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"Natural Water Cooled System"

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Abstract: - The cooling system shown above uses the principle of natural convection and conduction to cool a particular area in which it is being fitted. It's main parts are:-

- Aluminum box
- Insulating box
- Cooling tower
- Water pump
- Fins
- Base plate/tank

In this the cooled water from the cooling tower is allowed to fall on the roof of the aluminum box. After that it moves down the box by being in contact with the fins fitted on the walls, there by extracting heat from the air inside the aluminum box and hence cooling the room. This water is collected at the base tank and then transferred to the cooling tower through a water pump . In the cooling tower the water is cooled by natural convection. And then again the water is transferred on the roof of the aluminum box. Similarly, the cycle goes on and hence cooling is obtained inside the room. A fan circulates the air inside the room for proper cooling.

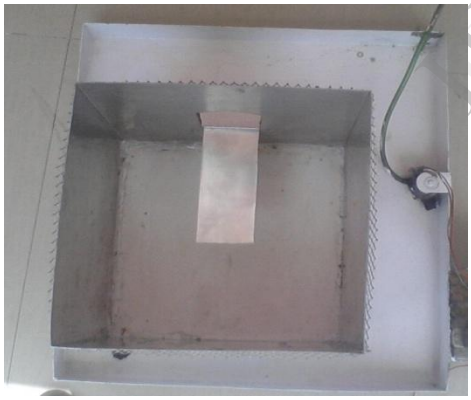
Keywords: - Natural convection, conduction, fin

Introduction:- The stainless steel plate is used as a base . The aluminum box is pasted over the stainless steel plate with the help of silicon. Fins are fixed around the aluminum plate. From one wall a door is made for the air to pass through the aluminum box , on the opposite wall small holes(6 in no) are made to allow the air from the fan which is fitted on the wall of the insulating plate . the insulating box is kept over the aluminum box with the a fan fitted on it .

The pump is fitted over the base plate with output fitted to the cooling tower and inlet from the base plate. The cooling tower is also fixed at the corner of the base plate. The outlet of the cooling tower is connected to the top of the insulating plate.

The various parts of the system are:-

- **Stainless steel plate**:- A stainless steel plate is used as the base of the project the dimensions of the sheet are (51 X 47 X 6) CM . The thickness of the sheet is 18 gauges.



- **Aluminium box**:- An aluminum box is used as the inner wall of the room through which the heat exchange takes place. The dimensions of the aluminum box are (29X29X29) cm. The thickness of the sheet is 20 gauges.
- **Fins**:- The fins of quarter inch are fitted around the aluminium box for more heat transfer. It also increases the time of contact of the water with the aluminium box.

- **Cooling tower** = A air cooled cooling tower is used to cool the hot water. The height of the cooling tower from the base is 65cm. at the top the falls on the smallest plate of the cooling tower and then in form of drops on the medium size plate and finally on the biggest plate. From where it is further carried through pipes to the aluminum box. The cooling tower is made up of galvanizing sheet of thickness 22 gauge.

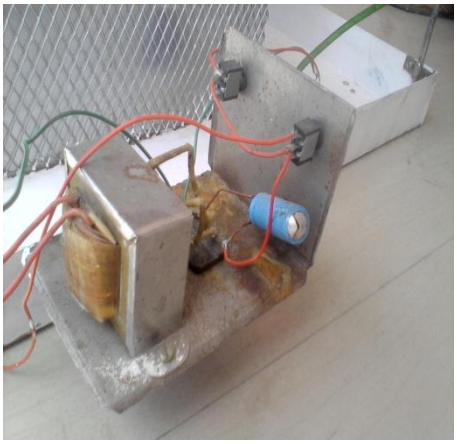
- **Insulating box** = An insulating box of etalon supported by steel wires are used to prevent the outside

atmosphere to affect the inside atmosphere.

- **Pump** = A 12 volt pump is used to transfer the water from the base plate to the cooling tower.

- **Fan** = A 12 volt fan is fitted on the wall of the insulating plate which regulates the air inside the aluminium box through holes on the aluminium box.

- **Electrical circuit** = The system runs through an electrical circuit which is connected to an ac source 220v and then connected to a transformer (220 to 12 v) . which then further supplies the power to the pump and fan. .



Literature survey :-

(1) During 1900 the definition of air conditioning considered as the control of both temperature and humidity. It was later on developed to add water particles in the stream of hot air to develop cool air. (2) Later on the concept of centrifugal compression was used in the refrigeration system . After that there were a no of developments in the design and working of compressors. It was patented in 1921 .(3) In 1928 the first residential 'Weather maker', an air conditioner for private home use. The Great Depression and then WW2 slowed the non-industrial use of air conditioning. After the war, consumer sales started to grow again. The rest is history, cool and comfortable history.(4) In 1931 invent an individual room air conditioner that sits on a window ledge—a design that's been ubiquitous in apartment buildings ever since. The units are available for purchase a year later and are only enjoyed by the people least likely to work up a sweat—the wealthy. (5) In 1935 an interesting centrifugal chiller that used water as the refrigerant. This eliminated the need for a chilled water heat exchanger. In 1937 to produce the first practical hermetic centrifugal suitable for wide distribution. The chiller had two barrels, a condenser above and a cooler below. Located in the end of the cooler was a motor with a two-stage centrifugal compressor.

Experiment set up and it's working:-

The stainless steel plate is used as a base . The aluminium box is pasted over the stainless steel plate with the help of silicon. Fins are fixed around the aluminium plate . From one wall a door is made for the air to pass through the aluminium box , on the opposite wall small holes(6 in no) are made to allow the air from the fan which is fitted on the wall of the insulating plate . the insulating box is kept over the aluminium box with the a fan fitted on it . The pump is fitted over the base plate with output fitted to the cooling tower and inlet from the base plate . the cooling tower is also fixed at the corner of the base plate . the outlet of the cooling tower is connected to the top of the insulating plate .

For the working of the project the base plate is filled completely with water . the pump and the fan are then switched on. the pump then throws the water over the cooling tower. The water is then cooled in the cooling tower naturally . the cooled water is then collected from the base of the cooling tower and is transferred through the pipe at the top of the insulating plate . this cooled water is then allowed to fall over the terrace of the aluminium plate from where this water is distributed to all the four sides of the aluminium box where this water moving along the fins extract the heat from aluminim box and then moves to the base plate . where this water is again pumped to the cooling tower for cooling and the cycle goes on . the function of the fan is to make the flow of air through the aluminium box regularly.

Result and discussion:-

(1)cooling comparison:-

Atmospheric temperature= 37degree C

Temperature inside the room before the cooling = 32degree C

Temperature inside the room after the water cooled system is on = T(W.C)

Temperature inside the room after the air conditioner is on is on= T(A.C)

s.no	Time (min)	T (W.C)
1.	15	29
2.	30	26.8
3.	45	25
4.	60	24
5.	75	23.5
6.	90	23.1

s.no	Time (min)	T (A.C)
1.	15	29
2.	30	27
3.	75	26
4.	90	25
5.	120	24
6.	150	23

(2)Cost comparison:-

DATA REPRESENATION:-

- Cost of aluminium plate (20 gauge) = 80rs/ft^2
- Cost of stainless steel plate (18 gauge) = 160rs/ft^2
- Cost of galvenized steel plate(22 gauge) = 60rs/ft^2
- Cost of fins (quarter inch) = 45rs/f

COST OF THE PROJECT FOR A ROOM (12*10*10):-

DIMENSIONS OF THE ROOM :-

- Aluminum area = 560ft^2
- Stainless steel plate area = 300ft^2

Costing calculation:-

- Alluminium cost = 80*560= 44800rs
- Stainless steel cost = 160*300= 48000rs

- Galvanized steel area =94ft^2
- Fan (75 w)= 1500rs
- Motor (1/2 HP) = 2500rs
- Wiring=3000rs
- Piping system = 2000rs

- Galvanized steel cost = 60*94= 5600rs
- Fan = 1500rs
- Motor = 2500rs
- Piping cost = 2000rs
- Fins = 25000rs

Total cost = 1,30,000rs(approx.)

Costing comparison:-

WATER CHILLER SYSTEM	**AIR CONDITIONER**
• Installation cost = 1,30,000rs • Energy consumption :- Energy consuming devices are :- 1. Electric motor=373w or0.373kw • In 1 hour the pump will consume 0.373kwh or 0.373 u(unit) . • 10 hour a day = 3.73u • In a year = 3.73*365= 1361.45u • Cost of 1 unit = 3rs • Cost of energy in a year = 1361.45*3 =4084.35 or 4100rs	**(1.5Ton and 2 star rating)** • Installation cost(I Ton) = 30,000rs • Energy consumption = 3kw • In 1 hour A.C will consume = 3kwh or 3u • For a day (8 hr)= 24u • In a year= 24*365= 8760u • Cost of 1 unit = 3rs • Cost of energy in a year= 3*8760 = 26,280 0r 25000rs(approx)

2. Electric fan = 75w or 0.075kw • I hr = 0.075 kwh • In a day (10 hr)= 0.75kwh • In a year = 0.75*365 =274 u • Cost of energy in a year = 274*3= 822rs **TOTAL ENERGY COST** = 5000rs **Year wise** **After 1st year = 130000+5000=135000** **2nd year= 135000+5000= 140000rs** **3rd year= 140000+5000=145000rs** **4th year=145000+5000=150000rs** **5thyear=150000+5000=155000rs**	**TOTAL ENERGY COST** = 25000 **Year wise** **After 1st year = 30000+25000** **=55000rs** **2nd year= 55000+25000=80000rs** **3rd year=80000+25000=105000rs** **4th year=105000+25000=130000rs** **5th year=130000+25000=155000rs**

Conclusion:-

- To cool a particular area it takes very less time than the air conditioner to reach the same temperature.
- Large amount of energy saving is done .
- The installation cost is although very large in comparison to an air conditioner, but after 5 years of working it gives the same total amount as an A.C. So in the 6th year there is a complete profit of 20,000 rs .

Future scope:-

- The plant works on the principle of natural convection, no requirement of forced system.
- To increase the conductivity fins are used on aluminum box.
- The plant uses water as a refrigerating liquid, which is in plenty at every place.
- In this era of energy scarcity , it will act as a major means of energy saving.

Reference :-

(1) In 1906 Stuart H. Cramer designed an apparatus which adds water vapor in the hot air. The method was adopted in textile mills.
(2)In 1910 Willis Havilland Carrier invented the first centrifugal compressor. This discovery gave the refrigeration system a new way.
(3)In 1928 Willis Havilland Carrier developed the first weather maker.
(4) In 1931 H.H. Schultz and J.Q. Sherman developed the first room air conditioner. It was made to fit on the window. it was very helpful in cooling buildings and apartments.
(5) In 1935, Ingersoll-Rand developed an interesting centrifugal chiller that used water as the refrigerant but the system fails. In 1937 Buensod-Stacey and Trane together form the first centrifugal chiller.