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Symmetrical Circular Tool Path Controller by Simple Linkage

[*]K. J. Jenish, J. Jeba Sharon, Prince Sahaya Sudherson
Rohini College of Engineering and Technology, Palkulam, Kanyakumari District
*Corresponding author Email:jenish1801@gmail.com

Abstract:*This project deals with the design, analysis and fabrication of symmetrical circular arc tool path controller. The objective of designing this linkage is that it can be used to control the tool or table movement in modern machineries in alternate to the piston cylinder arrangement. By using this mechanism, various types of tool and table motions in the machineries can be obtained. By the conventional piston and cylinder arrangement only linear motion can be achieved. But by using this mechanism angular and elliptical path can be traced. And hence complicated shapes in various profiles can be machined easily and the time required for machining these type of profiles gets reduced and hence the range of application of the machines increases. This can also be used for controlling robotic arms. Hence some complications in robotic arm movement can be avoided. This can be used for further more applications by modifying its components*
Keywords:*Mechanism, Symmetrical Circular arc.*

1. INTRODUCTION

This module is to learn the principles of geometrical construction The objective of a four-bar linkage which traces an exact symmetrical circular arc for a finite portion of its coupler curve. The Working Model program can then be used to determine different characteristics of the resulting linkage such as 'how precise is the resulting circular arc?' and 'for how many degrees of crank rotation is the circular arc?'.

2. FOUR BAR MECHANISM

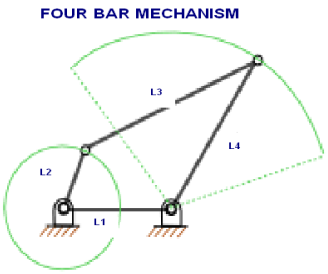

FIGURE 1. Four bar mechanism

Four bar mechanism has four links
L1 = frame
L2 = crank
L3 = connecting Rod
L4 = Lever
Crank rotate 360 degrees.
It should satisfy Grashaf's law:
L1+L3 < L1+L4
It can draw only arc of radius equal to the length of the link L4.

3. SYMMETRICAL CIRCULAR ARC LINKAGE

Symmetrical circular arc mechanism is a six-bar kinematics bar mechanism.
We developed this mechanism from basic four bar mechanism by introducing two new additional links.

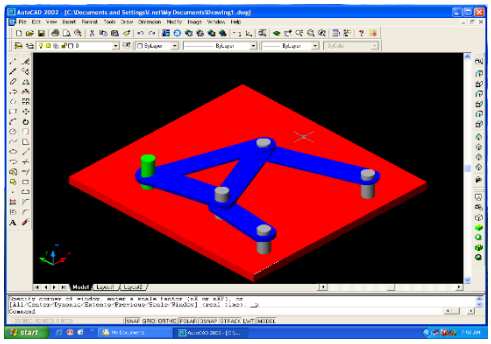

FIGURE 2. Symmetrical circular arc Linkage

Symmetrical circular arc mechanism
When the crank rotate link4 oscillates.
L6 traces an exact symmetrical circular arc.
L3 = L4 = L5.
The position of the curve changes with respect to the position of L1.
The curve changes with respect to link lengths.

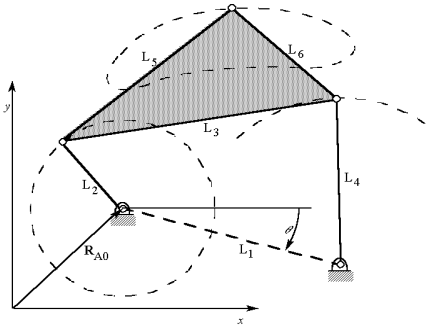

FIGURE 3. Curve changes

Applications
Symmetrical circular arc tool path controller.
Drawing curves of any radius of curvature.
Complex profile cam cutting machine.
Automatic material and tool handling mechanism.

4. SYMMETRICAL CIRCULAR ARC TOOL PATH CONTROLLER

To control the tool path automatically we designed this project. When the crank is rotated the tool fixed in the link-6 moves in a symmetrical circular path over a distance. We derived an equation to find out the tool position in the work table relative to the angular displacement of crank. We can place the tool at any precise position by setting the crank angle by a stepper motor.

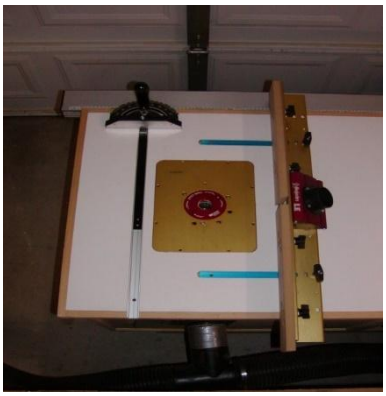

FIGURE 4. Symmetrical Circular Arc Tool Path Controller

Controlling Tool P Ath of Mordern Machines

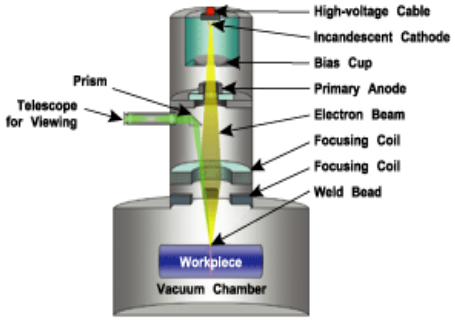

FIGURE 5. Controlling Tool P Ath of Mordern Machines

Used as automatic tool path controller to control the tool path of modern machines like.
Electron beam machining.
laser beam machining.
Water jet machining.
Abrasive jet machining.

5. DRAWING CURVES OF ANY RADIUS OF CURVATURE

The point c traces two curves in single revolution of crank.
Radius of curvature does not depend on length of a single link.
It depends on combined effective length of all the links.
Change in any length causes changes in radius of the curve.
Different curves can be obtained by varying Length of linksposition of fixed points.

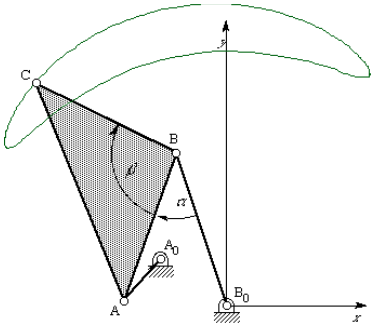

FIGURE 6. Drawing Curves of Any Radius of Curvature

6. SAMPLE CURVES OBTAINED

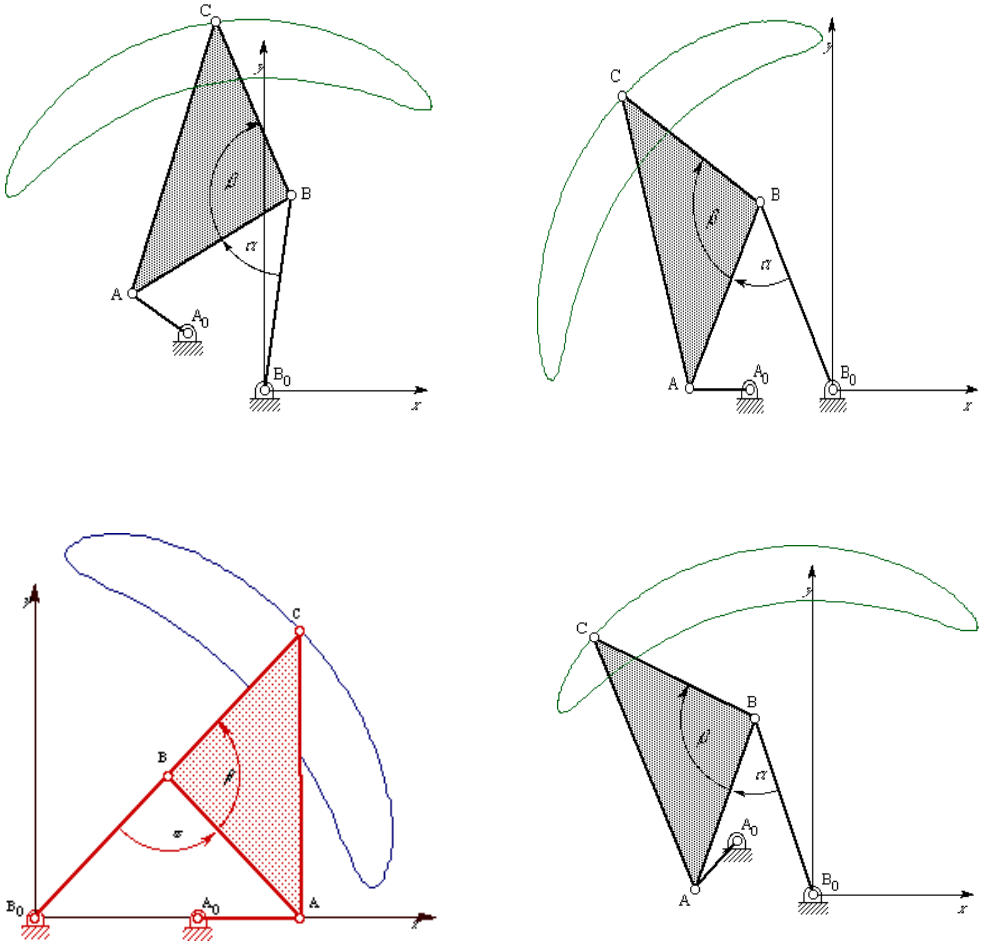

FIGURE 7. Sample Curves Obtained

***Complex Profile Cam Cutting Machine*:**Symmetrical circular arc linkage can be designed to draw any complex closed curves symmetrical shape.
It can be used as a tool in mass production cam cutting machines.
By varying the lengths of links we can achieve any complex shapes.
Symmetrical profile can be obtained by having the relation L3 = L4 = L5.

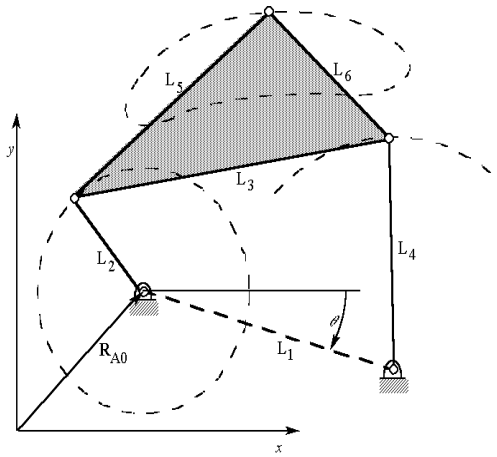

FIGURE 8. Complex Profile Cam Cutting Machine

Other Applications: Can be used as Automatic material and tool handling system.With some attachments it can be used for controlling the arms of bulldozers and heavy machines. Robotic arms can be controlled using this mechanismThis mechanism can be used in tool centers.

Comparison With the Existing System: For machining symmetrical circular arc shapes this mechanism is highly reliable because using this mechanism we can machine such curves in a single cut.Since this mechanism is cheap and simple to operate, it is more economical than other mechanisms.It is very simple in construction and so complications can be avoided.This mechanism can be used for tracing a closed path, which is difficult for the other mechanism to do so.The position of the tool can be sensed very easily by the position of crank angle.Machining time for machining these types of curves get reduced.AdvantagesThis mechanism is very simple to design and fabricate.This mechanism is highly reliable and easy to handle.Negligible maintenance required.The tool motion accurate.The position of tool can be accurately predicted by the crank angle.Accurate cutting can be done without viewing the cutting zone.This mechanism can be used to control tool path accurately in electron beam machining where cutting area cannot be viewed directly. Very effective for automatic control.Disadvantages These mechanisms can be used for machining some definite profiles only. The position of the profiles only can be varied. For the variation in the size of the profiles the length of the links must be varied.

7. CONCLUSION

I conclude that this symmetrical circular arc tool path controller will be a simplest and a efficient tool to control the tool path of modern machines and be a tool to machine complex cervical profiles.

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