

Study on the Reuse of Split Air Condition Wind-Heat

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Abstract. Nowadays, the energy problem is undoubtedly the world's leading problem. The use of air-conditioning in it takes a big part, so reusing of the residual energy is very meaningful, at present, the exhaust heat recovery system in this field is mostly aimed at the large central air-conditioning, merely on the split type air-conditioning. So we have done detailed research on heat and wind energy recycling of the split type air-conditioning.

First of all, we chose a direct feedback mode: electricity generation. We adopt the wind turbine power generator and semiconductor thermoelectric power generator, respectively. Secondly we have done a lot of experiments for air conditioning itself, including: test of thermal characteristics of wind and heat in the process of start-up, shutdown, and frequency conversion ,separately; test of semiconductor thermoelectric power generator characteristics ; Designing multi semiconductors connection mode in a more effective way of connection and the Stabilized voltage rectifier circuit for semiconductor thermoelectric generator. Finally, according the commissioning power generation with this combined device, we summarize its power characteristics, considering its practical feasibility, and further expand the ideas in this field.

Introduction

Energy is an important resource for the earth, and also the material basis for the development of human society. In recent years, domestic air conditioning in urban and rural areas is becoming more and more popular. Household air conditioner has a phenomenal growth rate. In China, the ownership of per hundred households had reached 143 sets on average at the end of 2014. The air conditioning energy reusing undoubtedly has become a huge Potential energy treasure! At present ,the exhaust heat recovery system has begun to take shape in this field. But most of this system aim at the large central air conditioning, rarely involves split type air conditioner. We focus on the research in this filed, so as to achieve energy conservation and emission reduction and the goal of green electricity through the reasonable use of waste heat and wind from air conditioning.

Research Foundation

Split Type Air-Condition: Split type air condition is a kind of air conditioner, which is divided into two parts: indoor unit and outdoor unit. Because of beautiful appearance, small in size and other advantages , the split type air-condition are widely used. However, in the process of using split type air condition , it will inevitably produce a waste of energy, in which the waste heat in condenser and the waste wind from air conditioner external unit take the largest proportion.

Wind Power Generator: The wind driven generator is composed of impeller and generator. The kinetic energy of air flow is acting on the impeller, and the kinetic energy is converted into mechanical energy to drive the impeller to rotate. Simultaneously, the rotating shaft of the impeller is connected with the rotating shaft of the generator to drive the generator to generate electricity.

Semiconductor Thermoelectric Generator: Semiconductor thermoelectric generator is an electric element that based on the see back effect , and it is composed of multiple PN junctions which make up of two thermoelectric materials (P-type and N-type).The P-type is rich cavity material, N-type is rich electronic materials. Put one end at high temperature condition, the other end at low temperature. Under the influence of thermal excitation, the concentrations of P (N) type

material high temperature end hole (electronic) higher than that of low temperature side. Because of the concentration gradient, holes or electronic began to spread to the low temperature end, and then form the electromotive force in the loop.

Research Results

Semiconductor thermoelectric generator: As shown in Fig. 1, after the experiment, there is an approximate linear relationship between open circuit voltage of single piece of semiconductor and temperature difference. Apparently, single chip semiconductor power generation is very small, even if there is large difference in temperature.

Integrating multiple semiconductors in parallel after the series first, as shown in Fig.2. Ten pieces, for example, under this connection mode, increasing both ends of the voltage and current at the same time can effectively increase the power generation. According to the experiment, open circuit voltage and temperature difference is nonlinear, and in the range of temperature range, the greater the temperature difference is, the more obvious the increase of voltage is.

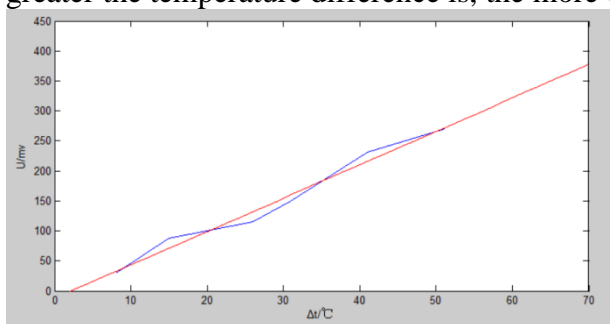


Figure 1. The relationship between temperature and power generation voltage in the case of single chip

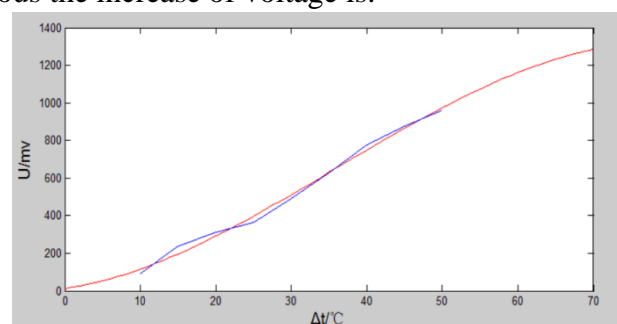


Figure 2. The relationship between temperature and power generation voltage in the case of multichip

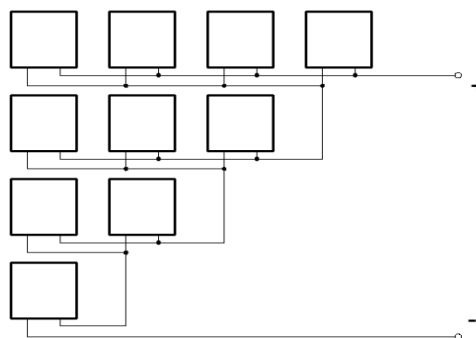


Figure 3. Schematic diagram of multi chip semiconductor connection

Outdoor Air Conditioning Outside the Work of Wind Speed and Thermal Energy Test:

First of all, we must ensure that our device (especially the wind turbine) do not have any impact to the air conditioning. Therefore, we choose to place the wind turbine at 1-2 meters away from the air conditioning machine, according to the experiment results.

Considering that the air conditioning exhaust wind speed and its working condition have a considerable relationship, we will roughly divide it into three states: boot, frequency conversion, shutdown.

Obviously when the air conditioning begin to work, wind speed is great. After working a certain period of time (about 10-20 minutes), indoor temperature roughly reaching the set goal, the wind speed start reducing, and then keep in a stable wind speed. In order to save energy, air conditionings

are mostly designed in frequency conversion, that is, the working power of the air conditioner changes with the indoor temperature. During frequency conversion, the wind speed will have a larger fluctuation, but most of the time it still maintain at a low wind speed. Similarly, when the air-condition shutdown, for energy saving, the indoor compressor will stop working immediately. It will maintain a certain heat has produced in the, but the fan will not shut down immediately, will still continue to work for a period of time (about 1 minutes), heat (cold) inside the compressor will still be used to the indoor work.

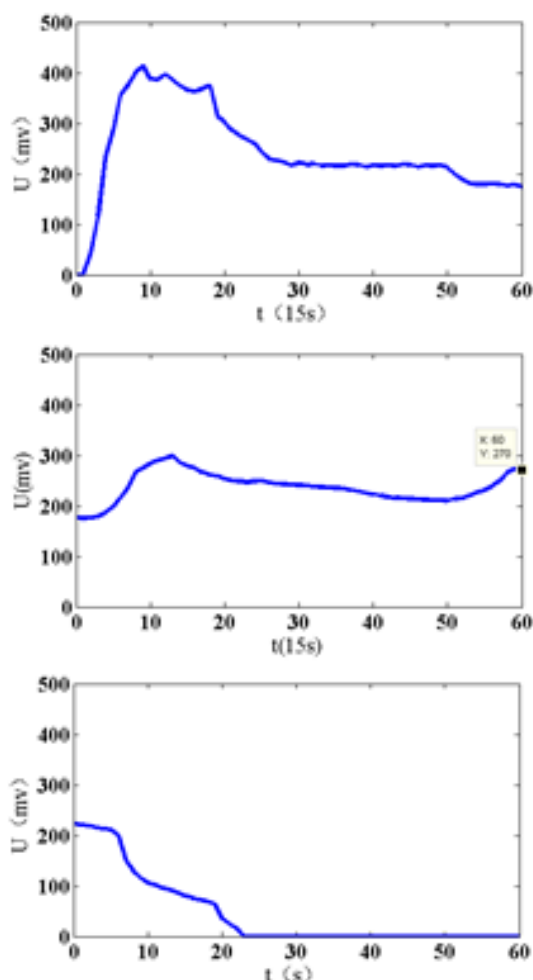


Figure 4. The wind speed during boot, frequency conversion, shutdown

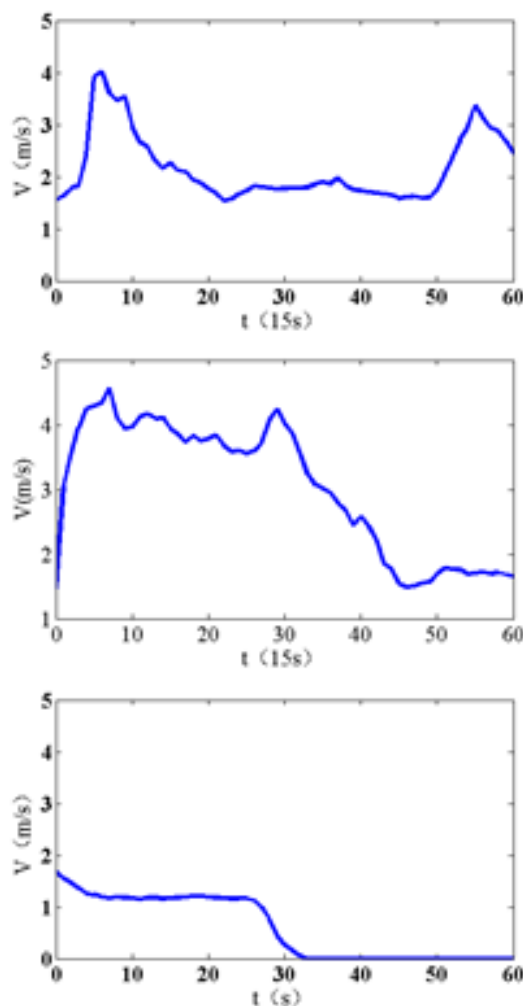


Figure 5. The thermal power generation voltage during boot, frequency conversion, shutdown

The Combination of Reusing Power of Wind and Heat: We integrate and compare the wind and heat power generation in different stages, and calculate the ratio of power generation. Results are as follows. According to the data, our electricity generation in this way is not very objective, but it also affected by the number of power generators and natural factors such as wind heat. Our experimental subjects (about 10 square meters) of air conditioning working is not much.

Table 1. The wind and heat power generation comprehensive table

| | boot | frequency conversion | shutdown |
|-------------------------------------|---------|----------------------|----------|
| average power [w] | 15. 492 | 9. 643 | 2. 404 |
| Proportion of wind power generation | 65. 3% | 52. 7% | 54. 2% |
| Proportion of heat power generation | 34. 7% | 47. 3% | 45. 5% |

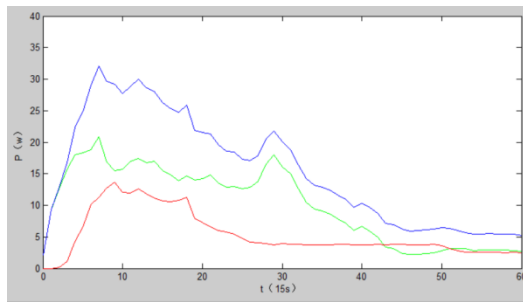


Figure 6. The wind heat power and total power in boot stage

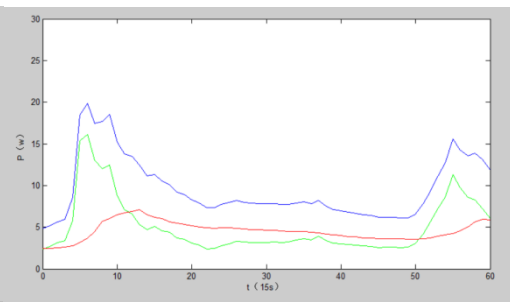


Figure 7. The wind heat power and total power in boot stage

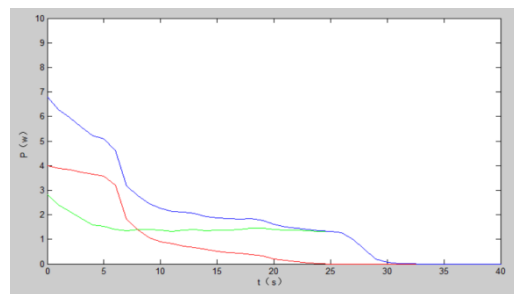


Figure 8. The wind heat power and total power in shutdown stage

According to the table 1, the wind energy utilization rate (power generation) is high, but it is not stable; on the contrary, the thermal power is relatively low, but the output is more stable. In general: by the means, reusing of heat and wind energy is subject to the air conditioner itself (operation and model). The natural environment makes the two wave shape similar to the trend, but the energy feedback is significantly slower than the wind, which lead the complementary effect by combination of these two kind of energy.

Conclusion

For individual users, the overall capacity of our project is not very handsome. The cost performance will be low if we use the way of battery storage. Relatively, for a large number of users, such as a school, a community, the quantity will be larger, but more efficient to achieve certain economic effect. And the wind and temperature difference power generation management information system software, which we have developed can help to make the management of the power generation situation more convenient. But due to the condition of limited resources, we are difficult to do a test of a large number of users with larger scale. We can only get the reasonable extended forecast, which is based on the data of the power generation by a single air conditioning. The results show that when the number of users is relatively large, after winds and waste heat can get better reuse, and has a certain economic value.

Prospect

1. The following research will not be limited to the independence of our device. We intend to make the generator supply power to the control module of the air conditioner directly. Considering the instability of the electric energy, a battery can be added as a buffer, at the same time, it can also be a backup power supply, which can ensure the stability of air conditioning module.

2. The waste heat power generation part of our project maybe can be used in the motor vehicle air conditioning system. Waste heat discharged from an engine or an exhaust tube can be reused and

produce some electric energy ,which can provide to the motor vehicle battery after a certain treatment.

References

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