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DESIGN AND CONSTRUCTION OF AUTOMATIC WEIGHING AND PACKING MACHINE

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ABSTRACT
The fast advancement in technology is making whole industrial procedures automated. By the automation it becomes easy to fill various materials within less time period as manual process is very much time consuming and can be inaccurate. The packing procedure that has been devised consists of two major components. The main aim of this project is to make an automatic weighing and packing machine. In olden days when there is improvement in the technical field most of the industries where not aware of automatic process. But now there may be some development but it is all depend upon the investment. For example we consider the model called packing and weighing machine which can be used in many manufacturing industries and other industries. Here we introduce a new concept called automatic weighing and packing machine with a very less amount of investment.
Keywords: Presicion , Accuracy,Loadcell,Arduino,Analog to digital convertor,Single point load cell

I.Introduction
In this chapter the automatic weighing and packing machine is equipment used in various industries, primarily in manufacturing and packaging processes. It combines the functions of weighing items and packing them into containers or packages, all done automatically with minimal human intervention.

1.1. Automated weighing and packing machine
In most of the small scale industries, the material packing is done by manually. This process takes more time and large human labors .There are number of packing machines are available in market. The cost of those machines is very high. Now the project has mainly concentrated on this difficulty, and hence a suitable electronic control unit has been designed such that the material can be packing in proper condition .The fabrication part of it has been considered with almost case for its simplicity and economy, such that this can be accommodated as one of the essential tools on industrial applications. 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 • 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.

1.2. Background survey
The manual packing process has many short comings as it will require more time to pack the packets. This problem faced by small industries so to overcome this problem they have developed this bottle packing machine. Their project is meant for small industries. It aims to eliminate problem faced by small scale bottle packing system. The entire packaging process is done with the help of electro pneumatics and motors. The control for the hardware is to be process by the programmable logic controller via the computer. The whole system executes the following processes: • Automation using the controller • Filling of material into the bag • Packaging • Sealing our objective is to pass the packing process from a manually operated Single Station Manned Cell to a semi-automated Single Station Manned Cell or to a Single Station Automated Cell. It means the task of operator passes from do manually the operation to supervise the process.

1.3. Objectives

The objectives of this study are

- to design and Implementation of an affordable and efficient, packing control machine for industrial application.
- to construct Automatic Hopper Filling unit using Arduino and Sensors.
- to work on software related to overall functional units of the machine.
- to design and construct stand and heating element
- to assemble the project and work on hardware and software improvements.

II.Literature

The packaging process is one of the most important stages of the production flow in various industries because it is responsible for containing the product (wheat grain), preserving its quality and providing protection during transportation and storage. Therefore, it is essential to have a processing that meets the fundamental requirements to provide a quality product. Currently, there are many packaging techniques that allow achieving the same objective. Automatic packaging has been able to develop over the years, becoming a vitally important equipment in the operations of large industries as it provides several benefits such as higher productivity, agility, adaptability, lower costs and errors. In this work, an automatic packaging machine will be designed and manufactured in order to increase the productivity and efficiency of bag filling and sealing activities.

This invention concerns creating a small scale cereal packaging machine which has capability of sealing 1 kg of any cereal per minute.The invention has particular application to automatic weighing and packaging and sealing using cheaper and more efficient alternative of food packaging machinery. The concept consists of a hopper from which the contents to be packaged are poured through. The amount of contents into the film is controlled by the rotation of the rotating weight meter just below the hopper. The weight meter weighs the amount of contents at the same time its rotation provides the path of the contents into the plastic film. A pair of rollers below the weight meter forms longitudinal seals between the two meshes of thermoplastic films. The other pair of rollers divides by cutting the completed package from the meshes. The package then falls by gravity sliding through the outlet. The roller width determines the seal thickness. The conclusion was the design operates on simple mechanical principles. The cost from the objectives is justifiable as depicted by the bill of quantities. The machine has a capability of packing 1packet which weighs 1kg per every minute. I would recommend the improvement of the machine so that it can pack a range of weights and the plastic should move automatically from the spring plastic holder.

The working principle of the invention is as followed: Products are passed on conveyor. They are sensed by the first proximity sensor and the counter is set to ‘1’. As soon as the product completely passes through the sensor, SENSOR 1 switches off. When the sensor switches off, timer (previously set to certain delay) starts. After certain delay, cylinder extends and seals the film. The extended cylinder rod is detected by SENSOR 2 and the counter is reset to ‘0’. This process is repeated for the required duration. This process is done using the following component and sensors: I. Inductive sensors: Inductive sensors use currents induced by magnetic fields to detect nearby metal objects. The net effect is that it changes the inductance of the coil in the inductive sensor. By measuring the inductance the sensor can determine when a metal have been brought nearby. These sensors will detect any metals. II. Capacitive Sensor: Capacitive sensors can directly sense a variety of things such as motion, electric field and indirectly sense many other variables which can be converted into motion or dielectric constant, such as pressure, acceleration, fluid level, and fluid composition. They are built with conductive sensing electrodes in a dielectric, with excitation voltages on the order of five volts and detection circuits which turn a capacitance variation into a voltage, frequency, or pulse width variation.

The range of application of capacitive sensors is extraordinary. III. Photoelectric Sensors: A photoelectric sensor is another type of position sensing device. Photoelectric sensors are similar to the

ones with a modulated light beam that is either broken or reflected by the target The control consists of an emitter (light source), a receiver to detect the emitted light, and associated electronics that evaluate and amplify the detected signal causing the photoelectric output switch to change state. It can be concluded from the case study that the automatic packing of different sized products is based on PLC. Photoelectric sensor senses the leading and lagging end of the product, and based upon the calculation in the program; packing of different sized products takes place.

This paper presents an automation of packaging and material handling using a programmable logic controller. The idea is to automate the process of placing the materials inside a box, detecting good and bad items in terms of weight, and sealing using a packaging tape. The purpose of the study is to replace the manual system being used in the Industry, compare the time, and manpower requirement for both the existing system with the proposed automated system. The Mitsubishi FX series programmable logic controller is used to mechanize the system. Sensors such as proximity and load sensor are used to provide the input to the system. The motors, pneumatics, and also the solenoids serve as the output. The researchers used a ladder diagram as a software that will control then the whole system between its input and output components. The system works during normal operation and greatly improves the automation processes with the use of the PLC ladder diagram. The wiring and installation procedure are also improved because the PLC input and output devices are assigned with specific addresses, and thus; further simplifies troubleshooting. Cost reduction mainly on the man-power or personnel cost is achieved in this paper. Hence, only one or two personnel are needed for the operation and maintenance with the automated system. After a thorough investigation, the researchers highly recommends extending the other automation processes such as adding input, adding output devices, and also the expansion of the ladder program. The utilization also of the other PLC brands and models may be suggested depending on the need and specifications of different processes.

The idea is to automate the process of placing the material on the paper sheet, detecting items and folding simple mechanism. The purpose of doing this project is to reduce human effort. Decreasing machine cost is also advantages of our design. This machine design is based on simple mechanism and can easily install. It is found out that the system decreases time and manpower requirements for every station as compared with traditional manual system. About 90% of full automation without humanism specified also in the system. The Working methodology is as followed:

Soap will pass from conveyor belt1. As soon as soap passes through conveyor belt1. Where creased box sheet already placed there at initial belt position from these points folding operation will be started. As box sheet goes further both side flap will be pulled up. Next step will be top left flap will flap will cover top portion on this portion glue will be spread with the help of small pin holed pipe. The same procedure will be follow for top right flap.

The next stage is this soap will be fall on conveyor belt 2 Then soap will be pushed on inclined surface where remaining side flap folding operation will be done. The mechanism used for these operations is same as first folding operation. The single most likely mode of failure for all stages of our machine depends on material selection. Material selectionwill be the paramount concern for anyone who chooses to develop this project further. Because of the multitude of small parts working in a common space, any bending or fracture during the machine's operation could cause part interference or even failure. A strong, lightweight material should be selected.

In the design shown above, a separate weighing mechanism is added. Load cell arrangement allows for accurate measurement of the material to be filled in the pouch. Load cell arrangement allows for accurate measurement of the material to be filled in the pouch. When the bowl is filled with the specific amount of material, it rotates and the material falls in the forming tube. A pneumatic cylinder and disc arrangement rotates the bowl. The forming collar is a uniquely designed structure by which the flat plastic film is turned into a vertical round film. Heat sealers are mounted vertically and horizontally to make vertical and horizontal seals. Two horizontal sealers are placed to make the bottom and top seals of the pouch. These heat sealers are actuated by pneumatic cylinders. A set of draw rollers are mounted vertically on the forming tube which pull the formed plastic downwards. These rollers are rotated with

the help of a motor. A cutter is placed between the horizontal seals to separate two consecutive bags from each other. Using currently available information and data on flexible automation techniques and mechatronics systems the automation of the machine has been developed. Due to a simple design and the use of low cost reliable components, the machine is developed in lesser cost as compared to other conventional machines. Hence, the Low cost automated Pouch Packing Machine is successfully developed which can benefit small Industries or enterprises. Safety of the workers is achieved as the machine requires very less human intervention.

III. Methods and materials

The main components of this study are,

- DC MOTOR
- SPUR GEAR
- BEARING
- LOAD CELL
- CONTROL UNIT

3.1 2D DIAGRAM

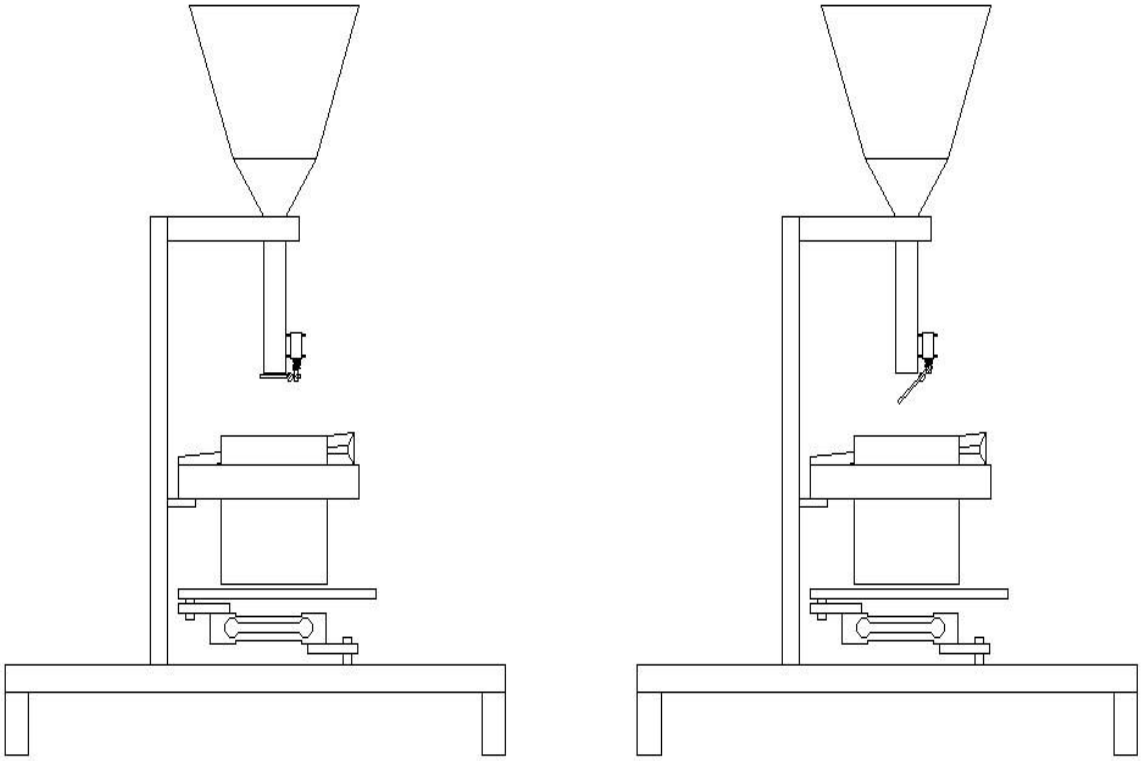

Figure 3.1 Design of Automatic weighing and packing machine

3.2 Fundamentals of DC motor

The d.c generators and d.c motors have the same general construction.

Moto Principle:

An electric motor is a machine which converts a electrical energy to mechanical energy.

All D.C machines have five principal components viz (i) Field system (II) armature core (iii) armature winding (iv) Commutator (v) brushes

(i) Field system:

The function of the field system is to produce Uniform field within which the armature rotates.it consists of a number of salient poles(of course, even number) bolted to the inside of circular frame (generally called yoke).the yoke is usually made of solid cast steel whereas the pole piece are composed of stacked laminations. Field coils are mounted on the poles and carry the d.c exciting current. The field coils are connected in such a way that adjacent poles have opposite polarity.

The e.m.f. developed by the coils produces a magnetic flux that passes through the pole pieces, the air gap, the armature and the frame. Practical d.c machines have air gaps ranging from 0.5mm to 1.5mm.since armature and field systems are composed of materials that have permeability, most of the m.m.f.of field coils is required to set up flux in the air gap. By reducing the length of air gap, we can reduce the size of field coils (number of turns).

(ii) Armature core:

The armature core is keyed to the machine shaft and rotates between the field poles. It consists of slotted soft-iron laminations (about 0.4 to 0.6mm thick) that are stacked to form a cylindrical core. The laminations are individually coated with a thin insulating film so that they do not come in electrical contact with each other. The purpose of laminating the core is to reduce the eddy current loss. The laminations are slotted to accommodate and provide mechanical security to the armature winding and to give shorter air gap for the flux to cross between the pole face and the armature "teeth".

(iii) Armature winding:

The slots of the armature core hold conductors that are connected in a suitable manner.this are known as armature winding. This is the winding in which "working"e.m.f. is induced.

The armature conductors are connected inseries-parallel: the conductors being connected in series so as to increase the voltage and in parallel paths so as to increase the current.the armature winding of a d.c.machine is a closed –circuit winding:the conductors being connected in a symmetrical manner forming a closed loop or series of closed loops.

(iv) commutator;

A commutator is a mechanical rectifier which converts the alternating voltage generated in the armature winding into direct voltage across the brushes.the commutator is made of copper segments insulated from each other by mica sheets and mounted on the shaft of the machine. The armature conductors are soldered to the commutator segments in a suitable manner to give rise to the armature winding.depending upon the manner in which the armature conductors are connected to the commutator segments, there are tow types of armature winding in a.d.c. machine viz(a) lap winding (b) wave winding.

Great care is taken in building the commutator because any eccentricity will cause the brushes to bounce, producing unacceptable sparking .the sparks may burn the brushes and overheat and carbonize the commutator.

(v) Brushes:

The purpose of brushes is to ensure electrical connections between the rotating commutator and stationary external load circuit. The brushes are made of carbon and rest on the commutator,the brush pressure is adjusted by means of adjustable springs. if the brush pressure is

Very large, the friction produces heating of the commutator and the brushes.on the other hand, if it is too weak, the imperfect contact with the commutator may produce sparking.

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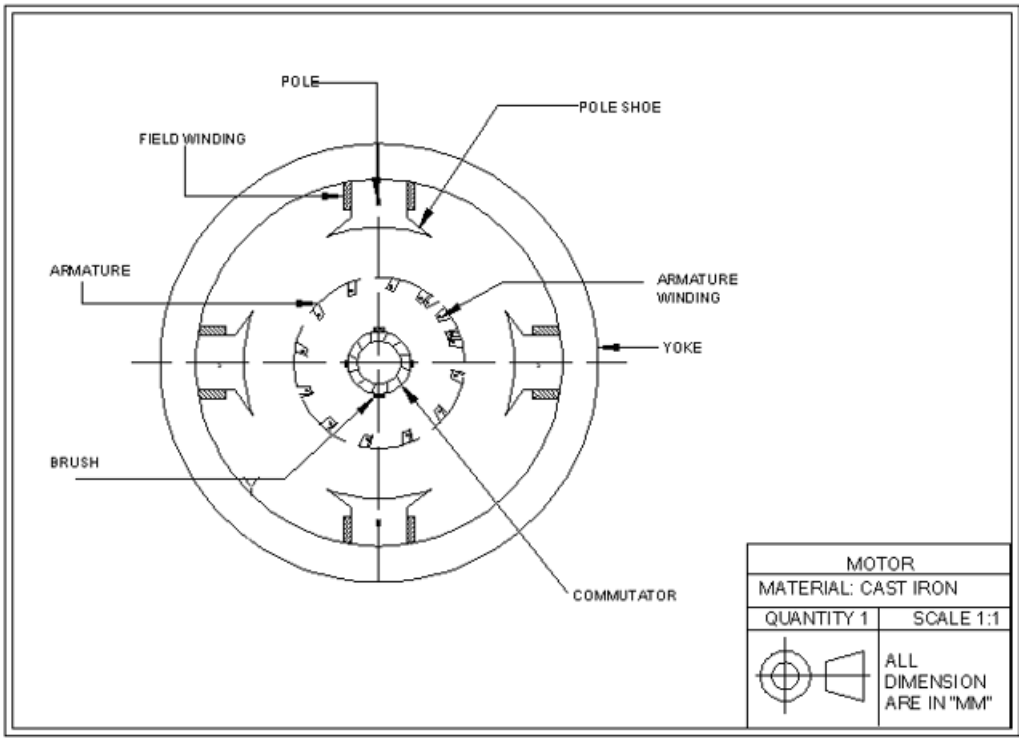
Figure 3.2 Design of bushes



STATOR:

The stator is the stationary part of an electric generator or electric motor. The non-stationary part on an electric motor is the rotor.

Depending on the configuration of a spinning electromotive device the stator may act as the field magnet, interacting with the armature to create motion, or it may act as the armature, receiving its influence from moving field coils on the rotor.

The first DC generators (known as dynamos) and DC motors put the field coils on the stator, and the power generation or motive reaction coils are on the rotor. This was necessary because a continuously moving power switch known as the commutator is needed to keep the field correctly aligned across the spinning rotor. The commutator must become larger and more robust as the current increases.

The stator of these devices may be either a permanent magnet or an electromagnet. Where the stator is an electromagnet, the coil which energizes it is known as the field coil or field winding.

ROTOR:

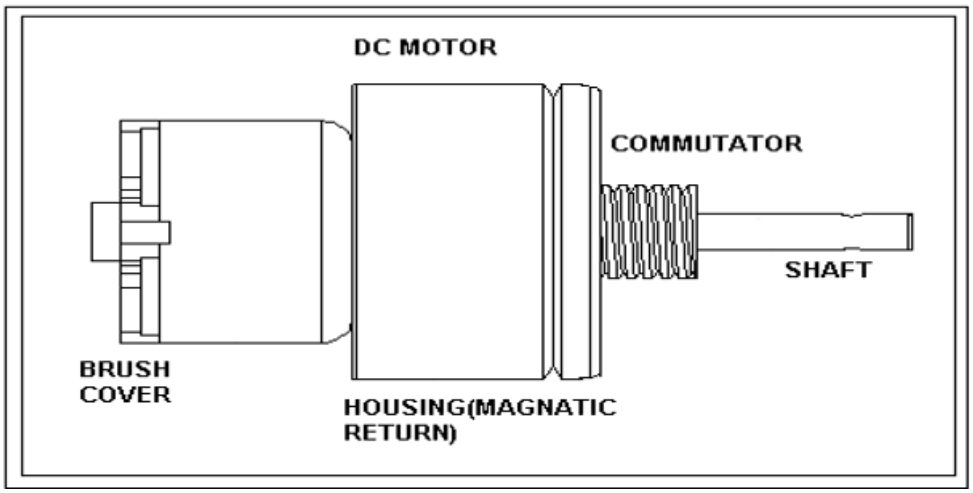
The rotor is the non-stationary part of a rotary electric motor or alternator, which rotates because the wires and magnetic field of the motor are arranged so that a torque is developed about the rotor's axis. In some designs, the rotor can act to serve as the motor's armature, across which the input voltage is supplied.

ELECTROMAGNETIC COIL:

An electromagnetic coil is formed when a conductor solid copper wire is wound around a core or form to create an inductor or electromagnet. One loop of wire is usually referred to as a turn, and a coil consists of one or more turns. For use in an electronic circuit, electrical connection terminals called taps are often connected to a coil. Coils are often coated with varnish and/or wrapped with insulating tape to provide additional insulation and secure them in place. A completed coil assembly with taps etc. is often called a winding. A transformer is an electromagnetic device that has a primary winding and a secondary winding that transfer’s energy from one electrical circuit to another by magnetic coupling without moving parts. The term tickler coil usually refers to a third coil placed in relation to a primary coil and secondary coil. A coil tap is a wiring feature found on some electrical transformers, inductors and coil pickups, all of which are sets of wire coils. The coil tap are points in a wire coil where a conductive patch has been exposed. As self induction is larger for larger coil diameter the

current in a thick wire tries to flow on the inside. The ideal use of copper is achieved by foils. Sometimes this means that a spiral is a better alternative. Multilayer coils have the problem of interlayer capacitance, so when multiple layers are needed the shape needs to be radically changed to a short coil with many layers so that the voltage between consecutive layers is smaller.

Figure 3.3 Design of electromagnetic coil



3.3 Fundamentals of Load cell

A load cell is an electronic device (transducer) that is used to convert a force into an electrical signal. This conversion is indirect and happens in two stages. Through a mechanical arrangement, the force being sensed deforms a strain gauge. The strain gauge converts the deformation (strain) to electrical signals. A load cell usually consists of four strain gauges in a Wheatstone bridge configuration. Load cells of one or two strain gauges are also available. The electrical signal output is typically in the order of a few millivolts and requires amplification by an instrumentation amplifier before it can be used. The output of the transducer is plugged into an algorithm to calculate the force applied to the transducer.

Although strain gauge load cells are the most common, there are other types of load cells as well. In industrial applications, hydraulic (or hydrostatic) is probably the second most common, and these are utilized to eliminate some problems with strain gauge load cell devices. As an example, a hydraulic load cell is immune to transient voltages (lightning) so might be a more effective device in outdoor environments. Other types include piezo-electric load cells (useful for dynamic measurements of force), and vibrating wire load cells, which are useful in geo mechanical applications due to low amounts of drift.

Every load cell is subject to "ringing" when subjected to abrupt load changes. This stems from the spring-like behavior of load cells. In order to measure the loads, they have to deform. As such, a load cell of finite stiffness must have spring-like behavior, exhibiting vibrations at its natural frequency. An oscillating data pattern can be the result of ringing. Ringing can be suppressed in a limited fashion by passive means. Alternatively, a control system can use an actuator to actively damp out the ringing of a load cell. This method offers better performance at a cost of significant increase in complexity.

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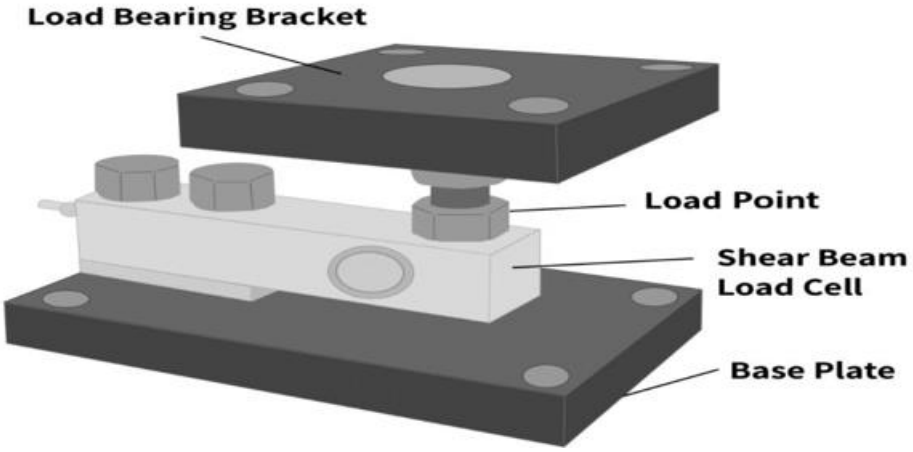

Figure 3.4 Diagram of load cell

3.4 Working Principle

The working of an automated weighing and packing machine involves several steps and components working together seamlessly to efficiently weigh, dispense, and pack products. Here's a generalized overview of the process:

Product Input:

The process begins with the introduction of products into the system. This can be done manually by adding the the product which is to be weighed is directly added into the funnel on top of the machine . Once the products are in place, they move to the weighing stage. This is where the automated weighing system comes into play . Modern weighing machines often utilize load cells or other weight-sensing mechanisms to measure the weight of the products accurately . The system is calibrated to ensure precise measurement according to predetermined weight parameters.After weighing, the products move to the dispensing stage. This is where the machine dispenses the appropriate quantity of product based on the desired weight.Dispensing mechanisms can vary depending on the type of product and packaging. They may include augers, vibratory feeders, gravity-fed chutes, or other specialized dispensers.Once the correct quantity of product is dispensed, it moves to the packaging stage. This is where the product is transferred into the packaging material.Packaging materials can range from bags and pouches to containers and cartons, depending on the product and industry requirements.The packaging material is usually pre-formed and supplied in a continuous roll or as individual units.After the product is filled into the packaging material, the package is sealed to ensure product integrity and freshness.Sealing methods can include heat sealing, ultrasonic sealing, or adhesive sealing, depending on the packaging material and product requirements.If required, the package may also undergo labeling, where relevant product information such as weight, expiry date, and barcode are printed or applied.

3.5 Advantages and Disadvantages

The automatic weighing and packing machine has advantages by implementing for the usage whereas it may have a few disadvantages which does not affect or make major drawbacks.

The various advantages are given below:

Efficiency: These machines can weigh and pack products at a much faster rate compared to manual methods, increasing overall productivity.

Accuracy: Automatic weighing systems are typically very precise, ensuring each package contains the correct amount of product, which can reduce waste and ensure customer satisfaction.

Consistency: They maintain a consistent level of quality and presentation in packaging, which is crucial for branding and customer experience.

Labor savings: By automating the weighing and packing process, businesses can reduce labor costs associated with manual labor, freeing up employees for other tasks.

Reduced human error: Automation minimizes the risk of errors that can occur with manual weighing and packing, such as incorrect measurements or inconsistent packaging.

Flexibility: Many automatic weighing and packing machines can be easily programmed to handle various products and packaging sizes, offering versatility to businesses.

The disadvantages are:

Initial cost: Automatic weighing and packing machines can require a significant upfront investment, which may be prohibitive for smaller businesses.

Maintenance: These machines require regular maintenance and occasional repairs to ensure optimal performance, adding to the overall operating costs.

Complexity: Operating and maintaining automatic weighing and packing machines may require specialized training, which can be a challenge for some businesses.

Product limitations: Certain products may not be suitable for automatic weighing and packing, particularly those with irregular shapes or sizes.

Dependency on technology: Any malfunction or breakdown in the machine can disrupt production and require immediate attention, leading to downtime and potential loss of revenue.

Adaptability: While some machines offer flexibility, others may struggle to adapt to changes in product specifications or packaging requirements, limiting their long-term usefulness.

Conclusion

In conclusion, automated weighing and packing machines represent a significant advancement in packaging technology, offering numerous benefits to industries worldwide. With their ability to automate repetitive tasks, ensure accuracy, and increase productivity, these machines have become indispensable in modern manufacturing facilities. As technology continues to evolve, we can expect further enhancements in efficiency, and integration capabilities of automated weighing and packing machines. Embracing this technology not only improves operational efficiency but also enhances product quality and customer satisfaction.

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