

- [54] **HEATED TRANSPORT INCUBATOR**
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3,110,633	11/1963	Bachmann	136/161
3,162,753	12/1964	Boyer	219/399
3,264,448	8/1966	Lehmer	219/210
3,299,253	1/1967	Lawson, Jr.	219/385
3,400,249	9/1968	Makjean et al.	219/378
3,569,669	3/1971	March	219/378
3,764,780	10/1973	Ellis	219/430

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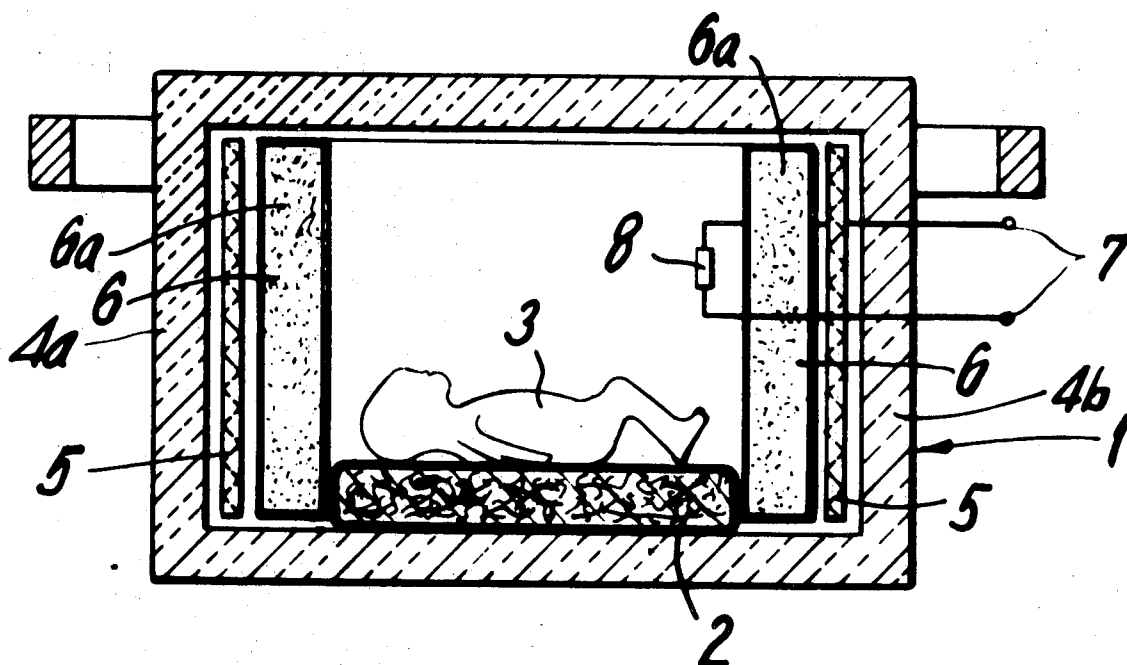
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- [56] **References Cited**
UNITED STATES PATENTS
- | | | | |
|-----------|---------|----------------------|-----------|
| 2,897,334 | 7/1959 | McFarlane et al..... | 219/436 |
| 2,944,134 | 5/1960 | Kenyon | 219/521 X |
| 3,070,086 | 12/1962 | Smith et al..... | 128/1 |

[57] ABSTRACT

An incubator for transporting babies while keeping them, during the transportation, under a constant ambient temperature is thermally insulated on all sides and comprises in the interior receptacles containing a chemical compound preferably tetradecyl alcohol having a melting temperature between 30–40°C and emitting latent heat when cooling down and crystallizing, this emitted heat being sufficient to compensate heat losses during transportation of the incubator and so to maintain the inner temperature for a certain time without heat supply. Before the transportation the chemical substance is melted by means of an electric heating device supplied from the outside and a thermostat keeps the inner temperature, before the transportation, slightly above the melting point of the substance.

6 Claims, 2 Drawing Figures



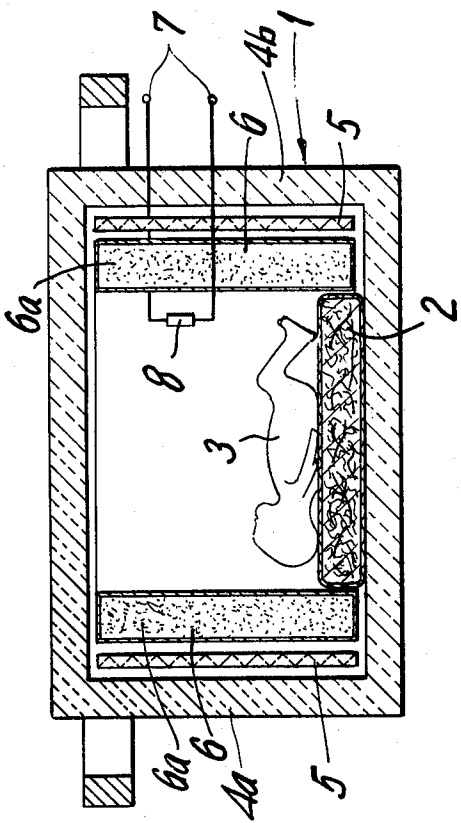


FIG. 1

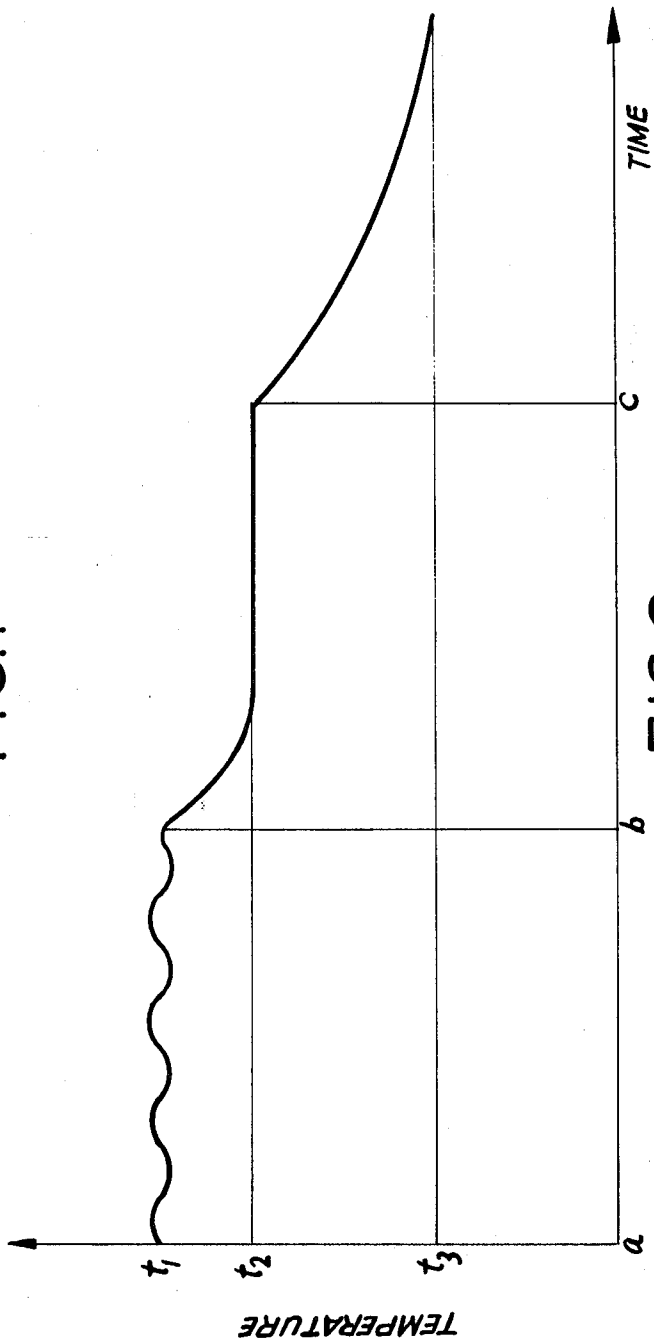


FIG. 2

HEATED TRANSPORT INCUBATOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates in general to incubators for babies and in particular to a new and useful method of keeping the temperature in the incubator constant during transportation of the baby without heat supply from the outside or from a special heating device, by placing in the incubator a chemical substance which, after being heated up above its melting temperature, harmless to the baby, cools down and solidifies under emission of latent heat, whose quantity is sufficient to compensate heat losses in the incubator during transportation. The device for carrying out this method comprises receptacles for the substance, a heating means for melting the substance and a temperature control means for maintaining the substance in a molten state before the transportation.

2. Description of the Prior Art

For the transportation of prematurely born or sick babies there are used so-called transport incubators which substantially serve to prevent a baby, during the transportation, from becoming cool. The mostly closed rest space of the baby is heated. The following designs are known:

One type of transport incubator is provided with an electric heating which is supplied by current from the network of the ambulance car. Because the output capacity of ambulance car networks is but limited, only a relatively small electric power can be withdrawn which is frequently insufficient, for example, in winter or when large transport incubators, such as used for the transfer of "intensive care" cases, are involved.

It is further known to connect electrically heated transport incubators to storage batteries which must be carried along. Here once more, only a small electric power is available. Also, storage batteries are heavy and hinder the transportation.

Finally, known transport incubators are provided with tanks which are filled with water which has been pre-heated or heated up before the transportation. A disadvantage is the troublesome handling of such devices. The water must be heated up to the right temperature and filled in. This work is also time consuming. It is moreover disadvantageous that after putting the device into service, the temperature continues to slowly decrease. A new heat supply is possible only after discharging the tanks and refilling them with heated water.

That is why the problem arose to provide a method and a device avoiding the above mentioned drawbacks in which the inside of the incubator can be kept, during a longer period of time, at an approximately constant temperature irrespective of power supply.

SUMMARY OF THE INVENTION

In accordance with the present invention, there is provided an improved method using a thermally insulated incubator adapted for transportation, in which a chemical substance is placed which is capable of melting at a temperature harmless to the baby and of cooling down and solidifying by emitting latent heat owing to chemical and/or physical changes of its constitution, the heating up of the substance slightly above the melting temperature being effected before the transportation, during a preparation time, and the substance cool-

ing down during the transportation. Thus, the temperature within the incubator can be held at an approximately constant level which is equal to or slightly below the melting temperature of the substance. The incubator used to carry out this method is provided with a heat insulation on all sides and comprises a heating device powered during the time the incubator is prepared for service, from the outside, with receptacles for the chemical substance and preferably a thermostat for keeping the temperature of the substance slightly above the melting point during the preparation time. The invention has the advantage that the service conditions of the incubator are prepared before the transportation, at a location where heating power is available from a network, whereupon the power is cut off because it is no longer necessary for maintaining the service conditions for the relatively long time of the transportation. The incubator is independent of any supply from the outside and keeps the inner temperature constant or approximately constant in spite of the heat losses to which the outside of the incubator is exposed.

In a simple embodiment of the invention, a substance is used having a melting point between 30 and 40°C. When such a substance, for example, a salt, is located within the incubator and heated up to temperature above the melting point and the incubator is closed, the temperature in the interior of the incubator first decreases to the melting temperature of the substance. After a further heat loss through the outer walls of the incubator, the substance begins to crystallize while releasing latent heat by which the temperature in the interior of the incubator is kept approximately constant until the whole molten substance is solidified.

Advantageously, an incubator is used which is provided with a heating insulation on all sides.

According to a development of the invention, the incubator may be provided with an electric heating. This heating is used to heat up the incubator, along with the substance located therein to a temperature above the melting point of the substance, in an emplacement where the preparation is made.

According to another feature of the invention, the electric heating may be located in the intermediate space between the substance or a substance receptacle and the wall of the incubator.

Also, the incubator may be provided with a thermostat by which the temperature of the substance in the preparatory state is held above the melting point.

The substance used may be hydrated sodium hydrogen phosphate $\text{Na}_2\text{HPO}_4 \cdot 12\text{H}_2\text{O}$, or tetradecyl alcohol $\text{C}_{14}\text{H}_{30}\text{O}$. The latter substance has the advantage of having a defined temperature of solidification depending upon the percentage purity.

Accordingly, it is an object of the invention to provide a method for transporting babies placed in an incubator under controlled temperature conditions in which the temperature within the incubator is kept constant without heat supply from the outside by permitting the cooling and solidification of a substance in the incubator whose melting temperature is harmless to the baby and which while solidifying emits latent heat so as to compensate the heat losses during transportation.

Another object of the invention is to provide an incubator adapted to carry out this method and therefore comprising receptacles for the substance to be melted and subsequently cooled down, heating means, prefera-

bly an electrical heating device powered from the outside for melting the substance during the preparation time, before the transportation, and temperature controlling means preferably a thermostat for maintaining the temperature of the substance during the preparation time slightly above the melting point.

Another object of the invention is to provide a substance having the desired properties, i.e. melting temperature between 30 and 40°C and the capacity of emitting latent heat while solidifying sufficient to compensate the heat losses in the incubator during transportation.

A further object of the invention is to provide an incubator which is simple in design, rugged in construction and economical to manufacture.

For an understanding of the principles of the invention, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

In the Drawings:

FIG. 1 is a longitudinal sectional view of an incubator constructed according to the invention; and

FIG. 2 is a temperature-time variation curve within the incubator of FIG. 1.

GENERAL DESCRIPTION OF THE PREFERRED EMBODIMENT

In a thermally well insulated housing or transport incubator receptacle 1, a baby 3 is received laying on a support or mattress 2. A receptacle 6 is located in the interior of the transport incubator and filled with a substance 6a having a melting point at approximately 30°-40°C. A flat electric heater 5 is connected to electrical supply terminals 7 and it is placed at least between the heat insulation layer of end walls 4a and 4b of the receptacle 1 and the container 6. With the aid of this heating, the receptacle 4 is heated during the preparation time until the substance 6a is melted. By means of a thermostat 8 the temperature of the substance to be melted is held at a level slightly above the melting point.

FIG. 2 shows the temperature variation as a function of time, it being assumed that at the time *a* the incubator is heated up to a predetermined temperature *t*₁. The preparation time ends at *b*. At this moment, the power supply of the electric heater 5 is cut off.

After placing the baby in the incubator, the transportation takes place and the temperature within the incubator drops to a value *t*₂ corresponding to the melting temperature of the substance. The substance begins to solidify. Latent heat of solidification is released which, as shown in FIG. 2, keeps the temperature in the receptacle 4 constant in spite of the continuing heat dissipation. During this time, the transportation of the baby is accomplished. Provided that the interior surface of the receptacle 4 is large as compared to the non-heated inner surfaces of the transport incubator and that the non-heated inner surfaces of the transport incubator

are thermally well insulated to the outside, an incubator temperature is produced which is close below the solidification temperature of the molten substance in the receptacle 4 and which is only little influenced by the outer ambient temperature. In consequence, during the transportation, the keeping of the temperature is independent of a power supply from the outside; the temperature in the interior of the incubator largely corresponds to the temperature of the molten substance in the receptacle 4 which remains constant for a long time in spite of the heat dissipation.

Only at the time *c* after the whole molten substance in the receptacle 6 is solidified, the transport incubator begins to slowly cool down to the ambient temperature *t*₃.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. A transport incubator which may be heated to a comfortable temperature for an infant by connection to an external heater actuator at a preparation station prior to transport, comprising a thermally insulated incubator container having means for supporting an infant therein, a substance having a melting point in a temperature range comparable to the temperature range comfortable for the infant disposed in a closed portion of said container, a heater in said container for heating said substance above its melting point to a temperature which is compatible with the desired temperature for the infant to prepare the incubator to receive the infant prior to transportation, said substance being capable of maintaining the interior of the incubator at the desired temperature in the vicinity of its melting point and to transfer heat to the incubator when it gives up its latent heat upon solidifying, and a heater connection connected to said heater and to the exterior of said container and having terminals connectable to the heater actuator at the preparation station.

2. A transport incubator according to claim 1, wherein said substance is a substance having a melting point between 30°-40°C.

3. A transport incubator according to claim 1, wherein all sides of the incubator are provided with a thermal insulation.

4. A transport incubator according to claim 1, wherein said incubator heater is provided with an electric heater.

5. A transport incubator according to claim 1, wherein said heater is an electric heater located between said substance and a wall of said incubator.

6. A transport incubator according to claim 4, including a thermostat connected to said heater by which, during the preparation for service, the temperature of the substance is held above the melting temperature of said substance.

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