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PORTABLE COOLING DEVICE

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ABSTRACT

More than 125 of the world's countries and territories are geographically located at least partially in the tropics which includes Sri Lanka, Brazil, Colombia, Costa Rica, Cuba, India, etc., These 125 countries experience maximum sun light when compared to the countries that are far from equator. Tropical areas are dense in population and it is expected to increase population further.

Most of the common public living in these countries including employees, workers, students, hawkers travel from one place to another place either by busses, bikes, cycles or by walk in which air conditioning is not available or possible and hence they get exposed to hot climate for longer durations. Due to excessive exposure to hot climate and sweating, people living in these areas get affected with health problems like sun stroke, skin diseases, etc., and also have to bear lots of discomfort.

As a relief to the above problem, we are planning to make a device that produces cold air and circulates it around the neck. The device uses thermos electric cooler and heat exchanger for producing cold air and the air circulation shall be done using air pump or a blower.

Advantages:-

- Protects from health problems like dehydration, sun stroke and skin diseases
- Discomfort due to hot weather will be reduced
- Easy to carry
- Low cost when compared to commercial large sized air conditioner.

CHAPTER 1 INTRODUCTION

1.1 SUN EXPOSURE IN INDIA

In India, Two-wheelers made up a share of about 75 percent of the total vehicle fleet in operation across India in financial year 2022. Cars, jeeps and taxis accounted for a combined Share of about 13 percent in the total registered vehicle population across the country.

The ongoing heat wave in India has broken several records. The month of March 2022 was reported to be the hottest in 122 years, whereas the national capital Delhi witnessed the second hottest April in 72 years with an average maximum temperature of 40.2^{0}C almost four degrees above the normal average of 36.30. while drinking water is not enough, bike users tries to cool themselves with cool water splashing on their face and body as shown in figure (2.1.1).

Fig (1.1.1) water splashing

Such heat waves bring with them a host of concerns, such as effects on people's health, crops, and economic activities. The World Health Organization has said of Indian heat waves, "Deaths and hospitalisations from heat can occur extremely rapidly (same day) or have a lagged effect (several days later) and result in accelerating death or illness in the already frail, particularly observed in the first days of heat waves. Unlike cars, bikes don't offer any cooling facilities to the person driving bike. Drivers experience dehydration and they splash water and in summer season they experience;

- Headache
- Nausea
- Dizziness
- Weakness
- Feeling irritable
- Thirst
- Lots of sweating
- Increased body temperature
- Peeing less than usual

They may also need drugs to control seizures or other complications. They'll likely be put on bed rest and monitored for 24 hours to several days.

1.2 NECK FAN COOLER

“Neck fans”, as shown in figure (1.2) are a popular item in the summer which can be worn around the neck and help fight off heat.

Fig (1.2.1) neck fan. Without having to be handheld, the gadget is praised as a clever invention by those who want a cooling breeze just for themselves while on the go, such as joggers, delivery workers or just outdoor lovers.

Fig (1.2.1) neck fan

Without having to be handheld, the gadget is praised as a clever invention by those who want a cooling breeze just for themselves while on the go, such as joggers, delivery workers or just outdoor lovers.

According to shinsegae International’s lifestyle brand Jaju, sales of summer home appliances including portable fans saw a 144 percent jump between June 27 and July 10 compared to the previous two weeks. “As heat waves and humid weather continue, neck fans or handheld fans appear to be particularly more popular,” one official at Jaju said.

The mood, however, changed sharply late July when one civic group alleged that the electromagnetic radiation found in neck fans can be “dangerous,” putting their safety under scrutiny.

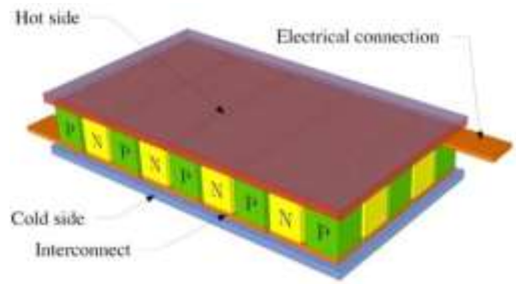
“As the fan is worn around the neck, your brain can’t escape the ‘attack’ from the electromagnetic radiation,” said Choi Ye-yong, director of Asian Citizen’s Centre for Environment and Health.

According to the group, the levels of electromagnetic field detected from the products averaged 188.77 Milli Gauss (MG), with the highest reading of 421.2 mG as shown in figure (1.2.2).

Fig (1.2.2) neck fan radiation check as for the neck fans, the Seoul-based group is not backingdown from its claim that the device’s risk is being underestimated, calling for more research.

1.3 THERMO-ELECTRO COOLER

Thermoelectric cooling, as shown in figure (1.3.1) uses the Peltier effect to create a heat flux atthe junction of two different types of materials.



A Peltier cooler, heater, or thermoelectric heat pump is a solid-state active heat pump which transfers heat from one side of the device to the other, with consumption of electrical energy, depending on the direction of the current. Such an instrument is also called a Peltier device, Peltier heat pump, solid state refrigerator, or thermoelectric cooler (TEC) and occasionally At thermoelectric battery. It can be used either for heating or for cooling, although in practice the main application is cooling. It can also be used as a temperature controller that either heats orcools.

This technology is far less commonly applied to refrigeration than vapour compression refrigeration is. The primary advantages of a Peltier cooler compared to a vapour compression refrigerator are its lack of moving parts or circulating liquid, very long life, invulnerability to leaks, small size, and flexible shape. Its main disadvantages are high cost for a given cooling capacity and poor power efficiency (a low coefficient of performance or COP). Many researchers and companies are trying to develop Peltier coolers that are cheap and efficient. (See Thermo-electric materials.)

A Peltier cooler can also be used as a thermoelectric generator. When operated as a cooler, a voltage is applied across the device, and as a result, a difference in temperature will build up between the two sides. When operated as a generator, one side of the device is heated to a temperature greater than the other side, and as a result, a difference in voltage will build up between the two sides (the See beck effect). However, a well-designed Peltier cooler will be a mediocre thermoelectric generator and vice versa, due to different design and packaging requirements.

PRINCIPLE

Thermoelectric coolers operate by the Peltier effect (one of three phenomena that make up the thermoelectric effect). The device has two sides, and when a DC electric current flows through the device, it brings heat from one side to the other, so that one side gets cooler while the other gets hotter. The "hot" side is attached to a heat sink so that it remains at ambient temperature, while the cool side goes below room temperature. In special applications, multiple coolers can be cascaded or staged together for lower temperature, but overall efficiency (COP) drops significantly. The maximum COP of any refrigeration cycle is ultimately limited by the difference between the desired (cold side) and ambient (hot side) temperature (the temperature of the heat sink). The higher the temperature difference (delta), the lower the maximum theoretical COP.

ADVANTAGES OF THERMO-ELECTRO COOLERS

A significant benefit of TEC systems is that they have no moving parts. This lack of mechanical wear and reduced instances of failure due to fatigue and fracture from mechanical vibration and stress increases the lifespan of the system and lowers the maintenance requirements. Current technologies show the mean time between failures (MTBF) to exceed 100,000 hours at ambient temperatures.

The fact that TEC systems are current-controlled leads to another series of benefits. Because the flow of heat is directly proportional to the applied DC current, heat may be added or removed with accurate control of the direction and amount of electrical current. In contrast to methods that use resistive heating or cooling methods that involve gasses, TEC allows for an equal degree of control over the flow of heat (both in and out of a system under control).

Because of this precise bidirectional heat flow control, temperatures of controlled systems can be precise to fractions of a degree, often reaching precision of milli Kelvin (mK) in laboratory settings. TEC devices are also more flexible in shape than their more traditional counterparts.

They can be used in environments with less space or more severe conditions than a conventional refrigerator. The ability to tailor their geometry allows for the delivery of precise cooling to very small areas. These factors make them a common choice in scientific and engineering applications with demanding requirements where cost and absolute energy efficiency are not primary concerns.

Another benefit of TEC is that it does not use refrigerants in its operation. Prior to their phase out some early refrigerants, such as chlorofluorocarbons (CFCs), contributed significantly to ozone depletion. Many refrigerants used today also have significant environmental impact with global warming potential or carry other safety risks with them.

APPLICATION OF THERMOS-ELECTRO COOLER

Thermoelectric coolers are used for applications that require heat removal ranging from Milliwatts to several thousand watts. They can be made for applications as small as a beveragecooler or as large as a submarine or railroad car. TEC elements have limited life time. Theirhealth strength can be measured by the change of their AC resistance (ACR). As a coolerelement wears out, the ACR will increase.

Consumer products Peltier elements are commonly used in consumer products. For example, they are used in camping, portable coolers, cooling electronic components, mattress pad sleeping systems and small instruments. They can also be used to extract water from the air in dehumidifiers. A camping/car type electric cooler can typically reduce the temperature by up to 20 °C (36 °F) below the ambient temperature, which is 25 °C if the car reaches 45 °C under the sun. Climate controlled jackets are beginning to use Peltier elements. Thermoelectric coolers are used to augment heat sinks for microprocessors. Some Intel Core CPUs from the 10th generation and onwards are capable of using the Intel Cryo technology, which uses a combination of thermoelectric cooling and a liquid heat exchanger to deliver a much greater cooling performance than normally possible with standard liquid cooling.

Industrial thermoelectric coolers are used in many fields of industrial manufacturing and require a thorough performance analysis as they face the test of running thousands of cycles before these industrial products are launched to the market. Some of the applications include laser equipment, thermoelectric air conditioners or coolers, industrial electronics and telecommunications, automotive, mini refrigerators or incubators, military cabinets, IT enclosures, and more.

Science and imaging Peltier elements are used in scientific devices. They are a common component in thermal cyclers, used for the synthesis of DNA by polymerase chain reaction (PCR), a common molecular biological technique, which requires the rapid heating and cooling of the reaction mixture for denaturation primer annealing, and enzymatic synthesis cycles.

With feedback circuitry, Peltier elements can be used to implement highly stable temperature controllers that keep desired temperature within ±0.01 °C. Such stability may be used in precise laser applications to avoid laser wavelength drifting as environment temperature changes.
The effect is used in satellites and spacecraft to reduce temperature differences caused by direct sunlight on one side of a craft by dissipating the heat over the cold shaded side, where it is dissipated as thermal radiation to space. Since 1961, some unmanned spacecraft (including the Curiosity Mars rover) utilize radioisotope thermoelectric generators (RTGs) that convert thermal energy into electrical energy using the Seebeck effect. The devices can last several decades, as they are fueled by the decay of high-energy radioactive materials.

Peltier elements are also used to make cloud chambers to visualize ionizing radiation. Just by passing an electric current, they can cool vapors below −26 °C without dry ice or moving parts, making cloud chambers easy to make and use.

Photon detectors such as CCDs in astronomical telescopes, spectrometers, or very high-end digital cameras are often cooled by Peltier elements. This reduces dark counts due to thermal noise. A dark count occurs when a pixel registers an electron caused by thermal fluctuation rather than a photon. On digital photos taken at low light these occur as speckles (or "pixel noise").

Thermoelectric coolers can be used to cool computer components to keep temperatures within design limits or to maintain stable functioning when over clocking. A Peltier cooler with a heat sink or water block can cool a chip to well below ambient temperature.

In fiber-optic applications, where the wavelength of a laser or a component is highly dependent on temperature, Peltier coolers are used along with a thermistor in a feedback loop to maintain a constant temperature and thereby stabilize the wavelength of the device.
Some electronic equipment intended for military use in the field is thermoelectrically cooled.

1.4 HEAT SINK

A heat sink, as shown in figure (2.4.1), (also commonly spelled heatsink) is a passive heat exchanger that transfers the heat generated by an electronic or a mechanical device to a fluid medium, often air or a liquid coolant, where it is dissipated away from the device, thereby allowing regulation of the device's temperature. In computers, heat sinks are used to cool CPUs, GPUs, and some chipsets and RAM modules. Heat sinks are used with high-power semiconductor devices such as power transistors and optoelectronics such as lasers and light emitting diodes (LEDs), where the heat dissipation ability of the component itself is insufficient to moderate its temperature.

Fig (1.4.1) heat sink

A heat sink is designed to maximize its surface area in contact with the cooling medium surrounding it, such as the air. Air velocity, choice of material, protrusion design and surface treatment are factors that affect the performance of a heat sink. Heat sink attachment methods and thermal interface materials also affect the die temperature of the integrated circuit.

Thermal adhesive or thermal paste improve the heat sink's performance by filling air gaps between the heat sink and the heat spreader on the device. A heat sink is usually made out of aluminium or copper.

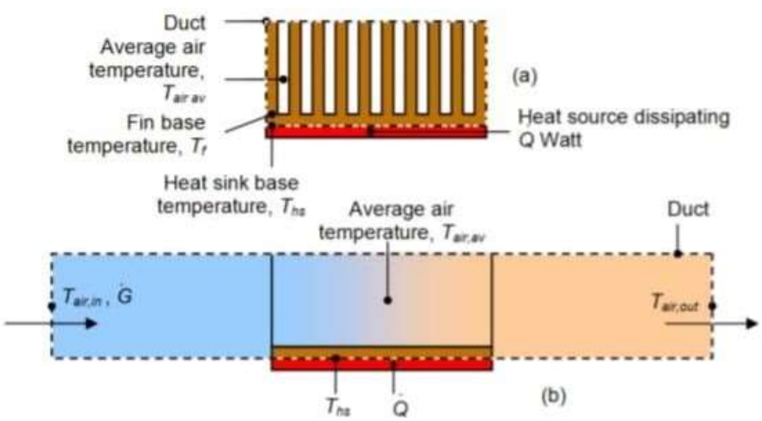
PRINCIPLE OF HEAT SINK

A heat sink transfers thermal energy from a higher-temperature device to a lower-temperature fluid medium. The fluid medium is frequently air, but can also be water, refrigerants or oil. If the fluid medium is water, the heat sink is frequently called a cold plate.

In thermodynamics a heat sink is a heat reservoir that can absorb an arbitrary amount of heat without significantly changing temperature.

Practical heat sinks for electronic devices must have a temperature higher than the surroundings to transfer heat by convection, radiation, and conduction.

The power supplies of electronics are not absolutely efficient, so extra heat is produced that may be detrimental to the function of the device. As such, a heat sink is included in the design to disperse heat.



Fig(1.4.2) Heat Sink in Duct

Fourier's law of heat conduction shows that when there is a temperature gradient in a body, heat will be transferred from the higher-temperature region to the lower-temperature region.

The rate at which heat is transferred by conduction, {\display style q_{k}}q_{k}, is proportional to the product of the temperature gradient and the cross-sectional area through which heat is transferred. When it is simplified to a one-dimensional form in the x direction, it can be expressed as:

Qk= -kAdt/dx

For a heat sink in a duct, where air flows through the duct, the heat-sink base will usually be hotter than the air flowing through the duct. Applying the conservation of energy, for steady state conditions, and Newton's law of cooling to the temperature nodes shown in the diagram gives the following set of equations.

$$\dot{Q} = \dot{m} c_{p,\text{in}} (T_{\text{air,out}} - T_{\text{air,in}}),$$
$$\dot{Q} = \frac{T_{\text{hs}} - T_{\text{air,av}}}{R_{\text{hs}}},$$

where

$$T_{\text{air,av}} = \frac{T_{\text{air,in}} + T_{\text{air,out}}}{2}.$$

$\dot{m}$ is the air mass flow rate in kg/s

$c_{p,\text{in}}$ is the specific heat capacity of the incoming air, in J/(kg °C)

R_{hs} is the thermal resistance of the heatsink

Using the mean air temperature is an assumption that is valid for relatively short heat sinks. When compact heat exchangers are calculated, the logarithmic mean air temperature is used.

The above equations show that:

- When the air flow through the heat sink decreases, this results in an increase in the average air temperature. This in turn increases the heat-sink base temperature. And additionally, the thermal resistance of the heat sink will also increase. The net resultisa higher heat-sink base temperature.
- The increase in heat-sink thermal resistance with decrease in flow rate will beshown later in this article.
- The inlet air temperature relates strongly with the heat-sink base temperature. For example, if there is recirculation of air in a product, the inlet air temperature is not the ambient air temperature. The inlet air temperature of the heat sink is therefore higher, which also results in a higher heat-sink base temperature.
- If there is no air flow around the heat sink, energy cannot be transferred.
- A heat sink is not a device with the "magical ability to absorb heat like a sponge and send it off to a parallel universe".

Natural convection requires free flow of air over the heat sink. If fins are not aligned vertically,or if fins are too close together to allow sufficient air flow between them, the efficiency of theheat sink will decline.

APPLICATIONS

Microprocessor cooling

Heat dissipation is an unavoidable by-product of electronic devices and circuits. In general, the temperature of the device or component will depend on the thermal resistance from the component to the environment, and the heat dissipated by the component.

To ensure that the component does not overheat, a thermal engineer seeks to find an efficient heat transfer path from the device to the environment.

The heat transfer path may be from the component to a printed circuit board (PCB), to a heat sink, to air flow provided by a fan, but in all instances, eventually to the environment.

Two additional design factors also influence the thermal/mechanical performance of the thermal design:

- The method by which the heat sink is mounted on a component or processor. This willbe discussed under the section attachment methods.
- For each interface between two objects in contact with each other, there will be a temperature drop across the interface. For such composite systems, the temperature drop across the interface may be appreciable. This temperature change may be attributed to what is known as the thermal contact resistance. Thermal interface materials (TIM) decrease the thermal contact resistance.

ATTACHED METHODS

As power dissipation of components increases and component package size decreases, thermal engineers must innovate to ensure components won't overheat. Devices that run cooler last longer. A heat sink design must fulfil both its thermal as well as its mechanical requirements. Concerning the latter, the component must remain in thermal contact with its heat sink with reasonable shock and vibration. The heat sink could be the copper foil of a circuit board, or a separate heat sink mounted onto the component or circuit board. Attachment methods include thermally conductive tape or epoxy, wire-form z clips, flat spring clips, standoff spacers, and push pins with ends that expand after installing.

Heat sink fan

A heat sink is efficient for heat dissipation from electronic components. A fan can move a lot of air, but on its own, a fan is not very efficient for dissipating heat from components. Thus, heat sink with fans were introduced as shown in figure (1.5.1).

A heat sink and fan (HSF) is an active cooling solution used to cool down integrated circuits in computer systems, commonly the central processing unit (CPU). As the name suggests, it is composed of a passive cooling unit (the heat sink) and a fan. The heat sink is usually made from a high-temperature conductive material such as aluminium and copper, and the fan is a DC brushless fan, which is the standard used for computer systems.

Fig (1.5.1) heat sink and fan

A heat sink and fan is often used in modern computer systems to keep the processor cool. Without it, the processor could easily overheat and become damaged. Therefore, this combination is often found in most low- to mid-range computer systems, and even in high- end notebooks. However, for PCs and computer systems that boast a more powerful processor, a more powerful cooling solution is required, such as liquid cooling.

The heat sink is a thermal conductive material that quickly carries heat away from the processor. It is designed to have the greatest amount of surface area in a small volume of space, so aside from the flat contact surface the heat sink has many thin "fins" that facilitate heat dissipation through thermal convection, which means the heat is further carried away from theheat sink itself by air. Often the normal flow of air is not enough to allow for quick cooling, so a fan has to be added. Together, the HSF is the least expensive cooling solution available, withefficiency varying according to the heat sink design and fan power.

PNEUMATIC HOLES AND TUBING

Hoses and tubes, as shown in figure (1.6.1) are regularly used in pneumatic systems to distribute compressed air to the different components of the system. Understanding your application and the selection criteria for hoses and tubes will ensure it meets your application'sdemands.

CHEMICAL RESISTANCE OF TUBE AND HOSE MATERIAL

Fig (1.6.1) pneumatic hoses and tubing

Compressed air contains by-products such as compressor oil, dust particles and condensate. The environment also needs to be taken into consideration.

The hose or tube materials need to be resistant to all these substances and conditions. For hosesand tubes, a slightly different definition is used.

When referencing a tube, they are typically monolayer. This means that they are made from one material.

This one material needs to be chemically resistant to both the compressor oils and condensate from the media while being protected from any environmental conditions.

When referencing a hose, these can be made from multiple layers of materials.

You can therefore ensure that the inner hose material is resistant to the compressor oils and condensate, but can then have a second material as the outer shell to protect it from environmental conditions.

THERMOPLASTICS

The majority of pneumatic tubing and hosing is made of thermoplastics. As discussed, they canbe monolayer or multi-layered depending on the application.

Below we briefly discuss the most common thermoplastics that are used specifically for pneumatic tubing. However, please read our hosing and tubing materials and see our chemical resistance chart for additional material information.

1. Polyurethane (PUR or PU): Kink and abrasion resistant, flexible, and strong.
2. Polyamide (PA or Nylon): Light, robust, dimensionally stable, good bend radius, goodflexural-fatigue resistance, and a low moisture absorption rate.
3. Polyethylene (PE): Flexible, good chemical resistance, and is cost-effective.
4. Polyvinylchloride (PVC): Light, flexible, and can be repeatedly sterilized with no illeffects.
5. Polypropylene (PP): Very light, good chemical and heat resistance, and hasgoodsurface hardness.

MAIN AIR SUPPLY

Pneumatic components like valves, cylinders, or pressure regulators are typically connected tothe main air supply line via flexible tubing or hoses as shown in figure (2.6.2) and to distributethe compressed air from the compressor to the application, either pipe work or hoses are used

Fig (1.6.2) pneumatic componentsWORK

SHOP PIPE WORK

For large industrial workshops, there is often a requirement to have multiple connections throughout the workshop to connect pneumatic tools. In these settings, usually, a rigid piping system is used because it offers protection against accidental impacts or puncture. These rigid pipe systems, however, are expensive and labor intensive to install. As durability is a key criterion, often aluminum, copper, stainless steel, or rigid PVC is used. They also require numerous fittings and joints, which increases the points of possible leakage. The environmentaltemperature also needs to be taken into consideration as pipework can expand and contract with a temperature change. For example, aluminum expands 0.24 mm per meter pipe for every10°C temperature increase. It is therefore important that the piping system is routed taking these movements into account, for example by using expansion loops.

AIR SUPPLY LINES

Flexible hoses are used in conjunction with rigid piping of the compressed air or by itself in smaller workshops. They are also used for temporary or mobile air supply. Because flexibility, ease of installation, and durability are important in these applications, often lightweight HDPEis used or heavy rubber lines. Flexible hoses also allow for fewer fittings when compared to pipework and there is less concern of temperature impact due to it not being rigid.

AIR SUPPLY TO COMPONENTS

Pneumatic components like valves, cylinders, or pressure regulators are typically connected to the main air supply line via flexible tubing or hoses. However, they can also be reinforced, like a metal-plastic pipe as this allows for durability along with it being light and flexible. Flexibility is important due to the components could be vibrating or moving, so having a flexible hose will account for this. They are also at the end of the pneumatic cycle; they can have the smallest needed diameter. They are connected to the main air supply line and individual components via fittings.

HOSE STORAGE

To maintain a safe work environment and to ensure no damage is done to the hose, they are often stored on reels or they are coiled.

AIR HOSE REELS

An air hose reel is a cylindrical spindle used to store a hose. Usually, they are mounted to the wall, ceiling or to the floor. They help to keep the hose organized and to avoid any kinks. Often,they are self-retracting with a spring driven mechanism, but they can be hand cranked as well. Usually, air hose reels are used in combination with pneumatic tools or any other application that requires only a temporary supply of compressed air. The hose is typically made out of rubber, PU, or PVC.

The mechanism of a self-retracting hose reel works by pulling out the hose until the desired length is achieved. The hose reel will make a rattling sound when unwinding, which means you can lock it into position by releasing it. To trigger the spring loaded self-retracting mechanism, the hose needs to be pulled slightly outwards. During the retraction keep hold of the hose until it is fully retracted. Never let it go during retraction as the whipping end of the hose could cause injuries or damage.

A hose reel offers the advantage of automatically storing a hose and ensures a tidy and safe working environment. This also prevents any premature hose failure to due wear from being stepped on, dragged, or accidently hit from something in the environment (another tool, vehicle, etc.).

COILED AIR HOSE

Coiled air hoses, as shown in figure (1.6.3) are often used in garages and workshops for supplying air to pneumatic tools such as impact wrenches, blow guns etc. They are light and self-retractable, so they do not take up a lot of space.

Fig (1.6.3) coiled air hose

The hose is usually not coiled all the way to the fittings. On both sides a small straight part is left, which is called a tail. The difference between the extended and retracted length depends on the coil diameter. For a standard coiled air hose, the extended length can be for example tentimes the retracted length. In order to produce a coiled air hose, the hose material needs to have a good elastic memory to return to their initial coiled form after being straightened. Therefore, rubber is not used and typically Nylon, PU, or PVC are used for these applications.

CHAPTER 2 LITERATURE SURVEY

1. **Muhammad Fairuz Remeli1et.al** A 20 x 26 x 18 mm mini thermoelectric Peltier cooler was designed and built in this study. The Peltier thermoelectric cell was sandwiched between an external and internal heat sinks that acted to remove heat from the cooler box. When the Peltier thermoelectric cell connected to an external power source, the Peltier effect caused the heat from the refrigerator internal space to be conducted and removed to the ambient. The experimental data from this study were used to validate the theoretical thermal resistance model. It was found that the Peltier cooler was able to produce COP higher than 0.5 which the output was quite high compared to previous studies. This cooler was able to lower cooler box temperature down to 18.5 °C from the ambient temperature by removing 25W of heat. In the future, the validated theoretical model could be used to estimate the suitable design parameter such as the type of heat sinks, the size of the cooler, the cooling temperature and the cooler performance including the coefficient of performance (COP).

2. **Chelliah** The helmet is critical safety equipment for a two wheeler drivers. The primary purpose of helmet is to protect the head against injuries and to safeguard the eye from sunlight and dust particles. It is crucial that the motorcyclist is comfortable while wearing the helmet. The inconvenient equipment may affect concentration and create hazards that could lead to accidents. The motorcyclist can be affected by temperature which results in loss of concentration. This work focuses on absorbing the heat produced inside the helmet. To achieve this, a suitable Phase change material (PCM) Glauber Salt is encapsulated inside an Aluminum Foil. In addition, holes are created on the front and rear sides of the helmet. This allows circulation of fresh air flow inside the helmet so that the heat produced in the helmet is instantaneously tapped out. Thus continuous cooling is achieved till it he entire PCM fuses. Solid works is mechanical design software; provide tools to help you implement a sophisticated standard based architecture. Solid works software sketcher is used model and flow simulation, heat is removed by providing the phase change material.

3. **S F Zambrano-Becerra** In Colombia, the most widely used means of transport today are motorcycles, which have become increasingly numerous, bearing in mind that they are subject to laws and regulations imposed by the country's mobility, transit and transport agencies, the use of helmets is mandatory for drivers and passengers, safety measures are monitored, the hull must be certified and meet the required technical standards; whereas its role is to protect people in the event of accidents, regulations require that the helmet be completely closed to protect the entire head and chin; the design of the helmet allows air entry and there is no concentration of temperature inside, all this is done by implementing air inlet and outlet ducts, which circulate air when the motorcycle is in motion, unfortunately this does not happen due to the accumulation of temperature in the back of the helmet that makes the user feel tired and uncomfortable. This research proposes the development of a prototype portable cooling system for motorcycle helmets by the physical principle of heat transfer, by using Peltier cells, to have low production cost, optimal operation, and low energy consumption thanks to natural air flow.

Chapter 3

DESIGN And FABRICATION

Front view of the portable cooling device with parts shown in figure 3.1

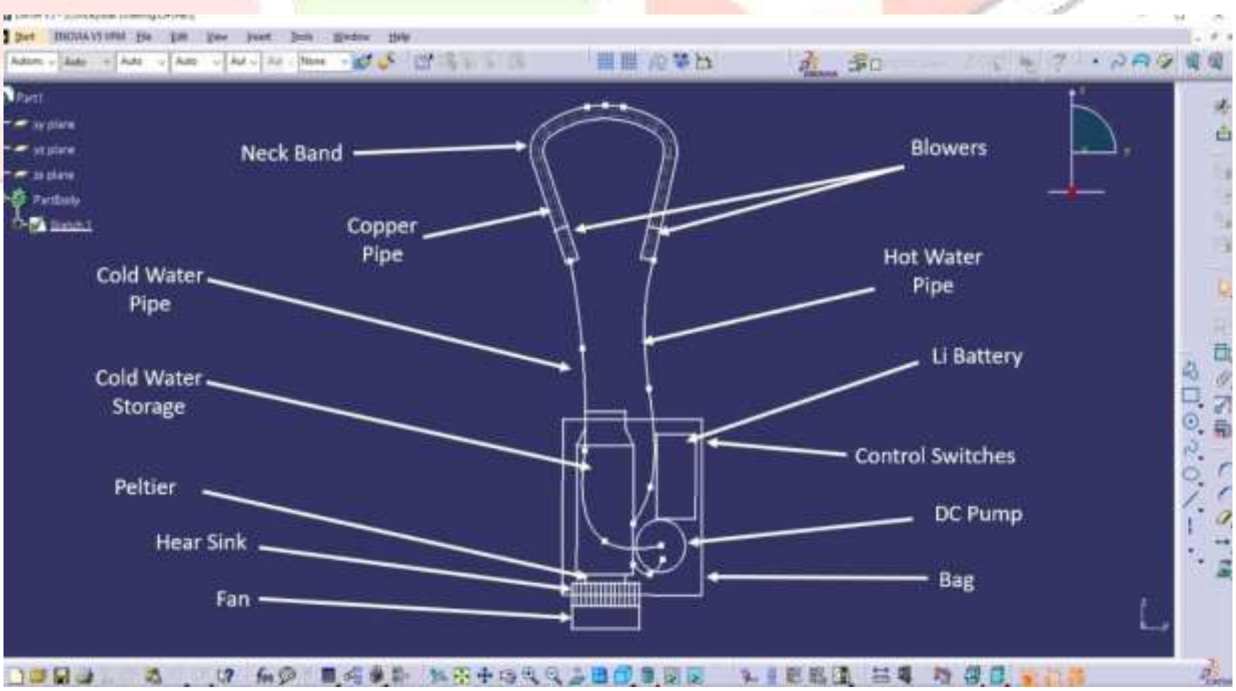


Figure 3.1 Front view ofportable cooling device

FABRICATION

PARTS PREPARATION:

3.1 Preparation of Neck Band

3.1.1 STRUCTURE

We have taken a PVC pipe of 1inch diameter and marked as per the required dimensions asshown in image below

Fig 3.1.1 PVC PIPE MARKING

We have performed cutting operation on the pipe with the help of angular grinder according tothe marking as shown in figure 3.1.2

Fig 3.1.2 CUTTING

3.1.2 Heating and Bending of pipe

We have heated and bent the pipe as per the requirement as shown in figure 4.1.2

Fig 4.1.2

3.1.3 Air Outlet Holes:

After bending operation we made holes on the bended section of pipe which is shown infigure 3.1.3

Fig 3.1.3 Outlet Holes

3.1.4 Making of Knobs

We made then knobs using raw thermo plastic material for the both ends as shown in figureand also fixed pneumatic coupling in it as shown in figures below

Fig 3.1.4 Knobs with couplings

We have inserted the copper pipe into the neck part which is connected to two pneumatic pipes at both the ends it is shown in figure 3.1.5 and sealed the open area using solder and M-Seal.

Fig 3.1.5

3.1.5 Fixing of Blowers

We made marking for fixing the blowers and we made cutting as for the requirements which is shown in the figure 3.1.6.1 below

Fig 3.1.6.1

We choose micro blowers which are smallest form of blowers present in the market they areshown in thew figure 3.1.6.2 below

Fig 3.1.6.2Micro Blowers

3.1.6 Cleaning and Painting

We cleaned the surface of the pipe using file and salt paper which helps in keeping the neck band smooth when we were it and also it helps in painting operation. The cleaning operation infig 3.1.7.1

Fig 3.1.7.1

We paint the neck band to make it look better and attractive

3.1.6 Painting

3.2 preparation of Thermoelectric Cooling system

3.2.1 Fixing of Fan and Heat Sink

We have fixed the fan and heat sink using screws, which will help in removing the heat fromthe heat sink

3.2.1. Heat Sink and Fan

3.2.2 Fixing of Peltier on Heat Sink

We have fixed the peltier on the heat sink which is already connected to the fan as shown in thefigure.

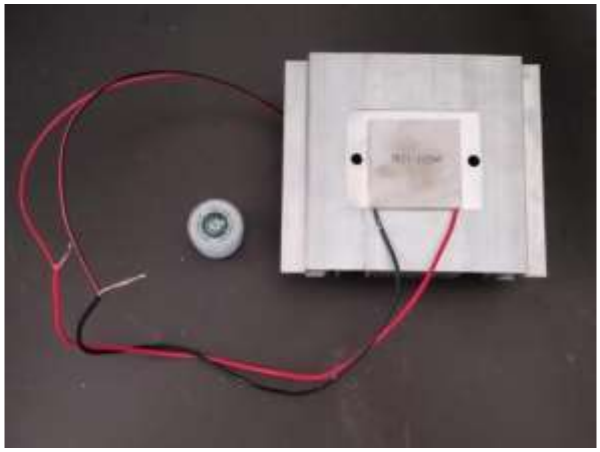


Fig 3.2.2 peltier and heat sink

3.2.3 Fixing of Coolant Storage Tank

Then we added the cooling storage tank on the peltier using the thermal glue as shown in figure 3.2.3 below.

Fig 3.2.3a Coolant storage tank

We have covered the coolant tank using the foam which helps in loosing of temperature in tankand it is shown in figure 3.2.4.

Fig 3.2.3b

3.2.4 Fixing the Pump and Battery for Making the Circuit Complete

We have fixed the pump and battery, And also connected the complete circuit inside a bag andthen joined the pipes as per the requirements.

Fig 3.2.4 Final Model of Project

Chapter-4 Results and Discussions

Calculations

Blower Power Consumption (Pb)	=	3W
Number of Blowers (Nb)	=	2
Total blower power consumption (Pbt)	=	Pb + Nb
	=	2 x 3
	=	6W
Pump power consumption (Pp)	=	12W
Continuous Power Consumption (Pc)	=	Pbt + Pp
	=	6 + 12
	=	18W
Thermo Electric Cooler / Peltier power consumption (Pt)	=	36W
Heat sink fan power consumption (Pf)	=	3W
Intermittent Power Consumption (Pi)	=	Pf + Pt
	=	3 + 36
	=	39 W
Time of period of peltier and fan operation per hr	=	20min/hr
Total power consumption per hr of operation (Pn)	=	(20 / 60) x Pi + Pc
	=	(20 / 60) x 39 + 18
	=	31Whr

Battery Power (Pbat)	=	72W
Hours of operation per full charge	=	Pbat / Pn
	=	72 / 31
	=	2.32

How ever for better life of battery it is recommended to discharge the battery only up to 60%

= 2.32 x 60%

Operable number hours per full charge = 1.39Hrs

Chapter 5 Conclusion

As a conclusion, we can conclude that the portable air cooler satisfies the needs of the consumer at the most economical cost. The portable air cooler has a very low maintenance cost. It provides the facility of portability and can move anywhere easily. It is smaller in size, hence it would sit nicely in our bedroom, drawing room, and kitchen and it is completely non- polluting because we are using water as a cooling medium.

References

1 DiSalvo, Francis (July 1999). "Thermoelectric Cooling and Power Generation"

2 "Heat sink selection" at the Wayback Machine, Mechanical engineering department, SanJose State University (27 January 2010)

3 "Pneumatics applied to Telegraphy".

4 Cumberland and Westmorland Advertiser, and Penrith Literary Chronicle. England. (13December 1864).

5 "The Pneumatic Despatch System". Birmingham Daily Gazette. England. (1 March 1865)

6 Pneumatic hoses and tubing: tameson.com (17 September 2018).

7 Muhammad Fairuz Remeli.

8 Chelliah.

9 S F Zambrano-Becerra.