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Horizontal Drilling using Elbow Mechanism

Gurav Kiran Prakash[1], Gound Chandan Ravindra[2], Goswami Rakesh Shailendra[3], Gupta Arun Subhash[4], Kushwaha Manish Ravindranath[5]
[1, 2, 3, 4, 5]*Student, Department of Mechanical Engineering, Theem College of Engineering, Boisar*

Abstract: ***Elbow transmission mechanism transmits power from input to output by means of sliding links that form revolute pair with hub. Links bent at required angle slide inside the holes in hub. This mechanism can be used for replacement for bevel gears and belt drive in low cost, low torque application's. It can transmit at any angle 0 to 180. Strength, Speed, Torque, Transmissibility of Elbow mechanism as this are very much important terms in defining applications of the mechanism in replacement of pulley.***
Computation of various parameters like Number of pins, Material used, Dimensional difference of elements, Speed, Torque. Many previous approach were made to find out the optimum design in order to make this mechanism better than old mechanism. Elbow mechanism is also known as Gearless transmission system, L-pin mechanism or Orbital transmission mechanism.
This elbow mechanism is simple in construction and can be easily made with minor precision. This mechanism is mainly used in replacement of bevel gears where the motion is to be transmitted at 90⁰. So, in general elbow mechanism angle between rod is taken 90⁰. This mechanism can also be used to transmit power at varying angle by changing the angle of L-pins or by providing universal joint at the corner.
This mechanism consist mainly 3 L-pins, further increase into L-pins will increase the smoothness of the system. Elbow Mechanism is being compact and portable equipment, which is skilful and is having something practice in the transmitting power at right angle without any gears being manufactured.
Keywords: Elbow mechanism, Transmissibility, Torque, Gearless.

I. INTRODUCTION

Today's world requires speed in each and every field. Hence rapidness and quick working is most important. Now a days for achieving rapidness, various machines and equipments are manufactured by man. Engineer is constantly conformed to the challenges of bringing ideas and design into reality. New machine and techniques are being developed continuously to manufacture various products at cheaper rates and high quality. The project "GEARLESS TRANSMISSION" being compact and portable equipment, which is skilful and is having something practice in transmitting the power at right angle without any gears being manufactured. This project gives us knowledge, experience, skill and new ideas of manufacturing. It is a working project and is having guarantee of success. In this project the equipment is useful to improve the quality of the gear being manufactured and can be made in less time, hence we have selected this project el-bow mechanism. It is an ingenious link mechanism of slider and kinematic chain principle.

This is also called as "gearless transmission mechanism". This mechanism is very useful for transmitting motion at right angles. However in certain industrial application "gearless transmission at right angle" can also work at obtuse or acute angle plane when compared to worm and worm gear or bevel and pinion gear which are invariably used in the industry for numerous application. The main feature for mechanism comparatively high efficiency between the input and the output power shafts with regards to the gear efficiencies. The El-bow Mechanism transmits the I/P power towards the O/P side such away that the angular Forces produced in the slacks are simply transmitted with the help of pins which takes up the I/P power and the right angle drive is transferred towards the O/P slack and pin assembly.

Hence very little friction plays while the power is being transmitted; the Hunting and back lash are absent. The Gearless transmission or El-bow mechanism is a device for transmitting Motions at any fixed angle between the driving and driven shaft. The synthesis of this mechanism would reveal that it comprises of a number of pins would be between 3 to 8 the more the pins the smoother the operation. These pins slide inside hollow cylinders thus formatting a sliding pair. Our mechanism has 9 such sliding pairs. These cylinders are placed in a Hollow pipe and are fastened at 40* to each other. This whole assembly is mounted on frame. Power is supplied by an electric motor. These roads are located at in the holes equally spaced around a circle and they are free to slide in & out as the shaft revolves. This type of drive is especially suitable where quite operation at high speed is essential but only recommended for high duty.

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II. METHODOLOGY

The consideration and planning for developing the machine are as follow: -

A. Study of research papers.
B. Study of elbow mechanism.
C. Selection of material.
D. CAD Modeling.
E. Fabrication and assembly.
F. Calculations.
G. Result

Selection Of Materials

No	Name	Material	Quantity	Specifications
1.	FRAME	MS	1	740x740x175mm
2.	MOTOR	STD	1	12v Dc Geared motor
3.	SHAFT	MS	2	DIAMETER 85mmx250mm
4.	L- LINK	MS	9	DIAMETER 11x502mm
5.	PILLOW BLOCK BEARING	CI	4	DIAMETER 86mm
6.	CHUCK	SS	1	
7.	Hub	MS	2	DIAMETER 220mm THICKNESS 170mm

Compressive Yield Strength MPa	250
Tensile Yield Strength MPa	250
Tensile ultimate strength	460
Hardness	229

III. DESIGN OBJECTIVE

The basic objectives of the projects are:

A. To make modification in design..
B. To check performance of mechanism by changing no. of L-pins.
C. To obtain increase in efficiency.
D. To build mechanism which is helpful for transmitting the power.

IV. COMPONENT FUNCTIONAND SPECIFICATION

1) L-Shaped Links: The L-shaped links are fabricated with stainless steel. In software we made two links of diameter 11mm then we generated u-shaped link to of dia 11mm to join those two links. These are sliding links in our mechanism. The no. of links used is Nine. The length of link is 500mm.

Fig.1 L-Pins

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2) *Elbow Mechanism:* Transmit the power between two shafts whose axes are at 90 degree through bent links. Nine links are slide relatively according to the motion given to input shaft. Due to this, the rotational motion of input shafts is converted into sliding motion of links which is then converted to rotational motion of the output shaft.

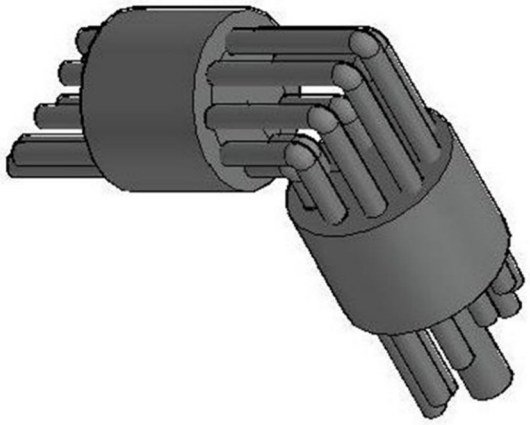

Fig.2 Elbow Mechanism(Nine L-pins)

3) *Pillow Block Bearing:* A pillow block bearing (or plummer block) is used to provide support for rotating shaft with help of compatible bearing and various accessories. Housing material for pillow block is typically made of cast iron or cast steel.

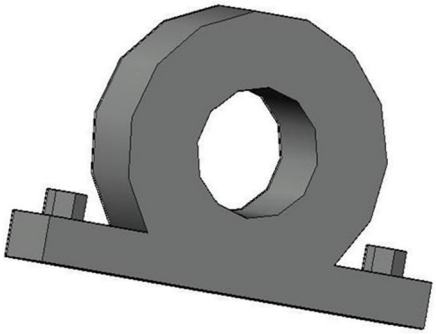

Fig. 3 Pillow block bearing

4) *Supporting Frame:* The frame is made up of mild steel. It is supported to assembles and also motor is fixed on the frame. The frame must be lighter in weight so that it will be easy to transfer.

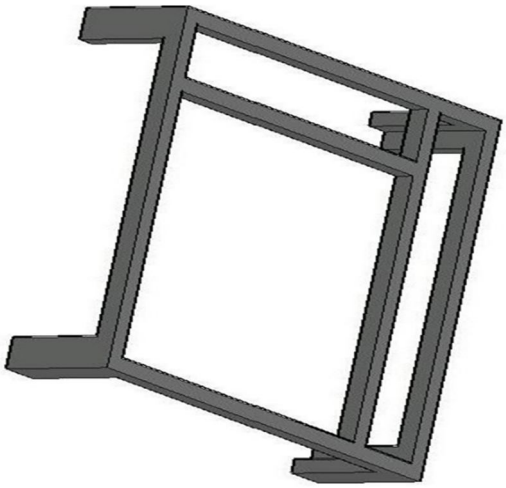

Fig. 4 Frame

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5) *Motor:* We used 12v Dc Geared Motor 35rpm. An electric motor is an electrical machine that converts electrical energy into mechanical energy. The reverse of this would be the conversion of mechanical energy into electrical energy and is done by an electrical generator.
6) *Hub Connected to Shaft:* It has 10 no. of holes, out of which nine are having same diameter which are at the circumference of the solid cylinder. The diameter of these nine holes are 11mm. The central hole is connected to shaft. The hub moves with speed of the motor as its attach to the shaft. The shaft is having larger diameter than L-shaped links that is 85mm. Material = Mild steel.

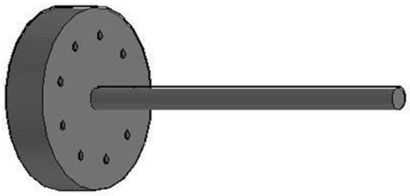

Fig. 5 Hub connected to shaft

7) *Chuck:* it is used to hold revolving cutter

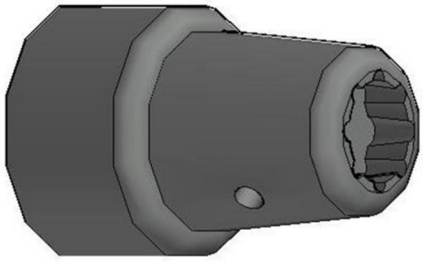

Fig. 6 chuck

V. WORKING PRINCIPLE

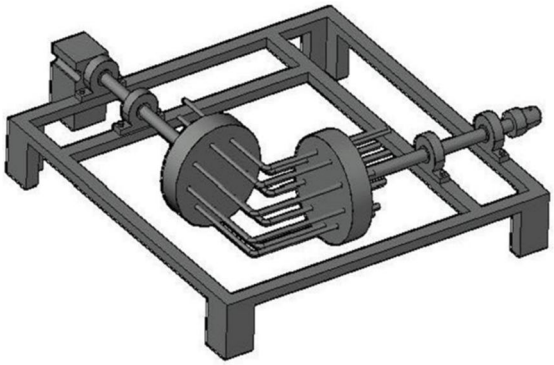

Fig.7 Horizontal drilling using elbow mechanism

At present the transmission of power at angle between the shafts are in between source to source is possible only by assembly of gears using gear ratios for varying speed. The gears maybe resulted to wear and tear after a particular period of working. To avoid this we have come up with the new mechanism called gearless power transmission. The working of this mechanism is put into actions for restricted degrees of angle. The mechanism that we are working with will be in action when the angle between the two shafts or in between the two sources is 80 to 120 degrees. At this 80 to 120 degrees of angle the transmission of power through gears is very much difficult for the reason the gears attain high loads at this angles. Moreover the gears are too costly to put into mechanism. To avoid all these difficulties we have come up with this new mechanism. While coming to the working of our mechanism it has three Elbow links which are in L- shaped (angle between the joint is 90 degrees) are attached to the discs having three holes of same diameter of the elbow links to be inserted. The disc has a central hole having diameter larger than the links diameter which is equal to the shafts diameter to avoid problems regarding strength and vibrations.

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The extended central shafts is attached to the motor. Similarly the other side has another discs having same dimensions of holes. The three elbow links are inserted into the pair of discs placed at 90 degrees of angles. The gap between the disc and the elbows is same on either side of the mechanism to one end of the extended shafts, motor shaft is attached and to the other end the required tools like drill bits, reamers, grinders, taps of various sizes can be attached to perform various operations on the work piece. Also the end of the shaft can be attached to any of the source like for transmitting motion, pull the loads etc., can be used to perform work. Now, on switching ON the power source to the motor the motor starts rotating at very high speed as the motor shaft is attached to the main shaft of the disc. The disc also rotates with the speed of the motor. The elbow rods are freely fitted into the two discs at an angle 90 degrees which are held freely without any firm force acting on them when the disc is set to rotate the three links starts adjusting themselves to get free from the disc but as they are hold in between the two discs avoiding not to come out of the two discs. They will slide to and fro continuously in the circular motion and thus they transmit the power to the next shaft attached to the disc which is at another side of the mechanism which is at 90 degrees to the motor side disc, thus the shaft attached to the second disc will also set to rotate with the same speed of the motor shaft. When the tool or any source is attached to the end of the second shaft would set to rotate performing the required operation, thus completing the working of the mechanism.

A. *Advantages*

1) Complete freedom of Interchangeability. More efficient than gear.
2) Power could be transfer to any desired angle.
3) Ease of manufacturing.
4) Low maintenance cost.

B. *Limitations*

1) Does not work at very low starting torque.
2) Sudden load would cause mechanical breakdown.

C. *Applications*

1) Used for angular drilling between 0 to 90 degree position.
2) Lubrication pump for C.N.C. lathe machine.
3) Air blower for electronic and computer machine.
4) The elbow mechanism is used for movement of periscope in submarines
5) Tower clocks
6) Gang drilling

VI. RESULT

P_{in} = 420 $Watts$

Input speed of the shaft = 35 rpm

From,

P = $\frac{2\pi NT}{60}$

Output speed of the shaft = 34 rpm

Torque induced in the shaft = 114.59 N-m

Output power ,

P_{out} = $\frac{2\pi \times 34 \times 114.59}{60}$

= 407.99 Watts

Efficiency,

$$\eta = {Pout}/{Pin}$$

$$= \frac{407.99}{420}$$

= 0.9714

= 97.14%

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VII. RESULT & DISCUSSION

We get efficiency of 97.14% in our project.

The final design thus obtained is capable of transmitting torque and power at 90 degree angle. With further research and advanced analysis in the design wide-ranging applications of the drive can be discovered. This project is the equipment useful to improve the quality of the gear being manufactured and may be made in much less time, consequently we have selected this undertaking el-bow mechanism is an inventive link mechanism of slider and kinematic chain principle. That is also called as “gearless transmission mechanism” this mechanism is very beneficial for transmitting movement at right angles. But in sure commercial software “gearless transmission at proper attitude” can also work at obtuse or correct angle plane can be in comparison to bug and Trojan horse gear or bevel and pinion equipment which are perpetually used inside the enterprise for several application. for the reason that factor referring to beneath frictional Forces among the mating tools teeth, the erratic hunting of the gears, the back lash among the tooth cannot be conquer and for this reason the performance can't be extra than 45% of recent gears of warm bevel type are being manufactured in poly propqlenerand epoxy material where the Frictional Forces are relatively eliminated. even though such gears are used for quite small programs the efficiency isn't extra than forty-two%.

The model works correctly as per the design. With the help of this system, we can efficiently reduce the cost in power transmission and further advancement in this technology can be made. There is clear in design and Fabrication of our project is safe at 60 rpm for gearless transmission system.

VIII. CONCLUSION

A. Any set of Diameter with any profile and skew shaft too can be used, but it should have rotation about it’s own axis.
B. Both the driving and driven shaft should run on the same RPM.
C. The rods should be equally radially spaced on the Cylindrical disc. (If 9 pins then 360/9=40 degree each rod).
D. The mechanism transmit the motion efficiently at 60 rpm.
E. Generally Stainless Still is used as the Rod material but here we used mild steel as a rod material.
F. Minimum 3 Nos. of pins should be used for to make transmission possible.
G. This mechanism can give up to 97% of efficiency (Gears can give maximum 42% of efficiency).
H. The links are bent to 90^0, but it can also be varied by using the universal joint.
I. General Diameter of Rod used is 11mm
J. General length of the rod used is 502mm.

VIII. ACKNOWLEDGEMENTS

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IX. CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this article.

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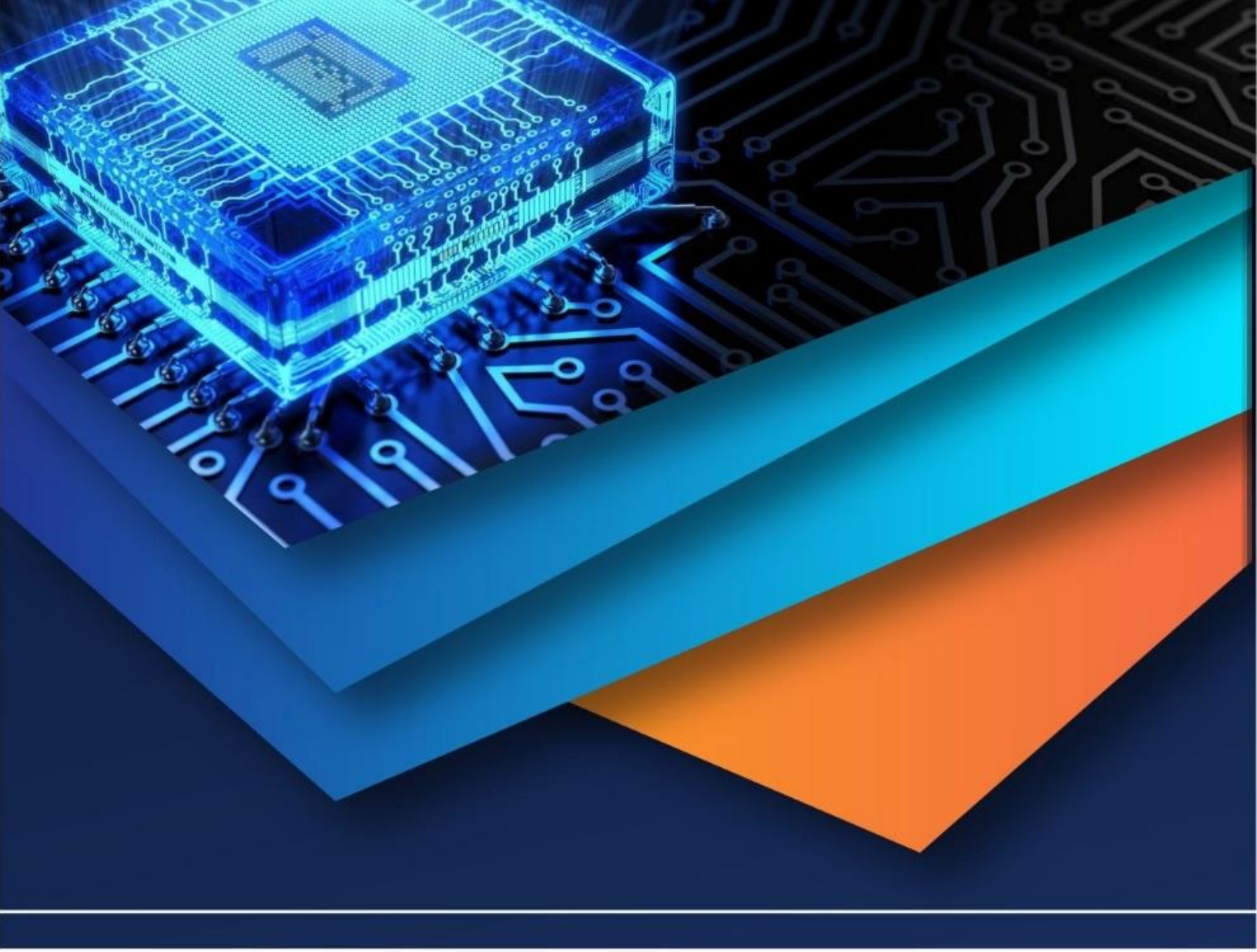

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