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DESIGN AND FABRICATION OF 360 DEGREE MOTION COOLER CUM HEATER

Prof. G.S.Mahajan1 , Mr. Akash Nimbole2, Mr. Harshwardhan Patil3, Mr. Krishnath Patil4,

Mr. Sajid Shaikh 5

1Professor 2,3,4,5Student,
Department of Mechanical Engineering,
P.E.S. Modern College Of Engineering, Pune, India

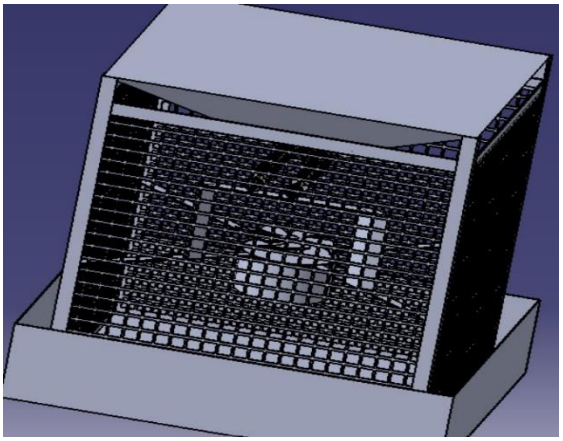
Abstract:

The 360° air cooler and heater serves as a versatile device, capable of adjusting air temperature according to user preferences. As humanity's energy consumption escalates over time, there's a growing concern that future generations may face energy scarcity. Embracing energy-efficient solutions like the 360° air cooler and heater becomes crucial in mitigating this issue. Moreover, this innovative system plays a pivotal role in combating global warming. Unlike conventional air conditioning units that emit Chloro-Fluoro Carbons, contributing to ozone layer depletion and climate change, the 360° air cooler and heater operates with significantly lower electricity consumption, thereby reducing heat emissions and environmental impact. Functioning on the principle of extracting latent heat of vaporization from the passing air, this system effectively lowers temperature and enhances specific humidity. Unlike traditional air conditioning systems, which rely heavily on electricity and contribute to global warming, the 360° air cooler and heater utilizes chilled water to cool air in all directions. During winter months, when air humidity is high and dry bulb temperatures are low, traditional coolers may experience reduced efficiency. However, incorporating a heater coil into the 360° air cooler and heater enhances its performance, ensuring optimal operation even in cold conditions by providing heated air when needed.

Introduction

Evaporative cooling, an ancient method, has recently gained thermodynamic validation. It involves saturating air adiabatically with water spray, costing less initially and to operate. Desert coolers exploit the principle of evaporative cooling, effectively reducing temperature in hot, dry regions. They consist of blowers and pumps, offering affordability and efficiency in such climates. However, they're ineffective in humid areas. 360° cooling entails direct contact of water particles with moving air, decreasing both humidity and temperature. While not a complete air conditioning solution, it does provide comfort by filtering and circulating cooled air. Before residential air conditioning, it was the primary method for summer comfort, except during humid periods. Efforts to promote energy efficiency led to increased usage of 360° coolers, but water consumption became a concern. Nagpur's groundwater management efforts focused on water-saving practices, favoring air conditioning despite its higher energy consumption. In Nagpur and similar dry regions, home cooling is essential. While air conditioning consumes more electricity, 360° cooling remains popular despite its

significant water usage. Evaporative coolers, also known as swamp coolers, offer an energy-efficient alternative by utilizing water's vaporization enthalpy to cool air, especially beneficial in dry climates.



OBJECTIVE:

1. It should have the capability to both cool and heat the air, making it suitable for use in both summer and winter seasons.
2. Low operating cost suitable for hot and dry regions.
3. Detects the water level automatically.

PROBLEM STATEMENT:

Nowadays, the power crisis is more pronounced, emphasizing the need for prioritizing power saving and energy conservation. Efforts are being concentrated on discovering resources and methods for conserving energy. This project aims to design, develop, and fabricate a 360˚ air cooler cum heater with low operational and overall costs. Traditional coolers are only effective in summer seasons, while during winter and monsoon, they remain idle. This inefficiency calls for a solution to effectively heat the air during colder seasons, maximizing its utilization and ensuring comfort for humans. The 360˚ directional feature enables people to sit comfortably anywhere.

SCOPE :

1. The cooling range of cooler can be varied by changing the fluid but it can also result in increasing the cost of cooler.
2. We can regulate the capacity of the blower fan by installing potentiometer so that as per the requirement the flow of air can be regulated.
3. We can install thermostatic expansion valve for auto cut off for the heater coil, so that the temperature of the heater coil can be set at the required and the desired value as per the temperature conditions.

METHODOLOGY:

Designing a 360-degree motion for an air cooler cum heater involves incorporating features that allow the device to distribute air in all directions. Below is a general methodology for achieving this:

1. Design Conceptualization:
    - Identify the need for 360-degree motion in the air cooler cum heater.
    - Consider the device's size, shape, and intended use.
2. Airflow Mechanism:
    - This could involve axial or centrifugal fans, or a combination of both.
    - Consider the optimal balance between airflow volume and power consumption.
3. Vertical Airflow Adjustment:
    - Incorporate a mechanism for adjusting the vertical angle of the airflow to cover different height levels.
    - This could involve an adjustable vent or a tilting mechanism.
4. Fan Blade Design:
    - Design fan blades that are efficient in pushing air in all directions.
    - Consider blade shape, size, and pitch for optimal performance.
5. Noise Reduction:
    - Implement noise reduction features to ensure quiet operation.
    - Choose materials and components that minimize vibrations and sound generation.
6. Quality Control:
    - Implement quality control measures to ensure the reliability and durability of the product.
7. Manufacturing Considerations:
    - Optimize the design for cost-effective manufacturing.
    - Ensure that materials are readily available and assembly is efficient.

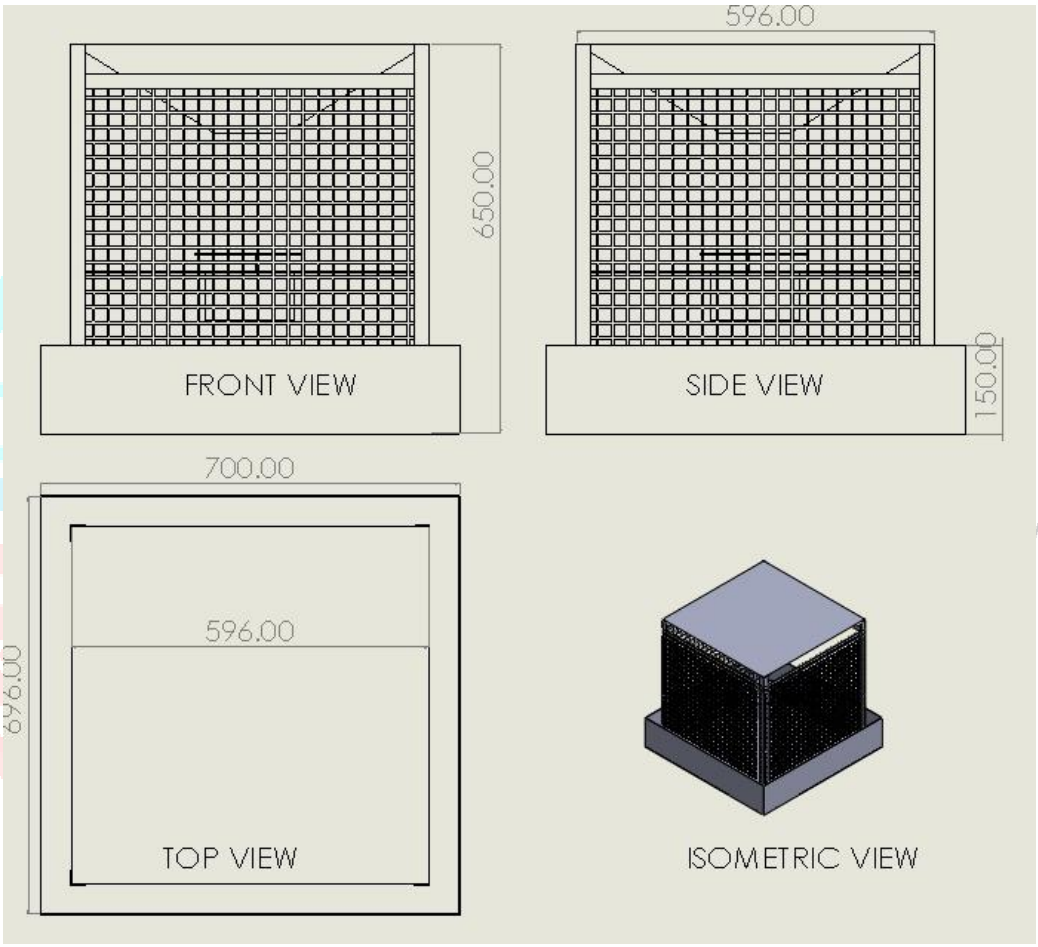
WORKING:

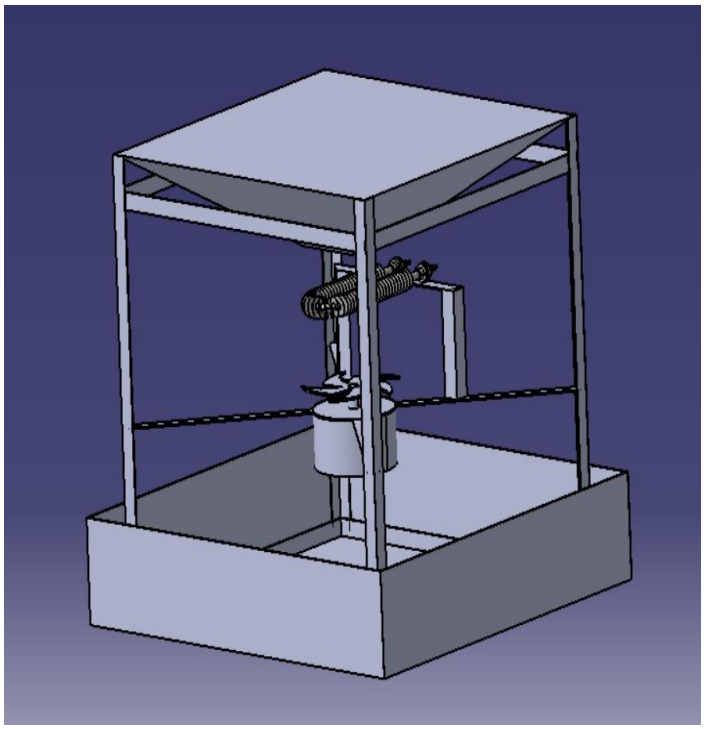
The operational principle of the 360˚ air cooler and heater is straightforward. It relies on the evaporation of water to create a cooling effect. When hot air with low relative humidity encounters water, it absorbs latent heat, causing the water to change phase into vapor. This vapor is then carried away by the air, resulting in a reduction in air temperature and an increase in relative humidity.

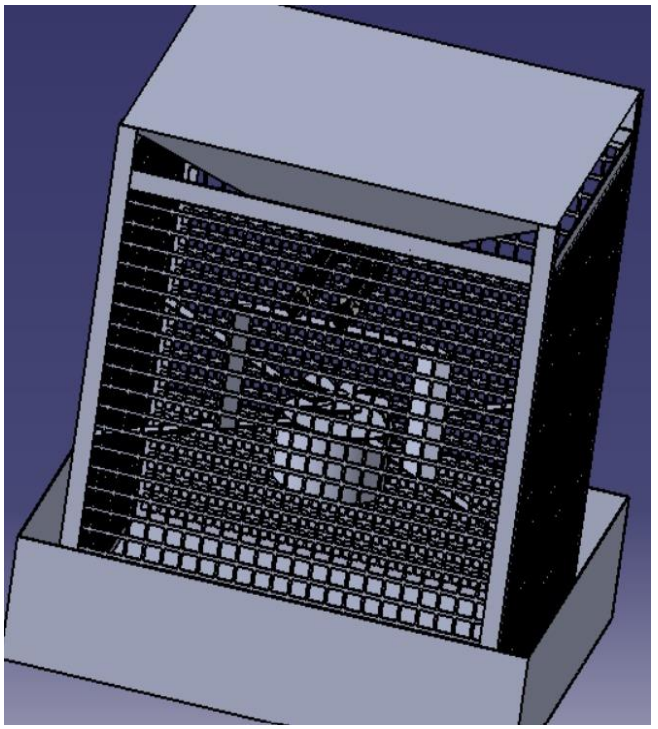
In this cooler, air enters from all four directions through a fan, pulling in outside hot air. This air passes through a cellular pad where water is sprinkled, facilitating evaporation and cooling. The cooled air then moves through channels and baffles before being distributed in a 360˚ direction. Water is sprinkled onto the cellular pad using a pump in the sump. The cooler is typically used during summer when cooling is needed. However,

during winter and monsoon seasons when higher temperatures are desired for human comfort due to low ambient temperatures, a heating coil is employed to raise the air temperature. The cooler includes a switch that determines whether power is supplied to the pump for cooling or to the heating coil for heating. When the switch is on, the pump receives power for the cooling process. Conversely, when the switch is turned off, power is redirected to the heating coil, and the cooling process ceases. The air follows the same route but is heated by the heating coil instead. This process is known as sensible heating since it does not affect the humidity of the air.

MODEL & DESIGN:







CALCULATION

CULATION FOR HEATING-

Assume,

Speed of fan N= 1400 RPM

velocity of air = velocity of fan (15% Reduction)

Velocity of fan = Πdn/60

D = Outer Diameter of fan in meter (0.2m)

Velocity of fan-ν

V = Π x 0.2 x 1400/ 60

V = 14.66 M/s

Velocity of air-

Consider the velocity of reduction in velocity of fan velocity of air is 85%.

Vair = 14.66 x 0.85

= 12.46 m/s

We know that Reynolds number Re: VL/ν

V = Velocity of Air

L = Thickness of Coil

ν = kinematic viscosity of air at 26°C

Re = 12.46 x 0.003 / 16 x 10-6 = Re = 2336.25

Nusselt number

Nu= C1x 1.1Ren x P10.33

Pr of air 250c, C1=0.224

Nu = 0 22x1.1x (2336.375) 0.612 x(0.701)0.33

Nu = 24.79

Nu=hl/k

Where k is Conductivity of air at 26°C is 0.02558

L is thickness of coil

h= heat transfer coefficient

24.79=h (0.002)/0.02658

h = 329.459

Connective heat transfer,

Q=hA (T2-T1)

CALCULATION FOR COOLER

Q1-2=GC Gpair + Cpwater x W) (T2-T1)

where

Q1-2= Heat transform form cooler to air

W= specific humidity of water is 0.014

at 32°C

CPair= 1.005 kg/kg0C

CPwater =1.88 kg/kg0 c

G = 3.9729 x 10-3 kg/sec

Q1-2= 3.9729X10-3X(1.005+1.88X0.014)X(27-32)

Q1= 20.5 J/Kg

CONCLUSION:

The 360 cooler/heater provides flexible temperature control that works well in a range of settings. Its small size guarantees efficiency and portability. Its dual purpose of heating and cooling makes it the perfect choice for year-round comfort in homes, workplaces, and outdoor environments. Individualized comfort levels are made possible by the simple controls and changeable settings. It reduces operating expenses and its impact on the environment by maintaining energy efficiency despite its multifunctionality. All things considered, the 360 cooler cum heater blends eco-friendliness, practicality, and functionality, making it an excellent choice for controlling temperature in a variety of settings.

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