FABRICATION OF LOW COST REFRIGERATION SYSTEM USING LPG

A thesis report submitted to the department of mechanical engineering for the partial fulfillment of the degree of Bachelor of Science in Mechanical Engineering.

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APPROVAL

This is to certify that the project on " **Fabrication of Low Cost Refrigeration System Using LPG"** By **Yeasin al Julfikar (ID No:ME 2002021207), Md. Nasim Hossen (ID No:ME 2002021232), Md. Rakibul Islam Rony (ID No:ME 2002021233), Md. Mahmudul Hasan Rokon (ID No:ME 2002021304), Sobuj Hossen (ID No:ME 2002021323)** has been carried out under our supervision. The project has been carried out in partial fulfillment of the requirements of the degree of Bachelor of Science (B.Sc.) in Mechanical Engineering of years of 2023 and has been approved as to its style and contents.

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DECLARATION

We, here by declare that the work presented in this project is the outcome of the investigation and research work performed by us under the supervision of **Md. Minhaz Uddin**, Assistant Professor, Department of Mechanical Engineering, Sonargaon University (SU). We also declare that no part of this project and thesis has been or is being submitted elsewhere for the award of any degree.

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ABSTRACT

Refrigeration is the science of maintaining the temperature of a substance below the atmospheric temperature That is done by removing the heat from the substance that needs to be cooled. A general refrigeration system uses electricity and Chlorofluorocarbon to accomplish the task. Chlorofluorocarbon (CFC) is also contributed to the ozone depletion. As electricity is not abundant in our country, the need of an alternate to the existing system has arisen. In such case, LPG refrigeration system has proven to be an effective for remote areas such as research sites, mines, & deserts and also free of pollution. Many engineering analysis has been done in the recent years in LPG refrigeration system, but practical implication of such analysis is yet to be reported. We will investigate the performance parameters is the refrigeration effect in certain time. A LPG powered refrigeration system has been fabricated by using different components and measuring instruments. High pressure gas from LPG was regulated to low pressure and it is directly fed to the throttle valve where further drop of pressure and temperature occurs. This low temperature gas passes through the copper tube in the refrigerating chamber absorbs heat from the chamber and thus produce refrigerating effect.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 01: INTRODUCTION

1.1 Introduction

For the large demand of electricity over the world, we think of recovering the energy which is already spent but not being utilized further, to overcome this crisis with less investment. The climatic change and global warming demand accessible and affordable cooling systems in the form of refrigerators and air conditioners. Hence forth, we suggest COST FREE Cooling Systems. LPG is stored in liquefied state in cylinder before its utilization as fuel. According to the energy survey, the refrigerator is one of the heaviest power consumers among household appliances. It works on the principle that the expansion of LPG will be takes place during the conversion of liquid LPG into gaseous form.

As a result of this, LPG gas pressure drops and the volume of gas will be increase. This will be result into dropped in temperature of gas and it acts as refrigerant. According to second law of thermodynamics, this process of cooling can only be performed with the aid of some external work. Hence, the power supply is regularly required to drive a refrigerator. The substance which capable of changes of phase at low temperature, used as the working fluid of a refrigerator is called refrigerant.

Globally 17500 metric tons of conventional refrigerants is consumed by domestic refrigeration like CFC, HFC which causes high depletion if ozone layer (ODP) and Global Warming Potential (GWP). The use of LPG instead of CFC 22 has made a better progress since it has an environment friendly orientation with no ODP. Good product efficiency is resulted by the use of LPG because of its characteristics. It indicates LPG can be used as an alternative refrigerant to CFC-22 after performing the test on new system.

1.2 Proposed Method

In this modern time, the innovation is gone to a higher-level development. In this project the system is proposed to develop a low-cost refrigeration system with LPG which can able to produce cooling in a refrigeration chamber and also use this gas in cooking. The working of this project is easy to explain and less costly. This project is developed for two works at a time. Here we use LPG gas for cooling and cooking.

1.3 Objective

The objectives of this project are:

- To study about Low Cost Refrigeration System using LPG.
- To design and construct a Low Cost Refrigeration System using LPG.
- To test the performance of the Low Cost Refrigeration System using LPG.

1.4 Organization of book

The report has been organized into five chapters:

- **Chapter 1:** Discusses introduction, proposed methods and objective.
- **Chapter 2:** Description of Structural design, block diagram.
- **Chapter 3:** Description of methodology of this project and its relevant project view and description of hardware which issue in this project such as , Evaporator, Temperature Controller, Pressure Gauge.
- **Chapter 4:** Here we describe about result, discussion, advantage, limitation, application in this part.
- **Chapter 5:** Finally we discuss about Conclusion and future scope of this project.

CHAPTER 02: LITERATURE REVIEW

2.1 History

LPG (liquefied petroleum gas) refrigeration systems have a history rooted in the development of refrigeration technology. The concept of using liquefied gases for cooling dates back to the early 20th century. However, LPG as a specific refrigerant gained attention later.

In the mid-20th century, researchers explored various refrigerants due to environmental concerns with traditional options. LPG, with its low environmental impact, emerged as a potential alternative. Propane and butane, two common components of LPG, were recognized for their favorable thermodynamic properties in refrigeration.

LPG refrigeration systems became more prominent in the late 20th century, particularly in applications where other refrigerants posed environmental challenges. These systems have been utilized in small-scale refrigeration units, mobile refrigeration, and certain industrial processes.

The appeal of LPG lies in its lower global warming potential compared to some traditional refrigerants. However, ongoing developments in refrigeration technology, including the search for even more environmentally friendly alternatives, continue to shape the landscape of refrigeration systems

This low cost refrigeration system using LPG is so effective and is a safe process. It is mainly used for multipurpose use in home or industry. After it used, we will do proper use of LPG gas in two purpose at a time. That’s how we can get good efficiency. This project is very easy to use and it works very effectively and accurately. A relevant picture is added below:

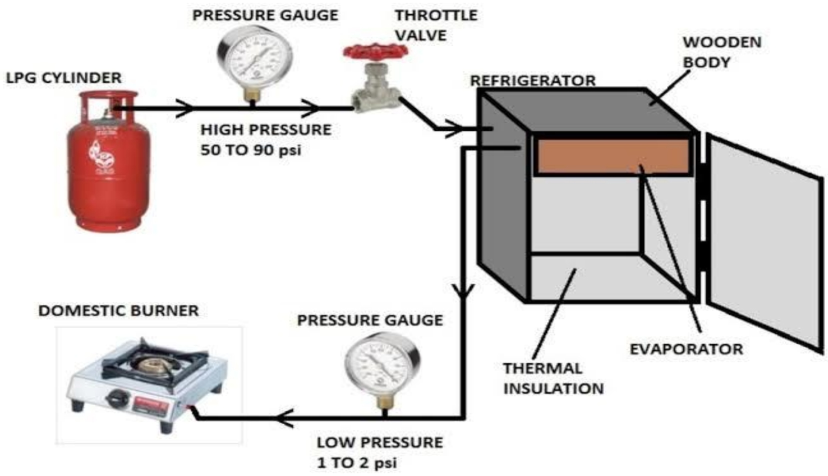


Figure 2.1: Structural System Diagram .

2.2 Block Diagram:

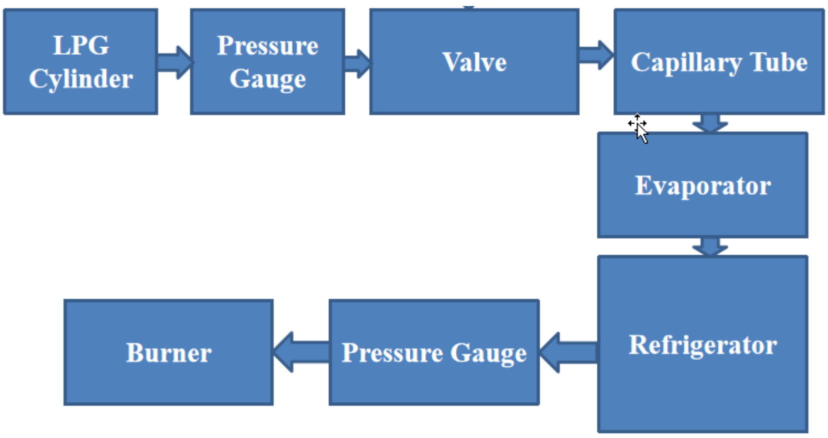


Figure 2.2: Block Diagram

2.3 Components List:

- LPG Cylinder.
- Pressure Gauge.
- Throttle Valve.
- Capillary Tube.
- Evaporator.
- Refrigerator (PVC Body).
- Burner.
- Regulator.
- Knob

CHAPTER 03: METHODOLOGY

3.1 Liquefied Petroleum Gas

Liquefied petroleum gas is a propane and butane mixture. It is a ti-carbon alkane that is in gaseous form at atmospheric pressure, but becomes a liquid at normal temperatures and low pressure. Produced from natural gas processing and crude oil refining, LPG is non-toxic, colourless and virtually odourless.

LPG is used as fuel gas in heating appliances, cooking equipment, and vehicles. It is increasingly used as an aerosol propellant and a refrigerant, replacing chlorofluorocarbons in an effort to reduce damage to the ozone layer. When specifically used as a vehicle fuel it is often referred to as auto gas.

Varieties of LPG bought and sold include mixes that are mostly propane (C3H8), mostly butane (C4H10), and, most commonly, mixes including both propane and butane. In the northern hemisphere winter, the mixes contain more propane, while in summer, they contain more butane. In the United States, mainly two grades of LPG are sold: commercial propane and HD-5. These specifications are published by the Gas Processors Association (GPA) and the American Society of Testing and Materials. Propane/butane blends are also listed in these specifications.

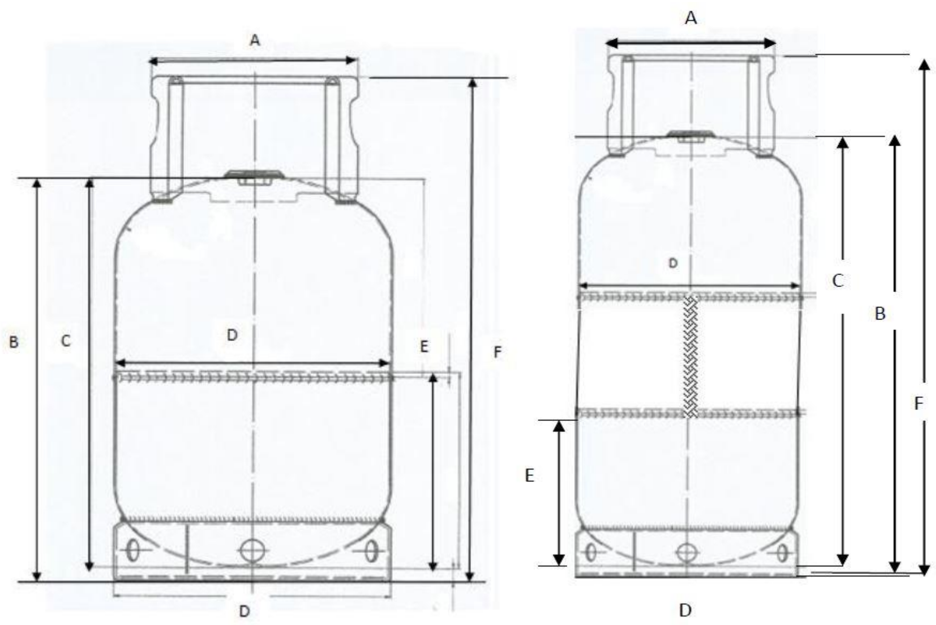
Propylene, hydrocarbons are usually also present in small concentrations such as C2H6 , CH4, and C3H8. HD-5 limits the amount of propylene that can be placed in LPG to 5% and is utilized as an auto gas specification. A powerful odorant, ethanethiol, is added so that leaks can be detected easily. The internationally recognized European Standard is EN 589. In the United States, tetra hydrotherophyte (thiophane) or amyl mercaptan are also approved odorants, although neither is currently being utilized.

Technical Specifications for Cylinder

- Service Pressure : 17 Kg/cm2.
- Hydrostatic Test Pressure : 34 Kg/cm2.
- Standard Specification : DOT-4BA-240 OR
- Equivalent Quality Control Standard : ISO 9001/ 9002.
- Internal Valve Pad Threading : ¾ inch 14 NGT.

Equivalent means other standards, which assures a technical specification of LPG Cylinder of equal or better quality than that of DOT-4BA-240. Any bidder offering Equivalent standard must be supported with Manufacturers Test Certificates to prove the equivalency in respect of manufacturing process, quality control standard, inspection procedures & standard, performance, size/ dimension and other characteristic. *Supply of LPG to domestic category consumer shall be made in 12 kg. Supply of LPG in 35 and/or45kg may also be made especially for non-domestic category of consumer. Only on special case, LPG in 5.5 kg is acceptable. Valve shall be uniform in all cases and regulator of the valve shall be capable of releasing LPG at a rate of 1/kg per hour at 30 mbar or 300 mm Water column.

Dimension:



Cylinder Capacity,		A±5	B±5	C±2	D±5	E±5	F±5
Kg LPG	WC±1, liter						
5.5(cooking gas)	12	228	270	245	300	130	385
12(cooking gas)	26	228	470	450	300	230	580
35(industrial gas)	74	228	860	840	360	#	990
45(industrial gas)	108	228	1150	1130	360	#	1285

to be reported

Figure 3.1: LPG Cylinder With Dimension

3.2 Pressure Gauge

Pressure measurement is called measuring the applied force by a fluid (liquid or gas) on a surface. Pressure is typically measured in units of force per unit of surface area like kg/cm2. Many techniques have been developed for the measurement of pressure and vacuum. Instruments used to measure and display pressure in an integral unit are called pressure meters or pressure gauges or vacuum gauges.

A manometer is a good example, as it uses the surface area and weight of a column of liquid to both measure and indicate pressure. Likewise the widely used Bourdon gauge is a mechanical device, which both measures and indicates and is probably the best known type of gauge. Burdon tube type pressure gauge is used in our project. On the other hand, A vacuum gauge is a pressure gauge used to measure pressures lower than the ambient atmospheric pressure, which is set as the zero point, in negative values (e.g.: −15 psig or −760 mmHg equals total vacuum). Most gauges measure pressure relative to atmospheric pressure as the zero point, so this form of reading is simply referred to as "gauge pressure". However, anything greater than total vacuum is technically a form of pressure. For very accurate readings, especially at very low pressures, a gauge that uses total vacuum as the zero point may be used, giving pressure readings in an absolute scale.

Applications:

- Altimeter.
- Barometer.
- Depth gauge.
- MAP sensor.
- Pitot tube.
- Sphygmo manometer

Figure 3.2: Pressure Gauge.

Working Principle of a Pressure Gauge:

Bourdon pressure gauges are widely used across industries, and they based on Hooke's law. Hooks law states that the force required to expand or compress a spring scales in a linear manner with regards to the distance of extension or compression. There is inner pressure and outer pressure. So, when pressure is applied works on the surface of the object, it is more on the inner side as the pressure area is less.

Digital pressure gauges are nowadays commonly used. In case of digital pressure gauges, the AC and DC power supplies play a major role. The switching circuit or AC is converted to DC. The measured pressure is transmitted to the sensor diaphragm which sense s the pressure, based on which an electrical signal is generated to reach to the computer or smartphone. These gauges come with a small LCD display.

Pressure gauges range from basic measuring ones to completely automated ones, which can be connected to your smartphone to send alerts. Pressure sensors are crucial components of pressure gauges. There are various types of pressure gauges in the market such as commercial gauges, general service gauges, stainless steel industrial pressure gauges, differential pressure gauges, double-sided pressure gauges, and so on. With so many choices, it is obvious to get confused.

Among various factors, the size of an application must be one of the key considerations when it comes to choosing the pressure gauges for any process. These pressure gauges need to be serviced and maintained regularly as an out of service gauge is as much a threat to the plant as not having one. So, it is always better to have few but well serviced gauges in your plant. From an accuracy perspective, installing and correct calibration of the pressure gauge are important aspects. Calibration can be a complicated task and needs to be done by experts, after considering the application requirements.

3.3 Evaporators

The Evaporation and vaporization are two processes in which simultaneous heat and mass transfer process occurs resulting into separation of vapor from a solution. Evaporation and vaporization occur where molecules obtain enough energy to escape as vapour from a solution. The rate of escape of the surface molecules depends primarily upon the temperature of the liquid, the temperature of the surroundings, the pressure above the liquid, surface area and rate of heat propagation to product.

Working Principle of Evaporator and its Types

The basic function of an evaporator in the refrigerator system is to remove the heat from the water, air, and other substances present in the refrigerator. The evaporators of refrigerator systems act as a heat exchange which helps in transferring the heat from the substance and make it cool by means of refrigerant. The refrigerant either boils as it flows through a pipe, tube or other type of space so that liquid is continuously wetting all the inside surface or it boils in a shell around submerged tubes through which the fluid to be cooling is flowing. Various methods are used for evaporators, depending upon the refrigerant to be used and evaporator application, but iron, steel and copper predominate. Refrigerant evaporators should be of extended surface or finned tube type whatever practical. In order to keep the average surface temperature down, a good bond between the fin and tube is essential. Integral fins formed out of the tube itself are best in this respect and give the best heat transfer rate.

Type of evaporators based on operating condition

- Flooded type evaporator.
- Dry or direct expansion type evaporator.

Type of evaporator based on construction

A. Bare tube evaporator.
B. Plate tube evaporator.
C. Finned tube evaporator.
D. Shell tube evaporator.
E. Tube in tube evaporator.

Bare tube evaporators: Bare tube evaporators represent a straightforward and uncomplicated form of evaporator design. Essentially, they consist of refrigerant tubes constructed from materials such as copper or aluminium. The tubes are filled with refrigerant, and as air passes over them, the refrigerant absorbs heat from the surrounding air and undergoes vaporization within the tube.

These evaporators are characterized by a structure comprising multiple turns of tubing. Their simplicity makes them well-suited for applications involving liquid chilling. In the context of blast cooling and freezing operations, atmospheric air is directed over the bare tube evaporator. The chilled air that exits the evaporator is then employed for cooling purposes. The bare tube evaporator functions as a vital component in the refrigeration cycle, facilitating the extraction of heat from the desired space or substance. Its design and usage make it particularly efficient for certain cooling applications, where its simplicity and direct heat exchange properties prove advantageous.

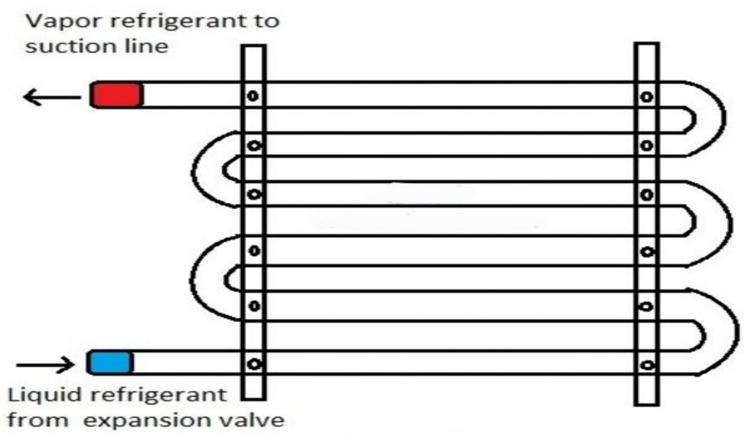


Figure 3.3: Bare Tube Evaporator

Plate evaporators: A plate Evaporator is a type of evaporator in which a thin film of liquid is passed and flows between the plates for the process of evaporation. The Plate Evaporators are also known as the gasket plate and frame evaporators. In plate type evaporators, the coil usually made of copper or aluminium is embedded in the plate so as to form a flat looking surface. Externally the plate type evaporator looks like single plate but inside it, there are several turns of the metal tubing through which the refrigerant flows.

The advantage of plate type evaporator is that they are more rigid as the external plate provides lots of safety. The external plate also helps increasing heat transfer from metal tubing to the substance to be chilled. These type of evaporators are ea sy to clean and can be manufactured cheaply. They can be converted into box shape, partitions or shelves as required for different purposes. Due to various advantage and flexibility offered by plate type evaporator, they are used extensively.

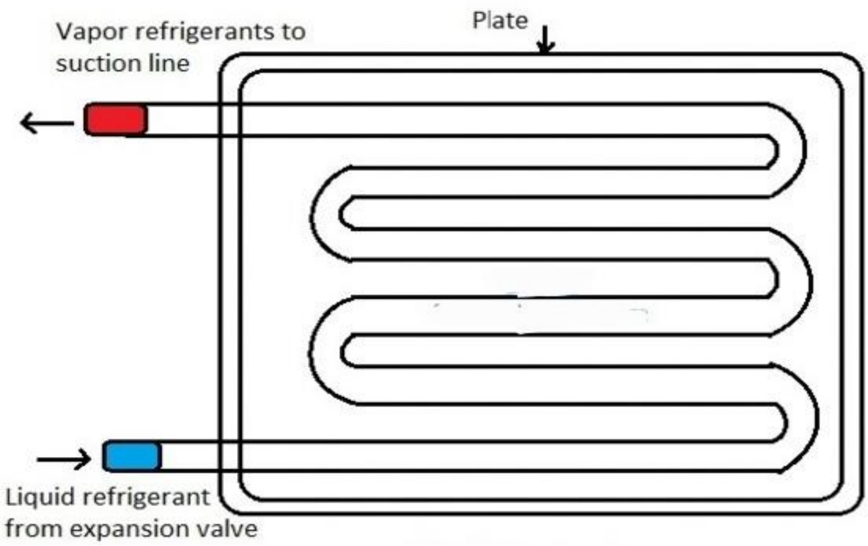


Figure 3.4: Plate Evaporator

Finned tube evaporator: Finned evaporators are bare tube evaporators that have been coated with fins. When the fluid (air or water) to be chilled flows over the bare tube evaporator, lots of cooling effect from the refrigerant goes wasted since there is less surface for transfer of heat from fluid to refrigerant. The fins on the finned tube evaporator increases contact surface area and increases heat transfer rate. Thus finned evaporators are more effective than bare tube evaporators. For fins to be effective, it is very important that there is good contact between coil and the fins.

In some cases, fins are soldered directly to surface of the coil and in other cases, the fins are just slipped over the surface of tubes or coils. The finned evaporators are most commonly used in the air conditioners of almost all type like window, split, packaged and central air conditioning. In this system, finned evaporator is known as cooling coil. The hot air flows over finned evaporator for cooling. To increase effectiveness of heat transfer from evaporator, the tubing are also given internal fins. These fins are made by forming different internal cross section shapes at the time of manufacturing of tubing.

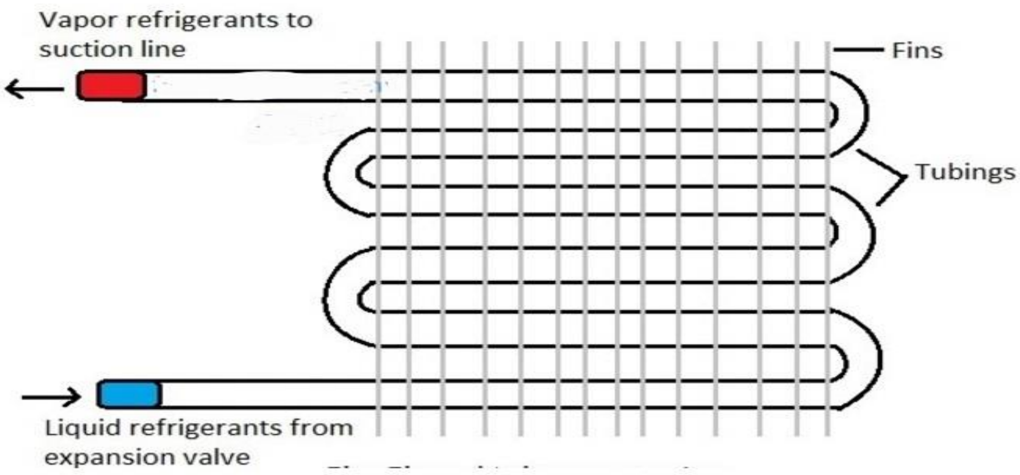


Figure 3.5: Finned Tube Evaporator.

3.4 Digital Temperature Meter

A thermometer is a device that measures temperature or a temperature gradient (the degree of hotness or coldness of an object). A thermometer has two important elements: a temperature sensor (e.g. the bulb of a mercury-in-glass thermometer or the pyrometric sensor in an infrared thermometer) in which some change occurs with a change in temperature; and some means of converting this change into a numerical value (e.g. the visible scale that is marked on a mercury-in-glass thermometer or the digital readout on an infrared model). Thermometers are widely used in technology and industry to monitor processes, in meteorology, in medicine, and in scientific research.

Some of the principles of the thermometer were known to Greek philosophers of two thousand years ago. As Henry Carrington Bolton (1900) noted, the thermometer's "development from a crude toy to an instrument of precision occupied more than a century, and its early history is encumbered with erroneous statements that have been reiterated with such dogmatism that they have received the false stamp of authority." The Italian physician Santorio Santorio (Sanctorius, 1561-1636) is commonly credited with the invention of the first thermometer, but its standardization was completed through the 17th and 18th centuries. In the first decades of the 18th century in the Dutch Republic, Daniel Gabriel Fahrenheit made two revolutionary breakthroughs in the history of thermometry. He invented the mercury-in-glass thermometer (first widely used, accurate, practical thermometer) and Fahrenheit scale (first standardized temperature scale to be widely used).

Figure 3.6: Digital Temperature Sensor

Specification

- Temperature range: -50~ +110°C
- Using environment: Temperature: -5~ +50°C Humidity: 5%~80%
- Accuracy: ±1°C
- Size: 47*28*14mm
- Weight: 22g
- Colour: Black and white

Working Principle:

The Digital LCD Thermometer likely operates based on a temperature sensor, such as a thermistor or an integrated temperature sensor. These sensors change their electrical properties in response to temperature variations. This device measures these changes and converts them into a digital signal. The working principle involves the following steps: Temperature Sensing: The built-in sensor in detects the temperature of the environment by responding to changes in electrical resistance or voltage as temperature changes.

Signal Processing: The analog signal generated by the temperature sensor is converted into a digital signal using an analog-to-digital converter (ADC). This digital signal is then processed by the internal circuitry of the thermometer.

Display: The processed digital signal is finally displayed on the LCD screen. The LCD (Liquid Crystal Display) is used to visually represent the temperature in a human-readable format.

Power Supply: The device is likely powered by batteries or an external power source, providing the necessary energy for the sensor, processing circuitry, and the LCD display to function.

In summary, the Digital LCD Thermometer works by sensing temperature through a dedicated sensor, converting the analog signal to digital, processing it, and then displaying the result on an LCD screen for easy interpretation.

3.5 Throttle valve

The throttle valve is a mechanical device whose function is to regulate and maintain the downstream pressure so that the inlet conditions for the expansion are constant. It does this by introducing a flow restriction, inducing a significant localized pressure drop in the fluid. Throttle valve reduces the pressure of high pressure liquid refrigerant to ensure the pressure difference between condenser and evaporator and make the liquid refrigerant in the evaporator evaporate and absorb the heat under low pressure, and finally achie ve the purpose of cooling. Secondly, the throttle valve can adjust the flow of refrigerant into the evaporator to adapt to the change of the heat load of the evaporator, so that the refrigeration device can work more efficiently.

Commonly used throttling mechanism has the following

a) Manual type expansion valve.
b) floating ball type expansion valve.
c) thermal expansion valve.
d) capillary expansion valve.

A) Manual type expansion valve: The manual type expansion valve shares a structural resemblance with the conventional stop valve, featuring a similar outer appearance. However, a notable distinction lies in its valve core, which takes the form of a needle-shaped cone or a cone with a V-shaped notch. This specific design of the valve core is crucial for its primary function in regulating the flow of fluid within a system.

The needle-shaped cone or the cone with a V-shaped notch is strategically engineered to enhance precision and control over the expansion process. The intricate design allows for a more nuanced adjustment of the valve opening, facilitating accurate modulation of fluid flow rates. This level of precision is especially critical in applications where precise control over temperature or pressure is essential.

Moreover, the outstanding characteristic of the manual type expansion valve is its inherent resilience to breakdowns. This reliability stems from the robust construction of the valve core and the materials used in its fabrication.

The needle-shaped cone or the V-shaped notch is crafted from durable materials, ensuring long-term durability and resistance to wear and tear. In practical terms, the valve's ability to resist breakdowns contributes to the overall efficiency and reliability of the system it is a part of. This reliability is particularly advantageous in industrial settings, where continuous and stable operation is imperative. The manual type expansion valve, with its intricate design and durability, stands as a dependable component in fluid control systems, offering precise regulation and prolonged service life.

Figure 3.7: Manual type expansion valve.

B) Floating ball type expansion valve: The floating ball type expansion valve serves as a crucial component primarily employed in full liquid evaporators. These evaporators necessitate a specific liquid level height, aligning perfectly with the operational features of the floating ball type expansion valve. This valve plays a pivotal role in regulating the flow of liquid refrigerant within the evaporator system.

There are two distinct configurations of the floating ball type expansion valve based on the flow characteristics of the liquid refrigerant. The first is the straight type, characterized by a linear flow path for the refrigerant. In contrast, the second type is the no-straight type, indicating a more complex and non-linear flow pattern for the liquid refrigerant.

In essence, the design and functionality of the floating ball type expansion valve cater to the specific requirements of full liquid evaporators. Its ability to control the flow of refrigerant, combined with the adaptability to different flow patterns, enhances its effectiveness in maintaining optimal conditions for the evaporator's operation. This detailed categorization of the valve types reflects the nuanced considerations in selecting the appropriate expansion valve for diverse refrigeration applications.

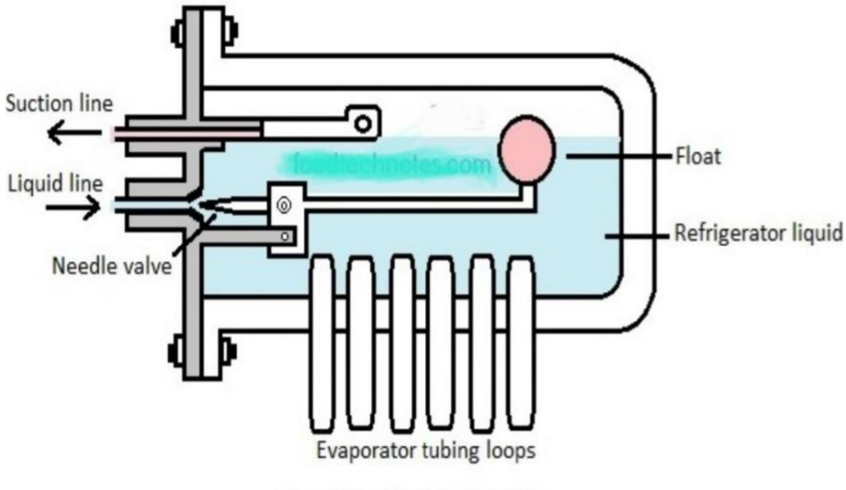


Figure 3.8: floating ball type expansion valve.

(C) Thermal expansion valve: The thermal expansion valve serves as a critical component in refrigeration systems, specifically tasked with regulating the flow of refrigerant into the evaporator. Its primary function involves controlling the degree of superheat of the refrigerant at the outlet of the evaporator. This valve finds extensive application in air conditioning and low-temperature systems, particularly in non-full liquid evaporators, with a notable prevalence in Freon refrigeration systems.

One key parameter that significantly influences the performance of the thermal expansion valve is its capacity. This capacity is contingent upon several important factors, with the most notable being the pressure differential before and after the expansion valve. The disparity in pressure levels plays a pivotal role in determining the efficiency and effectiveness of the valve's operation.

Additionally, the evaporation temperature is another critical factor impacting the capacity of the thermal expansion valve. As the temperature at which the refrigerant undergoes evaporation varies, it directly influences the overall capacity of the valve to control and regulate the flow of refrigerant within the system.

Furthermore, the supercooling degree of the refrigerant is a vital consideration in understanding the thermal expansion valve's capacity. The extent to which the refrigerant is cooled beyond its saturation point affects the valve's ability to precisely modulate the flow, ensuring optimal performance and system efficiency.

In summary, the thermal expansion valve plays a crucial role in managing refrigerant flow and superheat in non-full liquid evaporators. Its capacity, a key parameter, is intricately tied to factors such as pressure differentials, evaporation temperature, and the supercooling degree of the refrigerant, collectively contributing to the efficient operation of air conditioning and low-temperature systems.

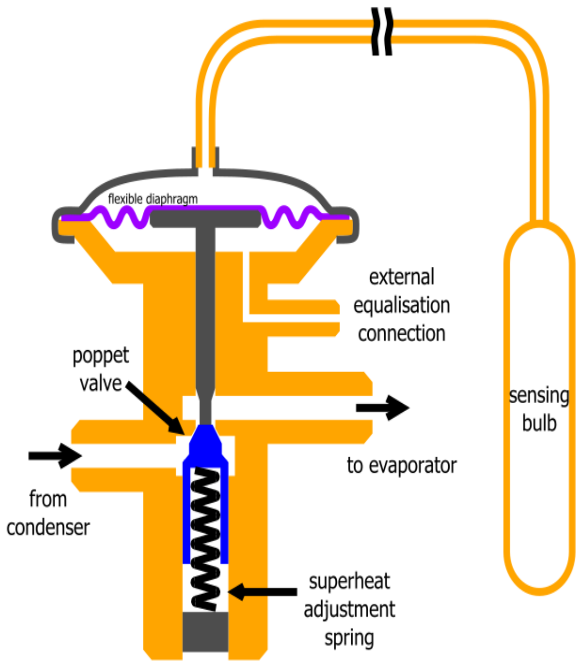


Figure 3.9: Thermal expansion valve with Cross Section View

(D) Capillary expansion valve: The capillary expansion valve operates on the fundamental principle that "liquid is easier than air to pass." This valve type leverages a capillary tube, and while it boasts certain advantages, it also comes with inherent limitations.

The capillary expansion valve is characterized by a simple structure, devoid of any moving parts. This simplicity not only contributes to its ease of manufacturing but also results in a cost-effective solution for refrigeration systems. Additionally, the capillary valve is known for its frugality in terms of refrigerant usage, making it an economical choice for various applications.

However, a notable drawback of the capillary expansion valve lies in its poor regulation performance. Due to its design and lack of sophisticated components, this type of valve struggles to adapt effectively to fluctuations in working conditions. Unlike some other expansion valves, the capillary valve lacks the capability for adjustment based on varying operational parameters. This limitation can pose challenges in maintaining precise control over the refrigerant flow and temperature regulation in response to changing environmental or system conditions.

In summary, while the capillary expansion valve offers simplicity, affordability, and minimal refrigerant consumption, its deficiency in regulation performance and the inability to adjust to fluctuations in working conditions may limit its suitability for applications that require more precise control over refrigeration processes.

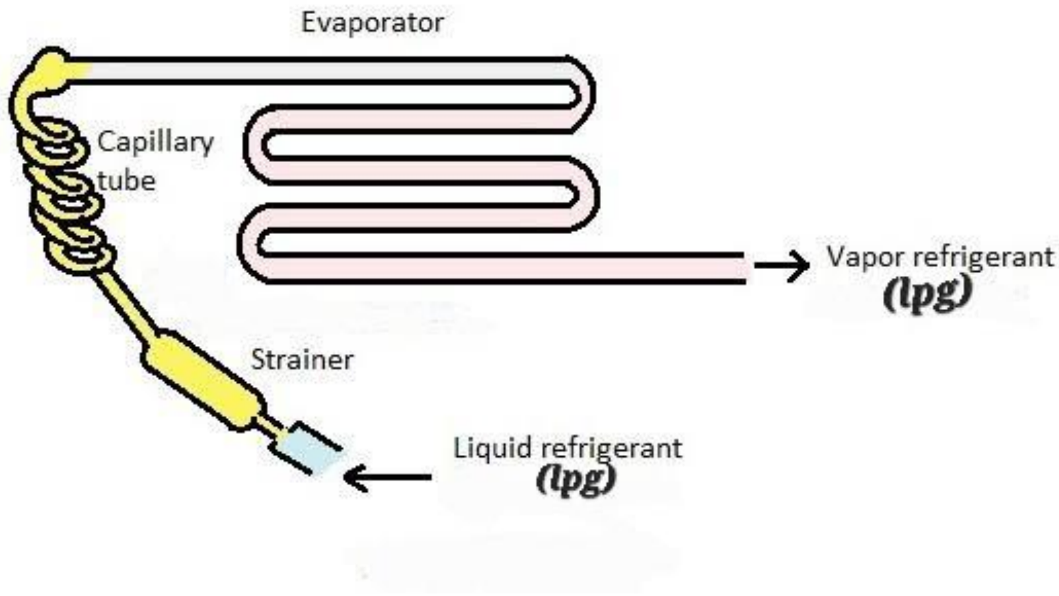


Figure 3.10: capillary expansion valve.

3.6 Methodology

The methodology for this project involves a systematic approach to the design and construction of a low-cost refrigeration system utilizing LPG (liquefied petroleum gas) as the refrigerant. The step-by-step process is outlined below:

- Developing / creating an idea Fabrication of a low cost refrigeration using LPG as refrigerant.
- Drawing and listing of components/materials to know which components / materials need to construct it.
- Collecting the all components / materials for construct the refrigeration system.
- Finally, we constructed this system with maintaining all safety & checked it.
- We found that its works very well.

3.7 Complete Project Prototype Image

Figure 3.11: Complete Project Picture (Front View).

Figure 3.12: Complete Project Picture (Side View)

3.8 Working Principle

Various components are used to complete this project. They are Pressure Gauge (Burdon tube),throttle valve, Evaporator, Regulator and digital Temperature meter etc. LPG from cylinder are flows inside of evaporator and produce cooling. High pressure LPG was discharged through the high pressure pipe from the LPG cylinder. A pressure gauge was use to regulate the pressure.

This LPG was directly fed to the throttle valve from the high-pressure pipe. The high-pressure gas from the cylinder was expanded to a low pressure and low temperature in this process. The process was carried out by using a capillary expansion valve. This low temperature gas was passed through the copper tube in the refrigerating chamber that absorbs heat from the substances placed inside the chamber, and thus produces a refrigerating effect.

The gas that was coming out of the chamber was directly fed to the burner. The insulating material used in refrigeration chamber helps in storing the cooling effect for a longer period of time. We have a digital temperature meter that allows us to monitor changes in temperature over time.

3.9 Cost Analysis

Sl. No.	Product name	Specification	QTY	Unit price	Total price	Market price
1	LPG cylinder	Nano	1	2000	2000	
2	Pressure sensor	Burdon type	2	650	1300	
3	Throttle valve	Capillary type	2	450	900	
4	Temperature Meter	DC	1	500	500	
5	Evaporator	HC SR04	1	2500	2500	
6	Burner	Domestic	1	1000	1000	
7	Miscellaneous				2500	
				Total	10700৳	15000৳

Table 01: Cost Analysis.

CHAPTER 04: RESULT AND DISCUSSION

4.1 Result

After followed all objectives and plan to build our project. We finally establish our project. In this project first we create our project circuit with sufficient equipment. All the setup is working well with our accurate implementation and plan.

Serial No.	Hour	Gas Pressure (psi)	Starting Temp. (°c)	Decrease Temp. (°c)	Last Temp. (°c)
Data 01	1 Hour	50**(psi)**	30**(°c)**	5**(°c)**	25**(°c)**
Data 02	After 2 hour	50**(psi)**	25**(°c)**	7**(°c)**	18**(°c)**
Data 03	After 3 hour	50**(psi)**	18**(°c)**	6**(°c)**	12**(°c)**

Table 02: Result Analysis of this Project

4.2 Discussion

The low cost refrigeration system using LPG works accurately, effectively and makes refrigeration system process easy, more precise and reliable and is more advantageous than the conventional methods reducing cost. LPG gas is cheaper than R134a gas because R134a is only use for refrigeration system but we will use LPG gas cooking and refrigeration system at a time.

The proposed prototype allows achieving an economical and a low cost automation. This refrigeration system can be made flexible according to the industrial needs.

This system also can be made with Arduino Uno, relay and temperature control system to automatically control temperature. But here we use a digital temperature meter which is reduce the cost so we use this temperature meter to measure temperature in this system. LPG gas is cheaper than R134a gas because R134a is only use for refrigeration system but we will use LPG gas cooking and refrigeration system at a time.

4.3 Advantage

- LPG is not OFF consumed during cooling process, only expanded and further used for cooking, as automobile fuel or for any industrial purposes.
- In this process, Cooling is free of cost as no electricity is needed for operating the refrigerator.
- The product is a green technology and is eco-Friendly, as if eliminates the use of ozone depleting refrigerants.

4.4 Application

The project has a major application in the:

- The system can universally be used in industrial central cooling and domestic refrigeration and air conditioning as well.
- It can be used in automobiles running on LPG or other Gaseous fuels for air conditioning.
- On the other hand the technology if implemented in heavy utility vehicles or transportation, it would help in distant transportation of eatables as the refrigeration system inside the vehicle and the cost of running the vehicle can be borne simultaneously.
- Cooling and storage of essentials in remote areas and in emergency vehicles, such as storage of essential bio chemicals, injections, etc. In an ambulance, is easily possible.

4.5 Limitation

It is a demo project so we found some limitation. In future we will work for reduce this kind of limitation. These limitations are:

- LPG refrigerators might have lower efficiency compared to electric ones.
- We use it in a fixed size refrigeration system.
- LPG is flammable, posing safety risks if not handled properly.
- There was no gas leakage system for protection.
- There is all manual controlling system.

CHAPTER 05: CONCLUSION

5.1 Conclusion

The utilization of LPG as refrigerant source and utilization of the energy of the high pressure in the cylinder for producing the refrigerating effect was experimentally studied in the current work. The main objective of this project was to develop a low cost refrigeration system based on certain specifications. This was successfully implemented. We consider this project as a journey where we acquired knowledge and also gained some insights into the subject which we have shared in this report. In a LPG refrigeration system capillary tube is more adjustable and better device. The initial and running cost of this LPG refrigeration system is really less. No outside energy source is required to run the system. This LPG refrigeration system has wide scale application in hotel industries, chemical industries where the LPG consumption is at a higher level.

5.2 Future Scope

The model can be improved by making some changes in the program and components. Some suggestions are given below:

- In future we will adding IOT system for online controlling ad monitoring purpose. IOT refers to the network of interconnected devices that can communicate and exchange data with each other over the internet.
- In future we will try to use it widely in our daily life. Al most every house of Bangladesh in rural area now a days has been using LPG for cooking purpose. So this project will help those people for saving electricity.
- In future we will adding a gas leakage diction system. If there will be any leakage in gas pipe then it will make an alert before getting any unwanted situation.

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