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Design and Fabrication of Elliptical Trammel

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Abstract - *This paper presents an approch to use double slider crank mechanism as a Bottle shaking Machine. In this mechanism two slidrers are used which moves in two two groves .Both the slider moves along these groves. The important thing is that these two groves are perpendicular to each other. A connecting rod is used to connect these sliders and make the motion constrained. The slotted Lever is fixed element in the mechanism. These are the various components of mechanism and relative motions of these components are described. Design of mechanism on the basis of their dimensions and deformation has been performed. Analysis of various components of the mechanism has been performed. Thus this an elliptical trammel from which the approximate straight motion of sliders is being used for shaking purpose of bottles.*

Key Words: Slider, Crank, etc (Minimum 5 to 8 key words)…

1. INTRODUCTION

A trammel of Archimedes is a mechanism that generates the shape of an ellipse. It consists of two sliders which are restricted ("trammeled") to perpendicular channels or rails, and a rod which is attached to the sliders by pivots at fixed positions along the rod. As the sliders move back and forth, each along its channel, the end of the rod moves in an elliptical path. A line segment of fixed length whose ends slide along two perpendicular axes. During the motion, a fixed point on the segment traces an ellipse with one quarter of the ellipse in each quadrant and traces a complete graph as an ellipse, a mechanism for drawing an ellipse.

The semi axes a and b of the ellipse are the distances between the end of the rod and the two pivots. An elliptical trammel of an Archimedes intended to draw, cut, or machine ellipses, e.g. in wood or other sheet materials. An elliptical trammel has the appropriate instrument (pencil, knife, router, etc.) attached to the rod. Usually the distances a and b are adjustable, so that the size and shape of the ellipse can be varied. The history of such ellipsographs is not certain, but they are believed to be there even to the time of Archimedes.

It is seen that it can be used as tool changing apparatus, for ellipse of different axes sizes and so on. The elliptical trammel mechanism has various applications as it can be made in various gestures. In this project we are going to show an single application of using a normal elliptical trammel to run as a mechanism for approximate straight path so that we can get a required stroke length. In this way we will be able to find the use of elliptical trammel in simple way. If this mechanism can be used as small scale apparatus, then it is surly a great gesture in major value graded mechanisms.

1.1 Inversion

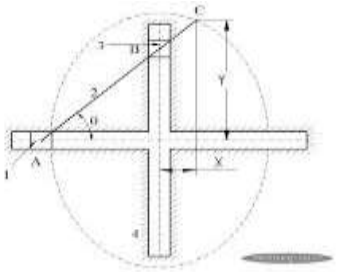
Elliptical trammel is an inversion of double slider crank chain mechanism. A double slider crank chain consist of four links forming two slinding pair and two turning pairs hence called as RRPP mechanism.

link 1 frame

link 2 slider -I

link 3 coupler

link 4 slider – II



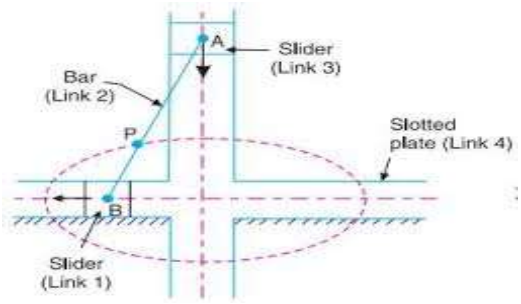
Pair A – sliding pair , Link 1 and link 4

Pair B – turning pair link 1 and link 2

Pair C – turning pair, link 2 and link 3

Pair D – sliding pair link 3 and link 4

1.2 Construction



Double slider crank mechanism,

It consists of two shuttles which are confined two perpendicular channels which is attached to the frame by pivots at fixed positions along the rod. In which link 1 is the slider-I, Link 2 is the connecting rod, Link 3 become a slider-II and link 3 are the fixed link. There are one slider travels horizontally and another slider is travels vertically direction. Our focus is to get the required approximate straight motion for bottle shaking with the help of elliptical trammel mechanism.

1.3 Importance of Elliptical Trammel

Ellipses are important curve used in the mathematical sciences. For example, the planets follow elliptical orbit around the sun.

Elliptical traces are required in surveying, Engineering, Architectural and machines drawing for two main reasons

First, any circle viewed at an angle will appear to be ellipse.

Second, Ellipses were common architectural elements, often use in ceilings, staircases, and windows, and needed to be rendered accurately in drawing.

1.4 Application

- It is use as automatic tool changer mechanism.
- Elliptical trammel are used for drawing ellipse.

They can be used to draw smaller ellipse but only draw on half at a time, having to be reverse to draw the complete ellipse.

2. DISCRIPTION

The elliptical trammel is simple mechanism which can trace and exact elliptical path. Fig 1 shows the geometry of this mechanism which consist of two sliding joint and two revolute joints. These joints guide the movement of a central rigid body.

It is RRPP mechanism, in which the connecting rod has simple harmonic motion but it is not truly simple harmonic motion, it is a periodic motion.

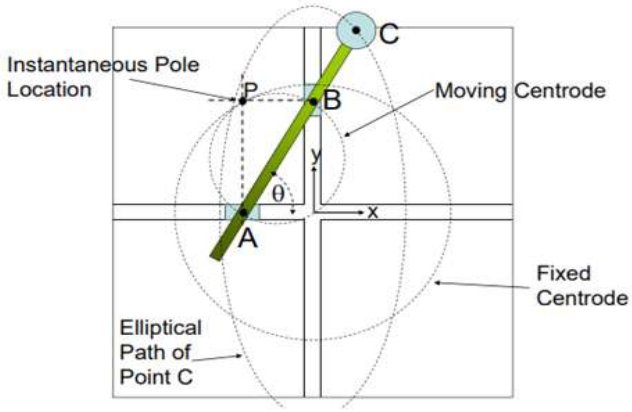


Fig 1 Diagram of the elliptical trammel , showing the geometry of the elliptical path as well as the fixed and moving centroids let A and B denotes the points on the moving rigid body that coincides with the revolute joint axes . Let C denote that point on the moving body that traces a path.

Define the following distances:

a = |AC| b = |BC| c = |AB| ..... (1)

For convenience, assign a reference frame with origin at the intersection of two prismatic joint axes, and with basis vectors collinear with the joint axes. Let θ denotes the angle between the line AC and the x axis. In this coordinate system the x and y coordinates of the point C is given by:

x = b cosθ; y = a sinθ .....(2)

Consequently,

$(x/b)^2 + (y\backslash a)^2 = 1$ .....(3)

Which is the equation for an ellipse with major and minor axes having dimensions a and b.

At each instant, the central body moves as if it was rotating about a pole. At each location of mechanism, each sliding block in the prismatic joints moves with a velocity that is equivalent to a rotation about any points which passes through a centre of the block and which is perpendicular to the axis of sliding. Both the lines intersect at a unit point (denoted P in fig.1). Hence, at each instant, the central body moves as if it wear rotating about ICR located at the center of these two lines.

Recall that the fix centroid consist of the state of instantaneous pole locations in the fixed reference frame, while the moving centroid consist of the set of the pole locations as described in the moving frame of the central body. The mechanism moves as if the moving centroid rolls without slipping on the fixed centroid. The geometry of the fixed centroid can be found as follows. For each feasible orientation of the central body(denoted by θ), the x and y coordinates of ICR P is:

$X_p = -c\cos\theta \quad Y_p = c\sin\theta$ .....(4)

Consequently, the moving centroid traces out the circle

$X_p^2 + y_p^2 = c^2$ .....(5)

3. CONCLUSION

Elliptical Trammel is a kinematic inversion of double slider crank mechanism which is used to draw ellipse of different major and minor axis. Again there are three such points which gives different traces of motions. The point at the pin joint of both slider gives straight motion while if the point is located at exact centre of crank then it gives a comlpete circle. Elliptical

trammel is treated as RRPP mechanism as it consists of two rotating pairs and two sliding pairs in which the slider forms two sliding pairs and the connecting rod makes the two rotating pairs and the fixed link act as a frame of mechanism. Thus here is an approximate straight motion is taken as an application of an elliptical trammel .

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