Academic Journal of Engineering and Technology Science
ISSN 2616-5667 Vol.2, Issue 4: 71-75, DOI: 10.25236/AJETS.2019.020610

Sign of Frost-Free Heating Device for Air Source Heat Pump

Xinze Li, Xiang Zhang*, Jiacheng Li, Zhao Zhang, Zhihang Zhang

Harbin University of Science and Technology, Harbin, China
**Corresponding Autho Email: 2605626017@qq.com*

ABSTRACT. *An air source heat pump is an energy-saving device that utilizes a high position to allow heat to flow from a low-level heat source to a high-level heat source. However, when the ambient temperature is lower than 5 °C, frosting will occur at and around the evaporator vent and then freeze, thereby blocking the air passage of the heat absorbing device and affecting the normal operation of the host. Aiming at the deficiencies of the prior art, this paper designs an air source heat pump frost-free heating device, which is used to solve the problem that the existing air source heat pump is easy to frost, thereby blocking the air passage of the heat absorption device and affecting the normal operation of the host.*

KEYWORDS: *Air source heat pump, Heating device, Low-temperature environment, Anti-frosting*

1. Introduction

Target tracking technology has an important application value in both military and civil fields [1]. In 1937, the first tracking radar station (SCR-28) appeared in the world [2]. Since then, with the continuous development and progress of sensor technology, target tracking systems based on radar, laser, infrared and satellite appear more and more in various fields. Moving target tracking is a hot topic in many scientific research institutes at home and abroad, which involves advanced technologies such as control, signal processing and communication. Among them, this technology is also widely used in the intelligent workshop product tracking system.

2. Introduction

In the winter, as the outdoor temperature gradually decreases, the air source heat pump evaporator will have frequent frosting, resulting in low energy efficiency of the air source heat pump. At present, air source heat pump anti-frosting technology is mainly divided into two categories: 1) Defrost technology. At present, there are many research contents on evaporator defrosting technology, such as reverse

circulation-hot gas bypass defrosting system,[1] multi-channel hot gas bypass defrosting system,[2]and phase change thermal defrosting technology[3], etc. 2) Prevent frosting technology. The evaporator prevents frosting technology by installing a dehumidifying fabric heat exchanger on the windward side of the evaporator, optimizing the fin tube shape and fin material of the evaporator.[4]Photoelectric sensor is distributed between the fins with obvious heat transfer characteristics of the evaporator[5].

In this paper, an air source heat pump frost-free heating device is designed to solve the problem that the existing air source heat pump is easy to frost, thereby blocking the air passage of the heat absorption device and affecting the normal operation of the host.

3. Introduction to Main Components

3.1 Air Source Heat Pump

The air source heat pump has good safety characteristics and is affected by the basic principle. The heat pump technology is not directly heated by the electric heating element. Therefore, compared with the conventional electric heating equipment, it has no safety accident caused by electricity and gas leakage.[6]

The air source heat pump body mainly comprises a compressor, a liquid storage tank and an expansion valve.

Compressor

The compressor is a machine that raises low-pressure gas into a high-pressure gas, and sucks low-temperature and low-pressure refrigerant gas from the intake pipe. After the piston is compressed by the motor, the high-temperature and high-pressure refrigerant gas is discharged to the exhaust pipe to provide power for the heating cycle, and the use of heat in the air is realized.

Liquid Storage Tank

The liquid storage tank is installed between the condenser and the expansion valve for evaporating a heating system with a large load change, in order to ensure sufficient liquid supply during high load circulation. At the same time, the liquid refrigerant does not invade the condenser during the low load cycle, which affects the heat dissipation effect. Therefore, the system is equipped with a liquid storage tank to make it work well.

Expansion Valve

As one of the basic equipment in the refrigeration system, the thermal expansion valve has the function of throttling and controlling the flow of the refrigerant, which directly determines the operating performance of the entire system. Thermal expansion valves are most commonly used in the supply of dry evaporators. It generally adjusts the refrigerant flow rate proportionally to the deviation of the

evaporator outlet superheat from the set static superheat, so that the supplied refrigerant liquid can be completely evaporated to the evaporator outlet. This avoids excessive liquid supply and ensures that the heat transfer area of the evaporator is fully utilized.[7]

3.2 Condenser

During the heating operation of the system, the condenser acts as a heat releasing component to transfer the heat obtained by the refrigerant at the heat source to the heating medium in the high temperature environment.[8]

When the system is running stably, the high temperature and high pressure superheated gaseous refrigerant from the compressor enters the condenser. At this time, the superheated refrigerant is continuously exothermic due to the temperature higher than the surrounding medium, and the cooling leaves the condenser in a state of being too cold, and the ambient medium absorbs the heat of the superheated refrigerant to increase the temperature of the heat to supply heat.

3.3 Evaporator

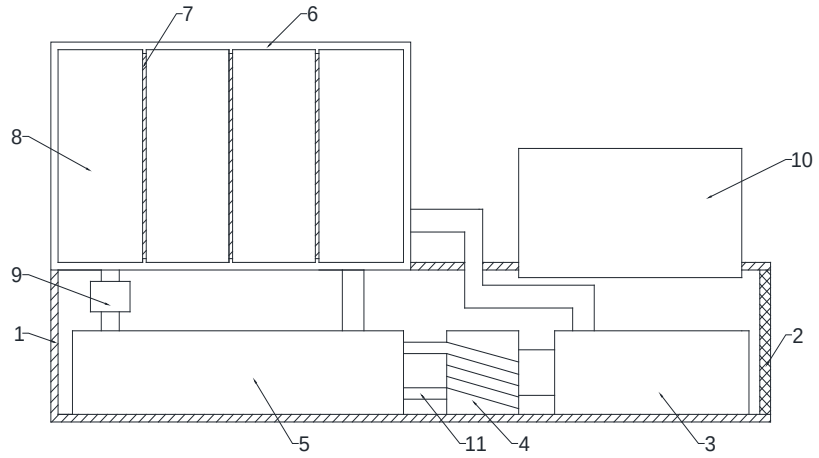
The evaporator is a device that absorbs heat from the outside to heat the refrigerant.

When the system is in stable operation, the low-temperature low-pressure super-cooled liquid refrigerant from the expansion valve enters the evaporator. Since the temperature of the super-cooled refrigerant is lower than the surrounding medium, the heat is continuously absorbed, and the temperature rises to the state of the superheated gas leaving the evaporator.

4. Connection Method

The right side wall of the first casing 1 is provided with an air inlet net 2 and an air source heat pump body 3. The left side of the air source heat pump body 3 is provided with an evaporator 4, and the left side of the evaporator 4 is provided with a water tank 5, an evaporator The water pipe 11 is wound around the surface of the water pipe 11, and both ends of the water pipe 11 are electrically connected to the water tank 5, respectively. The evaporator 4 and the water tank 5 are both located in the inner cavity of the first casing 1, and the second casing 6 is fixedly mounted on the top left side of the first casing 1. The inner chamber of the second housing 6 is provided with a heat exchanger 7, and the second housing surface is inlaid with a plurality of sets of thermally conductive sheets 8. The outer surface of the heat exchanger 7 is overlapped on the inner surface of the heat conducting sheet 8. The air source heat pump body 3 is electrically connected to the heat exchanger 7 and the evaporator 4 through a pipe, and a water pump is arranged between the water tank 5 and the heat exchanger 7. 9. The water pump 9, the heat exchanger 7 and the water

tank 5 are respectively circulated and connected through a pipe. The dehumidifier 10 is fixedly mounted on the top right side of the first casing 1. The surface of the water pump 9 is mounted with a timer, and the timer is electrically connected to the switch of the water pump 9 through wires.



1- First housing; 2- Intake net; 3- Air source heat pump; 4- Evaporator; 5- Water tank; 6- Second housing; 7- Heat exchanger; 8- Thermal sheet

9- Water pump; 10- Dehumidifier; 11- Water pipe

5. Working Principle of Air Source Heat Pump's Frost-Free Heating Device

In this paper, an air source heat pump frost-free heating device is designed to solve the problem that the existing air source heat pump is easy to frost, thereby blocking the air passage of the heat absorption device and affecting the normal operation of the host.

The device continuously absorbs external heat through the evaporator 4 to heat the refrigerant, and the gaseous refrigerant from the evaporator enters the air source. The heat pump 3 compresses and heats the air to become a superheated gaseous refrigerant. The superheated gaseous refrigerant from the compressor enters the heat exchanger 7 to exotherm heat to exchange heat, so that the heat exchanger 7 heats the heat conductive sheet (the heat conducting sheet used in the apparatus is made of aluminum sheet). Furthermore, the heat transfer sheet 8 is supplied with heat to the outside, so that the device can function as a heating. The water pump 9 can be automatically opened at intervals by the timer to allow the heat exchanger 7 to exchange heat with the water in the water tank 5. Due to the use of the dehumidifier 10 (the dehumidifier is a rotary dehumidifier in which the adsorption reel in the dehumidifier is located in the inner cavity of the first casing). This can reduce the water vapor content in the first casing 1, thereby preventing the occurrence of frosting, thereby solving the problem that the existing air source heat pump is easy

to frost, thereby blocking the air passage of the heat absorption device and affecting the normal operation of the host.

6. Conclusion

The device is combined with a dehumidifier to reduce the water vapor content in the first casing, thereby preventing the occurrence of frosting. Therefore, the existing air source heat pump is easy to frost, thereby blocking the air passage of the heat absorption device and affecting the normal operation of the host.

References

[1] Song, M. , Deng, S. , & Xia, L. (2014). A semi-empirical modeling study on the defrosting performance for an air source heat pump unit with local drainage of melted frost from its three-circuit outdoor coil. Applied Energy, vol. 136, pp. 537-547.

[2] Li, L. T. , Wang, W. , Sun, Y. Y. , Feng, Y. C. , Lu, W. P. , & Zhu, J. H. , et al.(2014). Investigation of defrosting water retention on the surface of evaporator impacting the performance of air source heat pump during periodic frosting–defrosting cycles. Applied Energy, vol. 135,pp. 98-107.

[3] Dong, J. , Li, S. , Yao, Y. , Jiang, Y. , Tian, Y. , & Tian, H. (2015). Defrosting performances of a multi-split air source heat pump with phase change thermal storage. International Journal of Refrigeration, vol. 55, pp.49-59.

[4] Huang, D. , Ri-Jing, Z. , Liu, Y. , & Yi, D. B. (2014). Effect of fin types of outdoor fan-supplied finned-tube heat exchanger on periodic frosting and defrosting performance of a residential air-source heat pump. Applied Thermal Engineering, vol.69, no.1-2,p 251-260.

[5] Wang, W. , Xiao, J. , Feng, Y. , Guo, Q. , & Wang, L. (2013). Characteristics of an air source heat pump with novel photoelectric sensors during periodic frost–defrost cycles. Applied Thermal Engineering, vol.50, no.1, pp.177---186.

[6] Liang, C. , Zhang, X. , Li, X. , & Zhu, X. (2009). Performance Simulation and Analysis of New Solar Assisted Air-Source Heat Pump Heating System. International Symposium on Heating.

[7] Whipple, W. (1996). Refrigeration system with electrically controlled expansion valve. Applied Thermal Engineering, vol.17, no.4, pp.XVIII.

[8] Quan, Z. H. , Wang, G. , Zhao, Y. H. , Deng, Y. C. , & Xu, P. . (2013). Experimental study of solar-air composite heat pump system. Advanced Materials Research, vol.827, pp.259-263.