DESIGN AND FABRICATION OF BELT CONVEYOR

A Project Report

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BONAFIDE CERTIFICATE

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ABSTRACT

In this racing world, time is considered as a prime factor. "One who saves more time wins the race "is the motto followed by everyone. Automation is the only solution for this problem that exists in industries. In this project the time taken by material inspection is saved by using conveyors.

Another factor which decides the winner is quality. Every industry has to produce product with quality so that their product is better than their competitors. It should be produced with no error. One of the best way to achieve is using sensors. Sensors are being used in every industry today to reduce the time taken by the process. It also minimizes the size of the machine to great extent.

Sensors are used to detect any physical quantity of the material and develop signals and send them to control unit. Sensors are being used in full swing in all mechanical and electronic industries.

Thus this project mainly deals with the quality testing of the materials which is done using sensors so that manual inspection is overcome by automation to save time, and produce error less products.

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CHAPTER-1

INTRODUCTION

This is an era of automation where it is broadly defined as replacement of manual effort by mechanical power in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

Degrees of automation are of two types, viz.

Full automation.

Semi automation.

In semi automation a combination of manual effort and mechanical power is required whereas in full automation human participation is very negligible.

1.1. SCOPE AND PURPOSE

This project deals with problem of reducing time on material inspection. Industries are mainly interested in delivering products to the customers in time and to utilize the available resources in efficient form. Therefore machine idle time parameters are introduced. The problem is intractable and consequently develops an efficient heuristic to obtain near – optimal solutions. The problem of avoiding manual material inspection is considered. The goal is to find an optimal solution, which avoids manual material inspection.

Infrared sensors have been used accordingly to calculate the physical dimension of the material and it is demonstrated with the help of conveyors for material inspection.

1.2. NEED FOR AUTOMATION

Automation can be achieved through computers, hydraulics, pneumatics, robotics, etc., of these sources, pneumatics form an attractive medium for low cost automation. The main advantages of all pneumatic systems are economy and simplicity. Automation plays an important role in mass production.

For mass production of the product, the machining operations decide the sequence of machining. The machines designed for producing a particular product are called transfer machines. The components must be moved automatically from the bins to various machines sequentially and the final component can be placed separately for packaging. Materials can also be repeatedly transferred from the moving conveyors to the work place and vice versa.

Quality Control and Inspection are the most important things in factory design. Automation plays a vital role in mass production of a product, the machining operations decides the sequence of machining. The machines designed for producing a particular product are called transfer machines. Conveyor Automation is a specialized activity for a modern manufacturing concern. It has been estimated that about 60-70% of the cost production is spent in material transferring activities.

1.3. NEED FOR CONVEYOR AUTOMATION:

- Reduction of labour and material cost
- Reduction of overall cost
- Increased production
- Increased safety
- To reduce the inspection time
- Reduction in fatigue
- Improved personnel comfort

1.4. SEQUENCE OF THE REPORT

This report starts with a brief introduction about quality inspection and sensors, then the problem faced in the industry has been described, literature survey has been done in detail, and the components of the instrument has been described. Then the design calculation and specification of the components have been described along with the drawing of the components. The fabrication method and the working operation of the instrument is explained next. The advantages and disadvantages of the instrument is explained and the conclusion of the project is arrived later.

1.5. LIMITATIONS OF THE PROJECT

This project also includes some limitations such as; only scalar dimensions can be measure using sensors. No angular measurements can be made and weight of the material is not considered. Only small materials which doesn't affect the conveyor arrangement can be used, no heavy material can be used for inspection.

CHAPTER – 2

LITERATURE SURVEY

2.1. PNEUMATICS

The word 'pneuma' comes from Greek and means breather wind. The word pneumatics is the study of air movement and its phenomena is derived from the word pneuma. Today pneumatics is mainly understood from the application of air as a working medium in industry especially the driving and controlling of machines and equipment.

Pneumatics has for some considerable time been used for carrying out the simplest mechanical tasks in more recent times and has played a more important role in the development of pneumatic technology for automation.

Pneumatic systems operate on a supply of compressed air which must be made available in sufficient quantity and at a sufficient pressure to suit the capacity of the system. When the pneumatic system is being adopted for the first time, it will indeed be necessary to deal with the question of compressed air supply.

The key part of any facility for supply of compressed air is by means of using reciprocating compressor. A compressor is a machine that takes in air, gas at a certain pressure and delivered the air at a high pressure.

Compressor capacity is the actual quantity of air compressed and delivered and the volume is expressed with that of the air at intake conditions mainly at atmosphere pressure and normal ambient temperature.

The compressibility of the air was first investigated by Robert Boyle in 1962 and found that the product of pressure and volume of a particular quantity of gas is a constant.

This is usual written as

$$PV = C \qquad (or) \quad P_1V_1 = P2V2$$

In this equation the pressure is the absolute pressure which for free is about 14.7 Psi and is of course capable of maintaining a column of mercury, nearly 30 inches high in an ordinary barometer. Any gas can be used in pneumatic system but air is the mostly used medium now a days.

2.1.1. Selection of pneumatics

Mechanization is broadly defined as the replacement of manual effort by mechanical power. Pneumatic is an attractive medium for low cost mechanization particularly for sequential (or) repetitive operations. Many factories and plants already have a compressed air system, which is capable of providing the power (or) energy requirements and the control system (although equally pneumatic control systems may be economic and can be advantageously applied to other forms of power).

The main advantage of an all pneumatic system are usually economic and simplicity, the latter reducing maintenance to a low level. It can also have out standing advantages in terms of safety.

2.1.2. Pneumatic power

Pneumatic systems use pressurised gases to transmit and control power. Pneumatic systems typically use air as the fluid medium because air is safe, low cost and readily available.

The Advantages of Pneumatics:

1. Air used in pneumatic systems can be directly exhausted back in to the surrounding environment and hence the need of special reservoirs and no-leak system designs are eliminated.
2. Pneumatic systems are simple and economical.
3. Control of pneumatic systems is easier.

The Disadvantages of Pneumatics:

1. Pneumatic systems exhibit spongy characteristics due to compressibility of air.
2. Pneumatic pressures are quite low due to compressor design limitations (less that 250 psi).

2.2. AIR COMPRESSOR

Air compressors reduce the volume of a gas while increasing the pressure and heat. There are many uses of air compressors and they are included in scuba diving gear, jet engines, refrigeration, air conditioners, medicine, automobile engines, and submarines. As you can probably guess, there are a great many other air compressor applications, wherein people would find it useful to be able to store larger quantities of gases. These applications often involve life support and locomotion.

There are many types of air compressors. Categorized by their construction methods, they are reciprocating compressors, centrifugal compressors, axial-flow compressors, scroll compressors, and rotary screw compressors. Most methods of air compression require a staged approach, since air compressors tend to increase the heat of the target gases. These stages allow the air to cool before continuing the process. If you are searching for air compressors manufacturers, many suppliers have listings online. Air compressors are often priced at several thousands of dollars per unit depending on the specific needs and robust requirements.

2.2.1. Production of compressed air

Pneumatic systems operate on a supply of compressed air, which must be made available in sufficient quantity and at a pressure to suit the capacity of the system. When pneumatic system is being adopted for the first time; however it wills indeed the necessary to deal with the question of compressed air supply.

The key part of any facility for supply of compressed air is by means using reciprocating compressor. A compressor is a machine that takes in air, gas at a certain pressure and delivered the air at a high pressure. Compressor capacity is the actual quantity of air compressed and delivered and the volume expressed is that of the air at intake conditions namely at atmosphere pressure and normal ambient temperature.

Clean condition of the suction air is one of the factors, which decides the life of a compressor. Warm and moist suction air will result in increased precipitation of condense from the compressed air. Compressor may be classified in two general types.

1. Positive displacement compressor.
2. Turbo compressor

Positive displacement compressors are most frequently employed for compressed air plant and have proved highly successful and supply air for pneumatic control application.

The types of positive compressor

1. Reciprocating type compressor
2. Rotary type compressor

Turbo compressors are employed where large capacity of air required at low discharge pressures. They cannot attain pressure necessary for pneumatic control application unless built in multistage designs and are seldom encountered in

2.3. RECIPROCATING COMPRESSORS

Built for either stationary (or) portable service the reciprocating compressor is by far the most common type. Reciprocating compressors lap be had is sizes from the smallest capacities to deliver more than 500 m^3/min. In single stage compressor, the air pressure may be of 6 bar machines discharge of pressure is up to 15 bars. Discharge pressure in the range of 250 bars can be obtained with high pressure reciprocating compressors that of three & four stages. Single stage and 1200 stage models are particularly suitable for pneumatic applications , with preference going to the two stage design as soon as the discharge pressure exceeds 6 bar , because it in capable of matching the performance of single stage machine at lower costs per driving powers in the range .

Reciprocating Compressors are utilized in all manufacturing industries. Because these machines are capable of providing high pressure along with variable loading, they are favored for many gas process applications. The total quantity of positive displacement reciprocating engines, pumps and compressors far exceed the number of centrifugal units.

Past studies within the Hydrocarbon Processing Industry (HPI) indicate that the maintenance costs for reciprocating equipment are approximately 3.5 times that of centrifugal equipment. Substantial savings in maintenance costs and an increase in run time may be achieved through basic monitoring of some if not all of the following Reciprocating Machine parameters.

Reciprocating compressors are positive displacement machines, meaning that they increase the pressure of the air by reducing its volume. The relationship between pressure and volume is illustrated in the figure below. This compressor has a crankshaft, connecting rods, and pistons. Single-stage and two-stage reciprocating compressors are commercially available. Single-stage compressors are generally used for pressures in the range of 70 psig to 100 psig. Two-stage compressors are generally used for higher pressures in the range of 100 psig to 250 psig.

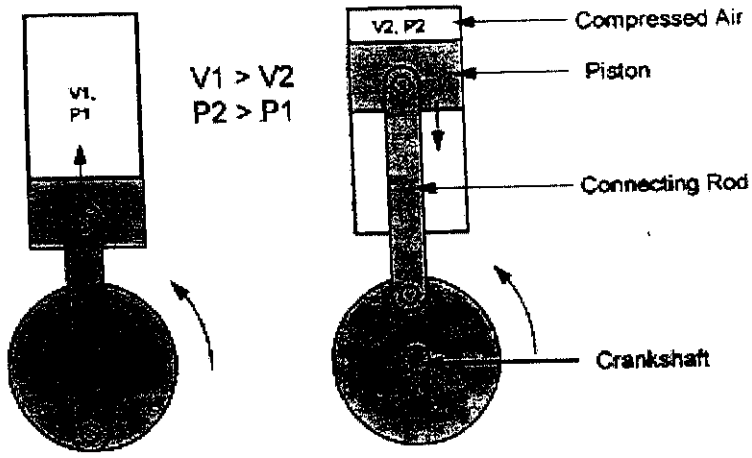
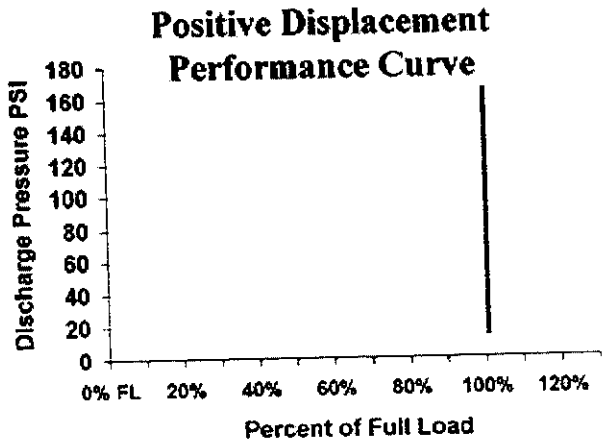


Figure 2.1 Reciprocating Compressor Schematic

A performance curve for a positive displacement machine is provided in the figure below. It can be seen that despite compressor discharge pressure, load remains constant. Load reduction is achieved by unloading individual cylinders. Typically, this is accomplished by throttling the suction pressure to the cylinder or bypassing air either within or outside the compressor. Capacity control is achieved by varying speed in engine-driven units through fuel flow control.



Source: Ingersoll Rand Co

Figure 2.2 Positive Displacement Performance Curve

2.4. DC MOTOR

One of the first electromagnetic rotary motors was invented by Michael_Faraday in 1821 and consisted of a free-hanging wire dipping into a pool of mercury. A permanent magnet was placed in the middle of the pool. When a current was passed through the wire, the wire rotated around the magnet, showing that the current gave rise to a circular magnetic field around the wire. This motor is often demonstrated in school physics classes, but brine is sometimes used in place of the toxic mercury. This is the simplest form of a class of electric motors called homopolar motors. A later refinement is the Barlow's Wheel.

Another early electric motor design used a reciprocating plunger inside a switched solenoid; conceptually it could be viewed as an electromagnetic version of a two stroke internal combustion engine.

The modern DC motor was invented by accident in 1873, when Zénobe Gramme connected a spinning dynamo to a second similar unit, driving it as a motor.

The classic DC motor has a rotating legature in the form of an electromagnet. A rotary switch called a commutator reverses the direction of the electric current twice every cycle, to flow through the armature so that the poles of the electromagnet push and pull against the permanent magnets on the outside of the motor. As the poles of the armature electromagnet pass the poles of the permanent magnets, the commutator reverses the polarity of the armature electromagnet. During that instant of switching polarity, inertia keeps the classical motor going in the proper direction.

The types of DC Motor are explained below

2.4.1. Wound field DC motor

The permanent magnets on the outside (stator) of a DC motor may be replaced by electromagnets. By varying the field current it is possible to alter the speed/torque ratio of the motor. Typically the field winding will be placed in series (series wound) with the armature winding to get a high torque low speed motor, in parallel (shunt wound) with the armature to get a high speed low torque motor, or

to have a winding partly in parallel, and partly in series (compound wound) for a balance that gives steady speed over a range of loads. Further reductions in field current are possible to gain even higher speed but correspondingly lower torque, called "weak field" operation.

2.4.2. Speed control DC motor

Generally speaking the rotational speed of a DC motor is proportional to the voltage applied to it, and the torque is proportional to the current. Speed control can be achieved by variable battery tappings, variable supply voltage, resistors or electronic controls. The direction of a wound field DC motor can be changed by reversing either the field or armature connections but not both, this is commonly done with a special set of contactors (direction contactors).

Effective voltage can be varied by inserting a series resistor or by an electronically-controlled switching device made of thyristors, transistors, or, historically, mercury arc rectifiers. In a circuit known as a chopper, the average voltage applied to the motor is varied by switching the supply voltage very rapidly. As the "on" to "off" ratio is varied to alter the average applied voltage, the speed of the motor varies. The rapid switching wastes less energy than series resistors. Output filters smooth the average voltage applied to the motor and reduce motor noise.

Since the series-wound DC motor develops its highest torque at low speed, it is often used in traction applications such as electric locomotives, and trams. Another application is starter motors for petrol and small diesel engines.

2.4.3. Universal motors

A variant of the wound field DC motor is the universal motor. The name derives from the fact that it may use AC or DC supply current, although in practice they are nearly always used with AC supplies. The principle is that in a wound field DC motor the current in both the field and the armature (and hence the resultant

mechanical force generated is always the same. In practice the motor must be specially designed to cope with the AC current (impedance must be taken into account), and the resultant motor is generally less efficient than an equivalent pure DC motor. The maximum output of universal motors is limited, and motors exceeding one kilowatt are rarely operated on commercial power frequency.

The advantage of the universal motor is that AC supplies may be used on motors which have the typical characteristics of DC motors, specifically high starting torque and very compact design if high running speeds are used. The negative aspect is the maintenance and short life problems caused by the commutator. As a result such motors are usually used in AC devices such as food mixers and power tools which are only used intermittently. Continuous speed control of a universal motor running on AC is very easily accomplished using a thyristor circuit while stepped speed control can be accomplished using multiple taps on the field coil. Household blenders that advertise many speeds frequently combine a field coil with several taps and a diode that can be inserted in series with the motor (causing the motor to run on half-wave DC with half the RMS voltage of the AC power line).

Unlike AC motors, universal motors can easily exceed one revolution per cycle of the mains current. This makes them useful for appliances such as blenders, vacuum cleaners, and hair dryers where high-speed operation is desired. Many vacuum cleaner and weed trimmer motors will exceed 10,000 RPM, Dremel and other similar miniature grinders will often exceed 30,000 RPM. A theoretical universal motor allowed to operate with no mechanical load will overspeed, which may damage it. In real life, though, various bearing frictions, armature "windage", and the load of any integrated cooling fan all act to prevent overspeed.

With the very low cost of semiconductor rectifiers, some applications that would have previously used a universal motor now use a pure DC motor, usually with a permanent magnet field. This is especially true if the semiconductor circuit is also used for variable-speed control.

The advantages of the universal motor and alternating-current distribution made [illegible] traction current distribution system economical for

some railway installations. At low enough frequencies, the motor performance is approximately the same as if the motor were operating on DC.

2.5. CONVEYOR BELT

A conveyor belt or belt conveyor consists of two end pulleys, with a continuous loop of material that rotates about them. The pulleys are powered, moving the belt and the material on the belt forward. Conveyor belts are extensively used to transport industrial and agricultural materials, such as grain, coal, ores, etc. Conveyor belts with regularly spaced partitions are often called elevator belts. Conveyor belts are used in self-unloading bulk freighters and in live bottom trucks. This technology is also used in conveyor transport such as moving sidewalks or escalators, as well as on many manufacturing assembly lines. Stores often have conveyor belts at the check-out counter to move shopping items. Ski areas also use conveyor belts to transport skiers up the hill.

In contrast, the moving floor system is a technology that uses reciprocating slats to move cargo through the floor. Also in contrast is a roller conveyor system, which uses a series of rotating rollers to convey boxes or pallets.

The longest conveyor belt in the world is in Western Sahara. It is 100 km long, from the phosphate mines of Bu Craa to the coast south of El-Aaiun.

Conveyor mechanisms are used as components in automated distribution and warehousing. In combination with computer controlled pallet handling equipment this allows for more efficient retail, wholesale, and manufacturing distribution. It is considered a labor saving system that allows large volumes to move rapidly through a process, allowing companies to ship or receive higher volumes with smaller storage space and with less labor expense.

2.5.1. Conveyor belt system

The conveyor belt system consists of a continuous moving belt that carries materials or packages from one place to another. This belting system is also used in conveyor transport systems such as moving sidewalks or escalators, as well as on many manufacturing assembly lines. A conveyor belt or belt conveyor consist

of two end pulleys and is usually suspended with a continuous loop of material that rotates about them. The Conveyor belt systems are widely used in an array of material transport applications such as manufacturing, food processing and heavy industry. They are extensively used to transport industrial and agricultural materials such as grain, coal, ores, etc. Such systems are also are used in self-unloading bulk freighters and live bottom trucks.

The conveyor belting system uses reciprocating planks to move cargo through the floor. Also, in contrast is a roller conveyor system, which uses a series of rotating rollers to convey boxes or pallets. The conveyor belt dimensions are more often flexible to match the user's specifications or application needs. The belt materials and pattern vary for specific uses such as roofing stones conveying, bakery oven belts for pies and pizzas, extracted gravel transport, and so on. Conveyor belts are available for a wide array of applications and transportation and more often application specific.

Primarily, these conveyor belts are more useful commercially than for local purpose. So keeping this in mind these belts are too designed in such a way that they solve a specific industry purpose. The agricultural belting system is basically designed for agricultural applications like transporting fodder and various farm equipments whereas retail belting system is generally used for transferring inventory. Construction conveyor belting system is designed for transporting or roofing heavy stones or plywood but forest conveyor belts are designed for carrying logs, tree farms and other related products.

The widely used and the most popular conveyor belt system is power transmission belting. It is designed and rated for use in power transmission applications like engine belts, belting for power takeoffs and industrial machineries. They are basically used to transfer heavy and bulky machines to the desired spot. These conveyor belts are generally made of a tough and strong material, making them carry heavy load with ease.

2.6. SOLENOID VALVE

A solenoid valve is an electromechanical valve (for use with liquid or gas) controlled by running (or stopping) an electrical current through a solenoid, (which is a coil of wire) thus changing the state of the valve.

A spring may be used to hold the valve opened or closed while the valve is not activated.

A common use for solenoid valves is in Central Heating. The solenoid valves are controlled by an electrical signal from the thermostat to regulate the flow of heated water from a heat pump to the in room radiators. Such valves are particularly useful when multiple heating zones are driven by a single heat pump. Commercially available solenoid valves for this purpose are often referred to as Zone valves.

2.7. PNEUMATIC SOLENOIDS

A pneumatic solenoid valve is a switch for routing air to any pneumatic device, usually an actuator of some kind. A solenoid consists of a balanced or easily moveable core, which channels the gas to the appropriate port, coupled to a small linear solenoid. The valve allows a small current applied to the solenoid to switch a large amount of high pressure gas, typically at around 100 psi (7 bar, 0.7 MPa, 0.7 MN/m^2).

Pneumatic solenoids may have one, two, or three output ports, and the requisite number of vents. The valves are commonly used to control a piston or other linear actuator.

The pneumatic solenoid is akin to a transistor, allowing a relatively small signal to control a large device. It is also the interface between electronic controllers and pneumatic systems.

2.8. THE BASICS OF SOLENOID VALVES

Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix gases and fluids. They are

found in many application areas, for example: Fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design.

Besides the plunger-type actuator which is used most frequently, pivoted-armature actuators and rocker actuators are also used.

2.9. FLOW CONTROL VALVE

A flow control valve regulates the flow or pressure of a fluid. Control valves normally respond to signals generated by independent devices such as flow meters or temperature gauges. Control valves are normally fitted with actuators and positioners. Pneumatically-actuated globe valves are widely used for control purposes in many industries, although quarter-turn types such as (modified) ball and butterfly valves are also used.

Control valves can also work with hydraulic actuators (also known as hydraulic pilots). These types of valves are also known as Automatic Control Valves. The hydraulic actuators will respond to changes of pressure or flow and will open/close the valve. Automatic Control Valves do not require an external power source, meaning that the fluid pressure is enough to open and close the valve. Automatic control valves include: pressure reducing valves, flow control valves, back-pressure sustaining valves, altitude valves, and relief valves. An altitude valve controls the level of a tank. The altitude valve will remain open while the tank is not full and it will close when the tanks reaches its maximum level. The opening and closing of the valve requires no external power source (electric, pneumatic, or man power), it is done automatically, hence its name.

2.10. SENSOR

A sensor is a type of transducer, or mechanism, that responds to a type of energy by producing another type of energy signal, usually electrical. They are either direct indicating (an electrical meter) or are paired with an indicator (perhaps indirectly through an analog to digital converter, a computer and a display) so that the value sensed is translated for human understanding. Types of sensors include electromagnetic, chemical, biological and acoustic. Aside from other applications,

sensors are heavily used in medicine, industry and robotics.

In order to act as an effectual sensor, the following guidelines must be met:

- the sensor should be sensitive to the measured property
- the sensor should be insensitive to any other property
- the sensor should not influence the measured property

In theory, when the sensor is working perfectly, the output signal of a sensor is exactly proportional to the value of the property it is meant to measure. The gain is then defined as the ratio between output signal and measured property. For example, if a sensor measures temperature and has an actual voltage output. When the sensor is not perfect, various deviations can occur, including gain error, long term drift, and noise. These and other deviations can be classified as systematic, or random, errors. Systematic deviations may be compensated for by means of some kind of calibration strategy. Noise is an example of a random error that can be reduced by signal processing, such as filtering, usually at the expense of the dynamic behavior of the sensor.

Sensor controlled system have become an integrated part of today's automobile.

2.11. TYPES OF SENSOR

There are various types of sensors available which are being used in different situations. Sensors are classified according to the situation in which they are used. The different forms of sensors are listed below.

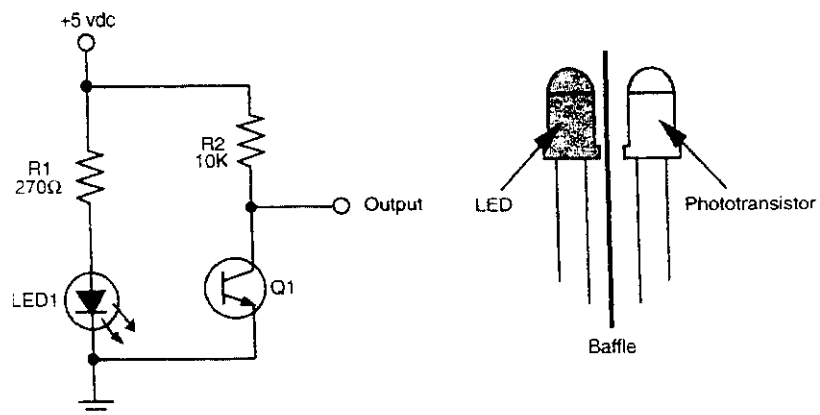
- Hall effect Sensor
- Infrared Sensor
- Angular rate Sensor
- Magnetic pick up Sensor
- Proximity Sensor
- Temperature Sensor
- Rollover Sensor

- Misfire Sensor
- Back Sensor
- Thermal Sensor
- Alcohol / LPG / Gas Sensor
- Oxygen Sensor
- Ultrasonic Sensor
- Coolant temperature Sensor
- Position Sensor
- Pressure Sensor

Some types of sensors are explained in details below which were helpful in deciding the suitable sensor for this project. They are

2.11.1. Infrared Proximity sensor :

The photo depicts the schematics for an infrared sensor which allows you to detect an object's distance from the robot. The big picture problem is attach this infrared sensor on both wings of the aerial robot. Attaching these sensors on the wing tips will help the robot navigate through the halls of any building.. This tutorial shows you how to construct and test one infrared sensor and takes approximately 3 hours to complete.



The basic design of the infrared proximity sensor.

Figure 2.3

2.11.2. Infrared Temperature Sensor :

Infrared (IR) radiation is part of the electromagnetic spectrum, which includes radio waves, microwaves, visible light, and ultraviolet light, as well as gamma rays and X-rays.

The IR range falls between the visible portion of the spectrum and radio waves. IR wavelengths are usually expressed in microns, with the IR spectrum extending from 0.7 to 1000 microns. Only the 0.7-14 micron band is used for IR temperature measurement.

Using advanced optic systems and detectors, noncontact IR thermometers can focus on nearly any portion or portions of the 0.7-14 micron band. Because every object (with the exception of a blackbody) emits an optimum amount of IR energy at a specific point along the IR band, each process may require unique sensor models with specific optics and detector types.

The intensity of an object's emitted IR energy increases or decreases in proportion to its temperature. It is the emitted energy, measured as the target's emissivity, that indicates an object's temperature.

Emissivity is a term used to quantify the energy-emitting characteristics of different materials and surfaces. IR sensors have adjustable emissivity settings, usually from 0.1 to 1.0, which allow accurate temperature measurements of several surface types.

The emitted energy comes from an object and reaches the IR sensor through its optical system, which focuses the energy onto one or more photosensitive detectors. The detector then converts the IR energy into an electrical signal, which is in turn converted into a temperature value based on the sensor's calibration equation and the target's emissivity. This temperature
value can be displayed on the sensor, or, in the case of the smart sensor, converted to a digital output and displayed on a computer terminal.

2.11.3. Pressure Sensor :

With the steam age came the demand for pressure measuring instruments. Bourdon tubes or bellows, where mechanical displacements were transferred to an indicating pointer were the first pressure instruments, and are still in use today.

Pressure metrology is the technology of transducing pressure into an electrical quantity. Normally, a diaphragm construction is used with strain gauges either bonded to , or diffused into it, acting as resistive elements. Under the pressure-induced strain, the resistive values change.

In capacitive technology, the pressure diaphragm is one plate of a capacitor that changes its value under pressure-induced displacement.

Pressure sensing using diaphragm technology measures the difference in pressure of the two sides of the diaphragm. Depending upon the relevant pressure, we use the terms ABSOLUTE, where the reference is vacuum , GAUGE, where the reference is atmospheric pressure , or DIFFERENTIAL, where the sensor has two ports for the measure of two different pressure.

2.11.4. Hall effect Sensor :

Hall Effect sensors are based on the small electrical potential created when a stationary magnetic field is placed perpendicular to a current-carrying conductor. They produce a digital or analogue output proportional to the magnetic field strength which is amplified to enable different voltage outputs. Hall Effect sensors are fast becoming an attractive alternative to inductive sensors, offering the same reliable, virtually unlimited life as a non-contacting technology, but at lower cost as they do not require sophisticated electronics. The main disadvantage is that they are sensitive to electromagnetic interference but this can be overcome with the use of appropriate shielding and good internal circuit design for all but the most demanding environments.

These are particularly suitable for designers in motorsport and heavy-duty applications who are looking for the long-life of a non-contacting sensor, but without the complex signalling that inductive sensors require. In most cases, wherever a rotary potentiometer is being used, it could (in theory) be replaced by a Hall Effect device depending on the surrounding environment.

2.11.5. Passive infrared sensors

Passive InfraRed sensors (PIRs) are electronic devices which are used in some security alarm systems to detect motion of an infrared emitting source, usually a human body.

All objects, living or not, whose temperature is anything above absolute zero (−273.15°C or −459.67°F) emit infrared radiation; see black body radiation. This radiation (energy) is invisible to the human eye but can be detected by electronic devices designed for such a purpose. The term "passive" in this instance means the PIR does not emit any energy of any type but merely sits 'passive' accepting infrared energy through the 'window' in its housing. The heart of the sensor is a solid state 'chip', approximately 1/4 inch square and often from a pyroelectric material, mounted on a printed circuit board which also contains the necessary electronics required to interpret the signals from this chip. The printed circuit board is contained in the housing which is then mounted in a location where the chip can 'see' the area to be 'protected'. The aforementioned window in the housing allows infrared energy to reach the chip. The window is covered with an infrared-transparent (but translucent to visible light) plastic sheet which may or may not have Fresnel lenses moulded into it. This plastic sheet prevents the intrusion of dust and insects while the Fresnel lenses, if present, focus the infrared energy onto the surface of the chip.

Some PIRs use a plastic segmented parabolic mirror or mirrors to focus the infrared energy onto the surface of the chip. Their plastic window cover has no Fresnel lenses molded into it. In either case, the PIR can be thought of as a kind of infrared 'camera' which remembers the amount of infrared energy falling on its surface, focused there by the mirrors or the Fresnel lenses. It might help to think of these focused points as 'hot spots' on the surface of the chip. Once power is

applied to the PIR the electronics in the PIR shortly settle into a quiescent state and energize a small relay. This relay controls a set of electrical contacts which are usually connected to the detection input of an alarm control panel.

The actual sensor on the chip is made from natural or artificial pyroelectric materials, usually in the form of a thin film, out of gallium nitride (GaN), caesium nitrate ($CsNO_3$), polyvinyl fluorides, derivatives of phenylpyrazine, and cobalt phthalocyanine. (See pyroelectric crystals.) Lithium tantalate ($LiTaO_3$) is a crystal] exhibiting both piezoelectric and pyroelectric properties.

An intruder entering the protected area is detected when the infrared energy emitted from his body is focused by a Fresnel lens or a mirror segment and overlaps a section on the chip which had previously been looking at some much cooler part of the protected area. That portion of the chip is now much warmer than when the intruder wasn't there. As the intruder moves, so does the hot spot on the surface of the chip. This moving hot spot causes the electronics connected to the chip to de-energize the relay, operating its contacts, thereby activating the detection input on the alarm control panel. Conversely, if an intruder were to try to defeat a PIR perhaps by holding some sort of thermal shield between himself and the PIR, a corresponding 'cold' spot moving across the face of the chip will also cause the relay to de-energize — unless the thermal shield has the same temperature as the objects behind it.

Manufacturers recommend careful placement of their products to prevent false alarms. They suggest mounting the PIRs in such a way that the PIR cannot 'see' out of a window. Although the wavelength of infrared radiation to which the chips are sensitive does not penetrate glass very well, a strong infrared source (a vehicle headlight, sunlight reflecting from a vehicle window) can overload the chip with enough infrared energy to fool the electronics and cause a false (non-intruder caused) alarm. A person moving on the other side of the glass however would not be 'seen' by the PIR.

They also recommended that the PIR not be placed in such a position that an HVAC vent would blow hot or cold air onto the surface of the plastic which

small amounts of infrared energy), the air blowing on the plastic window cover could change the plastic's temperature enough to, once again, fool the electronics.

PIRs come in many configurations for a wide variety of applications. The most common used in home security systems has numerous Fresnel lenses or mirror segments and has an effective range of about thirty feet. Some larger PIRs are fabricated with single segment mirrors and can sense changes in infrared energy over one hundred feet away from the PIR. There are also PIRs designed with reversible orientation mirrors which allow either broad coverage (110° wide) or very narrow 'curtain' coverage.

2.11.6. High Temperature Inductive Proximity Sensors

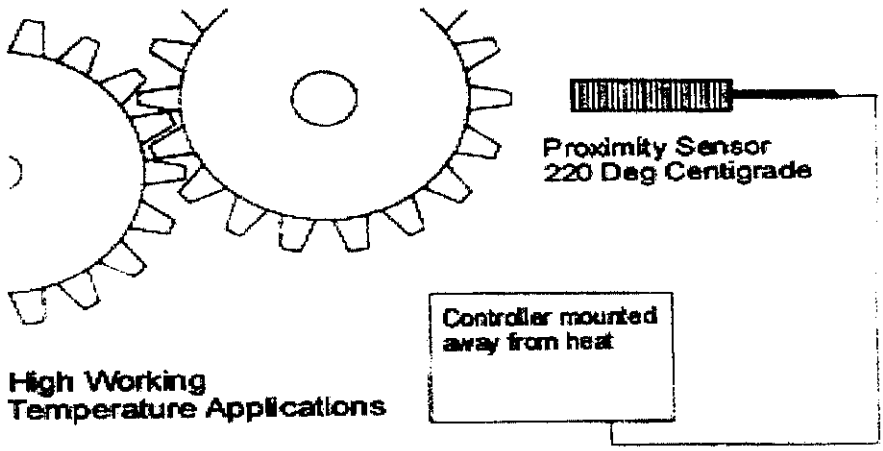


Figure 2.4 High temperature inductive proximity sensor

220° C Applications

High temperatures encountered in Industry can present problems for maintenance engineers as conventional proximity sensors have a maximum working temperature of 70° Centigrade.

MJB Electronics overcame this problem when they developed a inductive sensor to detect the position of conveyor wheel exiting ovens.

The equipment operates comfortably in temperature up to 220° Centigrade. Sensor heads are constructed using components impervious to high temperature to achieve this the connecting lead is made from PTFE.

2.12. APPLICATION OF SENSORS

Sensors are used in various areas. Now a days, sensors have become one of the basic component in all electronics system. Some of the areas in which sensors are used most profoundly are explained below

2.12.1. Sensors in Auto Racing :

The importance of sensors and senders relaying critical data to race teams has been proven time and again. Now, many of these products are available to grassroots race teams, at a fraction of their original cost.

Sensors and senders have become vital to a race team's success, from their essential use and development in high-end applications, such as Formula 1, to their growing profile in amateur ranks due to competitive pricing. This technology relays a wealth of information for controlling, monitoring and optimizing the race car's suspension, engine and exhaust setup.

"Knowing precisely how the car behaves on the track helps the driver and race engineer extract the best lap times," said Peter van Manen, McLaren Electronic Systems, Woking, Surrey, United Kingdom. "It also provides critical feedback to the engineers and technicians who are developing the vehicle. And, when something does start going wrong in a race or test, knowing about it early can be the difference between finishing the race or not."

Sensors and senders are critical because they directly measure what is happening on the car. Sensors monitor anything that can affect vehicle performance-pressures, speeds, temperatures, aerodynamics, braking loads and

torques, explained Mark Lane, Smith Systems, Brevard, North Carolina. "Many sensors provide only analog or digital signals which remote or onboard control systems interpret into useful data. More devices are becoming available, however, that provide current controlled output."

Sensors and senders report valuable information for controlling, monitoring and optimizing race cars' suspension, engine and exhaust setup. The benefits of using sensors and senders include transmitting information to help drivers and engineers achieve optimum lap times as well as determine where a problem may be located in the car. One manufacturer reported that a trend is toward sensors that are smaller and lighter but are capable of surviving high temperatures, especially with the increase in the operating temperature of racing car gearboxes and engines

Sensors monitor anything that can affect vehicle performance-pressures, speeds, temperatures, aerodynamics, braking loads and torques. While many sensors and senders are manufactured exclusively for high-end race teams, opportunities do exist for racing retailers to merchandise some of the more abundant products in this category. One manufacturer reported that with the price of sensors and senders having come down significantly over the past five to 10 years, many more racers have found that this technology is within their reach pricewise..

2.12.2. Sensors used to determine flow rate :

Motor speed control can also be used in smaller precise applications using diaphragm or peristaltic pumps.

Flow rates can be set from the front of the cabinet. Most applications require an accuracy of plus or minus 2.5% but more precise rates are possible.

This technique using a pump fed from a standard ball valve fed header tank has been found to work in processes where mains water pressure varies substantially.

The servo feedback control can easily be adapted to function as governor on a engine driven power generator or pump. Instead of measuring the flowrate, the 50 or 60HZ frequency from an alternator would be used.

The printed circuit used for this application can be calibrated to deliver a wide range of flow rates and outputs from a 0 to 5 volts to 10mV per unit of measurement, which can be litres or milliliters or imperial pints and gallons per minute, seconds or hour. The same board can be used as a tachometer.

The range of transducers suitable for feeding information into the PCB is also extensive. The board has a 5volt and 12 volt output to allow a standard self contained sensors that only requires a power supply and one output.

Components are provided on the PCB to allow a separate Infrared LED transmitter diode and a photo transistor to be connected.

2.12.3. Sensors used to count the batch materials :

The flow measuring equipment on the left is designed to regulate the volume of liquid used in industrial processes.

The picture shows 4 thumb wheel switches were a predetermined volume of liquid can be set. The maximum possible volume measured is 9999 liters.

2.12.4. Other applications of sensors :

The Sensors Technologies Program integrates with most other programs in CSREES. Nearly all aspects of production, processing, and management in agricultural and food systems (including forestry and natural resources) involve measurement of product/resource attributes (such as quantity, quality, size,

condition) or their environment (such as food impurities, or agricultural/forest air, water, and soils).

Rural economies and their infrastructures are also affected. Their biometric activities include inspection, monitoring, tracking, inventory, and valuation. The number of measurement variables—and their measurement frequency and level of detail—demands automated, high-resolution, and rapid technologies. In the interests of efficiency and wise stewardship, increasingly voluminous data are collected that must be further analyzed, interpreted, and applied to support intelligent decision making. Advances in biometrology and information technologies are required to address our need for timely and reliable information that has temporal and spatial relevance.

Food safety and quality represent one of the greatest public issues/concerns nationwide. Safety and quality depend on inspection and monitoring methods that can detect contaminants and discriminate defective (or poor quality) products. Whereas manual, microscopic, or bio-assay inspections cannot be performed quickly and accurately on 100 percent of any food product, sensor and instrumentation technologies currently under development and testing promise to offer inspection capabilities that are accurate, fast (in real time), and consistent. These technologies can range from detecting: internal bruising of apples to 10 cells of *Listeria* (a particularly virulent food pathogen) to insect infestations in a ship's cargo of grain.

Environmental quality is another area where sensor-based monitoring can be helpful. For example, animal feeding operators can use air quality monitoring around confined animals to keep ammonia or odor emission within acceptable limits. Water monitoring for nitrogen and phosphorus runoff from agricultural lands can help regulate freshwater algae blooms and costal-zone hypoxia. An ability to quickly and accurately measure carbon sequestration in soils can facilitate more widespread application of a carbon-credit and trading marketplace.

These types of measurement activities create special problems, however, because the elements being measured are molecular and they need to be quantified over large land areas. Nevertheless, these applications are scientifically possible; it

remains to develop the engineering and technology capability to make them economical and practical.

Remote sensing and animal health and feeding applications are covered by the Precision Farming program page.

2.13. SENSOR NETWORK

A sensor network is a computer network of spatially distributed devices using sensors to monitor conditions (such as temperature, sound, vibration, pressure, motion or pollutants) at a variety of locations. Usually the devices are small and inexpensive, allowing them to be produced and deployed in large numbers; this constrains their resources in terms of energy and memory.

Each device is equipped with a radio transceiver, a small microcontroller, and an energy source, most commonly a battery. The devices work off each other to deliver data to the computer which has been set up to monitor the information. Sensor networks involve three areas: sensing, communications, and computation (hardware, software, algorithms). They are applied in many areas, such as video surveillance, traffic monitoring, home monitoring and manufacturing.

2.14. IC TIMER 555

The 555 is an integrated circuit (chip) implementing a variety of timer and multivibrator applications. The IC was designed and invented by Hans R. Camenzind. It was designed in 1970 and introduced in 1971 by Signetics (later acquired by Philips). The original name was the SE555/NE555 and was called "The IC Time Machine". It is still in wide use, thanks to its ease of use, low price and good stability. Even today, Samsung in Korea manufactures over 1 billion units per year (2003).

The 555 timer is one of the most popular and versatile integrated circuits ever produced. It includes 23 transistors, 2 diodes and 16 resistors on a silicon chip installed in an 8-pin mini dual-in-line package (DIP). The 556 is a 14-pin DIP that combines two 555s on a single chip. The 558 is a 16-pin DIP that combines four,

slightly modified, 555s on a single chip (DIS & THR are connected internally, TR is falling edge sensitive instead of level sensitive). Also available are ultra-low power versions of the 555 such as the 7555. The 7555 requires slightly different wiring using fewer external components and less power.

The 555 has three operating modes:

- Monostable mode: in this mode, the 555 functions as a "one-shot". Applications include timers, missing pulse detection, bouncefree switches, touch switches, etc.
- Astable mode: the 555 can operate as an oscillator. Uses include LED and lamp flashers, pulse generation, logic clocks, tone generation, security alarms, etc.
- Bistable mode: the 555 can operate as a flip-flop, if the DIS pin is not connected and no capacitor is used. Uses include bouncefree latched switches, etc.

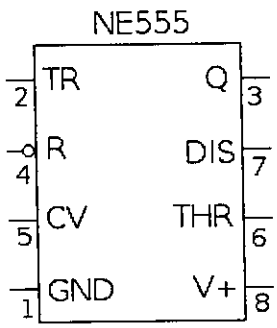


Figure 2.5 Schematic symbol of the 555 timer

The connection of the pins is as follows:

Nr.	Name	Purpose
1	GND	Ground, low level
2	TR	A short pulse high->low on the trigger starts the timer
3	Q	During a timing interval, the output stays at $+V_{CC}$
4	R	A timing interval can be interrupted by applying a reset pulse to low (0V)
5	CV	Control voltage allows access to the internal voltage divider (2/3 V_{CC})
6	THR	The threshold at which the interval ends (it ends if U.thr > 2/3 V_{CC})
7	DIS	Connected to a capacitor whose discharge time will influence the timing interval
8	V+, V_{CC}	The positive supply voltage which must be between 5 and 15 V, high level

Table 2.1 ICC 555 timer pin purpose table

Using simply a capacitor and a resistor, the timing interval, i.e. the time during which the output stays low, can be adjusted to the need of the specific application.

2.15. ULTIMATE AIM

The Automatic control of products using sensor can be widely used in low cost automation. The manpower requirement is negligible also reducing the inspection time of material.

CHAPTER – 3

DESCRIPTION OF COMPONENTS

3.1. MAJOR PARTS

The major parts "SENSOR BASED INSPECTION CONVEYOR" are described below:

- Pneumatic single Acting Cylinder
- 3/2 Single Acting Solenoid Valve
- Flow Control Valve
- Hose Collar and PU Connector
- Permanent Magnet D.C. Motor
- Electronic Control Unit
- IR Sensor
- Collecting Tray
- Conveyor Belt and Roller
- Frame Stand

3.1.1. PNEUMATIC CYLINDER:-

An air cylinder is an operative device in which the state input energy of compressed air i.e. pneumatic power is converted in to mechanical output power, by reducing the pressure of the air to that of the atmosphere.

a) Single acting cylinder

Single acting cylinder is only capable of performing an operating medium in only one direction. Single acting cylinders equipped with one inlet for the operating air pressure, can be production in several fundamentally different designs. Single cylinders develop power in one direction only. Therefore no heavy control equipment should be attached to them, which requires to be moved on the piston

return stoke single action cylinder requires only about half the air volume consumed by a double acting for one operating cycle.

b) Double acting cylinders:

A double acting cylinder is employed in control systems with the full pneumatic cushioning and it is essential when the cylinder itself is required to retard heavy messes. This can only be done at the end positions of the piston stock.

In all intermediate position a separate externally mounted cushioning derive most be provided with the damping feature. The normal escape of air is out off by a cushioning piston before the end of the stock is required. As a result the sit in the cushioning chamber is again compressed since it cannot escape but slowly according to the setting made on reverses.

The air freely enters the cylinder and the piston stokes in the other direction at full force and velocity.

GENERALLY USED MATERIALS

Cylinder Tube Materials:

LIGHT DUTY	MEDIUM DUTY	HEAVY DUTY
Plastic	Hard drawn brass tube	Hard drawn brass tube
Hard drawn Aluminium tube	Aluminium Castings	Hard drawn steel tube
Hard drawn Brass tube		Brass, Bronze, Iron Castings, welded steel tube

Table 3.1 Cylinder tube materials

Piston Rod Materials:

MATERIAL	FINISH	REMARKS
MILD STEEL	Ground and polished hardened, ground and polished.	Generally preferred chrome plated
STAINLESS STEEL	Ground and Polished	Less scratch resistant than chrome plated piston rod

Table 3.2 Piston rod materials

End Cover Materials:

LIGHT DUTY	MEDIUM DUTY	HEAVY DUTY
Aluminium stock (Fabricated)	Aluminium stock (Fabricated)	Hard tensile Castings
Brass stock (Fabricated)	Brass stock (Fabricated)	
Aluminium Castings	Aluminium, Brass, iron or steel Castings.	

Table 3.3 End cover materials

Piston Materials:

LIGHT DUTY	MEDIUM DUTY	HEAVY DUTY
Aluminium Castings	Aluminium Castings Brass (Fabricated)	Aluminium Forgings, Aluminium Castings.
	Bronze (Fabricated)	Bronze (Fabricated)
	Iron and Steel Castings	Brass, Bronze, Iron or Steel Castings.

Table 3.4 Piston materials

Mount Materials:

LIGHT DUTY	MEDIUM DUTY	HEAVY DUTY
Aluminium Castings	Aluminium, Brass And Steel Castings	High Tensile Steel Castings
Light Alloy (Fabricated)		High Tensile Steel Fabrication

Table 3.5 Mount materials

3.1.2. SINGLE ACTING 3/2 SOLENOID VALVE:-

The directional valve is one of the important parts of a pneumatic system. Commonly known as DCV, this valve is used to control the direction of air flow in the pneumatic system. The directional valve does this by changing the position of its internal movable parts.

This valve was selected for speedy operation and to reduce the manual effort and also for the modification of the machine into automatic machine by means of using a solenoid valve.

A solenoid is an electrical device that converts electrical energy into straight line motion and force. These are also used to operate a mechanical operation which in turn operates the valve mechanism. Solenoids may be push type or pull type. The push type solenoid is one in which the plunger is pushed when the solenoid is energized electrically. The pull type solenoid is one is which the plunger is pulled when the solenoid is energized.

The name of the parts of the solenoid should be learned so that they can be recognized when called upon to make repairs, to do service work or to install them.

3.1.2.1. Parts of a 3/2 Solenoid Valve

1. Coil

The solenoid coil is made of copper wire. The layers of wire are separated by insulating layer. The entire solenoid coil is covered with a varnish that is not affected by solvents, moisture, cutting oil or often fluids.

Coils are rated in various voltages such as 115 volts AC, 230 volts AC, 460 volts AC, 575 Volts AC, 6 Volts DC, 12 Volts DC, 24 Volts DC, 115 Volts DC & 230 Volts DC. They are designed for such frequencies as 50 Hz to 60 Hz.

2. Frame

The solenoid frame serves several purposes. Since it is made of laminated sheets, it is magnetized when the current passes through the coil. The magnetized coil attracts the metal plunger to move. The frame has provisions for attaching the mounting. They are usually bolted or welded to the frame. The frame has provisions for receivers, the plunger. The wear strips are mounted to the solenoid frame, and are made of materials such as metal or impregnated less fiber cloth.

3. Solenoid Plunger

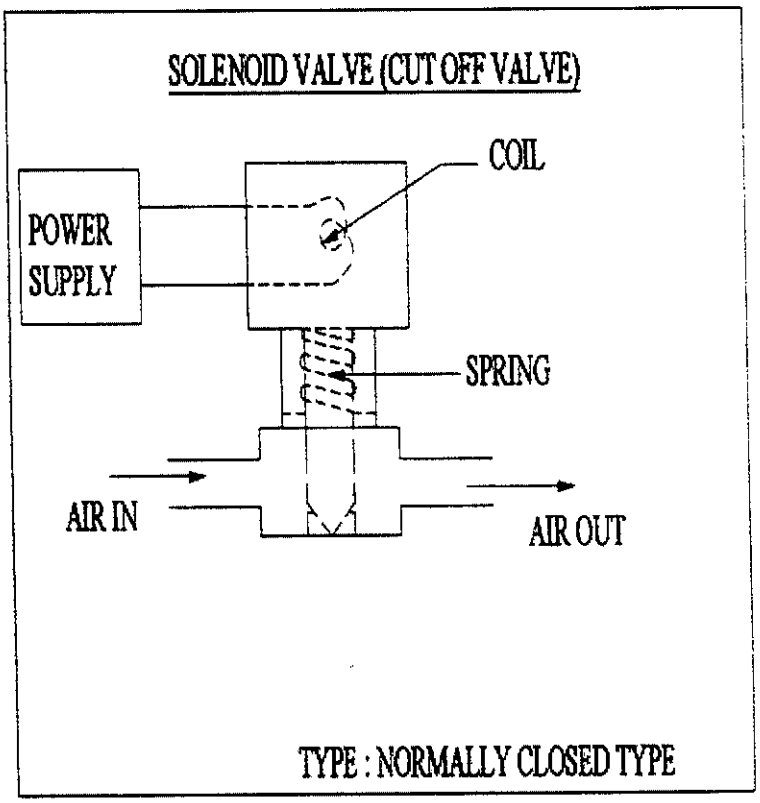
The Solenoid plunger is the mover mechanism of the solenoid. The plunger is made of steel laminations which are riveted together under high pressure, so that there will be no movement of the lamination with respect to one another. At the top of the plunger a pin hole is placed for making a connection to some device.

The solenoid plunger is moved by a magnetic force in one direction and is usually returned by spring action.

Solenoid operated valves are usually provided with cover over either the solenoid or the entire valve. This protects the solenoid from dirt and other foreign matter, and protects the actuator. In many applications it is necessary to use explosion proof solenoids.

Working of Solenoid Valve:

Figure 3.1 Solenoid valve



The Solenoid control valve is used to control the flow direction is called cut off valve or solenoid valve. This solenoid cut off valve is controlled by the electronic control unit.

In our project 3/2 Single acting solenoid valve is used. This solenoid valve is used to push the dimensionless materials into the collecting tray which is placed bellow the conveyor.

3.1.3. FLOW CONTROL VALVE:

In any fluid power circuit, flow control valve is used to control the speed of the actuator. The floe control can be achieved by varying the area of flow through which the air in passing.

When area is increased, more quantity of air will be sent to actuator as a result its speed will increase. If the quantity of air entering into the actuator is reduced, the speed of the actuator is reduced.

3.1.4. HOSE COLLAR AND PU CONNECTOR:-

In our pneumatic system there are two types of connectors used; one is the hose connector and the other is the reducer. Hose connectors normally comprise an adapter (connector) hose nipple and cap nut. These types of connectors are made up of brass or Al or hardened steel.

Reducers are used to provide inter connection between two pipes or hoses of different sizes. They may be fitted straight, tee, "V" or other configurations. These reducers are made up of gunmetal or other materials like hardened steel etc.

Hoses used in this pneumatic system are made up of polyurethane. These hoses can with stand at a maximum pressure level of 10 kg/cm2

3.1.5. D.C. MOTOR (PERMANENT MAGNET):

DESCRIPTION OF DC MOTOR

An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left hand rule.

When a motor is in operation, it develops torque. This torque can produce mechanical rotation. DC motors are also like generators classified into shunt wound or series wound or compound wound motors.

FLEMING'S LEFT HAND RULE:

Keep the force finger, middle finger and thumb of the left hand mutually perpendicular to one another. If the fore finger indicates the direction of magnetic field and middle finger indicates direction of current in the conductor, then the thumb indicates the direction of the motion of conductor.

PRINCIPLE OF OPERATION OF DC MOTOR:

Figure show a uniform magnetic field in which a straight conductor carrying no current is placed. The conductor is perpendicular to the direction of the magnetic field.

The conductor is as carrying a current away from the viewer, but the field due to the N and S poles has been removed. There is no movement of the conductor during the above two conditions. The current carrying conductor is placed in the magnetic field. The field due to the current in the conductor supports the main field above the conductor, but opposes the main field below the conduct Movement of Conductor.

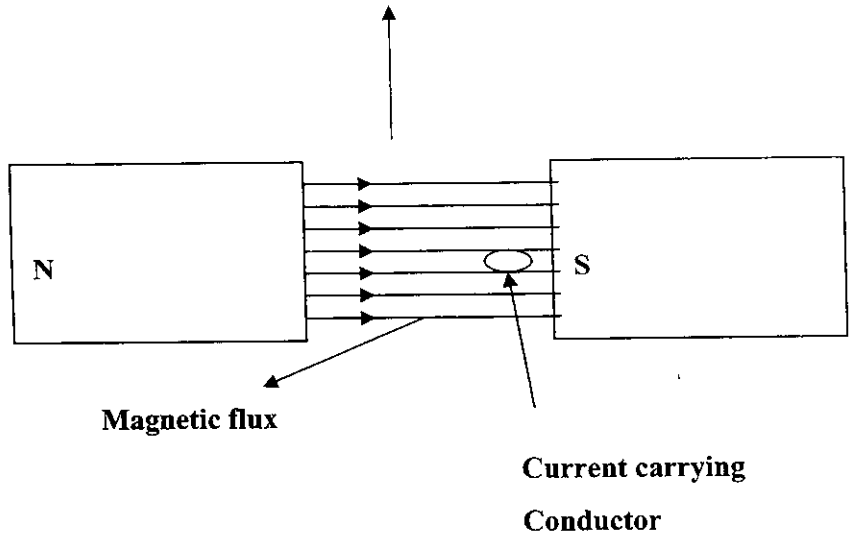


Figure 3.2 Principle of operation of DC motor

The result is to increase the flux density in to the region directly above the conductor and to reduce the flux density in the region directly below the conductor. It is found that a force acts on the conductor, trying to push the conductor downwards as shown by the arrow. If the current in the conductor is reversed, the strengthening of flux lines occurs below the conductor, and the conductor will be pushed upwards.

Now consider a single turn coil carrying a current as shown in the above figure. in view of the reasons given above, the coil side A will be forced to move downwards, whereas the coil side B will be forced to move upwards. The forces acting on the coil sides A and B will be of same magnitude. But their direction is opposite to one another. As the coil is wound on the armature core which is supported by the bearings, the armature will now rotate. The commutator periodically reverses the direction of current flow through the armature. Therefore the armature will have a continuous rotation.

The conductors are wound over a soft iron core. DC supply is given to the field poles for producing flux. The conductors are connected to the DC supply through brushes. Let's start by looking at the overall plan of a simple 2-pole DC electric motor. A simple motor has 6 parts, as shown in the diagram below.

- An armature or rotor
- A commutator
- Brushes
- An axle
- A field magnet
- A DC power supply of some sort

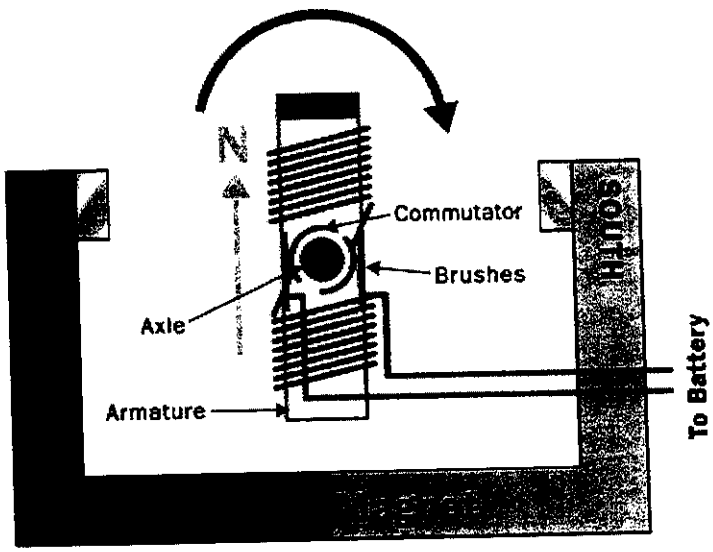


Figure 3.3 Simple motor

An electric motor is all about magnets and magnetism: a motor uses magnets to create motion. If you have ever played with magnets you know about the fundamental law of all magnets: Opposites attract and likes repel.

So if you have 2 bar magnets with their ends marked north and south, then the North end of one magnet will attract the South end of the other. On the other hand, the North end of one magnet will repel the North end of the other (and similarly south will repel south). Inside an electric motor these attracting and repelling forces create rotational motion.

In the diagram above and below you can see two magnets in the motor, the armature (or rotor) is an electromagnet, while the field magnet is a permanent magnet (the field magnet could be an electromagnet as well, but in most small motors it is not to save power).

Electromagnets and Motors:

To understand how an electric motor works, the key is to understand how the electromagnet works. An electromagnet is the basis of an electric motor. You can understand how things work in the motor by imagining the following scenario. Say that you created a simple electromagnet by wrapping 100 loops of wire around a nail and connecting it to a battery. The nail would become a magnet and have a North and South Pole while the battery is connected.

Now say that you take your nail electromagnet, run an axle through the middle of it, and you suspended it in the middle of a horseshoe magnet as shown in the figure below.

If you were to attach a battery to the electromagnet so that the North end of the nail appeared as shown, the basic law of magnetism tells you what would happen: The North end of the electromagnet would be repelled from the north end of the horseshoe magnet and attracted to the south end of the horseshoe magnet.

The South end of the electromagnet would be repelled in a similar way. The nail would move about half a turn and then stop in the position shown.

You can see that this half-turn of motion is simple and obvious because of the way magnets naturally attract and repel one another. The key to an electric motor is to then go one step further so that, at the moment that this half-turn of motion completes, the field of the electromagnet flips. The flip causes the electromagnet to complete another half-turn of motion.

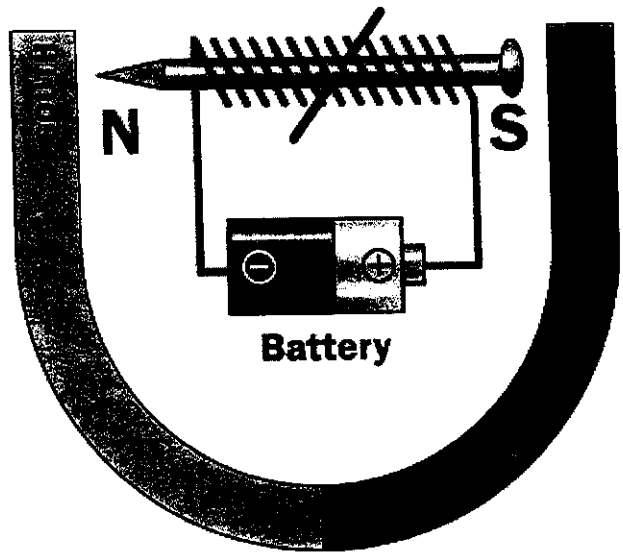
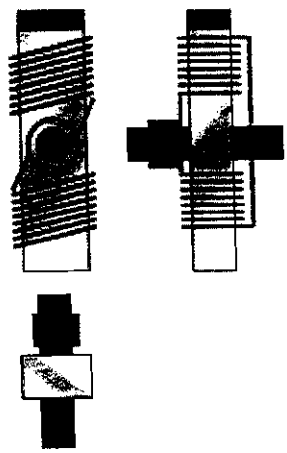


Figure 3.4 Electromagnetic motor

You flip the magnetic field simply by changing the direction of the electrons flowing in the wire (you do that by flipping the battery over). If the field of the electromagnet flipped at just the right moment at the end of each half-turn of motion, the electric motor would spin freely.

The Armature:

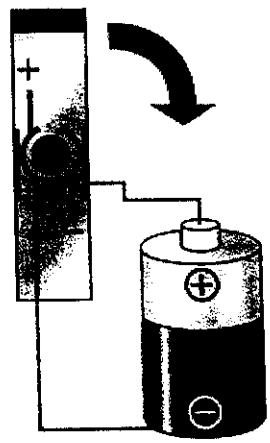
Figure 3.5 Armature



The armature takes the place of the nail in an electric motor. The armature is an electromagnet made by coiling thin wire around two or more poles of a metal core. The armature has an axle, and the commutator is attached to the axle. In the diagram above you can see three different views of the same armature: front, side and end-on. In the end-on view the winding is eliminated to make the commutator more obvious. You can see that the commutator is simply a pair of plates attached to the axle. These plates provide the two connections for the coil of the electromagnet.

The Commutator and brushes:

Figure 3.6 Commutator and brushes



The "flipping the electric field" part of an electric motor is accomplished by two parts: the **commutator** and the **brushes**. The diagram at the right shows how the commutator and brushes work together to let current flow to the electromagnet, and also to flip the direction that the electrons are flowing at just the right moment. The contacts of the commutator are attached to the axle of the electromagnet, so they spin with the magnet. The brushes are just two pieces of springy metal or carbon that make contact with the contacts of the commutator.

Putting It All Together:

When you put all of these parts together, what you have is a complete electric motor:

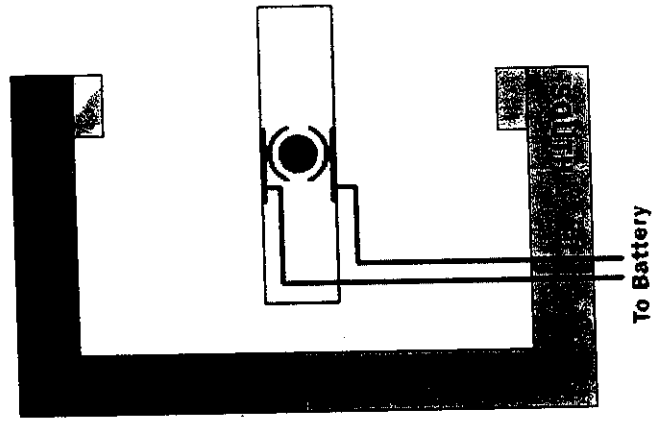


Figure 3.7 Combination of commutator and motor

In this figure, the armature winding has been left out so that it is easier to see the commutator in action. The key thing to notice is that as the armature passes through the horizontal position, the poles of the electromagnet flip. Because of the flip, the North Pole of the electromagnet is always above the axle so it can repel the field magnet's North Pole and attract the field magnet's South Pole. If you ever take apart an electric motor you will find that it contains the same pieces described above: two small permanent magnets, a commutator, two brushes and an electromagnet made by winding wire around a piece of metal. Almost always, however, the rotor will have three poles rather than the two poles as shown in this article. There are two good reasons for a motor to have three poles:

It causes the motor to have better dynamics. In a two-pole motor, if the electromagnet is at the balance point, perfectly horizontal between the two poles of the field magnet when the motor starts; you can imagine the armature getting "stuck" there. That never happens in a three-pole motor.

Each time the commutator hits the point where it flips the field in a two-pole motor, the commutator shorts out the battery (directly connects the positive and negative terminals) for a moment. This shorting wastes energy and drains the battery needlessly. A three-pole motor solves this problem as well. It is possible to have any number of poles, depending on the size of the motor.

3.1.6. ELECTRONIC CONTROL UNIT

This electronic control unit plays a major role in this inspection conveyor. The sensor signals are fed to the electronic control unit and it actuates the flow control valve, pneumatic cylinder and solenoid valves according to it. Every sensor based applications have electronic control unit which acts as a key element for its working. Here the electronic control unit in accordance to the sensor signal puts in the respective material in the collecting tray.

3.1.7. INFRARED SENSOR (IR SENSOR)

The infrared sensor is one of the important type of proximity sensor. The proximity sensors work on four flavours and infrared (IR) is one of the important flavour of proximity sensor.

Infrared proximity sensors work by sending out a beam of IR light, and then computing the distance to any nearby objects from characteristics of the returned (reflected) signal. There are a number of ways to do this, each with its own advantages and disadvantages:

There are three ways of detecting IR signal through infrared sensor, they are listed and explained below

Reflected IR strength

You could build a simple IR proximity sensor out of essentially just an IR LED and IR photodiode. This simple sensor, though, would be prey tobackground light (i.e., your IR "receiver" would be responding to naturally present IR as well as reflected IR).

Modulated IR signal

A better solution would be to modulate your transmitted IR (i.e., to send out a rapidly-varying IR signal), and then have the receive circuitry only respond to the

level of the received, matching, modulated IR signal (i.e., to ignore the DC component of the received signal, and only trigger off the AC component). This method, though, is still at the mercy of the characteristics (in particular, IR reflectance) of the obstacle you're trying to sense.

Triangulation

The best way to use IR to sense an obstacle is to sense the angle at which the reflected IR is returned to your sensor. By use of a bit of trigonometry, you can then compute distance, knowing the location of your transmit and receive elements. Needless to say, this isn't a simple sensor to build yourself.

You're probably money ahead by just buying an IR proximity sensor with this logic built in. One I particularly like is the Sharp GP2D15 IR Ranger. It has a built-in detection range of 24 cm (this keeps its cost, and the complexity of your interface circuitry down), is reasonably priced, and is available from Acroname. Acroname also has an interesting article covering the operation and utilization of all the impressive Sharp IR sensors here.

The GP2D15 interface is 3-wire with power, ground and the output voltage (the sensor outputs Vcc when it sees something at 24 cm distance); it requires 4.5 - 5.5 V power for operation, and eats about 50 mA of current as long as it is powered. So its advantages are (1) its simple interface, and (2) easy, reliable sensing of obstacles at a distance. Its disadvantages are (1) its requirement for 5 V power, and (2) its requirement for 50 mA of current regardless of whether anything is being sensed (neither of these recommend this sensor for solar-powered 'bots).

If your BEAMbot's circuitry has provision for a "touch-switch" contact sensor, the GP2D15 can easily be used instead. If the circuit uses ground-referenced tactile sensors, just an NPN transistor is needed to enable this substitution:

3.1.8. COLLECTING TRAY

Collecting tray is just a tray which is used to collect all the proper dimension materials. This tray can me made of any material, only to note that it should withstand the weight of the materials collected. Another collecting tray is also used to collect all the improper materials.

The tray should be placed in a proper position so that the material gets collected there automatically. If the position gets changed, materials fall outside the tray and may cause damage to the finished jobs.

3.1.9. CONVEYOR BELT AND ROLLER

Conveyor belt is used to carry out all the materials to their respective work stations. The conveyor belt is made of rubber and it can taken of any length according to the size of the apparatus. The materials to be inspected are placed on the conveyor belt and this conveyor belt is moved on the rollers by DC motor. Conveyors are used to full extent these days.

In all industries, conveyors are coming into existence. Conveyor belt sections are placed through out the industries so that the respective materials are placed on it and they get moved on the conveyors to the respective workstations and after completing the work, the material gets moved to the next station and the next work is carried out.

Conveyor belts are made up of rubber. The rubber strength is decided upon the material that is to be moved on the belt. In this case, buna N rubber is the material of the conveyor belt.

Roller used is the base in which the conveyor belt rests upon. Rollers are very important in maintaining the belts to stand in a correct position. If the rollers are not proper, the conveyor belt will slip from the roller and may cause heavy damage to the apparatus and sometimes may result in injuries to the operator nearby.

VIBRATING CONVEYOR

STANDARD EQUIPMENT

- 5" H beam frame, ¼" thick pan, 3/8 inch thick at drive section
- Pan sides 30 degrees (standard), straight sides or other angles optional
- One piece transition incorporated into the conveyor panning 17" Wide
- 10' long Vibrating Conveyor drive section with eccentric. Conveyor formed from 3/8" steel plate. Bottom width of 17", top width 25-1/2"with flared sides, 5-1/2" deep. 5" channel steel support frame. Double fiberglass shaker legs around drive. 22" Wide
- 10' long Vibrating Conveyor drive section with eccentric. Conveyor formed from 3/8" steel plate. Bottom width 22", top width 32-1/2" with flared sides, 7" deep. 5" channel steel support frame. Double fiberglass shaker legs around drive.

Note: Conveyors with different heights and widths are available. Conveying speed approximately 45' f.p.m. other speeds are available.

worth its weight in gold.

QUEUING / METERING CONVEYOR

1. Description :

The queuing / metering conveyor is a short conveyor designed to queue; index or separate bags wherever required like before merges, conveyor junctions, x-ray machines, etc, in a system.

This unit is designed for frequent start stop operation as well as for short acceleration / braking actions.

The basic design of the queue conveyor is standardised with adequate flexibility to accommodate the variations in the side guard height, belt width, overall length, conveyor speed and belt type.

2. Features:

1. The standard Queue conveyor is designed to be modular, standalone, robust, reliable, quite operation and easy maintenance type.
2. The Queue conveyor can be floor mounted or suspended from the ceiling type.
3. Standard length models are developed to meet most of the baggage handling systems. Can be built custom designed also.
4. Screw take-up designed to allow one side take-up adjustment.
5. Drive unit is provided with inverter control for varying the speed and frequent start/stops.
6. The unit is specifically designed for bag separation function.

3. Technical Data:

Standard Conveyor:

Belt width .....: 925mm

Conv. Length .: 1200mm (standard)

Speed .....: 30 ~ 85m/min

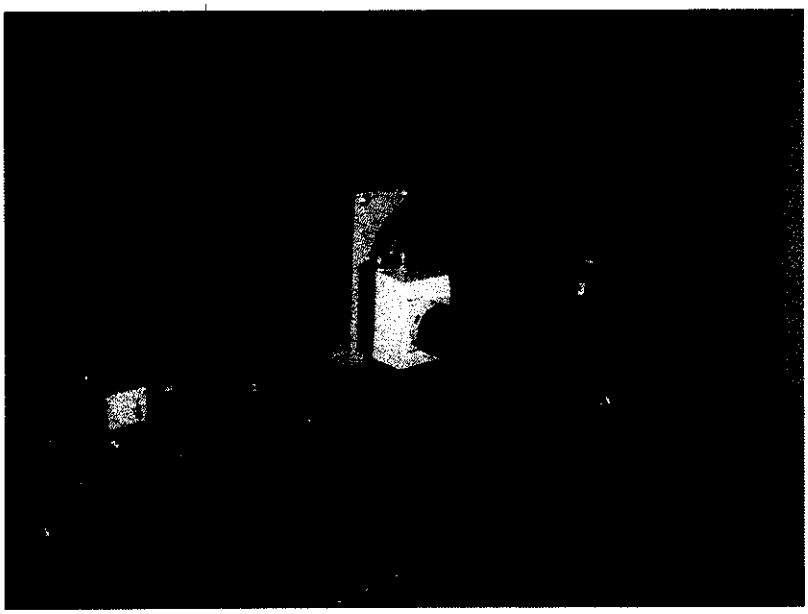
Live load .....: 90kg

Belt Top .....: Smooth

Motor.....: 0.75 kw , Inverter control

shaft mounted

Side guard .....: 250 / 500 mm height



Weigh Conveyor

A B Technical is again leading the way when it comes to the modernization of standard process line equipment. Flow control is the latest addition to our growing portfolio of updated machinery.

The same principles of utilizing new technology have been applied to the development of this range of in line weighing conveyors.

With on board PLC and color touch screen HMI this machine is ahead of the competition not only in terms of overall cost but also in its operator friendly interface which provides complete visual indication of the operating conditions of the equipment. One standard control system has been adopted which is incorporated on all models so that each machine can be installed to perform any of the standard in-line weighing applications whether it be Variable, Fixed or proportional add-back weighing. With auto belt tracking & tensioning as standard this machine incorporates all the features of its rivals with the exception of the price tag.

Key Features

All on board electronics are standard components with no fancy internal gadgetry only available from the OEM all spares are standard off the shelf items.

Easy on screen step by step visual calibration routine and functionality.

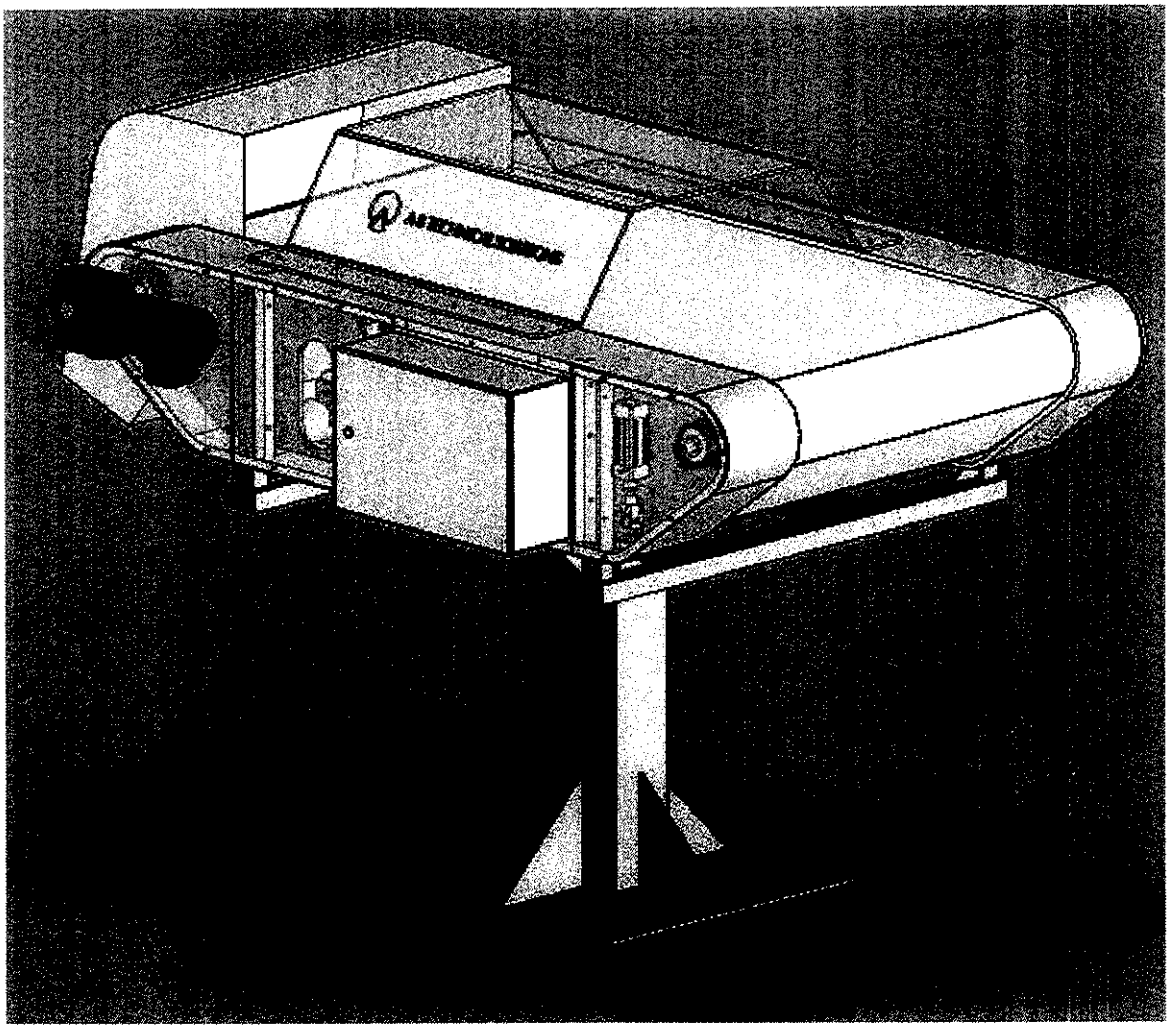
On board control panel mounted on hinges to give easy access to internal components mounted within the stainless steel side guard (HMI on control panel not shown)

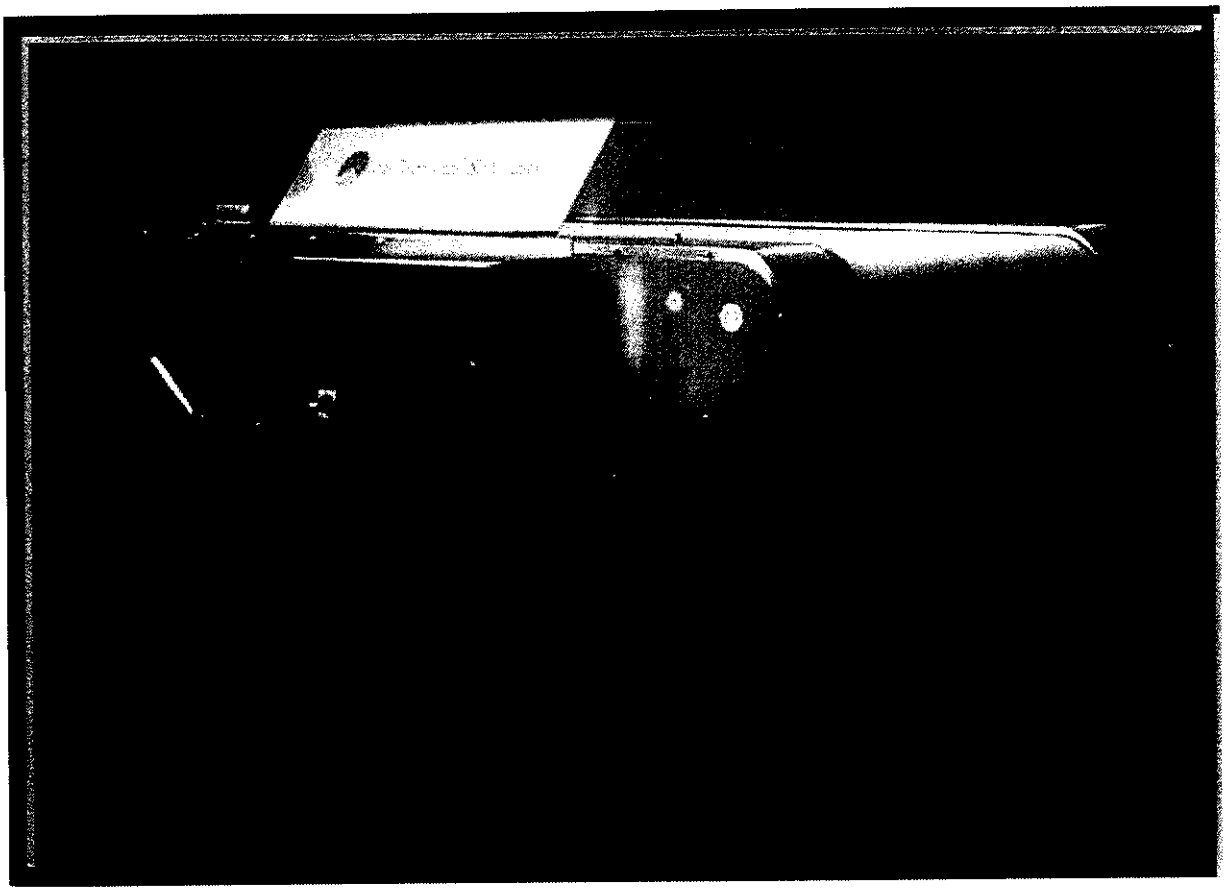
The TS3 fixed and variable speed Weigh Conveyors have been designed with high accuracy and cost effectiveness in mind, great attention has been paid to both the aesthetics and functionality of the equipment which sets it apart from the competition. Each machine is unique and is designed specifically to meet the

individual running requirements of the end user. The PLC and Touch screen are selected to meet the individual requirements of the customer. The only difference between the fixed and variable speed machines is the absence of a variable speed drive in the fixed speed machine and the fact that certain elements of the software which relate to the control of the variable speed drive have been deactivated although the software is still present. For further information regarding this product or indeed any other product in our constantly expanding
range of equipment. Variable speed machine installed and in full
production. The Metering tube presents a stable volumetric flow
of product to the band as it passes below and the equipment automatically varies its speed to achieve a pre-determined flow requirement (Kg per hr). For improved accuracy the belt is endless and the equipment has been designed to enable easy replacement from one side.

Illustrated Right

All calibration routines and flow-rate requirements are input via the onboard HMI Touch Screen, which also displays operational information such as trend graphs and totalise weight. A top cover which straddles the band provides protection
for the load cell weigh-span area. The support structure can be designed to suite almost any final installation position.





RC CONVEYOR/SLOPE CONVEYOR

- The GOMACO RC Conveyor is designed to place concrete across flat slabs or on slopes up to 135 ft. (41.15 m) wide.
- Designed with lattice-type, structural angle-iron frame with pin-connected sections which are interchangeable in 12 ft. (3.66 m), 6 ft. (1.83 m) and 3 ft. (.91 m) increments for fast setup and easy assembly.
- Conveyor with standard, double-flanged, steel trolley wheels runs on any type of rail system or paving forms. Traction speed is variable up to 38 fpm (11.58 mpm), forward and reverse.
- The bogies are designed to allow the frame to be set at any skewed angle up to 55 degrees. The travel speed of each bogie is independently controlled to allow negotiation through radii.
- The RC Conveyor includes self-widening capability for use on tapered decks and slabs.
- Concrete is discharged directly into receiving hopper from Ready Mix trucks.
- The diverter car discharges to the front or rear and is operated by hydraulically powered, positive chain drive. Variable hydraulic control of diverter car and of machine travel assures even and accurate placement of concrete.
- The conveyor is counterbalanced with console and receiving hopper at opposite ends, removing operator from congested area of receiving hopper.
- The self-contained console has easy-to-operate controls.

DESIGN CALCULATION

Speed=10rpm

Pulley dia=60mm

Velocity of pulley=3.14*.06*10/60

=0.0314m/sec

=30mm/sec

DESIGN OF PULLEY:

Speed ratio = 1

Speed = 10 rpm

Pulley diameter = 60 mm (both pulleys are same)

Torque transmitted = (P x 60) / (2 x 3.14 x N)

Torque transmitted = $(10 \times 10^3 \times 6) / (2 \times 3.14 \times 10)$

T = 5.738Nm

Also torque = (T1-T2) x d2/2

5.738x 1000 x 2 = 60 x (T1-T2)

T1-T2 = 191.08 N

From the table co efficient of friction = 0.25

Angle of contact = 180 degree = 3.14 radians

$T1/T2 = e^{??}$

$T1/T2 = e^{0.25 \times 3.14}$

$T1 = 2.192\ T2$

From above equation $2.192\ T2 - T2 = 191.08$

$T2 = 160.3N$

$T1 = 351.3\ N$

Belt width = T1/ max tension

Belt width = 351.3 /0.75 [0.75 N/mm from data book for single ply]

Belt width = 468 m

Belt width = 15 mm

Pulley width = 15 + clearance

Pulley width = 15 + 4

Pulley width = 19 mm

Pressure supplied by the piston:

F = 3 to 10 kg

Diameter of piston = 32 mm

Stroke length of piston = 100 mm

Pressure = force / area = 6.5 / (3.14 x d x l)

Pressure = 6.5 / (3.14 x 32 x 100)

Pressure = 6.468 x 10^ - 4 kg/mm^2

2.5 Power supply

2.5.1 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.

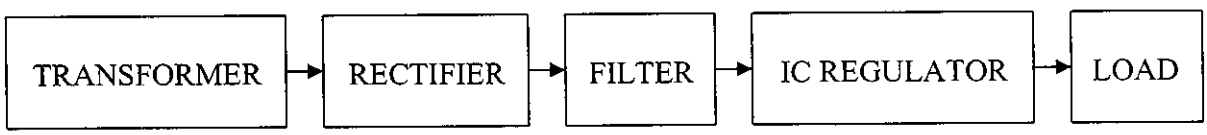


Figure2.5: Block diagram (Power supply)

2.5.2 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.

Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.

The path for current flow is from point B through D1, up through RL, through D3, through the secondary of the transformer back to point B. this path is indicated by the solid arrows. Waveforms (1) and (2) can be observed across D1 and D3.

One-half cycle later the polarity across the secondary of the transformer reverse, forward biasing D2 and D4 and reverse biasing D1 and D3. Current flow will now be from point A through D4, up through RL, through D2, through the secondary of T1, and back to point A. This path is indicated by the broken arrows. Waveforms (3) and (4) can be observed across D2 and D4. The current flow through RL is always in the same direction. In flowing through RL this current develops a voltage corresponding to that shown waveform (5). Since current flows through the load (RL) during both half cycles of the applied voltage, this bridge rectifier is a full-wave rectifier.

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.

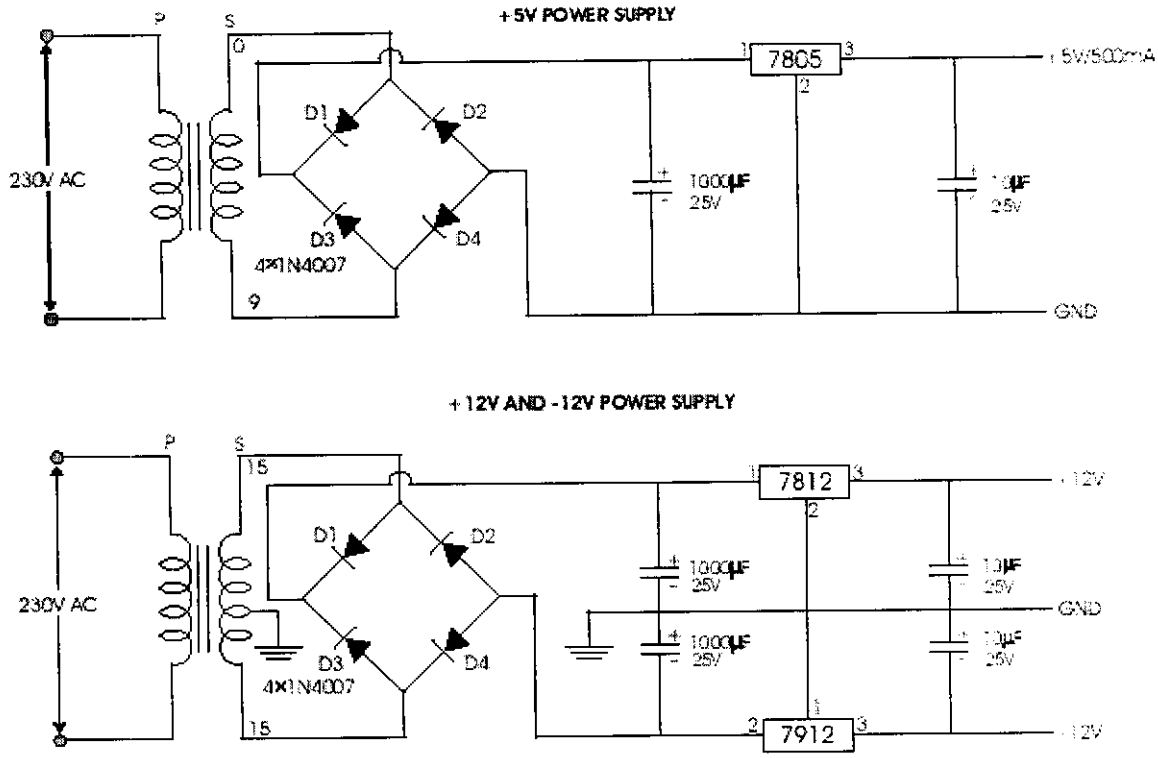


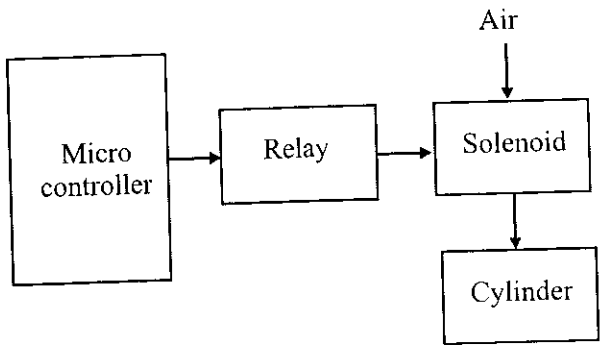
Figure2.6: Circuit diagram (Power supply)

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal connected to ground.

The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts.

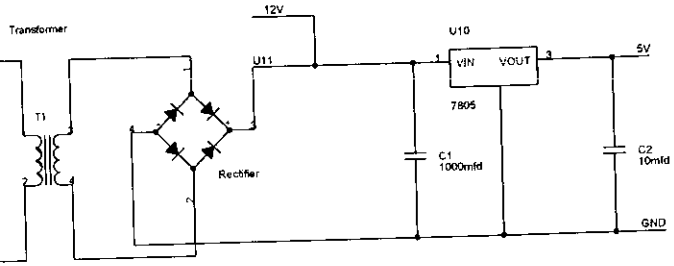
- For ICs, microcontroller, LCD --------- 5 volts
- For alarm circuit, op-amp, relay circuits ---------- 12 volts

PNEUMATIC BELT CONVEYER

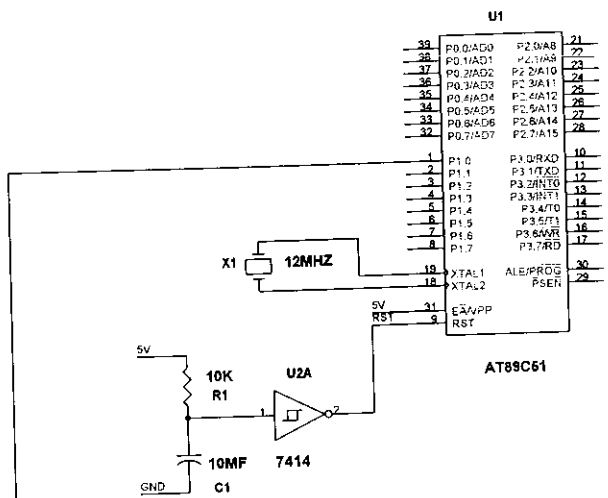


PNEUMATIC BELT CONVEYER

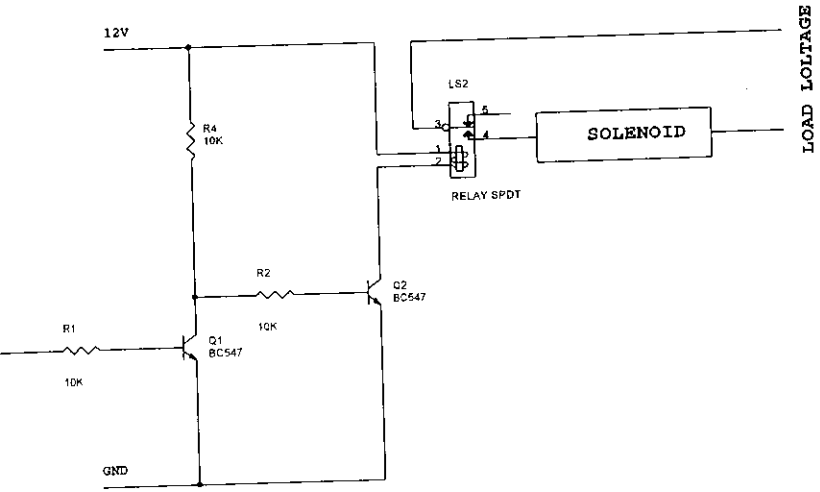
POWER SUPPLY



MICROCONTROLLER

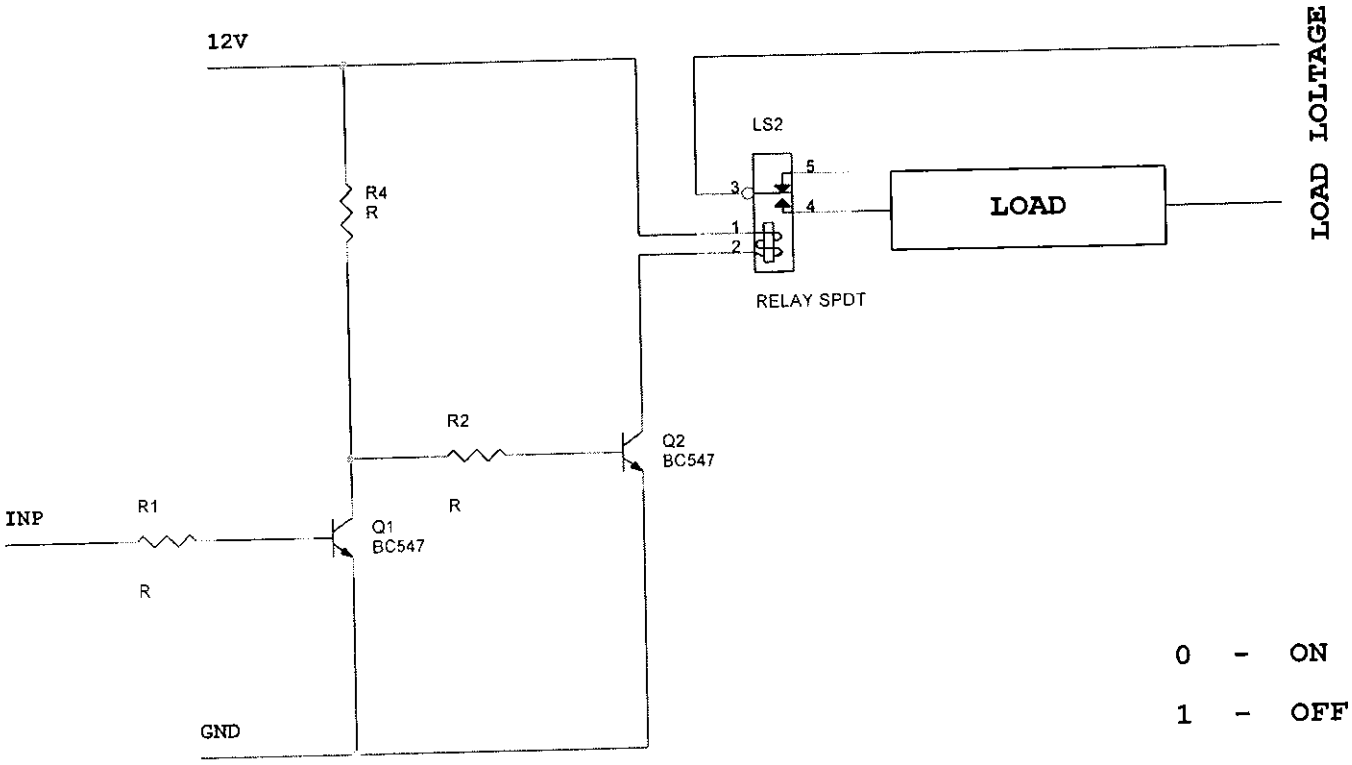


RELAY CIRCUIT - SPST



RESET CIRCUIT

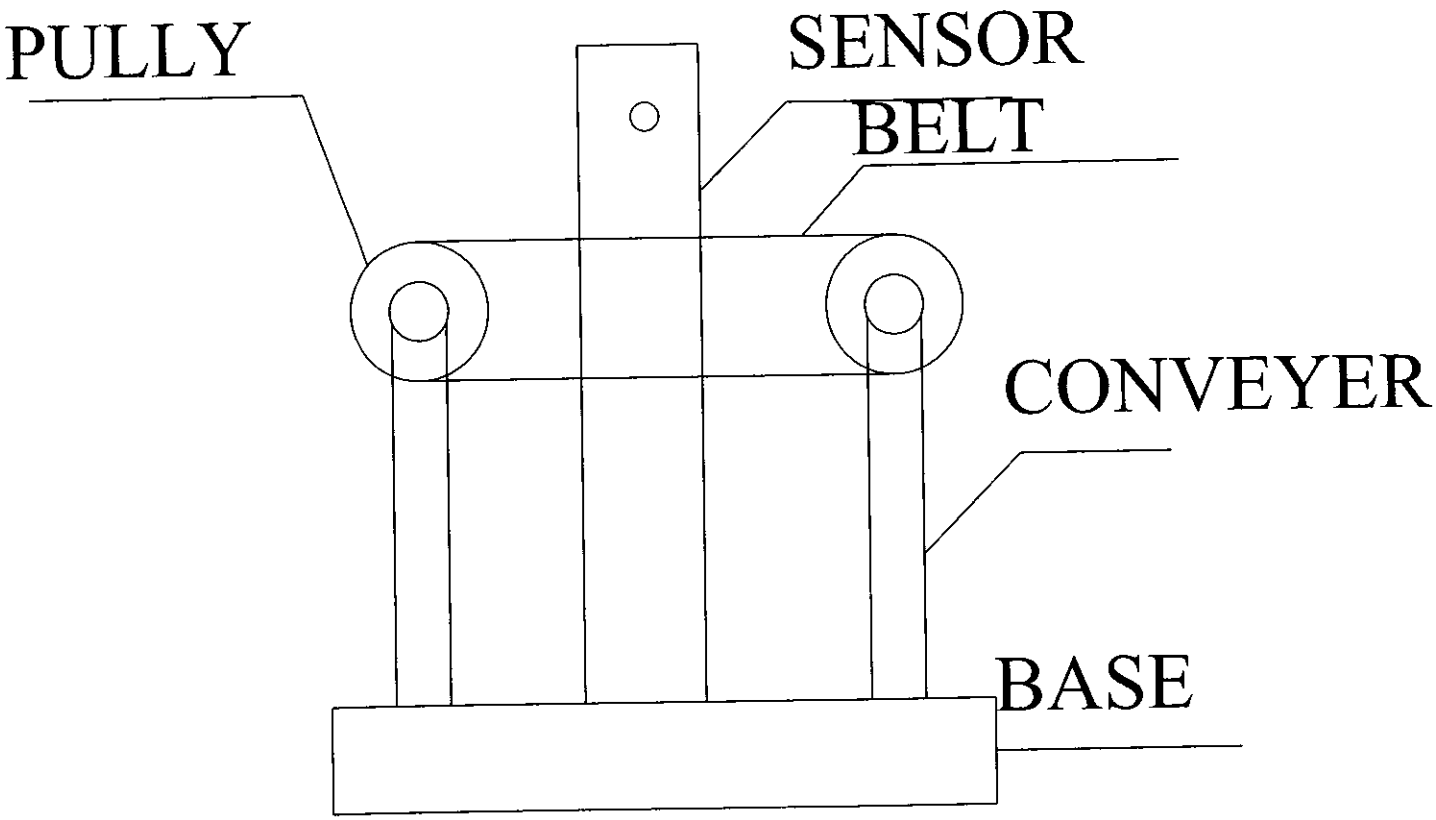
RELAY CIRCUIT - SPST

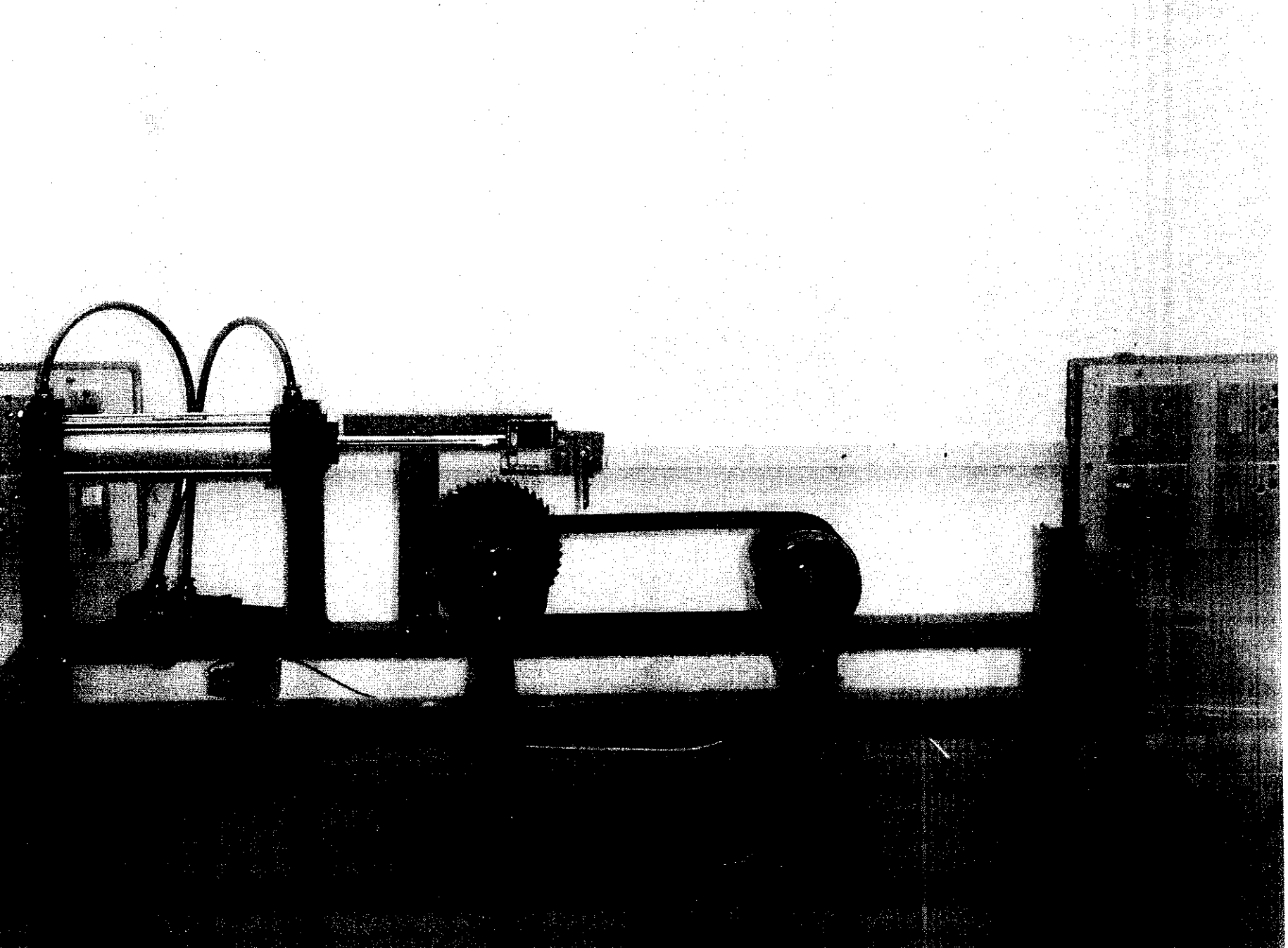


0 - ON

1 - OFF

BELT CONVEYER





CONCLUSION

Quality inspection and time reduction is achieved through this project. Sensor based inspection conveyor will make serious inroads in every industry by overcoming manual inspection. By the near future there are opportunities for developing inspection conveyor with other sensors so that cost of the apparatus may come down a bit.

Different sensors have been studied and it was found that infra red sensor was the suitable one for this project because it detects the nearby objects through infra red signals in a more efficient way than other sensors. Thus the project has been concluded in a more satisfying manner by achieving quality inspection and time reduction.

The limitations of this project would be overcome in the future and it would be helpful for the industries to compete with the racing world by using this sensor based inspection conveyor.

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