Influence of Shielding Plate on Operation Environment of Outdoor Unit of a Split-type Air-conditioner

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Abstract. The air temperatures surrounding the outdoor unit of a split-type air-conditioner are very important environmental factors for its operation. Shielding plate can avoid the short circuit of inlet and outlet air. Under different installation methods of the outdoor units, the inlet and outlet air temperatures of the outdoor unit were measured by Keighley's Model 2700 data acquisition system in this paper. The results show that the air temperature of left inlet with shielding plate is lower than that without shielding plate. Therefore, the air temperature of front outlet with shielding plate is lower than that without shielding plate. The shielding plate installed between left and front has great influence on the air temperature of left inlet than on that of rear inlet. Shielding plate between the left inlet and the front outlet outside the outdoor unit of a split-type air-conditioner can improve the air environment of outdoor unit and benefit to the operation of the air-conditioner.

1. Introduction

The installation platforms of the outdoor units for split-type air-conditioners are different around buildings. To keep the out wall appearance of a building in order or neat, some outdoor units are installed in small installation platform with stainless steel bracket. Installation place of the outdoor units directly affects the airflow distribution in cooling conditions. Some condensing units are located in the void place of the building, which is covered by louvers. This type of installation results in poor operating environment, the air conditioner may shut down especially in extreme weather. Therefore, the installation of outdoor units is widely investigated to guarantee the good operation effect of air-conditioner [1-3].

Optimum placement of condensers for a split-type air-conditioner is an important factor that can lead to a lower on-coil temperature and consequently lower energy consumption. A. Avira and E. Daneshgar [4] investigated the effect of installation height of the condenser from the finished roof on on-coil temperature, and recommended the minimum height of installation. S. A. Nada and M. A. Said [5] concluded that, for optimum performance, in case of open-bottom shaft it is preferable to distribute all the outdoor units on one wall of the shaft except at the top two levels the units preferable to be distributed on two adjacent walls in staggered arrangements. In order to reduce the operation temperature and save energy, R. Duane et al [6] analyzed various factors which have combined effects on the suction air temperature of outdoor units of split-type air-conditioners. And concluded that heat

dissipation of outdoor units of split-type air-conditioners was primarily affected by outdoor unit arrangement style and distance, as well as the louver angel.

The inlet air temperature of outdoor unit of a split-type air-conditioner has great influence on its outlet air temperature, and then on the energy efficiency of this split-type air-conditioner. High working temperature not only decreases the efficiency of split-type air-conditioners but also increase the energy consumption. The effect of shielding plate, which is installed between the left inlet and the front outlet outside the outdoor unit of a split-type air-conditioner, was investigated for air temperatures of inlet and outlet of the outdoor unit in this paper. Its influence on the operation environment of the outdoor unit of the split-type air-conditioner was also discussed.

2. Experiment and Measurement

The outdoor unit of a split-type air-conditioner is placed on the fixed platform as Figure 1 shows. The rear side of the outdoor unit is a solid wall, and the other three sides are shuttered with adjustable louvers. The air inlets of the outdoor unit of this split-type air-conditioner are on its left side and rear side. The air outlet of this outdoor unit is on its front side. If the left louver or right louver is closed, this side becomes a solid wall. Then the inlet air of the outdoor unit on this side should only from its upside.

While the left louver is closed, the front air outlet with high temperature may flow to left side and mix with left air inlet. This air short circuit will increase the inlet air temperature of the left side. To avoid this case, a shielding plate should be placed between the left side and front side outside the outdoor unit as Figure 1 shows.

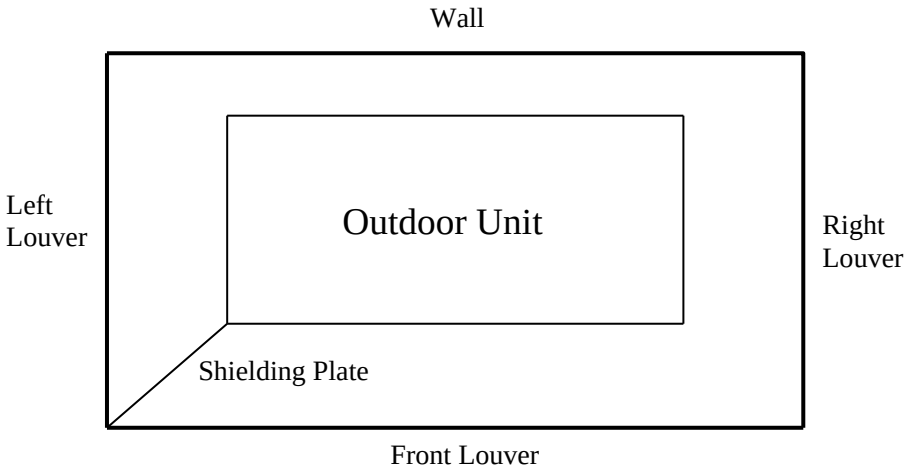

Figure 1. Layout of outdoor unit of air-conditioner.

The experiment was carried out by controlling louvers of left and right sides opening and closing, and measuring the air temperatures of front outlet and left and right inlets. Figure 2 shows the Keithley Model 2700 data acquisition system with 20 available channels which could be selected by switching module from channel 1 to channel 20. This system could be used to measure the values of resistance, current or voltage in an electric circuit, and the values of temperatures of multiple points simultaneously. It was applied to measure the values of inlet and outlet air temperatures of the outdoor unit in this experiment.

The Keithley data acquisition system is connected to four-line PT100 thermal resistance probes, which are fixed on the testing points to acquire the surrounding temperatures. The data could be read when the air-conditioner operates normally and the environment out of the outdoor unit is steady. The

data of air temperatures flow from the probes to the PC terminal through Keithley Model 2700 data acquisition system.

Figure 2. Keithley Model 2700 data acquisition system.

3. Results and Discussion

The results for air temperatures of inlet and outlet of outdoor unit are shown in Table 1. It was tested in six different installation methods of outdoor unit for a split-type air-conditioner by opening or closing the louvers of left side and right side in Figure 1, while there is shielding plate and no shielding plate between the left side and front side outside the outdoor unit.

Table 1. Air temperatures of inlet and outlet of outdoor unit.

Test	Installation method	Air temperature of left inlet (°C)	Air temperature of rear inlet (°C)	Air temperature of front outlet (°C)
1	Opening two sides without shielding plate	35.5	35.1	41.5
2	Opening two sides with shielding plate	35.2	35.2	41.0
3	Closing right side without shielding plate	40.6	38.9	44.3
4	Closing right side with shielding plate	35.8	39.9	43.5
5	Closing two sides without shielding plate	58.1	44.2	58.5
6	Closing two sides with shielding plate	49.8	42.5	51.4

For the method of opening two sides of left and right louvers, the air temperature of left inlet with shielding plate is lower than that without shielding plate. The reason is shielding plate could restrain air flow from front outlet to left inlet. Therefore, the air temperature of front outlet with shielding plate is lower than that without shielding plate, though the air temperature of rear inlet with shielding plate is little higher than that without shielding plate for the air flow from front outlet. Since the journey of air flow from front outlet through right to rear is longer than that to the left, the shielding plate

installed between left and front has great influence on the air temperature of left inlet than on that of rear inlet.

For the method of closing right louver, the air temperature of left inlet with shielding plate is lower than that without shielding plate because shielding plate restrains air flow from front outlet to left inlet. Therefore, the air temperature of front outlet with shielding plate is lower than that without shielding plate, though the air temperature of rear inlet with shielding plate is little higher than that without shielding plate for the air flow from front outlet.

For the method of closing two sides of left and right louvers, the air temperature of left inlet with shielding plate is much lower than that without shielding plate because shielding plate restrains air flow from front outlet to left inlet. Therefore, the air temperature of front outlet with shielding plate is much lower than that without shielding plate, and the air temperature of rear inlet with shielding plate is also lower than that without shielding plate.

Table 1 also shows that shielding plate has great influence on air temperatures of inlet and outlet under the method of closing two sides of left and right louvers. On this condition, the air of front outlet is much easier to flow to the left inlet because of the bounce of the front louver.

The outlet air temperatures of outdoor unit of a split-type air-conditioner are increasing with the increase of their inlet air temperatures. From the above analysis, it is concluded that shielding plate between the left inlet and the front outlet can restrain air mixing from two sides, and lower the air temperatures of left inlet and front outlet. It will improve the air environment of outdoor unit and increase the operation efficiency of the air-conditioner.

4. Conclusion

Comparing with laying shielding plate between the left side and front side with no shielding plate, different installation methods of outdoor unit for a split-type air-conditioner by opening or closing the louvers of left side, right side and front side were tested. The inlet and outlet air temperatures of the outdoor unit were measured by Keithley Model 2700 data acquisition system.

Shielding plate between the left inlet and the front outlet outside the outdoor unit of a split-type air-conditioner can lower the air temperatures of left inlet and front outlet by restraining air mixing from the two sides. And it will improve the air environment of outdoor unit and benefit to the operation of the air-conditioner.

Acknowledgments

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