

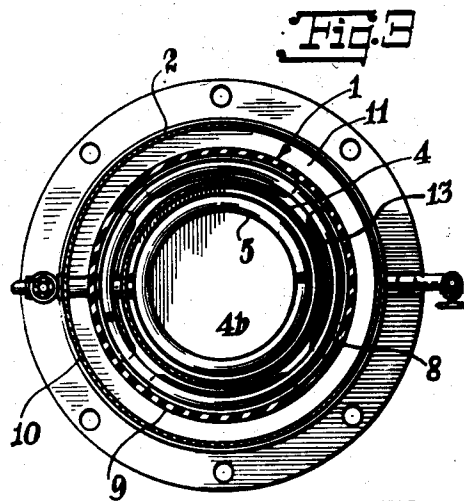
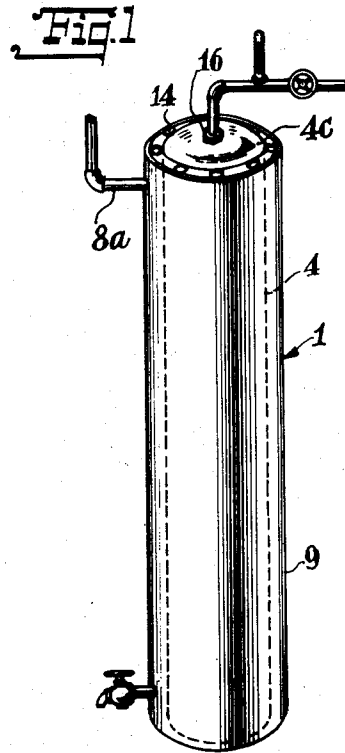
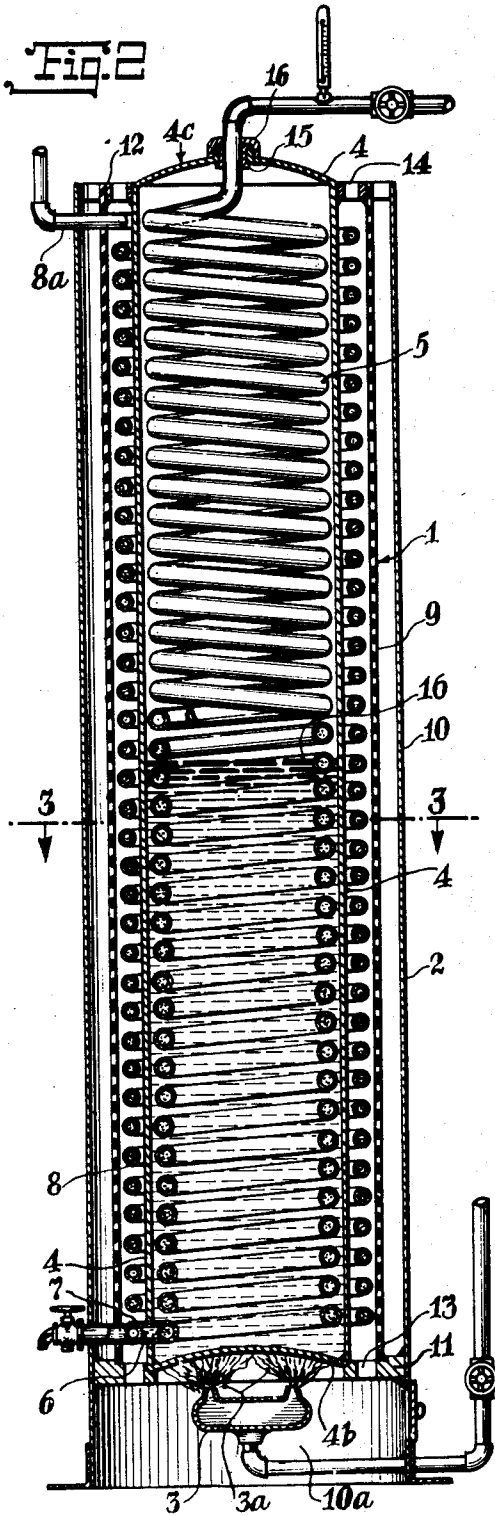
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AMMONIA CONTAINING WATER HEATING UNIT

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AMMONIA CONTAINING WATER HEATING
UNIT

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3 Claims. (Cl. 122-32)

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This invention relates to an ammonia-containing water-heating unit and water heaters embodying same.

The heat-absorbing property of anhydrous ammonia is so high that if the heat absorbed by air is denoted by unity or one, the heat absorbed by anhydrous ammonia will be nearly 1200. Anhydrous ammonia is a colorless liquid which, at atmospheric pressure, boils at -28° F. and freezes at -108° F. Compressed into cylinders, it is in a liquid state and is obtainable commercially so compressed into metallic cylinders. Such liquid anhydrous ammonia has a high coefficient of expansion (about 1.5% on a 10° F. temperature increase), and in order to avoid exerting a hydraulic pressure within such cylinders which might result in bursting, a safety factor is provided that permits such cylinders to be filled with such liquid to approximately eighty-eight per cent (88%) at their maximum volume at average storage temperatures, thus leaving a gas filled space of approximately 12% of such maximum volume. Such liquid anhydrous ammonia in a cylinder so filled will at 145° F. have expanded to fill the cylinder completely and is, therefore, not allowed to reach a temperature of over 120° F. This gas-filled space of twelve (12%) per cent is considered a reasonable safety factor in the handling of such metallic cylinders.

One of the objects of this invention is to greatly minimize the percentage of heat that is now wasted in usual water heaters by the failure to absorb heat from the hot gases of combustion and to utilize the high heat-absorbing properties of liquid anhydrous ammonia in a water-heating unit by providing a metallic container comprising a strong, durable metallic container or cylinder and introducing or inserting therein liquid anhydrous ammonia in a quantity which will provide a sufficient gas-filled space in the cylinder above the liquid that the expansion of such liquid cannot possibly result in the exertion of an hydraulic pressure within the cylinder, and will provide a safety factor when the liquid anhydrous ammonia within the cylinder is heated to any degree encountered in metallic water heating cylinders.

Another object of my invention is to provide means for transmitting heat from such contained liquid anhydrous ammonia to water comprising a coil immersed in such liquid anhydrous ammonia within said cylinder.

Still another object of my invention is to produce a water-heating unit comprising a cylinder composed of a metal that is not materially af-

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ected by and/or is highly resistant to the corrosive properties of liquid anhydrous ammonia and having contained therein liquid anhydrous ammonia in a quantity providing a high factor of safety and being so arranged over a gas burner, or other combustion device, as to initially absorb a highly-increased percentage of heat of combustion produced in the burner or burners (so as to minimize the percentage of such heat that is now wasted and usually passes up the flue), combined with a coil of similar metal immersed in the liquid anhydrous ammonia within the cylinder so as to efficiently transmit the absorbed heat to water, which may be then stored in a tank or employed in a heating system.

Another object of my invention is to provide within a container of the type specified, a quantity of liquid anhydrous ammonia so limited in relation to the maximum volume at average storage temperature that, under operating conditions, the liquid anhydrous ammonia will be permitted to expand within a safety space above the liquid, which, at average room temperature, amounts to one-half of the maximum volume and is filled with readily compressible ammonia gas, so as to avoid any possibility of such expansion as would result in hydraulic bursting pressure, and to mount within said container or cylinder, and to immerse within the liquid anhydrous ammonia therein, a metallic water coil of a metal that will also not be injuriously affected by the liquid anhydrous ammonia, and that will efficiently enable the transmission of heat absorbed by the liquid anhydrous ammonia within said container to water within said coil.

Still another object of my invention is to utilize a primary heating element comprising an ammonia-resistant metallic cylinder having contained therein a quantity such as hereinabove specified of said liquid anhydrous ammonia, and having mounted therein an internal water-containing coil composed of a similar metal immersed within said contained liquid anhydrous ammonia, combined with a preheating element comprising an external water-containing coil having a water-circulating connection with said internal coil and being composed of copper or like metal having high heat conducting properties, said preheating water-containing coil being wrapped about and having heat-absorbing contact with the outside surface of said container to cause transmission of heat that passes through the walls of said cylinder to water within the coil, and also to transmit to said water within

said preheating coil heat from the combustion of gases in a burner or like device that is not absorbed by the liquid anhydrous ammonia in the metallic container.

Still another object of my invention is to mount a preheating coil of the type specified in position to cause a heat-absorbing contact with gases from the combustion burner in their movement toward the outlet.

Still another object of my invention is by the use of the ammonia-containing cylinder hereinabove specified, to reduce the size and minimize the cost of water-heating units generally.

With these and other objects in view, the invention comprises the combination of members and arrangement of parts so combined as to contact and cooperate with each other in the performance of the functions and the accomplishment of the results herein contemplated, and comprises in one of its adaptations the species or preferred form illustrated in the accompanying drawings, in which:

Fig. 1 is a perspective view of an ammonia-containing heat-absorbing unit embodying my invention;

Fig. 2 is a vertical cross-section showing a unit such as illustrated in Fig. 1 installed in a water-heater over a gas burner; and

Fig. 3 is a section on the line 3-3 of Fig. 1 looking in the direction of the arrows.

Referring now to these drawings, 1 in Fig. 1 indicates an ammonia-containing water heating unit which is adapted to be installed in a water-heater casing 2 over a combustion element 3 which, in the embodiment shown in Fig. 2, comprises a gas burner. In accordance with my invention, I provide a cylindrical metallic container 4 which is composed of a metal, such as stainless steel, having high tensile strength, high resistance to pressure and which is not corrodible or otherwise deleteriously affected by liquid anhydrous ammonia, introduce into said cylinder a body or quantity of liquid anhydrous ammonia and mount in said cylinder 4 a primary water-heating coil 5 preferably having within the cylinder a maximum number of coils of suitable diameter, so as to produce a high degree of contact between the metal of the coil and the body of the liquid anhydrous ammonia contained within the tank and to procure maximum heat transmission from the liquid anhydrous ammonia (both liquid and gaseous) to water in said coil 5. This coil is also composed of a metal such as stainless steel which will not in any way be corroded or otherwise deleteriously affected by the liquid anhydrous ammonia within which it is immersed. The end portion of said coil extends through an opening at 6 in the cylinder wall of the container and a non-leaking joint between the metal of the coil and the metal of the cylinder wall is provided by a careful welding thereof. The projecting end portion of the coil 5 is connected at 7 with the lower end portion of a preheating coil 8, which is preferably composed of a high heat-conductive metal, such as copper, and is wound or wrapped around the outer surface of the container 4 to provide a metal-to-metal contact between the coil and cylinder, and thus to absorb and transmit to water contained in said preheating coil 8 a maximum quantity of heat from the liquid anhydrous ammonia that passes through the walls of said cylinder 4. The cylinder 4 and preheating coil 8 are, as illustrated, enclosed within an interior casing 9 of insulating material, and the

cylinder and coil so enclosed constitute my preferred form of water-heating unit 1.

To produce the water-heater of my invention, the unit 1 is suitably mounted within and enclosed by a casing or shell 10 and a combustion burner 3 is employed as the source of heat to be absorbed by the liquid anhydrous ammonia. As shown, the burner 3 is placed in direct contact with a concave cylinder-bottom 4^b so as to transmit the heat of combustion of burned gases through the metal of the tank to the liquid anhydrous ammonia within the same. As illustrated, the unit 1 is supported at its lower end on a base member 11 which is suitably connected to and extends from the internal surface of the shell or casing 10 at a position to provide a suitable combustion chamber 10^a at the bottom of the casing 10. A top member 12 also connected with the shell or casing 10 engages and holds the top of the unit against tilting.

I have found that because of the high heat-absorbing properties of the compressed ammonia gas known as liquid anhydrous ammonia a highly-increased percentage of the heat produced by gas flames may be utilized, first, by such absorption within the cylinder, second, by transmission to water in a coil immersed in the liquid anhydrous ammonia within the cylinder, third, by absorption by water in the preheating coil of heat passing through the wall of the cylinder, and, fourth, by absorption of additional heat directly from the gases of combustion from said flame which will pass upwardly through the apertures 13 in the base member 11 so as to contact with the preheating coil 8. These gases devoid of substantially all their heat will then pass upwardly and outwardly through the apertures 14 in the top mounting member 12.

The coil 8 is connected with a water supply pipe 8^a extending from any suitable source of supply (not shown). As shown, the water supply pipe is connected to the upper end of said preheating coil 8 while the primary immersed coil 5 preferably extends upwardly through the top head 4^c by a sealed joint 15 which is preferably formed of lead or solder protected and reinforced by a nut 16, and is so arranged as to prevent any possibility of leakage.

In the preferred embodiment of my invention, the cylinder is preferably filled at room temperature with said liquid anhydrous ammonia to fifty per cent of its maximum volume and the other fifty per cent (50%) of the maximum volume or space within the cylinder is filled with ammonia gas which has expanded from said charge of liquid anhydrous ammonia, thus providing a safety factor so that, notwithstanding the high coefficient of expansion of liquid anhydrous ammonia (about 1.5% on a 10° F. temperature increase), such filling will permit expansion of the liquid under any increase in temperature that may be encountered through the gas-heating conditions specified and still leave a sufficient gas-filled space to provide a factor of safety that will completely avoid the exertion of any hydraulic pressure within the cylinder that might result in a bursting thereof. Such filling would theoretically, at the rate of expansion above specified, permit a rise in temperature from a room temperature of 65° F. to a temperature of 395° F. Such a temperature of the liquid anhydrous ammonia will never be reached in a water heater of the type specified and a safety space and safety-factor is thus provided which cannot be exceeded

under even the most extraordinary circumstances in the operation of this device.

In addition to the factor of safety hereinabove specified, my container for liquid anhydrous ammonia comprises a heavy, strong and durable cylinder, composed of high quality stainless steel, which has such a high resistance against internal pressure that, even if hydraulic pressure of the liquid anhydrous ammonia were encountered, no bursting or explosion could possibly take place.

Having described my invention, I claim:

1. A water heating unit comprising a liquid container of tank form and composed of a metal having a high tensile strength and embodying high resistance to internal hydraulic pressure and corrosion, said container being provided with an internal charging chamber having charged into a lower part thereof and permanently sealed therein a charge of anhydrous liquid ammonia, said anhydrous liquid ammonia having a low boiling point of approximately minus 28° F. with a correspondingly high heat-absorption and a coefficient of expansion of approximately 1.5% on a 10° increase in temperature, said internal charging chamber being of a maximum volume substantially double the volume of said charge of compressed anhydrous liquid ammonia to provide above said charge of liquid a connected expansion space, said connected expansion space having charged therein above said liquid a contractible anhydrous gas, said gas-filled space amounting to substantially fifty per cent of said maximum volume of said charging chamber of the container, and producing a safety expansion-space factor that will permit hydraulic expansion of the liquid anhydrous ammonia and will avoid the production within said container of hydraulic pressures at any temperature that could possibly be encountered in use as a heating unit by providing for a range of expansion of the charge of anhydrous liquid ammonia that would occur only upon application thereto of temperatures up to substantially 395° F., a burner positioned beneath said container to project a gas flame into contact with the lower part thereof for applying heat to the charge of liquid anhydrous ammonia contained therein, and a water-heating element comprising a series of coils mounted within said internal charging chamber and having a suitable number of water-containing coils extending into said expansion space, said water heating element being immersed in both the anhydrous liquid and gaseous ammonia contained in said container, whereby a high degree of contact is produced between the metal of the

coils of said water-heating element and said anhydrous ammonia in its variant forms.

2. A water heating unit comprising a cylindrical liquid container having its axis positioned vertically and composed of a steel having a high tensile strength and embodying high resistance to internal hydraulic pressure, said container having permanently contained therein a charge of anhydrous liquid ammonia and having an internal charging chamber of a maximum volume substantially double the volume at room temperature of said charge of liquid to provide a connected expansion space filled with ammonia gas above said charge of liquid ammonia amounting to substantially fifty per cent of said maximum volume of said charging chamber of the container, whereby a safety expansion-space factor is produced that will permit expansion of the entire charge of liquid under high temperature and will avoid the production of hydraulic pressure within said container at any temperature encountered in use as a heating unit, a fuel-burner positioned beneath said container and projecting into contact therewith; a gas flame for applying heat through said container to the charge of liquid ammonia contained therein, a water-containing coil composed of stainless steel immersed in the liquid ammonia in said container and a preheating coil arranged in metal to metal contact with the outside surface of said container, composed of copper and having a higher heat-conductivity than the internal coils.

3. A water heating unit as claimed in claim 2 in which a casing of heat insulating material is arranged to surround said preheating coil and means is provided for conducting unabsorbed heat from said gas flame into contact with the coil between the outside surface of the tank and said casing of insulating material.

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