International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Temperature Controlled Bottle

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Abstract

I have designed a Device which could control(heating or cooling)or stabilize the temperature of our hydrating source (like water ,juice etc). This device is specially designed for the soldiers working in extreme cold or heat condition s. The introduction of solar battery as a Power source will make it feasible to be used in remote areas with no electron flow(electricity). Let's say our soldiers are stuck in the Himalayan mountain range at the height of 500m above the sea level, they somehow run out of water. They will be able to put ice in the bottle and will be able to melt it to it boiling point in a matter of minutes.

Keywords: no

Imagine yourself as a traveller who visits different masses frequently; exploring different tradition culture , people , infrastructure is your supreme goal. With so much difference in the mentioned suspects ,there comes a good difference in the climate as well as weather conditions. Keeping ourselves protected and comfortable in those scenarios in order to stay healthy is a very important part for anyone. Having to travel and adapt with different climates and weather conditions can be a very challenging task for the person. Hydration is always one the number one priorities while travelling different masses , in order to stay healthy and energetic hydration source should be feasible at different temperature conditions. Lets say you are currently living in Rajasthan with an average daytime temperature of 40 degree celcius and you plan on visiting Leh ladakh (temperature below 0 degree celcius) next week , would your temperature requirement for your hydrating source would be constant in both the cases? The basic answer would be no, so how would to manage to cause the temperature difference without having a power source . To solve this problem i have designed a device which would be able to heat and well cool our hydration source according to our needs .The device is gonna have the capacity to cause a temperature change(both cooling and heating). The device is going to be a water bottle with its own in-built cooling and heating system with 2 rechargeable power sources.

MATERIALS REQUIRED

- **Lithium ion battery:** This is going to be the first power source of the device. The battery is going to be placed under the surface of the bottle (under the chamber of water storage ; just next to the compressor). This will be the rechargeable power source ; which will power the cooling and heating systems.
- **Solar battery:** I have decided to use light as a power source for increasing the practicality of the device as having 2 power sources is always better than having just one. Light energy can always be used in case the user failed to charge the main power source(lithium ion battery), it will be like a

continuous power source for heating and cooling the device as long as the sun stays. It will be placed in such way that it covers half of the surface area of the bottle(vertically).

- **Heating rod:** I have decided to use 2 heating rods attached with the inner surface of the bottle ;where it will be in direct contact with the hydrating source(water). One rod should be attached vertically with the inner surface and the other should be attached horizontally(parallel to the ground and just above the battery).
- **Evaporator coils:** This is going to be the part of the cooling system present in the bottle. It will help in absorbing the heat present in the water bottle via the refrigerant liquid. During the process of heat evaporation process the liquid refrigerant will flow through the coil like structure present above the surface of water(no contact) it will absorb all the heat from the inner surroundings and go through a phase change(liquid to gas) which results in the reduction of pressure.
- **Micro Compressor as per scale:** It plays the crucial role of bringing the reduced pressure(due to the absorbtion of hot air from the bottle) back to the normal pressure in order to convert the gaseous refrigerant back to liquid; for the upcoming repetitive cycles for cooling.
- **Digital thermometer:** It will have aa digital thermometer attached in its cap for the user to be able to control the temperature accoding to his will.
- **Throttling device:** It is going to be the most crucial component of the cooling system . It performs the task of producing the cold refrigerant. It is basically a device which works on the throttling phenomenon. The refrigerant returns from the condenser after going through a state change (gas to liquid) and it returns to the throttling device (under high pressure). Throttling device is an obstruction to the the flow to high pressure liquid ; which results in a huge temperature drop. Due to the pressure drop the boiling point of the refrigerant comes down which results in the evaporation of a portion the refrigerant. The energy required for the evaporation comes from the refrigerant which results in the temperature drop and then the cold liquid is send to the evaporation coils for absorbing the heat of the water bottle.
- **Condenser:** This device is going to be responsible for the conversion of gas refrigerant into liquid refrigerent for further cooling cycle. This well help in transferring the heat present in the refrigerant to the atmosphere ; it will cool down the gas into its liquid form by transferring the latent heat into the atmosphere. Then it will send the hot liquid refrigerant into the throttling device for further cooling, so that it can be reused as a cooling fluid and can be send back to the evaporating coil.
- **Small metal net:** This net will be wraped around half the vertical area of the bottle as the condenser would want to be able to transfer the latent heat into its surrounding. This net is compulsory for the user in order to protect his hands from getting burned .
- **Fully transparent glass:** This will be wraped around the other half of the vertical area of the bottle in order for the sun light to reach the solar panel without any hindrance.

Connectivity

Throttling device will be connected to the evaporator, the evaporator will be connected to the compressor, the compressor will be connected to the condenser and the condenser will be connected to the throttling device.

Full cycle: Throttling device- evaporating coil-compressor-condensor-throttling device (full cycle repeats)

WORKING OF COOLING SYSTEM

After the user presses the button for cooling his liquid ,the refrigerant goes to the top of the water bottle where the evaporating coil is present , the liquid refrigerant would travel through the different twist and turns in the coil during that period it will absorb an amount of hot air present in the water and during that absorbtion process it will go through a phase change (liquid to gas) . The phase change also results in a reduction in pressure of the refrigerant as it becomes a gas , so then the refrigerant is sent to a micro compressor present below the surface of the bottle . The compressor will increase the pressure of the gaseous refrigerant in order for it to be converted back to its liquid phase for continuing further cooling of the hydrating source. Then after the compressing process it will go through the condenser for the exchange of latent heat with environment for phase change(gas to liquid). While the high pressure hot gas passes through the condenser it will release all of its heat into the environment and will come back to its liquid state after the process is over. Then after becoming a high pressure hot liquid it will then go to the throttling device for cooling process; the throttling device will refuse the passing of high pressure hot liquid coming from the condensor . Due to the passing of high pressure liquid through the throttling device, a huge pressure drop occurs and the boiling point of the refrigerant gets reduced which results in the evaporation of a portion of the refrigerant; the energy required for the evaporation comes from the refrigerant itself, which results in a huge temperature drop accoss the capillary coil(throttling device) as it is endothermic. After the temperature and pressure drops , the extremely cold liquid refrigerant is send back to the evaporator(evaporating coil) for further got air absorbtion from the bottle. This cycle is known as vapour compression cycle and it will continue till the user switches off the button for cooling.

Working of the heating system

After the user presses the heating button the heating rods will take energy for either of the 2 energy sources and start heating . It will basically do the same work as a geyser in a more practical way.The heating rods will be in direct contact with the water (inside the bottle), the water will reach a boiling temp in a short period of time.

Best and unique feature

Temperature control: This device will have the unique feature of controlling the temperature according to the users will. Lets say the user pressed the heating button but forgot to stop it after a certain period of time; the water is now at a boiling temperature ,but the user wanted the water to reach lukewarm temperature . This is where the cooling system takes action , the user can immediately switch on the cooling system and it will start the evaporation process and within a couple of minutes the boiling water will reach its desired temperature set by the user(lukewarm). Same goes for cooling system , lets say the user wanted cold chilled water , but due to some reason he forgot to switch it off ; the user can immediately switch on the heating rods and will have chilled drinking water in a matter of minutes. Basically the user will be able to play with the heating and cooling system in order for him to get a hydrating source at a temperature of his choice in the middle of nowhere with no energy source.

HYPOTHETICAL SCENARIO FOR BETTER UNDERSTANDING

Imagine your in the mountains of the great “Himalayan range” , you are kilometres away from the nearest hotel and you want hot water as all of your water source is now frozen. There comes the solution to the given problem(temperature controlled bottle). You will be able to have hot water in a blink of an eye even in such extreme conditions and even without any power source. Lets say you are in a Rajasthani desert in the middle of nowhere with a normal plastic water bottle and the water brought by

you is now hot due to the high relative temperature. Can you describe a way to get chilled water without any powersource and hotels nearby? The answer would be no, but with this device you can get chilled water even in such impossible situations like this.

HELPING OUR MILITARY SOLDIERS

Imagine the extreme situations in which our military soldiers stay for days in order to protect us from enemy countries. This idea can be extremely useful for our soldiers stuck in the Himalayan mountains protecting us , they can basically take a bunch of frozen snow from the unlimited supply and transform it into boiling hot water (free of bacteria) in a matter of minutes even without any actual burning of things. They can enjoy a warm cup of tea in a cave situated in a place having the temperature of negative 25 degrees. Imagine having the benefit to use solar battery as a power source in such conditions , where there are no plug points situated anywhere near. Soldiers would be able to use sun as a power source during the daytime and enjoy their hot cup of tea in the night time. I couldn't think of a better way to heat up liquid for people deployed in such extreme conditions. It can even lighten their loads by a huge amount as carrying liquefied water wouldn't be much of a problem due to having solar powered heating rods present in the device which can turn ice into boiling water in a matter of minutes.

Small problem and its solution

Due to the cooling of the air inside the water bottle , a layer of frost might cover the evaporator coil after few cooling repitititve cycles. The solution is obvious , we can use the 2 heating rods to increase the temperature of water ; which will result in the automatic meltdown of the ice frost from the evaporator. If someone uses tje device for daily heating and cooling certain liquids, the mentioned problem might never happen. The chances of this problems are high when the user is using the device only for cooling purpose, simultaneous heating and cooling wouldn't allow any frost to be formed on the evaporator.

Parts used

Compressor

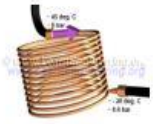
Heating Rod

Solar battery

Lithium Ion battery

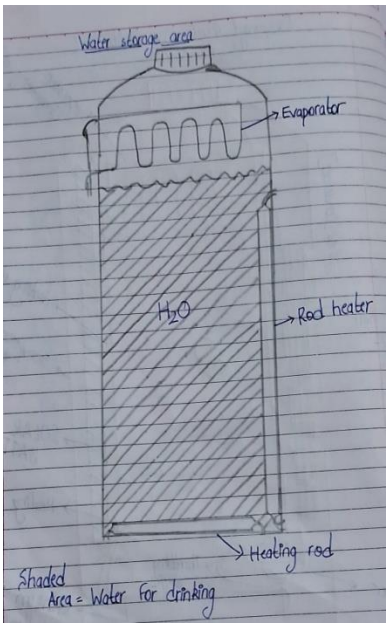
Condensor

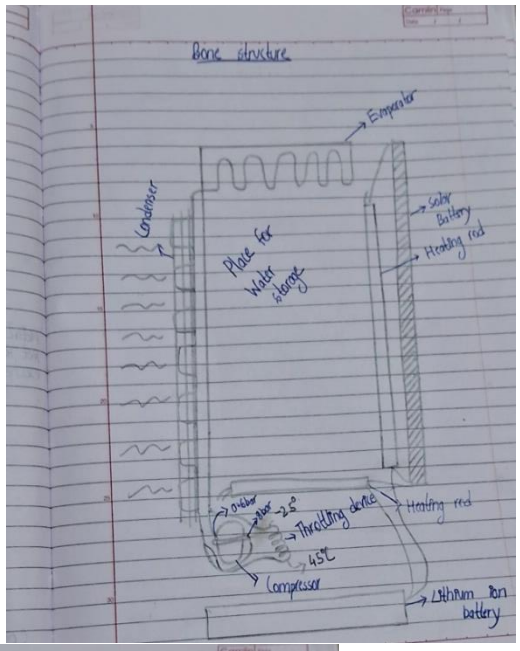
Throttling device

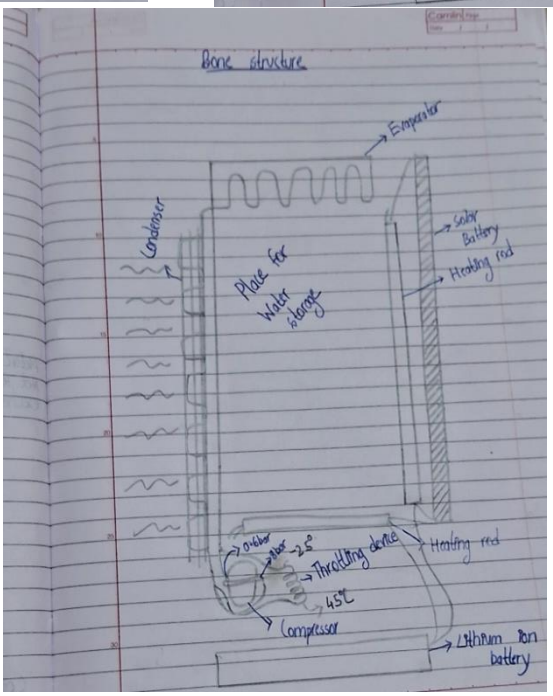


Evaporation coil

Schematic diagrams


Water storage area
Evaporator
H_2O
Rod heater
Heating rod
Shaded
Area = Water for drinking


Bone structure
Evaporator
Condenser
Solar Battery
Heating rod
Place for Water storage
0.4 bar
2°
Throttling device
45°C
Heating rod
Compressor
Lithium ion battery


Bone structure
Evaporator
Condenser
Solar Battery
Heating rod
Place for Water storage
0.4 bar
2°
Throttling device
45°C
Heating rod
Compressor
Lithium ion battery