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ANALYSIS OF MODIFICATION OF CAR AC COMPRESSOR TO SPLIT AC COMPRESSOR ON COOLING RATE

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Abstract. Refrigeration or cooling technology is increasing, especially regarding the coolant, almost all new vehicles now use air conditioning to condition the air in the vehicle cabin, but there are still many aspects that currently have not been paid much attention, especially to compressors, compressors for now still rely on the engine as a direct driver which makes fuel consumption more wasteful and reduces the performance of the vehicle. The purpose of this research is to modify a conventional compressor into an electric compressor by utilizing a split ac compressor. The research method uses the direct experimental method, can a split ac compressor replace a conventional compressor. Testing without changing a lot of the cooling system on the car, only changing the compressor without any other changes. The results of the research on split ac compressors can be applied to cars, but the cooling rate is slower than car ac compressors.

Keywords : refrigeration, compressor, air conditioning, car ac, split ac.

1. INTRODUCTION

Comfortable and coolness when driving, especially in a car is very necessary. Various ways and efforts made by humans so that driving comfort can be achieved. One of the more effective ways to get comfortable in the car is to installed air conditioning. The performance of the air conditioning system is strongly influenced by the compressor work [1]. Air conditioning is the process of treating air to regulate temperature, humidity, cleanliness and distribution simultaneously in order to achieve the comfortable conditions needed by the occupants inside [2]. Air refreshing is the process of cooling air so that it can reach the required temperature and humidity to the air condition of a particular room [3]. Every vehicle space, especially four-wheeled vehicles that carry cargo in the form of people or goods, really requires a certain level of comfort and fitness, both for passengers and goods [4]. almost all new vehicles now use air conditioning to make air of condition in the vehicle cabin, but there are still many aspects that currently have not been given much attention, especially to the compressor, the compressor currently relies on the engine as a direct driver which makes fuel consumption more wasteful. and reduce the performance of the vehicle. Air conditioning in the room serves to regulate air conditioning in the room, this conditioning aims to provide comfort, so as to reduce fatigue [5]. The use of the AC system in the car aims to maintain the air temperature in the car in comfortable conditions, especially for the driver and passengers. In addition, the installation of a car air conditioner can also be useful to avoid condensation on the windshield during the rainy season [6]. Air conditioning in a room regulates humidity, heating and cooling of indoor air. This conditioning aims to provide comfort, so as to reduce fatigue which has an effect on increasing fitness [7]. Thermal comfort is needed by the body so that humans can carry out activities properly (at home, school or in the office/work place). Szokolay in the 'Manual of Tropical Housing and Building' states that comfort depends on climate variables (sun/radiation, air temperature, humidity, and wind speed) and several individual/subjective factors such as clothing, acclimatization, age and gender, level of obesity, health level, type of food and drink consumed, and skin color [8]. Energy savings in the cooling system are carried out in several ways, namely improving compressor efficiency, varying compressor rotation, looking for alternative refrigerants, varying fan

rotation, and refrigerant control systems [9]. The main components of an air freshener are the compressor, condenser, expansion valve and evaporator. The function of the compressor is to flow and increase the pressure of the refrigerant gas which then enters the condenser, the condenser functions as a heat transfer device released from the hot refrigerant vapor to the cooling medium so that the refrigerant hot vapor will condense and change its phase from a vapor state to a liquid [10]. To increase the workability of the COP (Coefficient of Performance) cooling device, the condenser can be modified by using water media cooling, and the blower is no longer used so that it can save the driving power of the blower [11]. As technology develops, safety, comfort, and human safety should become a priority, and do not forget the environmental aspects which are the main targets [12]. Air refreshing is a process of cooling the air so that it can reach the required temperature and humidity for the air condition of a particular room. In addition to regulating airflow and cleanliness [13]. The use of air conditioning is considered capable of stabilizing the air temperature and humidity of an area with a cooling system [14]. The split ac compressor can be turned on using a dc to ac inverter but not all types of inverters are able to turn on a split ac compressor for the work process [15]. From the description and some of the research above, it is very necessary to use air conditioning to stabilize thermal conditions in a room especially vehicles, with a stable temperature it will make the mind calm and relaxed especially when driving, but the problem here is that the air conditioner in vehicles still uses a compressor driven by engine, the researchers here will change the car compressor to a split ac compressor.

2. METHODS

The method in this study uses experimental research which aims to analyze the modification of the split ac compressor applied to the car. The research framework is according to the picture below.

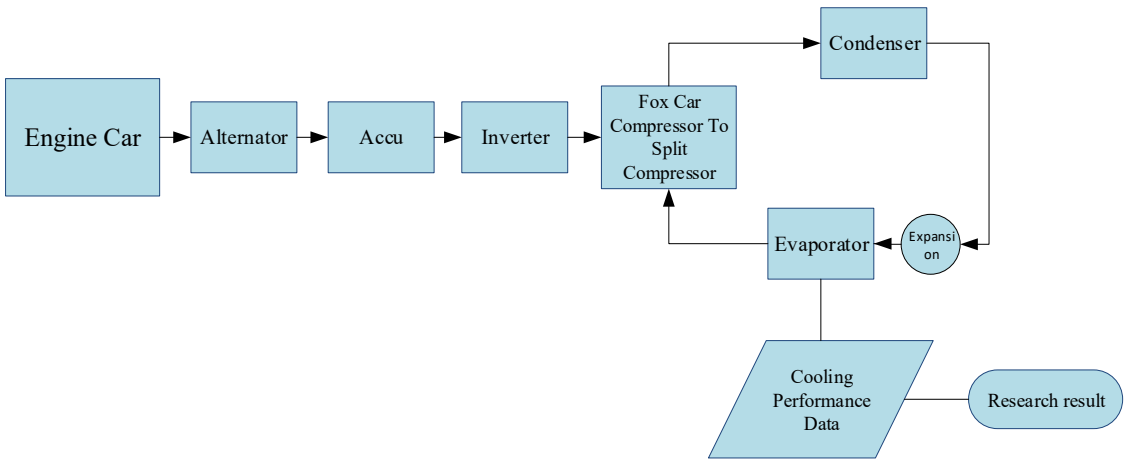

Figure 1. Research framework

The main cooling work system in a car is the compressor driven by the engine from the shaft pulley directly from the crankshaft, while in this framework the compressor that should be driven by the engine is converted into an electric compressor in split ac, the difference between a car compressor and an ac compressor split is on the piston player inside to compress the freon, namely the engine is rotated on the car compressor and the electric motor is driven on the split ac compressor. From the change in the compressor, it will circulate to the condenser – expansion valve – evaporator and then to the compressor again, the evaporator will see the temperature that comes out whether there will be a change in temperature which results in the cooling rate.

3. RESULTS AND DISCUSSION

3.1 Figure and Table

Figures and tables can be seen as follows.

Figure 2. Compressor modification data collection process

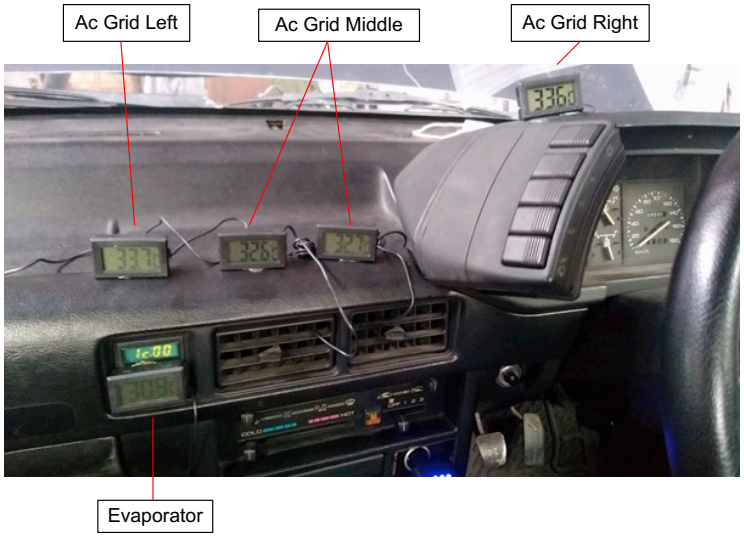

Figure 3. Cooling rate data collection process

Figure 2. shows the process of testing the compressor modification, with 1 can of freon R134a 390 grams for both tests, the pressure obtained is 15 psi for both tests, the modified compressor uses a split ac compressor 1/2 PK without making any changes. Figure 3 shows the data collection process in 4 places, the first in the evaporator, the second on the left ac lattice, the middle ac lattice and the right ac lattice.

Table 1. Cooling rate data with car compressor

Minutes	Temperature Evaporator (^{0}C)	Ac Grid Temperature (^{0}C)		
		Left	Middle	Right
0	32,3	36,9	35,8	35,9
0,5	27,7	34,5	31,9	33,9
1	25,8	32,6	29,5	32,4
1,5	23,2	31	27,7	30,9
2	20,4	29,6	26,3	29,8
2,5	19,4	28,5	25,3	28,8
3	18,5	27,8	24,7	28,1
3,5	18,1	27,2	24,2	27,5
4	17,5	26,1	23,8	27,1
4,5	17,5	26,3	23,6	26,7
5	17,2	26,1	23,4	26,4
5,5	16,8	25,8	23,1	26
6	16,7	25,6	22,9	25,9
6,5	16,2	25,3	22,7	25,7
7	15,5	25,1	22,5	25,6
7,5	15,5	24,9	22,3	25,2
8	15,5	24,8	22,1	25
8,5	15	24,5	21,9	24,9
9	15,1	24,5	21,9	24,8

Table 2. cooling rate data with split ac compressor / room ac

Minutes	Temperature Evaporator (^{0}C)	Ac Grid Temperature (^{0}C)		
		Left	Middle	Right
0	32,2	34,0	32,2	34,0
0,5	31,7	33,6	31,8	33,7
1	31,2	33,2	31,5	33,3
1,5	30,6	32,9	31,1	33,0
2	30,1	32,5	30,7	32,6
2,5	29,6	32,6	30,9	32,6
3	29,1	31,9	30	32
3,5	28,8	31,4	29,5	31,6
4	28,2	31	29,1	31,2
4,5	27,3	30,5	28,6	30,7
5	26,6	30,1	28,1	30,3
5,5	26,1	29,6	27,7	29,9
6	25,7	29,3	27,4	29,6
6,5	25,1	29	27	29,2
7	24,6	28,7	26,8	28,9
7,5	24,3	28,5	26,5	28,7
8	23,6	28,2	26,2	28,5
8,5	23,3	27,9	26	28,1
9	22,9	27,7	25,5	27,9

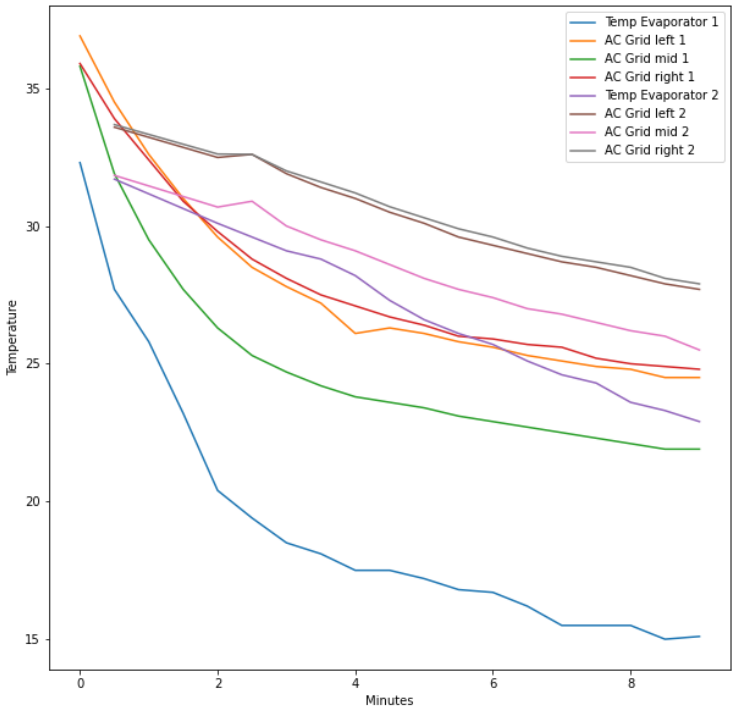

Figure 4. Cooling rate of car compressor 1 and split ac compressor 2

Figure 4 shows a graph of the cooling rate of a car compressor and a split ac compressor. Temp evaporator 1, ac grid left 1, ac grid mid1 and ac grid right 1 shows the cooling rate using a car ac compressor data collection is in accordance with figure 3. Meanwhile, at temp evaporator 2, ac grid left 2, ac grid mid2 and ac grid right 2 shows the cooling rate with a modified room/split ac compressor to the vehicle system.

3.2. Compressor Modification

The cooling system in the car has been redesigned based on the standard cooling work cycle, only making changes to the compressor using a ½ PK split ac compressor, in this design there are no changes to the condenser, evaporator, filter, expansion valve and piping. The coolant used for the test is R134a in the contents of 1 can of 390 grams and the contents are exactly the same for both tests, which have not been modified and those that have modified the compressor.

3.3. System Work

From the modification of a car ac compressor to a split ac compressor, different cooling is obtained, the cooling rate is faster than a conventional car ac compressor because without changes to other components such as freon, expansion falve and filters, but even without making significant changes it can still produce a sufficient cooling rate. The difference in cooling rate between the two in 9 minutes is 7^0C.

4. CONCLUSION

The result of this research is that the split ac compressor can be used to change the car ac compressor even without significant changes. The weakness in this study is that the cooling rate is different, the split ac compressor takes longer, this difference is because the refrigerant and the split ac compressor system are not exactly the same as the conventional car ac compressor system. In this research, it is necessary to further refine the split ac compressor change system, such as changing refrigerant, expansion valve to capillary pipe and filter.

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