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Housing Design and Flame Sensing of Gas Yarn Singeing Machine

A Project Report

Submitted by

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KUMARAGURU COLLEGE OF TECHNOLOGY

COIMBATORE – 641 006

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BONAFIDE CERTIFICATE

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20 April 2006

This is to certify that the following students of B.E. final year Mechanical Engineering of Kumaraguru College of Technology, Coimbatore had done a project work titled **"Housing Design and Flame Sensing of Gas Yarn Singeing Machine"** at our company from January'06 to April'06. During this period their conduct and character was found to be good and remarkable.

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ABSTRACT

Today's technological advancement coupled with market demands has forced the companies to deliver their products with up to date engineering. Current market demands are such that companies are required to satisfy high quality standards based on efficient production management and they must enhance their machine for that reason. In particular the quality of clothes that we use in our day to day life depends on the yarn used, so we focused on a textile yarn preparation machine to improve the quality of yarn.

The singeing machines are an excellent way of obtaining high quality fabrics and to technologically meet the present manufacturing traditions our project on the singeing machine, with all its safety and control devices, should be accurately set for future production needs.

Design of a sophisticated housing for the burner in the existing machine and by sensing the burner flame the high risk that is usually tied to a combustion machine has been reduced to a minimum using a control system that will stop the machine if there is a malfunction and by maintaining a constant flame temperature this project ultimately increases the yarn quality.

ACKNOWLEDGEMENT

At this pleasing moment of having successfully completed our project, we wish to convey our sincere thanks and gratitude to **Dr.V.VELMURUGAN** Department of Mechanical engineering for his kind guidance and encouragement during this project

We are also grateful to the Dean and Head of Department **Dr.T.P.MANI** for his constructive suggestions & encouragement during our project.

We would like to express our sincere thanks to our principal **Dr.K.K.PADMANABAN** for forwarding us to do our project and offering adequate duration in completing our project.

We would like to express our sincere gratitude to the management of **SUSIRAM ENTERPRISES,** Coimbatore for providing us this project and the guidance and help rendered.

We specially thank **Mr.R.SARAVANAN** Managing Director **SUSIRAM ENTERPRISES** who guided us in the company and rendered all the help needed to us to complete this project successfully.

We shall be failing in our duty if we do not thank all the department staff, lab technicians and our friends for having encouraged us and supported us morally while doing the project. Finally, we thank one and all who co-operated with us in bringing out this project successfully.

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CHAPTER – 1

INTRODUCTION

1.1 BACKDROP OF THE PROJECT

Clothing does a lot more than covering our body. From the beginning, clothing has served the same basic human needs such as protection, adornment and identification, modesty and status appreciation of clothing will be broadened as one become more aware of the influences engineering and technology has on the machines used. Throughout history, clothing has had great meaning. It has indicated peoples handcraft skills, artistic imagination, and cultural rituals. It also reflected advances in technology.

Textile companies must have technology, fashion, and marketing skills to succeed with their textile lines. So textile manufacturing machines should involve specialized machinery and technology. There are four main steps in the production of finished fabrics. The first step is producing fibers. Next is the mill production of yarns. Then manufacturing plants make the fabrics. Finally the fabrics are finished. These processes involve highly specialized machinery and great skill. Keeping this in account the project is taken up in an existing textile yarn finishing machine and to use the technology up to date so that the machine produces quality yarn

1.2 PROJECT SIGNIFICANCE

The industry technology is kept up-to date by efforts in research and development. R&D has been a vital part of the technology industry for many years. The development of computerized, electronic machines has made textile manufacturing faster and better. The new manufactured fibers using new technology have revolutionized the textile and garment industries.

Innovation is the creative, forward thinking introduction of new ideas. Finding or creating a market for specific goods or services. Effective fabric producers identify a customer, and focus promotional efforts to the target market. The textile industry is a worldwide industry The United States is the most efficient The US imports a great deal of textile fibers, yarns, and fabrics from other countries especially from India. There is a trade deficit that exists. That means that there are more imports into the United States than there are exports out of the United States in textiles

1.3 SCOPE OF THE PROJECT

The singeing machine, with all its safety and control devices, can be accurately set for future production needs. The high risk that is usually tied to a combustion machine has been reduced to a minimum by using a control system that will stop the machine if there is a malfunction. This machine technologically meets the present manufacturing traditions. By this new machine, modern, technological, and safety requirements have been taken in due consideration.

1.4 PROGRESSION OF REPORT

- Description of yarn
- Yarn hairiness
- Factors affecting yarn hairiness
- Removal of yarn hairiness-singeing
- Description of gas yarn singeing machine
- Need for burner housing
- Generation of CAD model for the housing
- Fabrication & fitting of housing in burner
- Influence of flame intensity on yarn quality
- Introduction to flame sensors
- Design of flame sensing circuit
- Actuator mechanism
- Study of increase in yarn quality
- Results and discussion
- Conclusion

1.5 LIMITATIONS OF OUR PROJECT

Our project is limited in increasing the yarn quality by fitting housing to the burner and then further extending the project to sense the flame of the burner to ensure that singeing of the yarn is continuous. The yarn taken for study and increasing its quality is a 2 ply cotton yarn. There are different types of yarn such as jute, flax, viscose, spun silk etc. but this project is limited with cotton yarn.

CHAPTER – 2

TEXTILE YARN

2.1 DEFINITION OF YARN

A yarn is a constructed assemblage of textile fibers which acts as a unit in fabric formation. Yarn is a continuous usually twisted, strand of fibers suitable for weaving, knitting or other processing into fabrics. The value of a length of woven material lies primarily in the time taken in design, loom preparation, the weaving and the fabric finishing.

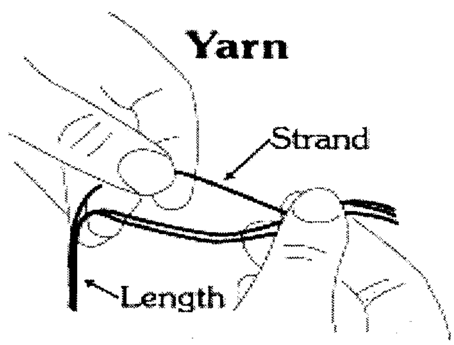


Figure 2.1 Yarn

The cost of the yarn is generally a very small proportion of the final value. At first sight there is a huge range of yarns available to the hand loom weaver. Poor yarn selection can ruin all the work invested in the fabric. Savings from buying a cheap yarn are rarely a good or wise investment.

2.2 YARN PRODUCTION

Yarn manufacturing was one of the very first processes that were industrialized. Mills spin fibers into yarn. Several fibers are twisted together to form long strands of yarns used to make fabrics. Yarn can be made from any number of synthetic or natural fibers. Very thin yarn is referred to as thread. Yarns are made up of any number of ply, each ply being a single thread these threads being twisted (plied) together to make the final yarn. In some cases, thread may be monofilament, in which case it is a single fiber. The only natural fiber that is counted as monofilament is silk.

Yarn is manufactured by either a spinning or air texturizing (commonly referred to as *taslanizing*) process. Yarn used for fabric manufacture is made by spinning short lengths various types of fibers. Synthetic fibers which have high strength, artificial lusture, and fire retardant qualities are blended with natural fibers which have good water absorbance and skin comforting qualities ,in different proportions to manufacture yarn for fabric. The most widely used blends are cotton-polyester and Wool-acrylic fiber blends. Textile manufacturing plants weave or knit yarns into fabrics. Huge mechanized looms and knitting machines produce huge amounts of knitted goods very fast

2.2.1 Production of Finished Fabrics

There are four main steps in production of finished fabrics.

1. The first step is producing fibers.
2. Next is the mill production of yarns.
3. Then manufacturing plants make the fabrics.
4. Finally the fabrics are finished.

These processes involve highly specialized machinery and great skill. Unfinished fabrics are called Greige (gray) goods.

2.3 TYPES OF YARN

2.3.1 Monofilament Yarns

Simply single filaments, usually of a high denier. One example of monofilaments is the single strand yarns in women's hosiery.

2.3.2 Multifilament Yarns

The yarns are formed by twisting the many continuous strands of fiber being extruded through the spinneret at the same time. As the degree of twist becomes tighter, the yarn becomes stronger, and harder, and more compact. A low twist is used for most multifilament yarns.

2.3.3 Spun Yarns

Made with staple fibers. The fibers are usually held together by mechanical spinning. Fibers spun from staple fibers are more irregular than filament yarns. The short ends of the fibers produce a fuzzy effect on the yarn surface.

2.3.4 Ply Yarns

Formed by twisting together two or more single yarns. Each strand is called a ply. Ply refers to the number of yarns twisted together. This adds extra strength.

Figure 2.2 Double ply yarn

Figure 2.3 Four ply yarn

2.3.5 Warp Yarns

Yarns that run lengthwise (parallel to the selvage in) in woven fabrics.

2.3.6 Combinational Yarn

A ply yarn composed of two or more yarns that differ in fiber composition, content, and/or twist level, or composed of both spun staple and filament yarns.

2.4 YARN COUNT

The yarn count, also called yarn number, of a yarn is the number of hanks of yarn needed to make up one pound of yarn.

2.5 YARN SIZE OR YARN NUMBER

To give us a measure of yarn size that is comparable for different materials, we use linear density or reciprocal of linear density, because the length and mass of the yarn can each be accurately measured

2.5.1 Indirect System

Linear density of the yarn is expressed as length (Hanks) per unit weight.

2.5.2 Direct System

Linear density of the yarn is expressed as weight (grams) per unit length.

2.6 YARN CONDITIONING

Moisture in atmosphere has a great impact on the physical properties of textile fibers and yarns. Relative humidity and temperature will decide the amount of moisture in the atmosphere. High relative humidity in different departments of spinning is not desirable. It will result in major problems. But on the other hand, a high degree of moisture improves the physical properties of yarn. Moreover it helps the yarn to attain the standard moisture regain value of the fiber. Yarns sold with lower moisture content than the standard value will result in monetary loss.

Therefore the aim of conditioning is to provide an economical device for supplying the necessary moisture in a short time, in order to achieve a lasting improvement in quality.

2.7 YARN HAIRINESS

Yarn hairiness is a complex concept, which generally cannot be completely defined by a single figure. The effect of yarn hairiness on the textile operations following spinning, especially weaving and knitting, and its influence on the characteristics of the product obtained and on some fabric faults has led to the introduction of measurement of hairiness. Hairiness occurs because some fiber ends protrude from the yarn body. In the past, hairiness was not considered so important. But with the advent of high-speed looms and knitting machines, the hairiness has become a very important parameter.

In general, yarn spun with Indian cotton show high level of hairiness due to the following reasons.

1. High short fiber content in mixing.
2. Low uniformity ratio.
3. High spindle speeds

2.7.1 Factors Affecting Yarn Hairiness

The factors effecting hairiness can be sub divided into 3 major components

a) The fiber properties.

b) Yarn parameters.

c) Process parameters

2.7.2 Measurement of Hairiness

Hairiness is measured in two different methods.

2.7.3 Uster Hairiness Index

This is the common method followed in India. The hairiness index H corresponds to the total length of protruding fibers within the measurement field of 1cm length of the yarn.

2.7.4 Zweigle Hairiness Index

This Zweigle hairiness measurement (S3) gives the number of protruding fibers more than 3 mm in length in a measurement length of one meter of the yarn.

From the above you can infer that Uster hairiness index give the total length of hairs whereas Zweigle hairiness testers give the absolute number of fibers. Though the later measurement is more accurate, most of the Indian spinners are still following Uster hairiness index only

Hence most of the Indian yarns have a hairiness index above 50% Uster standards. However, as this parameter is becoming more and more important, Indian spinners are concentrating more on this aspect and try to reach at least 25% standards by conducting lot of trials.

CHAPTER – 3

SINGEING

3.1 INDUSTRIAL PROCESSES IN TEXTILE INDUSTRY

The textile industry is comprised of a diverse, fragmented group of establishments that produce and/or process textile-related products (fiber, yarn, fabric) for further processing into apparel, home furnishings, and industrial goods. Textile establishments receive and prepare fibers; transform fibers into yarn, thread, or webbing; convert the yarn into fabric or related products; and dye and finish these materials at various stages of production. The process of converting raw fibers into finished apparel and non apparel textile products is complex; thus, most textile mills specialize.

In its broadest sense, the textile industry includes the production of yarn, fabric, and finished goods. The four production stages are.

1. Yarn formation
2. Fabric formation
3. Wet processing
4. Fabrication

3.2 FABRIC PREPARATION

Most fabric that is dyed, printed, or finished must first be prepared, with the exception of denim and certain knit styles. Preparation, also known as pretreatment, consists of a series of various treatment and rinsing steps critical to obtaining good results in subsequent textile finishing processes. . In preparation, the mill removes natural impurities or processing chemicals that interfere with dyeing, printing, and finishing. Typical preparation treatments include Desizing, scouring, and bleaching. Preparation steps can also include processes, such as singeing and mercerizing, designed to chemically or physically alter the fabric. For instance, the mercerizing stage chemically treats the fabric to increase fiber strength and dye affinity, or ability to pick up dyes. This, in turn, increases the longevity of fabric finishes applied during finishing.

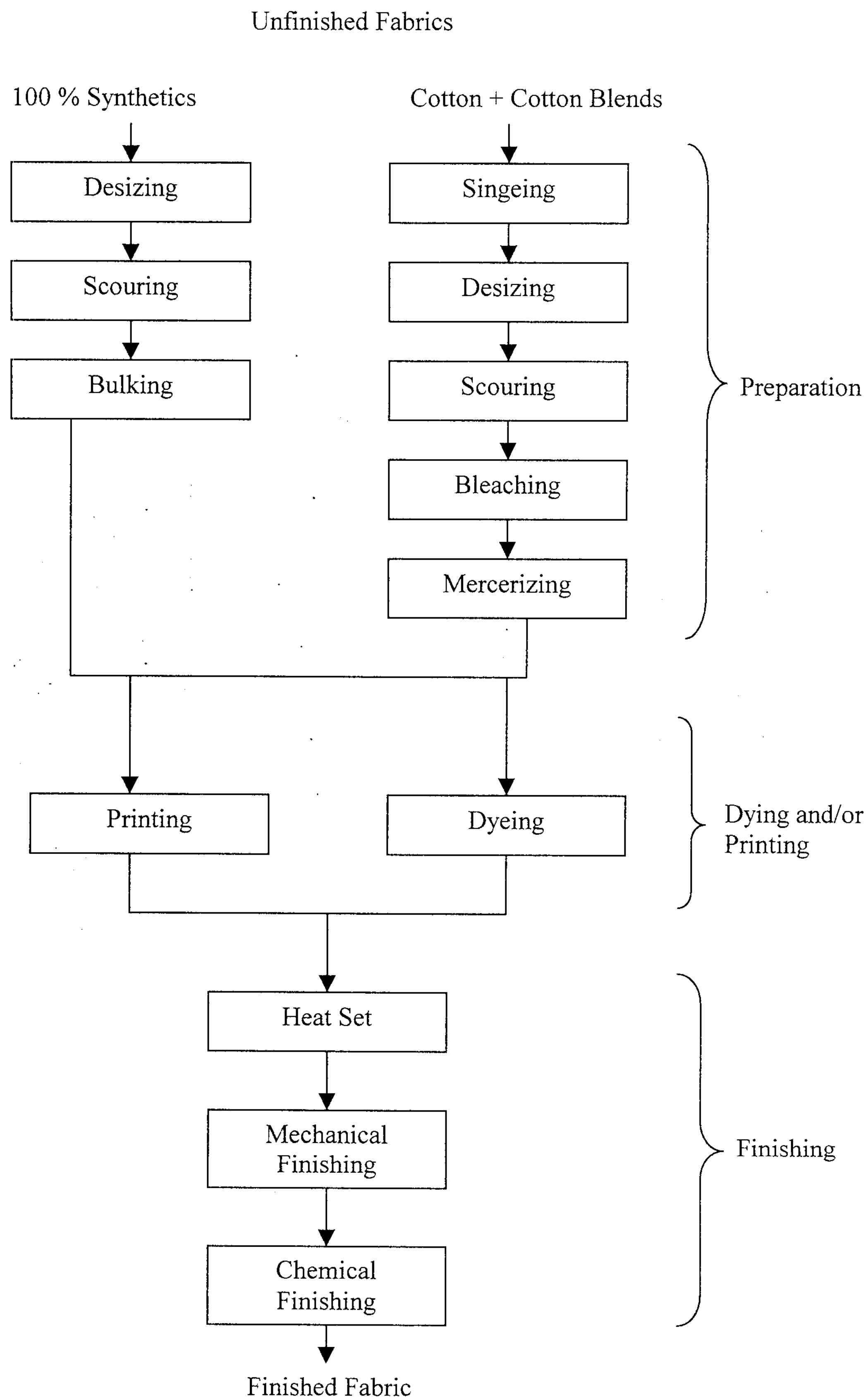


Figure 3.1 Processing steps for fabrics

3.3 SINGEING

If a fabric is to have a smooth finish, singeing is essential. Singeing is a dry process used on woven goods that removes fibers protruding from yarns or fabrics. These are burned off by passing the fibers over a flame or heated copper plates. Singeing improves the surface appearance of woven goods and reduces pilling. It is especially useful for fabrics that are to be printed or where a smooth finish is desired. Pollutant outputs associated with singeing include relatively small amounts of exhaust gases from the burners.

Singeing is the process of removing the protruding from the fibers from the surface of the yarn. This process is suitable for all natural fibers. And also this is a value adding process.

3.3.1 What Will Happen During Singeing?

1. The protruding fibers on the yarn surface are fired and removed as ash. The cleared yarn may be seen.
2. The thin, thick and other character of the yarn can be clearly viewed.

Figure 3.2 Yarn hairiness

3.3.2 Benefits

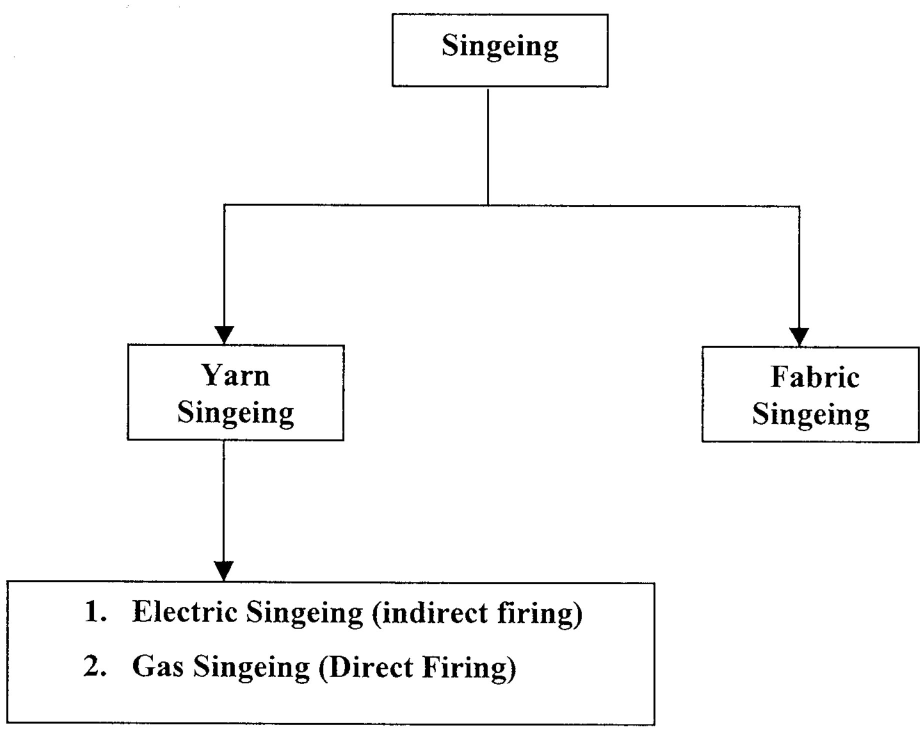
1. Very less hairiness on the surface. This helps the next process like knitting and weaving in a way like less breakage and many more way.
2. Fabric produced with gassed yarn give comfort feeling & Luster.
3. The Singeing process will help the dyeing process like less dye stuff consumption, quick dye absorbency.
4. Singed & mercerized yarn csp is higher than the normal and it will produce the fine and strengthen fabric.
5. In general all the problems are solved because of hairiness.
6. This yarn may cause very low Pilling effect.

3.4 TYPE OF MATERIAL MAY BE SINGED

1. All the natural fibers like Cotton, Jute, flax, etc., can be singed.

3.5 TYPE OF SINGEING

Singeing can be done in the form of yarn and fabric. In general singeing is done in the form of yarn in high volume.



3.5.1 Electric Singeing (In Direct Firing)

In this process the hairiness is removed by the temperature generated heating metal filament. No flame is produced. Approximately 350 degree Celsius temperature is generated in the singeing zone. Therefore, the hairs are fired and removed by the heat.

3.5.2 Gas Singeing (Direct Firing)

In this process, Liquefied Petroleum Gas (LPGas) or natural gas is used as a fuel for firing. A direct flame is produced in this type and approximately 950 degree Celsius (For LPGas); 450 degree Celsius (For Natural Gas) temperature is generated in the singeing zone. Here the hairs are removed by direct flame.

3.5.3 Merits and Demerits of Electric and Gas Singeing

1. In Electric Singeing (indirect singeing), the temperature produce is low hence the yarn may be processed at lower speed.
2. Indirect singeing is time consuming.
3. The hairs on entire surface are not removed, and only 270 degree portion only cleared in this process.
4. In Gas Singeing (Direct Singeing), a more temperature is produced hence the yarn may be processed at a higher speed.
5. The yarn is directly entering in to the flame hence the entire 360 degree surface hairs is removed.

3.6 WEIGHT LOSS

In singeing process the hairs removal are indicated by the means of weight loss %. More the weight loss % higher the removal of hairs and vice versa. In the field 4.5% to 8 % weight loss is reached to remove the required degree of hairs.

3.7 CHECKING OF SINGEING EFFECTS

Singeing effects are checked by the way of

1. Loss in weight compare to un gassed (gray) yarn
2. Hairiness testing equipment.
3. Change in count.
4. Change in colour.

3.7.1 Loss in Weight

Weight Loss may be calculated with the help of weighing balance.

$$\text{Weight Loss\%} = \frac{(\text{Weight of Grey Yarn}) - (\text{Weight of Gassed Yarn})}{(\text{Weight of Grey Yarn})} \times 100$$

3.7.2 Hairiness Testing Equipment

Available hairs when compare to un gassed (gray) yarn & Available hair's length compare to un gassed (gray) yarn

There are two major manufacturers of hairiness testing equipment on the market, and both have their advantages and disadvantages. Some detail is given below.

USTER

The USTER hairiness H is defined as follows. H =total length (measured in centimeters) of all the hairs within one centimeter of yarn.

(The hairiness value given by the tester at the end of the test is the average of all these values measured, that is, if 400 m have been measured, it is the average of 40,000 individual values). The hairiness H is an average value, giving no indication of the distribution of the length of the hairs. For an example consider two yarns

	0.1cm	0.2cm	0.3cm	0.4cm	0.5cm	0.6cm	0.7cm	0.8cm	0.9cm	1.0cm	total
yarn 1	100	50	30	10	5	6	0	2	1	0	398
yarn 2	50	10	11	5	10	0	5	10	0	11	398

Table 3.1 Hairiness index

Both yarns would have the same hairiness index H, even though yarn is more desirable, as it has more short hairs and less long hairs, compared to yarn 2.

This example shows that the hairiness H suppresses information, as all averages do. Two yarns with a similar value H might have vastly different distributions of the length of the individual hairs. The equipment allows evaluating the variation of the value H along the length of the yarn. The "sh value "is given, but the correlation to the CV of hairiness is somehow not obvious. A spectrogram may be obtained.

ZWEIGLE

Zweigle is a somewhat less well-known manufacturer of yarn testing equipment. Unlike USTER, the Zweigle does not give averages. The numbers of hairs of different lengths are counted separately, and these values are displayed on the equipment. In addition, the S3 value is given, which is defined as follows:

S3 =Sum (number of hairs 3 mm and longer)

In the above example, the yarns would have different S3 values:

S3 yarn 1 =2.

S3 yarn 2 =4.

A clear indication that yarn 2 is "more hairy "than yarn 1. The CV value of hairiness is given a histogram (graphical representation of the distribution of the hairiness) is given. The USTER H value only gives an average, which is of limited use when analyzing the hairiness of the yarn. The Zweigle testing equipment gives the complete distribution of the different lengths of the hairs. The S3 value distinguishes between long and short hairiness, which is more informative than the H value.

3.7.3 Change in Count

This study may be done by the help of Wrap Reel and Weighing Balance.

3.7.4 Change in Color

This way helps to compare the produced yarn with the master sample of Yarn.

CHAPTER - 4

SUSIRAM ENTERPRISES

4.1 COMPANY HISTORY

Susiram Enterprises Company was started in the year of 2000, Initially they supplied the spares for gas yarn singeing machine, and gave their service to many of the customers in South India. Now a step ahead they are manufacturing Gas Yarn Singeing Machine with user friendly mechanism. They incorporated many electronic components for the fool proof functioning of the mechanisms and also under take Electric Singeing to Gas Singeing Conversion Work. The main aim of the company is delivering a high quality gassing machine at a competitive price in more volume with excellent after sales support.

4.2 MISSION STATEMENT OF THE COMPANY

"Our mission is delivering high quality Gas Yarn Singeing Machine with updated technology for ever"

4.3 OTHER COMPONENTS BY THE COMPANY

- Electronic Yarn Sensors
- Regenerative model Air Blower
- Filter for Regenerative Air Blower
- Flow Meter
- AIR Line & LPG Line
- Modified Tension Device Winding Machine
- Cradle Assembly
- LPG line items like Pressure Regulators, Click on Adopters
- Solenoid Valve and other fittings
- Burner
- Assembly Winding Machine

4.4 OUTSTANDING FEATURES OF THE MACHINE

- Universal Supply Package Holder – Adopts all type of cones.
- Wider Spark Shielding Pane with lappet hooks model balloon arrestor.
- Horizontal Tension Device with self threading Yarn path.
- Newly developed Stainless Steel Burner.
- Specially fabricated Suction system to maintain a uniform suction.
- 6" Traverse Solid Aluminum Hard Anodized Drum.
- Double Arm Spindle less Cradle to hold 4 0 20' Take up Cones.
- A wider storage tray.
- Almost all the yarn passage areas are covered by ceramic guides.
- Specially Designed Yarn Inlet Mechanism with Package Starting.
- Each Side Drive motors are connected with AC Inverter Drive
- Any speed from 75 mpm to 1200 mpm (Mechanically).
- Inbuilt Ribbon Minimiser.
- Unique Control Box with Isolator & cooling fan.
- Machine can be used for Gassing process or Rewinding purpose.
- Electronic Tachometer – To measure / monitor the winding speed.
- Specially Designed Air and LP Gas integration Chamber.
- Pneumatically Controlled Package Lifting Mechanism.
- Heavy Solid Machine Frames and Shafts on Noiseless Ball Bearings
- Major components are powder coated.

CHAPTER – 5

GAS YARN SINGEING MACHINE

Gas yarn singeing machine essentially consists of one or more burners giving continuous flat or vertical flame produced by a mixture of compressed air and coal gas. The flame issues from a narrow slit, which is adjustable with respect to width and thickness. When the cloth is drawn over the flame at high speed the flame impinges on its surface and burns the protruding fibers without damaging the cloth. The speed of transmission of the cloth through the singeing machine has to be adjusted to suit the amount of the singeing required without the risk of burning the cloth.

When the flame impinges on the cloth surface the fiber ends present in the interstices of the warp and weft are also singed. Then the singed cloths passed between a pair of draw rollers and wound in a cone situated above. In order to remove the burnt fibers and exhaust gases, suction fans are provided.

5.1 COMPONENTS OF GAS YARN SINGEING MACHINE

Gas yarn singeing machine basically have the following components

- Universal package holder
- Spark shielding pane
- Horizontal tension device
- Dust collection box
- Burner assembly
- Suction funnel
- Traverse drum

5.1.1 Universal Package Holder

This holder is used to hold the cone containing the yarn whose hairiness is to be removed. The holder is available at the bottom of the machine it is called universal package holder since it can accommodate common types of cone. It has tightening arrangement to hold the cone in position.

5.1.2 Spark Shielding Pane

As the name indicates this spark shielding pane is used to protect the spark from the burner from damaging the yarn in the universal package holder. It has provision for allowing the yarn to flow through

5.1.3 Horizontal Tension Device

The yarn should be in tension while flowing through the burner so that it does not get in to contact with the sides of the burner and also they are responsible for allowing the uniform flow of yarn so that the hairiness is removed when the yarn flows through the burner.

5.1.4 Dust Collection Box

The yarn hairs that are burnt in to ashes are to be collected from the suction funnel to the dust collection box from the box the dust is sent to the atmosphere through the chimney arrangement

5.1.5 Burner Assembly

The most important and sophisticated arrangement in the gas yarn singeing machine is the burner assembly. This assembly contains the burner having the arrangement for allowing a mixture of air and liquefied petroleum gas through tiny pores in the burner. To withstand the temperature the burner is made of cast iron.

5.1.6 Suction Funnel

The suction funnel contains a suction pump and it sucks the burnt out hairs from the yarn passing through the burner.

5.1.7 Traverse Drum

Prepared yarn is then made to wound in the cone using the traverse drum that has special dimensions to wind the yarn. This drum is made of bakelite material.

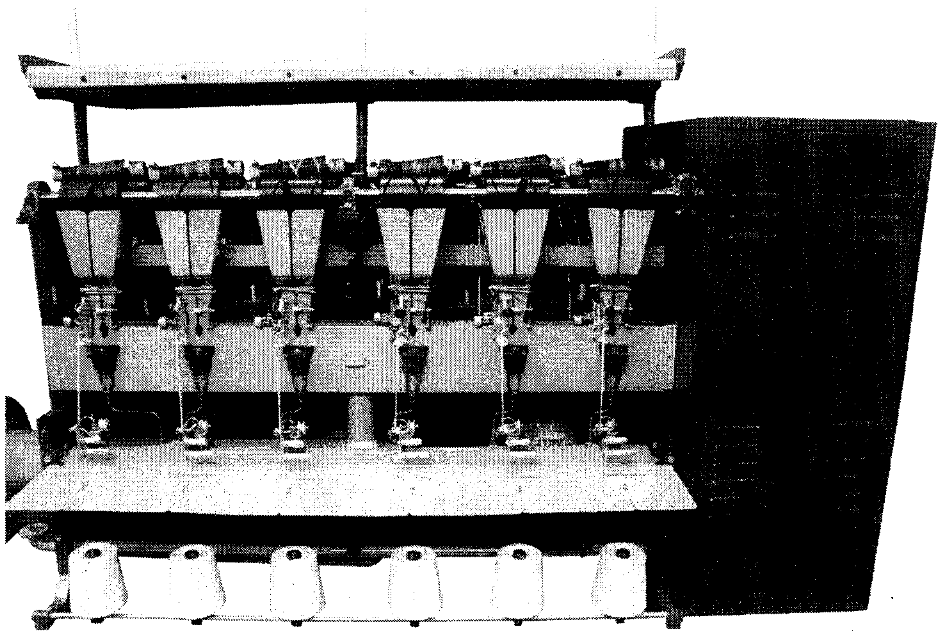


Figure 5.1 Gas yarn singeing machine

5.2 ADVANTAGES

- Uniform singeing of cloth is obtained
- No question of unwanted lusture as there is no contact with any metal surfaces as in the case of other singeing machine such as roller and plate type
- Fibers in the interstices are burnt
- Speed is high as 300-600 mts. /min.

5.3 DISADVANTAGES

- There is a chance of fire o the cloth if the flame is not controlled properly

5.4 PRECAUTION IN GAS YARN SINGEING MACHINE

- The supply of gas to the burner is automatically controlled if the mixture of gas and air does not burn or if the fabric fails to move
- The machine is enclosed with hood and exhaust fan otherwise the dust, will affect the eyes.

CHAPTER – 6

GAS BURNER

The burners are the heart of the singeing machine. Burner uses the mixture of gas and Liquid Petroleum Gas (LPG) for producing flame. Its operating temperature is about 700^0C. The pressure of air and LPG gas are 4 psi and 15 psi respectively. The rate of flow of mixture is optimized and controlled by flow meters but then the burner may cut off due to the following reasons.

1. Bigger size of the knot
2. External disturbance
3. Over head clearance
4. Slough off

6.1 REASONS FOR BURNER FLAME CUT OFF

6.1.1 Bigger Size of the Knot

It's impossible to get yarn of continuous length, so knot will be definitely there of various size. Knot will be either made of hand or by machine and it varies according to the type of yarn used. If the size of the yarn's knot is bigger, then it may be the cause for the burner flame to cut off when it is passed through the burner.

6.1.2 External Disturbance

Due to the flow of atmospheric air in the surroundings, the burner may be subjected to disturbance. Also due to the external suction compressor and disturbances from worker's passing by burner may sometimes cut off. It cannot be controlled even if proper shielding is provided. If the intensity of the flame is increased, then we can minimize the problem but the operating cost will be so high. Also it may leads to fire hazard sometimes when the cut off of the burner is not watched.

6.1.3 Over Head Clearance

Ash from the burner will spread over the machine even it is sucked by the external compressor. So it's necessary to keep the machine clean. For this purpose a blower and a suction pump is used. It may also disturb the burner.

6.1.4 Slough Off

Unprocessed yarn is supposed to travel from the cone placed vertically below the burner and tensioning device. Due to protruding fibers in the yarn, more number of wounds may travel at a time from the cone to the burner. This phenomenon is termed as slough off. It will lead to close the passage of the mixture of air and LPG. It leads to burner off. But due to the tension at the upper wounding spindle the yarn will be retrieved leaving the mixture to flow freely. Also it will lead to fire accident if more number of burners is subjected to the same problem simultaneously.

6.2 NECESSITY OF BURNER HOUSING & FLAME SENSING

If the burner gets off due to some reasons, then the unprocessed yarn will be wounded back again. If its so, then the production is said to be 100% defect. So the burner should be watched and maintained properly here and then. In order to reduce the manual work for watching the burner, a sophisticated shielding for the burner has been designed for effective burning and a flame sensor has been fitted so that it will be watching all the time. If the burner gets off, then the sensor will sends the signal to actuate the pneumatic cylinder to retract the upper cone from the drum which is under the revolution with the main spindle. So even if the burner gets off the unprocessed yarn will not be wound with the processed cone. The burner gets off at an average of 2-3 times per hour for a 60 drum machine. The average working hours of the machine is 22 hours per day.

CHAPTER – 7

GENERATION OF CAD MODEL OF HOUSING

7.1 DESIGN CONSIDERATIONS

A CAD model for the burner housing is designed. The various steps involved in the process of design could generally be summarized as follows.

- A close study of the Condition to be fulfilled, the aim of the design.
- Preparation of simple schematic diagrams.
- Conceiving the shape of the unit/machine to be designed.
- Preliminary strength calculations.
- Consideration of factors like selection of material
- Manufacturing method to produce most economical design.
- Mechanical design.
- Preparation of detailed manufacturing drawing of individual components and assembly drawings.

7.2 COMPONENTS OF HOUSING

Following are the components of the housing that are to be designed

1 Yarn guiding arrangement
2 Housing frame
3 Burner flame shielding arrangement
4 Spring tensioned special twisting arrangement

7.2.1 Yarn Guiding Arrangement

Yarn guiding arrangement is provided to guide the yarn coming from the burner.

7.2.2 Housing Frame

Frame is provided to fit the yarn guiding arrangement, burner flame shielding arrangement and the spring tensioned twisting arrangement.

7.2.3 Burner Flame Shielding Arrangement

The shielding for the burner flame is provided by this shielding arrangement. They are designed for maintaining the flame temperature.

7.2.4 Twisting Arrangement

In order to clean the burner at regular intervals it must be removed from the burner but this involves time so a special spring tensioned twisting arrangement is provided so that the housing can be twisted away from the burner and can be cleaned easily.

7.3 MODELING SOFTWARE

The software used for designing the housing is pro engineering wild fire version number-1.

7.4 PRO-E MODELS OF THE HOUSING

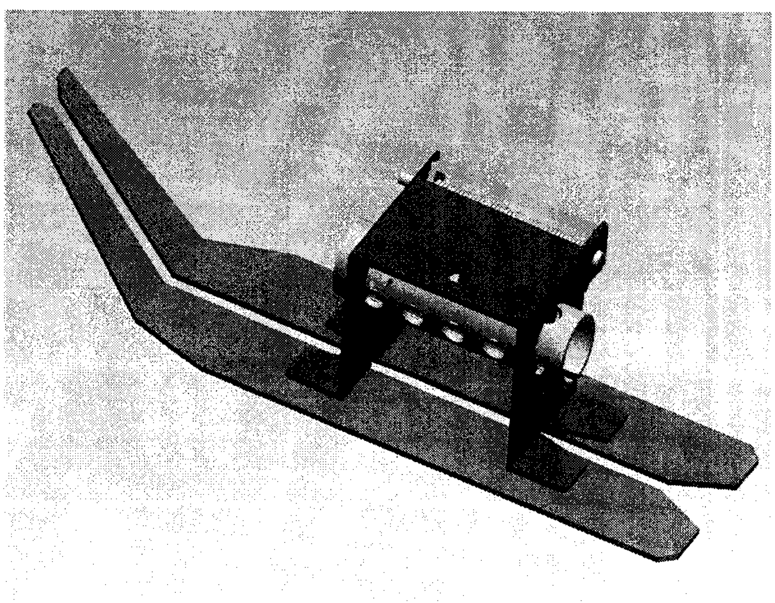


Figure 7.1 Yarn guider

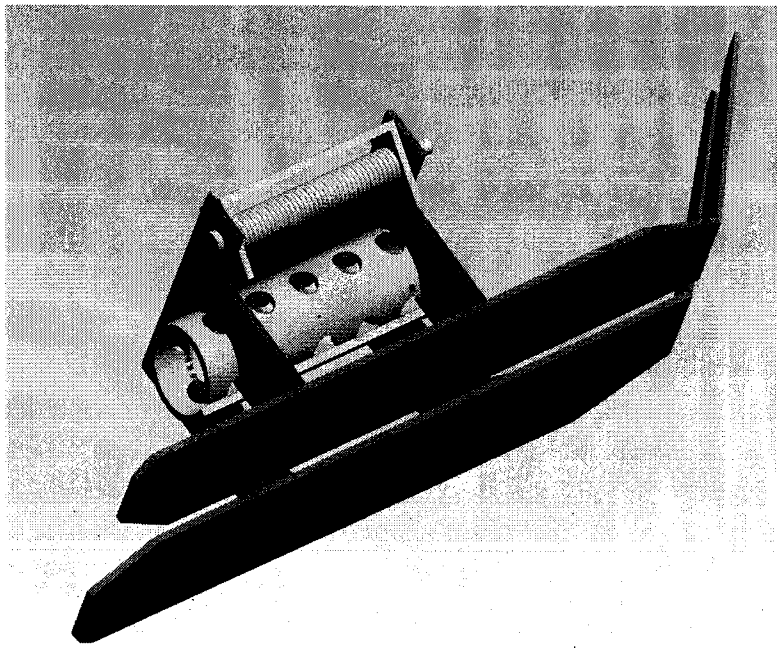


Figure 7.2 Burner shielder

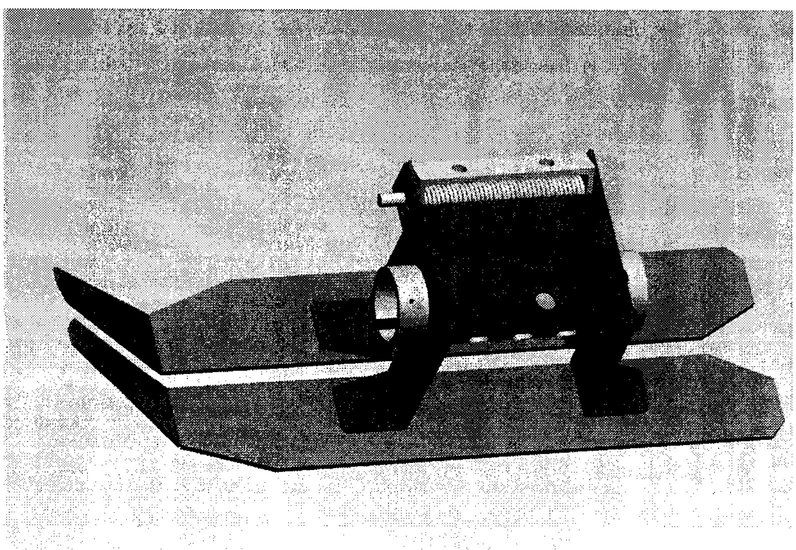


Figure 7.3 Housing frame

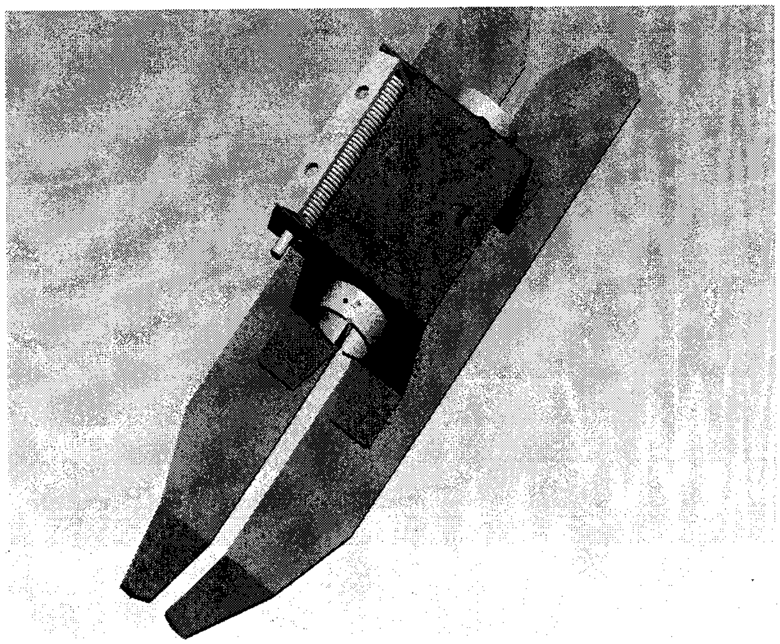


Figure 7.4 Twisting arrangement

CHAPTER – 8

FABRICATION AND FITTING OF HOUSING

8.1 FACTORS DETERMINING THE CHOICE OF MATERIALS

The various factors, which determine the choice of material, are discussed below

8.2 PROPERTIES

Material selection is an important part of engineering practice. The selection of the proper material is a key step in the design because it is a crucial decision that links calculation and lines on an engineering drawing with a real or working design.

Selecting the best material involves more than selecting a material that has the properties to provide the necessary performance. It is also intimately connected with the processing of the materials into finished components. Thus a poorly chosen material can add to manufacturing defects, unnecessary increase in cost of the part, change in the required properties of the part due to change in material processing and finally increase the maintenance cost. Thus the material should be selected based on both material properties and material processing. The number of possible combinations is almost boundless. Our responsibility was to choose a proper material as per the machine requirement and working conditions.

The material selected must posses the necessary properties for the proposed application. The various requirements to be satisfied can be weight, surface finish, rigidity, ability to withstand environmental attack from chemicals, service life, reliability etc.

The following four types of principle properties of materials decisively affect their selection

- Physical
- Mechanical
- From manufacturing point of view
- Chemical

The various physical properties concerned are melting point, Thermal Conductivity, Specific heat, coefficient of thermal expansion, specific gravity, electrical Conductivity, Magnetic purposes etc. The various Mechanical properties Concerned are strength in tensile, compressive shear, bending, torsional and buckling load, fatigue resistance, impact resistance, elastic limit, endurance limit, and modulus of elasticity, hardness, wear resistance and sliding properties.

The various properties concerned from the manufacturing point of view are.

- Cast ability,
- Weld ability,
- Brazability,
- Forge ability,
- Merchantability,
- Surface properties,
- Shrinkage,
- Deep drawing etc.

8.3 MANUFACTURING CASE

Sometimes the demand for lowest possible manufacturing cost or surface qualities obtainable by the application of suitable coating substances may demand the use of special materials.

8.4 QUALITY REQUIRED

This generally affects the manufacturing process and ultimately the material. For example, it would never be desirable to go for casting of a less number of components, which can be fabricated much more economically by welding or hand forging the steel.

8.5 AVAILABILITY OF MATERIAL

Some materials may be scarce or in short supply. It then becomes obligatory for the designer to use some other material which though may not be a perfect substitute for the material designed.

The delivery of materials and the delivery date of product should also be kept in mind.

8.6 SPACE CONSIDERATION

Sometimes high strength materials have to be selected because the forces involved are high and the space limitations are there.

8.7 COST

As in any other problem, in selection of material the cost of material plays an important part and should not be ignored.

Some times factors like scrap utilization, appearance, and non-maintenance of the designed part are involved in the selection of proper materials.

8.8 CRITERIA FOR THE SELECTION OF MATERIALS

The selection of the material for the machine is reduced to three broad constraints

1) Service requirements
2) Fabrication requirements
3) Economic requirements

The service requirements are paramount. The material must stand up to service demand; such demands commonly include dimensional stability, corrosion resistance, strength, hardness, toughness and heat resistance. Fabrication requirements include the possibility to shape the material and to join it into other materials. The assessment of the fabrication requirements concerns the question of machining; harden ability, ductility, Cast ability, and weld ability qualities which are sometime quite difficult to access.

8.9 MATERIAL USED

Considering the above factors and criteria for selection of the materials the material used for fabrication of the housing is stainless steel of grade 304.

8.10 MACHINING PROCESS

These are some of the machining process used in the fabrication of burner housing.

1. Cutting
2. Pressing
3. Punching
4. Folding
5. Spot welding
6. Drilling
7. Buffing

Cutting

The stainless steel is cut to the required dimensions

Pressing

After cutting the metal is pressed and bend as required

Punching

It is a cutting operation in which various holes is made in the housing frame and the shielding arrangement.

Folding

Then folding operation is performed in the housing frame and twisting arrangement

Spot welding

Spot welding is done for fitting the yarn guiding arrangement with the housing frame

Drilling

Drilling is done for fitting the housing frame in the machine and in the special twisting arrangement.

Buffing

Buffing operation is done for polishing the housing. The work piece ia brought in contact with a revolving cloth buffing wheel that is charged with very fine abrasives.

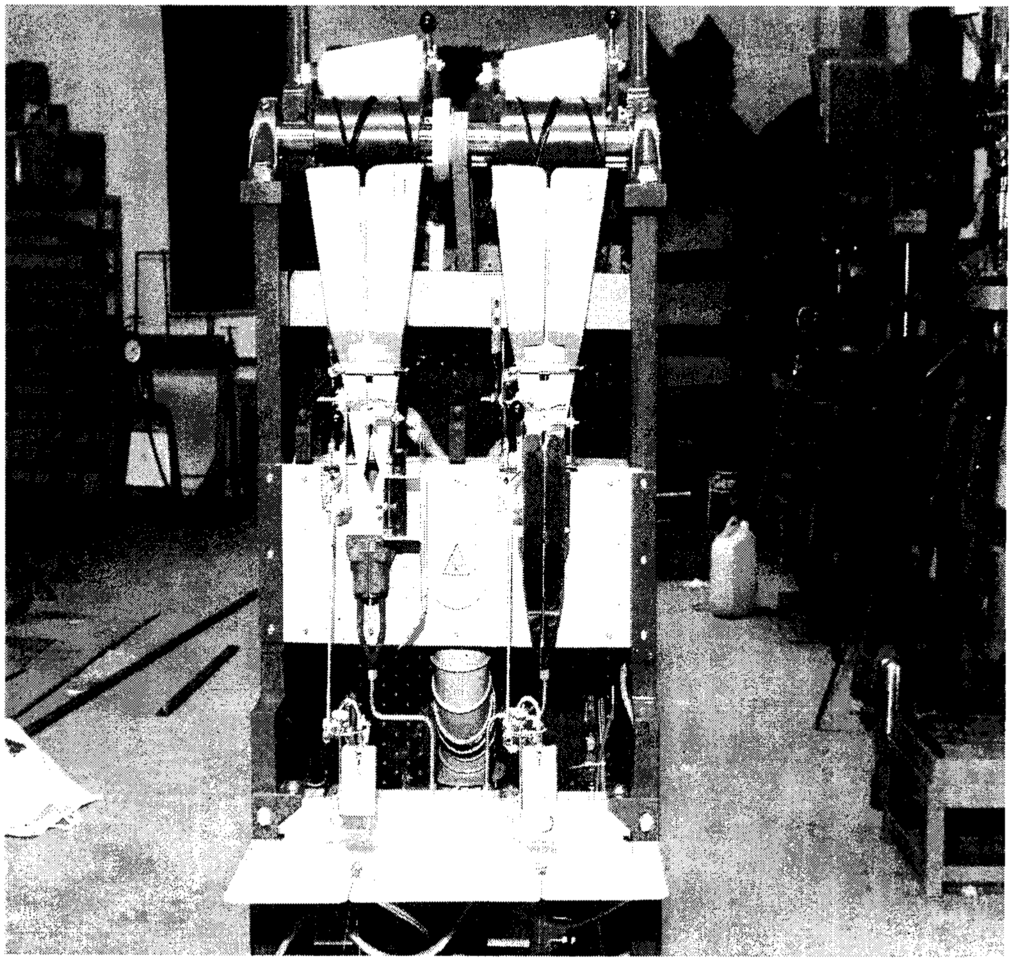


Figure 8.1 Burner fitted with the housing

CHAPTER – 9

INTRODUCTION TO SENSOR

Sensor: Devices that receives and responds to a signal or stimulus

Receive: They measure a physical quantity; e.g. temperature, pressure, light intensity.

Respond: They convert it into an electrical signal of some kind; e.g. voltage.

Sensors can be as simple as to recognize a force, or as complex as a camera.

9.1 BASIC TYPES OF SENSORS

Analog- Return values between 0 and 255 by varying the amount of current flow.

Digital- Boolean sensors, they return 0 or 1 by grounding current, or letting it flow at high. Thus, digital sensors can be regarded as a special case of analog sensors.

9.2 CLASSIFICATIONS OF SENSORS

Passive- Receives information using a pulse of power.

Powered- Supplied power by the RCX to amplify or output signals, and must use the same wire t o respond to stimuli.

Light (digital, powered) - Recognizes IR light, measures reflection by providing a light source.

Touch (digital, passive) - Measures a force.

Rotation (analog, powered) - Measures angle of deviation from a given point.

Temperature (analog, passive) - Measures current through a temperature sensitive resistor.

9.3 FLAME SENSOR

In our project we use intensity detector as sensors, which are essentially photo resistors or photoconductors. A photoconductor is a device consisting of a slab of semiconductor in bulk form or in the form of a thin film deposited on an insulating surface with ohmic contact fixed at opposite ends.

If radiation (flame) falls upon a semiconductor its conduction capability increases. This photoconductive effect is explained as follows, the conductivity of the material is proportional to the concentration of charge carriers present. Radiant energy supplied to the semiconductor causes covalent bonds to be broken and hole-electron pairs in excess to those generated thermally are created. These increased current carriers increase the voltage of the material, and hence such a device is called a intensity sensors or photoconductor may change by several kilo ohms.

A bar of semiconductor material will typically pass a photoconductor of 30^f/millilumen input. Where as a thin film photoconductor may pass photoconductor may pass photocurrent of 10ma/millilumen of broadband (sunlight) illumination

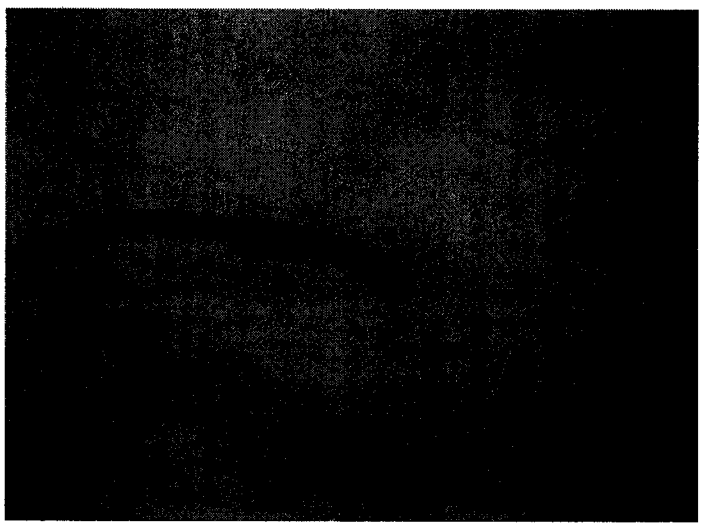


Figure 9.1 Flame sensor

CHAPTER – 10

DESIGN OF FLAME SENSING CIRCUIT

The flame sensing circuit contains the following components

1) Power supply circuit
2) Flame sensing circuit
3) Alarm circuit
4) Relay circuit

10.1 POWER SUPPLY CIRCUIT

10.1.1 Block Diagram

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

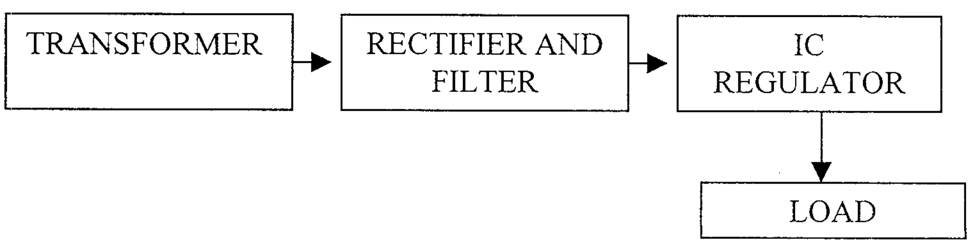


Figure10.1 Block diagram (Power supply)

10.1.2 Working Principle

Transformer

The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC; rest of the circuits will give only RMS output.

Bridge Rectifier

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners.

One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

This may be shown by assigning values to some of the components shown in views A and B. assume that the same transformer is used in both circuits. The peak voltage developed between points X and y is 1000 volts in both circuits. In the conventional full-wave circuit shown—in view A, the peak voltage from the center tap to either X or Y is 500 volts. Since only one diode can conduct at any instant, the maximum voltage that can be rectified at any instant is 500 volts.

The maximum voltage that appears across the load resistor is nearly-but never exceeds-500 v0lts, as result of the small voltage drop across the diode. In the bridge rectifier shown in view B, the maximum voltage that can be rectified is the full secondary voltage, which is 1000 volts. Therefore, the peak output voltage across the load resistor is nearly 1000 volts. With both circuits using the same transformer, the bridge rectifier circuit produces a higher output voltage than the conventional full-wave rectifier circuit.

IC Voltage Regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to tens of watts.

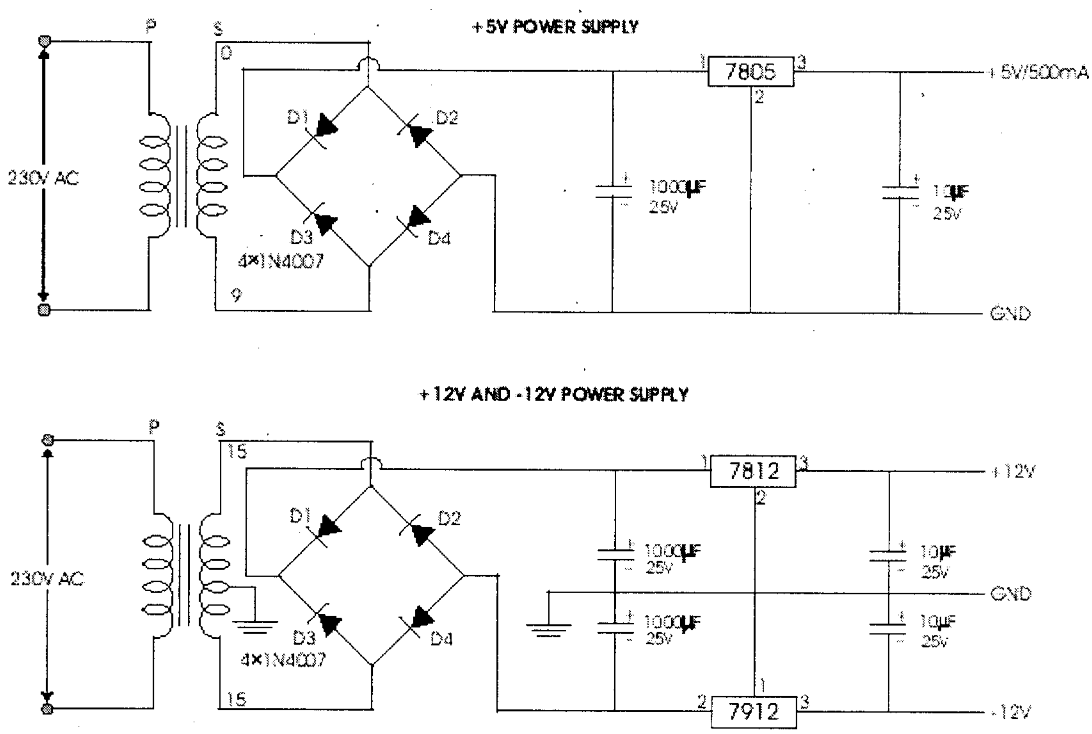


Figure 10.2 Circuit diagram (Power supply)

For ICs, microcontroller, LCD	---------	5 volts
For alarm circuit, op-amp, relay circuits	----------	12 volts

10.2 FLAME SENSING CIRCUIT

If radiation (flame) falls upon a semiconductor its conduction capability increases. This photoconductive effect is explained as follows, the conductivity of the material is proportional to the concentration of charge carriers present. Radiant energy supplied to the semiconductor causes covalent bonds to be broken and hole-electron pairs in excess to those generated thermally are created. These increased current carriers increase the voltage of the material, and hence such a device is called a intensity sensors or photoconductor may change by several kilo ohms.

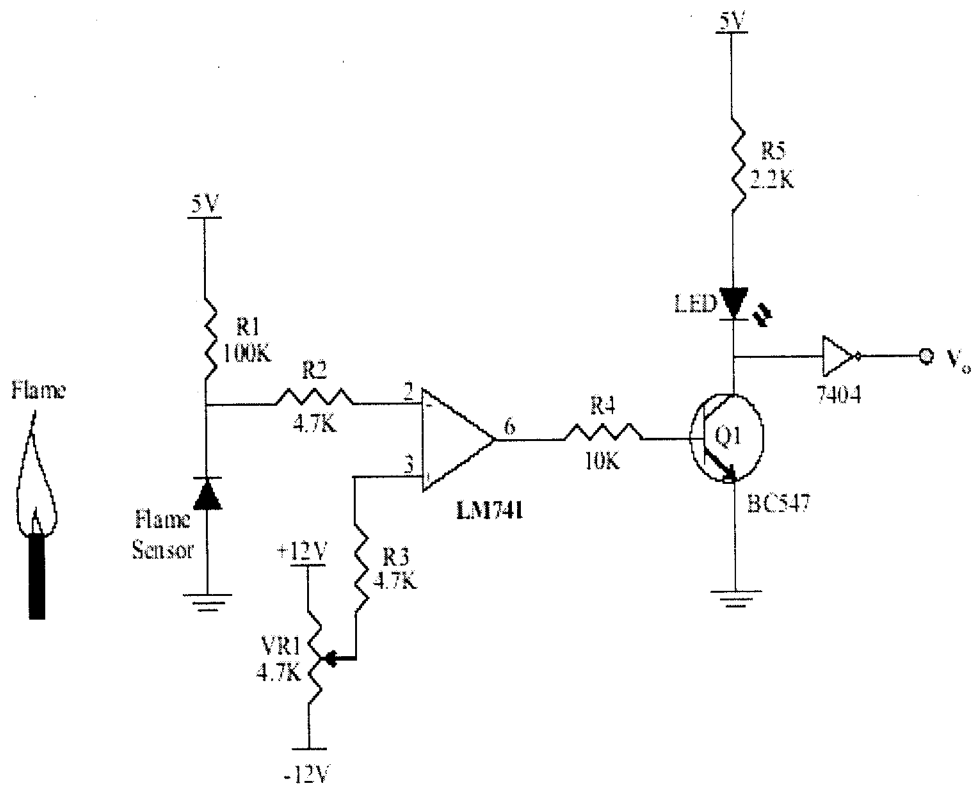


Figure 10.3 Flame sensing circuit

10.3 ALARM CIRCUIT

In this circuit transistor BC547 is used as a switch. The control signal is given to the base terminal of the transistor. The collector is attached to the Buzzer. When the controller output from the PC is high the transistor will be in the ON state, so Buzzer is energized. When the controller output from the PC is low the transistor will be in the OFF state, so Buzzer is de-energized the valve will open. When the Buzzer is de-energized the valve will close. So according to the controller output the valve will open or close and thus level is maintained.

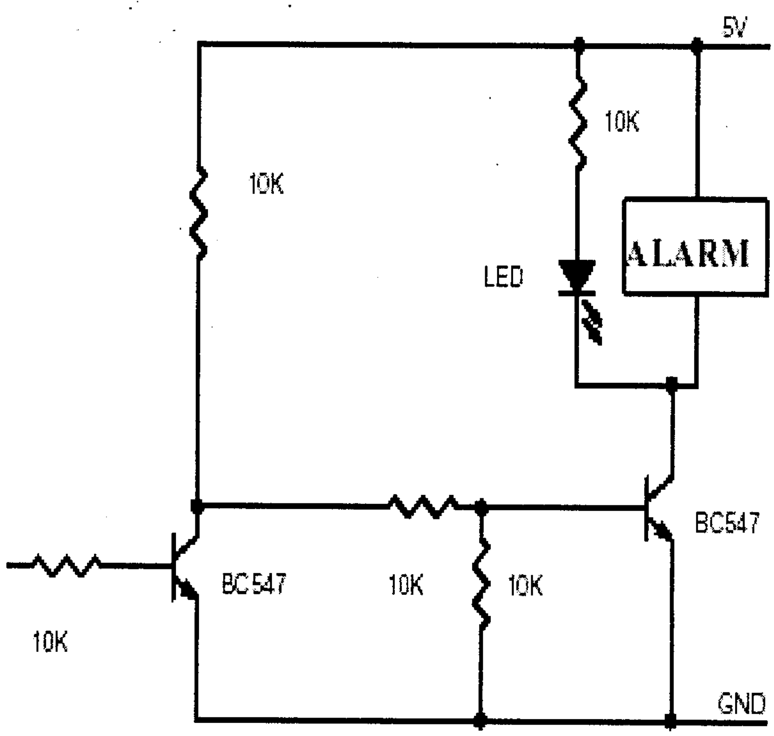


Figure 10.4 Alarm circuit

P- 1665

10.4 RELAY CIRCUIT

A relay is a switch worked by an electromagnet. It is useful if we want a small current in one circuit to control another circuit containing a device such as a lamp or electric motor which requires a large current, or if we wish several different switch contacts to be operated simultaneously.

When the controlling current flows through the coil, the soft iron core is magnetized and attracts the L-shaped soft iron armature. This rocks on its pivot and opens, closes or changes over, the electric

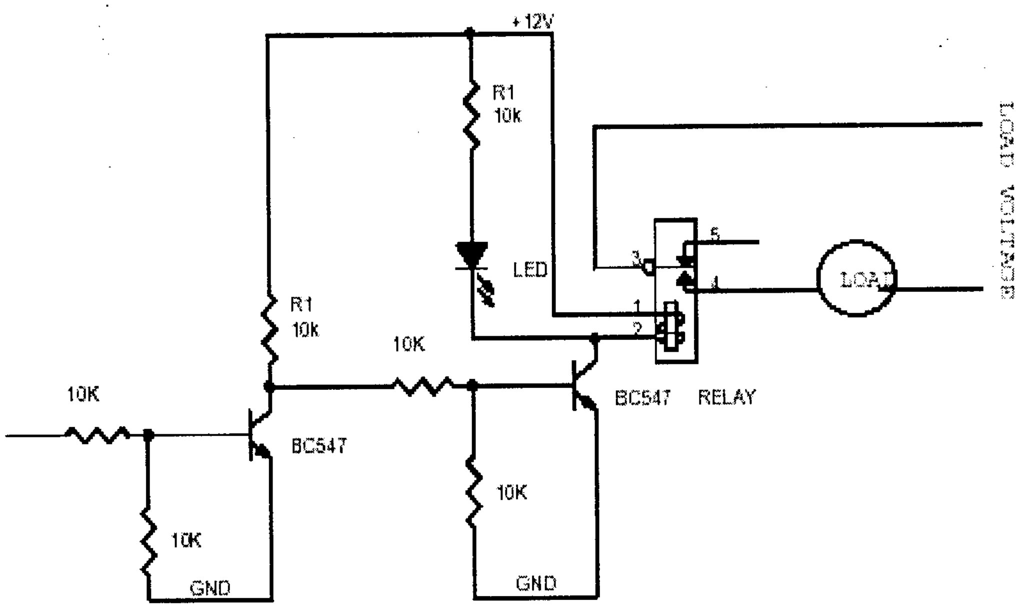


Figure 10.5 Relay circuit

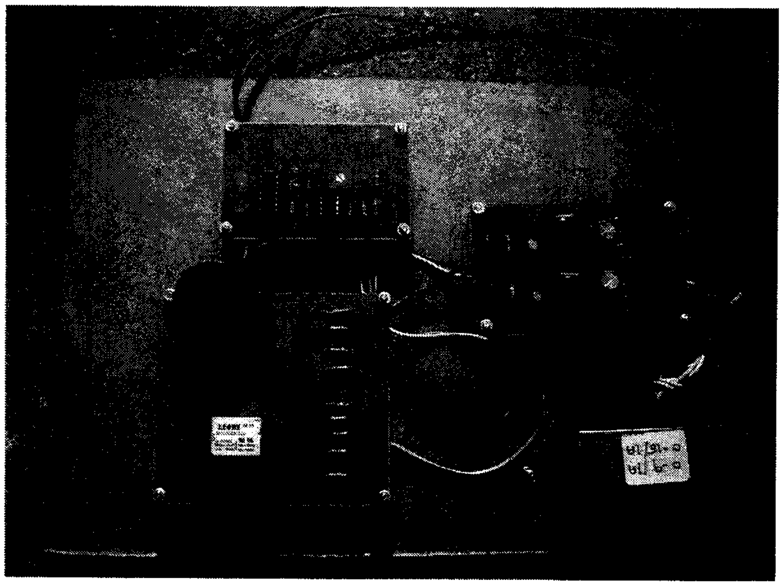


Figure 10.6 Entire circuit

CHAPTER – 11

ACTUATOR MECHANISM

11.1 ACTUATORS

An actuator is a device that is used to apply a force to an object Fluid power actuators can be classified into two groups:

- Linear actuators are used to move an object or apply a force in a straight line.
- Linear actuators can be divided into two types.

They are

1. Single acting cylinders

2. Double acting cylinders

A single acting cylinder is powered by fluid for the movement of the piston in one direction with it being returned in the other direction by an internal spring or an external force, a double acting cylinder is powered by fluid in both directions.

Rotary actuators are used to move an object in a circular path. Rotary actuators are the fluid power equivalent of an electric motor.

11.2 CYLINDERS

Cylinders are the one, which offers the rectilinear motion to mechanical elements. Cylinders are classified as light, medium, and heavy duty with respect to their application.

11.2.1 Single Acting Cylinders

In this type, the cylinder can produce work only in one direction. The return movement of the piston is effected by a built in spring or by application of an external force. The spring is designed to return the piston to its initial position with a sufficiently high speed.

Types of single acting cylinders:

- Diaphragm cylinder
- Rolling diaphragm cylinder

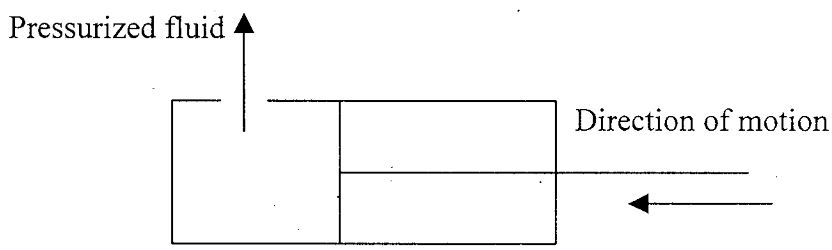


Figure 11.1 Single acting cylinder

11.2.2 Double Acting Cylinder

The force exerted by the compressed air moves the piston in two directions in a double acting cylinder. They are used particularly when the piston is required to perform work not only on the advance movement but also on the return. In principle, the stroke length is unlimited, although buckling and bending must be considered before we select a particular size of piston diameter, rod length and stroke length.

We use cylinders that are double acting type (i.e.) the compressed oil can be passed to either end of the cylinder. These cylinders are made up of cast iron.

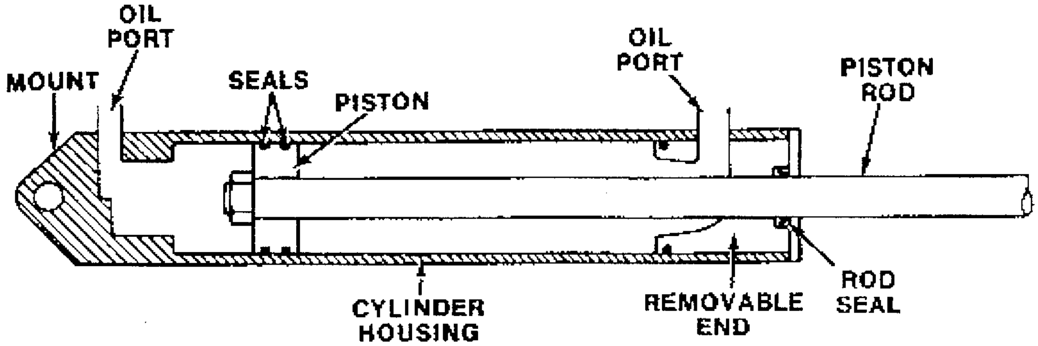


Figure 11.2 Double acting cylinder

11.3 RELAY OUTPUT FOR PACKAGE LIFTING

The flame sensor will continuously sense the burner flame, if the flame cuts off then the relay will get energized. The energized relay will actuate the double acting cylinder so that the winding process of the processed yarn will get away from the main spindle thereby the winding process gets stopped. ie, the package will be lifted up.

CHAPTER – 12

RESULTS AND DISCUSSIONS

HAIRNINESS TESTER RESULTS

Test length (m) : 100

Yarn count : 2/74 Ne

Twist : 26

Doubling : 2 ply yarn

Tested at : SITRA

TABLE 12.1 TEST RESULTS FOR NON GASSED YARN

mm indicates Number of hairs in the length zone

Cone no.	1 mm	2mm	3mm	4mm	6mm	8mm	10mm
1	13070	2599	1026	629	86	11	-
2	16405	3115	1287	690	67	15	-
3	14231	2287	784	332	31	1	-
4	14528	2739	1042	551	76	9	1
5	13174	2263	729	327	34	2	-
6	14517	2614	933	437	36	2	-
7	14803	2942	1124	630	54	5	-
8	11515	2015	648	291	30	-	-
9	14611	2839	1103	644	58	8	-
10	15594	2983	1019	547	38	3	-

Test length (m) : 100

Yarn count : 2/74 Ne

Twist : 26

Doubling : 2 ply yarn

Tested at : SITRA

TABLE 12.2 TEST RESULT FOR GASSED YARN

mm indicates Number of hairs in the length zone

Cone no.	1 mm	2mm	3mm	4mm	6mm	8mm	10mm
1	1375	70	7	-	-	-	-
2	2137	114	20	1	-	-	-
3	2868	232	41	9	1	-	-
4	2988	243	39	7	-	-	-
5	1865	85	5	2	-	-	-
6	1409	79	5	2	-	-	-
7	1459	61	10	-	-	-	-
8	979	39	6	-	-	-	-
9	1730	79	12	1	-	-	-
10	2912	214	26	5	-	-	-

Test length (m) : 100

Yarn count : 2/74 Ne

Twist : 26

Doubling : 2 ply yarn

Tested at : SITRA

TABLE 12.3 TEST RESULTS FOR GASSED YARN AFTER FITTING THE HOUSING

mm indicates Number of hairs in the length zone

Cone no.	1 mm	2mm	3mm	4mm	6mm	8mm	10mm
1	1100	70	7	-	-	-	-
2	975	100	10	-	-	-	-
3	845	75	12	1	-	-	-
4	1120	97	8	-	-	-	-
5	1725	115	11	-	-	-	-
6	970	98	12	-	-	-	-
7	825	120	5	2	-	-	-
8	989	89	8	-	-	-	-
9	1190	75	13	-	-	-	-
10	955	90	15	-	-	-	-

From the above test results there was increase in yarn quality after fitting the housing. Also there was increase in 10 % to 15 % productivity.

CHAPTER – 13

LIMITATIONS OF PROJECT WORK

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