"Survey Paper on Gearless Power Transmission by Using Elbow Mechanism"

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ABSTRACT— This review paper gives information about the Strength, Speed, Torque Transmissibility of Elbow mechanism as this are considerably important terms in defining applications of the mechanism in replacement of gears. It mainly focused on the theoretical, analytical and FEA method. Computation of varied parameters like Number of pins, Material used, Dimensional difference of elements, Speed, Torque. Many previous approach were made to seek out the optimum design so as to form this mechanism better then old mechanism by using different analysis software. It consist Theoretical & Analytical method for the planning of elbow mechanism.

Keywords: Gearless Transmission, Elbow Transmission, Universal Joint, Power Transmission.

I. Introduction:

In today's world, as limited quantity of the resources available, it's necessity to utilize that resources in such way that it gives maximum of them. The major problem for the gear transmission is that the manufacturing of drugs is complex process which consumes longer and takes considerably precision and manufacturing cost is high .[1,2,4,7,8] The another major problem is that the transmission having gear cause the jamming thanks to the backless error and produces more noise compared to other drives thanks to pitch mismatch.[3] This elbow mechanism is additionally referred to as Gearless transmission , L-pin mechanism or Orbital mechanism . This elbow mechanism is straightforward in construction and may be easily made with minor precision. This mechanism is mainly utilized in replacement of bevel gears where the motion is to be transmitted at 90º. So, generally elbow mechanism angle between rod is taken 90º. [1,2,4,5,6,7,8,11,12,14] This mechanism also can be wont to transmit power at varying angle by changing the angle of L-pins or by providing universal at the corner.[3,9,10,13] This mechanism consist mainly 3 L-pins, further increase into L-pins will increase the smoothness of the system.[8] Elbow Mechanism is being compact and portable equipment, which is skilful and has something practice within the transmitting power at right angle with none gears being manufactured. This mechanism are often used for any diameter of the driving and driven shaft.[13] Maximum efficiency of drugs drive is merely up to 42% but, by this mechanism we will rise up to 90 to 92% of efficiency.[12]

Literature Survey:

R.Somraj et al. [1] Analyzed the planning and Fabrication of Gearless Transmission For Skew Shafts. 3 Nos. of L-pin rods were used. Overall mechanism is taken into account to be running on 0.25 HP motor with 140 RPM and Torque of 1238 N-mm. Design of Hub is completed by Considering a hub of internal diameter is 32mm and outer diameter is 92mm, length is 82mm. Design of shaft was done by taking maximum tensile stress of 60 N/mm2 and maximum shear stress of 40 N/mm2 .Diameter of elbow rods was 8mm. it had been Concluded that given arrangement are often for skew shafts of any angle but the shaft's must be having the rotational motion about his own axis, transmission of motion is extremely smooth and desirable and used only for the equal R.P.M. of driving shaft and driven shaft by employing links or given sort of links for appropriate joints for revolute pair. it had been also found that successful mechanical devices function smoothly however poor fly they're made while other does this only by virtue of an accurate construction & fitting of their moving parts.

Neeraj Patil et al. [2] Researched on Gearless mechanism and its Applications. link of C-45 was used. Links bent at required angle slide inside the holes within the hub Mechanism can transmit at any angle 0 to 180.The mechanism is studied and a possible go-kart transmission layout is fabricated and few future applications are suggested. Into This weight of model along side rider Assumed 1500 N. Kart was loaded with 4 Nos. of tires each with 375 N of load. Coefficient of friction between road and tire was Considered 0.7. Tire of radius 0.1778m Taken. Torque required **to** maneuver Was 46.67 N-m with Torque on each link 15.55 N-m Tangential force of 311.15N was working on links. Diameter of every link was 10mm. After study of the mechanism it had been concluded that this mechanism is especially applicable to low cost applications where torque is low to medium. With future development in low friction materials (graphene coating) and stronger composite materials, the efficiency and capacity of this

mechanism can be increased. Also if rather than bent links, bolted links or links held by universal joints are used then transmission is feasible even when angle changes on the go. Ashish Kumar et al. [3] performed study on Multi Angular Gearless Drive. The mechanism was loaded with 3 Nos. of L-pins. Parts of mechanism were modeled on Solid Works and therefore the analysis of the mechanism was administered on ANSYS. The study of mechanism was carried with 0.63 Moment of Inertia (Provided by Solid Works). Behavior of system is plotted on different charts i.e. Velocity vs. Time, Acceleration vs. Time, Angular Acceleration vs. Time, Separation Distance vs. Time. From This it had been concluded that the ultimate design thus obtained is capable of transmitting torque and power at varied angles counting on the angular limitation of the hooks joint. With further research and advanced analysis in the design wide-ranging applications of the drive are often discovered. Solanki Nehal et al. [4] studied Design And Analysis Of Gearless Transmission Through Elbow Mechanism which may be used into the replacement of the bevel gears. 4 Nos. of L-pins was used into this fabricated model. With input of 1HP motor. Links of 10mm diameter were used of S.S , M.S material. Shafts are rotating with speed of 1440 RPM and 4947.066 N.mm of Torque. Stimulation is done by the ANSYS 16.2 and analysis of mechanism was done at 50,100,150,200RPM for both the fabric . it's been concluded from that analysis that mechanism with 6 elbow rods made from low-carbon steel material is works perfectly. The mechanism runs smoothly when it's kept at 150 RPM Also it are often concluded that because the no of elbow rods increases smoother the operation would be.Shiv Pratap Yadav et al. [5] performed Real time and motion study for Design, Analysis and Fabrication of Gearless Power Transmission by using Elbow Mechanism. They used 3 Nos. Of elbow rods inclined to the 90º.Modeling and rendering of mechanism is completed into the CATIA V5 and therefore the analysis was carried on ANSYS. The mechanism was working between 80 to 100 RPM. after this it had been concluded that it's a high scope in future to exchange the cumbersome usage of gears which will be replaced simple, elegant usage of the shafts which will change the general cost management of the industries using gear technology presently to realize more profits. Navneet Baradiya et al. [6] had done Analysis and Simulation of Gearless Transmission Mechanism. The system is to be analyzed in Solid Works package software to observe the response of the elbow rods and therefore the also the hub (coupled with shaft). Motion analysis is performed by running the mechanism at 15 revolutions per minute and better speeds, reaction forces and reaction moment are plotted against clock run of 5 seconds by using post processor. Theoretical calculations are made to get allowable stress by making use of design data values. As a result, response of elbow rod and hub is investigated to seek out the permissible speed of mechanism. Elbow rods of diameter 7.55mm of stainless steel were used. it's Concluded that for smooth and safe running of mechanism it should be kept below 140 rpm. With this study it's concluded that gearless transmission mechanism is capable of running up to 120 rpm under normal conditions. Further fatigue analysis are recommended for gearless transmission mechanism.

Amit kumar et al. [7] Introduced gearless power transmission arrangement used for skew shafts. 3 Nos. of L-pins were used and therefore the elbow mechanism was compared with S-R-R-S links. During performing on experimental it's concluded that proposed arrangement used for any set of diameters with any profile of shafts for skew shafts of any angle but the shaft's must be having the rotational motion about his own axis, transmission of motion is extremely smooth and desirable and used only for the equal R.P.M. of driving shaft and driven shaft by employing pins or given sort of links for appropriate joints for revolute pair. Jagushte G. S et al. [8] had done research about Design, Analysis and Fabrication of Gearless Transmission by Elbow Mechanism. This technique was loaded with 3 L-pins each at 1200 of the cylindrical disc. The L-pins are made from the Stainless Steel (X6cr17). The rod diameter was taken 12.6mm. part modeling was done in Solid Works and Analysis is carried on Autodesk Inventor (2016).It Was Concluded after analysis and Fabrication 140rpm to 160rpm is safe for gearless transmission system. Thus simulation results satisfy motion analysis results. Also The model works correctly as per the planning . With the assistance of this technique , we can efficiently reduce the value in power transmission and Further advancement during this technology are often made. Mahantesh Tanodi et al. [9] Researched about Gearless Power Transmission Offset Parallel Shaft Coupling. 4 holes were drilled into the shafts and Z-links were inserted into the each hole on shafts. This paper was a part of a study investigating the Gearless power transmission for parallel shafts. Gearless Transmission which is compact and portable equipment, which is skillful and is having something practice within the transmitting power between parallel shafts without any gears getting used . This Couplings for parallel shaft gives sort of displacement and torque from a minimum of 1 to 500 mm and from 5.4 to 80000 Nm respectively. Analysis of Z-pins finished the various angles and variation in length of pins is checked. By the geometric analysis of configuration it had been analyzed that the dimensions of the Z-link connector decreases, because the off-set to shift ratio increases. And hence the strength of the connector comes down. Hence it's advisable to take care of smaller offset to shift ratio for the rigid and stronger Z-link connector. By this study they need concluded that hat the proposed conceptual design are often applied for the transmission of power between two parallel shafts having proper shift and off-set by employing different geometries of Z-pins

Anand C. Mattikalli et al. [10] researched on Gearless Power Transmission- L Pin Coupling. 4 pins are used for every 45º , 90º , 135º.The design was checked by varying the Nos. of pins from 1 to 4 and to seek out out the optimum Nos. of pins used for better transmission. Analysis is completed in CATIA V5. Analysis is completed just for two intersecting shafts. At the top of the study By CATIA® analysis, It can be concluded from the results that the proposed conceptual design are often applied for the transmission of power between two Intersecting shafts having proper angular misalignment by employing different geometries of L-pins and it's found that minimum number of L-Pins required are 3, for continuous smooth power transmission.
Atish Lahu Patil et al. [11] had studied Gearless Mechanism in Right Angle . The mechanism was consisting 3 pins bent equally at 90º . it had been found from study that the more the Nos. of link will make the operation smoother. The pins were made from bright bar with a excellent surface finish. The wood cutter was mounted on the output shaft which may hack to 250mm width of wooden sheet.By performing on experimental setup and after an extended Study it's Concluded that proposed arrangement used for any set of diameters with any profile of shafts for skew shafts of any angle but the shaft's must be having the rotational motion about his own axis, transmission of motion is extremely smooth and desirable and used
only for the equal R.P.M. of driving shaft and driven shaft by employing links or given sort of links for appropriate joints for revolute pair.
M. Lokesh et al. [12] had fabricated model for Gearless Power Transmission Mechanism using 6 Elbow Rods. From the study it's been stated that this mechanism can transmit the facility with 92% of efficiency. The mechanism was consisting 6 Nos. of L pins bent equally at 90º. The compressor and pump also introduced into project when the links inside the drilled holes reciprocates also
rotate inside cylinder. It gives pumping and compression effect. Among the 6 links first pin goes at inner dead centre it sucks the air and begin moving outer dead center when further revolving. After study it had been concluded that Elbow transmission mechanism is feasible in almost for brief lengths and also it's suitable for medium length by increasing the housing diameter and therefore the setup indicates that by increasing the elbow a rod in account increases the smoothness of the transmission also The absence of friction ultimately raises the efficiency of the mechanism.
Amit Kumar et al. [13] Presented an appointment for Power Transmission Between Co-Axial Shafts of various Diameter. There in arrangement motion is transmitted between the co-axial 18 shafts of various diameters. Up to eight Nos. of pins was used. If more pins used motion are going to be smoother, but increase in no. of pins not at the value of strength of shaft. Holes drilled very accurately & the axis of both the shafts was co-axial. The designed arrangement are often work for parallel shaft displacement up to 500 mm and torque capacities from 5.4 to 80000 Nm. It was concluded that the Proposed arrangement are often used for any set of diameters with any profile of shafts but the shaft's must be co-axial and having rotational motion along the common axis, transmission of motion is extremely smooth and desirable and used just for the equal R.P.M. of driving shaft and driven shaft by employing different geometries of Z-pins and Elbow pins or link.

System Study:-

In this transmission Nos. of pins used are between 3,4,5,….which were inserted into the opening drilled on the cylindrical disc. If we use but 3 pins then it will not work and can cause jamming.
The motion is transmitted by sliding and rotating movement of the L-pins simultaneously .This L-pins are inserted into same angle of 120º on the cylindrical disc.The Elbowmechanism contains the subsequent part :

- L Pin
- Cylindrical Discs
- Shaft
- Base plates
- Arm Supports(Bearings)

Working Principle:

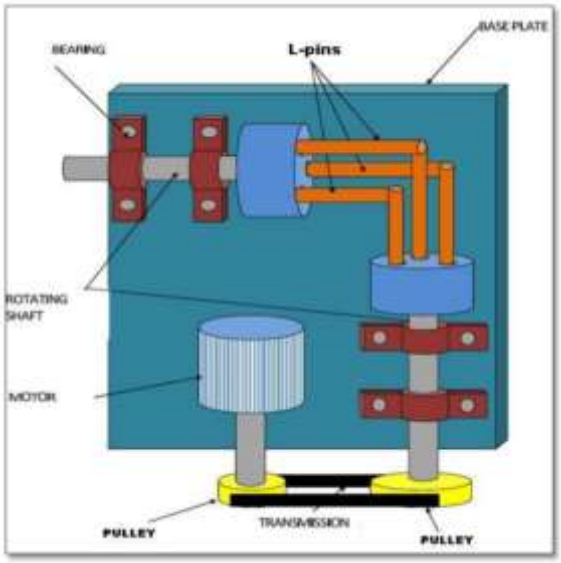

Figure 1: General Layout Of Mechanism

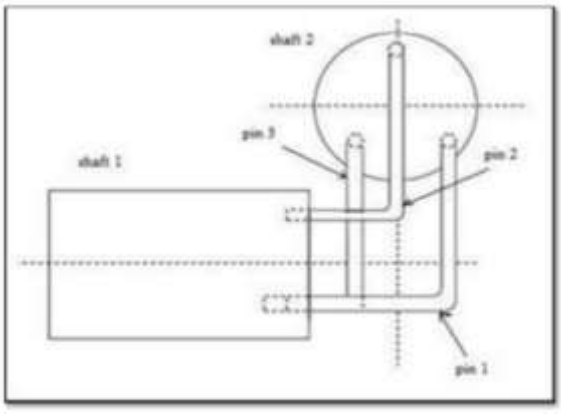

Figure 2: Setup of L-pins

After studying synthesis of mechanism it get revealed that this technique contains 3,4,…up to eight pins and increasing the Nos. of pins mechanism will work more smoothly. Power to the present mechanism is furnished

with motor. Motion is transmitted from driving to driven shaft with the assistance of L-pins. This L-pins starts TO and FRO motion when power is supplied. The motion is transmitted through the S-RR-S pair made by L-pins and cylindrical disc.

Let at the starting instant shaft 1 starts rotation with 3 pins in anticlockwise direction and a reaction force developed at the pin surface which in touch with the shaft and this force transferred to the opposite end of the pin which is within the shaft and applying on the shaft 2 thanks to which shaft 2 starts rotating within the same direction as shaft 1, after 120 degree rotation pin 1 comes at the place of pin 2 & pin 2 comes at the place of pin 3 & pin 3 comes at the place of pin 1 by sliding in shaft and self-adjusting. This motion repeated for next 120 degrees and further for next 120 degrees and pins are exchanging the position in successive order.

Conclusion & Future Scope:

Any set of Diameter with any profile and skew shaft can also be used, but it should have rotation about it's own axis. Both the driving and driven shaft should run on an equivalent RPM. The rods should be equally radially spaced on the Cylindrical disc. (If 3 pins then 360/3=1200 each rod).The mechanism transmit the motion efficiently up to 150 RPM . Generally Stainless Still is employed because the Rod material. Minimum 3 Nos. of pins should be used for to form transmission possible..

This mechanism can hand over to 92% of efficiency (Gears can give maximum 42% of efficiency).The links are bent to 90º, but it also can be varied by using the universal joint. General Diameter of Rod used is 8 to 10 mm.

General length of the rod used is 250mm.

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