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BODY COOLING APPARATUS

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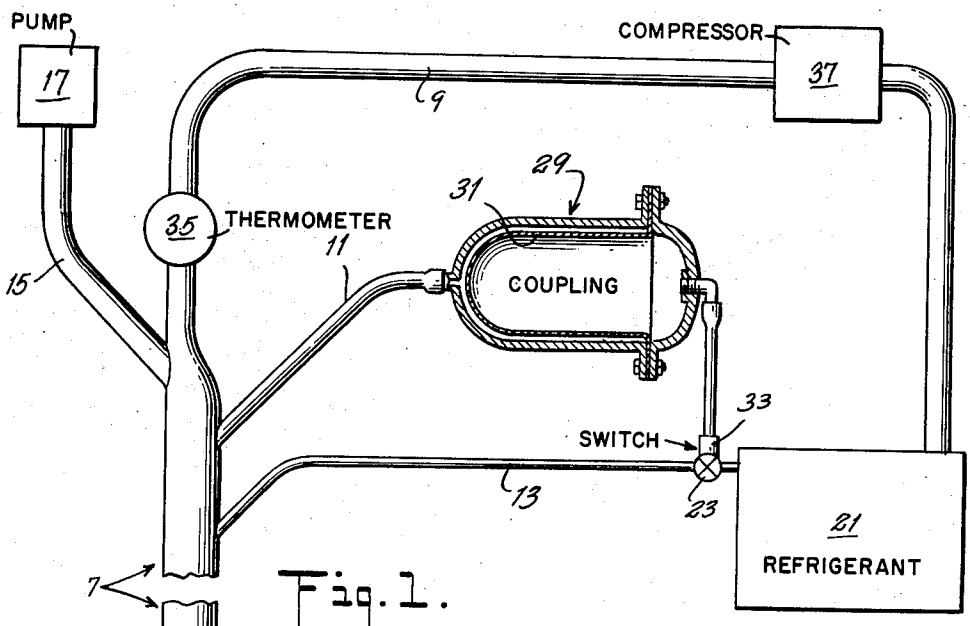


Fig. 1.

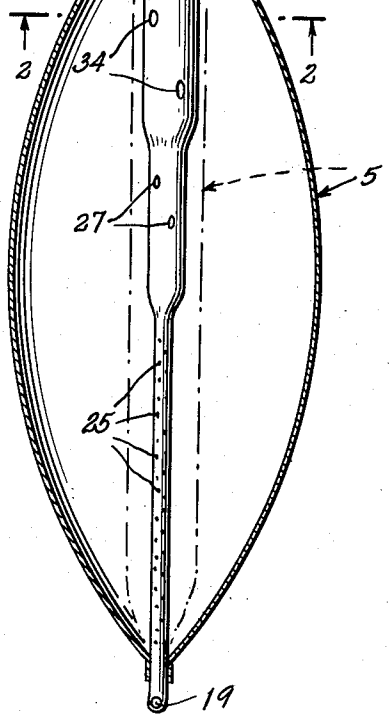
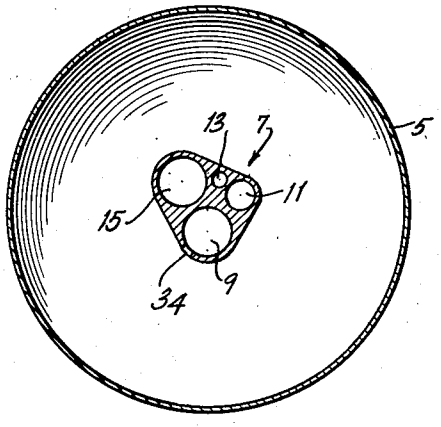


Fig. 2.



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BODY COOLING APPARATUS

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This invention relates to new and useful improvements for cooling a part or all of the body of a warm blooded animal and is more particularly concerned with a simple unit that provides refrigeration at the specific body site where cooling is desired, i.e., permits a liquid refrigerant to evaporate at the desired body site to obtain direct, quick, simple and efficient cooling.

Much attention has been given recently to cooling the entire body (for certain types of surgery) or a portion of the body for local surgery or to relieve certain conditions, e.g., stomach hemorrhages caused by perforated or bleeding ulcers.

For cooling the entire body external ice baths are generally used which is shocking to the body and inefficient as the surface blood circulation is automatically reduced to thus set up an insulation barrier between the cooling bath and the internal organs and blood supply.

For cooling a specific body organ such as the stomach internally, cold water way be introduced into the stomach through a "Levin" tube in an emergency, or a more expensive device permits the circulation of cold brine through tubes placed in the stomach.

The latter unit is quite expensive and thus not available in many hospitals and, moreover, takes more than an hour to get started as the brine must first be cooled to the necessary temperature. Furthermore, it takes extensive tubing within the stomach to have a large heat exchange surface and the response of the unit to controls is not very sensitive. The cold water technique is crude, shocking and, at best, considered only as an emergency measure.

Therefore, it is an object of this invention to provide a simple, direct and efficient method of cooling all or parts of the body where the cooling action of a conventional refrigerant is applied directly to the body member.

It is a further object of this invention to be able to start cooling the desired body member almost immediately after demand.

It is an additional object of this invention to provide a cooling method for reducing the temperature of the entire body by application of heat exchange to internal organs rather than to the outer body surface.

We have found that a conventional refrigerant may be cycled in a controlled manner whereby the evaporating and cooling cycle is performed in contact with a body member to be cooled so as to quickly, efficiently and simply cool said member to the degree desired.

This is particularly applicable to the internal stomach where quick, effective and controlled measures are often desirable in dealing with hemorrhages caused by ulcers. It further permits efficient cooling as more intimate exchange is made with greater amounts of the blood supply which is the heat carrier of the body.

With these and other objects and features in view, the nature of which will be more apparent, the invention will be more clearly understood by reference to the drawings, the accompanying detailed description and the appended claims.

In the drawings:

FIG. 1 is a diagrammatic section of a gastric cooling apparatus constructed in accordance with this invention; and

FIG. 2 is a section taken on line 2—2 of FIG. 1.

This invention as illustrated is embodied in a refrigeration unit especially adapted for cooling the stomach and includes a portion that rests inside the stomach, a long tube to reach the stomach through the esophagus and nasal passages or mouth, and an exterior control unit for circulating, compressing and controlling the amount of refrigerant.

A balloon 5 in a deflated state, as shown in dotted lines along with the esophageal tube 7, is swallowed through the oral cavity, fed through the nostrils, or otherwise placed into the stomach by conventional means. The balloon is made of any thin, non-toxic, non-irritating material, e.g., vinyl plastic and the tube is made of any conventional catheter material such as rubber or plastic with a radioopaque material coated or impregnated thereto. The tube 7 has sufficient length to reach from the stomach through the esophagus to a point outside the patient's mouth where the tube is divided into four subtubes (non-radioopaque), namely, a gas-refrigerant return tube 9, a pressure monitoring tube 11, a liquid-refrigerant feed tube 13, and a "Levin" tube 15. These four tubes have separate and independent bores (see FIG. 2) through the esophageal tube 7 into the balloon 5.

The "Levin" tube 15 is connected at its outer end with a pump 17 and has an opening 19 at its other end outside the balloon 5 at the extreme end of the unit and thus may be used to pump material in or out of the stomach cavity in a conventional manner.

A reservoir 21 contains a non-toxic refrigerant e.g., an inert material such as "Freon C–318" (octafluorocyclobutane) or "Freon 12" (dichlorodifluoromethane) at room temperature, which will thus exert from about 12 to 15 pounds per square inch pressure. Tube 13 is connected at its outer end to the reservoir 21 and carries a valve 23 which controls the flow of refrigerant through the tube. Tube 13 is provided at its inner end with a plurality of small orifices 25 through which the refrigerant sprays into the balloon 5 thereby inflating the balloon against the stomach wall as it sprays and simultaneously evaporates to create a cooling action throughout the balloon. The pressure should be maintained at a comfortable level for the patient which is up to about 16 ounces per square inch with the preferred range being about 1 to 6 ounces.

The pressure in the balloon is communicated, through openings 27 and the pressure monitoring tube 11, to a coupling 29 provided with a sensitive diaphragm 31 so arranged that only a minimum volume of refrigerant is involved whereas the major volume in the coupling is on the opposed side of the diaphragm and may be occupied by air or other cheap fluid. The opposed side of the diaphragm is connected to a pressure responsive solenoid switch 33 which is connected to and controls valve 23 to maintain the desired pressure in the balloon.

The gas refrigerant in balloon 5 is withdrawn through openings 34 and tube 9 past thermometer 35 positioned immediately outside the patient where the temperature has been found to be close to that within the balloon. The gas is withdrawn by the compressor 37 which includes a radiator cooling unit to cool the liquid refrigerant to room temperature after compression and prior to storage in the reservoir 21.

All the apparatus shown here outside the patient, i.e. pump 17, coupling 29, switch 33, valve 23, thermometer 35, compressor 37 and reservoir 21 will be conveniently mounted as a single unit on a stand with provision for detachably securing the subtubes 9, 11, 13 and 15. As a rule, there will be several tubular-balloon units for every stand unit as the tubular-balloon units should be washed and sanitized after each use.

The specific apparatus described herein is adapted par-

ticularly for direct contact with the stomach but a similar balloon may be placed in other body cavities such as the rectum, abdomen and chest or wrapped around body members such as the arms or legs to secure direct contact for efficient cooling. The cooling effect may be local as desired for gastric hemorrhages or sufficient to cool the entire body as for heart surgery. The whole body can readily be cooled from internal sites such as the stomach or rectum.

Using "Freon C–318" at about 1 to 4 ounces per square inch pressure within the balloon we have found the temperature in the balloon to be about 30° F. and about 32° F. at the thermometer 35. Patients with bleeding or perforated ulcers, who have been acutely ill and in great pain, have been greatly improved by use of the device at these levels for from 15 to 600 minutes, the cooling action starting within 10 minutes of decision to use the unit and the improvement in the patients being noted within 10 to 60 minutes.

The unit is also excellent for inducing general hypothermia quickly, efficiently and without shivering by the patient. One patient, with the balloon positioned within the stomach, had his temperature reduced from about 98° F. to about 86° F. over a period of 2¼ hours.

We claim:

1. A body cavity cooling device comprising a thin-walled inflatable container adapted to be positioned within said cavity and capable of lining the boundary wall of said cavity, an elongated member extending through and leading from one end of said container and adapted to reach from said cavity through a natural channel to the exterior of said body, a feed tube extending through said elongated member terminating at a plurality of small orifices in said container adapted for spraying a liquid refrigerant, a withdrawal tube extending through said elongated member terminating in an opening in said container adapted to withdraw gaseous refrigerant therefrom, and a monitoring tube extending through said elongated member terminating in an aperture in said container adapted to communicate the pressure in said container to the exterior of said body.

2. The cooling device of claim 1 which additionally comprises an access tube extending through said elongated member and terminating in a hole outside said container near the end opposed to said one end of said container.

3. An animal stomach cooling device comprising a thin-walled inflatable container adapted to be positioned within said stomach and capable of lining the boundary wall of said stomach, an elongated member extending through and leading from one end of said container and adapted to reach from said stomach through the esophagus to the exterior of said animal, a feed tube extending through said elongated member terminating at a plurality of small orifices in said container adapted for spraying a liquid refrigerant, a withdrawal tube extending through said elongated member terminating in an opening in said container adapted to withdraw gaseous refrigerant therefrom, a monitoring tube extending through said elongated member terminating in an aperture in said container adapted to communicate the pressure in said container to the exterior of said animal, means to force refrigerant through said feed tube and orifices whereby said refrigerant evaporates in said container, means to withdraw said evaporated refrigerant through said withdrawal tube, means to compress and cool said evaporated refrigerant to the liquid state, and means to recirculate said compressed and cooled refrigerant at a rate to maintain a pressure in said container.

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