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Experimental Analysis of Automatic Conveyer for Moving Box

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ABSTRACT

This paper discuss the about the automatic conveyer that help in box moving or shifting setup with a simple mechanism, operated with crank and links arrangements. As by the electric motor rotary motion is converted into to and from motion of the linkages, it takes very simple. The rotary motion is converted into liner motion by the crank and mechanical linkage arrangement. 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.

Keywords: automatic conveyer, dc motor, electric motor

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INTRODUCTION

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 added 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 provides 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 device with mathematical and organizational tools to create complex system for a rapidly expanding range of application and human activities.

PRINCIPLE

The principle of box moving is to change circulatory motion of the DC motor into translator motion with the help of levers and linkages through metal connecting rod in this machine can comfortable for moving the product from one place to another place with safely. The machine is placed and working process is very easy for using persons. In this machine, the control unit is control the motor drive for rotation of the crank shaft. The motor is placed and the crank shaft is attached with the motor with the help of bearing. The products are safely placed in the stored place and then motor is ON, the crank is rotated and the first box is move from first place to second place in the first rotation, after that the second box is placed in the first position, the second rotation is started the first box is move from second place to third place, in the mean time the second box is move from first place to second place. In this based the boxes are move from one place to another place simultaneously. The products are safely transfer from one place to another in conveyor using crank.

CONVEYOR

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in

applications involving the transportation of heavy or bulky materials (Figure 1). Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. Many kinds of conveying systems are available and are used according to the various needs of different industries. Similarly, the same kind of operation done by this box shifting mechanism. This box shifting machine helps in transfer of boxes smoothly by use of four bars with a simple arrangement. But it operated by four bar mechanism which converts rotary motion into reciprocating motion [1–3].

Industries That Use Conveyor Systems

Conveyor systems are used widespread across a range of industries due to the numerous benefits they provide. Conveyors are able to safely transport materials from one level to another, which when done by human labor would be strenuous and expensive. They can be installed almost anywhere and are much safer than using a forklift or other machine to move materials.

They can move loads of all shapes, sizes and weights. Also, many have advanced safety features that help prevent accidents. There are a variety of options available for running conveying systems, including the hydraulic, mechanical and fully automated systems, which are equipped to fit individual needs [4].

Conveyor systems are commonly used in many industries, including the automotive, agricultural, computer, electronic, food processing, aerospace, pharmaceutical, chemical, bottling and canning, print finishing and packaging. Although a wide variety of materials can be conveyed, some of the most common include food items such as beans and nuts, bottles and cans, automotive components, scrap metal, pills and powders, wood and furniture and grain and animal feed.

Fig. 1. *Conveyor.*

Growth of Conveyor Systems

As far as growth is concerned the material handling and conveyor system makers are getting utmost exposure in the industries like automotive, pharmaceutical, packaging and different production plants. The portable conveyors are likewise growing fast in the construction sector and by the year 2014 the purchase rate for conveyor systems in North America, Europe and Asia is likely to grow even further. Mostly purchased conveyor equipment are Line shaft roller conveyor, chain conveyors and conveyor belts at packaging factories and industrial plants where usually product finishing and monitoring are carried.

Functional Description

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.[5] 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 [6]. 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 (Figure 2). 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.

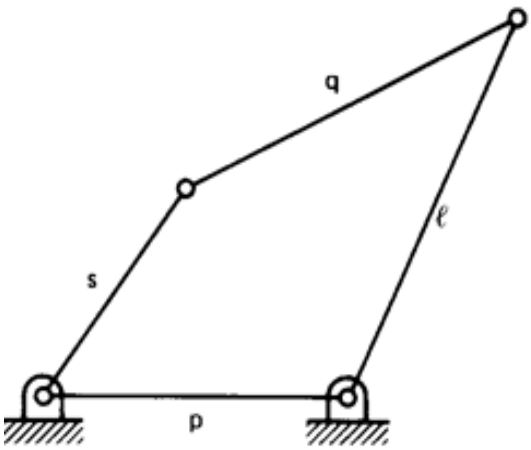
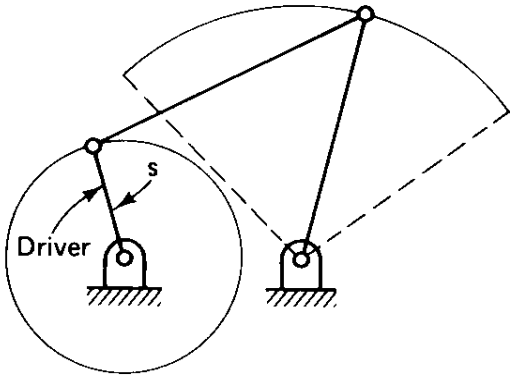


Fig. 2. *Four bar linkage.*

Shortest Link + Longest Link < Summation of the Other Two Links

In Ricci, shortest link is the driver with either one of the intermediate links as the ground link (fixed) (Figure 3). The result is two different types of crank-rocker mechanisms, input link rotates 360 (crank) and output link oscillates (rocker) [1].

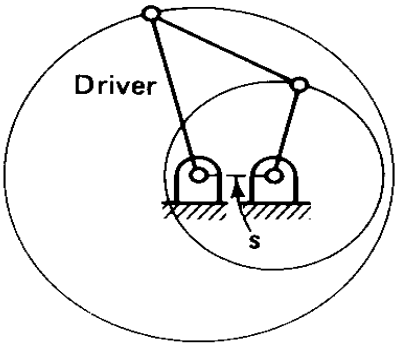


$s + \ell < p + q$

Fig. 3. *Crank-rocker.*

Shortest Link + Longest Link < Summation of the Other Two Links

Shortest link is fixed. The result is a double-crank mechanism. Both, input and output links rotate 360 (Figure 4).



$s + \ell < p + q$

Fig. 4. *Double-crank.*

Shortest Link + Longest Link < Summation of the Other Two Links

The longest link is fixed and either one of the intermediate links is the driver. The

result is a double-rocker mechanism. Both, input and output links oscillate (Figure 5).

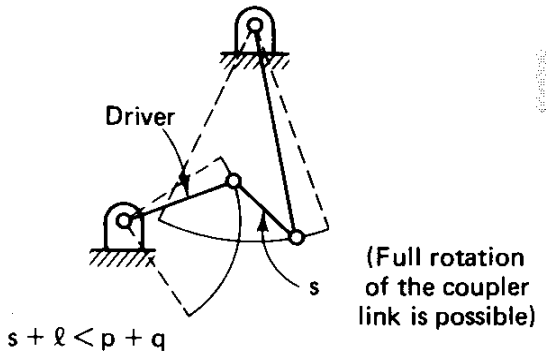


Fig. 5. *Grashof rocker–rocker.*

Shortest Link + Longest Link > Summation of the Other Two Links

There are four possible mechanisms depending on which link is fixed. All mechanisms are double rockers (Figure 6).

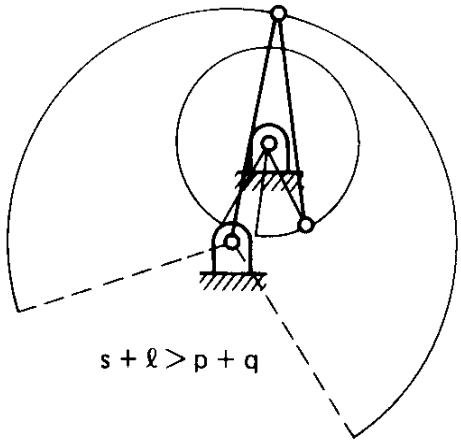


Fig. 6. *Non-grashof rocker–rocker (Triple-rocker).*

EXPERIMENTAL METHODOLOGY

Linkages

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 [7].

A linkage modeled as a network of rigid links and ideal joints is called a kinematic chain. Linkages may be constructed from open chains, closed chains, or a combination of open and closed chains. Each link in a chain is connected by a joint to one or more other links. Thus, a kinematic chain can be modeled as a graph in which the links are paths and the joints are vertices, which is called a linkage graph [8].

The movement of an ideal joint is generally associated with a subgroup of the group of Euclidean displacements. The number of parameters in the subgroup is called the degrees of freedom (DOF) of the joint. Mechanical linkages are usually designed to transform a given input force and movement into a desired output force and movement.

The ratio of the output force to the input force is known as the mechanical of the linkage, while the ratio of the input speed to the output speed is known as the speed ratio. The speed ratio and mechanical advantage are defined so they yield the same number in an ideal linkage.

Functions of Linkage

The function of a link Mechanism is to produce rotating, oscillating, or reciprocating motion from the rotation of a crank or vice versa. Stated more specifically linkages may be used to convert:

- Continuous rotation into continuous rotation, with a constant or variable angular velocity ratio.
- Continuous rotation into oscillation or reciprocation (or the reverse), with a constant or variable velocity ratio.
- Oscillation into oscillation, or reciprocation into reciprocation, with a constant or variable velocity ratio.

Grashof's Theorem

It states that a four-bar mechanism has at least one revolving link if, s + l <= p + q (5-1). And all three mobile links will rock

if, s + l > p + q(5-2). The inequality is Grashof's criterion. All four-bar mechanisms fall into one of the four categories listed below (Table 1).

***Table 1**. Category of mechanics.*

Case	l + s versus p + q	Shortest bar	Type
1	<	Frame	Double-crank
2	<	Side	Rocker-crank
3	<	Coupler	Double rocker
4	=	Any	Change point
5	>	Any	Double-rocker

We can see that for a mechanism to have a crank, the sum of the length of its shortest and longest links must be less than or equal to the sum of the length of the other two links. However, this condition is necessary but not sufficient. Mechanisms satisfying this condition fall into the following three categories:

- When the shortest link is a side link, the mechanism is a crank-rocker mechanism. The shortest link is the crank in the mechanism.
- When the shortest link is the frame of the mechanism, the mechanism is a double-crank mechanism.
- When the shortest link is the coupler link, the mechanism is a double-rocker mechanism.

Design and Fabrication Methodology

Methodology to design and fabrication the box transport mechanism.

[1] Analyse box sifting mechanism
[2] Designing the required components
[3] Selection of required materials
[4] Purchasing the materials
[5] Fabrication of the box sifting mechanism

Drawing and Design

Drawing and designs are shown in Figures (7–13).

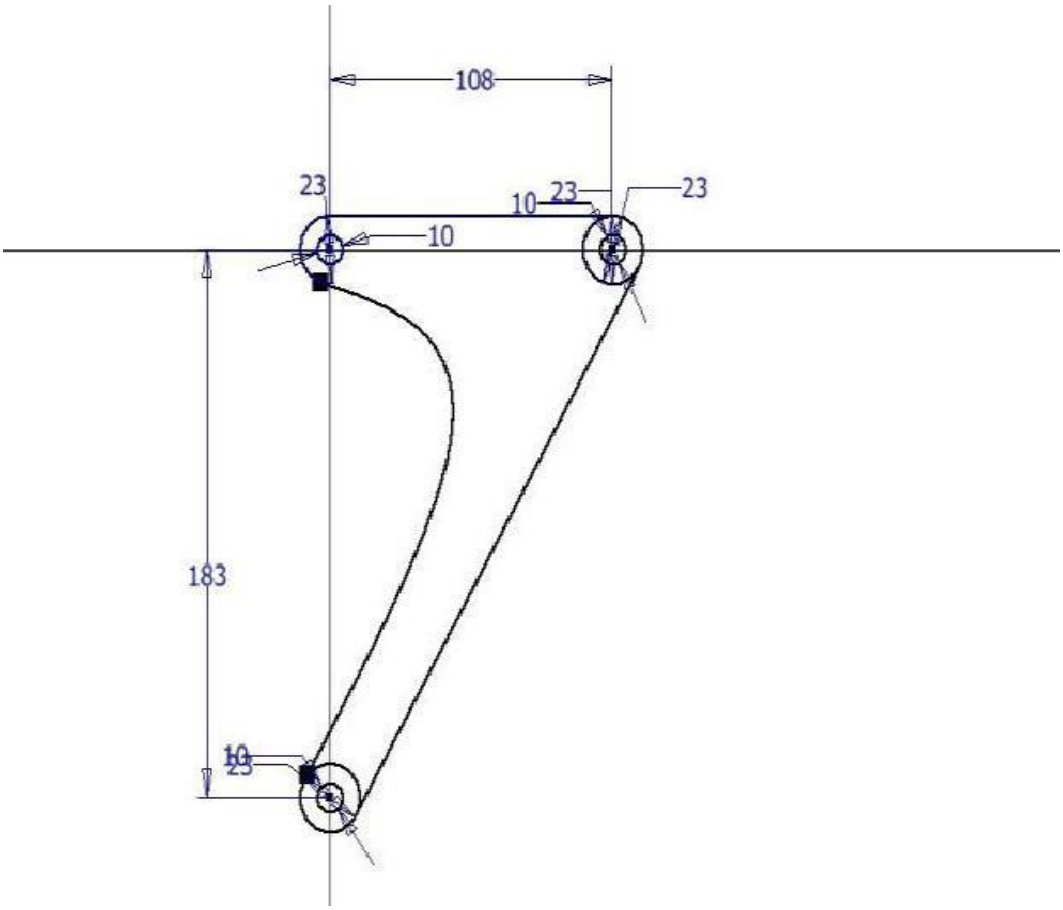


***Fig. 7.** Design of shaft 1.*

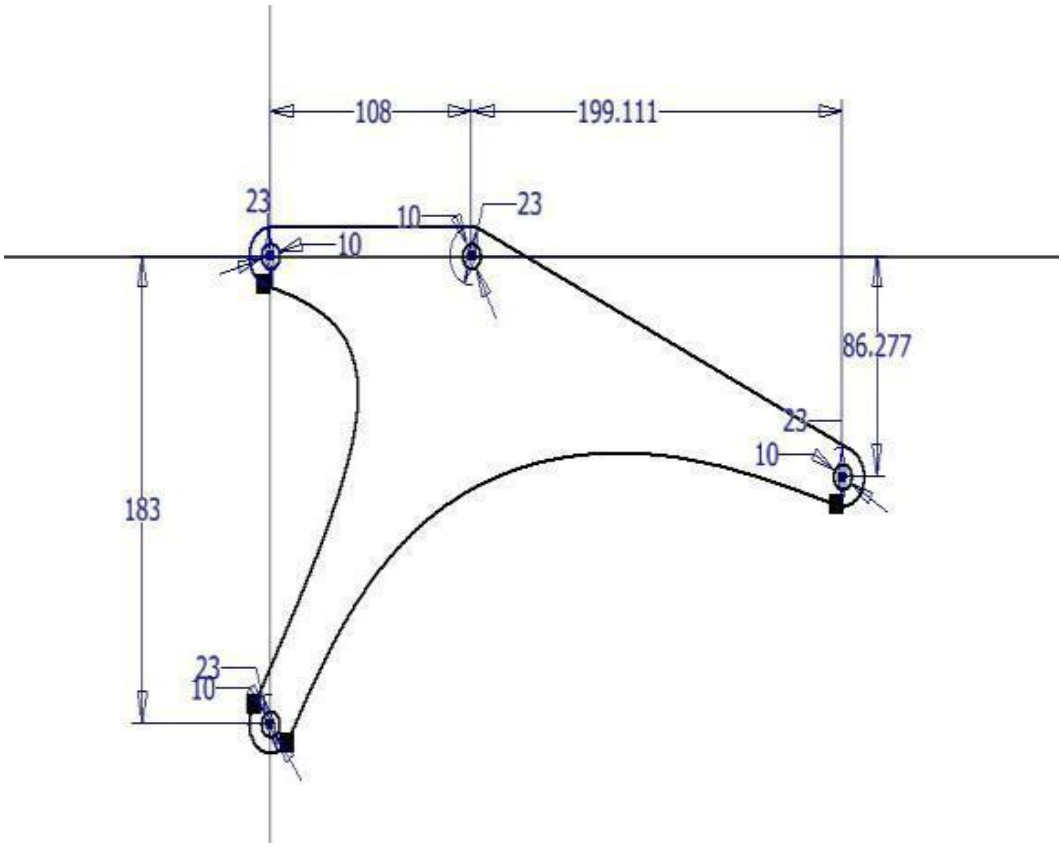


Fig. 8. *Design of shaft 2.*

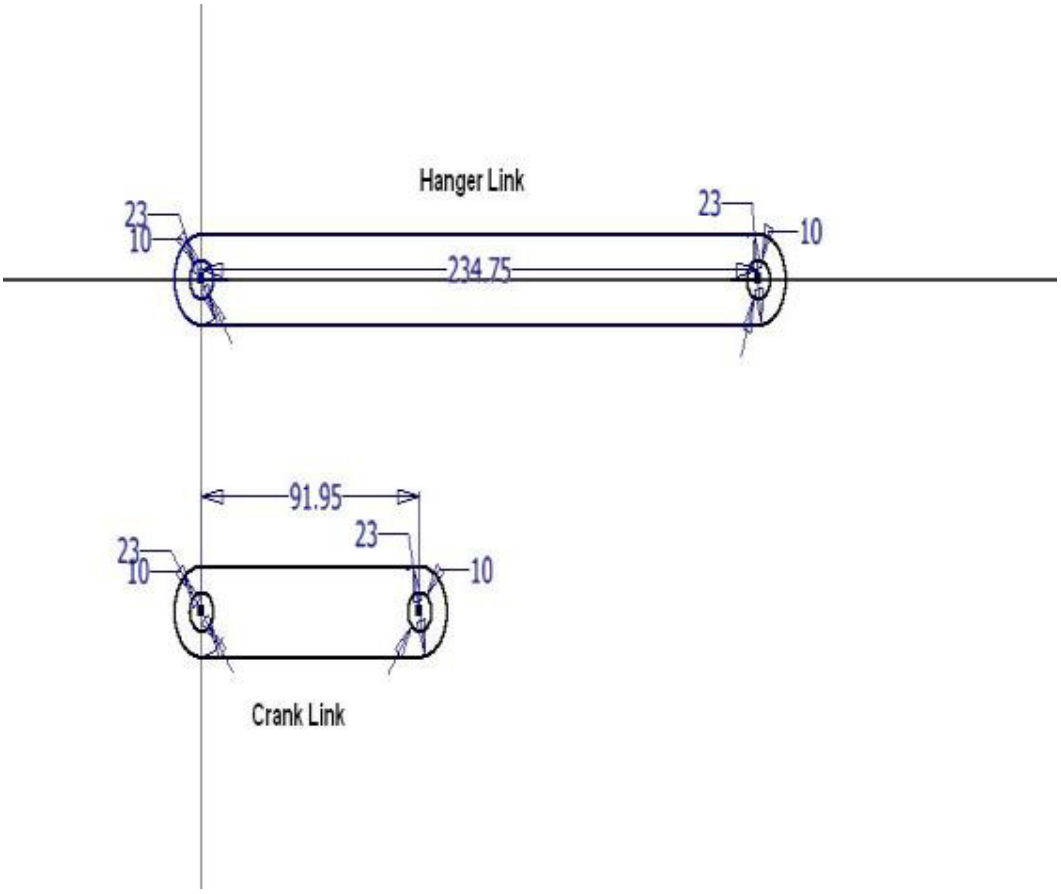


Fig. 9. *Design of hanger and crank.*

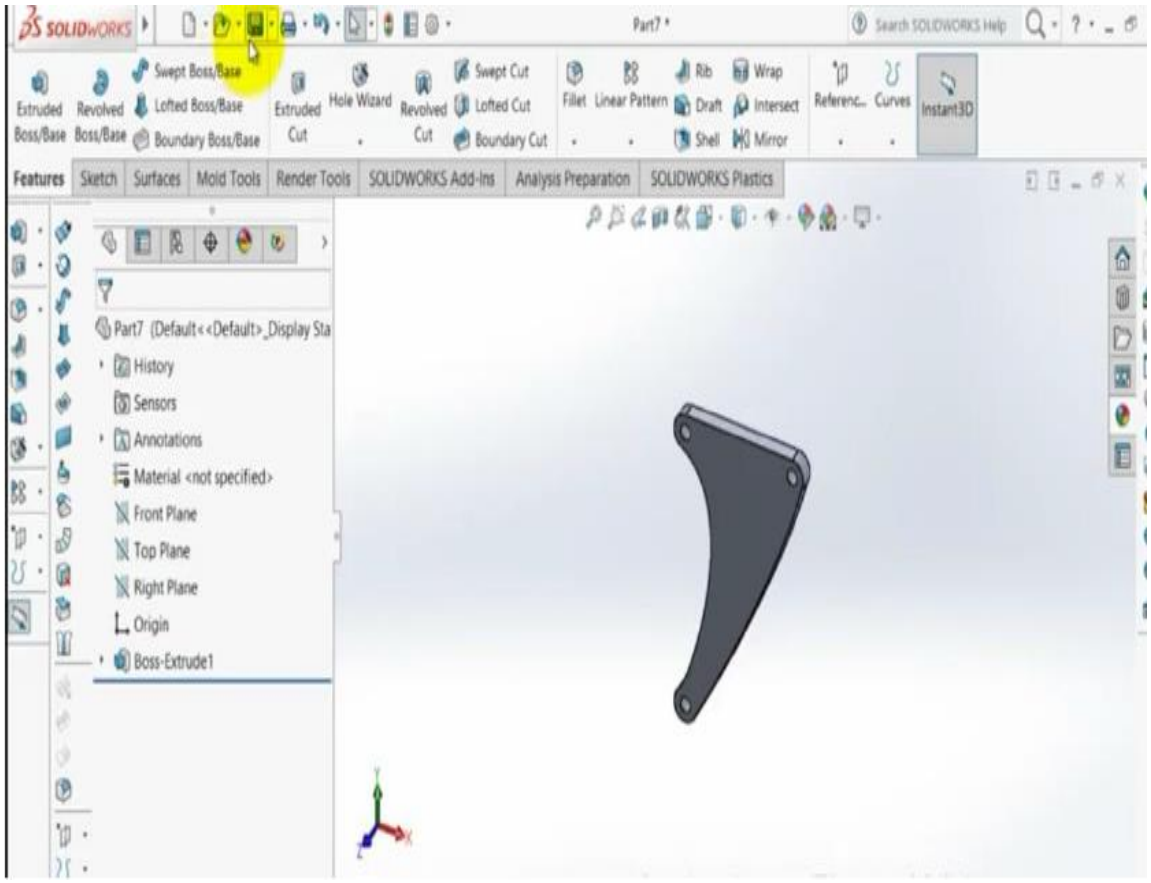


Fig. 10. *3d design of shaft-1.*

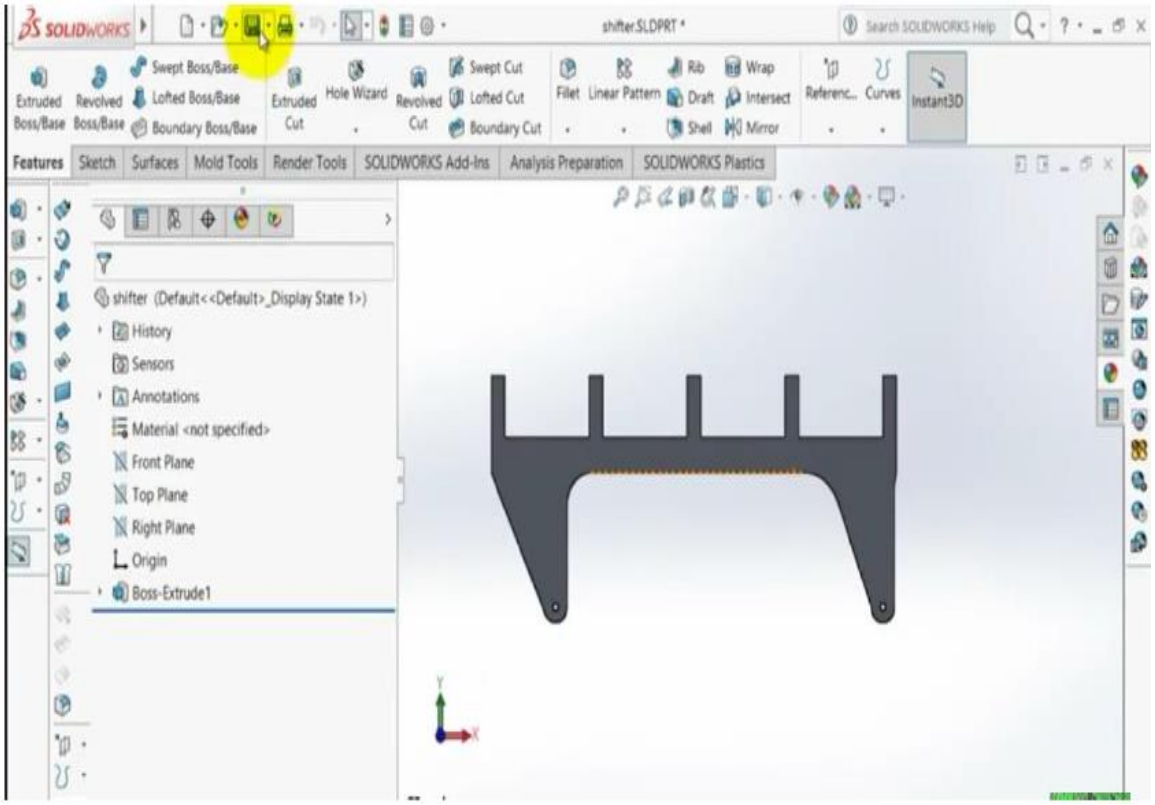


Fig. 11. *3d design of slider.*

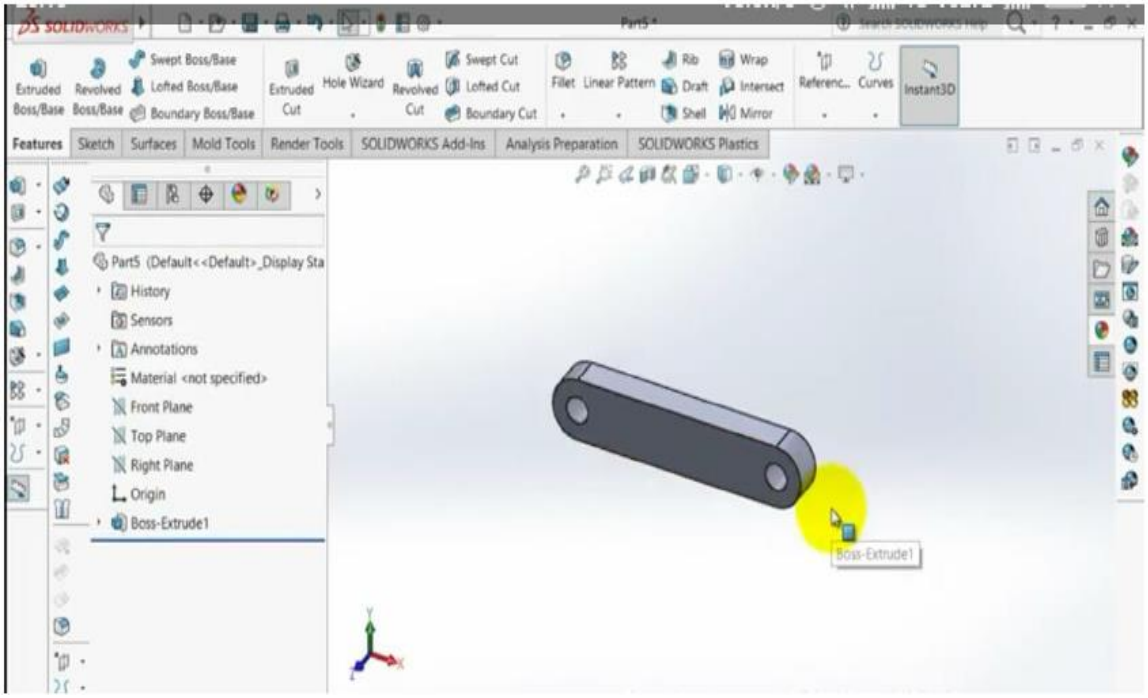


Fig. 12. *3d design of crank.*

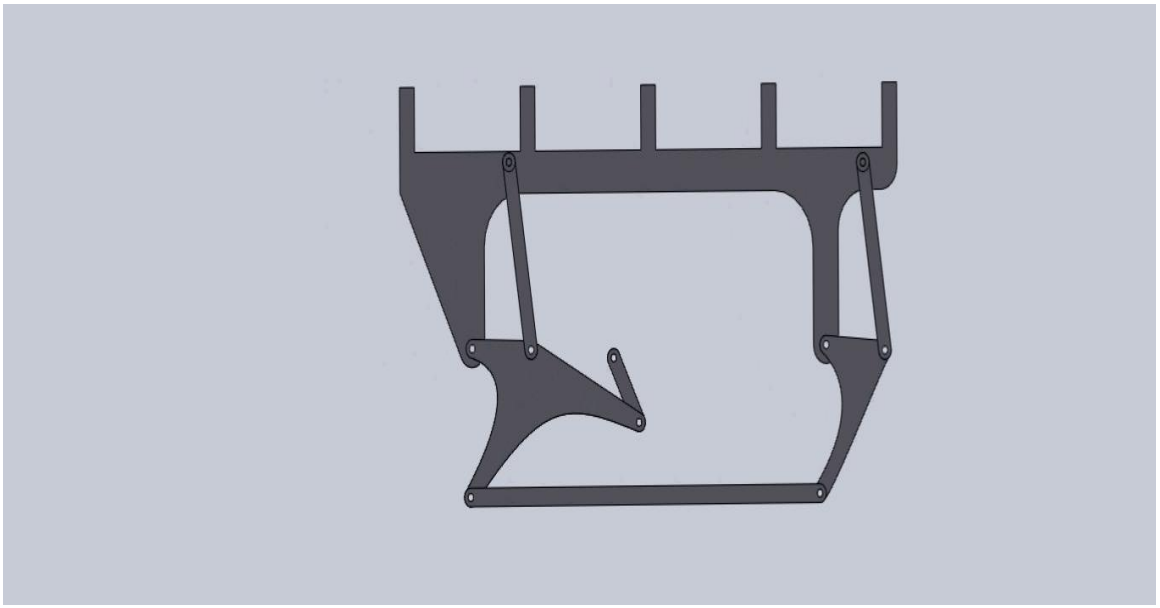


Fig. 13. *Assembled figure.*

Specifications of Mechanism

- DC motor speed: 100 rpm
- Box size: 220mmx80mmx80mm
- One to other box distance: 85mm (inner), 245 mm (outer)
- Rail distance: 44 inches (length), 36 inches (height)
- Mechanism: Crank with linkages
- Crank angle: 220 degrees
- Materials: MS (mild steel) and wood
- Total mechanism weight: 11 kg (approx.)
- Box transmission: Step wise movement (delay between moving boxes).

Selection of Materials

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 frame build by using rectangular hollow pipes and steel rods these are connected by welding operation. [9]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.

[1] Linkages
[2] Dc motor
[3] Dc battery
[4] Frame
[5] Bearing
[6] Bolts nuts and washers

DC Motor

A DC motor is any of a class of electrical machines that converts direct current electrical power into mechanical power. The most common types rely on the forces produced by magnetic fields (Figure 14). A windscreen wiper or windshield wiper is a device used to remove rain and debris from a windscreen 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.

Fig. 14. *DC motor.*

DC Battery

A battery is a device that can create electricity using a chemical reaction. It converts energy stored in molecules inside the battery into electricity. They produce direct current (dc) electricity (electricity that flows in one direction and does not switch back and forth). Using the electricity from an outlet in a house or building is cheaper and uses less energy, but a battery can provide electricity in areas that do not have electric power distribution. It is also useful for things that moved around and cords would get in the way [10]. 12V batteries are available for the use. And current will vary. Two wheelers have 7A and four wheelers have 40A. We use a 7a battery for this demonstration purpose.(Figure 15).

Fig. 15. *DC battery.*

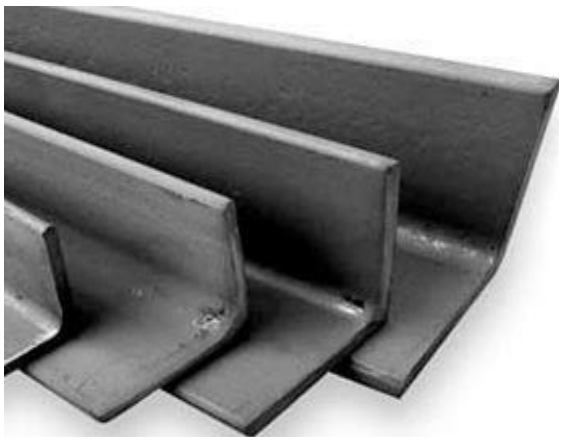


Fig. 16. *Angle iron.*

Angle Iron

Angle iron is a building technique with a "skeleton frame" of vertical steel columns and horizontal I-beams, constructed in a rectangular grid to support the floors, roof and walls of a building which are all attached to the frame. The development of this technique made the construction of the skyscraper possible (Figure 16).

Bearing

It can be mounted where the seated shaft is in a parallel plane to the mounted surface, and vertical to the middle line of the mounted holes, used to move the shaft freely and gives the support to shaft (Figure 17).

Fig. 17. *Ball bearing.*

Fig. 18. *Nuts and washers.*

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 (Figure 18).

Process for Fabrication

Welding

In welding process, the electric arc is used to melt the two metals and joint them permanently. Electrode is used to produce electric arc. The gap between electrode and metal is 3mm. If welding is overlapped, it affects the quality of metal joint. It is used to inter connect the columns (Figures 19, 20).

Fig. 19. *Welding machine.*

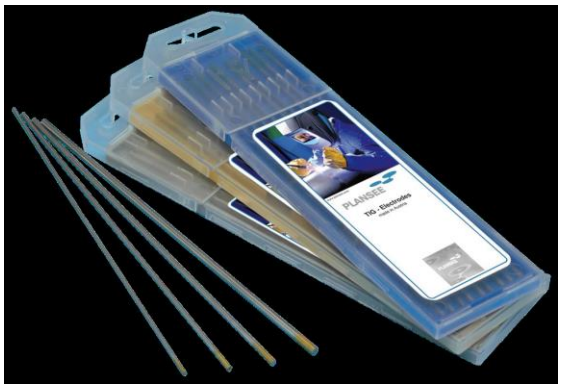


Fig. 20. *Electrode.*

Metal Cutting

The square circular shaft and hylem board cut for our required dimension by using metal cutter. The circular shaft acts a

column of box shifting machine. The hylem pieces are act as linkages. Metal cutter cuts all material to required dimension (Figure 21).

Fig. 21. *Sheet cutting machine.*

Drilling

Drilling is used to screwing the screw through the drilling. To tight the linkages, the screw is screwing through the drilling and helps to fix the linkages (Figure 22).

Fig. 22. *Drilling machine.*

CONCLUSION

The box conveying mechanism plays a dominant role in industries, the process of transporting or shifting products from one place to another was to be maintained by conveyors only. So, it is successfully modified this with a box relocation mechanism using the kinematics links and a motor.

We as a whole team 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.

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