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DESIGN AND ANALYSIS OF DOMESTIC REFRIGERATOR USINGLPG CYLINDER

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ABSTRACT:

Supply of continuous electricity is still not available in several areas of the country and the world and refrigerator consuming more electricity. In this project we eliminate the problem of electricity.

In this project using LPG as refrigerant we have design and analyze refrigerator. LPG is stored in cylinder at high pressure. As this pressurized LPG is passed through the capillary tube of small internal diameter, the pressure of LPG is decreased due to expansion and phase change of LPG occurs in an isenthalpic process. Due to phase change from liquid to gas latent heat of evaporation is gained by the liquid refrigerant and the temperature decreased. In this way LPG can produce refrigerating effect in the surrounding. After complete investigation we observed that the COP of LPG Refrigerator is higher than domestic Refrigerator.

KEYWORDS: LPG Refrigeration, Evaporator, Vapour compression cycle, Capillary Tube, COP, Refrigeration Effect.

1. INTRODUCTION:

The Refrigerating systems commonly used in present era are running on halogenated Refrigerant. Although these systems have excellent thermodynamic and thermo-physical properties, it has adverse impact on environment. Refrigerator is one ofthe appliances which are running 365 days in year. It means the Refrigerator consumes more electricity than other domestic appliances. LPG Refrigerator eliminates the use of electricity for Refrigeration. In LPG refrigeration system, Conventional VCR (Vapour Compression Refrigeration System) uses LPG as refrigerant and produced the refrigerating effect produced by use of LPG as refrigerant. But in our proposed very simple type of refrigeration system in which the high pressure LPG is passing through a capillary tube and expands. After expansion the phase of LPG is changed and converted to gas from liquid and then it passes through the evaporator where it absorbs the heat and produces the refrigerating effect. After evaporator low pressure gas passes through the gas burner where burns. The substance which works in a refrigerator to extract heat from a cold Body and to deliver it to a hot body i.e.to surrounding is called refrigerant.

OBJECTIVE:

The Objectives of this project are as follows:

1) Compare various characteristics between LPG refrigeration system and CFC-22 refrigeration system.

2) To detect various waste in Domestic refrigeration system.
3) To compare cost of Domestic and LPG refrigerator.
4) Also the performance of domestic refrigerator and LPG refrigerator is to be compared.

SCOPE OF WORK:

The basic objective of this project is to study and analyze vapour compression refrigeration system. We have substituted Compressor and condenser by LPG Cylinder. LPG is stored in cylinder at high pressure and hence this pressure energy of LPG can be used for Refrigeration.

2. EXPERIMENTAL SETUP:

2.1 WORKING PRINCIPLE:

The LPG Refrigerator uses evaporation of LPG to absorb heat. LPG is stored in cylinders at pressure at about 80 psi. We lowering this pressure to pressure of 1 psi so that the heat absorbed adiabatically from refrigeration box and cooling is obtained on surrounding. LPG is stored in the LPG cylinder under high pressure. When the gas tank of regulators is opened then high pressure LPG passes in gas pipe. This LPG passed to capillary tube at high pressure. High pressure LPG is converted in low pressure at capillary tube with enthalpy remains constant.

Low pressure LPG is passed through evaporator. LPG is converted into low pressure and temperature vapour from passing through the evaporator which absorbs heat from the refrigeration box . Thus the refrigeration box becomes cools down. Thus we can achieve cooling effect in refrigerator. LPG from evaporator is then passed through pipe to the burner.

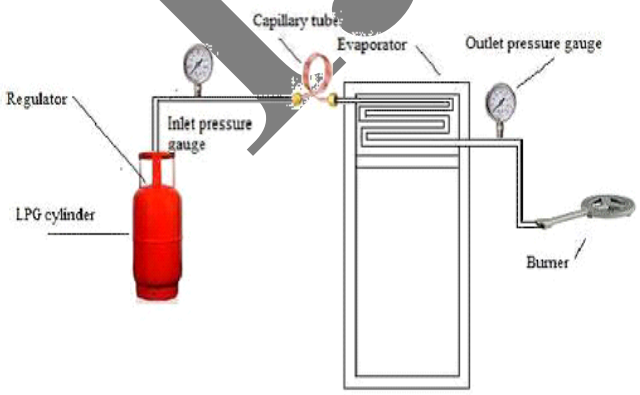

Fig.1.Schematic setup of LPG refrigeration system

2.2 CONSTRUCTIONAL FEATURES:

A. LPG GAS CYLINDER:

LPG is Liquefied Petroleum Gas which contains mainly Propane (0C3H8) and Butane (C4H10).These two either stored separately or together as a mix. LPG can be used as a fuel for domestic, industrial, agricultural, cooking, heating and drying processes. It can also used as an automotive fuel or as propellant for aerosol.

Fig2.LPG cylinder

The LPG is stored in the cylinder at about 12.5 bars. The use of LPG Cylinder eliminates the compressor and condenser from the system.

B. EVAPORATOR:

In any refrigeration system evaporator is an important component. The cooling effect is produced by passing the refrigerant through evaporator coil. The evaporator removes heat from the substance and transfers it to the refrigerant. It means the evaporator act as heat exchanger.

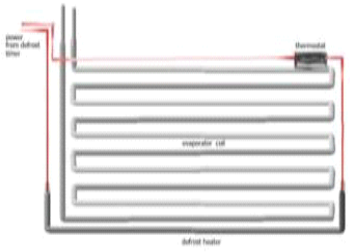

Fig3.Evaporator

C. CAPILLARY TUBE :

Capillary tubes are tubes with small internal diameter. This diameter varies from 0.5 to 2.28 mm. Commonly used capillary tubes are made up of copper. When the refrigerant enters in the capillary tube, due to

very small diameter its pressure drops down suddenly. The decrease in pressure of the refrigerant through the capillary depends on the diameter of capillary tube and the length of capillary tube. Smaller diameter and more length of capillary and has more drop in pressure of the refrigerant as it passes through it.

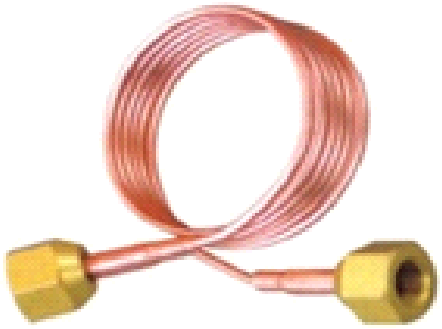

Fig4.Capillary Tube

The phase change occurs at exit point of the capillary tube. The liquid phase of LPG is changed to gaseous phase. The pressure of LPG increases and it expands due to throttling process. This high pressure refrigerant is further given to evaporator.

D. PRESSURE GAUGE:

Pressure gauges are the instruments used for measuring the pressure. In our project we have used pressure gauges to measure the pressure at various stages. The most commonly used mechanical gauge is Bourdon type pressure gauge. It is a stiff, flattened metal tube bent into a circular shape. The fluid whose pressure is to be measured is inside the tube. One end of the tube is fixed and other end is free to move inward or outward.

Fig.5 Stainless steel pressure gauge

E. HIGH PRESSURE PIPES:

The high pressure pipes are needed to be used as the LPG is delivered from cylinder at very high pressure. It consists of a steel pipe with steel spheres fixed at both the terminals.

Fig6.High pressure pipe

Two swiveling connection nipples press these balls against the sealing of the connecting hole and thus sealing against gas leakage.

3. SPECIFICATION OF COMPONENTS:

3.1. CAPILLARY TUBE:

We have selected the capillary tube with internal diameter 0.78mm and length 2.95m, According to the pressure and flow rate of the process.

3.2. EVAPORATOR:

We have used same evaporator which is used in domestic refrigerator i.e. Plate and tube type evaporator. The evaporator has following dimensions:
Length = 330mm, Breadth = 270 mm and
Height = 140 mm.

3.3. COPPER TUBES:

The pressure of the system is as high as 100 psi, so we have used copper tubes with thickness 1.5 mm and outside diameter 8 mm.

3.4. SAFE AND ECO-FRIENDLY:

This is another important requirement which is to be fulfilled by this project. The device should not harm the user in any way. Also it should not affect the environment and contribute to global cause.

4. OBJECTIVES OF THE PROJECT:

4.1. ECONOMICAL:

The components we are using for design should be cheap and easily available. Also the overall cost of the product should be less.

4.2. INEXPENSIVE AND AFFORDABLE:

This project should reduce the cost of designing refrigerator.

4.3. REFRIGERATION CAPACITY:

This is the main goal of our project. We are designing the device which will meet all different cooling loads.

5. ADVANTAGES:

1. There is no any noise or vibration as the system does not contain any moving part.
2. One energy source is utilized for refrigeration and burning processes, Hence energy saving system.
3. It can use waste heat for operation.
4. No electricity is required, so power saving system.

6. LIMITATIONS:

1. Efficiency is poor.
2. Leakage of LPG causes the blast.
3. Repairing and servicing of the system is difficult.
4. System is very bulky.

7. COMPARISON BETWEEN DOMESTIC AND LPG REFRIGERATOR:

The domestic refrigerator requires high input power. The COP of domestic refrigerator is normally up to 2.95 which is less than LPG refrigerator. Also operation of domestic refrigerator is noisy. Also it is harmful to environment. To overcome all these limitations we can use LPG refrigerator.

8. FUTURE SCOPE:

We have invented a device which can have positive effect in the field of refrigeration. The main aim is to focus on big restaurant and community program hall, mid-day meal of school so to preserve food products like vegetables, milk etc. Due to elimination of compressor and Condenser from the system, the cost of the system is minimized.

Two applications where this product can be used are as follows:

1. This product finds scope in LPG air conditioning.
2. Also this device can work effectively in desert, mines and research areas and also in the countries where the electricity supply is not available sufficiently.

9. CONCLUSION:

Our main aim was to use high pressure of the LPG gas stored in cylinder for producing cooling effect. In the process of refrigeration, adiabatic expansion of LPG takes place 100 psi to 10 psi.And due to this , thermodynamically it absorbs heat from surrounding and cooling effect can be achieved. This cooling effect can be in the range 15 to 50 degrees.

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