Nov. 6, 1945. W. A. CALDWELL 2,388,466

CHEMICAL IMMERSION HEATER

Filed Jan. 9, 1942

Fig. 1.

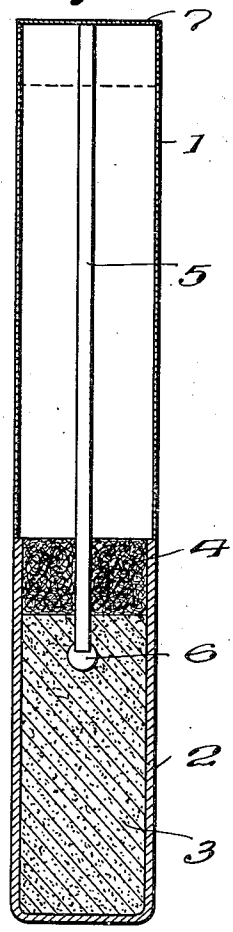


Fig. 2.

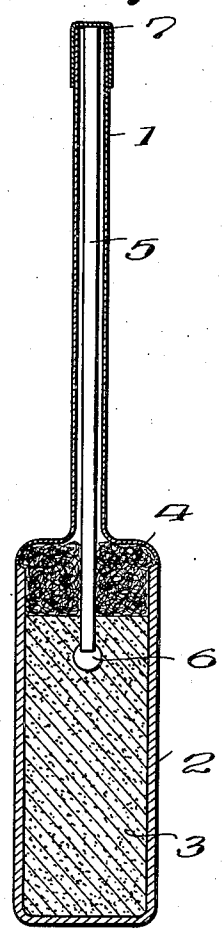


Fig. 4.

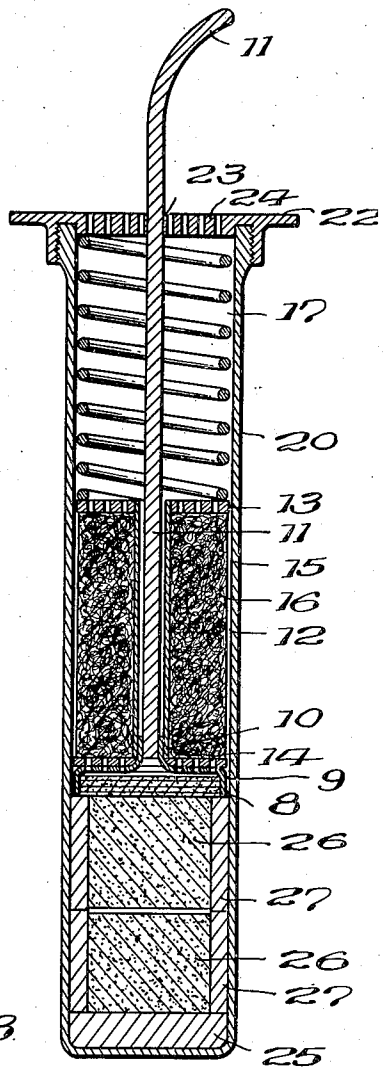
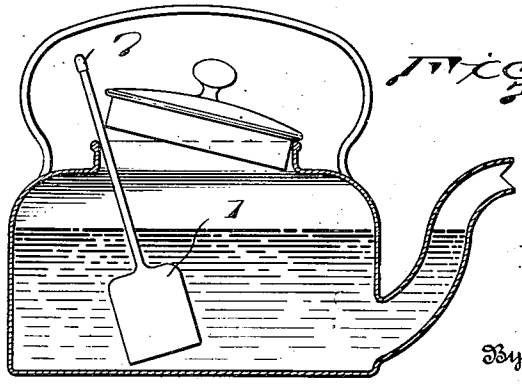


Fig. 3.



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CHEMICAL IMMERSION HEATER

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8 Claims. (Cl. 126—263)

This invention relates to a heating device, and in particular to an immersion heater suitable for use when ordinary heating appliances are not available or are inapplicable, the heating material employed being such as to give rise to no inflammable vapours on storage.

Circumstances often arise when it is desirable to have the means for heating materials such as water or liquid foods when there is no access to gas or electric supply or ordinary kitchen heating apparatus. Numerous forms of portable stoves burning volatile fuels are known, but the immersion heaters of the present invention can be employed in situations in which volatile fuels are inapplicable or cannot conveniently be used, for instance under rough weather conditions or in confined spaces such as rooms sealed against the entry of poison gas. They are more easily handled than stoves.

It has been proposed to use for heating purposes chemical compositions which generate heat when moistened, but the compositions employed have only a low heat evolution and have not been used in immersion heaters.

According to the invention an immersion heater comprises a container charged with a composition comprising ingredients capable, on ignition, of undergoing chemical reaction with the generation of heat but substantially without the evolution of inflammable gas or vapour; means operable from outside the container for igniting the said composition; a vent leading from the space occupied by the said composition to the exterior of the immersion heater; filtering means interposed between the heating composition and the exit from the vent adapted to permit the passage of any heated air or gas but to retain any solid particles; and heat insulation interposed between the heating charge and the surface or surfaces of the container adapted to come into contact with the immersion medium when the heater is in normal use; the immersion heater being also so adapted that in such use the exit from the vent is outside the said immersion medium. The heating charge suitably comprises a mixture of solid oxidising and reducing agents adapted to react with the generation of intense heat and substantially without the evolution of gas. The container may advantageously be tubular and the invention will be described hereinafter with reference to a tubular container.

It must either be provided with a device whereby it can be held with the opening of the tube outside the substance being heated, or also be of such shape that an end can itself act as such a device. Also according to the invention the heater may be internally lined with heat insulating material, e. g. with asbestos paper, at the portion containing the charge, the purpose of the lining being to prevent heat flowing to the exterior of the tube too fast and so causing singeing, charring or other local overheating effects. Alternately the tube may be made of poorly conducting material.

According to a further feature of the invention the tube may be made so that after the reaction is over the residue can be removed and replaced with a new charge, and, if necessary, a new ignition device; while a further feature of the invention comprises a reloadable tube which is adapted to accommodate charges of different sizes, so that the user can adjust the charge to the quantity of substance he wishes to heat.

The heating mixture may comprise a pulverulent metal alloy or silicide and a pulverulent oxidising agent that react together when thermally initiated to yield intense heat but little or no gas. Suitable mixtures may be formed for instance from calcium silicide and red lead and/or iron oxide (hammerslag), aluminium and iron oxide, ferrosilicon and red lead, or antimony and potassium permanganate. Other combinations of oxidising and reducing agents on which the heating mixture may be based include mixtures of antimony, zinc and potassium permanganate; antimony alloys and oxidising agents such as potassium permanganate; red lead and sulphur; mixtures of selenium or tellurium with oxidising agents such as barium peroxide or potassium permanganate; red lead and ferrosilicon 87:13, lead chromate calcium silicide 90:10, zinc potassium permanganate 60:40, iron potassium permanganate 30:70, tin lead peroxide 35:65, tin potassium permanganate 40:60, magnesium barium peroxide 6:94, calcium silicide red lead 30:70.

The intensity of the reduction may be controlled by varying the proportion of reducing agent to oxidising agent, or by the inclusion of such ingredients as talc or china clay, or other chemically inert heat absorbing solid diluent, but the mixture should be such as to assume a red to white heat when ignited in an uncooled vessel. The mixture may be compressed or caked to minimise its bulk.

The ignition means operable from the exterior may comprise an element adapted to be initiated by a small source of heat such as a match fuzee or the like, for instance a length of touch paper coated with a nitrocellulose composition and dusted with a slag forming igniting mixture, or a

length of quick match fuze or some other type of fuze passing through the vent. The fuze composition may itself be of a gasless nature. Percussion or friction ignition means may however be provided.

Since the heating mixture may be difficult to ignite it is in some cases desirable, especially when the mixture has been diluted with inert heat absorbing material, to provide an intermediate priming charge, which may advantageously consist of an easily ignitable gasless mixture.

The tube can be made of any substance which will withstand having simultaneously one side submitted to the high temperature of combustion and the other side to the cooling effect of being in contact with the substance being heated. For instance a tube of thin sheet steel, tin plate, brass or silicate may be used. It may be made for instance from sheet metal by any method yielding a gas tight closure, such as drawing or folding, seaming and soldering.

The end and a portion of the side may be lined with a layer of asbestos, china clay, sodium silicate mixture, or other heat resisting material.

As ignition means a fuse may be introduced through the venting means into the tube so that one end is embedded in the heating mixture.

The filtering means may advantageously consist of a plug of glass wool or asbestos wool and the fuse may pass through it. According to one form of the invention the part of the tube which remains empty may be pressed flat. This prevents the contents of the tube from falling out, grips the fuse in position, while the presence of the fuse prevents the tube from being entirely flattened and ensures a passage for the egress of the heated air.

For storage and transport the event and the ignition means may be temporarily closed in, for instance by means of adhesive tape or paper, a soldered metal tear off or the like.

In use the end of the heater containing the charge is placed in contact within the substance to be heated in such a way that the whole of this part of the heater is embedded or immersed in the substance, while the vent is kept outside. The fuse is then ignited and in its turn ignites the heating mixture which rapidly reacts leaving a residue at a very high temperature.

Another form of immersion heater which can be reloaded comprises a tube having at the base a layer of heat insulating material. Into the bottom of this tube are dropped one or more pellets of the heating mixture, possibly containing a small quantity of silicate, to act as a binder. Each pellet is made up with a tubular layer of heat insulating material surrounding it and of such size as to fit conveniently into the heater. Above the pellets of heating mixture is placed a perforated metallic disc having an ignition composition on the side facing the heating material and having a tubular extension parallel to the tube in the opposite direction, which extension is crimped around the end of a piece of safety fuse. This tubular extension is adapted to pass into a central tube which passes right through a removable block of glass wool or other filtering material, which is held in shape by a perforated plate at each end. A perforated cap can be screwed into the open end of the tube carrying a spring which presses on the filter and so keeps the contents of the tube in position. A length of the safety fuse will pass through this cap.

This invention is as illustrated by the accompanying drawing in which Figures 1 and 2 are two cross sections at right angles to each other through the axis of the heater. Figure 3 illustrates the heater in use to boil a kettle of water, while Figure 4 illustrates a section through a form of heater which can be reloaded. Referring to Figures 1 and 2, the outer case 1 of thin steel is cylindrical at one end and flattened at the other. The cylindrical end is closed. A lining 2 made by a mixture of china clay and sodium silicate is placed in the cylindrical portion of the heater forming a cup shaped receptacle which is filled with the heater composition 3 consisting of 35 parts of calcium silicide, 65 parts of red lead and 8 parts of talc. Above this heating mixture is a block 4 of glass wool. Through this block of glass wool is the fuse 5 which extends from the open end of the heater to a priming composition 6 consisting of a mixture of calcium silicide and red lead. The top end of the tube is closed by a protective layer 7 of adhesive tape.

The method of using the heater is illustrated in Figure 3. The heater is dropped into a kettle with the flattened end sticking out through the lid opening.

The lid is placed so that it closes as much of the opening as possible so as to preserve the heat. The protective tape 7 is then torn off and the match applied to the end of the fuse. We have found that by using a heater containing 150 gm. of the above heating mixture that we can bring to the boil 1 pint of water in 90 seconds. Instead of putting the lid into place as shown in Figure 3 it is sometimes an advantage to stir the liquid which is being heated with the immersion heater.

Referring to Figure 4 a metal container 20 having tubular side walls 15 is fitted with a screw cap 22 which is perforated centrally at 23 to take the end of the safety fuse and also at 24 to allow the escape of gases from inside the tube. At the foot of the tube 15 is a lining 25 of china clay and sodium silicate. Two charges 26 each having previously been made up with a tubular layer 27 of china clay and sodium silicate are placed on top of the heat insulating layer 25. On the top of the upper pellet of heating material is pressed a layer 8 of ignition composition, which layer is carried by perforated plate 9 having a tubular extension 10 crimped on to a safety fuse 11 which passes through the central hole 23 of the cap 22. The tubular extension 10 and the safety fuse 11 pass into a metal tube 12 which extends between two perforated plates 13 and 14 which together with the tubular member 15 enclose the filter of glass wool 16. This filter is pressed in a downward direction by the spring 17 which abuts on the cap 22.

To reload the device after it has been used the cap 22 is removed and the filter is pulled right out of the tube by means of the remains of the safety fuse 11 which together with the plate 9 is then discarded. The slag of the heating mixture will still be enclosed in the china clay and silicate tubes and can be jerked out of the tube.

In accordance with the amount of liquid which is to be heated a number of pellets are introduced into the tube. The user is provided with an ignition mixture fitted to a new plate 9 with the new safety fuse 11, crimped into the extension 10. The fuse is first threaded through the tube 12 and then the fuse and filter are together pressed into the tube, the spring 17 placed on top and the cap 22 screwed into place.

I claim:

1. A portable immersion heater comprising an elongated container having a closed end, a lin-

ing of heat-insulating material therein adapted to retard the transfer of heat from the interior to the walls of the container, a charge of heating composition in the container adjacent the closed end, said charge having ingredients which react chemically and produce heat upon ignition, a filter substantially coextensive in cross-sectional area with the interior of the container above the charge, comprising a gas pervious plug of substantial thickness of refractory wool through which gases from the charge may pass and having a central fuse passage therethrough, means for confining the filter and the charge in the container, vent means in the other end of the container through which gases passing through the body of the plug may escape to the outside, and a fuse accessible from the outside and extending through the vent means and the central passage in the filter to said charge.

2. A portable immersion heater comprising an elongated tubular container having a body closed at one end and lined with heat-insulating material, means defining a vent opening of restricted size, an elongated hollow neck of corresponding size projecting from the vent opening and providing an elongated vent passage, a charge of ignitable heating composition confined in the body adjacent the closed end thereof, said charge having ingredients which react chemically and produce heat upon ignition, and a fuse accessible from the outside and extending through the vent passage and vent opening to the charge.

3. A portable immersion heater adapted for insertion in a vessel to heat the contents thereof, comprising a tubular container having a body closed at one end and lined with heat-insulating material, means at the other end of the body defining a vent opening of restricted size, an elongated hollow neck projected outwardly from the vent opening and providing a vent passage of correspondingly restricted size adapted to discharge exteriorally of the vessel to be heated, a charge of heating composition confined in the body adjacent the closed end thereof, said charge having ingredients which react chemically and produce heat upon ignition, a filter of porous refractory material of substantial thickness in the body between the charge and the vent opening and substantially coextensive in cross-sectional area with the interior of the body, and a fuse accessible from the outside and extending through the vent passage, the vent opening and the filter to the charge.

4. A portable immersion heater adapted for insertion in a vessel to heat the contents thereof, comprising a tubular container having a body closed at one end and lined with heat-insulating material and having an integral elongated neck of restricted cross sectional area extending outwardly from the outer end thereof and providing an elongated vent passage adapted to discharge exteriorly of the vessel to be heated, a charge of heating composition confined in the body adjacent the closed end thereof, said charge having ingredients which react chemically and produce heat upon ignition, a filter comprising a gas permeable plug of fibrous, refractory material in the body between the charge and the vent passage and of substantially the same cross-sectional area as the charge, and a fuse extending from the outer end of the passage through the filter to the charge.

5. A portable immersion heater adapted for insertion in a vessel to heat the contents thereof comprising a tubular container closed at one end and lined with heat-insulating material and having a flattened neck of restricted cross sectional area extending outwardly from the other end thereof and providing a vent passage adapted to discharge exteriorly of the vessel to be heated, a charge of heating composition in the body adjacent the closed end thereof, said charge having ingredients which react chemically and produce heat upon ignition, a filter interposed between the charge and the vent passage, and a fuse extending from the outer end of the passage through the filter to the charge.

6. A portable immersion heater adapted for insertion in a vessel to heat the contents thereof, comprising a tubular container closed at one end and internally lined with heat-insulating material adjacent its closed end, a substantial portion of the body of said container extending to its opposite end being flattened to provide a vent of restricted cross sectional area, adapted to discharge exteriorly of the vessel to be heated, a charge of heating composition confined in the closed end of the container, said charge having ingredients which react chemically and produce heat upon ignition, a filtering substance of substantial thickness packed upon the charge of heating composition between the charge and the flattened end of the body and coextensive in cross-sectional area with the charge, and a fuse communicating with said charge and extending through the filtering substance and the vent for access from the exterior of the heater.

7. A portable immersion heater comprising a tubular container having a closed end lined with heat-insulating material, a charge of heating composition in the container surrounded by said lining, said charge having ingredients which react chemically and produce heat upon ignition, a plug of refractory filtering material having a central bore disposed in the container above the charge, a priming device between the filter and the charge, means for retaining the filter and the priming device in the container, and a fuse extending from the outside through the last-mentioned means and the filter to the priming device.

8. A portable immersion heater comprising a tubular container having a closed end lined with heat-insulating material, a charge of heating composition in the container surrounded by said lining, said charge having ingredients which react chemically and produce heat upon ignition, a primer adjacent the heating charge, a plug of refractory filtering material between the charge and the other end of the container, an apertured closure for the latter end of the container, a spring between the closure and the plug for holding the plug and the charge in the container, and a fuse extending from the outside through the closure, the spring and the plug to the primer.

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