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IMPROVISED COOLING DEVICE

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ABSTRACT

Modified cooling device is the adaptation of the conventional desert cooler. It's a low cost and low operating cost Air Conditioner. It is developed for better cooling effect than conventional device at low cost by modifying the refrigeration arrangement. In this way, moisture content of the air is marginally reduced while delivered through the device and also better relative humidity in summer time is maintained than conservative means of cooling. Erected refrigeration arrangement includes a chilling box, a compressor, expansion device and condenser. Chilling box provides frosty effect with the help of exhaust fan that transferred to embattled space.

KEYWORDS: Modified Cooler, Refrigerated System, Controlled Room Temperature

In India, during summer season, the average temperature is about 40˚C to 45˚C and even reaches up to 48˚C during mid months. To maintain comfortable ambient in-doors conditions, various appliances are in practice such as 'Air Conditioner', 'Room Coolers', Exhaust fans with water spraying nozzles, etc.

Refrigerating Device

Refrigerating device is used to lowering the temperature of an enclosed space by removing heat from that space and transferring it elsewhere and named as Air Conditioner, Refrigerator, Air Source Heat Pump, Geothermal Heat Pump, Chiller, etc.

Basic Difference between Conventional and Modified Coolers

Conventional Room Coolers are basically equipped with cooler body, motorized exhaust fan, motorized water pump and control switch etc. Whereas, Refrigerated Cooler is equipped with the Body of Cooler, Exhaust Fan (blower) with motor, Reciprocating Compressor, Condenser, Expansion Device (Capillary Tubes), Evaporator (Ice Box), Control Switch, etc.

Vapour Compression Refrigeration System (VCRS)

VCRS is one of the many refrigeration cycles which is most widely used method for domestic and domestic and commercial refrigerators, large-scale storage, refrigerated truck, oil refineries, petrochemical, chemical processing plants, natural gas processing plants, air-conditioning of buildings and automobiles. VCRS basic components are compressors, condensers, expansion devices, evaporators with supportive accessories like: filters, driers, various controls, etc.

LITERATURE REVIEW

Few available literatures were reviewed for better understanding of the concepts and techniques used in the present reseadeveloped cooling deviceh paper, which are as under:

Yari et al. (1) had modified the refrigeration cycle of ejector-vapour compression to improve its performance with the help of intedeveloped cooling deviceooler and heat exchanger. They had encountered the encouraging result in pedeveloped cooling deviceentage of higher single digit of around 8% improvement in both coefficients of performance and efficiency of second law.

Selvaraju et al. (2) had analyzed a vapour ejector refrigeration system with environment friendly refrigerants like heat extracted from industrial processes waste and solar energy that could satisfactorily be operated at generator temperature as low as 650C.

Bergander (3) had explored the new Regenerative Rankine Cycle for vapour compression refrigeration for chilling purposes with higher two digits percent economized energy and same digits amplified ejector pressure.

Akintunde (4) had validated the design model of vapour compression refrigeration system where used compressor was of reciprocating nature and found 16% of

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increment results in performance and 16% savings in consumables.

Yu et al. (5) had developed an ejector supported Novel Auto cascade Refrigeration Cycle (NARC) so that compressor suction pressure will improve by recuperate some of the obtainable work. NARC had also enhanced the refrigeration cycle performance by operating at low pressure ratio.

Zhu and Jiang (6) had combined the vapor compression refrigeration system with an ejector cooling system. Whereas, waste heat exhausted by vapor compression refrigerator was used in ejector cooling cycle system and so generated cooling effect were directly used by vapor compression refrigerator through it evaporator to improve the C.O.P. of the developed combined refrigeration system.

Banker et al. (7) had tested the performance of HFC R134a refrigerant by using thermal compression using a string of adsorption compressors as supplement to conventional compression to convert into hybrid compression process. They had observed that even 60% energy were sufficient in the developed hybrid compression process by attaining the saving of 40% energy means developed process is practicable even at low grade energy.

Chesi et al. (8) had examined a vapor compression machine in combination with an ejection machine that was operated over solar power to know the operational performance of this combination in respect of cooling effect, energy balance and cost cutting on consumed power. All parameters were examined after one year observation at four different locations worldwide and concluded with inspiring results on all fronts with enhanced overall efficiency of the developed combined system.

Selvaraju and Mani (9) had conducted an experiment over the performance of a vapor ejector refrigeration system that was worked over R134a refrigerant. The experiment was conducted over subjected refrigeration system of cooling capacity of 0.5 kW (rated) to measure the performance by varying the temperature of condenser, generator and evaporator. With varying configuration, they reached to an optimum temperature to achieve utmost C.O.P.

PROBLEM FORMULATION

In country like India, average temperature rises to even 48˚C during summer season and to cope up with that, search to maintain ambient in door conditions comfortable is the great task and to maintain that in more economical way is a great challenge.

OBJECTIVE OF THE STUDY

The objective of this paper is to maintain room temperature in less time and in a comparable economic way.

METHODOLOGY

To change the design of Conventional Cooler, this cooling device is being developed consisting cooler body, blower, reciprocating compressor, condenser, capillary tube as expansion device, evaporator and control switch. Designed and opted details of used components in the developed cooling device are briefly elaborated subsequently:

Body Frame

A body frame similar to conventional cooler with size 18*15*9 ft^3 was fabricated by using glass wool filled sheets over all six sides and created a window of size 6*0.4 ft^2 in front sheet to transmit the refrigerated cooling effect to the persons in the targeted space.

Blower

An electric fan of 500 r.p.m. speed with 170 watt motor was selected to circulate the generated cooling effect in the target space of size 18*15*9 ft^3.

Reciprocating Compressor

Reciprocating compressor of 0.5 tons capacity was used which were to compress the refrigerant adiabatically and send it into high temperature high pressure vapour refrigerant to the condenser.

Condenser

A wire - tubes type air cooled condenser with tube diameter, 6.35mm was used, where refrigerant cooled by atmospheric air and after cooling the refrigerant in condenser, refrigerant to send to expansion device; the capillary tube as an expansion device.

Capillary Tube

A capillary tube of diameter, 0.8mm and of length, 2.42m; was used as an expansion device where refrigerant releases its latent heat and refrigerant changes its phase vapour refrigerant into liquid refrigerant and it will goes to evaporator.

Evaporator

Cooling effect is collected in the evaporator of length and diameter of 6.62 m and 6.4 mm respectively where cooling effect is transmitted into the targeted space by using blower.

Line diagram of designed cooling device is given by figure 1 below:

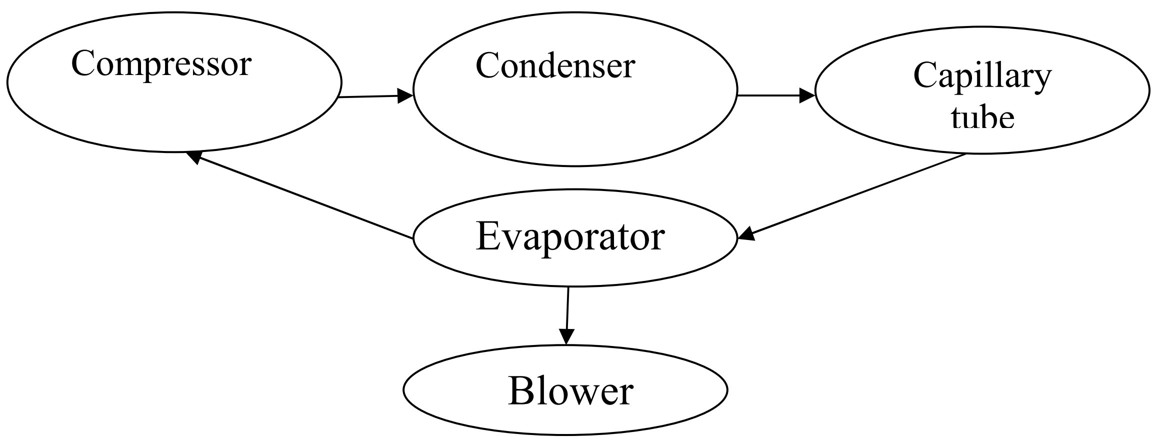

Figure 1: Line diagram of designed cooling device

Specifications

Specifications of used components in developing the cooling device are as such:

- Compressor: Reciprocating compressor with capacity of 0.5 tons.
- Expansion device: Capillary tubes with diameter of 0.8mm and length of 2.42m.
- Refrigerant: R134 (a) in 250 ml. quantity.
- Condenser: Wire and tubes types air cooled condenser with 6.35mm tube diameter.
- Evaporator: 6.62m length with 6.4mm diameter.

OBSERVATIONS

Few observations were taken by Conventional Cooler over cooling effect and are detailed in the table 1.

Table 1: Observations made by conventional cooler

S.N.	Area (Sq. ft.)	Initial temp. (^{0}C)	Final temp. (^{0}C)	Time taken (minutes)	No. of persons
1	18*10 = 180 ft^2	40	25	50	3
2	15*12 = 180 ft^2	40	25	42	2
3	12*10 = 120 ft^2	40	25	30	2

- In observation 1, conventional cooler cools area of 180 Sq. ft. to 25 0C from 400C within the time span of 50 minutes for three persons.
- In observation 2, conventional cooler cools area of 180 Sq. ft. to 25 0C from 400C within the time span of 42 minutes for two persons.

- In observation 3, conventional cooler cools area of 180 Sq. ft. to 25 0C from 400C within the time span of 30 minutes for two persons .

Another set of observations were taken by developed cooling device over cooling effect and are detailed in the table 2.

Table 2: Observations made by developed cooling device

S.N.	Area (Sq. ft.)	Initial temp.(^{0}C)	Final temp. (^{0}C)	Time taken (minutes)	No. of persons
1	18*10 = 180 ft^2	40	25	40	3
2	15*12 = 180 ft^2	40	25	30	2
3	12*10 = 120 ft^2	40	25	15	2

- In observation 1, developed cooling device cools area of 180 Sq. ft. To 25 ^{0}C from 40^{0}C within the time span of 40 minutes for three persons.
- In observation 2, developed cooling device cools area of 180 Sq. ft. To 25 ^{0}C from 40^{0}C within the time span of 30 minutes for two persons.
- In observation 3, developed cooling device cools area of 120 Sq. ft. to 25 ^{0}C from 40^{0}C within the time span of 15 minutes for two persons.

RESULTS

Developed cooling device had given very encouraging results by saving cooling time from 20% to 50 % for equal cooling capacity as of conventional cooler.

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