INVESTIGATION ON EFFECT OF AIRFLOW FIELD AROUND SPIRAL CONDENSER ON A REFRIGERATOR PERFORMANCE

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Abstract: The constrained convection condenser is generally utilized as a part of refrigerator. The condenser, and compressor are typically set in a rear the refrigerator bottom. Both air inlet and outlet grilles are introduced on the cooler back panel and separated from condenser and on its same side. The deviation makes most airflow go through piece of condenser close to back panel. Then, airflow tends to go through free gap amongst condenser and its nook because of littler weight drop and has little contact with condenser, in this way trading less heat. An outer foam ring and central foam were applied to improve airflow distribution around a spiral condenser (SC) in this paper. The external foam was situated around the downstream part of spiral condenser to block of the free gap between spiral condenser and it's enclosed. The central foam was installed in the upstream part to obstruct the centre stage of spiral condenser. More airflow was directed to pass through and exchange heat with spiral condenser, causing decrease in condenser middle and outlet temperatures respectively. The consolidating temperature decrease contributed to less refrigerant heat relocation into evaporator from condenser during compressor-off period, and thus compressor-off time expanded by 3.15%. Finally, refrigerator energy consumption was decreased by 4%.

Key words: R-600a, COP-Coefficient of performance, Spiral condenser.

1. INTRODUCTION

The popularity of the frost-free refrigeration is increasing due to the many advantages provided by it, like vast inner volume to store foods, automated defrosting, less temperature variation range to get quality food, cooling the food faster and other. Hence, improved performance of the refrigerator is attracting many researchers who are dedicated to saving the energy and environment conditions. In the open literatures mainly included topping the performance of finned-tube evaporators. .The condenser is one of four key parts of the refrigeration system. Effective heat transfer performance can decrease the condensing pressure (condensing temperature) or increase sub cooling degree which brings about more prominent cooling limit and of refrigeration system. Which brings about more prominent cooling limit and of refrigeration system. Right now, the spiral condenser is generally utilized in domestic refrigerators, and it has most part has to generally two commonplace the external suspension condenser and the spiral condenser. The outside suspension condenser is placed in back wall of the refrigerator, and its main heat transfer pattern is characteristic natural convective and radiation. Hence, the surrounding space between the wall and refrigerator is of great importance when it comes to spiral condenser is most part utilized for ice-free refrigerator with higher cooling capacity. Although spiral condenser is widely used in frost-free refrigerator, research on spiral condenser (SC) is seldom found in public literatures up to now. From the limited English literatures the authors can find, the reference of Barbosa and Sigwalt is the only one.

They focused on the effect of geometric parameters on the heat transfer performance, such as tube passes, wire spacing and tube spacing and the airflow passed through the spiral condenser along its centre line direction. Thus, the inlet and outlet air was uniform from around spiral condenser, which is different from the real engineering situation where the air inlet and outlet was back in the refrigerator. Normally the compressor, and the spiral condenser are installed in the frost-free refrigerator, back panel of the refrigerator. And the condenser and stay on its bottom side. In addition, the airflow through the hollow centre of spiral condenser also does not have a sufficient contact with improvement of the external suspension condenser. Compared with the external suspension condenser, and the spiral condenser SC has a more compact structure. The spiral condenser and as a result exchanges less heat with the refrigerant. Hence, heat transfer performance of spiral condenser will be gravely deviated from the theoretical value. Improving the airflow organization around the spiral condenser SC could enhance its performance. Therefore, this paper focuses on airflow field around the SC and its effect on corresponding refrigerator performance, as a supplement to studies of the SC used in a refrigerator. The outside foam ring was located around the back part of spiral condenser to block most of the gap between the spiral condenser and its space while the central foam block was equipped in the upstream part of the spiral condenser to disguise its centre. The airflow field, foams, was studied comparatively, in terms of effective airflow that actually passed through and exchanged heat with the spiral condenser. Then, comparison between SC performance with foams was conducted. Finally, effect of the optimization on the refrigerator performance was investigated to explore the dominant reason that the daily energy consumption was reduced.

2. RESEARCH METHOD

Experimental apparatus and procedure:

The tried refrigerator system has an aggregate volume of 215L.The detailed technical specifications of the refrigerator shows that the Spiral condenser SC, and the compressor were located inside the base of the refrigerator. Both the air inlet and outlet grilles were set in the back panel and separated from the spiral condenser. The deviation may cause most airflow to pass through part of the SC close to back panel, as is illustrated in the wire diameter, the tube outside diameter and the tube thickness of the spiral condenser were 1.4 mm, 4.76 mm and 0.71 mm, respectively. The section area of the hollow centre and the gap between the SC and its enclosing structure accounts for about 20% of total area, as is illustrated. Hence, some airflow will get around the condenser through the gap and the hollow centre due to a smaller pressure drop in the conventional situation. Consequently, this airflow rarely contacted with the spiral condenser and exchanged less heat with in the refrigerant, thus reduce the spiral condenser performance.

Test procedures:

The spiral condenser is used to improve the performance of the refrigerator. By implementing the spiral condenser effective cooling takes place in the refrigerator, so that it reduce the compressor work. The refrigeration system experimentation was carried out with

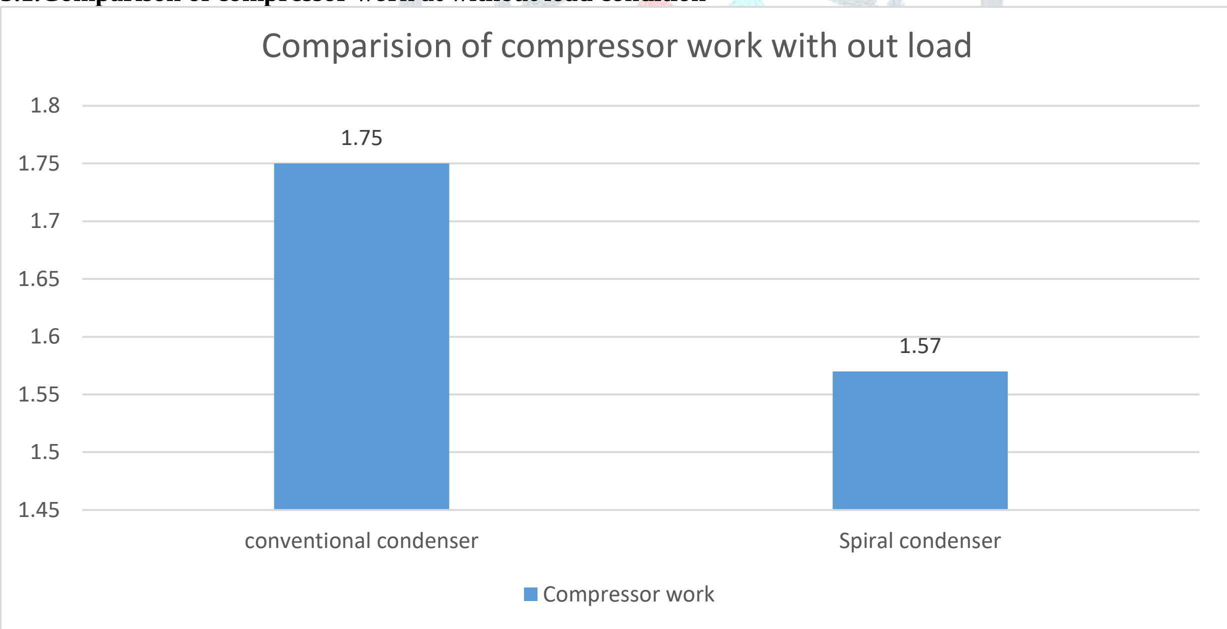
1. Conventional VCR system with R600a as refrigerant.
2 .VCR System with R600a as refrigerant with spiral condenser without load.
3. VCR system with R600a as refrigerant with spiral condensed with load.

Experiments are tired all cases and also the values of pressures and temperatures are tabulated and calculations are done.

3. RESULTS AND DISCUSSION

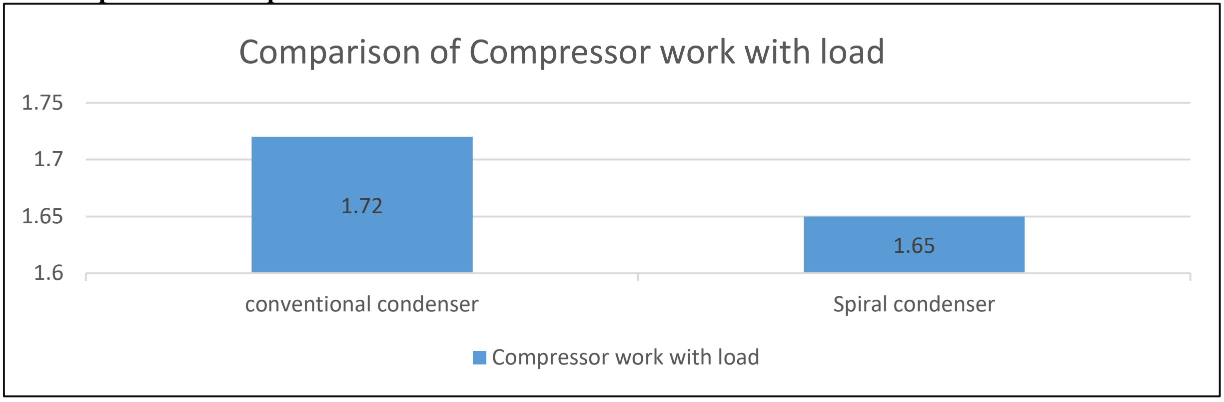
Experiments are conducted on 215L capacity refrigerator using copper coiled condenser along with inlet of the condenser. By utilizing spiral condenser the compressor work decreased, in view of changing over all kinetic energy accessible at condenser intake the pressure energy. Sub cooling is obtained by high heat transfer rates of the copper coiled condenser which leads to increase in refrigeration effect.

3.1.Comparison of compressor work at without load condition



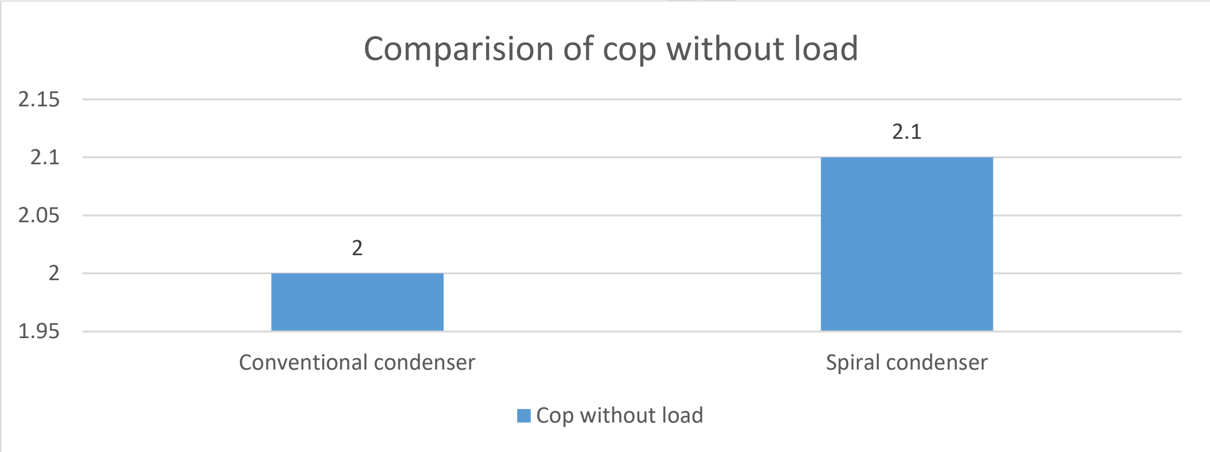
From fig. 3.1, it is clear that compressor work of the modified refrigeration system decreased by 11.4% when compared with conventional system.

3.2.Comparison of compressor work at with load condition



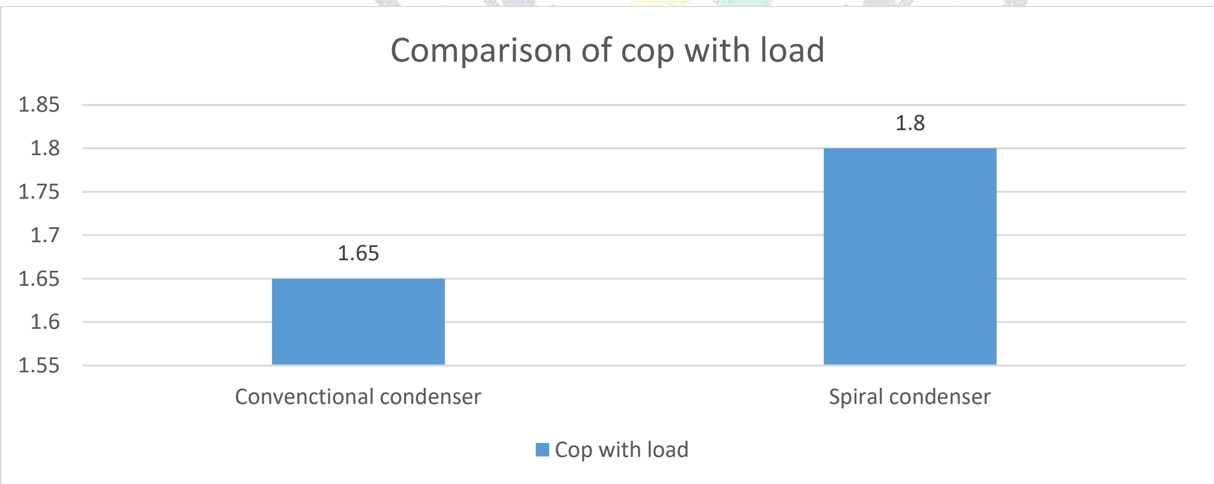
From fig. 3.2, it is clear that compressor work with load modified refrigeration system increased by 4% when compared with conventional system

3.3.Comparison of COP at without load condition



From fig. 3.3, it is clear that coefficient of performance Cop will be increased by 4.7% when compared with conventional system system.

3.4 Comparison of COP at with load condition



From fig.3.4, it is clear that coefficient of performance Cop and the modified system increased by10% when compared with normal system.

4.CONCLUSION

The execution of the refrigeration system is expanded by reducing the space of high thermal conductivity material fins. High heat exclusion through the condenser assist to increase COP. In the modified system, due to the combined effect of 12mm fins spaced condenser, And the performance of the system is increased by 10%, power consumption is reduced by 11.4%, work done of compressor is decreased by 4%.

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