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Design & Fabrication of Box Shifting Mechanism

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ABSTRACT: There has been a serious demand for intermittent movement of packages in the industry right from the start. Though the continuous movement is more or less important in the same field of sporadic motion has become essential. The objective of this study is to design a mechanism that delivers this stop and move motion using mechanism linkages. The advantage of this system over the conveyer system is that the system has a time delay between the moving packages and this delay can be used to introduce alterations in the packages or move the packages for any other purpose.

KEYWORDS: Euclidean displacement; Linkage Mechanism; Transmission angle; Bell Crank Linkage

I.INTRODUCTION

The box moving and shifting has a simple mechanism, operated with crank and linkage arrangement. As by the electric motor rotary motion is converted into To and Fro motion of linkages, it takes very simple. The rotary motion is converted into linear motion with the help of crank and mechanical linkages arrangement.

A linkage may be a mechanism formed by connecting two or more levers together. Linkages are often designed to vary the direction of a force or make two or more objects move at an equivalent time. A linkage constructed with combination of rigid links and ideal joints is called a kinematic chain. Linkages may either be modelled from open, closed, or combination of open and closed chains. Each link of a chain is connected by a joint to one or more other links. The movement of an ideal joint is normally 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.

II.RELATED WORK

This machine basically works on the principle of Single Slider Crank Mechanism. It converts rotary motion into a reciprocating motion. This project can be utilized in industry. As an alternative to the 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[2]. The main advantage is that it can transfer box with much more efficiency than the conveyer belt system in all aspects. Unlike conveyer belt system it only focuses on shifting of boxes [1].

Industries right from the start are critically demanding intermittent movement of the packages. Periodic motion is also becoming more essential in the industries where continuous movement is given a significant importance . Linkages can be designed to change the direction of a force or make two or more objects move at the same time.

The advantage being that when in transit any alterations needed in packages can be done without much effort Objective is to supersede the conventional conveyers by mechanical conveyers in order to compensate for the comparative low efficiency and high maintenance cost of the conventional ones. Operating of the mechanism is solely based on four bar mechanism and with use of a simple small motor rotary motion is converted to reciprocating motion.

III.AIMS AND OBJECTIVES

A. AIMS:

- The aim of the project is to fabricate the work moving mechanism, which may make easier to maneuver jobs from one section to other while processing within the factories.

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- In a workstation, production line so as to get the specified production rate and to realize a minimum amount of idle time.

B. OBJECTIVES:

- Fabricate a job transport mechanism which can move things from one place to another.
- Understand project planning and execution.
- Understand the fabrication techniques in a mechanical workshop [1].
- Understand the usage of varied mechanical machine tools and measuring tools.

IV.LINKAGE MECHANISM

Linkages are often classified consistent with their primary functions:

- Function generation: the relative motion between the links connected to Frame.
- Path generation: the path of a tracer point.
- Motion generation: the motion of coupler link [2].

A. SIMPLE PLANAR LINKAGES

Reverse Motion Linkage: The mechanism can force the job to move in opposite direction; this can be done by using the input link as lever. If the fixed pivot is equidistant from the moving pivots, output link movement will equal input link movement, but it will be in opposite direction. This linkage can also be noted through 360º.

Push-Pull Linkage: Can make the object or force move in the same direction, the output link moves in the direction as input link. Technically closed as a four bar linkage, it can be rotated through 360º without changing its function.

Parallel-Motion Linkage: can make objects or forces move in the same direction, but at a set distance apart. The moving and fixed pivots on the opposing links in the parallelogram must be equidistant for this linkage to work correctly.this linkage can also be rotated through 360° without changing its function

Bell-crank Linkage: Can change the direction of objects or force by 90°. This linkage rang doorbells before electric clappers were invented. This was done by pinning two bell cranks bent 90° in opposite directions together to form tongs. By squeezing the two handlebarlevers linked to the input ends of each crank, the output ends will move together.

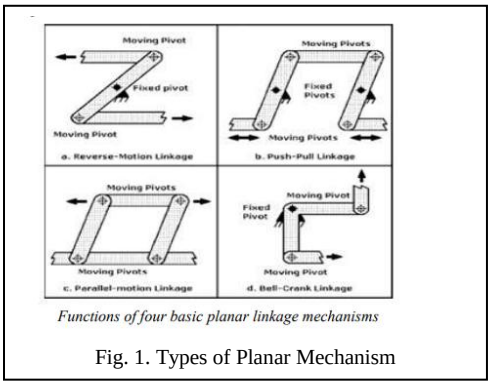

Fig. 1. Types of Planar Mechanism

B. CRANK ROCKER MECANISM FOR JOB TRANSPORT MECHANISM

The four bar linkage is the simplest and offer times, the most useful mechanisms. As we mentioned before a mechanism composed of rigid bodies and lower pairs is named a linkage. In planar mechanism, there are only two kinds of lower parts – revolute pairs and prismatic pairs. Planar quadrilateral linkage, RRRR or 4R linkages have four rotating joints. One link of the chain is typically fixed, and is named the bottom link, fixed link, or the frame. The two links connected to the frame are called the grounded links and are generally the input and output links of

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Vol. 7, Issue 1 , January 2020

the system, sometimes called the input link and output link. The last link is that the floating link, which is additionally called a coupler or rod because it connects an input to the output.

Assuming the frame is horizontal there are four possibilities for the input and output links:

• **A crank:** can rotate a full 360 degrees

• **A rocker:** can rotate through a limited range of angles which does not include 0° or 180°

• **A 0-rocker:** can rotate through a limited range of angles which includes 0° but not 180°

A π-rocker: can rotate through a limited range of angles which includes 180°

C. FUNCTION OF LINKAGES

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

- Continuous rotation into continuous rotation, with a continuing or variable angular velocity ratio.
- Continuous rotation into oscillation or reciprocation, with a continuing or variable velocity ratio.
- Oscillation into oscillation, or reciprocation into reciprocation, with a constant or variable velocity ratio.

V.DESIGN AND FACBRICATION

Proper designing of any 4 bar mechanism is very important to get required output motion for specific input motion with keeping in mind to minimize the overall cost of mechanism as well as to maximize the efficiency of mechanism by reducing the unnecessary loss of energy either by unrequired friction and in improper geometry. The length of each link is calculated by process known as 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.

A. CALCULATING TRANSMISSION ANGLE

First step of the design process is to calculate the transmission angle. Transmission angle is an angle form between connecting link and output link during the entire motion. In fig. 2, if AB is the input link, the force applied to the output link, CD, is transmitted through the coupler link BC. (That is pushing on the link CD imposes a force on the link AB, which is transmitted through the link BC). For sufficiently slow motion (negligible inertia forces), the force in the coupler link is poor tension or compression (negligible bending action) and is directed along BC[2]. For a given force in the coupler link, the torque transmitted to the output bar (about point D) is maximum when the angle β between coupler bar BC and output bar CD is π/2. Therefore, angle BCD is called transmission angle.

$\alpha \max = |90^o - \beta|\min < 50^o$

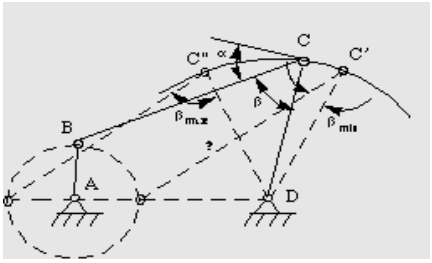

Fig. 2. Transmission angle

When the transmission angle deviates significantly from π/2, the

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torque on the output bar decreases and may be sufficient to overcome the friction in the system [3]. For this reason, the deviation angle $\alpha = |\pi/2 - \beta|$ should not be too great. In practice, there is no definite upper link for α, because the existence of the inertia force may eliminate the undesirable force relationships that are present under static conditions.

In the given fig. 3, value of d is the predetermined value and we have to determine the crank radius r, for a given radius value of rocker R. .Let the oscillation of rocker is Q degree at point B.

From ΔABC,

$d = 2AC$

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

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

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

Now from crank and rocker mechanism:

$2r = (R*Q*3.14)/180$

Putting the value of Q we get: $r = (R*3.14/180)*\sin^{-1}(d/2R)$

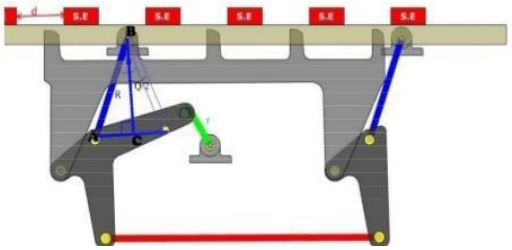

Fig. 3.

Fig. 3.

B.CAD MODELLING :

After completing the theoretical calculation for various length of links, I run the entire mechanism in Adams software to study the dynamics of mechanism and check whether the all links are following proper geometry or not. After that did the cad modelling of the entire links, upper structure and base structure on Creo 3.0 software using the Adams final geometry.

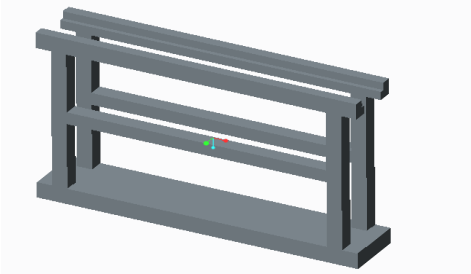

Fig. 5. Base Structure

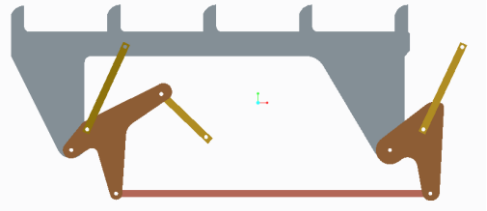

Fig. 4. Linkage Assembly

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C. CAE

After modeling different part of mechanism in CAD software, the parts are now analyses on Hyperworks CAE software. Firstly,ranthe analysis for 250 kg of weight load with taking material thickness of 5mm. For making the assembly cost chosen mild steel over aluminum. After preprocessing the component in Hypermesh the static analysis is done in optistruct. The following results were obtained from analysis:

TABLE 1
CAE RESULTS

Sr No.			
	Component	***Max. Stress***	***Max. Displacement***
1	Upper Structure	299.9 Mpa	0.48 mm
2	Connecting Rod	132.2 Mpa	0.33 mm
3	Crank Rod	99.6 Mpa	044 mm

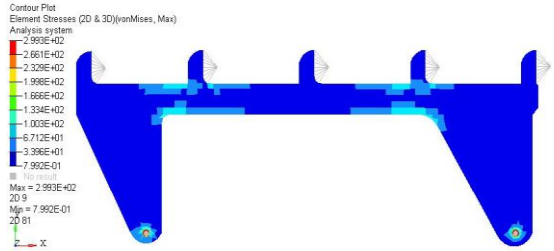

Fig. 6. Upper Structure CAE

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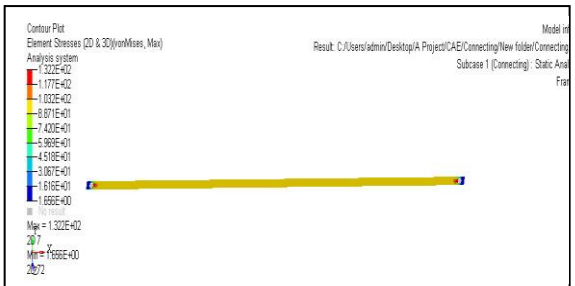

Fig. 7. Connecting Rod CAE

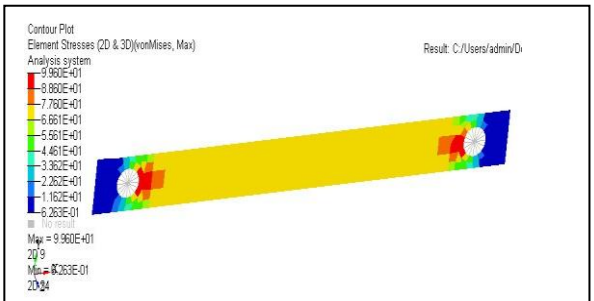

Fig. 8. Crank RoadFig. 8. Crank Road CAE

When all components pass in the CAE with Minimum Factor of safety 1 the project is then proceed to the fabrication stage. For providing movement to the mechanism I used the DC Wiper Motor of car because of its low rpm and high

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Vol. 7, Issue 1 , January 2020

torque value. Fabrication is done by using various processes such as cutting, Grinding, Drilling, Machining and Welding.

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