Fabrication of Hot and Cold Water Dispenser
Sana Shaikh¹, Priyanka Rawate²

¹,²Bharati Vidyapeeth’s Institute of Management and Information Technology, Navi Mumbai

Abstract— In any Refrigeration system heat energy released by the system is lost to the surrounding and it goes as a waste. This heat which is lost to the atmosphere can be used at other application if certain modifications and changes are made. In a separate water heater electricity is consumed to heat water. To address this problem, we are working on a research which will utilize the out coming heat from the system and reduce the power consumption. This heat recovery from the household refrigerator is done by replacing air cooled condenser with water cooled condenser which uses the heat rejected from the condenser to heat the water. The water cooled condenser is fabricated along with insulated storage tank to store the hot water for further use. The Objective of this paper is to modify refrigerator to serve both the purposes as refrigerator and hot-cold water dispenser.

Index Terms— Refrigerant, Thermal insulation, Condenser, Dispenser, Compressor, Evaporator.

I. INTRODUCTION

Vapor-compression refrigeration is one of many refrigeration cycles available for use. It is the most widely used method for air-conditioning of offices, private residences, hotels, large public buildings, restaurants, automobiles, hospitals and theaters. It is also used in private and economic refrigerators, large-scale warehouses for chilled or frozen storage of foods. Oil refineries, petrochemical and chemical processing plants, and natural gas processing plants are many types of industrial plants that often use large vapor-compression refrigeration systems.

A household refrigerator is a common household gadget that consists of a thermally insulated compartment and which when works, transfers heat from the inside of the chamber to its external environment so that the inside of the thermally isolated compartment is cooled to a temperature below the surroundings temperature of the room. Heat rejection may occur directly to the air in the case of a traditional household refrigerator having air-cooled condenser.

The utilization of waste heat is profitable when heating and refrigeration are needed at the same time, or where waste heat can be stored:

- In air conditioning systems to reheat exhaust air
- In butcheries, dairies, hotels, etc., where, on the one hand, cold storage rooms are supervised and where there is always a great demand for domestic hot water
- In shops, where in addition to cooling foodstuff, need of heat also occurs
- In cold storage facilities, for heating and domestic hot water.

Waste heat rejected from refrigeration and air conditioning systems can be used by intercepting it before it is vented to atmosphere by passing refrigerant gas through water cooled condenser to deliver heated water. Heat can be recovered by using the water-cooled condenser and the system can work like a waste heat recovery unit. The recovered heat from the condenser can be used for domestic use.
This idea is selected keeping its scope in mind for various applications along with the overall cost. The thought process was to modify the refrigerator in such a way, enabling it to produce cold and hot water without consuming extra electric power, while improving the efficiency of the refrigeration system. Saving heat energy which is usually lost to the surrounding in domestic refrigerators and utilizing it in a useful way. Manifesting this model in desired form, at expense of cost comparable with the cost of available refrigerators is our aim. The same concept can be applied to a water cooler working on refrigerant cycle, thus modifying it into hot and cold water dispenser.

This concept has numerous applications which can save large amount of energy and money.

A. LITERATURE REVIEW

The Refrigeration systems changes according to the objective and the type of refrigerant used. They are the means by which we can actually perform the refrigeration process. A better understanding of them is thus, very essential. Methods of Refrigeration systems can be classified as:


1.1 Vapor-Compression Refrigeration System -

Vapor-Compression Refrigeration System (VCRS) is the most widely used method for air-conditioning of buildings and automobiles. Vapor compression cycle is an improved type of air refrigeration cycle in which a suitable working termed as refrigerant, is used. The refrigerants generally used for this objective are ammonia (NH3), carbon dioxide (CO2) and sulphur-dioxide (SO2). The refrigerant used, does not assent the system, but is circulated throughout the system alternately condensing and evaporating.

1.2 Vapor-Absorption Refrigeration –

The Vapor Absorption Refrigeration is heat operated system. In the absorption system the compressor of the vapor compression system is reintegrated by the combination of absorber and generator. A solution known as the absorbent, which has an affinity for the refrigerant used, is circulated between the absorber and the generator by a pump. The absorbent in the absorber draws (or sucks) the refrigerant vapor formed in the evaporator thus maintaining a low pressure in the evaporator to enable the refrigerant to evaporate at low temperature. In the generator the absorbent is heated. There by releasing the refrigerant vapor (absorbed in the absorber) as high pressure vapor, to be condensed in the condenser. Thus the suction function is performed by absorbent in the absorber and the generator performs the function of the compression and discharge. The absorbent solution carries the refrigerant vapor from the low side (evaporator-absorber) to the high side (generator-condenser). Thus establishing circulation of the refrigerant through the system.

1.3 Gas Refrigeration Cycle –

Just as the vapors are used for cooling in the vapor compression cycle and vapor absorption cycle, the gas is used for cooling in gas refrigeration cycle. When the gas is throttled from very high pressure to low pressure in the throttling valve, its temperature reduces suddenly while its enthalpy remains constant. This principle is used in gas refrigeration system.

2.1 Ice Refrigeration –

In this method the ordinary ice is used for keeping the space at temperature below the surrounding temperature. The temperature of ice is considered to be zero degree Celsius hence it can be used to maintain the temperatures of about 5 to 10 degree Celsius. To use the ice for refrigerating effect a closed and insulated chamber is required. On one side of the chamber ice is kept while on the other side there is a space which is to be cooled where some material to be cooled can be placed. If the temperature below 0 degree Celsius is required, then the mixture of ice and salt is used. This method of cooling is still being used for cooling the cold drinks, keeping the water chilled in thermos, etc.

2.2 Dry ice refrigeration –

Dry ice is the solid carbon dioxide having the temperature of -78 degree Celsius. Dry ice disciple directly from solid state to gaseous; this process is called as sublimation. Dry ice can be pressed into various sizes and shapes as blocks or slabs. Dry ice is usually packed in the frozen food cartons along with the food that has to be kept frozen for long time. When the dry ice gets converted into vapor state it keeps the food frozen. The process of dry ice refrigeration is now-a-days being used for freezing the food in aircraft transportation.

II. METHODOLOGY

The modification of domestic refrigerator into hot and cold water dispenser is explained below. It is achieved by replacing the air cooled condenser with water cooled condenser. It includes construction and fabrication of tank which will act as structure for water cooled condenser.

Construction of Hot and Cold Water Dispenser

Domestic refrigerator has air cooled condenser as shown in below figure. We are going to replace it with a Tank & Coil condenser.

A. Air Cooled Condenser
The above figure shows the system for cooling found in domestic refrigerator. It has air cooled condenser, in which coils is exposed to air and it releases the heat directly into the atmosphere.

**B. Water Cooled Condenser**

Tank and Coil condenser is fabricated from Galvanized Iron sheet with dimensions as Length: 17 inches, Width: 6 inches, Height: 10 inches, Thickness: 5mm, Capacity: 10 liters

![Working Diagram of Water Cooled Condenser](image)

The tank and coil condenser will be having following sub-components:

1. **Condenser Coil:** Condenser coil made of copper tube having size of $\frac{1}{4}$ inch and thickness 18 mm. It is bend using tube bender and fit into the tank.

2. **Supply Valve:** It will act as inlet for water supply to the tank. Water from purifier or tap will enter through this valve.

3. **Float Valve:** Float valve will keep the water level in check. If the level of water is to fall below the set level, it opens and water is filled in the tank.

4. **Outlet Valve:** It will act as outlet for warm water.

**C. Refrigerant**

A refrigerant is a fluid that is used in air conditioners and refrigerators, to take heat from the contents of refrigerator or the room (like ACs) and throw the heat out in the atmosphere. A refrigerant undergoes phase changes from a liquid to gas (while absorbing heat) and back to liquid (when a compressor compresses it). The choice of ideal refrigerant is made based on: its fa-vorable thermodynamic properties, non-corrosive nature and safety. Although many fluids can be used to act as refrigerant, CFCs are the most popular refrigerants. Taking energy efficiency, global warming and safety, going for an Air Conditioner with R-410A and Refrigerator with R-134A is the best bet as of
today. So the refrigerant we are going to use is R-134A.

**D. Process**

A Galvanized Iron Tank is fabricated and assembled with the valves, condenser coil. It is welded onto the back of Refrigerator in place of air cooled condenser it had. Provisions are made to supply water into the tank either from tap (if not for drinking) or manually. The discharge line from compressor is joined with the copper condenser coil in tank. And the outlet of condenser coil goes to evaporator through expansion valve/capillary tube.

The working of cycle will be same as before except that the heat energy is not lost to the atmosphere but used to heat water. In brief, Refrigerant will be compressed to high pressure and high temperature by compressor. It enters the tank and coil condenser in form of vapor. Tank is filled with water supplied through inlet from water source. Float valve keeps check on level of water. Water-cooled condenser acts as a heat exchanger that removes heat from refrigerant vapor and transfers it to the water in it. In doing so, the vapor condenses and gives up heat to the water. This warm water is supplied through outlet/tap so that it can be used for different chores.

![Figure 1.4: Working of Water Cooled Refrigeration System](image)

**III. CONCLUSION**

It is possible to use the rejected heat from the system, without affecting the performance of the system. Some of conclusions that can be derived from are as follows.

1. Water can be heated to temperature suitable for domestic applications such as washing hands, bathing, dish washing, washing clothes etc.

2. Efficiency of this system is same compared to system using air cooled condenser.

3. No energy and power consumption in heating the water. The waste heat from the system is utilized for heating purpose.

4. As system is rather a bit expensive compared to the air cooled condenser as it requires water supply and time to time maintenance, but it is hardly anything major to be worried about.
REFERENCES