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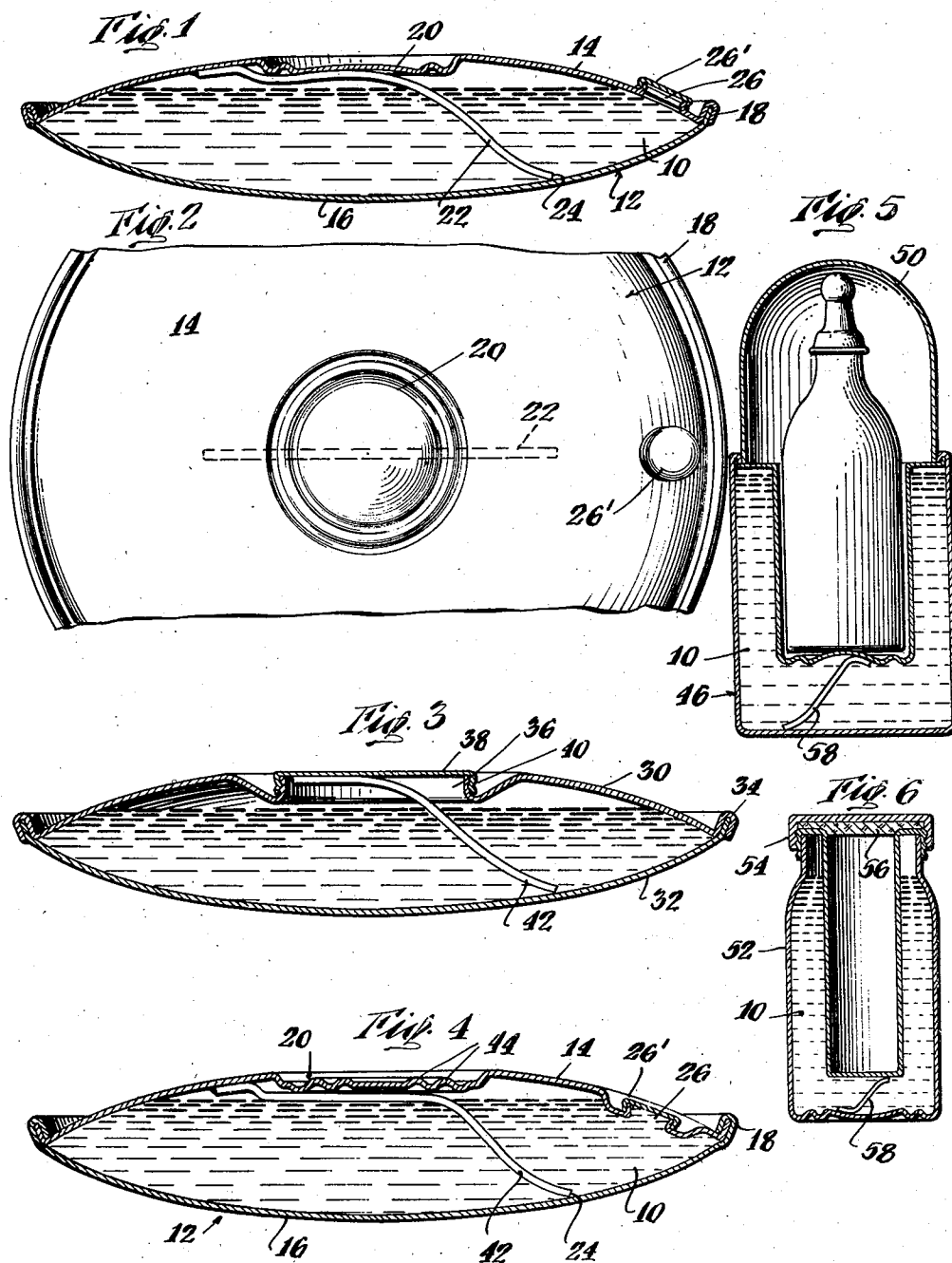
D. F. OTHMER

2,220,777

VALVELESS CHEMICAL HEATER

Filed Feb. 1, 1939

3 Sheets-Sheet 1



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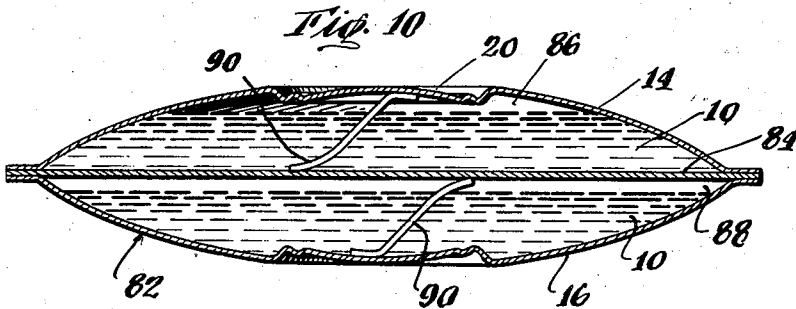
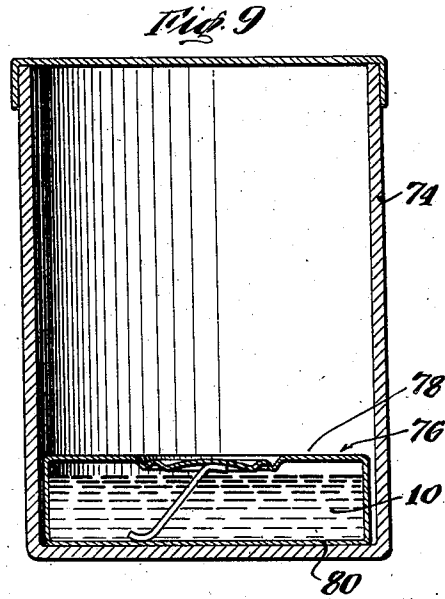
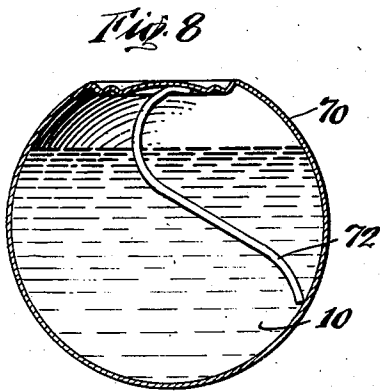
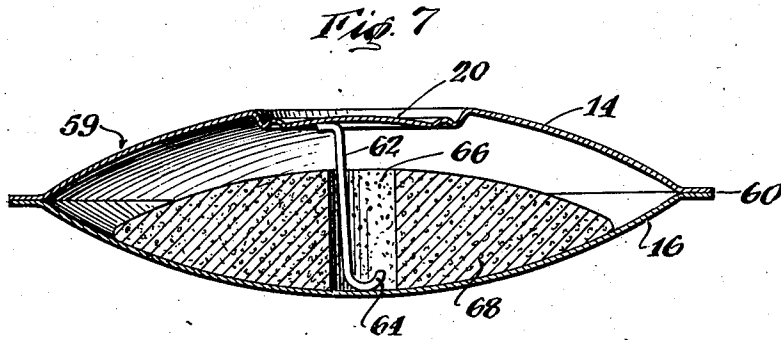
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VALVELESS CHEMICAL HEATER

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3 Sheets-Sheet 2



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VALVELESS CHEMICAL HEATER

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Fig. 11

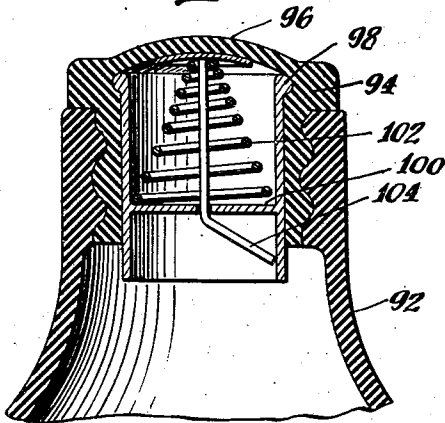


Fig. 12

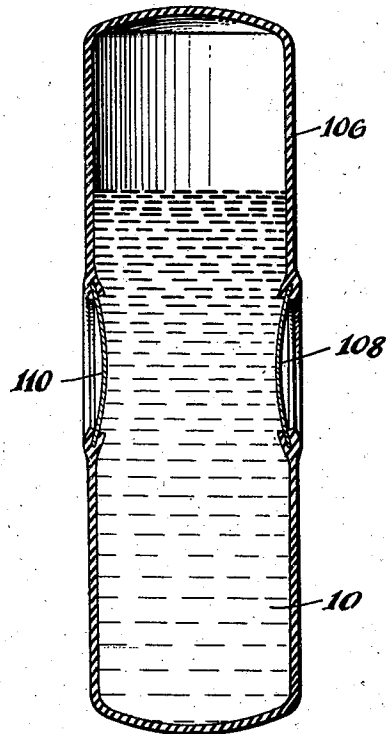


Fig. 13

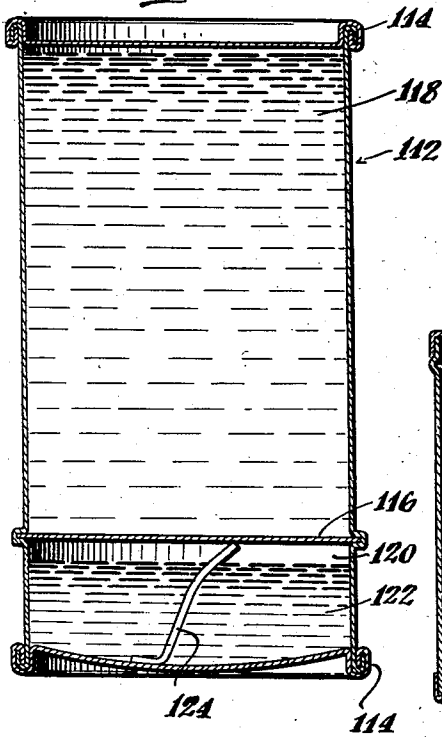
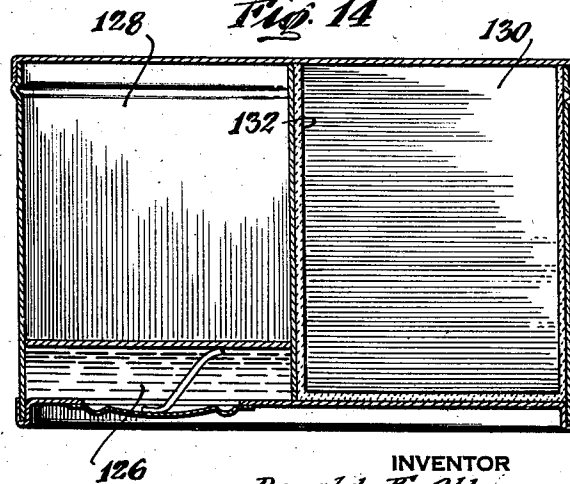


Fig. 14



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2,220,777

VALVELESS CHEMICAL HEATER

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Application February 1, 1939, Serial No. 253,949

7 Claims. (Cl. 126—204)

This invention generally relates to hermetically sealed chemical heater units suitable for the same purposes as the hot water bottles now commonly existent or like devices employing heat, and wherein heat of crystallization generates the heat.

Heretofore varied forms of chemical heaters have been suggested particularly those employing supersaturated solutions of sodium acetate where heat was developed by crystallizing the solution, but all of these heaters have been objectionable because they have had openings therein; namely, these heaters had apertures through which a seed crystal could be introduced to start the crystallization, or had valves allowing the introduction of air or of solid crystal to commence the crystallization process. If air was introduced through the valve, in certain instances a valve stem was provided upon which a thin layer of the crystalline solution dried into solid crystals which latter, by manipulation, would be later dropped into the solution to "fire" the same. All of these former containers which employed the heat of crystallization of supersaturated solutions, were open to one or more of the following objections: (1) The containers leaked solutions, clogging the valves and making unsightly deposits on the exterior of the containers; (2) The chemical heater was found to fire spontaneously; (3) The containers could not be "fired" positively and efficiently with one or two manual movements but required repeated efforts; and (4) Solid crystals to seed the solutions were not always conveniently at hand.

Accordingly, it is an object of my invention to eliminate all valves or openings in such class of chemical heaters.

It is a further object to provide chemical heaters dependent for their heat upon the heat of crystallization generated from "firing" supersaturated solutions, of a type which are permanently hermetically sealed, which do not leak, and which "fire" positively preferably due to scraping the interior of the container with a piece of metal.

It is a further object of my invention to provide such chemical heaters with a piece of metal interiorly of the same so that the metal will scrape another metal surface when the container is shaken, or when a flexible diaphragm in the container is pressed inwardly.

It is a further object of my invention to provide various forms of such chemical heaters, so arranged that controlled and different amounts of heat will be generated within the container

and so that objects in contact with the heater, or encompassed thereby in whole or in part, will receive a predetermined amount of heat.

It is a further object of my invention to provide such chemical heaters in the form of body heaters, heaters for milk bottles for babies, double-walled heater units for liquids, hot trays and a variety of other purposes and adaptations which will be more or less apparent from my description hereinafter, including if desired flexible walled non-metallic containers, preferably permanently sealed.

It is still a further object of my invention to provide permanently hermetically sealed chemical heaters in which heat is generated from crystallizing supersaturated solution, and which is preferably "fired" by a metallic rubbing action occurring within the container, but which may be "fired", if desired, through other rubbing means and possibly certain vibrations.

It is a further object to provide an economical and convenient form of sheet metal hot water bottle which is feasible for quantity production commercially.

With these and other objects in view the invention consists in the construction and novel combination and arrangement of parts; herein-after fully described, illustrated in the accompanying drawings in reference to specific embodiments thereof, and pointed out in the claims hereto appended, it being understood that various changes in the form, materials, proportion and details of construction, within the scope of the claims, may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

In the drawings:

Fig. 1 is a vertical cross-section of a hot water bottle embodying my invention;

Fig. 2 is a fragmentary plan view of the hot water bottle illustrated in Fig. 1;

Fig. 3 is a vertical cross-section of a modification of the bottle shown in Figs. 1 and 2;

Fig. 4 is a vertical cross-section of a further modification of the hot water bottle shown in Figs. 1 and 2;

Fig. 5 is a vertical cross-section of a chemical heater designed to heat milk bottles for babies;

Fig. 6 is a vertical cross-section of a double-walled chemical heater for heating liquids;

Fig. 7 is a vertical cross-section of a modified form of my invention, indicating a solid block of crystal adapted to be originally loaded in the container and having a center hole therein to accommodate a "firing" pin;

Fig. 8 is a vertical cross-section of a modified form of my heater invention adapted to efficiently transfer heat to liquids;

Fig. 9 is a vertical cross-section of a warming container and removable heater unit contained therein, the heater unit having a flat top and bottom surface;

Fig. 10 shows a vertical cross-section of a double heater unit;

Fig. 11 is a fragmentary cross-section of a rubber heater unit with a flexible stopper and "firing" means inserted therein;

Fig. 12 is a diagrammatic cross-section of a rubber or other suitable flexible walled container, having two metallic inserts adapted to be rubbed together to "fire" the container;

Fig. 13 is a vertical cross-section of a container for liquids to be heated, having a heater unit formed integrally therein; and

Fig. 14 is a vertical cross-section of a container having an integral heater unit for a liquid compartment, and an insulated second compartment.

Referring generally to these figures in which similar numerals are used to indicate common parts, and specifically to Figs. 1 and 2, a supersaturated aqueous solution 10, preferably sodium acetate plus slight impurities, is placed within a circular container 12 which container is preferably hermetically sealed and comprises in its preferred form two convex portions namely top and bottom portions 14 and 16, lock sealed together as indicated at 18. The container 12 will ordinarily be made of light gauge sheet iron or steel, if desired covered with some coating such as tin or other appropriate substance. As indicated in the figures container 12 will be substantially but not completely filled and the solution will ordinarily comprise one part of water and thirteen parts sodium acetate crystals and slight impurities by weight, although this may be varied as to proportion and as to substance, as will be hereinafter described in detail.

Illustrated in Figs. 1 and 2 is a depressed integral disc shaped portion 20 in container top 14 which is arranged so as to be flexible due to the material out of which the container is constructed. A metal wire 22, which will be made of spring steel or any other appropriate steel or iron or alloy substance, will normally be placed in position upon the inside of container top 14 adjacent depressed portion 20 so that curved rod portion 22 will be in contact with depressed portion 20, and curved rod portion will extend preferably downwardly to the container bottom 16 in such manner as illustrated, that when flexible depressed portion 20 is manipulated inwardly, point 24 of rod 22 will scrape container bottom wall 16. Other methods of scraping the inside of the container can be employed, and it is an important part of my invention to hermetically seal the container 12 and even though so sealed to be able to scrape an inside wall portion thereof, thereby "firing" the supersaturated solution of sodium acetate plus impurities to generate heat. The heat generated will raise container and contents to approximately 140° F.

If desired, the sodium acetate may be introduced into the container 12 through opening 26, after parts 14 and 16 are lock sealed together, opening 26 being closed hermetically by cover portion 26' as indicated. Wet or dry filling methods may be employed.

As a modification of my invention illustrated in Figs. 1 and 2, Fig. 3 shows a container formed

of top and bottom portions 30 and 32 lock sealed together as at 34, or otherwise sealed, which is provided with an opening 36, which opening is closed by a closure 38 comprised of a circular disc having a depending flange 40 and a rod 42 soldered or otherwise secured to the closure 38.

Fig. 4 is a vertical section of a container very similar to the ones shown in Figs. 1 and 2, with the exception that flexible circular depressed portion 20 is provided with a series of concentric rings 44 which give added flexibility and which also permit the use of heavier stock. It will be recognized that having depressed portions 20 and 44 below the contour of convex top portion 14, that accidental firing is largely avoided. If desired, portion 20 may be a separate part soldered or welded or otherwise positioned in place. By "firing" it will be understood that I mean causing the supersaturated solution to start to crystallize. In the example given, the metal to metal scratching or rubbing starts crystallization, evidently by the exposure of the new metal surface. I have also found the rubbing or scraping of other materials, such as glass or various of the organic plastics, will "fire" such supersaturated solutions.

As modifications of my invention, a double-walled heater 46 is shown in Fig. 5 adapted to heat milk bottles for babies or other suitable containers, the heater 46 being provided with cover 50, and encompassing the milk bottles snugly and "firable" by pressure of the bottle; also in Fig. 6 is shown a double-walled chemical heater 52 adapted for containing liquids which are to be heated, and provided with a screw top 54 and a washer 56. Both of these last two described chemical heaters are provided with firing pins, or metal scraping devices indicated as 58.

In the form shown in Figs. 5 and 6 a predetermined amount of heat can be generated and transferred to the milk bottle by properly arranging the shape of the container, the form of solution and the amount of time the bottle is left within the heater. The solution may be made somewhat more stable (less likely to crystallize) if the ratio is reduced as desired even down to ten parts of sodium acetate to one of water by weight, and this reduction also allows a regulation of the maximum temperature which will be generated, thus controlling the heat conditions, which will often prove advantageous. However, where more water is used, starting the crystallization is somewhat more difficult, and where about less than nine parts of sodium acetate to one of water are used, crystallization will be started only with extreme difficulty.

In operation I find that a hermetically sealed metal container as shown in Figs. 1 and 2, substantially filled with sodium acetate solution having thirteen parts sodium acetate and one part of water by weight, works entirely satisfactorily simply by scraping a side of the metal container with a metal rod or post, all as described.

It is known to those skilled in the science of physical chemistry that the study of supersaturation may be classified in two ways; first, the labile and second, the metastable states. Without reference to these terms and the definitions which they imply, it is a known fact that in the use of a heating unit of this type it is necessary to have the crystal in solution under conditions of such stability that the unit may be cooled, shaken, or otherwise treated without causing the material inside to start its crystallizing except by rubbing or scraping.

It is a fact known to physical chemists that the presence of an impurity in a liquid material lowers the temperature at which crystallization occurs. Thus namely, the freezing point of water is lowered by the presence of ordinary salt, or in other words the water is less apt to crystallize, or is more "stable." In order to obtain the desired stability in the solution, I have found that it is desirable to introduce certain impurities in the sodium acetate or other suitable solution, whereas in the past attempts have been made to utilize highly pure solutions of the respective salts. I have discovered that pure solutions are undesirable because they are less stable than more impure solutions. For example, if sodium acetate is used as the crystallizing salt, I have found that a small amount of sodium formate, sodium propionate, sodium butyrate, or any one or more of the sodium salts of the homologous series of acids to which acetic belongs, is effective in stabilizing the salt solution so that it will not crystallize under conditions of cooling below room temperature or of rough handling. Furthermore, I have found that under some conditions of purification the sodium acetate made from the relatively impure acetic acid containing all of the above mentioned sodium salts and certain other impurities is desirable as such a material because of the impurities which it naturally contains. A material so formed and used in conjunction with the known art is found to be considerably more stable so as to allow the cooling of the solution to the freezing point and considerable rough handling.

Generally speaking the amounts of sodium salts of acids other than acetic mentioned should be not more than two or three per cent of the total material. Also, small amounts of sodium carbonate or sodium hydroxide may be present in the sodium acetate and these also may likewise increase stability. Also, I have found that sodium acetate prepared from acetic acid obtained in wood distillation is suitable for use in my heaters and the impurities which are naturally present in the sodium acetate prepared in this way greatly increase the stability of the product. Thus, a lower grade of acetic acid and a cheaper form of sodium acetate may be utilized than hitherto thought possible and with greatly improved stability characteristics.

The sodium acetate produced from crude acetic acid prepared from wood distillation will contain not only small amounts of sodium formate, varying from one-half to two per cent but also similar small amounts of sodium propionate and sodium butyrate. Besides these acid salts there are known to be traces of certain other materials such as alcohols, esters, ketones, cresols, and other organic chemicals which are present unchanged by the neutralization process. These traces of organic matter have been found to increase the stability of the liquid solution, used in my heaters.

In the variant forms of my invention shown in Figs. 7-14, Fig. 7 illustrates a container 50 generally similar to the container shown in Fig. 1, except that top and bottom portions 14 and 16 may be soldered together, as at 60. Container 50 is here illustrated as provided with a generally vertically disposed firing trigger 62, having a hook end as at 64 which extends downward to an opening 66 in circular block 68 of sodium acetate crystals, which block contains the necessary water in the desired proportions. The block 68 may be inserted in bottom portion 16, the top

portion 14 permanently affixed thereto: the heater can then be made ready for use by being boiled in boiling water for approximately ten minutes, subsequently cooled, and may be then fired by its trigger mechanism.

In Fig. 8, the circular heater unit 70 diagrammatically illustrated with its firing mechanism 72, is a chemical heater for warming liquid solutions, and affording an efficient heat exchange therewith by being immersed therein.

Fig. 9 illustrates a fiber board, or other convenient form of insulated container 74 having a removable chemical heater unit 76 therein, the said unit 76 being provided with flat top and bottom surfaces 78 and 80, for the sake of convenience and so that vessels containing liquids can be readily placed upon the flat top 78.

Fig. 10 indicates a heater unit 82 generally similar to that shown in Fig. 1 except that there is a middle partition 84 dividing the unit 82 into two compartments 86 and 88 respectively, there being two individual firing mechanisms provided, indicated as 90 respectively, thereby providing an integral unit 82 having two compartments which may be fired one after the other, giving heat for a longer time than the unit shown in Fig. 1.

Fig. 11 is a fragmentary cross-section of a preferably flexible sided rubber bottle 92 having a stopper 94 with a flexible portion 96. The stopper 94 may be provided with a metal collar 98 having a partition 100, a spring 102, and a metal scraping arm 104, all as clearly indicated in the said figure. It will be recognized that stopper means 94, providing metal friction device as indicated, may be adapted to various types of containers, flexible walled or not as desired, which may be filled with a salt solution and the "firing" stopper means associated therewith; in fact, such "firing" stopper means could be utilized with standard rubber hot water bottles.

Fig. 12 shows an alternate form for a fully flexible sided container and indicates in cross-sectional view a rubber container 106 of generally rectangular cross-section and provided with two metal inserts 108 and 110 respectively, so positioned in opposite walls that the two may be brought together and scraped by proper manipulation of the user.

Fig. 13 illustrates in vertical cross-section an integral metal unit 112, of common tin can type, with lock seamed portions as indicated at 114. A partition is indicated at 116 to provide a separate liquid compartment 118, suitable for holding, for example, liquid soup, as indicated, and a lower compartment 120 for the chemical heater solution 122 and firing mechanism indicated as 124.

Fig. 14 illustrates generally triple compartmented unit suitable for picnic lunches or the like, having a heater unit indicated generally as 126, a compartment for liquids or other materials to be heated indicated as 128, above heater unit 126, and a storage compartment 130 suitably insulated as at 132 from compartments 126 and 128.

Although I have described a specific form of chemical heaters and the use of sodium acetate plus certain impurities in detail, it is obvious that certain other salts and substances may be utilized in either pure or slightly impure form for the heating units. In essence my invention includes the use in hermetically closed containers of a supersaturated solution of sodium acetate in slightly impure form which is adapted to generate a heat of crystallization, and the starting of crystallization by simply a scraping process preferably involving a metal rod. It is obvious that

various modifications of my invention may be made by those skilled in the art including the utilization of other forms of containers, the starting of the crystallization or "firing" possibly by vibrations, including sonic vibrations, and also the placing of various pieces of metal within a container which contains a supersaturated salt solution and the starting of the crystallization by merely shaking the container. Also by making chemical heaters with two or more self-contained cells, each with its individual firing means, it is apparent that sustained heats can be obtained from such chemical heaters. Also if desired a three or four legged tripod form of firing mechanism may be placed within the shell, arranged under slight tension and so that with repeated boilings and crystallizations of the solution that the legs will tend to slightly change their positions, thus avoiding wearing through the walls of the shell because of often repeated "firings."

Therefore, for a definition of my invention, reference should be had to the appended claims.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A closed and hermetically sealed chemical heater formed of a substantially rigid metal shell having an integral flexible diaphragm and which includes a supersaturated salt solution within the heater which causes the temperature of the unit to rise when crystallized, and means which upon manual manipulation of the flexible diaphragm without opening the container are adapted to cause a metal to metal friction within the container, thereby crystallizing said solution.

2. A permanently closed and hermetically sealed chemical heater which includes a substantially rigid metal shell formed of two generally

circular portions each having a convex cross-section, a flexible diaphragm in one of said portions, a supersaturated salt solution having heat of crystallization within said heater, and metal friction means arranged to scrape a wall of the container upon manual manipulation of said diaphragm.

3. A heater as defined in claim 2 which additionally includes a permanently capped and hermetically sealed filling orifice for said heater.

4. A heater as defined in claim 2 wherein said diaphragm is depressed below the convex surface of the portion of the heater of which it forms a part, thereby affording a degree of protection to the heater against accidental discharge.

5. A permanently closed and hermetically sealed chemical heater which includes a substantially rigid metal shell body, a flexible diaphragm portion formed integrally in said substantially rigid metal shell body, a supersaturated salt solution having heat of crystallization within said body portion, and metal friction means arranged to scrape an interior wall of the body portion upon manual manipulation on said flexible diaphragm.

6. A structure as defined in claim 5 wherein said flexible diaphragm is formed by means of concentric grooves and ridges formed in the rigid walled metal body member.

7. A structure as defined in claim 5 wherein said metal friction means comprises a metal member movable by said diaphragm and extending from one side of the container to another, said metal member being affixed internally to a portion of the heater.

DONALD F. OTHER.