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APPARATUS AND METHOD FOR CHARGING CONTAINERS WITH VOLATILE MIXTURES

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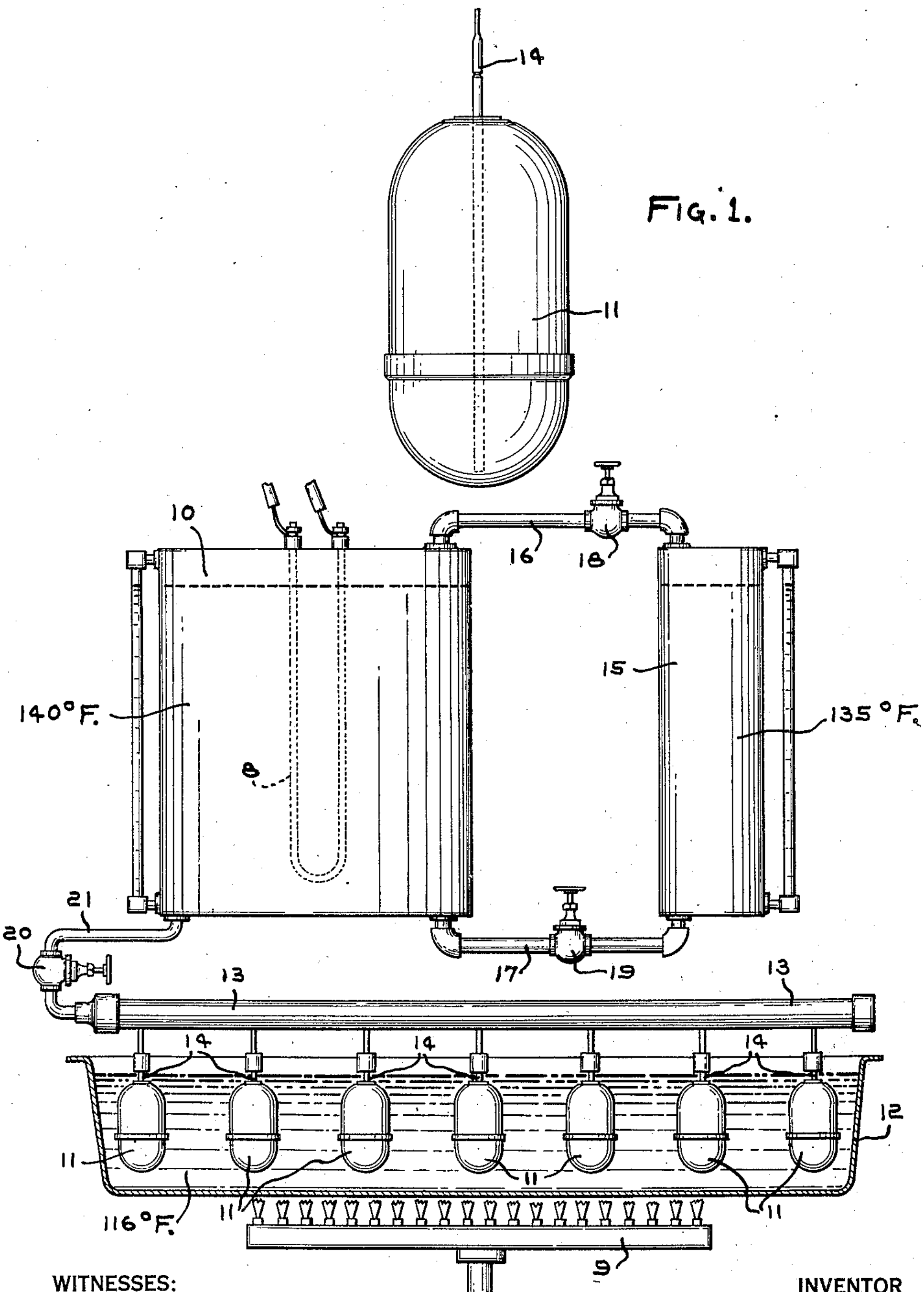

FIG. 1.

FIG. 2.

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APPARATUS AND METHOD FOR CHARGING CONTAINERS WITH VOLATILE MIXTURES

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12 Claims. (Cl. 62—1)

My invention relates to a charging method and apparatus and particularly to a method of and apparatus for charging a mixture of a highly volatile liquid and a relatively nonvolatile substance from a large container into a smaller container, or into a plurality of smaller containers.

It is an object of my invention to provide an improved charging method and more particularly to maintain the proportions of the mixture substantially constant regardless of the level of the mixture in the large container.

It is another object of my invention to maintain the proportions of the mixture substantially constant as the level in the large container drops and to accomplish this result without the use of metering devices, pumps or other moving parts, and without supervision.

It is still another object of my invention to provide an improved method for charging a mixture of an insecticide, such as pyrethrum extract, or pyrethrum extract and sesame oil, and a volatile refrigerant, such as dichlorodifluoromethane, into insecticide dispensers. It is a further object of my invention to provide improved charging apparatus for a mixture of a highly volatile liquid and a nonvolatile substance.

These and other objects are effected by my invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is an enlarged view of one of the containers or dispensers to be filled; and,

Fig. 2 is a diagrammatic view of the charging apparatus embodying my invention.

The copending application of William B. Anderson, Serial No. 462,257, filed October 16, 1942, also assigned to the Westinghouse Electric & Manufacturing Company, discloses and claims a charging system for charging a volatile fluid, or a mixture of a volatile fluid and a nonvolatile substance, such as pyrethrum extract, from a large container into smaller containers or dispensers for insecticide mixture, for example. In accordance with the Anderson invention, a quantity of highly volatile fluid such as dichlorodifluoromethane, and nonvolatile substances such as pyrethrum extract and sesame oil are mixed in a large container **10** (see Fig. 2) which is maintained at an elevated temperature by a heater **8**. A plurality of containers or dispensers **11** to be filled are placed in a tank of water **12**, which is maintained at an elevated temperature by a heater **9**, but at a lower temperature than container **10**. The containers **11** are connected to the large container **10** by a manifold **13** through capillary tubes **14** associated with each container **11**. The air is not exhausted from the containers **11**, but the difference in temperature in container **10** and in dispensers **11** forces a predetermined amount of mixture from the large to the small containers. After the containers **11** have been connected to the large containers **10** for a sufficient length of time, the containers **11** are removed and the exposed ends of the capillary tubes **14** are sealed off.

It was found, however, that in practicing the above charging method, variations occurred in the proportions of the mixture which was charged into the small containers **11**. In other words, the amount of volatile substance decreased as the level of mixture in the large container **10** dropped during a charging cycle. In charging insecticide dispensers, the cost of the main nonvolatile substance, namely, pyrethrum extract, is about twenty-five times that of the volatile liquid, so that it is important from the cost standpoint as well as from a quality control standpoint to maintain the proportions of the mixture substantially constant. In charging the containers with the insecticidal mixture set forth in the aforesaid Anderson application, the following proportions by weight should be maintained:

	Ounces
Pyrethrum extract	0.8
Sesame oil	0.33
Dichlorodifluoromethane	14.87
Total	16.00

The reason why the amount of volatile substance in the mixture varied is that, as a charging cycle progressed and the liquid level in the large container **10** dropped, some of the volatile liquid from the mixture vaporized to occupy the space vacated by the liquid mixture, thus robbing the liquid mixture of its volatile constituent.

In accordance with the present invention, the loss of volatile liquid from the mixture as the liquid level drops is automatically compensated for without the use of complicated controls, moving parts, meters and without supervision.

Referring again to Fig. 2 of the drawing, I have shown diagrammatically a tank or standpipe **15** connected by a conduit **16** at the top thereof to the top of the large container **10** and by another conduit **17** to the bottom of container **10**. Valves **18** and **19** are provided in the conduits **16** and **17**, respectively. The standpipe **15** must be properly proportioned as to size with respect to the large container 10, as will be explained in detail hereinafter, and contains only the volatile liquid and vapor.

In practicing my method, valves 18 and 19 and a valve 20 in a conduit 21 leading to manifold 13 are first closed. The large container 10 is filled to the level shown with the desired mixture, for example, the insecticidal mixture set forth above, and the standpipe 15 is filled to the same level with the volatile liquid only, in this case, dichlorodifluoromethane.

The mixture in the tank 10 is heated to a temperature, for example, of 140° F. and the volatile liquid in standpipe 15 is maintained at a temperature of about 135° F.

Valve 18 is then opened and the vapor pressures in the tank 10 and standpipe 15 equalize through conduit 16. Valve 19 is then opened and the liquid levels in the tank 10 and standpipe 15 equalize through conduit 17. Valve 20 is then opened and the small containers 11 begin to fill with a resulting drop in the level of the mixture in the tank 10.

After the valves 18 and 19 are opened and regardless of whether mixture is being withdrawn from tank 10, vapor from the large container passes through conduit 16 and condenses in standpipe 15 due to the lower temperature therein. However, the amount of vapor condensed is immediately returned to container 10 as liquid through conduit 17, the constant circulation thus maintaining a constant proportion of mixtures. This also prevents the mixture from diffusing into the standpipe 15. As liquid mixture is withdrawn from the large container 10 for filling the dispensers 11, the level in the large container 10 drops, with the result that a certain amount of liquid dichlorodifluoromethane from the standpipe 15 enters the mixture container 10 through conduit 17 to maintain the liquid levels in both tanks constant. The amount of liquid dichlorodifluoromethane which enters the mixture container must equal in weight the amount of dichlorodifluoromethane vapor which has vaporized to occupy the space in the large container 10 vacated by the mixture, plus the amount of dichlorodifluoromethane vapor which has vaporized to occupy the space in the standpipe 15 vacated by the dichlorodifluoromethane liquid. The liquid dichlorodifluoromethane mixes with the mixture in tank 10 and maintains the proper proportion of the constituents of the mixture.

Knowing the temperatures and pressure prevailing in the container 10 and standpipe 15, the relative size of the standpipe 15 to the mixture container may be calculated from known properties of any given refrigerant. For example, in the apparatus shown, the temperature of the mixture in the container 10 is 140° F. and the temperature of the dichlorodifluoromethane in the standpipe 15 is 135° F. At 135° F., the density of liquid dichlorodifluoromethane is 73.63 pounds per cubic foot and the density of the saturated vapor at 140° F. is 5.57 pounds per cubic foot. Therefore, one cubic foot of liquid dichlorodifluoromethane will supply 13.22 cubic feet of vapor space vacated by mixture in the container 10. However, the dichlorodifluoromethane liquid in standpipe 15 must also supply one cubic foot of vapor to take the place of the space vacated by one cubic foot of the liquid dichlorodifluoromethane in the standpipe. Subtracting 1 from 13.22, it is seen that the mixture container 10 should be approximately 12.22 times the diameter or cross-sectional area of the standpipe 15.

In actual practice, it was found that a large tank having an external diameter of 30 inches (with an inside diameter of $29\frac{3}{16}$ inches) and two standpipes with 6-inch internal diameters gave a ratio sufficiently close to effect compensation, standard sizes of tank and standpipes being readily available. The temperature of the standpipes may be adjusted to compensate for variations. The tank had an internal cross-sectional area of 660 square inches and the standpipes totaled 56.5 square inches, so that the tank was 11.64 times the cross-sectional area of the standpipes when theoretically it should be 12.22 times the area of the standpipes. Thus, there is a small error, but this is not too great for practical purposes.

Obviously, for different temperatures of dichlorodifluoromethane, or for other refrigerants, the proportion of the cross-sectional areas of the mixture container and standpipe would vary. These proportions may be calculated in the same manner as the above values are calculated.

From the foregoing, it will be apparent that I have provided an improved method and means of charging a mixture of relatively nonvolatile and highly volatile liquids from a large container into smaller containers wherein the proportions of the mixture remain substantially constant, and furthermore, I accomplish this result without the use of pumps, metering devices or other moving parts and without supervision.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. Those steps in the method of maintaining a constant proportion of the parts of a mixture being withdrawn from a closed container, which mixture comprises a highly volatile liquid and a relatively nonvolatile substance, which steps comprise providing a supply of said highly volatile liquid in another container so positioned that a common liquid level is maintainable in both containers, the containers being so proportioned that sufficient volatile liquid will be added to the mixture to compensate for the amount of volatile liquid from the mixture which goes into the vapor phase in the mixture container when mixture is withdrawn therefrom, equalizing the pressures in the two containers and placing the liquid phases of the two containers in communication.

2. Those steps in the method of maintaining a constant proportion of the parts of a mixture being withdrawn from a closed container, which mixture comprises a volatile refrigerant and a relatively nonvolatile liquid, which steps comprise providing a supply of said volatile refrigerant in another container so positioned that a common liquid level is maintained in both containers, the cross-sectional areas of the containers being so proportioned that sufficient volatile refrigerant will be added to the mixture to compensate for the amount of the volatile refrigerant from the mixture which goes into the vapor phase in the mixture container when mixture is withdrawn therefrom, equalizing the pressures in the two containers and placing the liquid phases of the two containers in communication.

3. Those steps in the method of maintaining a constant proportioning of the parts of a mixture being withdrawn from a closed container, which mixture comprises a highly volatile liquid and pyrethrum extract, which steps comprise providing a supply of said highly volatile liquid in another container so positioned that a common liquid level is maintainable in both containers, the cross-sectional areas of the containers being so proportioned that sufficient volatile liquid will be added to the mixture to compensate for the amount of volatile liquid from the mixture which goes into the vapor phase in the mixture container when mixture is withdrawn therefrom, equalizing the pressures in the two containers and placing the liquid phases of the two containers in communication.

4. Those steps in the method of maintaining a constant proportion of the parts of a mixture being withdrawn from a closed container, which mixture comprises dichlorodifluoromethane and pyrethrum extract, which steps comprise providing a supply of dichlorodifluoromethane in another container so positioned that a common liquid level is maintainable in both containers, the cross-sectional areas of the containers being so proportioned that sufficient dichlorodifluoromethane will be added to the mixture to compensate for the amount of dichlorodifluoromethane from the mixture which goes into the vapor phase in the mixture container when mixture is withdrawn therefrom, equalizing the pressures in the two containers and placing the liquid phases of the two containers in communication.

5. The steps of the method claimed in claim 4 wherein the mixture comprises dichlorodifluoromethane, pyrethrum extract and sesame oil.

6. The method of maintaining a constant proportion of the parts of a mixture being withdrawn from a closed container, which mixture comprises a highly volatile liquid and a relatively nonvolatile substance, which method comprises maintaining the mixture at an elevated temperature in its container, providing a supply of said highly volatile liquid in another container at a lower temperature than that of the mixture, said latter container being so positioned that a common liquid level is maintainable in both containers, the cross-sectional areas of the containers being so proportioned that sufficient volatile liquid will be added to the mixture to compensate for the amount of volatile liquid from the mixture which goes into the vapor phase in the mixture container when mixture is withdrawn therefrom, equalizing the pressures in the two containers, placing the liquid phases of the two containers in communication, and withdrawing the mixture from its container.

7. The method of maintaining a constant proportion of the parts of a mixture being withdrawn from a closed container, which mixture comprises a highly volatile liquid and a relatively nonvolatile substance, which method comprises disposing a quantity of the mixture in said container, providing a supply of said volatile liquid in another container, said containers being so positioned that a common liquid level is maintainable in both containers, maintaining a temperature differential between the volatile liquid and the mixture such that the temperature of the mixture is higher than that of the volatile liquid, the cross-sectional areas of the containers being so proportioned that sufficient volatile liquid will be added to the mixture to compensate for the amount of volatile liquid from the mixture which goes into the vapor phase in the mixture container when mixture is withdrawn therefrom, equalizing the pressures in the two containers by placing their vapor phases in communication, placing the liquid phases in the two containers in free and open communication, and withdrawing the mixture from its container.

8. The method of maintaining a constant proportion of the parts of a mixture being withdrawn from a closed container, which mixture comprises a highly volatile liquid and a relatively nonvolatile substance, which method comprises providing a supply of said highly volatile liquid in another container, said containers being so positioned that a common liquid level is maintainable in both containers, maintaining a temperature differential between the volatile liquid and the mixture such that the temperature of the mixture is higher than that of the volatile liquid, the cross-sectional areas of the containers being so proportioned that sufficient volatile liquid will be added to the mixture to compensate for the amount of volatile liquid from the mixture which goes into the vapor phase in the mixture container when mixture is withdrawn therefrom, condensing vapor of the volatile liquid and raising the liquid head in the cooler container by placing the vapor phases of the two containers in communication, transferring volatile liquid from the volatile liquid container to the mixture container by placing the liquid phases of the two containers in free and open communication with each other, thus utilizing the difference in the liquid head for said transfer, and withdrawing the constantly proportioned mixture from its container.

9. Those steps in the method of maintaining a constant proportion of the parts of a mixture being withdrawn from a closed container, which mixture comprises a highly volatile liquid and a relatively nonvolatile substance, which steps comprise providing a supply of said highly volatile liquid in another container so positioned that a common liquid level is maintainable in both containers, the cross-sectional areas of the containers being so proportioned that sufficient volatile liquid will be added to the mixture to compensate for the amount of volatile liquid from the mixture which goes into the vapor phase in the mixture container when mixture is withdrawn therefrom and so that the correct amount of volatile fluid in the other container will vaporize as the level in said other container drops, equalizing the pressures in the two containers and placing the liquid phases in the two containers in communication.

10. Those steps in the method of maintaining a constant proportion of the parts of a mixture being withdrawn from a closed container, which mixture comprises a highly volatile liquid and a relatively nonvolatile substance, which steps comprise providing a supply of said highly volatile liquid in another container so positioned that a common liquid level is maintainable in both containers, the cross-sectional areas of the containers being so proportioned that sufficient volatile liquid will be added to the mixture to compensate for the amount of volatile liquid which goes into the vapor phase in the mixture container when mixture is withdrawn therefrom and also to compensate for the amount of volatile liquid which vaporizes in the latter container when the liquid level drops therein, equalizing the pressures in the two containers and placing the liquid phases of the two containers in communication.

11. Apparatus for charging a continuously uniform mixture of highly volatile liquid and a relatively nonvolatile substance into one or more receptacles and for maintaining the proportions of the mixture uniform, which apparatus comprises, a container for the mixture, a second container for holding a quantity of the volatile liquid only, means adjacent the top of the containers for placing them in free and open communication to equalize constantly the pressures therein, means adjacent the bottom of the containers for equalizing the liquid levels therein, means for maintaining the temperature of the mixture container and its contents higher than that of the second container and means for discharging liquid mixture from its container to said receptacle.

12. Apparatus for charging a continuously uniform mixture of highly volatile liquid and a relatively nonvolatile substance into one or more receptacles and for maintaining the proportions of the mixture uniform, which apparatus comprises, a container for the mixture, a second container for holding a quantity of the volatile liquid only, means adjacent the top of the containers for placing them in free and open communication to equalize constantly the pressures therein, means adjacent the bottom of the containers for equalizing the liquid levels therein, the cross-sectional area of said containers being so proportioned that volatile liquid flows automatically from the second container to the mixture container in a volume sufficient to compensate for the liquid lost from the mixture by vaporization as the level in the mixture container drops, means for maintaining the temperature of the mixture container and its contents higher than that of the second container and means for discharging liquid mixture from its container to said receptacle.

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