Automatic cooling coverall for workers confort.

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Abstract

The main target of this Paper is to provide comfort to the workers which are working outside in summer or hot surroundings. This project will solve many health problems which can happen at higher temperatures like heat stroke, heat exhaustion, heat cramps, sunburn, and many more. This project aims to provide healthy, safe, and comfortable environments for the workers, and if these things are there then workers will work effectively without any hesitation, tiredness, uncomfortableness, etc. This project will help a lot of outside workers because it will automatically maintain the body temperature of the outside workers in hot climates.

And taking about the features of this project automatic cooling coveralls for workers' comfort can promote sweat evaporation, improve ventilation, and increase airflow to the whole body. And with the help of thermodynamics, Convection heat transfer, Heat and mass transfer concepts project is successfully performing the operations for implementation of project into a prototype. Finally, effectively reduce body temperature after it reduced the body temperature system will automatically turn off. This coverall can be easily used by any worker. There is a reflective strip on both the solder and in legs that can keep you safe during the night.

So, the concept and vision of this project are simple, Keeping the priority on health the scope of the project is to provide outside workers satisfactory and healthy environment for the workers. So after the evaluation convection of heat transfer from the body is Q = 327.75 watts.

I. INTRODUCTION

In many industries like goldmines companies and construction companies, their workers are working in the hot climate or hot environments for 10 hours to 12 hours continuously which is not good for their health. This project aims to provide healthy, safe, and comfortable environments for the workers, and if these things are there then workers will work effectively without any hesitation, tiredness, uncomfortableness, etc. The purpose of this project is to create a healthy environment and comfortable environment for outside workers who are working in goldmines, construction areas, etc. This project will help a lot of outside workers because it will automatically maintain the body temperature of the outside workers in hot climates.

Thermodynamics is a branch of physics that deals with the relationship between heat and other from energy. It describes how thermal energy is converted to and form other forms of energy and how thermal energy affects matter. Heat transfer in fluids generally takes places via convention. Convection currents are set up in the fluid because the hotter part of the fluid is not as dense as the cooler parts, so there is an upward buoyant force on the hotter fluid, making use of upward convection current to rise while the cooler, denser, fluid sinks.

II. WORKING PRINCIPLE AND PROTOTYPE DESIGN

Heat transfer is a process known as the exchange of heat from a high-temperature body to a low-temperature body. Heat is a kinetic energy parameter, included by the particles in the given system. As a system temperature increases the kinetic energy of the particle in the system also increases. The energy of the particle from one system to another system is transferred when these systems are brought into contact with one another.

Heat transferred by the process of convection can be expressed by the following equation,

$$Q = H_C A (T_{HOT} - T_{COLD})$$

Here, Hc is the heat transfer coefficient.

Q is the total heat transfer due to convection

A is the area of contact between fluid & body

T_{hot} is the body temperature

Tcold is the forced air temperature

The metabolic heat generated in the body is dissipated to the environment through the skin and the lungs by convection and radiation as sensible heat and by evaporation as latent heat.
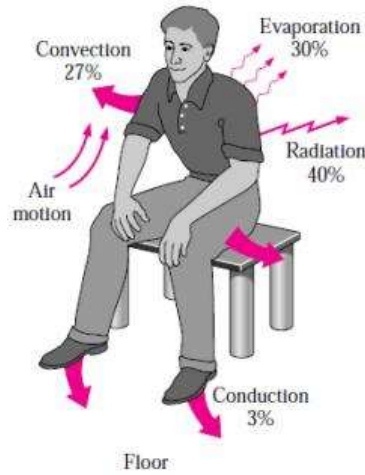
Figure -01 Convection heat transfer

Convection heat transfer evaluation using design prototype :
The transfer of heat from one place to another due to the movement of fluid. It should not be confused with the dynamic fluid phenomenon of convection, which is typically referred to as natural convection in thermodynamic contexts in thermodynamic contexts in order to distinguish the two.

Table-01 – Convection heat transfer coefficient & standard deviation STD experimental data as per ASHRAE

Fan speed (r.p.m)	Static test (standing still)		Dynamic tests (45 step/min	
	Convective heat transfer coefficient h_{conv}(W/m^2.°C)	Standard deviation STD	Convective heat transfer coefficient h_{conv} (W/M^2. °C)	Standard deviation STD
0 r.p.m	3,5	0,035	4,5	0,015
10 r.p.m	3,5	0,037	4,8	0,08
17 r.p.m	5,7	0,009	6,0	0,038
25 r.p.m	6,2	0,022	6,7	0,029
31 r.p.m	6,7	0,005	7,4	0,004
77 r.p.m	11,3	0,052	11,4	0,058
151 r.p.m	16,4	0,053	17,0	0,782
301 r.p.m	22,4	0,069	23,0	0,324

As per the fan selected for the prototype the speed ranging from 300rpm, hence we select the dynamic test data of human body from the Table-01 and further evaluate the heat transfer rate.
Using the general condition of convention heat transfer

$$Q = H_C A (T_{HOT} - T_{COLD})$$
$$Q = 23 (1.9) (45° – 37.5°)$$
$$Q = (23) (1.9) (7.5)$$
$$Q = 327.75$$

III. MATERIALS IN USED

1. Coverall
A piece of clothing worn specifically over other clothing to protect the upper and lower body and to keep workers safe while working in construction zones, gold mine working zones, etc. Workers in many industries are shielded from harm and dirt by coveralls.

2. 12V Battery
A special kind of battery is referred to as a 12-volt battery, but its voltage is higher than 12 volts. A product of this type should measure approximately 12.6 volts between the terminals when it is fully charged. Batteries with a voltage of 12 volts are frequently used in RV, boat, and other automotive systems.

3. Wire
The red wire is typically used to carry positive voltage in DC electronics, and the black wire serves as the circuit ground. Typically, the black is marked as (-) and the red as + (plus) (minus).

4. Fan
DC fans, also known as direct current fans, are powered by a fixed potential, such as the voltage of a battery. Four permanent magnets mounted on the sides of the rotor form a cross pattern in brushless DC motors (BLDC motors), which are used in brushless DC fans. With speed ranging from 300 to 2000 rpm

5. Snap fastener (Tich button)
A snap fastener, also known as a snap button, snap and tich (or tich button), is a pair of interlocking discs. It is frequently used in place of traditional buttons to fasten clothing and other items.

6. Male and female wire connector
In most cases, the female connection acts as a receptacle to hold and accept the male connector. A male connector is one that is attached to a wire, cable, or piece of hardware, has one or more exposed, unshielded electrical terminals, and is designed to fit snugly inside a female connector to ensure a strong electrical and physical connection.

7. Cotton ribbon tape
An adhesive tape with a cloth backing is called cloth tape, and it provides flexibility and durability. The tape can be used for several things, including bandages, wall sealing, electrical and plumbing operations, and more. All cotton tapes are made of natural, unbleached cotton and are narrow width woven tapes without any glue.

8. On off switch
The circuit is closed, and the electricity is turned on when the switch is pushed in. Power on and power off are indicated by the line and circle symbols, respectively.

IV. PROCEDURES

Step 1: Check the temperature controller by connecting with the 12v battery to input and fan to output whether system will work properly or not, follow this diagram for the wearing.
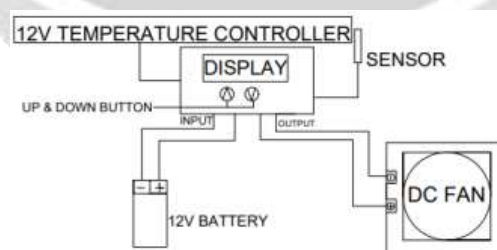

Figure number: 02

Step 2: Mark and make cut in the coverall to install a fan.

Figure number: 03

Step 3: Draw a marking for the wiring and stitch the cotton ribbon to cover all the wire.

Figure number: 04

Step 4: Stitch the sensor outside the clothes and make one small hole to bring the wire inside of the clothes.

Figure number: 05

Step 5: Wiring, first connect the sensor to battery to give power and connect each fan into output wire. (Flow the diagram)
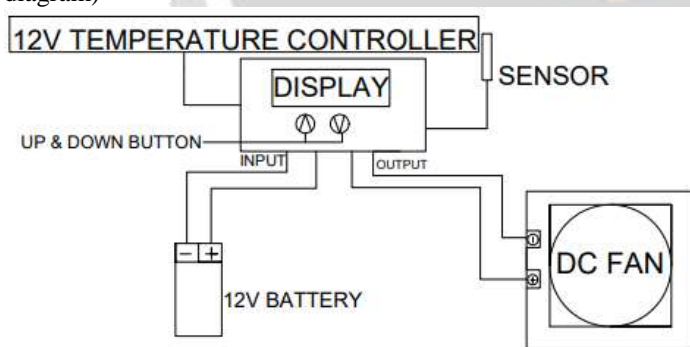

Figure number: 06 (AutoCAD design of wiring diagram for the working model)

RESULT

This project aims to provide healthy, safe, and comfortable environments for the workers, and if these things are there then workers will work effectively without any hesitation, tiredness, uncomfortableness, etc. It successfully worked as expected it is working as convective heat transfer. It's working as when a temperature is set for the coverall, a controller monitors the actual temperature inside of the coverall. If it goes higher above the set temperature, it sends a signal to activate the cooling fan to decrease the temperature back to the set point.

When the temperature goes high it will start to work and when the temperature goes below according to the set temperature system will stop to work. Keeping the priority on health, the scope of the project is to provide outside workers satisfactory environment or a healthy environment to the workers and it is in successful working conditions workers will feel they are working in a good and healthy environment. So after the evaluation convection of heat transfer from the body is Q = 327.75 watts.

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