

EXPERIMENTAL INVESTIGATION ON SOLAR POWERED AUXILIARY AUTOMOBILE AIR CONDITIONING SYSTEM

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Abstract

This paper is concerned with experimental investigation on solar energy driven automobile vapor compression air conditioning system fitted in the luggage boot as an auxiliary unit not disturbing the engine driven conventional air conditioning system. An array of 150W solar cells is settled on the roof of the car to evaporated blower are run by the current from the solar energy charged batteries.

Key words: *Solar Cells, Auxiliary unit, Open type compressor, luggage boot, Greenhouse effect.*

1. Introduction

The average temperature during the summer typically exceeds 27⁰C in subtropical and tropical regions. Furthermore, the greenhouse effect causes the temperature in automobiles to reach 6⁰C 7⁰C [1-3] in open parking lots; people cannot usually endure such temperatures comfortably. Moreover, the instrumentation panel, leather seats and plastic accessories, among other items, age rapidly if exposed to these temperatures for a long period [4]

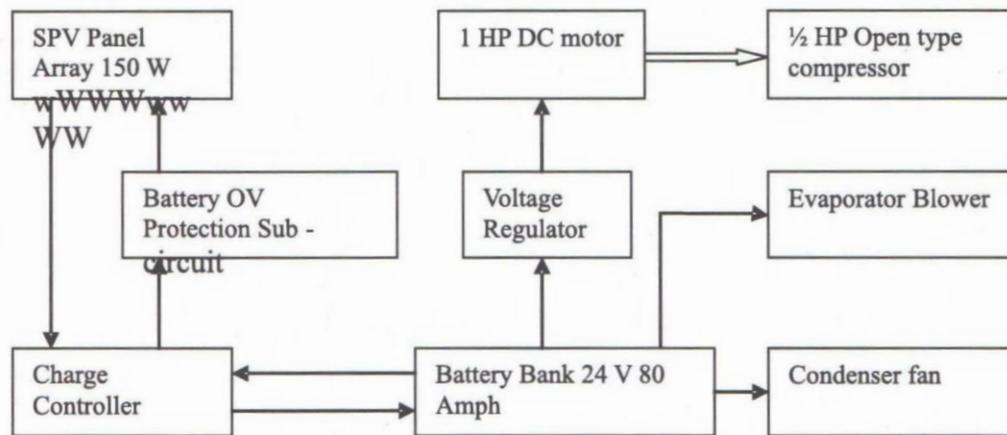
Like other air conditioner systems, the automobile air conditioner must provide adequate comfort cooling to the passenger in the conditioned space under a wide variety of ambient conditions. In automobile air conditioning load factors are constantly and rapidly changing as the automobile moves over highways of different speeds and through all kinds of surroundings. As the car moves faster there is greater amount of baking down on a black top road will raise its temperature to 50⁰C 60⁰C approximately and thus increases the amount of heat transmitted into the car. When driving through a grassy terrain, much less radiant heat is expected than when passing through sandy flats or rocky hills. Therefore the car is subjected to varying amount of heat load when its orientation changes during the journey.

An automobile engine utilizes only 35% of available energy and rest are lost to the cooling and exhaust system. If one is adding conventional air conditioning system to the automobile, it further utilizes about 5% of the total energy. Therefore the automobile becomes costlier, uneconomical and less efficient [5]. Adding of conventional air conditioner in a care also decreases the life of the engine due to abrasion and increases the fuel consumption.

The solar energy module can be employed to absorb solar power and turn it into electric power during driving or parking and charge the battery. The battery runs a DC motor which in turn drives an open type refrigerant compressor producing refrigeration effect. This auxiliary air conditioning system will run nonstop as long as sufficient solar energy is available to charge the battery. The cooling effect produced ensures improved human comfort, increased engine service life, energy conservation and environmental protection.

2. The concept and the structure of the auxiliary air conditioning unit.

The power source for the ancillary air conditioning unit is the 1 HP DC motor. The current for the DC motor is drawn from a 24V battery charged by an array of 150 W solar cells settled on the car roof top. The DC motor runs a ½ HP open type compressor to produce the cooling effects inside the car cabin. The block diagram of the ancillary air conditioning system is shown in Fig.1 the 24 V batteries, the 1 HP DC motor, ½ HP open type compressor, the condenser coil are assembled in the luggage boot of the car roof top. Devices to convert 12 V from solar cells to 24V to battery, to prevent flow of current from battery to solar cells, to prevent battery deep discharge and to step down the voltage to DC motor to have the rated compressor rpm are included in the electrical circuit of the system. The current to drive the



3. Performance Test

Experimental was carried out to analyze the performance of the fabricated system by measuring various related parameters.

The table 11 shows the current consumption by the evaporator blower, condenser fan and the DC motor. The devices are so selected to make the total current consumption as minimum to increase the battery backup capacity

Table 1. Current consumption by different system devices

Sl.No	System Devices	Current A
1	DC Motor	20
2	Condensor	1.4
3	Evaporator	
	1. Low	0.8
	2. Medium	1
	3. High	2

The 2a, b, c, Shows the data acquired by conducting the experimental and the calculated actual COP. The average COP of the system is found to be 0.66

Tab 2a COP calculation for Blower fan speed of 3.9m/sec (Low Speed)

S.No.	Time Min	Cabin Temp 0C		Current A			Total Current A	Power input WCO	COP
1	10	40	37	1.4	0.8	20	22.2	400	0.70
2	10	37	32	1.4	0.8	20	22.2	400	0.70
3	10	32	27	1.4	0.8	20	2.2	400	0.70

Tab 2b COP calculation for Blower fan speed of 4.6m/sec (Medium Speed)

S.No.	Time Min	Cabin Temp 0C		Current A			Total Current A	Power input WCO	COP
1	10	40	36	1.4	1	20	22.4	403	0.66
2	10	36	29	1.4	1	20	22.4	403	0.66
3	10	29	24	1.4	1	20	22.4	403	0.66

Tab 2c COP calculation for Blower fan speed of 7.2 m/sec (HighSpeed)

S.No.	Time Min	Cabin Temp 0C		Current A			Total Current A	Power input WCO	COP
1	10	40	35	1.4	2	20	23.4	421	0.61
2	10	35	32	1.4	2	20	23.4	421	0.61
3	10	32	23	1.4	2	20	23.4	421	0.61

4. Result and Discussion

From fig 2 the COP is found to decrease with the blower speed although the blower speed increases the rate of fall in temperature as well as the attainment of temperature as low as 23⁰C. The battery capacity last for 2.5 hours of continuous operation without the solar cells charging. With charging and discharging taking place simultaneously the charging rate is found to higher than the discharge rate hence ensuring continuous running of the system.

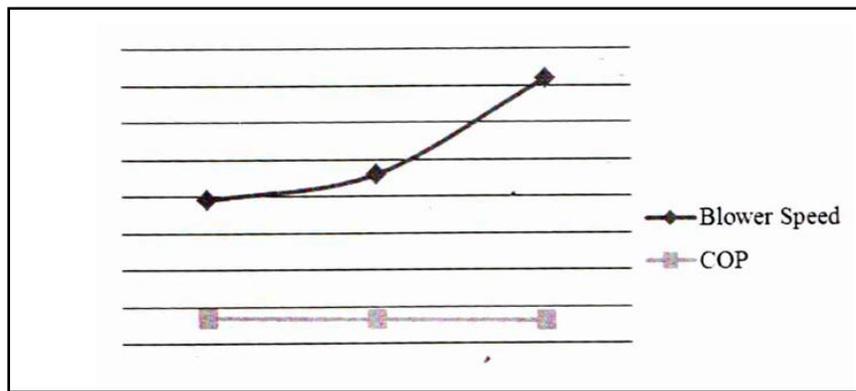


Fig.2. COP variation with Blower speed

The concept running on auxiliary car air conditioning system using solar energy is provided successful and feasible. This system will be more useful during sun soaking of the vehicle as it put down the temperature appreciably reducing the pull down load on the conventional engine fitted air conditioner. This not only increase vehicle mileage but also increase the life of the engine due to less wear and tear, it will increase the passenger

comfort even while parking and the engine not running. As the cabin temperature in no circumstances shoots beyond the ambient temperature the interior furnishing do not age quickly.

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