April 20, 1965 B. P. SANDSTO 3,178,896

BEER KEG COOLER

Filed April 6, 1964

FIG_1

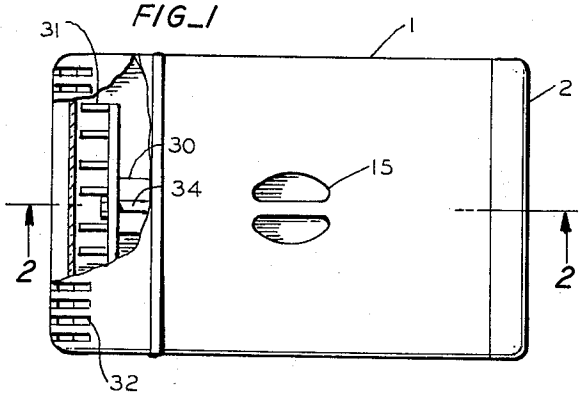


FIG_3

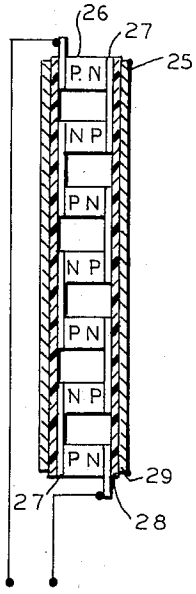


FIG_2

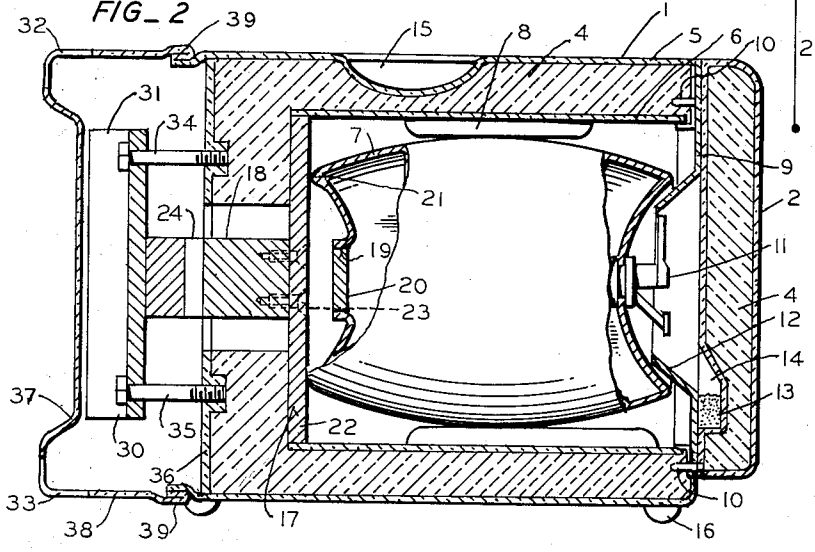
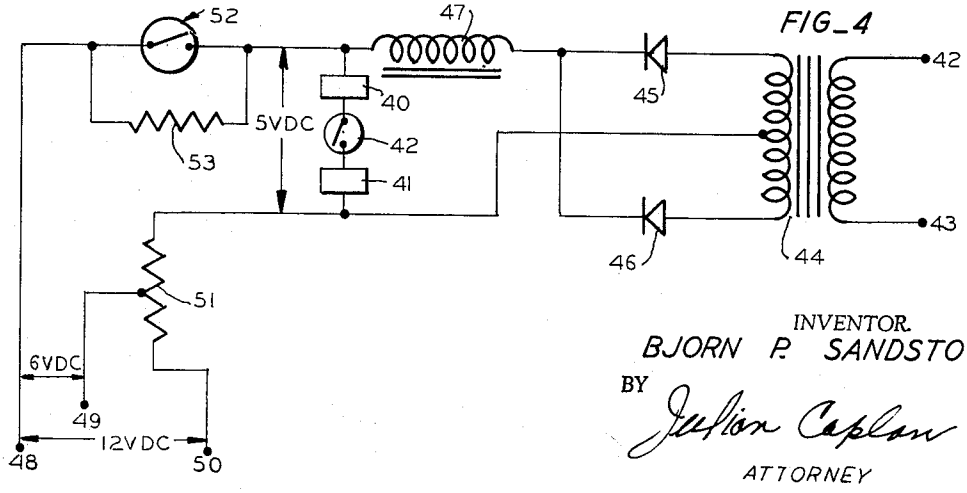


FIG_4



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BEER KEG COOLER

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This invention relates to a new and improved beer keg cooler for use in cooling small beer kegs and other items, characterized by the simplicity of its cooling system and the portability and freedom from moving parts of the cooler itself.

A primary feature of this invention is that it is a compact and lightweight refrigeration system having no moving parts. The refrigerator element preferably utilizes a plurality of bismuth telluride semiconductor thermoelectric modules which effectively operate to pump heat out of the space and object to be cooled. When utilized to cool a keg of beer, this invention serves as a portable and convenient means of providing cooling for such a keg at any time or location. It also serves to cool cans and bottles of beverages as well as other small items.

Still another feature of this invention is that it is adapted to cool a small capacity keg of draft beer (e.g. nine quarts) such as that keg currently manufactured by the Reynolds Metals Co. Even though such a keg is designed to fit in a standard home refrigerator, it occupies a considerable proportion of the available space in such a refrigerator. The present invention provides cooling for such a keg in the home, thereby avoiding the necessity of utilizing valuable home refrigerator space.

A further advantage of the present invention is that it greatly facilitates the use of draft beer in kegs for private and home consumption. Some advantages of draft beer are: superior taste, lower price, no problem of disposal of bottles or cans, and smaller bulk for a given quantity of beer.

A principal objection to draft beer in kegs has been the large size of the keg for use in the home and the problem of cooling both in the home and out-of-doors. The present invention solves these problems by providing a system which can cool a small keg both in-doors and out-of-doors.

A still further feature of this invention is the provision of an electrical control system and refrigeration element which can be powered by either conventional A.C. power or a D.C. battery or generator source as found in an automobile, boat or airplane. When utilized with a battery source, the cooler can easily be operated out-of-doors.

A further advantage of this invention is the incorporation of semiconductor thermoelectric crystals, which contain no moving parts, consume little power, comprise a refrigeration system of light weight and small volume, can be removed as one unit, and are reliable and long-lasting.

A still further advantage of the invention is that the cooler can be used to refrigerate beer cans or bottles or other food, simply by placing such items in the cooler when not using a keg.

Further features of the invention are: the provision of an idler switch which minimizes battery drain when desired; the provision of inner and outer doors to avoid cooling losses when tapping the keg and serving beer; the provision for cooling by air convection as well as conduction through metal; provision for stacking the coolers on one another, thereby facilitating shipping and storage; and low cost of production and ease of operation.

Other objects of the present invention will become apparent upon reading the following specification and referring to the accompanying drawings.

In the drawings:

FIG. 1 is a top plan of a beer keg cooler constructed in accordance with the present invention, with a segment of the cover broken away to expose a portion of the refrigeration apparatus.

FIG. 2 is an enlarged vertical sectional view taken substantially along line 2—2 of FIG. 1, showing the cooler with beer keg, partially broken away, in place and with inner and outer doors secured.

FIG. 3 is a fragmentary enlarged sectional view of a semiconductor refrigeration module used with the cooler.

FIG. 4 is a wiring diagram of the power and control circuit utilized in connection with the refrigeration module.

Draft beer has consistently enjoyed widespread popularity in commercial eating and drinking establishments. However, its acceptance for home or picnic consumption has been limited because of the large and unwieldy kegs which were required for containers. These kegs could only be kept cold under such conditions by some awkward means of ice cooling. The problems of size and ease of handling have recently been solved by the introduction of the nine-quart keg by the Reynolds Metals Co. However, the problem of practical cooling both in and out-of-doors has still remained. This problem is solved by the present invention, which provides refrigeration means for a small keg which can easily be utilized both in and out-of-doors.

Essentially, the present invention consists of an insulated and refrigerated container especially dimensioned and designed to carry the small nine-quart size beer keg **7**. Referring to FIG. 1, the container **1** is of rectangular shape and of a size adequate to hold the desired size of beer keg. The container is provided with an outer door **2**, for access to the interior. Referring to FIG. 2, the outer door **2** is held in place by means of a magnetic gasket **3**. Container **1**, as well as outer door **2**, are preferably formed of polyurethane or equivalent insulation **4** to minimize heat loss by conduction, encased by a fiberglass outer case **5** and an aluminum inner case **6**.

A beer keg of typical construction is shown in place within the container. The keg **7** is guided into the container and held securely in place by a plurality of nylon runners **8** extending longitudinally along the sides of the interior surface of the container. These runners improve circulation of air around keg **7**. Beer keg **7** is retained in the container when outer door **2** is opened to tap the keg by means of an inner door **9** which is formed with a round opening of lesser dimension than the container which provides for tapping the keg and drawing beer from the tapping spout **11**. Door **9** is only removed when keg **7** is removed. This arrangement minimizes heat intrusion into the container when it is necessary to remove the outer door **2**. Inner door **9** is held in place by means of friction-type fasteners **10**, extending inwardly from the door. Inner door **9** is formed with a flange **12**, extending inwardly from the opening in the door. Flange **12** acts as a drip catcher to control dripping from the spout into the interior or inner door opening after the keg has been tapped. Flange **12** guides any drops from the spout to a piece of household-type sponge **13** which is placed in recess **14** formed in the inner surface of outer door **2**.

Container **1** is formed with a recessed carrying handle **15** which preferably does not project above the level of the top of the container, and allows stacking of a plurality of containers on top of each other for convenient shipping and pre-sale or pre-rental storage. A plurality of raised studs or rubber rests **16** are affixed to the bottom of the container opposite carrying handle **15** to protect the surface of the container from scratching or marring where resting on that surface.

Cold plate **17** is fixed at the end of the interior of container **1** opposite doors **2**, **9** and is dimensioned to bear against the bottom rim **22** of keg **7** in heat conducting

relation. Plate 17 also is in heat convection relation with the interior of the container. Thus the apparatus is effective with keg 7 or with other items, such as cans and bottles. Plate 17 is cooled by conduction by means of cold block 18 which is directly connected to the refrigeration means hereinafter described. Both cold plate 17 and cold block 18 are composed of a suitable thermally conductive material such as aluminum. Beer keg 7 is filled by the manufacturer with draft beer through filler opening 19 at the lower end of the keg and then sealed with filler seal 20. When keg 7 is in place in container 1, the entire circumference of rim 21 of beer keg 7 bears directly on face 22 of cold plate 17. Thus, keg 7 is directly cooled by conduction through cold plate 17.

Cold plate 17 is formed with a large surface area exposed to the air in the interior of container 1. Thus, keg 7 and the interior of container 1 are cooled by air convection as well as by conduction. Cold plate 17 is secured to cold block 18 by means of recessed screws 23.

The heart of refrigeration system 24 is a combination of semiconductor modules. When current is passed through a bismuth telluride crystal, it transforms thermal energy at one pole into electrical energy at that pole. This electrical energy is then re-transformed into thermal energy at the opposite pole. An effective heat transfer is thus effected in the overall system and one pole becomes cold while the opposite pole becomes hot. The polarity of this heating-cooling effect can be reversed by reversing the direction of the current flow through the crystal. A crystal is made up of a donor or N-type portion joined to an acceptor or P-type material. By connecting a plurality of such crystals in series in an electrical circuit, the total heat pumping effect can be increased directly proportional to the number of crystals used.

Referring to FIG. 3, module 25 is shown comprising a plurality of individual bismuth telluride semiconductor crystals 26, each having an N-pole and a P-pole. Refrigeration element 24 is comprised of an appropriate plurality of modules 25. The crystals are connected in series by means of conducting strips 27. The module is held together by means of two strips of an epoxy, non-electrically-conductive bonding material 28. Each of the strips 28 is faced on the outward side with an aluminum strip 29 to facilitate thermal conduction. By combining means for the removal of heat transformed with means for thermally insulating the hot side from the cold side of module 25, a simple, practical and commercially effective refrigerator can be constructed. Such a module as shown in FIG. 3 is presently commercially available as a unit.

Since thermal energy appears at the hot side of the module 25, provision must be made to dispose of the heat drawn out of the keg 7 and the interior of container 1. This is accomplished by means of heat sink 30 which bears directly on the hot side of refrigeration element 24. Heat sink 30 is formed with a plurality of cooling fins 31, which dissipate heat drawn to them from keg 7 and interior of container 1, via the cold plate 17, cold block 18 and refrigeration element 24. Since cooling fins 31 dispose of heat by means of convection, provision is made for openings in container 1 in the form of a plurality of air vents at 32 and 33. Outside air drawn across cooling fins 31 is heated up and flows out again. Heat sink 30 is anchored to container 1 by means of bolts 34 and 35 which screw into threaded portions of fiberglass wall 36, thereby thermally insulating heat sink 30 from cooled portions of the container. The heat sink end of container 1 is formed with indentation 37, to force a greater quantity of air from vents 32 and 33 across cooling fins 31 of heat sink 30.

The end of container 1 housing refrigeration element 24 is formed as a separate shell 38, to fit on the main section of container 1 by means of pressure at points 39. Refrigeration element 24 is made as a plug-in unit for easy replacement. To replace element 24, it is only necessary to remove cover 38 and remove heat sink 30 by means of bolts 34 and 35. This provides simple and rapid servicing of the refrigeration element and accompanying electrical controls.

Refrigeration element 24 is controlled and powered by the circuit shown in FIG. 4. Two semconductor modules 40 and 41 are shown in series, being essentially the type of module previously described as 25 in FIG. 3. Thermal cut-off switch 42 is connected in series between modules 40 and 41 to cut off current flow should the modules overheat. When the modules have cooled down to a point within their operating temperatures, switch 42 will close again to resume operation. Modules 40 and 41 can be powered by either standard 115 v. A.C., 60 cycle house current or by a direct current source, as is found in automobile batteries.

For use with an alternating current house supply, lines 42 and 43 are plugged into a wall socket. Voltage is stepped-down through transformer 44 to about 5.5 v. This voltage is rectified in the full-wave rectifier circuit comprising diodes 45 and 46 and is then smoothed out through inductance choke 47 to provide a D.C. current for modules 40 and 41.

For use with an automobile direct current supply, lines 48 and 49 or 48 and 50 are plugged into the auto cigarette lighter receptacle through a special plug of commercially available type. For an automobile with a 6 v. system, lines 48 and 49 should be used and for a 12 v. system, lines 48 and 50 should be used. The plug for these lines can be polarized to avoid using the wrong set of leads with the appropriate system. The automobile D.C. supply is reduced to 5 v. through resistor 51.

For full load of operation, when maximum cooling is desired, switch 52 remains closed. However, when the ambient temperature is low or when minimum battery drain is desired, switch 52 should be opened, current to be reduced and power to be consumed in resistor 53, so that the system can be said to be "idling." This "idling" condition is desirable when the unit is used in a boat, plane or auto when the motor is not running.

Although the foregoing invention has been described in some detail, by way of illustration and example for purposes of clarity of understanding it is understood that certain changes and modifications may be practiced within the spirit of the invention and scope of the appended claims.

What is claimed is:

1. A refrigeration system comprising,
an insulated container for holding and insulating an object to be cooled, said container having an aperture in one wall for installation of said object to be cooled,
an insulated outer door for said aperture,
an inner door immediately inside said outer door, said inner door having an aperture smaller than said aperture in said wall positioned for access to said object while preventing a substantial intrusion of ambient air into the interior of said insulated container,
a heat conduction element in said container positioned in heat transfer relationship to said object to be cooled inside said container,
a semiconductor thermoelectric element in heat transfer relationship to said heat conduction element,
a heat dispersal element in heat transfer relationship to said semiconductor thermoelectric element, and
electrical means for energing said semiconductor thermoelectric element.

2. A system according to claim 1, which further comprises a magnetic gasket to secure said outer door to said insulated container.

3. A system according to claim 1, in which said outer door is formed with a recess on its inner surface to hold a sponge, and said inner door is formed with a flange extending inwardly from the edge of said aperture in said inner door, toward the center of said insulated container to cause drops of liquid from the opening of an object to

be cooled to flow along said flange to a sponse held in said recess in said outer door.

4. A system according to claim 1, which further comprises a snap pressure lock to secure said inner door to said insulated container.

5. A refrigeration system comprising,

an insulated container for holding and insulating a beer keg to be cooled, said container having an end opening, a door for said end opening, said beer keg having a rim,

a heat conduction element in said container remote from said door,

a semiconductor thermoelectric element in heat transfer relationship to said heat conduction element,

a heat dispersal element in heat transfer relationship to said semiconductor thermoelectric element,

electrical means for energizing said semiconductor thermoelectric element, and

means located at said end of said container for forcing said rim of said beer keg in place in heat conducting relation with said heat conduction element, said means permitting access to said keg for removal of beer within said keg.

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