Feb. 13, 1951 S. A. ALEXANDER 2,541,736

CHEMICAL HEATING DEVICE

Filed Dec. 9, 1948 2 Sheets-Sheet 1

Fig. 1.

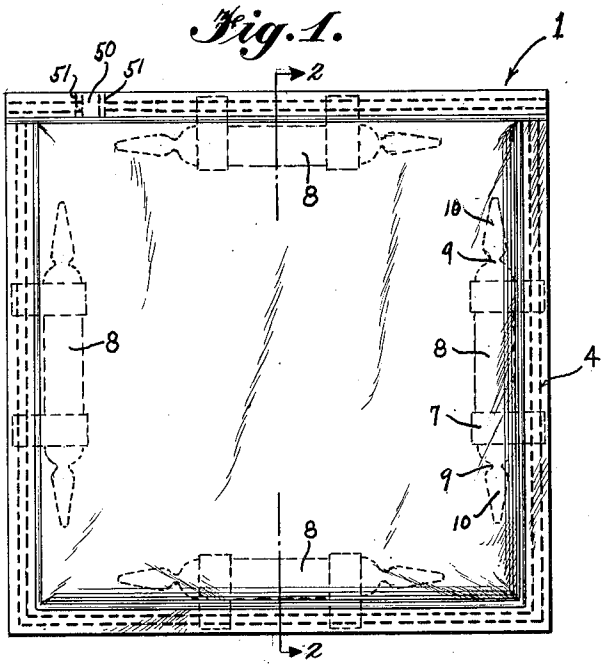



Fig. 2.

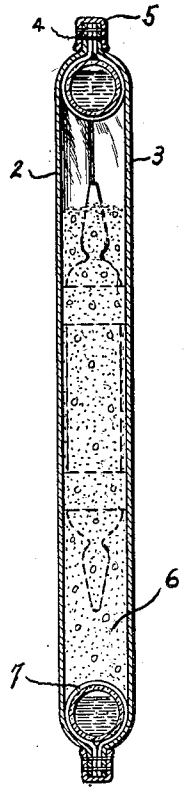



Fig. 3.

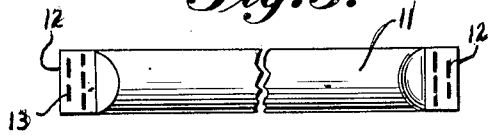



Fig. 4.

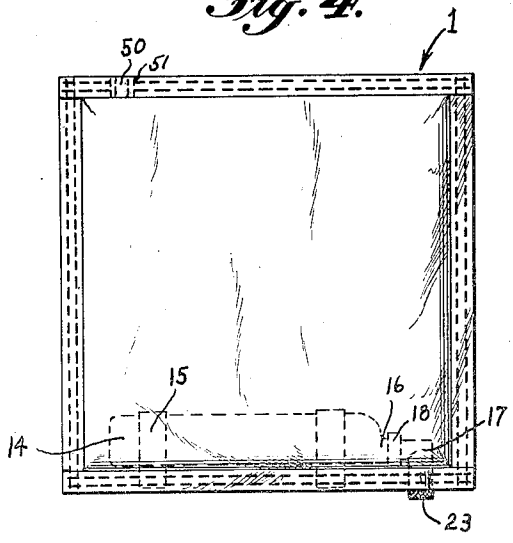
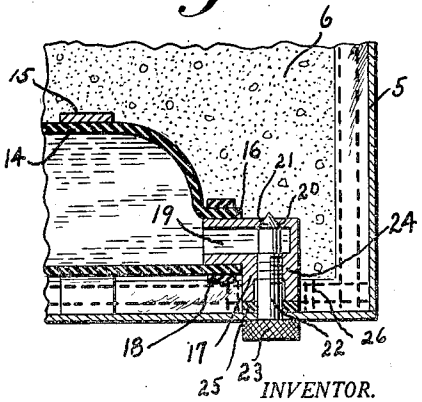



Fig. 5.




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Fig. 6.

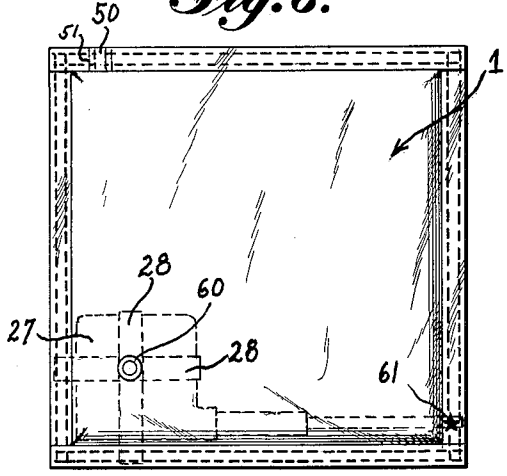



Fig. 8.

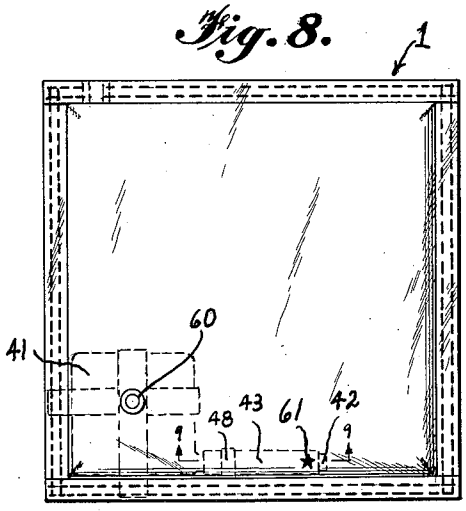



Fig. 7.

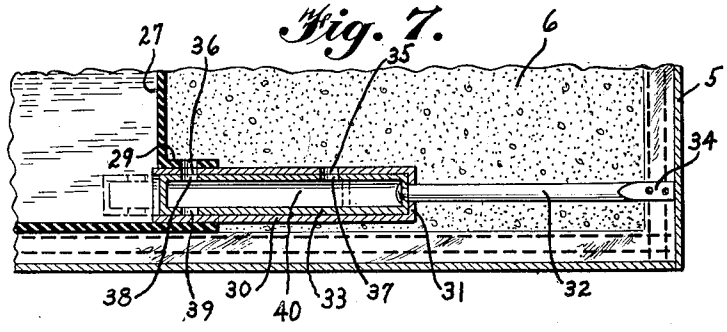



Fig. 9.

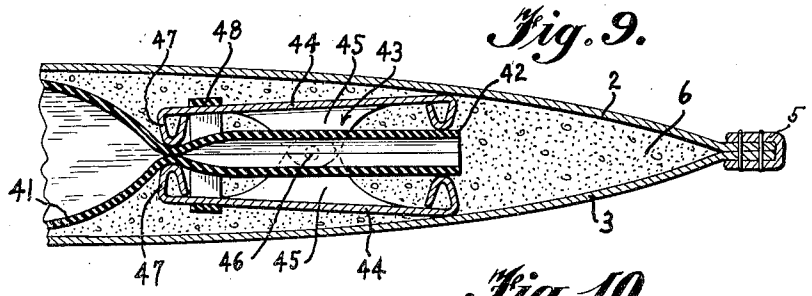
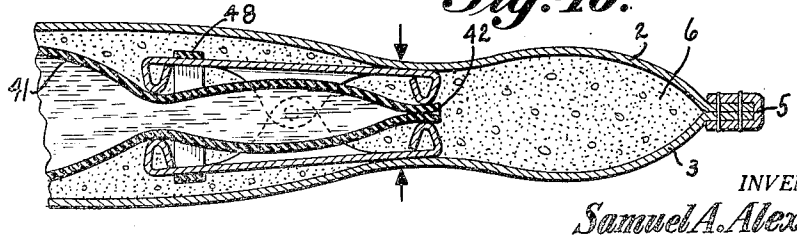



Fig. 10.




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# UNITED STATES PATENT OFFICE

2,541,736

## CHEMICAL HEATING DEVICE

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Application December 9, 1948, Serial No. 64,333

12 Claims. (Cl. 126—263)

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This application is a continuation-in-part of copending application, Serial No. 520,704, filed February 1, 1944, now abandoned.

This invention relates to a chemically heated unit or pad and relates particularly to that type of heating unit wherein two chemicals are intermixed to produce an exothermic reaction.

Heating pads of this general type have been known heretofore and involve a closed container having one of the chemical components enclosed therein, the other chemical component being introduced from the outside or by breaking a frangible container therefor which is also within a rigid container. In the previous devices, one of the chemicals usually consists of water and the other a dry powder. In one form of device, wherein the water was provided in a frangible container within the device, only one such container was provided having enough water therein to completely react all of the powdered chemical. Such an arrangement is unsatisfactory for use against a body since the temperatures produced are excessively high and result in burning or blistering persons using the unit in lieu of a hot water bottle. All of the heat is produced in a relatively short period of time and much of it wasted. Another type of known device consisting of a flexible bag having the dry powder therein has an opening through a wall through which water or other liquid can be poured as desired to produce the reaction and consequent heating. This type of device has proven unsatisfactory since it necessitates an available supply of water or other fluid chemical separate from the unit, and the bother of pouring it through the inconveniently located opening provided. Quite often the water was spilled with consequent soiling of clothing, and the chemical powder could leak through the opening, thus, becoming lost and also soiling clothing on the user. Such devices are not adapted to an accurate control of maximum temperature and are subject to other disadvantages.

According to the present invention, a closed flexible container of a dry powder is provided and a supply of liquid chemical, such as water, is provided in the container, but maintained separated from the powder. Various means are provided for releasing the water in predetermined quantities or at predetermined rates to the powder, whereby the maximum temperature attained by the unit is controlled within relatively narrow limits and the general efficiency of the unit is increased. Since the container is substantially completely closed there is no leakage of either the liquid or the powder to soil clothing

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or surrounding equipment, and heating may be accomplished in successive steps to prolong the useful life of the unit while maintaining a sufficiently high temperature. In general, means are provided for metering predetermined quantities of liquid to the powder at the will of the user or in fixing the rate at which the liquid is continually discharged into the powder. All of the above functions are accomplished under the control of the user and from externally of the completely closed heating unit.

It is an object of this invention to provide a chemical heating unit in which all component parts are contained within a unitary member.

It is a further object of this invention to provide a chemical heating unit wherein the temperature may be controlled at the will of the user to insure temperatures not exceeding a safe maximum.

It is a still further object of this invention to provide a chemical unit of the above type wherein the temperature is controlled by controlling the quantity of reactants intermingled at one time, thus, limiting the temperature attained.

Further objects and advantages will become apparent as the description proceeds, in connection with the accompanying drawings, wherein:

Fig. 1 is a plan view of one form of heating unit embodying the present invention;

Fig. 2 is a sectional view on line 2—2 of Fig. 1;

Fig. 3 is a view of a liquid container that may be used in place of the container disclosed in connection with Figs. 1 and 2;

Fig. 4 is a plan view of a modified form of heating unit;

Fig. 5 is a partial sectional view of the control valve elements of the embodiment of Fig. 4;

Fig. 6 is a plan view of a still further modified form of heating unit;

Fig. 7 is a partial sectional view of a portion of Fig. 6 showing the liquid metering means;

Fig. 8 is a plan view of a fourth modification, and

Figs. 9 and 10 are partial sectional views taken substantially along the line 9—9 of Fig. 8, showing the valve parts in different positions.

In all of the embodiments illustrated and to be described hereinafter, the heating unit comprises an outer flexible bag 1 made up of opposed side panels 2 and 3, fastened together at their terminal edges such as by stitching 4. Preferably, the peripheral edges are bound by a folded tape, or the like, binding element 5, and the stitching extends through the tape and the side panels to provide a closed container. The sack or container

is preferably water proof and may be formed of rubber, a rubber-coated fabric, a closely woven, water-tight fabric, or any other suitable material that is flexible and water proof.

Within the sack is a supply of a dry flexible powdered chemical 6 capable of combining with the chosen liquid in an exothermic reaction, that is, a reaction in which heat is liberated. The powdered material 6 may be of any well-known or preferred composition and, if desired, may be the heating chemical compounds shown in any of the following U. S. Patents: 1,488,656; 1,558,248; 1,602,456; 1,760,102; 1,910,874; 1,978,388; or 2,040,406.

The nature and construction of the sack just described is common in all of the embodiments and the dry chemical employed may be the same in each.

In the embodiment illustrated in Fig. 1 a plurality of tape or clip elements 7 are attached to the terminal edges of the bag and hold containers 8 of water or the like. The holding means 7 may, if desired, be of elastic material to exert a firm grip on the water containers. The containers 8 comprise vials made of glass or other frangible material having reduced neck portions 9 and closure tips 10. As shown, four such containers are provided and the quantity of water therein will be such that the total water in all of the vials is just sufficient to completely react on all of the powder 6, thus, each vial contains enough water to react with only approximately one-fourth of the powder. When it is desired to place the unit in operation, it is only necessary for the user to grasp the sack 1 adjacent one of its edges, and since the sack is flexible, it will be possible to detect the position of the closure caps 10 which may be pinched between opposite side panels 2 and 3, and by bending or the application of a bending force, the closures may be broken from the vials 8 at the reduced neck portions 9 to open the container and permit the contained water to mix with the chemical and react to produce heat. A closure 10 is shown at each end of each vial so that the opening provided at one end constitutes a passageway for the water and the other constitutes a vent to admit air or other gas to replace the water. If desired, the neck portions 9 may be scored or otherwise weakened to further facilitate their breakage. It will be readily apparent that after the reaction resulting from the water contained in one vial has terminated and the unit has cooled below the desired temperature, the second vial may be opened to admit a second charge of liquid to the powder 6, thus repeating the previous cycle of operation. In this manner, the maximum temperature attained can be kept below a desired value. Clearly the total supply of liquid may be divided into more or fewer than the four equal parts shown.

Fig. 3 illustrates an alternative form of water container to be employed in the sack shown in Fig. 1. The container 11 is a short length of tubular metal foil or the like having a predetermined charge of water therein. The ends of the tube are folded over, as at 12, to provide a seal and may be stitched as at 13, or crimped, or embossed in any suitable manner to prevent accidental opening. With containers of this type in the sack of Fig. 1, it is only necessary for the user to squeeze the container, through the flexible side panels 2 and 3, thus producing enough internal pressure to rupture the crimped or folded ends and release the contained water to the dry powder 6.

The embodiment shown in Figs. 4 and 5 comprises a flexible sack 1, constructed in the same manner as described in connection with Fig. 1, but having a single container 14 for water therein. The container of this embodiment is preferably of a flexible nature and may be made of rubber or other suitable material. Clips or bands 15 are attached to the sack 1 in the same manner as the elements 7 of Fig. 1 and act to hold the container 14 in fixed position in the unit. The water holding means 14 preferably has a reduced neck portion 16 in which a valve element 17 is sealed as by means of a rubber band 18 or the like. Clearly the valve body 17 could be sealed to the reduced neck portion 16 by a suitable cement if desired. The valve body 17 has a bore 19 therein communicating with an outlet opening 20. The opening 20 may be of conical shape to receive a conical valve element 21 carried by a threaded shank 22 and having a head 23. The head 23 will preferably be located on the outside of the flexible bag for ready manual manipulation. The valve body 17 has an angular portion 24 extending adjacent the outer edge of the sack, and a sealing ring or washer 25 may be provided to prevent escape of water from the sack.

In the operation of this embodiment of the invention, the user may manipulate the head 23 of the valve 21—22 to move the valve or closure portion 21 a short distance from the seat 20, thus providing a passageway for water to the dry powder 6. The valve may be opened to any extent desired, and it may be found necessary upon starting operation to apply pressure to the flexible container 14 to force liquid through the passageway. After the heating reaction has commenced, air trapped in the sack 1 and/or gaseous products of the reaction will create sufficient pressure in the sack and on the container 14 to force water from the latter. The operator may leave the valve open for a sufficient length of time to discharge a predetermined quantity of water and then close the valve and use the heated pad in the normal way. As an alternative mode of operation, the valve 21 may be left open a very small amount and, since the pressure within the sack will be applied to the container 14, a continuous small stream of water will flow to the dry powder. In this manner a relatively constant temperature may be maintained, and experience will teach the proper opening to obtain any desired maximum temperature. If desired, the head 23 may be calibrated to indicate the proper opening for the desired conditions. In this construction the stitching around the periphery of the main sack will of necessity terminate adjacent the portion 24 of the valve body and cross stitching 26 may be provided to effect a satisfactory seal between the sack and the portion 24.

The embodiment shown in Figs. 6 and 7 comprises a flexible sack 1, as previously described, having a flexible water container 27 therein. The container 27 may be of the configuration shown, in which case a pair of crossed loops 28 are provided to retain it in position, or it may be of any other desired configuration. The container 27 will preferably be provided with a reduced neck portion 29 in which a rigid tubular structure 30 is sealed or otherwise secured in liquid sealing relation. The tube 30 is provided with a closed outer end 31 having an opening therethrough to slideably receive an actuating rod 32. The actuating rod 32 is rigidly attached to a closed end tubular structure 33 snugly and slideably received within the tubular structure 30. The

outermost end of the actuating rod 32 may be flattened as at 34 and suitably attached to the marginal portion of the flexible sack by pins, stitching, or in any other suitable manner. The reduced or flattened portion 34 will preferably extend between the peripheral edges of the side panels of the sack. The rigid tubular structure 30 is provided with a pair of openings 35 and 36. The opening 36 may be within the neck portion 29 of the container 27, in which case a registering opening through said neck piece will be necessary, or it may be located outwardly therefrom. The closed tubular structure 33 is provided with a pair of openings 37 and 38 registering with the openings 35 and 36, respectively, when the parts are in the position shown in full lines in Fig. 7. The closed structure 33 may be further provided with an opening 39 adjacent its inner end. It is preferable that the openings 36, 38 and 39 be as near as practical to the innermost end of the tubular structure 33. The container 27 will be positioned in the sack 1 filled with water, and when it is desired to operate the heating unit the user may grasp the actuating bar or rod 32 adjacent the end 34, and since the sack 1 is flexible, the rod 32 may be moved inwardly relative to the tubular structure 30, thus moving the inner tubular structure 33 to the position shown in dotted lines in Fig. 7. In this position, the openings 37 and 38 are moved out of registry with the openings 35 and 36, and the openings 38 and 39 will move beyond the innermost end of the tube 30 and into the container 27. In this position, water may enter one opening 38 or 39, and air may leave the member 33 through the other opening. In this manner the chamber 40 defined by the inner member 33 may be filled with water. In some instances it may be necessary to apply pressure to the container 27 to effect filling of the chamber 40. After the chamber 40 has been filled, the operator may then pull on rod 32 and return the parts to the position shown in full line in Fig. 7, in which position water may leave the chamber through opening 37 or 38 or other gases may enter the chamber to replace the water through the other of said openings. The structure just described is what is commonly known as a "trap chamber" and, as will be seen, is effective to discharge predetermined quantities of the liquid to the dry powder 6 upon actuation in the manner described. It is contemplated that the dimensions of the parts be so determined that the chamber 40 will hold sufficient water to react with enough of the dry powder 6 to produce the desired temperature at each actuation.

The modification illustrated in Fig. 8 comprises the flexible bag 1, hereinbefore described, and a container 41, which may be similar to that described in connection with Fig. 6. In this modification also it is preferred that the container 41 be of suitable flexible water impervious material. Referring to Figs. 9 and 10, it will be seen that the container 41 is provided with an elongated reduced tubular neck portion 42. A pinch-cock device 43 is arranged around the neck portion 42 and comprises a pair of similar elements having longitudinally extending body portions 44 and angularly arranged flanges 45. The flanges 45 are pivoted to each other, as at 46, and the terminal ends of the body portions 44 may be bent over in the manner shown at 47 to provide abutments for a purpose to be described. An elastic band 48 of rubber, or the like, may be provided adjacent the innermost end of the pinch-cock to normally maintain the parts as shown in Fig. 9. In this position the in-turned end portions 47 at the inner end of the pinch-cock, being urged together by the band 48, will pinch the tubular neck portion 42 of the container 41 and effectively seal the neck from the interior of the container. Any water in the neck portion 42 at this time will be free to flow into the powder 6 to react therewith and produce heat.

When it is desired to discharge more water to the powder 6 it is only necessary that the user squeeze the flexible side panels 2 and 3 of the bag 1 where its panels overlie the outermost ends of the pinch-cock (as indicated by the arrows in Fig. 10) to pivot the parts to the position shown in Fig. 10. In this position, the outermost end of the neck portion 42 will be pinched closed, whereas the portion of the neck previously held closed will be allowed to open and water may flow or be forced into the intervening neck portion to completely fill the same. Upon release of the pressure applied as indicated at Fig. 10, the band 48 will return the parts of the pinch-cock to the position shown in Fig. 9, thus releasing the water in the neck to flow into the powder 6. The container 41 is preferably made of flexible material so that upon opening of the cock to the Fig. 10 position, pressure on the sides of the container will force water into the neck portion 42. It will be evident that upon each actuation of the pinch-cock a predetermined quantity of liquid will be discharged into the powder and will produce a predetermined quantity of heat. The metering arrangement just described may also be termed a "trap chamber." If desired the neck portion 42 may be molded or otherwise formed to normally assume a flattened or collapsed form to thus force all the contained water therefrom when the parts are in the position of Fig. 9.

In each of the modifications disclosed above, a supply of water or other liquid chemical is contained within the flexible sack and means are provided for releasing that liquid in predetermined quantities to the dry powder chemical. In each case, the quantity of water released each time is insufficient to react the entire supply of powdered chemical, and in each case the total supply of water available is sufficient to completely react with the powder. Applicant has provided a means for controlling the rate of heat production whereby a satisfactory and efficient heating unit or bag may be made.

In each of the embodiments shown and described the peripheral stitching 4 is interrupted at some such point as 50 and cross stitching 51 employed to define a relatively small restricted passageway from the interior of the sack to the exterior. The stiffness of marginal portions of the sack will be sufficient to maintain the restricted passageway normally closed to prevent leakage of powder therethrough, but will permit high pressure within the sack to be vented. High pressure may be developed within the sack by virtue of expansion of trapped air when heated or by production of gases during the exothermic reaction contemplated.

In many instances, it will be desired to produce a heating unit that may be brought into operation after exposure to extremely low temperatures and if water is employed as one of the reactants, provision must be made to prevent freezing of the water. Satisfactory results are ob-

tainable by combining equal parts, by volume, of water and "Prestone," which is a well-known anti-freeze composition. Other suitable anti-freeze compositions may be used, such as alcohol, salt, etc. The proportions of water and the particular anti-freeze employed may vary according to the conditions under which the heating unit is to be used.

Indicia 60 and 61, shown in Figs. 6 and 8 may be provided on the outer surface of the flexible sack to indicate the positions of the manipulatable or movable control members. For instance, the indicia 61 of Fig. 6 may indicate the location of the portion of the rod 32 to be grasped to actuate the closure means 33, and the marking 60 may indicate the approximate center of the container 27 to show where to apply pressure to insure filling of the trap chamber. In like manner, the indicia 60 may be employed to indicate the approximate center of the container 41 in Fig. 8, and the mark 61 may indicate the points at which to apply pressure to actuate the pinch-cock of this embodiment. The indicia or markings may be visual, or may be raised projections to enable the user to actuate the device in the dark or whenever it is inconvenient to directly observe the heating unit, and either type may be used on any of the modifications.

In each of the embodiments, after the particular passageway has been opened by manipulation of the closure and water has been admitted to the powder, it is desirable to thoroughly distribute the water throughout the powder, and to this end the sack may be turned upon its edge to cause flow downwardly from the discharge means or by otherwise agitating the heating powder 6.

Although water has been described herein as one of the reacting chemicals it is to be understood that the invention is not limited thereto but that any chemical compound capable of being handled in the manner described may be employed with any other suitable chemical with which it will react to produce heat.

In all of the described embodiments, a supply of water sufficient to react all of the powder is contained within the heating unit. In many instances, due to the location of its use, it may be unnecessary to provide the water or other liquid in the unit. For instance, life preservers may be provided with containers for the powdered chemical and, since such life preservers will be in water when in use, it will be unnecessary to provide a supply of water in the heating unit itself. In such instances the water-admitting means of Figs. 4 to 10 may be incorporated in the wall of the powder container and be manipulated in the manner described to admit water surrounding the life preserver to the chemical powder.

It is also contemplated that the heating unit of the present invention may be equipped with a thermostatic device to effect periodic manipulation of the closure means upon the attainment of predetermined temperature conditions. The adaptation of such known thermostatic devices to the heating unit of the present invention will be readily apparent to those skilled in the art. For instance, the relatively movable elements of the embodiments of Figs. 6 and 8 may be joined by a bi-metallic unit to effect operation thereof at the limits of a predetermined temperature range for which the device is set. Likewise, the embodiment of Fig. 5 may have a valve 21 movable directly by a bi-metallic or other temperature responsive element to control the flow. In any thermostatically controlled unit, however, it would be necessary to provide means to render the control inoperative until such time as the heating of the pad and the maintenance of a predetermined relatively high temperature is desired.

Although a limited number of embodiments have been shown and suggested, it is clear that the invention is capable of expression by other means, and all such embodiments are contemplated as fall within the scope of the appended claims.

I claim:

1. In a chemical heating device, a flexible sack, a divided flexible chemical mass held within the sack, a plurality of sealed frangible tubes arranged in spaced relation within the sack, means to hold the tubes in position within the sack adjacent to the edges of the sack, each tube containing a measured amount of liquid to react with a portion only of the chemical mass, the liquid being released when the tube is broken or crushed, the chemical mass and liquid being adapted to produce an exothermic reaction when combined.

2. In a chemical heating device, a flexible sack for holding a flexible chemical mass, a rigid container arranged within the sack and having a reduced frangible neck to be broken by a bending pressure applied to the exterior of the sack, the container holding a chemical, the chemical mass and said chemical being adapted to produce an exothermic reaction when combined and constituting the entire reactants.

3. In a chemical heating device, a relatively thin flexible sack having a marginal edge and adapted for holding a flexible chemical mass, a rigid tube arranged within the sack adjacent to the marginal edge and having a reduced frangible neck to be broken by a bending pressure applied to the exterior of the flexible sack, the container holding a chemical, the chemical mass and said chemical being adapted to produce an exothermic reaction when combined, and means to hold the rigid tube in place in the sack adjacent to the marginal edge.

4. In a chemical heating device, a relatively thin flexible sack having a marginal edge, a flexible chemical mass arranged within the flexible sack, rigid tubes arranged within the sack and held therein adjacent to the marginal edge and extending longitudinally of the marginal edge, each rigid tube having a reduced frangible neck spaced from its end to be broken by a bending pressure applied to the exterior of the flexible sack, a measured amount of a chemical held within each tube sufficient to react only with a portion of the chemical mass, the chemical mass and said chemical being adapted to produce an exothermic reaction when combined.

5. In a chemical heating device, a relatively flat flexible sack, a flexible dry finely divided chemical compound held within the sack, a rigid tube mounted within the sack and provided at points spaced from its ends with reduced frangible necks to be broken by a bending pressure applied to the exterior of the flexible sack, and a liquid chemical held within the rigid tube, the liquid chemical being rapidly discharged from the tube when both necks of the tube are broken, the chemical mass and liquid chemical being adapted to produce an exothermic reaction when combined.

6. A chemical heating device, comprising a

sack, a chemical mass held within the sack, a plurality of closed frangible containers within the sack, and a measured amount of liquid within each container and of a volume to react only with a portion of the chemical mass, the liquid being released from each container when such container is broken, the liquid being adapted to produce an exothermic reaction with the chemical mass, the chemical mass and liquid constituting the entire reactants.

7. In a chemical heating device, a flexible sack adapted to contain a dry finely divided chemical compound, liquid holding means within said sack and adapted to hold a supply of liquid separated from said chemical compound, said liquid and said chemical compound being adapted to produce an exothermic reaction when combined, and means manipulatable from exteriorly of said sack to release a predetermined fractional portion of said supply of liquid to said chemical compound, said predetermined fractional portion being sufficient to react only a portion of said chemical compound.

8. In a chemical heating device, a flexible sack adapted to contain a dry finely divided chemical compound, liquid holding means within said sack and adapted to hold a supply of liquid separated from said chemical compound, said liquid and said chemical compound being adapted to produve an exothermic reaction when combined, said supply of liquid being sufficient to substantially completely react said chemical compound, and means manipulatable from the exterior of said sack to release a predetermined fractional portion of said liqquid to said chemical compound, said predetermined fractional portion being sufficient to react only a portion of said chemical compound.

9. In a chemical heating device, a flexible sack adapted to contain a dry finely divided chemical compound, liquid holding means within said sack and adapted to hold a supply of liquid separated from said chemical compound, said liquid and said chemical compound being adapted to produce an exothermic reaction when combined, said liquid holding means including a portion having an opening adjacent said chemical compound, movable means adapted to admit a measured quantity of liquid from said supply to said portion and to release said measured quantity of liquid to said chemical compound through said opening.

10. In a chemical heating means, liquid impervious flexible wall means defining an enclosed space and having an opening therethrough, a flexible mass of chemical compound contained in said space, said wall means arranged to separate said chemical from a supply of liquid adjacent said wall means, movable closure means for said opening, said closure means being manipulatable from outside said enclosed space to admit a portion of liquid adjacent said wall means to said chemical compound, said liquid and said chemical being adapted to combine with an exothermic reaction and said portion of liquid being sufficient to react only a portion of said chemical mass.



11. In a chemical heating means, liquid impervious wall means defining an enclosed space and having an opening therethrough, a flexible mass of chemical compound contained in said space, said wall means arranged to separate said chemical from a supply of liquid adjacent said wall means, movable closure means for said opening, said closure means defining a trap chamber to hold a predetermined quantity of liquid, said closure means being manipulatable from outside said enclosed space to admit a portion of liquid adjacent said wall means to said chemical compound, said liquid and said chemical being adapted to combine with an exothermic reaction and said predetermined quantity of liquid being sufficient to react only a portion of said chemical mass.

12. In a chemical heating device, a flexible sack, a flexible dry finely divided chemical compound held within the sack, liquid holding means within said sack and adapted to hold a supply of liquid separated from said chemical compound, means providing a passageway for liquid from said supply to said chemical compound, movable closure means for said passageway and having an actuating portion adjacent said flexible sack whereby said closure means may be moved by applying pressure to said sack adjacent said actuating portion to admit liquid to said chemical compound from said holding means.

SAMUEL A. ALEXANDER.

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