May 23, 1961 K. L. BELL 2,984,974

THERMOSTAT-POWERED PROPULSION UNIT FOR TOY VEHICLES

Filed June 5, 1957

FIG. 1

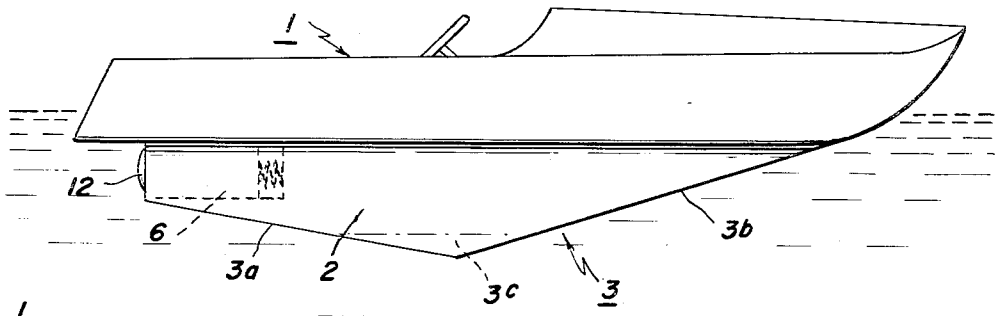


FIG. 2

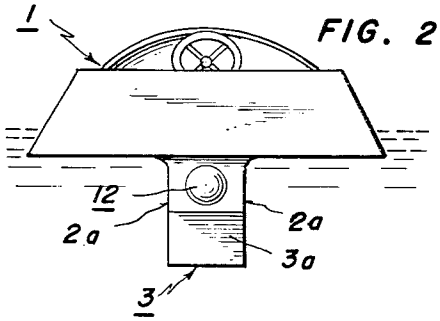


FIG. 3

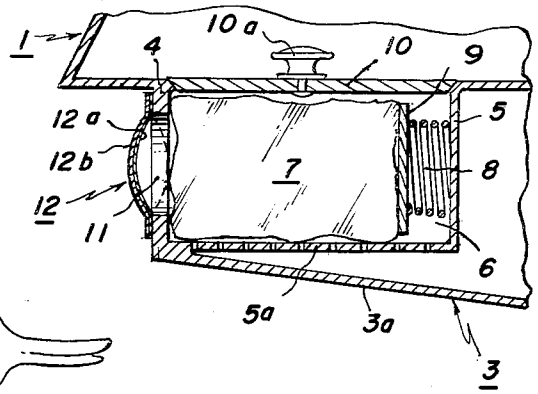


FIG. 4

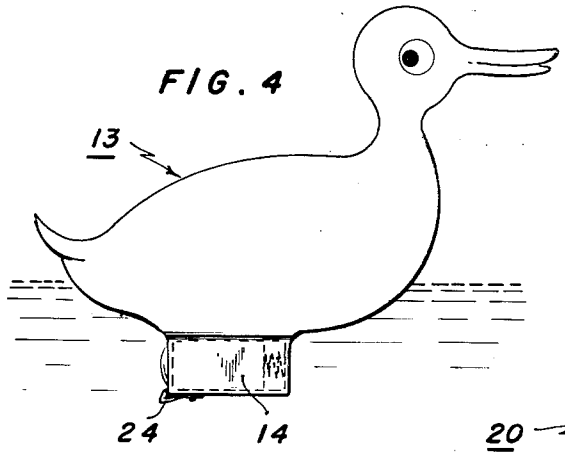


FIG. 5

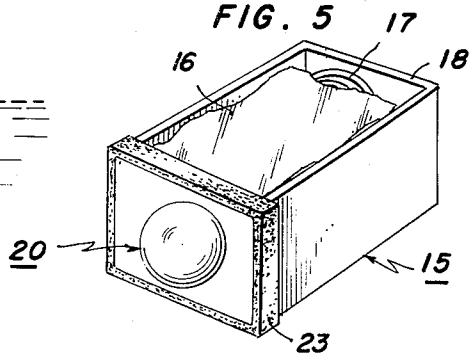
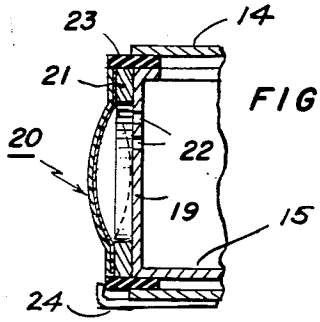


FIG. 6



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THERMOSTAT-POWERED PROPULSION UNIT FOR TOY VEHICLES

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12 Claims. (Cl. 60—35.56)

This invention relates to a thermostat-powered propulsion unit for play toys and which is especially suitable for use with aquatic play toys such as toy boats or floating figure toys.

More particularly the invention has for an object to provide a propulsion unit of the above character comprising a receptacle for containing a thermal medium, which may be either a cooling medium or a heating medium, and a thermostatic element of the snap type, such as a bimetallic diaphragm composed of laminated materials having different coefficients of expansion and contraction, the construction and arrangement being such that the thermostatic element is adapted to periodically snap in one direction to establish contact, or approximate contact, with the thermal medium and to alternately snap in the opposite direction out of contact with the thermal medium to impart propulsive thrusts to the toy. In the case of aquatic toys these propulsive thrusts act against the water in which the toy is partially submerged to propel the toy through the water.

Another object of the invention is to provide a thermostat propulsion unit of the above character which is capable of utilizing as the thermal medium either a frozen solid, such as ice or "Dry Ice" (solidified carbon dioxide) or, alternatively, a heat emitting chemical, such for example as any of the well-known compositions that are commonly used in heating pads and that are adapted to be activated by contact with water.

Still another object of the invention is to provide an inexpensive play toy having no complicated mechanical parts and which is completely safe for use by children.

Other objects and advantages will be apparent from the following detailed description of a preferred embodiment of the invention, reference being made to the accompanying drawnig, in which:

Figure 1 is a side view of a toy boat;

Figure 2 is a stern end view of the boat;

Figure 3 is a fragmentary longitudinal cross-sectional view of the stern of the boat showing the propulsion unit;

Figure 4 is a side view of a floating figure toy utilizing a propulsion unit representing another embodiment of the invention;

Figure 5 is a detailed perspective view of a thermal medium container forming a part of the propulsion unit of Fig. 4; and

Figure 6 is a fragmentary longitudinal cross-sectional view of the outer end of the chamber and container for receiving the thermal medium.

The toy boat **1** illustrated in Fig. 1 may be of any suitable design and comprises a hull made of plastic or other light-weight material. Extending medially along the bottom of the hull is a comparatively wide keel **2** molded integral with the hull and comprising side walls **2***a* and a bottom wall **3**. This keel defines a trough opening into the interior of the hull and is closed at its stern end by a vertical wall **4**. The bottom wall **3** of the keel slopes forwardly and downwardly for a substantial portion of the length of the hull, as indicated at **3***a*, and thence forwardly and upwardly, as indicated at **3***b*, toward the bow of the boat, the two angularly disposed bottom sections forming a catch-basin or sump **3***c* in the trough for a purpose later to be explained.

A vertical partition **5** and a preforated bottom partition **5***a* bridge the two side walls **2***a* of the trough adjacent its stern end, these partitions forming with the two side walls and the end wall **4** a square or rectangular-shaped chamber **6** of approximately the size of an ice cube (indicated at **7**) of the kind that is frozen in ice trays of the usual household refrigerators. The chamber **6** is of somewhat greater length than the ice cube so as to provide space for a coil spring **8** abutting at one end against the partition **5** and at its other end against a presser plate **9** adapted to contact the ice cube and urge it toward the end wall **4**. A cover **10** provided with a handle or knob **10***a* normally closes the top of the chamber **6** but is removable to allow the introduction of an ice cube into the chamber. The inner walls of the chamber may be faced with water-impervious paperboard or other heat-insulating material (not shown) to prevent too rapid melting of the ice cube. However, such insulation is not essential since the low heat-transfer characteristic of the plastic composing the material of the boat will usually be sufficient to provide adequate insulation.

The end wall **4** of the chamber is provided with an opening **11** which is closed by a flexible diaphragm **12** composed of two laminated materials **12***a* and **12***b* having different coefficients of expansion and contraction so that when subjected to heat this diaphragm will snap in one direction and upon cooling will snap in the opposite direction. Such bimetallic thermostatic elements are well known per se in the mechanical and electrical arts, being commonly used in blinker lighting circuits to momentarily interrupt the electrical current to a lamp. While herein referred to generally as "bimetallic" elements, the laminated materials may be non-metals, for example plastics, which possess suitably different coefficients of expansion and contraction. The term "bimetallic" as used herein is therefore used broadly to include thermostats employing any two laminated materials having different thermal coefficients of expansion and contraction. The diaphragm is illustrated in the form of a button which is adapted to warp from the full line position to the dotted line position shown on an exaggerated scale in Fig. 3. The end wall **4** of the chamber **6** is thickened surrounding the opening **11** as shown in Fig. 3 to provide an abutment against which the ice cube is urged by the presser plate **9** in order to afford a clearance through which the button is free to snap into engagement, or substantially into engagement, with a surface of the ice cube in one direction of flexing of the diaphragm.

The operation of the thermostat propulsion unit just described is as follows: The cover **10** of the chamber **6** is removed and an ice cube **7** is inserted into the chamber between the presser plate **9** and the end wall **4**, after which the cover is restored and the boat is placed in a body of warm water. The submerged diaphragm being exposed to the heat of the water will buckle inwardly to the position shown exaggerated in dotted lines in Fig. 3 due to the difference in expansion of the laminated materials composing the diaphragm. This causes the diaphragm to contact a surface of the ice cube which rapidly abstracts heat from the diaphragm and causes the diaphragm to buckle outwardly in the opposite direction. The periodic contraction and expansion of the diaphragm occurs quite rapidly, causing the diaphragm to buckle inwardly and outwardly with a pulsating snap action so as to propel the boat forwardly through the water.

As the ice melts, the cube will be continuously urged into engagement with the end wall **4** by the presser plate

9. The water melted from the ice passes through the perforated bottom 5*a* of the chamber 6 and drains down the inclined bottom 3*a* of the trough to collect in the sump 3*c*, located approximately midship, where its weight does not interfere with the stability of the boat. The cold water resulting from the melted ice should be prevented from coming into contact with the inner face of the diaphragm where it would interfere with the thermostatic operation of the diaphragm. When the ice cube has entirely melted, the boat may be taken from the water and overturned to drain therefrom the water resulting from the melted ice, after which another ice cube may be inserted in the chamber 6. The boat is ideally suited as a children's play toy for the bath tub where the water is sufficiently warm to cause the thermostatic motor to operate efficiently.

A modification of the invention is shown in Figs. 4, 5 and 6 applied to a floating figure toy. The figure toy 13, here illustrated in the form of a duck, may be made of any suitable material, for example plastic, being preferably hollow inside to render the figure light and buoyant in order to float partially submerged in the water. Molded integral with the body of the duck or attached thereto below the float line is a rectangular shaped watertight chamber 14 open at its end opposite the direction in which the duck is facing.

A rectangular-shaped ice container 15 having side, end and bottom walls is adapted to contain an ice cube 16 as shown in Fig. 5. A coil spring 17 is interposed between an end wall 18 of the container and the ice cube so as to urge the cube against the opposite end wall 19 of the container. The end wall 19 is composed of thin sheet material through which heat is readily transmissible and, if desired, the entire container may be made of thin sheet metal.

Secured to the outer face of the end wall 19 is a button-type thermostat 20 which may correspond in all essential respects to the thermostat 12 heretofore described in connection with the toy boat of Figs. 1, 2 and 3. The diaphragm 20 is marginally supported upon a rectangular spacer frame 21 which, in turn, is secured to the outer face of the end wall 19 of the container whereby the diaphragm is free to flex into the dotted line position indicated, somewhat exaggerated, in Fig. 6, in which position the diaphragm contacts the end wall 19. The end wall 19 is pierced to provide breather apertures 22 to allow flexing of the diaphragm. Bonded to and encircling the container 18 adjacent the end wall 19 is a rubber packing strip 23 adapted to seal the space between the chamber 14 and container 15 to prevent the entrance of water into the chamber when the duck is in the water. A spring latch 24 secured to the bottom of the chamber is adapted to engage a margin of the outer end of the container to retain the container in the chamber.

The mode of operation of this embodiment of the invention is essentially the same as that described in connection with the toy boat of Figs. 1 through 3. An ice cube, or a supply of chipped ice or Dry Ice, is placed in the container 15 and the container is inserted into the chamber 14, being retained therein by the latch 24. When the duck is placed in warm water the thermostatic diaphragm will snap back-and-forth into and out of contact with the cold end wall 19 of the container 19 and this pulsating action will impel the duck forwardly through the water. By locating the diaphragm below and offside of its center of gravity, a rocking or bobbing motion may be imparted to the duck as it moves through the water. The water from the melting ice will collect in the container and be maintained out of contact with the diaphragm.

While in the above embodiments of the invention the thermal medium for the thermostatic propulsion unit has been described as an ice cube, manifestly any other frozen solid such as ice chips or Dry Ice may be substituted as the cooling means. Such cooling medium is satisfactory when the toy is to be floated in warm or hot water. However, in the event the toy is to be used in cold water, a heating medium must be substituted for the cooling medium in order to provide the necessary differential in temperature to which the thermostat is exposed. Such a heating medium may comprise a composition, of which sodium acetate is an example, in which heat is generated by introducing water into the chemical. Such compositions are well known in the heating pad art and reference is made to the patents of Jost No. 1,812,243 and Johnson No. 1,481,208 as an example of such compositions. Such compositions are usually packaged in rubber, fabric or paper bags or packets and these may be made of a size approximately the size of an ice cube so as to fit within the chamber reserved for the thermal medium.

Manifestly various changes in construction, arrangement and design may be made in the form of the inventions described and illustrated herein without departing from the spirit of the invention as defined by the following claims.

I claim:

1. A propulsion means for floatable bodies comprising the combination with a floatable body having an outer surface a portion of which surface is adapted to lie in contact with the liquid in which the body is floated, of a bimetallic thermostatic diaphragm of the snap-type formed of materials having different thermal coefficients of expansion, said diaphragm forming a portion of said surface and adapted to be exposed upon one of its faces to the pressure and temperature of the liquid and upon its other face to the pressure and temperature of the air, and means for maintaining a temperature zone appreciably different from atmospheric temperature located in spaced relation to the air-exposed face of the disk but adapted to be intercepted by said face in one position of movement the snap diaphragm to alter the temperature of the diaphragm.

2. In a propulsion unit for toys, the combination of a container for containing a thermal medium, a flexible diaphragm of the bimetallic snap type formed of materials having different thermal coefficients of expansion, said diaphragm forming a portion of the wall of said container, and means for maintaining a thermal medium within said container a spaced distance from the diaphragm corresponding approximately to the range of buckling movement of the diaphragm, whereby the diaphragm is adapted to buckle substantially into and out of contact with the thermal medium to intermittently impart a change of temperature to the diaphragm.

3. A thermostat-powered propulsion unit for floating aquatic toys comprising a chamber for containing a thermal medium, a flexible diaphragm of the bimetallic snap type formed of materials having different thermal coefficients of expansion, said diaphragm forming a portion of the wall of said chamber angularly inclined to the horizontal and disposed below the float line of said toy, and means for supporting the thermal medium a spaced distance from the diaphragm when the diaphragm is in its outward position of flexure, said spaced distance corresponding approximately to the range of buckling movement of the diaphragm, whereby the diaphragm is adapted to buckle substantially into and out of contact with the thermal medium to intermittently impart a change of temperature to the diaphragm.

4. A thermostat-powered propulsion unit for floating aquatic toys comprising a chamber for containing a thermal medium, a flexible diaphragm of the bimetallic snap type formed of materials having different thermal coefficients of expansion, said diaphragm forming a portion of the wall of said chamber angularly inclined to the horizontal and disposed below the float line of said toy, and means for supporting the thermal medium a spaced distance from the diaphragm when the diaphragm is in its outward position of flexure, said spaced distance

corresponding approximately to the range of buckling movement of the diaphragm, whereby the diaphragm is adapted to buckle substantially into and out of contact with the thermal medium to intermittently impart a change of temperature to the diaphragm, and means resiliently urging the thermal medium towards said diaphragm.

5. A thermostat-powered propulsion unit for floating aquatic toys as set forth in claim 4 wherein the container has a wall of highly heat-conductive material disposed opposite the diaphragm.

6. A thermostat-powered propulsion unit for floating aquatic toys comprising a chamber for containing a cooling medium in solid form, a flexible diaphragm of the bimetallic snap type formed of materials having different thermal coefficients of expansion, said diaphragm forming a portion of the wall of said chamber angularly inclined to the horizontal and located below the float line of said toy, abutment means for maintaining the solidified cooling medium within the chamber a spaced distance from the diaphragm when the diaphragm is in its outward position of flexure, said spaced distance corresponding approximately to the range of buckling movement of the diaphragm, whereby the diaphragm is adapted to buckle substantially into and out of contact with the cooling medium to intermittently impart a change of temperature to the diaphragm.

7. A thermostat-powered propulsion unit for floating aquatic toys as set forth in claim 6, including means for preventing liquid melted from said cooling medium from contacting said diaphragm.

8. A thermostat-powered propulsion unit for floating aquatic toys as set forth in claim 6, including drainage means for directing liquid melted from said cooling medium out of contact with said diaphragm.

9. A thermostat-powered propulsion unit for floating aquatic toys as set forth in claim 6, in which the bottom

of the chamber is provided with drainage openings, including a sump for collecting the liquid melted from said cooling medium passing through said drainage openings.

10. A thermostat-powered propulsion unit for floating aquatic toys comprising a chamber open at one end, a container for a thermal medium insertable into said chamber having a wall of heat-conductive material closing the open end of said chamber, a flexible diaphragm of the bimetallic snap type formed of materials having different thermal coefficients of expansion, said diaphragm mounted upon the chamber-closing end of said container angularly inclined to the horizontal and located below the float line of said toy, said diaphragm being supported in spaced relation to the heat-conductive wall of the container in one position of flexure of said diaphragm and substantially in contact with the heat-conductive wall of the container in the opposite direction of flexure of said diaphragm, and releasable means for retaining said container in said chamber.

11. A thermostat-powered propulsion unit for floating aquatic toys as set forth in claim 10 in which the container is provided with enclosing bottom and side walls for confining the thermal medium within said container.

12. A thermostat-powered propulsion unit for floating aquatic toys as set forth in claim 10 in which the container is made of relatively thin sheet metal.

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