

## **BOX TRANSFER MECHANISM, THROUGH KINEMATIC LINK**

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### **ABSTRACT**

*There has been a serious demand for intermittent movement of packages in the industries right from the start. Though the continuous movement is more or less important in the same field of the sporadic motion has become essential. The objective of this study is to design a mechanism that delivers this stop and move motion using the mechanical linkages. The advantage of this system over the conveyor system is that the system has a time delay between moving packages and this delay can be used to introduce any alterations in the package or move the package for any other purpose and likewise. While in the normal conveyor mechanism such actions cannot be performed unless programmed module is used to produce intermittent stopping of the belt which is basically costly. The prototype design requires an electric motor, shafts and the frame of which, the frame and platform on which the packages are moved is fabricated. All the links are made up of normal MS (mild steel) and wood including the head which has a direct contact with the boxes that are to be moved. The system is expected to move as heavy packages as 2 KGs approximately. The aim of the project work is to design and fabricate a box moving mechanism that makes much easier to move with the so called quad staying machines by means of which a box blank is folded or set-up into box like form. These set-up boxes are transferred by means of a conveyor to an operator, who picks up the boxes and places and centers' them on wrappers with which the boxes are to be covered. The boxes and wrappers are then conveyed to a box wrapping machine where the wrapper is folded around and glued to the box. Usually, the operation of the wrapping machine is controlled by means of a switch actuated by the box forming machine so that their operating speeds are related to each other.*

### **I INTRODUCTION**

The box moving or shifting set up has a simple mechanism, operated with crank and links arrangement. As by the electric motor rotary motion is converted into the To and Fro motion of the linkages, it takes very simple. The rotary motion is converted in to linear motion by the crank and mechanical linkages arrangement. The conveyor system is either continuous movement or if the time delay is to be produced there will be definite requirement of software programming which will be costly. So a basic module of moving packages is designed with time delay which can be used to do alterations if required in the package or move the package for any other purpose. This invention relates to

improvements in transfer and conveying devices, and it relates particularly to devices for transferring set-up cardboard boxes from a box folding or forming machine to the operator of a semi-automatic box wrapping machine. A great many manufacturers of fancy wrapped or covered cardboard boxes used for packaging candies, cakes and other confections, cosmetics and other articles are equipped computer-aided technologies [CAD, CAM]), to control industrial machinery and processes, reducing the need for human intervention. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist them with the muscular requirements of work, automation greatly reduces the need for human sensory and mental requirements as well. Processes and systems can also be automated. Automation plays an increasingly important role in the world economy and in daily experience. Engineers strive to combine automated devices with mathematical and organizational tools to create complex systems for a rapidly expanding range of applications and human activities.

## **II CONCEPT OF THE BOX TRANSPORT MECHANISM**

- This is mainly used for transporting (moving/shifting) boxes automatically.
- It is driven through a DC motor and is powered through the main battery supply.

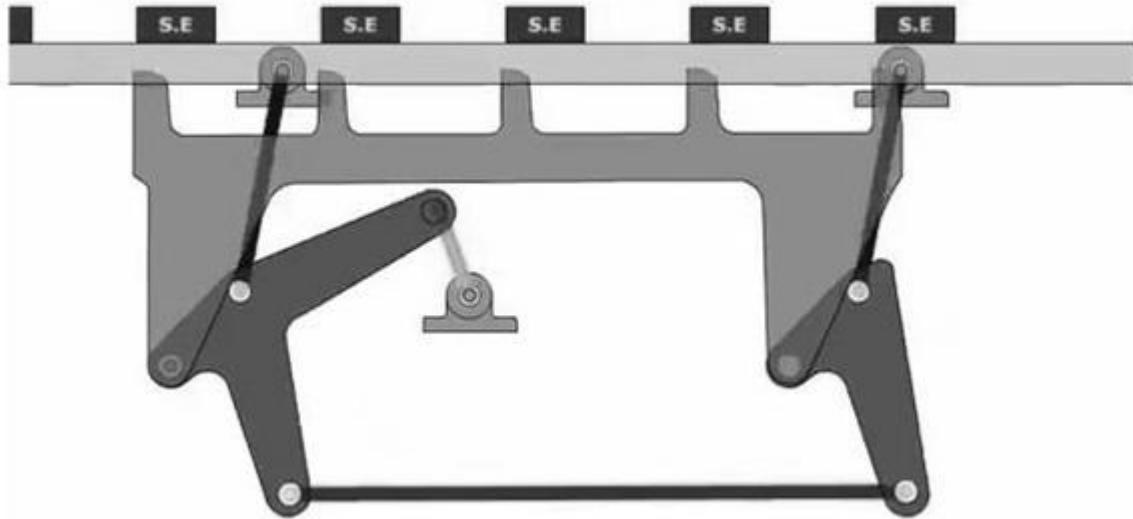
## **III PRINCIPLE**

- The principle of box moving is to change circulatory motion or cycling motion of the DC motor into translator motion with the help of levers and linkages through metal connecting rods.
- Application
- Can use this mechanism in medical production fields.
- It also can be used in bottle filling process.
- Can use this mechanism in cool drinks production.

## **IV ADVANTAGES**

- Lubricants not required.
- Simple to construct.
- Low speed motor is sufficient.
- Easy maintenance.
- Less skilled operator is sufficient.
- Noise of operation is reduced.

## **V CONSTRUCTION**



## **VI ADVANTAGES**

- Replacing human operators in tedious tasks.
- Replacing humans in tasks that should be done in dangerous environments (i.e. fire, space, volcanoes, nuclear facilities, underwater, etc.)
- Making tasks that are beyond the human capabilities such as handling too heavy loads, too large objects, too hot or too cold substances or the requirement to make things too fast or too slow.
- Economy improvement. Sometimes and some kinds of automation implies improves in economy of enterprises, society or most of humankind. For example, when an enterprise that has invested in automation technology recovers its investment; when a state or country increases its income due to automation like Germany or Japan in the 20<sup>th</sup> Century or when the humankind can use the internet which in turn use satellites and other automated engines.

## **VII DISADVANTAGES**

- Technology limits. Current technology is unable to automate all the desired tasks.
- Unpredictable development costs. The research and development cost of automating a process is difficult to predict accurately beforehand. Since this cost can have a large impact on profitability, it's possible to finish automating a process only to
- Discover that there's no economic advantage in doing so.
- Initial costs are relatively high. The automation of a new product required a huge initial investment in comparison with the unit cost of the product, although the cost of automation is spread in many product batches.

The automation of a plant required a great initial investment too, although this cost is spread in the products to be produced.

## **IX SPECIFICATIONS OF THE MECHANISM**

<b>DC Motor Speed:</b>	10 RPM
<b>Box Size:</b>	220mmx80mmx80mm
<b>One to other box distance:</b>	85mm (inner), 245 mm (outer)
<b>Rail distance:</b>	44 inches (length), 36 inches (height)
<b>Mechanism:</b>	Crank with linkages
<b>Crank Angle:</b>	220 degrees
<b>Materials:</b>	MS (Mild Steel) and Wood
<b>Total mechanism weight:</b>	11 Kg (approx.)
<b>Box transmission:</b>	Step wise movement (delay between moving boxes)

## **X FUNCTIONAL DESCRIPTION OF THE PROJECT**

The functional description of the project work is explained in brief here. For better understanding, the total project work is divided into various blocks and each block explanation is provided here. The complete block diagram of this project work is provided in the next chapter. The following is the description of overall function of the module. A box shifting machine is used to transfer boxes/cartons generally on an assembly line. Industries worldwide use conveyors as a mechanism to transport boxes from place to place. This mechanism includes strong belts, pulleys and heavy motors to rotate the pulley to move the conveyor. As an alternative to this conveyor type, more simple and comfortable machine using four bar mechanism can be used. This box shifting machine helps in transfer of boxes smoothly by use of four bars with a simple arrangement. The four bar mechanism includes four links. One link is fixed and the other links act as crank, follower and connecting rod. The rotary motion of the crank is transferred to the follower by using connecting rod and is converted to the same rotary motion. This machine requires an electric motor to provide input to the system.

### **Four-bar linkage**

A four-bar linkage also called a four-bar is the simplest movable closed chain linkage. It consists of four bodies, called bars or links connected in a loop by four joints. Generally, the joints are configured so the links move in parallel planes and the assembly is called a planar four-bar linkage. If the linkage has four hinged joints with axes angled to intersect in a single point, then the links move on concentric spheres and the assembly is called a spherical four-bar linkage. Bennett's linkage is a spatial four-bar linkage with hinged joints that have their axes angled in a particular way that makes the system movable.

### **Inversion of Four bar Mechanism**

A mechanism is one in which one of the links of a kinematic chain is fixed. Different mechanisms can be obtained by fixing different links of the same kinematic chain. These are called as inversions of the mechanism. By changing the fixed link, the number of mechanisms which can be obtained is equal to the number of links. Excepting the original mechanism, all other mechanisms will be known as inversions of original mechanism. The inversion of a mechanism does not change the motion of its links relative to each other. One of the most useful and most common mechanisms is the four-bar linkage. In this mechanism, the link which can make complete rotation is known as crank (link 2). The link which oscillates is known as rocker or lever (link 4). And the link connecting these two is known as coupler (link 3). Link 1 is the frame.

#### **Inversions of class 1 four bar mechanism:**

- When link 'b' is fixed : Crank Rocker or Crank Lever mechanism, in the shortest link rotates 360 degree whereas the other link oscillates
- When link 'a' is fixed : Crank Rocker or Crank Lever mechanism, in the shortest link rotates 360 degree whereas the other link oscillates
- When link 'd' is fixed : Drag link or Double crank mechanism in which the links 'a' and 'b' undergoes complete 360 dig motion
- When link 'c' is fixed: Double rocker or Double lever mechanism in which no link makes a complete rotation about its joints. In such case it is similar to class 2 four bar mechanisms

A mechanism has been defined above as a kinematic chain in which one of the links is fixed. From the four bar mechanism, different versions of each of them can be obtained by fixing any one of the links p, q 1 or s. Such different versions, which can be obtained by fixing any of the different links, are called its "Inversions". Many a time, a particular inversion of a mechanism may give rise to different mechanisms of practical utility, when the proportions of the link lengths are changed. By this principle of inversion of a four bar chain, several useful mechanisms can be obtained.

### **Design of four bar mechanisms**

The synthesis, or design, of four bar mechanisms is important when aiming to produce a desired output motion for a specific input motion. In order to minimize cost and maximize efficiency, a designer will choose the simplest mechanism possible to accomplish the desired motion. When selecting a mechanism type to be designed, link lengths must be determined by a process called dimensional synthesis. Dimensional synthesis involves an iterate-and-analyze methodology which in certain circumstances can be an inefficient process; however, in unique scenarios, exact and detailed procedures to design an accurate mechanism may not exist. The picture shown below is for illustration purpose only. The actual model may not be exactly same as shown in the previous figure.

### **Selection of Materials**

- Linkages
- DC motor
- M.S. Frame
- Bearings

The design and fabrication of box shifting mechanism constructed by various components such as hilum board, dc wiper motor, dc battery, steel stand and wooden pieces. In this steel frame build by using rectangular hollow pipes and steel rods these are connected by welding operation. The hilum boards are cut by using cutting operation. The dc wiper motor fitted on the frame by using bolt and nut joint. Power supply given from the dc battery (12volts and 7amps) through copper wires.

### **Dc motor**

A windscreens wiper or windshield wiper is a device used to remove rain and debris from a windscreens or windshield. Almost all motor vehicles, including trains, watercraft and some aircraft, are equipped with such wipers, which are usually a legal requirement. A wiper generally consists of an arm, pivoting at one end and with a long rubber blade attached to the other.

The blade is swung back and forth over the glass, pushing water from its surface. The speed is normally adjustable, with several continuous speeds and often one or more "intermittent" settings. Most automobiles use two synchronized radial type arms, while many commercial vehicles use one or more pantograph arms.

### **Bearings**

A bearing is a machine element that constrains relative motion between moving parts to only the desired motion. The design of the bearing may, for example, provide for free linear movement of the moving part or for free rotation around a fixed axis; or, it may prevent a motion by controlling the vectors of normal forces that bear on the moving parts. Bearings are classified broadly according to the type of operation, the motions allowed, or to the directions of the loads (forces) applied to the parts.

### **External Factor**

The service life of the bearing is affected by many parameters that are not controlled by the bearing manufacturers. Examples are bearing mounting, temperature, exposure to external environment, lubricant cleanliness and electrical currents through bearings etc.

### **Maintenance and lubrication**

Many bearings require periodic maintenance to prevent premature failure, although some such as fluid or magnetic bearings may require little maintenance. Most bearings in high cycle operations need periodic lubrication and cleaning, and may require adjustment to minimize the effects of wear. Bearing life is often much better when the bearing is kept clean and well-lubricated. However, many applications make good maintenance difficult. For example bearings in the conveyor of a rock crusher are exposed continually to hard abrasive particles. Cleaning is of little use because cleaning is expensive, yet the bearing is contaminated again as soon as the conveyor resumes operation. Thus, a good maintenance program might lubricate the bearings frequently but never clean them.

### **Packing**

Some bearings use thick grease for lubrication, which is pushed into the gaps between the bearing surfaces, also known as packing. The grease is held in place by a plastic, leather, or rubber gasket (also called a gland) that covers the inside and outside edges of the bearing race to keep the grease from escaping. Bearings may also be packed with other materials. Historically, the wheels on railroad cars used sleeve bearings packed with waste or loose scraps cotton or wool fiber soaked in oil, than later used solid pads of cotton.

### **Ring Oiler**

Bearings can be lubricated by a metal ring that rides loosely on the central rotating shaft of the bearing. The ring hangs down into a chamber containing lubricating oil. As the bearing rotates, viscous adhesion draws oil up the ring and onto the shaft, where the oil migrates into the bearing to lubricate it. Excess oil is flung off and collects in the pool again.

## **XI FABRICATION OF THE MACHINE**

There are few types of fabrication methods are done on the machine. They are:

- Arc cutting.
- Drilling.
- Grinding.

### **Further Operation**

- Cleaning.
- Assembling.

### **Machining Operations**

In this project it is used to cut the raw material such as plates, rod. This is done by arc cutting machine.

### **Drilling**

Drilling is used to produce holes in objects. In this project the square type pipe required the holes for making rake assembly. These holes are done by vertical type drilling machine.

### **Fine Grinding**

It is nothing but a grinding process, which is done as smooth with fine grains. It is done by convention grinding machine.

### **Further Operations**

#### **Cleaning**

It is the operation to clean the all machined parts without burrs, dust and chip formals. By meaning the parts they are brightened and good looking.

## **Electric Motors – An Over View**

Electric motors, both ac & dc motors, come in many shapes and sizes. Some are standardized electric motors for general-purpose applications. Other electric motors are intended for specific tasks. In any case, electric motors should be selected to satisfy the dynamic requirements of the machines on which they are applied without exceeding rated electric motor temperature. Thus, the first and most important step in electric motor selection is determining load characteristics -- torque and speed versus time. Electric motor selection is also based on mission goals, power available, and cost.

## **Power Source Description**

The power supplies are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A RPS (Regulated Power Supply) is the Power Supply with Rectification, Filtering and Regulation being done on the AC mains to get a Regulated power supply for the devices being used. The motor used requires a supply of +12V DC, which is derived from the single phase supply of 230V AC. A power supply unit can be broken down into a series of blocks, each of which performs a particular function. A DC power supply which maintains the output voltage constant irrespective of AC mains fluctuations or load variations is known as “Regulated D.C Power Supply”.

## **XII CONCLUSION**

The box shifting mechanism plays a major role in industries, the process of transporting or shifting products from one place to another was to be maintained by conveyors only. So we just successfully altered this with a box shifting mechanism using the kinematics links and a motor. We had just implemented our basic mechanical knowledge and designing skills for designing and fabricating this project successfully. Thus this project work might be useful in all industries. For practical applications this is fabricated for light duty operation. Its height, weight and other mechanical designs may be not suitable for any other heavy operation or work on hardened material. We are proud

that we have completed the work with the limited time successfully. The project works with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities.

## **REFERENCES**

1. "A Review on Kinematic and Dynamic Analysis of Mechanism" by Shrikant R. Patel, D. S. Patel, B. D. Patel Research Scholar, Associate Professor, Assistant Professor.
2. [http://en.wikipedia.org/wiki/Crank\\_\(mechanism\)](http://en.wikipedia.org/wiki/Crank_(mechanism))
3. A Text Book of Automobile Engineering by R. K. Rajput
4. A Text Book of Theory of Machines by R. S. Khurmi, J.K. Gupta
5. S.K. Hajra Choudhry and A.K. Hajra Choudhry, Workshop Technology (VOL II).
6. W.A. Chapman, Workshop Technology.
7. Raghuvanshi, Workshop Technology.
8. K.R. Gopalakrishnan, Machine Drawing.
9. Anderson & Tatro, Shop Theory.
10. Gerling, All About machines.
11. Mechatronics – Electronic Control Systems in Mechanical and electrical Engineering – By: W. Bolton.
12. Mechatronics and measurement systems - By: DAVID G. ALCIATORE and MICHAEL B. HISTAND.