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Cooling Performance Comparison Of The Number Of Swash Plate Compressor Cylinders For Cars

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Abstract
In this study, the effects of the compressor for the air conditioning system on the fuel economy were experimentally investigated in an actual automobile. performance tests were conducted on the compressor calorimeter according to the number of cylinders of the variable-cylinder swash plate type compressor, the performance and characteristics of the compressor by number of cylinders in each cylinder. Performance of the compressor is proportional to the number of revolutions of the compressor, and inversely proportional to the compression ratio. Power consumption is the number of cylinders you see a trend similar to the difference between the 5 individual compressor performance, power consumption and compressor is small, but seven individuals, in the case of individual compressor cylinder number 6 shows the low power consumption. Therefore, the number of six individual cylinder compressor with low power consumption, is the best compressor in terms of fuel economy.

Keywords*:* Compressor, Variable Swash Plate, Power Consumption, Cooling Capacity

1. Introduction

The use of air conditioners in accordance with the trend of quality improvement and advanced life is a situation that is growing. In particular, rapid growth in air conditioning and refrigeration, such as air conditioners have many difficulties in power supply. Car compressor also improves the efficiency of the development of various air-conditioning compressor performance and the compression method to improve performance of the compressor having a largest influence on the power consumption of the air conditioner that has been introduced is important, depending on the importance of energy saving highlighted there. Constant speed that is designed to maintain a certain cooling capacity type air conditioner has failed to respond appropriately to continuously varying loads depending on the time of air cooling period, the room temperature reaches the set temperature, the operation of the compressor is stopped and re-load the room temperature by increasing the air turns has on / off a compressor driven approach. It is slightly different depending on the type of compressor operation, but the torque of the motor is about two to three times because it is stopped and the power consumption increased according to the start-up operation at the time of operation is the leading cause of increasing the running cost of the air conditioner. Therefore, appropriate response to the air load, and the trend of how the system is increased by using the variable displacement compressor for performing a cooling and heating function fully.

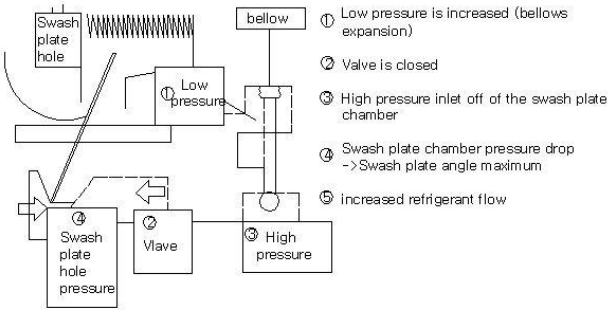
Cha, Y.U. Etc. (1) it was confirmed by experiment that the fuel efficiency by reducing the compressor through the discharge capacity up to improve performance of the heat transfer characteristics change of the refrigerant pipe of the air conditioning system can be improved about 2.4%. Lee, C.W. Etc. [2] has made the fuel efficiency by developing the power train and air conditioning compressors control logic. There is active research underway at the compressor side has progressed from a variety of experiments, including research about the conditions that fuel economy rating stationary compressors with variable torque characteristics of the compressor. Kim, D.K. Etc. [3] Operating the air conditioning in the car found out about 15.92% degree fuel economy than when not working air conditioning throughout the experiment worsened. Denso Corporation of Japan is developed based on the variable displacement compressor is a swash plate type compressor began to be mounted on a car, low energy, the research to develop a compressor of a high efficiency has been actively conducted.

Accordingly, a number of car companies in situations that require research on compressors for car air conditioners. This paper is to have a vehicle air conditioning compressor study experimentally the effect of the vehicle fuel consumption, performance tests were conducted on the compressor calorimeter according to the number of cylinders of the variable-cylinder swash plate type compressor, the performance and characteristics of the compressor by number of cylinders in each cylinder. It analyzes suggest the direction of the compressor to come.

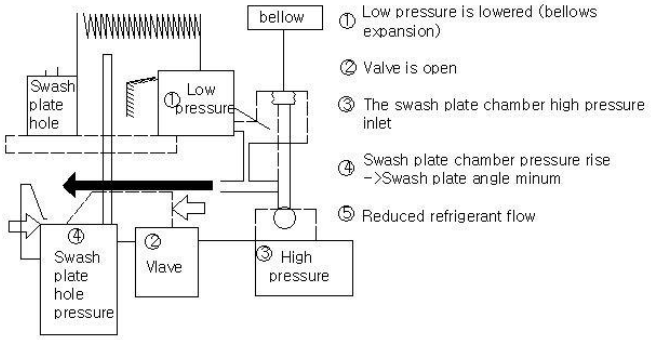
2. Structure and Features

compressor has been used in air conditioning systems for cars are now a variety, it is typically a variable swash plate compressor. A variable swash plate type compressor controls the angle of the disc plate to move the internal variable compression piston. It is to consume less energy, have a better performance than the fixed compressor. It consists of piston, shoe, swash Plate and housing. The plate is linked to axis and seven pistons are installed in a consistent angle pivoting around the axis. Shoe between the swash plate and piston is installed at both sides of the swash plate. The variable swash plate air conditioning compressor is powered by the car

engine. As shown at Fig. 1, the angle of the swash plate varies depending on thermal load; big (a) and small (b). With big thermal load, low pressure of the compressor increases, bellow expands, the valve closes and high pressure flows out of the swash plate chamber. When this happens, the pressure of the chamber drops and the plate angle becomes maximum, which make the piston stroke big, thus increasing refrigerant flow. As shown at Fig. 2 (b), when the thermal load is small, low pressure of the compressor lowers, bellow contracts and the valve opens. After this, high pressure flows into the swash plate chamber through the open valve, which makes the swash plate angle minimum with rising pressure and reduces the refrigerant flow. Therefore, the refrigerant flow changes depending on thermal load [4].



(a) big thermal load



(b) small thermal load

Fig. 1 Operation of variable swash plate compressor depending on thermal load [4]

3. Experimental methods

To drive the compressor while the compressor calorimeter measures the temperature of the refrigerant state, pressure, flow rate, and the drive torque, and calculates the capacity of such a compressor, cooling capacity at each condition. Samples of each experiment the number of cylinders of the compressor Table. 1 is 5, 6, 7 be the case up to the discharge capacity was divided by the compressor. The experiment was considered the driving conditions of the vehicle. And it was working range including the condition of various air-conditioning

Table.1 Compressor Specifications Compare

Cylinder	5Cylinder			6Cylinder			7Cylinder		
Discharge rate (cc/rev)	9	11	12	12	14	16	12	14	16

Table.2 Experimental Conditions

RPM	1000			2000			3000		
Compressor ratio(Pd/Ps)	7	8	9	7	8	9	7	8	9

Table. 2 exhibited a Compressor ratio according to the RPM of the detailed experimental conditions, the number of revolutions of the compressor is taken into account the vehicle running condition.

The result obtained by the experiment, each condition in the compressor calorimeter with respect to the swash plate type compressor having a discharge capacity of the cooling capacity of the power consumption for each experimental condition was used for the expression.

$$\Phi = Gf(hgs - hfa) + \Phi p \quad (1)\ [5]$$

$$HP = \frac{2\pi \times Nm \times Mtrq}{60 \times 76.04} \quad (2)\ [5]$$

Equation (1) represents the performance of the compressor to heat the compressor performance of the evaporator calorimeter.

Equation (2) represents the power consumption of the compressor by using a torque meter of the compressor calorimeter.

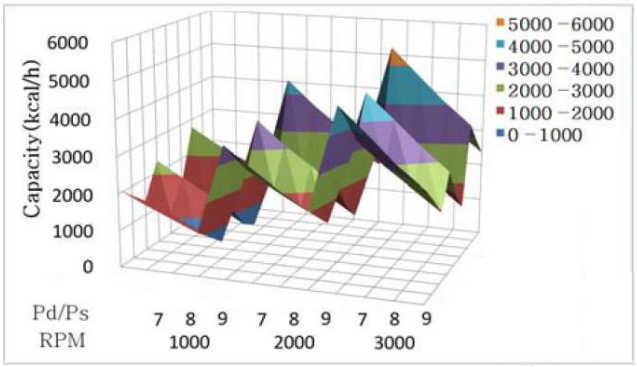


Fig. 2 Experimental result of cooling capacity

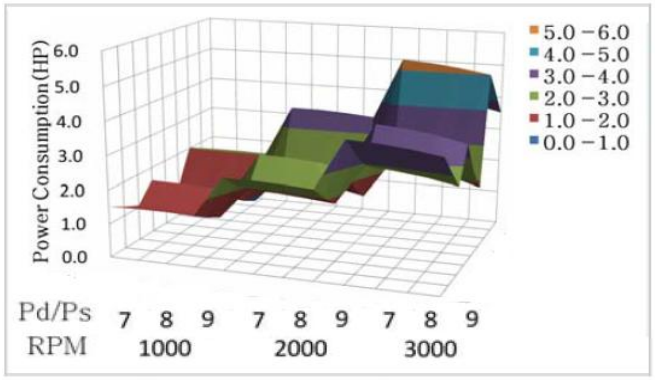


Fig. 3 Experimental result of power con-sumption

Fig results obtained by the experiment, each condition with respect to the swash plate type compressor having a discharge capacity of several types. 2, Fig. 3 shows.

4. Experimental results

Power consumption seems to look for increases in proportion to the number of revolutions of the compressor discharge capacity of the compressor. The compression ratio was not significantly affected. Power consumption seems to look for increases in proportion to the number of revolutions of the compressor discharge capacity of the compressor. The compression ratio was not significantly affected.

The number of cylinders in the compressor discharge capacity when compared against the same result, If there was a performance of the compressor cylinder 5 personal best was good Next, 7, was the order of 6. It showed that the performance of the compressor is proportional to the number of revolutions of the compressor, and inversely proportional to the compression ratio It showed a shape similar to the power consumption performance. Cylinder power consumption difference between the number 5 and 7 private individual compressor compressor is small, In the case of individual compressor cylinder number 6 shows a low power consumption.

Therefore, the number of 6-cylinder compressor individuals were able to determine that the most efficient compressor in terms of fuel efficiency with low power consumption.

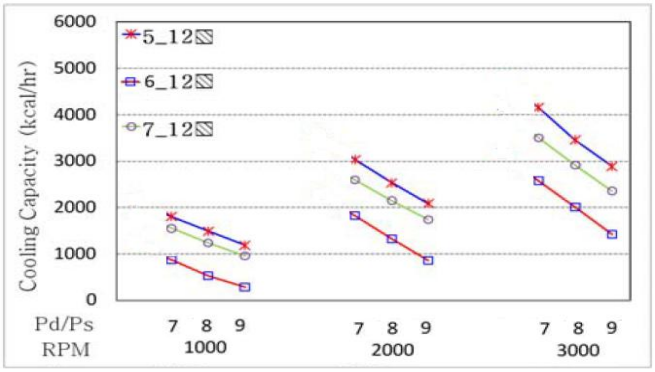


Fig. 4 Experimental comparison of cooling capacity

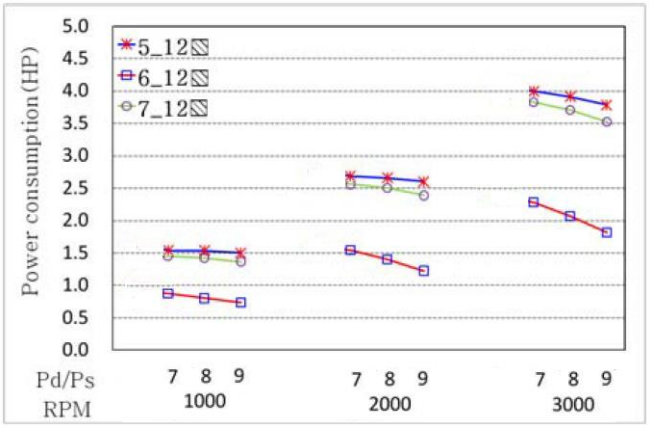


Fig. 5 Experimental comparison of power con-sumption

4. Conclusion

By the conditions under which air conditioning is operating in substance to the variable swash plate type compressor of car air conditioners it is being developed every day tested the power consumption of the compressor via the torque of the compressor performance, compressor calorimeter by number of cylinders in the compressor calorimeter.

The results were as follows in this study. Design specification of the swash plate type compressor has been developed into a technology developed to improve the coefficient of performance to improve performance. Performance of the swash plate type compressor in the same discharge amount is decreased the greater the compression ratio, the greater is the tendency to increase the rotational speed. Number 6 cylinder swash plate compressor personal power consumption is low coefficient of performance is superior to most excellent in terms of fuel economy.

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