BOX TRANSPORT MECHANISM

Major Project Report

Submitted in partial fulfilment of the requirement for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

MECHANICAL ENGINEERING

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CERTIFICATE

We hereby certify that the work which is presented in this project report entitled, **"BOX TRANSPORT MECHANISM"** in partial fulfilment of the requirements for the award of degree of Bachelor of Technology in Mechanical Engineering and being submitted in Mechanical Engineering Department of Faculty of Engineering & Technology, Gurukula Kangri Vishwavidyalaya, Haridwar is the bonafide work done by us under the supervision of **Prof. Praveen Kumar Pandey**.

The matter presented in this report has not been submitted for the award of degree/diploma of this or any other university.

Date: 26-5-2017

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This is to certify that the above statement made by the candidate is correct and true to the best of my knowledge.

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ACKNOWLEDGEMENT

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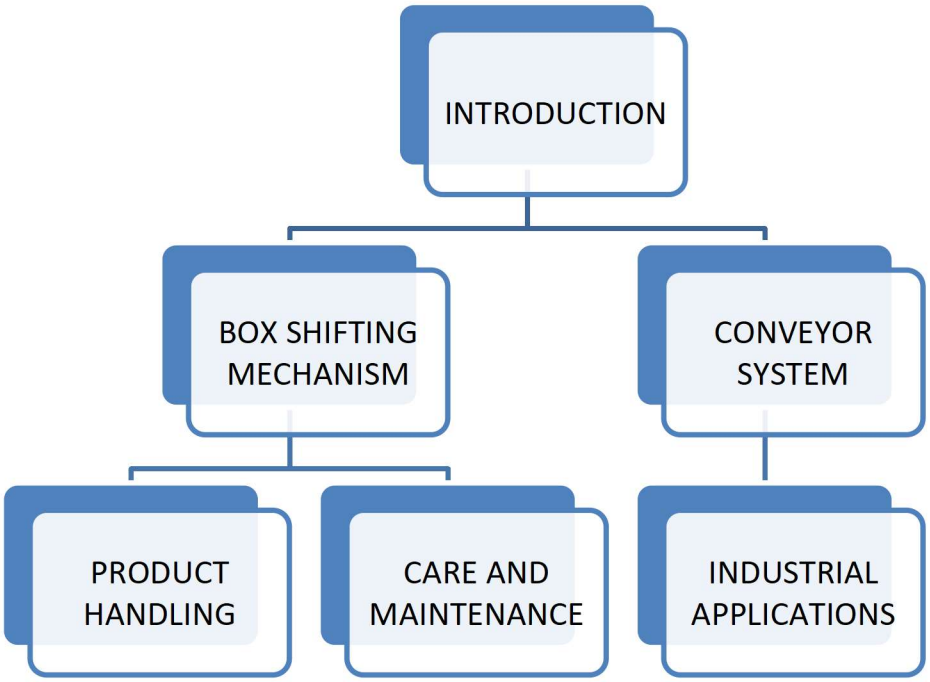
ABSTRACT

BOX TRANSPORT MACHINE basically works on the principle of Single Slider Crank Mechanism which is the heart of this machine and it converts rotary motion into a reciprocating motion. In this project we have fabricated the conveyor using crank mechanism machine which can be utilized in industry. Industries in worldwide use conveyors as a mechanism to transport boxes from place. This mechanism do not 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.

CONTENTS

OBJECTIVE

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. All the links are being made of Aluminium which reduces the weight of the whole system including the head which has a direct contact with the boxes being moved. The system is expected to move as heavy packages as 2 to 3kg approximately.



INTRODUCTION

Box shifting mechanism

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 with the so called quad staying machines by means of which a box blank is folded or set-up into boxlike form. These set-up boxes are transferred by means of a conveyor to an operator, who picks up the boxes and places and centres 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.

Fully automatic machines are available for both setting up the boxes, placing them on the wrappers and feeding the assembly to the wrapping machine. In many instances, however, the cost of replacement of the semi-automatic machines with fully automatic machines, is so great that it cannot be justified by the increased rate of production possible with automatic machines.

The principal difference in the rate of operation of the fully automatic machines and the semi-automatic machines resides in the human factor, namely, the operator or feeder of the semiautomatic wrapping machine. Considerable manual dexterity and skill are required to pick up the boxes and centre them accurately on the wrappers as they move past the operator's station. The movements of the operator are further dependent upon the position of the setup boxes with respect to the operator. With the usual conveyor arrangement, it is necessary for the operator to reach across the conveyor which feeds the wrapping machine and pick up a box from the conveyor leading from the quad. Inasmuch as. The operator must reach across the conveyor to pick up the boxes, the speed of the operator is decreased. Moreover, the constant reaching and stretching for the boxes is very tiring so that the operator can Work for only .a relatively short period of time. This requires the service of another operator or shutting down of the machines.

We have found that when. The set-up boxes are. Four points into a position which is closer to the operator and more conveniently located with respect to the conveyor for feeding the wrapping machine, the efficiency of the operator is greatly increased, the work is made less tiresome and the output of wrapped boxes can be increased to such an extent that it is closely, comparable to that of the fully automatic machines.

The present invention, therefore, has as its principal object the provision of a device which can be used with box forming and semi-automatic wrapping machines to transfer the set-up boxes from the conveyor of the box-forming machine into a position which enables the operator to, pick up and place the boxes on the wrappers with a minimum of reaching and resulting fatigue.Other objects of the invention, and the advantages thereof, will become apparent from the following description of a typical device embodying the present invention.

In accordance with the present invention, I have provided an article-controlled transfer mechanism, by means of which the boxes being advanced by the conveyor of the box-forming machine, are transferred into a position in front of the operator of the wrapping machine and closely adjacent to the wrapperscarried by the feed conveyor of the wrapping machine so that the operator can pick up the boxes and transfer them directly to the wrapper with a minimum of reaching and other movements.More particularly, the transfer mechanism includes a pusher member controlled by means of an electric eye which pushes the set-up boxes from the conveyor from the box-forming machine on to a table or platform to form an advancing row of boxes, the nearest one being directly in front of the operator so that it can be picked up by the operator and transferred to the conveyor of the wrapping machine.

Moreover, the transfer mechanism can be controlled independently by the operator to render it ineffective when a damaged or improperly formed box is discharged from the box former or toby-pass and accumulate boxes when the wrapping machine is shut down for reloading, adjustment or the like.

My transfer mechanism has been found to increase greatly the rate of production of the wrapped boxes so that the production rate is comparable to that of a fully automatic machine, while, at the same time, it is considerably less tiring to the operator

METHODS

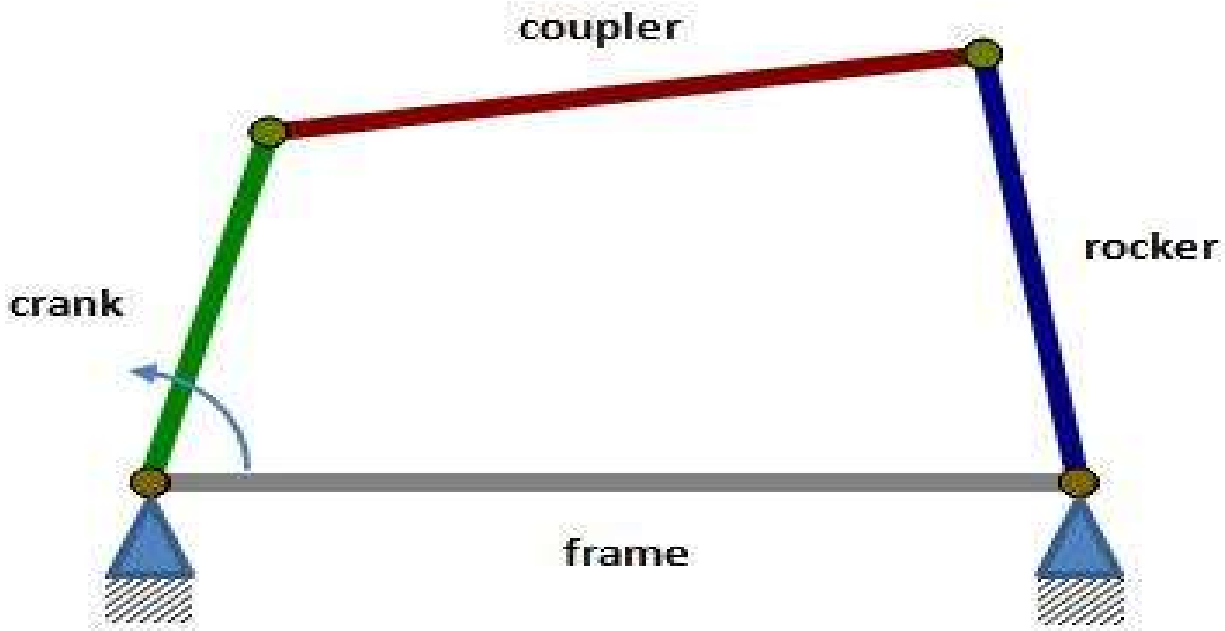
Four-bar linkage

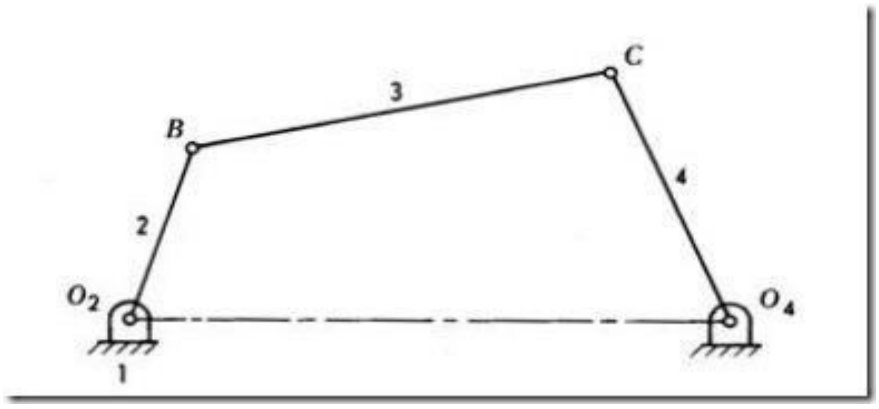
A four-bar linkage, also called a four-bar, is the simplest movable closed chain linkage. It consists of four bodies, called bars or links, connected in a loop by four joints. Generally, the joints are configured so the links move in parallel planes, and the assembly is called a planar four-bar linkage.

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:

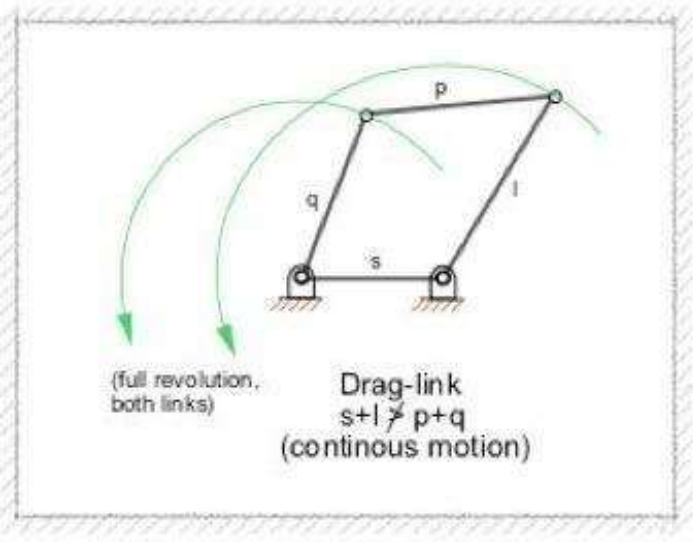
1. When link 'b' is fixed : Crank Rocker or Crank Lever mechanism, in the shortest link rotates 360 degree whereas the other link oscillates.
2. When link 'a' is fixed : Crank Rocker or Crank Lever mechanism, in the shortest link rotates 360 degree whereas the other link oscillates.
3. When link 'd' is fixed : Drag link or Double crank mechanism in which the links 'a' and 'b' undergoes complete 360 deg motion.
4. 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 l or s. Such different versions, which can be obtained by fixing any of the different links, are called its “Inversions”.There are three inversions of four bar mechanisms, which are obtained by fixing different links of the kinematic chain.

They are:

a) Double Crank Mechanism
b) Crank Rocker Mechanism
c) Double Rocker Mechanism
d) Parallel Crank Mechanism

Double Crank Mechanism

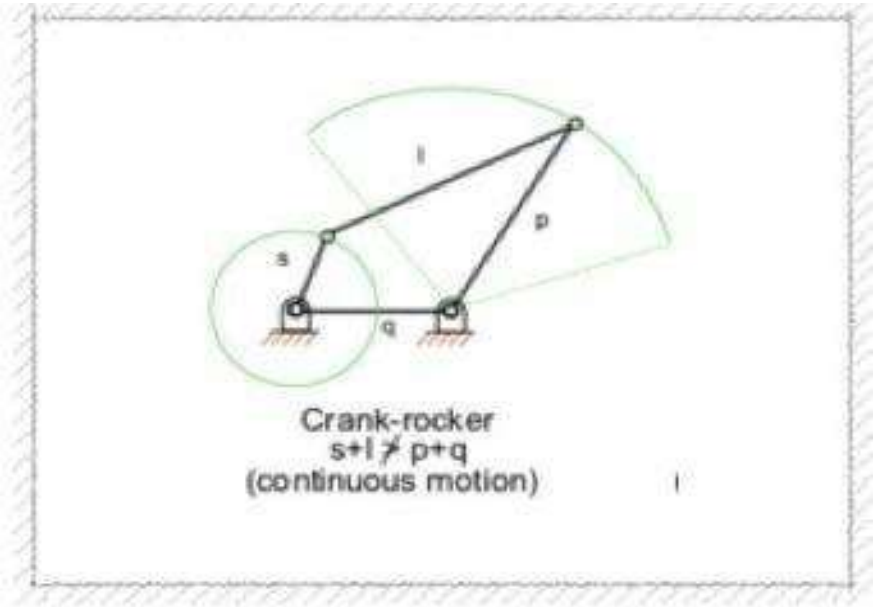


A double crank converts rotary motion from a crank to a second crank or link in a different plane or axis. It is also known as crank-crank, drag-crank or rotary-rotary converter. The links p, q and l shown above rotate through one complete revolution. This is one of the first inversions of four-bar mechanisms.

In this discussion, let's call the link's' the frame as the fixed link. We will call the link 'q' the crank, 'p' the coupler and 'l' the lever for now. Crank is notdefined as the link, which is attached to the driver shaft; rather it's the link, which does a complete revolution. And in this configuration, as there are two links, both q and l, which revolves completely about the hinged point on the frame, both of them, is cranks. The term is commonly used in automotive technology for the link in a four bar steering linkage that converts rotation of a steering arm to a centre link and eventually to tie-rod links which pivot the wheels to be steered. A double crank is used when the steering arm operates in a plane above the other links. The double crank converts the sweeping arc of the steering arm to linear motion in the plane of the other steering links.

Crank-Rocker Mechanism

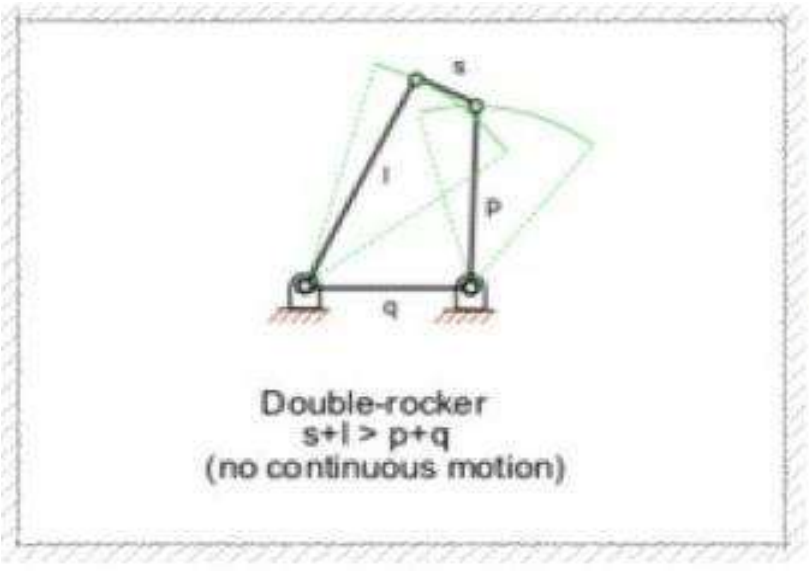
In a four bar linkage, if the shorter side link revolves and the other rocks (i.e., oscillates), it is called a crank-rocker mechanism. In this case, there is only a slight change, leave the smallest side and connect any of its adjacent side as the frame. Then (in figure) the smallest side 's' will have full 360 degree revolution while the other link adjacent to the frame has only oscillating motion (link p).



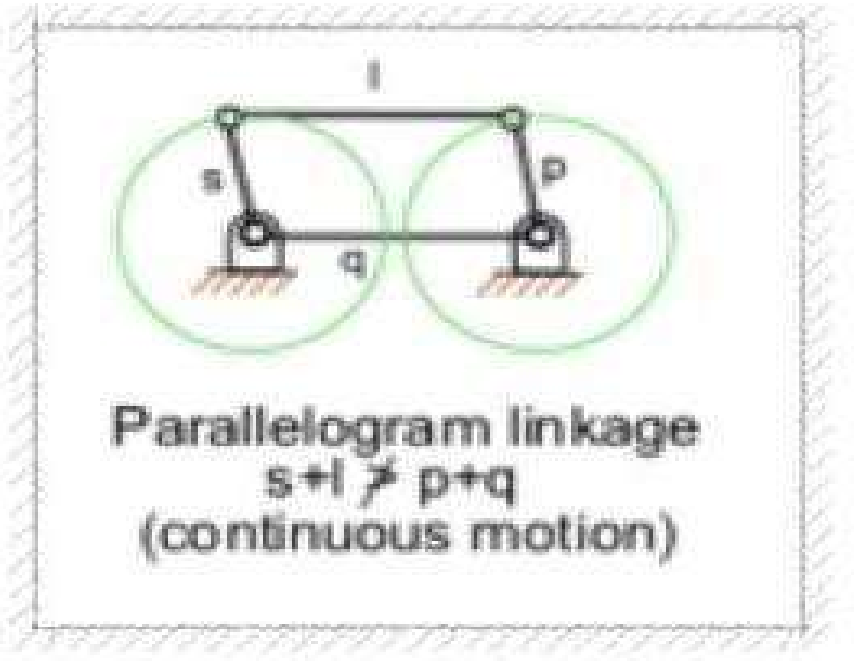
This kind of mechanism is hence called a crank-lever mechanism or a crank-rocker mechanism or a rotary-oscillating converter.

Double-Rocker Mechanism

A linkage in which no link undergoes entire 360-degree revolution but only oscillations is known as a **double-lever** mechanism. This linkage results when the shortest side in the mechanism is made the coupler. The other two links only get to oscillate in their place. A linkage in which the sum of the longest and shortest link is less than the sum of the other two sides, is known as a Class I mechanism, otherwise it's Class II. This mechanism is achieved when it is Class II. It's also called rocker-rocker mechanism, double-rocker mechanism or oscillating oscillating-converter.



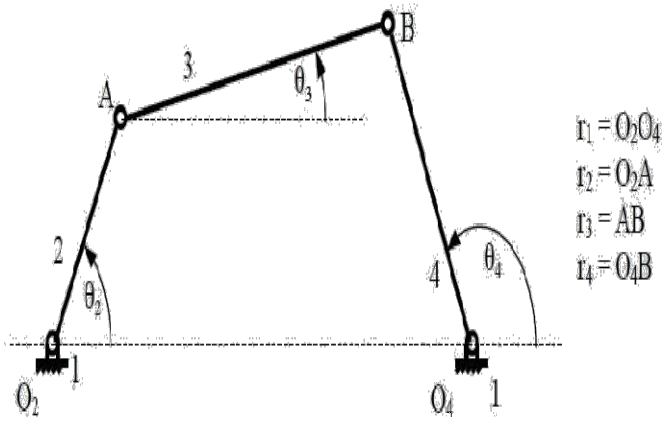
Parallel Crank Mechanism



If in a 4 bar linkage, two opposite links are parallel and equal in length, then any of the links can be made fixed, regardless, the two adjacent links will always act as a pair of cranks, i.e. , both will have complete revolution about their joints on the frame. The use of such mechanism is made in coupled wheels of locomotives in which the rotary motion of one wheel is transmitted to the other wheel.

Position analysis of Grashof four bar mechanism:

For a planar four bar linkage, the sum of the shortest and longest links cannot be greater than the sum of the remaining links if there is to be continuous relative rotation between two members.



The position of the points on the links A (Ax, Ay) and B (Bx, By) The coordinates

of the point A are found using trigonometry as follows:

$$A_x = a\cos\theta_2$$

$$A_y = a\sin\theta_2$$

$$b^2 = (B_x - A_x)^2 + (B_y - A_y)^2$$

$$c^2 = (B_x - d)^2 + B_y^2$$

$$B_x = \frac{a^2 - b^2 + c^2 - d^2}{2(A_x - d)} - \frac{2A_yB_y}{2(A_x - d)} = S - \frac{2A_yB_y}{2(A_x - d)}$$

Where,

$$B_y = \frac{-Q \pm \sqrt{Q^2 - 4PR}}{2P}$$

$$P = \frac{A_y^2}{(A_x - d)^2} + 1 \quad Q = \frac{2A_y(d - S)}{A_x - d} \quad R = (d - S)^2 - c^2 \quad S = \frac{a^2 - b^2 + c^2 - d^2}{2(A_x - d)}$$

RESULT

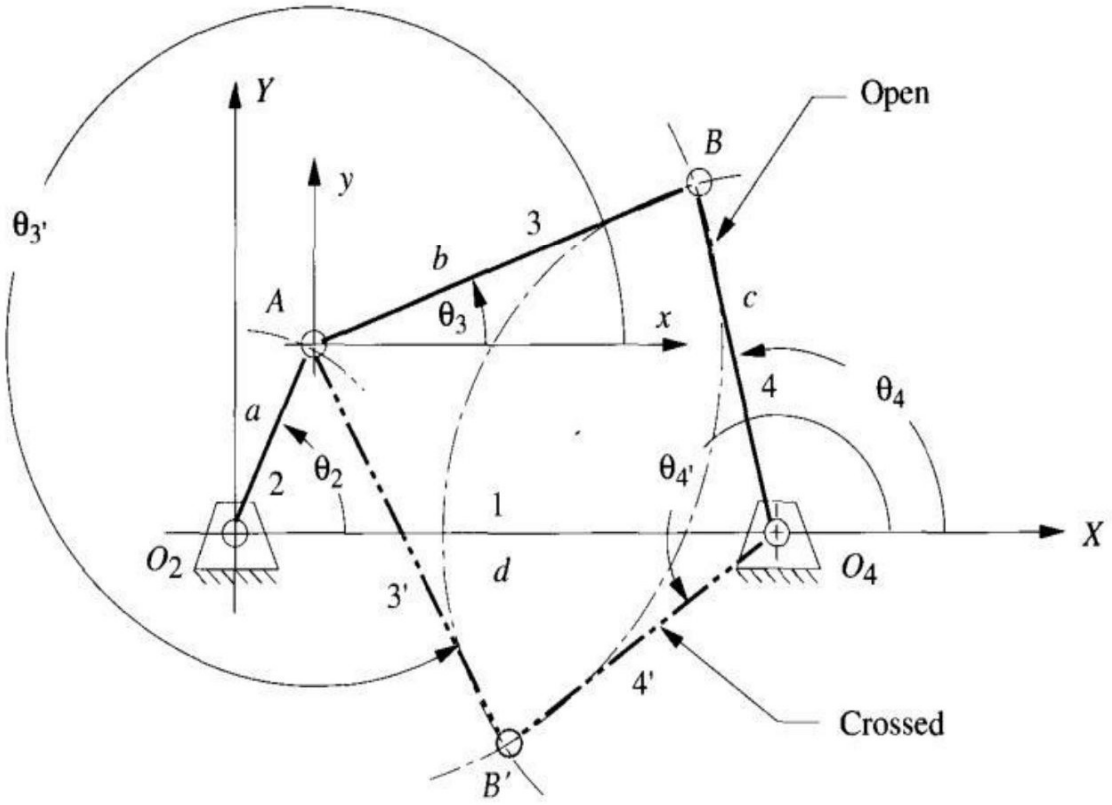
From the study of different 4-bar mechanisms, we have reached to this conclusion that when crank is fixed i.e., **double crank mechanism** gives us desired **WHITWORTH QUICK RETURN MECHANISM**.

Design of QUICK RETURN MECHANISM

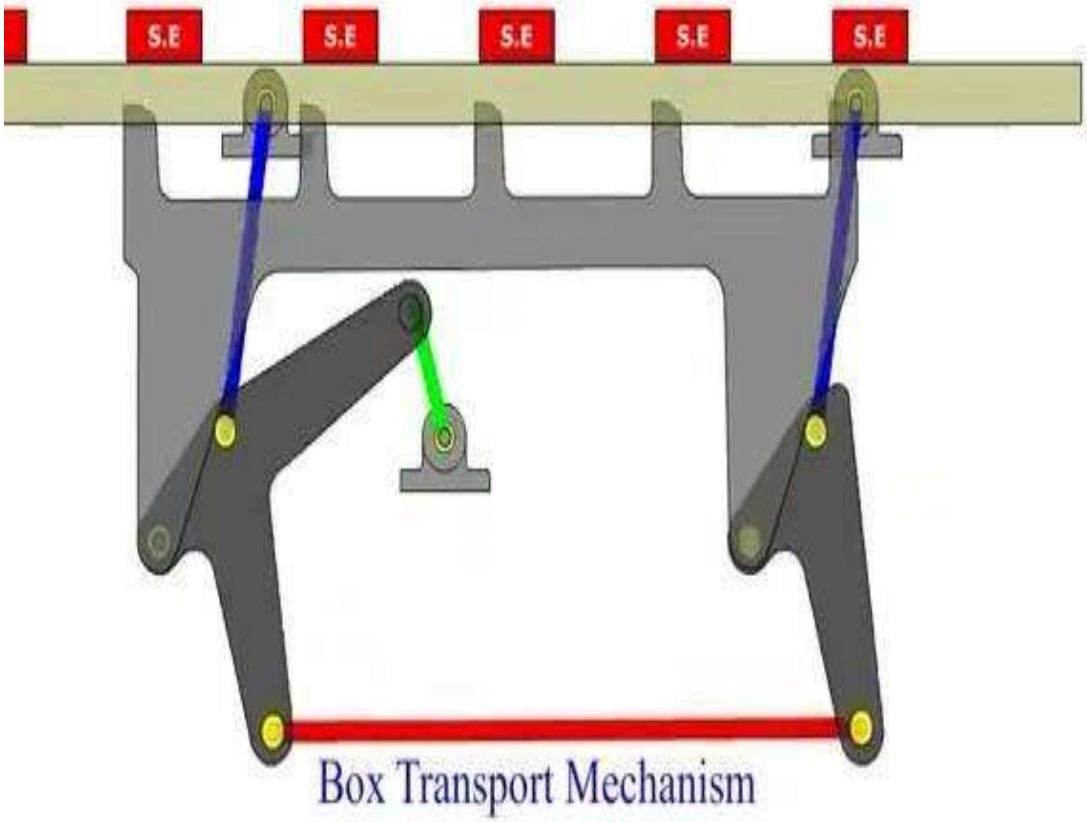
The synthesis, or design, of four bar mechanisms is important when aiming to produce a desired output motion for a specific input motion. In order to minimize cost and maximize efficiency, a designer will choose the simplest mechanism possible to accomplish the desired motion. When selecting a mechanism type to be designed, link lengths must be determined by a processcalled 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.

$$\theta_3 = \tan^{-1}\left(\frac{B_y - A_y}{B_x - A_x}\right)$$

$$\theta_4 = \tan^{-1}\left(\frac{B_y}{B_x - d}\right)$$

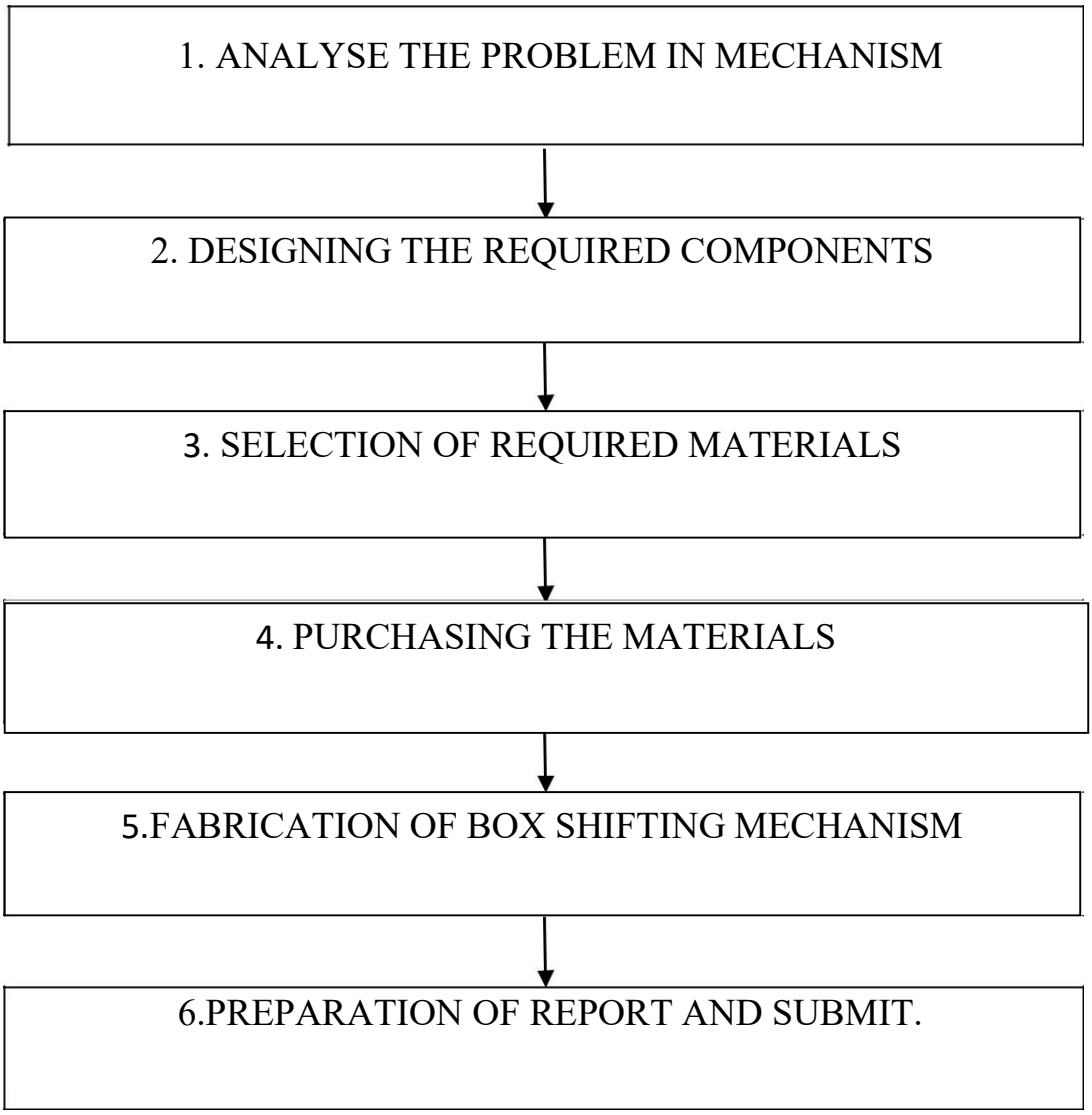


Schematic Diagram



Design and Fabrication Methodology

Methodology to Design and Fabrication the Box Sifting Mechanism



REQUIRED MATERIALS

- **Linkages**
- **DC motor**
- **Transformer**
- **Steel Frame**

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.

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.

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.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. Thespeed ratio and mechanical advantage are defined so they yield the same number in an ideal linkage.

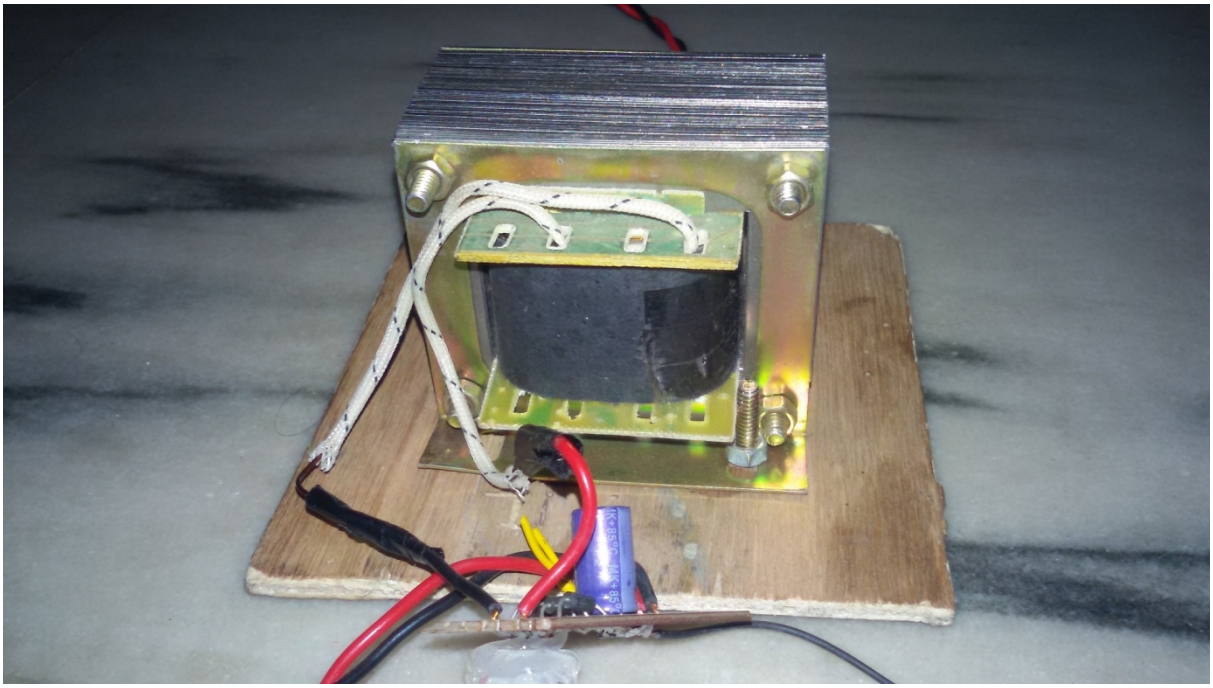
DC motor

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.

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.

TRANSFORMER

Transformer is an electrical device which is used to increase or decrease the voltage of an alternating current as is required by the component. It transfers electrical energy between two or more circuits through electromagnetic induction.



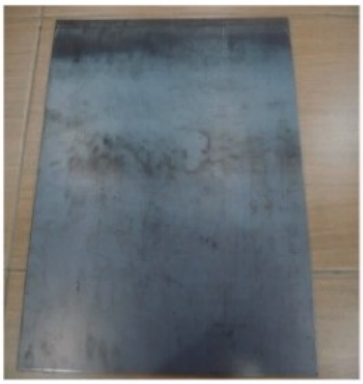
Steel Frame

Steel frame 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.

TOOLS USED

Drill machine

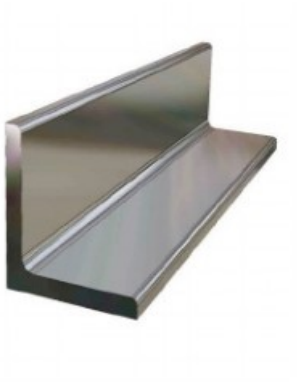
Electric motor



Mild Steel plate

Steel plate cutter

VICES



Iron angles

Welding machine

Lathe Machine

WORK PLAN

STAGE1: Collecting the Materials

The links are drawn by using the auto cad 2010 software then this diagram printed in a A2 sheet. Then hylem sheet brought from a hylem shop dimension 610*420. Then paste the A2 sheet on the hylem then it will be cutted by using cutting machine and it drilled by the drilling machine.

Dc wiper motor and dc battery brought from an automobile spare shop. After completing these works the frame would be designed in welding work shop

STAGE 2: Fabrication of Components

The following components are fabricated for the box shifting machine.

DC battery : It is used to run the wiper motor. When power required then that time it give the power to the wiper motor.

DC motor: It is used run the whole linkages.

Bolt and Nut: It is used to connect the linkages and used to fix linkages on the frame.

Steel Frame: It is used hold whole parts of this machine. It is made by using G.I rectangular pipes and sheets.

Linkages: These linkages are made by using hylem boards done by cutting operation

STAGE 3: 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.

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.

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.

STAGE 4: Assembling the Components

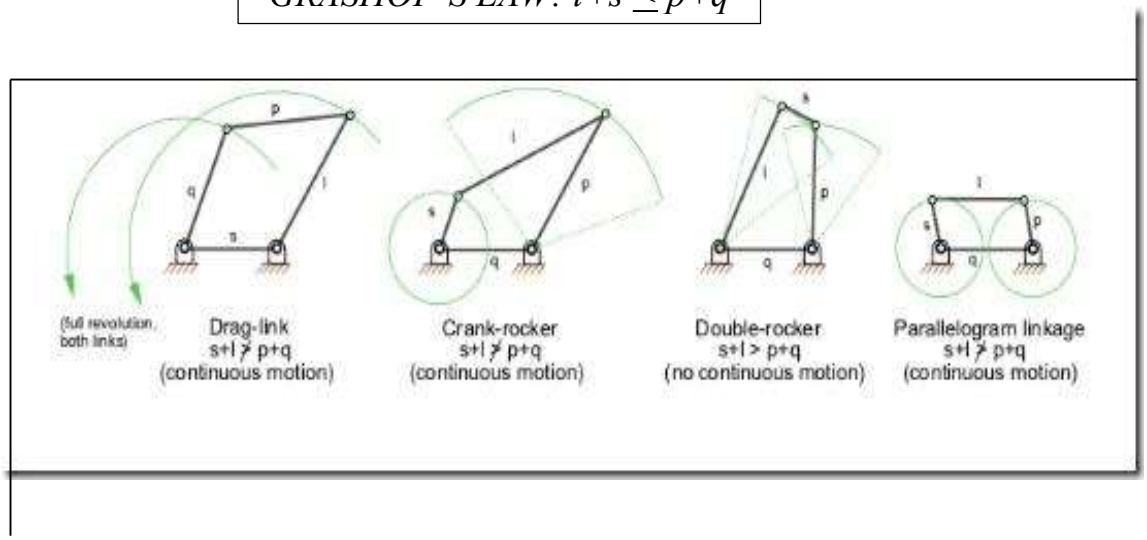
All the components are assembled in a correct manner. Then is will be re checked again and undergoes to the painting process.

CALCULATIONS

Selection of Length:

The length of the links are selected as such they fulfill the requirements of transmission as well is of compact. For a Quick Return Mechanism we will have to obtain a **Crank Rocker Mechanism** by satisfying Grashof's Law.

GRASHOF'S LAW: $l+s \leq p+q$



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

Now we will choose the shortest link i.e crank as reference .

S.NO.	LINKS	LENGTH
1	CRANK	90mm
2	CONNECTING ROD	200 mm
3	COUPLER	250mm
4	SLOTTED BAR	300mm

Now, for continuous motion we require to satisfy Grashof's Law-

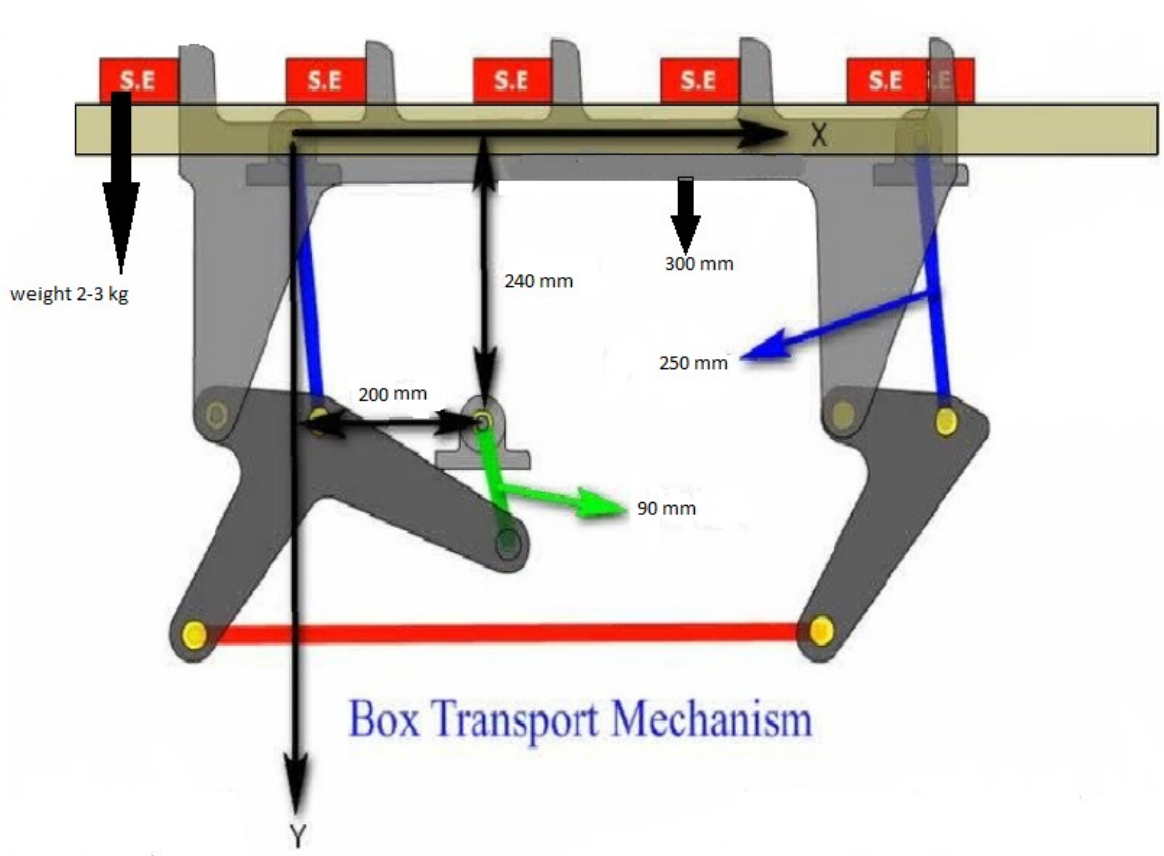
$$s+l \leq p+q$$

$$90+300 \leq 200+250$$

$$390 \leq 450$$

Hence satisfied.

All the length of links are shown in the figure given-



CALCULATION OF STROKE :

$$\text{Stroke} = \frac{2\text{x(length of slotted bar)x(length of crank)}}{\text{(length of connecting rod)}}$$

$$= \frac{2\text{x } 300 \text{ x} 90}{200}$$

$$= 270 \text{ mm}$$

Hence STROKE LENGTH is 270 mm.

SELECTION OF MOTOR :

For shaper machine working on same mechanism -

Power of motor =3 HP for 1750 kg

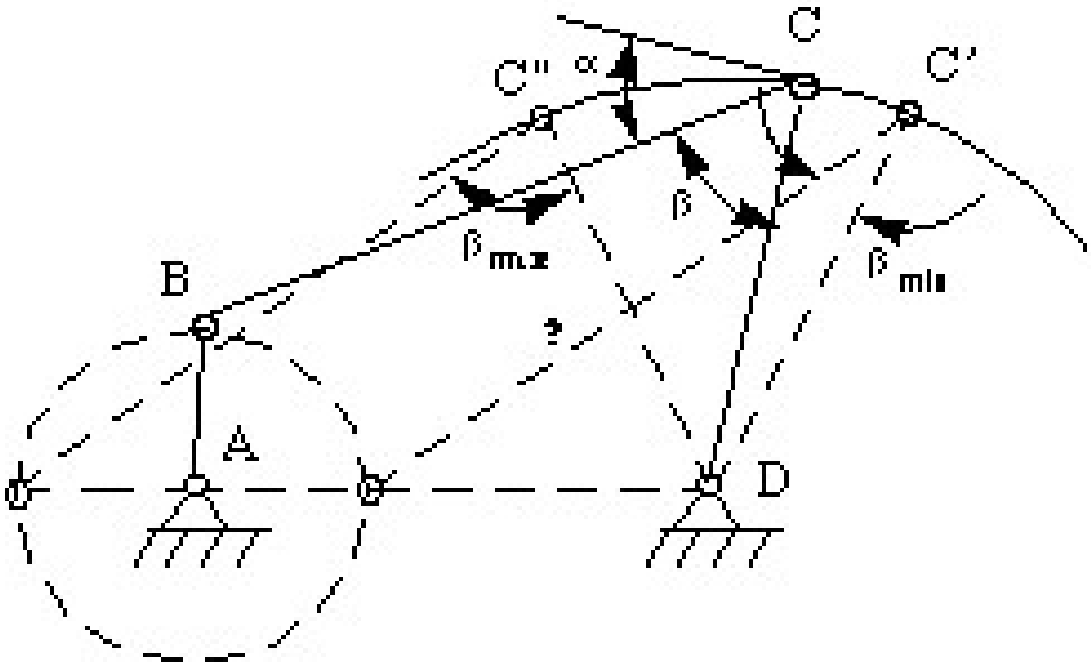
Stroke length=600 mm

Hence, Similarly for the box transport machine specifications on the basis of analogy-

Power of motor=180 W for 2 to 3 kg

Stroke length = 270mm

TRANSMISSION ANGLE :



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 motions (negligible inertia forces), the force in the coupler link is pure tension or compression (negligible bending action) and is directed a long BC. For a given force in the coupler link, the torque transmitted to the output bar (about point D) is maximum when the angle between coupler bar BC and output bar CD is π/2. Therefore, angle BCD is called transmission angle.

$$\alpha_{max} = |90° - \beta|_{min} < 50°$$

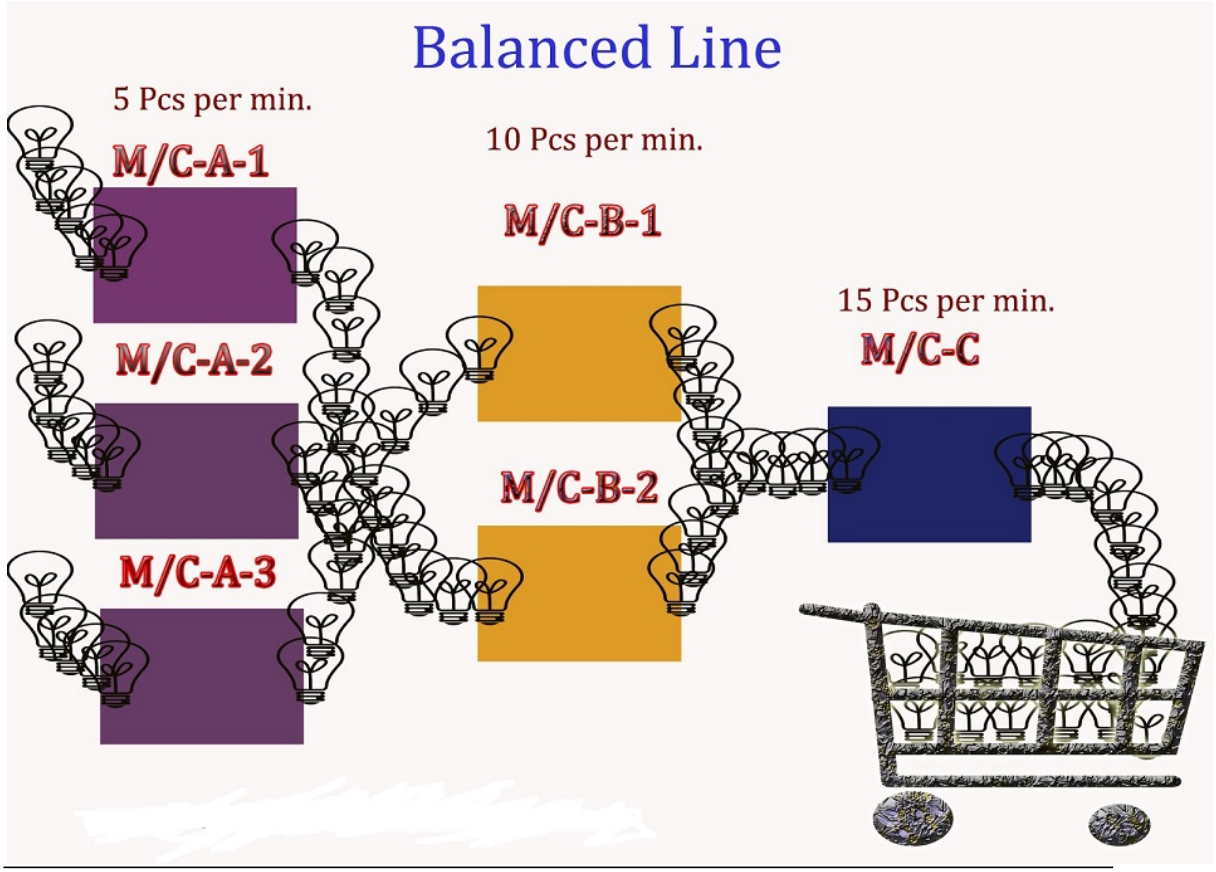
When the transmission angle deviates significantly from π/2, the torque on the output bar decreases and may not be sufficient to overcome the friction in the system. For this reason, the deviation angle =| π/2- β| should not be too great. In practice, there is no definite upper limit for , because the existence of the inertia forces may eliminate the undesirable force relationships that is present under static conditions.

APPLICATION

- In medical production fields.
- In bottle filling process
- In cold drink production companies.
- Easy transportation of heavy tools from one work station to another in industries.
- Creating a balance line in the assembly line.

What is assembly-line balancing?

- To a workstation within an assembly line in order to meet the required production rate and to achieve a minimum amount of idle time.
- Line balancing is the procedure in which tasks along assigning each task the assembly line are assigned to work station so each has approximately same amount of work.



How Can Balancing line help in Organization?

- Time Saving
- Money Saving (Time Is Money, make changes in virtual world).
- Simplifies complex assembly line balancing problems.
- Increased efficiency.
- Increased productivity.
- Potential increase in profits and decrease in costs.

ADVANTAGES

→ Lubricants not required.

→ Simple to construct.

→ Low speed motor is sufficient

→ Easy maintenance.

→ Less skilled operator is sufficient.

→ Noise of operation is reduced.

MODIFICATIONS :

1. Using solar panel we able to run this motor we get more efficiency
2. We are modify it to remove hylem board and use aluminum plate

BOX TRANSPORT MECHANISM

REFERENCES

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