



FABRICATION OF PUSH BOX WITH KINEMATIC LINK MECHANISM

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Abstract: In this paper the work is done by converting rotary motion into reciprocating motion by means of a single slider crank mechanism. The main motive behind this prototype is to replace conventional conveyer systems with fully mechanical, highly efficient, having low initial and maintenance costs. These small-scale mechanical conveyers Box transport systems are mainly focused on small-scale manufacturing plants and businesses. Conventional conveyer systems consist of belts, large input/output motors, etc., which increase the initial as well as maintenance cost. This prototype is based solely on a four-bar mechanism and employs a simple small rotary motor. This rotary motion is converted to reciprocating motion. This prototype will surely reduce the efforts required by small-scale industries. 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.

Index Terms—push box mechanism, box transportation, slider crank mechanism, DC motor, push box.

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 From 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. 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. As shown in Figure 1.



Fig:1 Box transfer mechanism

LINKAGE MECHANISM: A linkage is a mechanism formed by connecting two or more levers together. Linkages can be designed to change the direction of a force or make two or more objects move at the same time. Many different fasteners are used to connect linkages together yet allow them to move freely such as pins, endthreaded bolts with nuts, and loosely fitted rivets. There are two general classes of linkages: simple planar linkages and more complex specialized linkages; both can perform tasks

such as describing straight lines or curves and executing motions at differing speeds. The names of the linkage mechanisms given here are widely but not universally accepted in all textbooks and references.

CRANK-ROCKER MECHANISM FOR BOX TRANSPORT MECHANISM: The four-bar linkage is the simplest and often, the most useful mechanism. As we mentioned before, a mechanism composed of rigid bodies and lower pairs is called a linkage (Hunt 78). In planar mechanisms, there are only two kinds of lower pairs revolute pairs and prismatic pairs. The simplest closed-loop linkage is the four-bar linkage which has four members, three moving links, one fixed link and four pin joints. A linkage that has at least one fixed link is a mechanism.

SOME IMPORTANT CONCEPTS IN LINK MECHANISMS:

1. Crank: A side link which revolves relative to the frame is called a crank.
2. Rocker: Any link which does not revolve is called a rocker.
3. Crank-rocker mechanism: In a four bar linkage, if the shorter side link revolves and the other one rocks (i.e., oscillates), it is called a crank-rocker mechanism.
4. Double-crank mechanism: In a four bar linkage, if both of the side links revolve, it is called a double crank mechanism.
5. Double-rocker mechanism: In a four-bar linkage, if both of the side links rock, it is called a double-rocker mechanism.

PUSH-PULL LINKAGE: The box moving mechanism has a simple mechanism and is operated with a crank and links arrangement. Here the electric motor rotary motion is converted into the To and Fro motion or linear motion of the link. The output link moves in the same direction as the input link. Technically classed as an eight-bar linkage, it can be rotated through 360° without changing its function. The rotary motion is converted into linear motion by the crank and mechanical linkages arrangement.

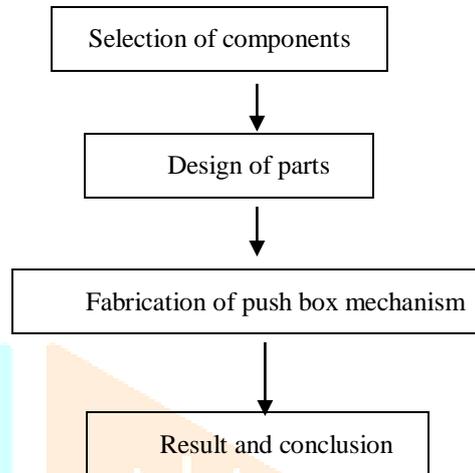
II. LITERATURE REVIEW

R. Poojari et.al., [1] The box moving or shifting set up has a simple mechanism, operated with crank and links arrangement. The rotary motion is converted in to linear motion by the crank and mechanical linkages arrangement. This is mainly used for transporting (moving/shifting) boxes automatically. 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. Can use this mechanism in medical production fields. It also can be used in bottle filling process. A. Sandesh shinde et.al., [2] The box transfer or displacement system has a simple mechanism, operated with chain and gear crank arrangement. Using electric motor the linkages of the shaft convert the turning motion to linear movement of the linkages, it is very simple .So a basic module of moving packages is designed with time delay which could be using to do alterations if required in the package or move the package for any other purpose.Push and pull link, ,make the things or objects move in the similar direction ; The input link move as per the movement of output link in the identical direction .without any changes in function as 360 degrees it can rotate by the four bar linkage and is classed technically. Haris's khan et.al., [3] The box transfer or displacement system has a simple mechanism, operated with chain and gear crank arrangement. Using electric motor, the linkages of the shaft convert the turning motion to linear movement of the linkages, it is very simple. The turning motion is converted in to linear motion by the crank and mechanical linkages with chain and gear crank arrangement Wiper motor is generally is used in cars to wipe the water films on a glass. In this chain and gear crank mechanism it is used to move the main frame by using linkages. Piyush pagar et.al., [4] The need of moving the manufactured components of any industrial plant is one of the basic needs that need to be fulfilled in order to ensure the efficiency of the plant as a whole. There has been various prototypes dedicated solely for the in-plant transport of components/ equipment/ totally manufactured final products. But the thing which does not comply with most of the conveyor belt systems is that they are not cost efficient. They require a large amount of capital investment which is not something that is affordable by everyone. Our design for the "BOX TRANSPORT MECHANISM" is dedicated to the small-scale industries for whom conventional conveyor belt systems are not accessible or simply who do not need such a large scale systems such as in-house assembly line. The advantage of our design is the stop and go motion which provides a time delay for each box. P.R.Kothule et.al., [5] 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. M.Viswanath et.al., [6] 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. Patel Bhaytik et.al., [7] 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. J.R.Sanaik et.al., [8] 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. D.Mahesh Naidu et.al., [9] The box transport mechanism has a simple mechanism, as it operated with a crank and links arrangement. As by the electric motor rotary motion is converted into the to and fro motion of the linkages, the linear motion is obtained by conversion of

rotary motion by the use of cranks and mechanical linkages. If we take the fact that same work can be done by thread mill of other mechanisms which are used in large scale industries and factories but small scale industries will not be able to afford them so this box transport mechanism comes in handy. In the case of thread mill mechanism as it always in continues in motion so when a human involvement is introduced to it sometimes causes time delays which causes an effect on production process this problem can be solved by using box transport mechanism. Prasad Kulkarni et.al., [10] A linkage is a mechanism formed by connecting two or more levers together. Linkages can be designed to change the direction of a force or make two or more objects move at the same time. Many different fasteners are used to connect linkages together yet allow them to move freely such as pins, end-threaded bolts with nuts, and loosely fitted rivets. There are two general classes of linkages: simple planar linkages and more complex specialized linkages; both are capable of performing tasks such as describing straight lines or curves and executing motions at differing speeds. The names of the linkage mechanisms given here are widely but not universally accepted in all textbooks and references. Mandar Paramane et.al., [11] In today's era of automation and mass production for industries to be competitive and cost effective we tried to find a solution for packaging industries. As there are number of items required in day-to-day life like soaps, confectioneries, automobile components, food items are produced in small and medium scale industries. For packaging these items using labor is quite costly affair and even production output is limited due to human abilities and there are some human errors too. So, we have tried to find the best feasible working solution for this kind of industries. Also, we have considered the cost angle for the small and medium sized industries. We have analyzed the change in output and overall performance of this machine. Siva Krishna et.al., [12] 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 the sporadic motion has become essential. The objective of the project is to produce a mechanism that delivers this stop and move motion using mechanical linkages. The advantage of the 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 conveyor system such actions cannot be performed unless programmed module is used to produce intermittent stopping of the belt which basically is costly. MohneshMandhane et.al., [13] Continuous demand for intermittent movement of packages in the industries right from the start. The continuous movement is more or less important in the same field the sporadic motion has become essential. The objective of this system is to produce a mechanism that delivers this stop and move motion using mechanical linkages. The prototype design requires an electric motor, shafts and the frame on which the frame and platform of the packages are moved is fabricated. All the links are made from Aluminum which reduces the weight of the system including the head. The system is expected to carry heavy packages as 2 to 3 kgs approximately. This machine is basically working on the Single Slider Crank Mechanism which is the heart of this machine and it converts rotary motion into a reciprocating machine to crush the Cans/Plastic bottles. N.Dileepan et.al., [14] 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 the sporadic motion has become essential. The objective of our project is to produce a mechanism that delivers this stop and move motion using mechanical linkages. The advantage of our 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 conveyor system such actions cannot be performed unless programmed module is used to produce intermittent stopping of the belt which basically is costly. The prototype design requires electric motor, shafts and the frame of which the frame and platform on which the packages are moved is fabricated. Ram Prasad et.al., [15] 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. Piyush Ukey et.al., [16] In this project, as discussed in the above paragraph, we are trying to combine the two different mechanisms, namely, Box Shifting Mechanism and Gearless Power Transmission Mechanism. These mechanisms are very unique yet simple in nature and have their own significance in industrial applications. So, starting with the Box Shifting Mechanism, it is a simple mechanism which is operated with the help of a crank and link arrangements. In this mechanism, the rotary motion of a Crank results into the back and forth linear motion of the Linkage Mechanism. This back and forth linear motion of Linkage Mechanism helps boxes on the conveyor to move further. Now, coming to the Gearless Power Transmission Mechanism, which can also be called as the Bent-Link Mechanism. Anjali vardai et.al., [17] There is 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 the sporadic motion has become essential. The objective of our project is to produce a mechanism that delivers this stop and move motion using mechanical linkage. The advantage of our system over the conveyors 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 packages for any other purpose. The box transport mechanism has a simple mechanism, it can be operated with a crank and links arrangement. The wiper motor rotary motion is converted into the to and fro motion of the linkages, the linear motion is obtained by conversion of rotary motion by the use of cranks and mechanical linkages. A linkage is a mechanism formed by connecting two or more levers together. Khan Mohsim Saeed et.al., [18] 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 the sporadic motion has become essential. The objective of our project is to produce a mechanism that delivers this stop and move motion using mechanical linkages. The advantage of our system over the conveyer 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 conveyer system such actions cannot be performed unless programmed module is used to produce intermittent stopping of the belt which basically is costly. The prototype design requires electric motor, shafts, and the frame of which the frame and platform on which the packages are moved is fabricated. A.Vijay et.al., [19] The design and fabrication of box shifting mechanism constructed by various components such as hylem 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 hylem 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. A mechanical linkage is

an assembly of bodies connected to manage forces and movement. The movement of a body, or link, is studied using geometry so the link is considered to be rigid. The connections between links are modeled as providing ideal movement, pure rotation or sliding for example, and are called joints. Karthick.S et.al., [20] In an organization, Manufacturing plays a vital role, hence the focus of our project focuses on “design and fabrication of box transport machine”. The box moving or shifting set up has a simple mechanism, implementing a crank and lever arrangement. The rotary motion of the motor is used to actuate the links enabling the to and fro motion of the teeth. 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 system transfers and includes shifting of boxes by using simple and basic mechanical principles.

III. METHODOLOGY



Selection of components:

- Wiper motor
- Steel frames
- Linkages
- Bolts nuts and washers

A four-bar linkage, also called a four-bar, is the simplest movable closed chain linkage. It consists of four bodies, called bar 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 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.

The project, as discussed, is the combination of two different mechanisms. One is Box Shifting Mechanism and the another one is Gearless Power Transmission Mechanism. The set up consists of similar Circular Plates with drilled holes at the Pitch Circle Diameter of 100mm. The two circular plates are then connected with the help of three Links. These three links are bent at an angle of 90°. When the power is transmitted to the shaft, it starts rotating. This is a driver shaft which is already connected to the first circular plate. This circular plate starts rotating with the help of driver shaft. As we have stated earlier that the three bent links are connected to these two circular plates. So, because of this, the power transmission to the second circular plate becomes possible. The rotary motion of the crank is transferred to the Couplers and then the power gets transmitted to the upper structure.

IV. FABRICATION

Main components used:

- Wiper motor
- Battery 12V
- Steel frame
- Bolts nuts and washers

Wiper motor: Wiper motor is generally is used in cars to wipe the water films on a glass. In this chain and gear crank mechanism it is used to move the main frame by using linkages. the capacity of the motor is 24V this helps to regulate the speed (fast or slow) and the rpm of this motor is 35 .It is used to give intermittent motion. As shown in Figure 2.



Fig:2 Wiper motor

Battery 12 v: Battery generally provides the electric power to any electronic devices such as electric bulbs, motors, more it is used in the automobiles (horn, self-start etc...).in this mechanism it is used to run the motor which will work due to the supply of power from the battery and it is rechargeable. As shown in Figure 3.



Fig:3 Battery

Steel Frame: Steel frame are used to construct the structure of any skeleton by arranging in horizontal and vertical manner as per the dimensions and structure is build according to the database. As shown in Figure 4.



Fig:4 Steel frame

Bolts Nuts and Washers: Bolts and nuts are used to joining the two links and the nut is usually of metallic block these are available in most common structures like square or hexagonal which the hole is designed by threading and this can be mated together with a bolt. And the washers are used to prevent the slippages, this can give the tightness to the joints etc. and are available in different types such as flat rings, leather, metal, rubber. As shown in Figure 5.



Fig:5 Bolts nuts and washers

EXPERIMENTATION:

- First of all, we have prepared the drawing for the equipment.
- A frame is made with angles by cutting them with the help of a cutting machine.
- Arc welding method is used to join the cut pieces to get the final frame of the mechanism.
- Mild steel plates were used to prepare the seating for the boxes on the conveyor.
- The shaft and hanger were machined as per the dimensions on the lathe.
- Holes were drilled as per the drawing with the help of a drilling machine.
- The shaft which takes the boxes to the next level is prepared.
- All the welded joints were given finishing look with the help of a flat file.
- The electric motor is then fixed on the bed which drives the whole mechanism.
- Then the crank and hanger were fixed and connected to the motor. The box transport mechanism is ready. In figure 6.

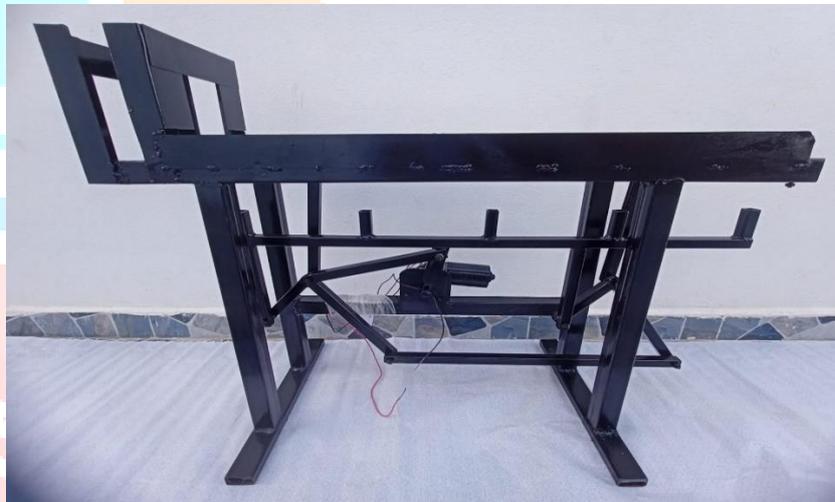


Fig:6 After Experimentation

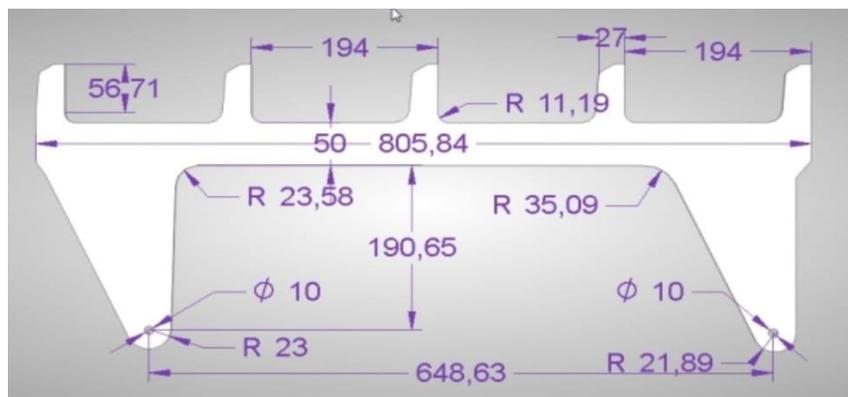
V. CALCULATION

Fig:7 Crank Rocker Mechanism

In the given fig value of d is the predetermined value and we have to determine the crank radius r for a given radius value of rocker R . In figure 7.

Let the oscillation of rocker is Q degree at point B

From the triangle AB

$$d = 2 AC$$

$$d = 2 R \sin(Q/2)$$

$$Q/2 = \sin^{-1}(d/2R)$$

$$Q = 2 \sin^{-1}(d/2R)$$

From Crank and Rocker motion

$$2r = R * Q * 3.14321 / 180 \dots (1)$$

On putting the value of Q from equation (1), we get

$$r = (R * 3.14321 / 180) * \sin^{-1}(d/2R) \dots (2)$$

Here, the dimension (radius) of crank for displacement of 215 mm at the rocker radius of 250 mm.

Given that:

$$R = 250 \text{ mm} \ \& \ d = 215 \text{ mm}$$

Put the value of R & d in equation (2),

$$r = (250 * 3.14321 / 180) * \sin^{-1}(215/2 * 250)$$

$$r = 111.18 \text{ mm}$$

RESULT: This Box Transport Mechanism Project task utilizes system for moving stuffed merchandise one by one among which some action can be conveyed like examination, shutting, naming and so forth among the travel and will move the products one by one by the bar linkages. This entire box shifting mechanism project is comprised of gentle steel material. Numerous connections are used to move the case forward, the fundamental connection is associated with the engine which changes over the turning movement into liner, which responds movement for the shifter joins.

VI. 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 can understand the difficulties in maintaining the tolerances and also quality. We have done to our ability and skill making maximum use of available facilities.

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