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DESIGN AND FABRICATION OF POLYETHENE BAG SEALING AND CUTTING MACHINE

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Abstract

Polyethene bags have become indispensable daily and are utilised in various industries for packaging and storage. The efficiency and quality of these bags greatly depend on the sealing and cutting processes during manufacturing. This review provides a comprehensive overview of polyethene bag sealing and cutting machines, focusing on their design, operation, and applications. The review begins by highlighting the importance of polyethene bags in today's world, underlining the need for advanced machinery to ensure reliable sealing and precise cutting. The review also explores the recent technological advancements in this field, including incorporating digital controls and automation for enhanced efficiency and precision. The applications of these [redacted]

machines across industries, such as food packaging, medical supplies, and retail, are explored, emphasising their role in ensuring product safety and shelf-life extension. Additionally, environmental considerations related to the use of polyethene

Keywords: Fabrication, Polythene Bag, Cutting Machine, Sealer Machine, Sequence of Operation.

bags and the sustainability of sealing and cutting processes are discussed. Finally, prospects in developing polyethene bags, sealing and cutting machines are highlighted, focusing on emerging technologies, eco-friendly materials, and the potential for increased automation. The comprehensive overview in this review aims to assist researchers, engineers, and industry professionals in understanding these machines' significance and role in the modern packaging industry.

Introduction

The portable sealing machine is one of the most important fabrications of engineers of the 20th century; the achievements led to sweet relief for agriculturists, industrialists, marketers, etc. For this purpose, the production of agricultural and industrial goods that need appropriate attention for packaging and storage has been on the increase. Previously, the packaging system used paper, clothing material, etc. These methods are either given way to the cellophane packaging system. Different types of packaging systems emerged owing to the invention of which cellophane packaging and sealing are the most commonly used (Hall, 1989). Polyethylene is used in packaging goods like ice cream, umbrellas, exercise books, pure water, beverages, weavon, packet shirts, bread, biscuits, etc. The following properties of polyethene possess the reasons for its variety of purposes: how, cost of production, inertness, resistance to acid, and corrosion water. The use of polythene cannot be overemphasised. Most food packaging is hygienic. The technology of cellophane permits raw materials of textile industries to be carried with sealed polyethene, and the finished products are either marketed or exported with polyethene packaging. Most utensils are packaged with polyethene. Special polyethene materials have been invented recently that have shock absorbers, which protect breakable material. Since this packaging came up, therehas been a safer conveyance of glass and ceramics materials, especially for transporting and exporting finished goods (Hishinuma, 2009). Also, it is in the packaging of most electronic gadgets, which includes computers, amplifiers, calculators, radios, TV sets, etc., for safety purposes. It would be needless to talk about polyethene without talking about the machines used in sealing generally. Some of the machines used in the industries include cellophane sealing machines used in sealing polyethene materials, pneumatic, electrical sealing machines handled by the electrical heaters and needlepoint action and hand sealing (Dperry & Chilton, 2005).

History of Sealer Machine

Polyethylene bag sealing and cutting machines have been in use for several decades. The history of these machines dates back to the mid-20th century when polyethene bags became widespread in the packaging industry.

In the early days, polyethene bags were made by cutting them manually. However, this process was time-consuming and labour-intensive, which led to the development of a machinethat could automate the process. The first bag-sealing machine was designed to seal the bag using heat. These machines were equipped with a heating element that would melt the edge of polyethene bags, sealing them shut. However, these machines were very efficient and required many operation skills to produce good seals (Nwajei, 1998).

Sealing Machine Component

A good design can be produced by studying each material used. In order to produce the best design, studies on the principal component should be done. The sealer machine component is as follows: Plain Bearing, Pvc, Iron rod, Control speed, Impulse sealer, One-way switch, Drilling machine, Nut and Screw.

Materials For Fabrication and Their Properties

Engineering materials include wood, metal, rubber and ceramics. Wood is one of the earliest engineering materials. It has a complex structure and is mainly compounded with cellulose and lignin. Some 15% of wood structures comprise starch, resins, gums, wares, tannins, and little organic acid.

In fabrication, there are two types of wood: hard and softwood. Hardwoods are deciduous woods. They are dicotyledons, and they have board leaves. Their seeds are in an enclosed structure and have widely varying properties. Examples include Mahogany, Oak Abara, white and Black Afara and Iroko. Examples of softwood are somidoloro fir and pines. Brady (G. S., R.H. & J. A, 2002). In comparison, the distinguishing features between hardwood and metal from other Engineering materials by considering their physical/mechanical properties is that metal is opaque and can be polished to give a solid surface. Most metals are considerably heavier than other Engineering materials, although some ceramics, like concrete, rock, and glass factory bricks, are heavier than some very light metals like magnesium. Metals are of two broad groupings: ferrous and non–ferrous metals. Examples of ferrous metals are iron, alloy steel, stainless steel, and tool steel, and brass, copper, zinc, etc. are examples of non–ferrous metals. Non-ferrous metals are classified according to their special properties and how they occur. This can be summarised as follows:

Classification	**Elements**
Heavy	Copper, Nickel, Lead, Zinc and Tin
Light	Aluminum, Mg, Be, Lit, Ca, K.
Noble	Gold, Silver, Platinum, Indium.
Minor	Antimony, Cadmium, Mercury
Refractory	Molybdenum, Tantalum, Vanadium
Rare - Earth	Scandium, Lanthanum.
Ferro – Alloy	Chromium, Manganese.

Selection of the fabrication materials

In engineering fabrication, one needs to know and understand the machine's operation function before understanding the material's properties to be fabricated and constructed. In the engineering school, selecting materials for fabrication is an essential part of the design. In general, the selections of engineering materials are based on specific criteria, which include cost of materials, mechanical strength (toughness and hardness), corrosive resistance, heat conductivity, electrical conductivity, portability, etc. In this project, hardwood was used to build the machine case box containing the transformer and other electrical components. The use of hardwood is preferable to that of softwood to ensure maximum protection of its content. The structure of the polyethene bag sealing and cutting machine was made of mild steel, which is preferably used because of its properties. (Kundig 2002).

The Elements: This is one of the most electrical components of the machine. It is usually made of an alloy of two elements (Nickel and Chromium). The manufacturing of this alloy is based on the idea that when current passes through a resistance wire, most of the electrical energy is transformed to heat energy, therefore causing a heating effect in this machine that seals and cuts a polyethene bag. The element is connected to the two output terminals of a step-down transformed, which supplies the needed current for the heating effect of the element. The heat is used to seal and cut the polyethene bag without leakage.

The Transformer: Generally, a transformer is an electrical set device used to step up and down current. This project used a step-down transformer to construct the machine's electrical part. It comprises the primary and secondary coils. The input (primary coils)has 600 turns and receives current from the output terminals, while the output (secondary coils) has just 30 turns and gives current to the element through the connectors.

The Regulator: Based on the advancement of technology, regulators are now used to regulate the period of heating of the element. This is achieved by regulating the current flow period from the transformer's output to the element with the help of mutual communication and understanding between the regulator and the microswitch (contractor). This regulator isconnected to the transformer's input terminals.

The Micro Switch: This works in conjunction with the regulator to regulate the element's heating period. When it closes, the current passes from the secondary coil to the element, but when it opens, the current stops, and the heating stops. The microswitch is connected to the regulator's two extra terminals.

The Taphlon Tape: This covers the element's surface to ensure smooth sealing of the polyethene bag.

The Formica: This synthetic polished material gives a beautiful finish to the fabricated material. It also protects the woods, water penetration, insect attacks, etc.

The Chain: The Pedal chain is used for depression to bring the element in contact with the nylon to seal and cut.

FABRICATION SPECIFICATION

The size of the electrical sealing machine is in such a way that it is portable to handle because of its lightweight. The rectangular shape chosen for this fabrication is for optimum fabrication construction. The rectangular box is of length 164mm, width 68mm, and height 214mm. The heating element is 135mm long with a thickness of 0.5mm, while the flat rubber is 335mm long on the depreciation lever for cutting or sealing and a width of 25mm. The foam is 143mm long with a width of 35mm. The transformer consists of a primary and secondary coil. The primary coil has several turns, 600 turns, and the secondary coil has 30 turns.

Calculations

$V = 1R$ (1)

$P = 1V$ (2)

Where P = Power

I = Current

R = Resistance

By substitution

$P = I2R$

Therefore, the electrical power varies with the current.Rectangular box

Length = width =, height

Volume = length x width x height = 164 x 68 x 214

= 2, 386, 528cm3.

SEQUENCE OF OPERATION

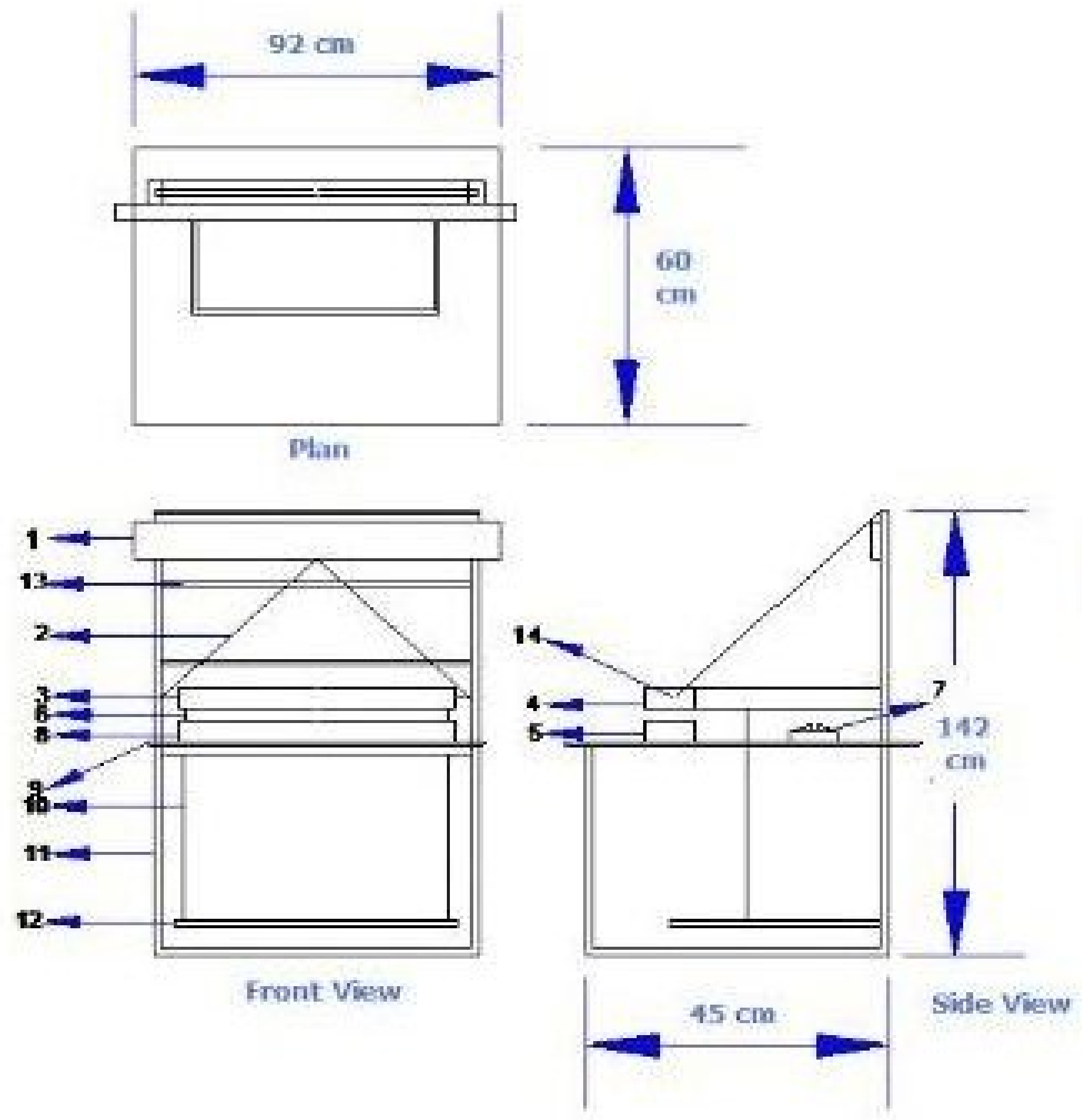
S/N	OPERATION	EQUIPMENT USED	DESCRIPTION OF OPERATION	REMARKS	TIME
1	Engineering drawing of the Machine.	Drawing sheet, pencil, tracing paper and eraser.	This involves the putting of the conceived structure of the machine in drawing form to aid the fabrication of the machine. We drew the orthographic views, which includes the front elevation, pan and side elevation with all the dimensions specified in the drawing.	Based on the Experience encountered we Enjoyed Practicing drawing.	4 hours
2	Measuring and making out.	Measuring tape, scribers and try Square.	After the materials needed for the project have been purchased, from the market, a measuring tape calibrated in meter was used to measure out all the components parts required, as shown in Engineering drawing with the specified Dimensions. When a part is measured, the marking out was done with the help of thescriber, which gives distinctive mark on metal face.	It was a Successful experienced and well taken.	3 hours
3	Cutting	Hacksaw, File vice try square and chisel	When the marking out was completed, the hacksaw was used to cut out the angle bar according to the market. The	Despite the hard nature of this operation, it was exciting.	3 Hours

			bars were clamped on the vice while cutting. After this, files were used to smoothen the rough edges of the angle bars. Also, while cutting, try square was used to check squareness before the cutting was done a little way from the required point; they filled to the exact point. The cutting of other parts was also done in the same way.		
4	Drilling	Hand drilling machine 6mm drill bit.	A hand drilling machine of drill bit 6mm was used to drill holes in the pedal and the frame structure to accommodate the pedal mechanism, which comprises two extension springs and two supporting rods.	Satisfactory	1:45 Mins
5	Assembly	Try square, welding electrode (3.2mm) welding machine grinder	After cutting off the parts, there was a need to assemble the parts together, which was done by welding. The squareness of the bars to be formed and were first checked. We first all tacked the joints, using a lower amperage of 80 – 100 for the weld, and then finally, we welded with 120 – 150 amperage so that it would have much weld deposit.	We observed the following precautions While welding, wear safety goggles.	2 hours
6	Frame pedal assembly	Welding machine, electrode guage (12), two rods	The pedal was connected to a frame structure by two supporting rods, which were	It was very successful	1:45 Mins

			welded on the frame structure on both ends of the rods. A return spring was used to connect the pedal also to the frame to return it to its original position after depression.		
7	Connection of the electrical components of the machine	Connecting wires, ammeter and soldering iron	The different electrical components of the machines include transformers, micro switch, etc., were connected using wires and connected using wires and connectors, so as to form a circuit. The wires were joined together by lead, using soldering iron.	Satisfactory	1:30 Mins
8	Painting	Brush, point and cylindrical tins.	The brush was used by dipping it into the cylindrical tin containing paints. After dipping it, then rub it on the machine until it gives a smooth and shiny colour to your desire.	It was very satisfactory	2 hours

Description of A Simple Polyethene Sealing and Cutting Machine

A typical polyethene bag is divided into Mechanical and electrical sections. The mechanical comprises the frame structure and the lever and pedal mechanism, while the electrical section comprises the element, transformer, timer, mero switch and indicator light. Generally, the simple polyethene bag sealing and cutting machine has a rectangular shape with four legs to support it up to a comfortable level above the ground. This structural shape creates a way for parts and components of the machine to be assembled. The top end of the machine is covered with a board on which the element is located; the leg stand of the machine is located between the springs and pedal mechanism for controlling the down (reciprocating) movement of the top frame level, which, when at its lowest level, presses hard on the element for effective cutting and sealing.



Polyethene bag sealing and cutting machine

Face board, Rubber bend, Nail hook, Arm, Asbestos, Twine, Regulator switch, Foam Strip, Sealing platform, Twine, Metallic Frame, Pedal, Crossbar, and heating element.

Results and Discussions

In this study, the automated filler and sealing parts are constructed separately. After successful construction, these two parts are assembled with the conveyor belt. Performance results show that all parts of this sealing system work as desired. Also, it can seal any polythene bag. Automated filler and sealing parts are shown in the three figures below, respectively.


Final Construction of Sealing System **Power Consumption Per Seal**

For cost analysis, we have to determine the cost for each seal. Here, current flow, $I = 3amp$

; the resistance of the $wire = 6000\,\Omega$ time. $t = 1\ hour$

Power, $P = I^2Rt = \frac{9\times6000\times1}{1000} = 54$kw/h

Each seal requires 2.6s. So seal/hour $= \frac{3600}{2.6} = 1385$ piece Power consumption per seal.

$= 54/1385 = 0.038\ kW.$

The experimental results clearly show the massive gap between manual and automatedprocesses. The initial setup cost might be higher for the automation system, but in the long run, it is more cost-effective as it eliminates the labour cost permanently. The payback period is short, and the setup cost will soon be recovered. The automated polythene bag sealer process has been successfully developed, is eligible for industrial use, and has a high sealing rate. Though this process best suits small bags, large bags can also be sealed. With power consumption on the higher side of 0.038 kW/seal in the industry, it has room for improvement. The automated polythene bag sealer has a great application in many packaging industries: food production, limp material (cotton), small packaging, and many more. The demand for this product will only follow an upward graph for its limitless application.

Conclusion

From the discussion of the Polyethene cutting and sealing machine, it is evident that the sealing machine was fabricated/constructed with both metallic materials. Metallic materials used were heating elements, screws, and copper wires, and some non–metallic components used are rubber, wood Formica, Tapelon etc. The machine can seal 600 – 1200 bags per hour, making it highly useful in our daily sealing. The machine seals and packages low-density material of (8 – 9) microbead polyethene. If the maintenance regulations are kept properly, the machine will go a long way in alleviating the problems we have been having, partly due to packaging. With the new trend in technology, the initial problem of getting overheated during operation for a long duration is taken care of by the timer, which controls the amount of electric current that enters the system.

Recommendation

After due analysis of the polyethene cutting and sealing machine, it is found that introducing these products to the market and various production industries will stabilize the price of commodities due to the low cost of production and running of the machine with high taste satisfaction. We have to recommend future research on the fabrication/construction of the sealing machine because of the following reasons.

A multiple-purpose machine can be produced for longer production and has electrical heating elements, such as the feeder, receiver, counter, etc. With such a machine, millions of sealed bags can be produced daily for exploration. This can help the economy grow. In future fabrication/construction, the element Sharpton should be arranged in such a way that it should have three elements: the first will be sealing, the second will be cutting, and the third will be equally bagging. This can also enhance production.

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