air enters through the entrance ports 21 and reaches the vertically movable sprayer or rose 42, being there released to rise through the liquid. Since the sprayer or rose 42 is floated at its substantially constant depth of immersion, it follows that in operation the air sucked into the device is released at the sprayer or rose to rise through substantially its constant depth of the water.

A rubber or other flexible hose could, of course, be used in place of the jointed conduit 48, 49 and 51 and similarly coiled about the pipe 22′ but the cheapness of production of rigid tubular sections loosely interthreaded as shown renders the latter generally preferable.

Also I do not consider it essential even with rigid tubular links, that threaded swivel joints be employed, or that a sprayer in the exact form shown in Figs. 2, 3 and 4 be utilized therewith. For instance, I may use a sprayer formed as an annularly complete tube having a lateral opening 53 through which the sprayer connecting link 48′ may merely project for loosely engaging with the sprayer 42 pivotally, both to follow the movements thereof and to deliver air thereto.

It will be understood that the novel principles of construction and arrangement represented in the float-buoyed sprayer and connecting swivel-jointed air conduit, shown in Figs. 2, 3 and 4, are in no way necessarily dependent for their function or use upon incorporation within a humidifier of such simple and improved construction as is herein disclosed, this form of humidifier being chosen merely to illustrate an advantageous application of such principles. Thus the

pipe 22′ and its carried, float-actuated parts may be rigidly supported in any sort of liquid container and assembled, if desired, upon any sort of closure or cover therefor, preferably to be removable with such cover from the container.

Many other and equivalent arrangements of a jointed air conduit composed of rigid tubular links, as herein illustrated, will suggest themselves to those skilled in the art and all such equivalent forms and modifications of structure are intended to be covered in the following definitions of my invention.

What I claim is:

1. In humidifier apparatus, in combination, a container for a body of liquid, a float buoyed but submerged air sprayer with means extending into the liquid to guide the rising and falling movements of the air sprayer while submerged and as caused by the alterations in the depth of said liquid, and a mobile air conduit connected at one end with a stationary source of air supply and at the other end with said sprayer at a point submerged in said body liquid and adapted thereby to follow the vertically guided movements of said float buoyed sprayer while delivering air thereto.

2. In humidifier apparatus, in combination; a container for a body of liquid; a float-buoyed but submerged air sprayer with means to guide the rising and falling movements thereof while submerged and as caused by alterations in the depth of said liquid; and a mobile air conduit connecting at one end with a stationary source of air supply and at the other end with said sprayer at a point submerged in said body liquid and adapted thereby to follow the vertically guided movements of said float-buoyed sprayer while delivering air thereto.

3. In humidifier apparatus, in combination; a container for a body of liquid; a float-buoyed air sprayer submerged in said body of liquid and constrained to rise and fall while submerged and in a vertical path with changes in depth thereof; and a mobile conduit for supplying air to said submerged sprayer; said conduit being connected to said sprayer so as freely to follow the submerged movements thereof and disposed beneath the same as a coil surrounding the vertical line of movement of said sprayer, whereby said conduit is adapted to collapse compactly to accommodate movement of said sprayer to its lowest position.

4. In humidifier apparatus, in combination; a container for a body of liquid; a float-buoyed but submerged air sprayer; a vertically disposed rigid pipe supported to extend both above and below the operative levels of said body of liquid and arranged as guide means to constrain the rising and falling movements of said sprayer; and a mobile air conduit connecting at one end with the submerged end of said pipe and at the other end with said sprayer, whereby air is conducted from said pipe to said sprayer in different vertical positions of the latter.

5. In humidifier apparatus, in combination; a container for a body of liquid; a float-buoyed but submerged air sprayer; a vertically disposed rigid pipe supported to extend both above and below the operative levels of said body of liquid and arranged as guide means to constrain the rising and falling movements of said sprayer; and a mobile air conduit connecting at one end with the submerged end of said pipe, disposed thereabove in a coil about said pipe and connecting at the other end with said sprayer, whereby air is conducted from said pipe to said sprayer in different vertical positions of the latter.

6. In humidifier apparatus, in combination; a container for a body of liquid; a float-buoyed but submerged air sprayer; a vertically disposed rigid pipe supported to extend both above and below the operative levels of said body of liquid and arranged as guide means to constrain the rising and falling movements of said sprayer; and a swivel-jointed conduit composed of a system of relatively movable tubular sections;—the tubular section at one end of said system connecting with said sprayer and the tubular section at the other end connecting with said pipe, whereby air is conducted from said pipe to said sprayer in different vertical positions of the latter.

7. In humidifier apparatus, in combination; a container for a body of liquid; a float-buoyed air sprayer submerged in said body of liquid; a vertically disposed rigid pipe supported to extend both above and below the operative surface levels of said liquid, said pipe being arranged as guide means to constrain the rising and falling movements of said sprayer; and a swivel-jointed conduit composed of a system of tubular links in threaded engagement at the ends thereof and arranged to be relatively swingable about axes parallel to one another and to the liquid level, the end links of said system connecting respectively with said pipe for conducting air from the latter to the former.

8. In humidifier apparatus, in combination; a container for a body of liquid; a float-buoyed air sprayer submerged in said body of liquid; a vertically disposed rigid pipe supported to extend both above and below the operative surface levels of said liquid, said pipe being arranged as guide means to constrain the rising and falling movements of said sprayer; and a swivel-jointed conduit composed of a system of curved tubular links progressively forming

a coil around said pipe and arranged to be relatively swingable about axes parallel to one another and to the surface level of the liquid, the end links of said system connecting respectively with said sprayer and with said pipe for conducting air from the latter to the former.

9. In humidifier apparatus, in combination; a container for a body of liquid; a float-buoyed air sprayer submerged in said liquid and forming an annularly disposed inclosure having a circular series of perforations in a circumferential wall thereof; a vertically disposed rigid pipe supported to extend both above and below the operative surface levels of said liquid, and passing centrally through said air sprayer, so that the annular inclosure comprising the same surrounds said pipe to guide the rising and falling movements of said sprayer; and a swivel-jointed conduit composed of a system of tubular links relatively swingable in end-to-end engagement and about axes parallel to one another and to the surface level of said liquid; the end links of said system connecting respectively with said sprayer and with said pipe for conducting air from the latter to the former.

10. In humidifier apparatus, in combination; a container for a body of liquid; an air sprayer submerged in said liquid and forming an annularly disposed inclosure having perforations in a circumferential wall thereof; a float connected above said sprayer and concentrically therewith for buoying the same; a vertically disposed rigid pipe supported to extend above and below the operative surface levels of the body of liquid and passing centrally through said air-sprayer and through a central opening in said float thereby to constrain the rising and falling movements of both these parts; and a swivel-jointed conduit composed of a system of tubular links relatively swingable in end-to-end engagement and about axes parallel to one another and to the surface level of said liquid; the end links of said system connecting respectively with said sprayer and with said pipe for conducting air from the latter to the former.

11. In humidifier apparatus, in combination; a container for a body of liquid; an air sprayer submerged in said liquid and forming an annularly disposed inclosure having perforations in a circumferential wall thereof; a float connected above said sprayer and concentrically therewith for directly buoying the same; said float being of downwardly converging shape so as to separate air bubbles rising from said perforations through the liquid; a vertically disposed rigid pipe supported to extend both above and below the operative surface levels of the body of liquid and passing centrally through said air-sprayer and through a central opening in said float, thereby to constrain the rising and falling movements of both these parts; and a swivel-jointed conduit composed of a system of tubular links relatively swingable in end-to-end engagement and about axes parallel to one another and to the surface level of said liquid; the end links of said system connecting respectively with said sprayer and with said pipe for conducting air from the latter to the former.

12. Humidifier apparatus embodying a liquid container having an opening at the top, a substantially circular cap adapted for removable assemblage with said container to close and seal the opening therein, and a structure carried by and depending from said cap, said structure having an outlet for gas below the level of the liquid in the container, and means for causing said gas to spread as it rises through the liquid in the container.

13. Humidifier apparatus embodying a liquid container having an opening at the top, a substantially circular cap adapted for removable assemblage with said container to close and seal the opening therein, and a structure carried by and depending from said cap, said structure having an outlet for gas below the level of the liquid in the container, and means for causing said gas to spread as it rises through the liquid in the container, said cap having an outlet for the humidified gas adapted to be connected to the intake of an internal combustion engine.

14. A decarbonizing apparatus for automobile engines embodying a decarbonizing material container having an opening at the top, a cap adapted for removable assemblage with said container to close and seal said opening, said cap having a depressed filling portion and a body part rigid with said cap, said body part having two distinct openings respectively providing an inlet both for air and for said material, and a suction outlet, adapted for piping connection to said automobile engine, whereby the container may be filled with said decarbonizing material without removal of said cap.

15. A decarbonizing apparatus for automobile engines embodying a decarbonizing-material container having an opening at the top, a cap adapted for removable assemblage with said container to close and seat said opening, said cap having a depressed filling portion and a body part structurally distinct from but assembled rigidly with said cap, said body part having two distinct openings respectively providing an inlet both for air and for said material, and a separate suction outlet, adapted for piping connection to said automobile engine, whereby the container may be filled with said decarbonizing material without removal of said cap.

16. In a vaporizing apparatus for supple-

menting the intake charge of an automobile engine, in combination, a liquid container having an opening at the top and a removable cap adapted to close said opening and having an inlet therethrough into the container, there being a suction outlet carried by said cap and receptive to piping connection from the engine and there being a hollow formed in said cap around said suction outlet so as to constitute a pouring trough or funnel relative to said inlet.

17. A humidifier apparatus embodying in combination, a liquid container having an opening at the top thereof, a metallic cover structure adapted for removable assemblage with said container to close and seal said opening, said structure having an inlet port 21 therethrough and further having a depressed formation arranged to serve as a pouring trough for filling the container through said port 21, a separate opening 17 in said structure providing a separate outlet for the gas taken through the container and adapted to receive piping connections for installing the apparatus and a conduit 22 depending from the cover structure and in communication with said port 21 for leading a gas from said port into the container.

Signed at Boston, Massachusetts, this 26th day of July, 1918.

RAYMOND D. SMITH.