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A Review Paper On Design and Experimental Analysis Of Kinematic Transmission Linkages-Zero to Max Drive

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ABSTRACT

This project proposes an analytical approach to the robust design of speed change mechanism, to achieve motion and accuracy. The purpose of this project to maintain desirable speed at any step in mechanical machines by using kinematics transmission linkages. Design of components of steeples drive will be taking place. Components mainly include design of clutches and design of bearings. due to the application of kinematic 6 bar linkages power consumption reduce, also operator operates machines at any speed without stopping the machine. Kinematic Linkage Transmission is a mechanical adjustable speed drive. The speed range is infinitely adjustable from 0 to ¼ of input speed under full rated load. Speed Adjustments are easily made by moving a lever control through an arc. Precise speed control settings are possible. Kinematic linkage design will be done using kinematic overlay method, to find change in speed ratio for various control link positions; this will be done using Autocad -R 2016. Theoretical design of components for strength parameters will be done and Ansys workbench will be used for analytical validation of strength. The experimental testing will be done to validate theoretical results of speed ratios.

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I. INTRODUCTION

1.1 Problem statement

There are many machines and mechanical units that under varying circumstances make it desirable to be able to drive at an barely perceptible speed, an intermediate speed or a high speed.Thus a infinitely variable (or steeples speed variation in which it is possible to get any desirable speed .Some mechanicals devices serve as such infinitely variable drives .However the torque Vs speed characteristics of these drives do not match that of steeples drives at increased driving torque at low speeds.

Hence the need of an infinitely variable drive with the following characteristics.

1. Infinitely variable speed
2. Wide range of speed variation.
3. Shifting should be shockless while changing speed from one position to other.
4. For speed changing minimum no of controls are required.
5. Operation is easy.
6. Closed construction.

1.2 Principle of operation-

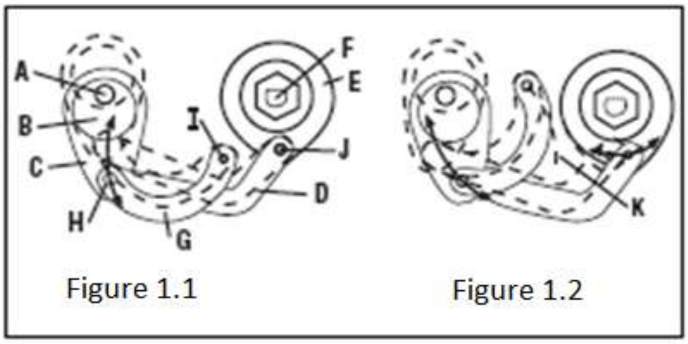

Figure 1

Externally, the Zero-Max Drive consists of a rugged case, an input shaft, output shaft and speed control. Speed of the output shaft is regulated accurately and easily through a control lever which includes a suitable locking mechanism or a screw control to hold speed at a desired setting. The general principle of operation of Zero-Max Drives gives infinitely adjustable speed by changing the distance that three or more one-way clutches rotate the output shaft when they move back and forth successively. The number of strokes per clutch per minute is determined by the input speed. Since one rotation of the input shaft causes each clutch to move back and forth once, it is readily visible that the input speed will determine the number of strokes or urgings the clutches give the output shaft per minute. For example, with four clutches working in series and an input of 1800 RPM, the output shaft is urged 7200 times per minute (1800 x 4) or 120 times per second (7200 ÷ 60). If the input speed is dropped to 900 RPM the shaft is urged only 3600 times per minute and the maximum output speed will be cut in half.

Looking at Figure 1, the input section consisting of a shaft (A), eccentrics (B), and connecting rods (C), converts rotary motion into linear motion. At the zero setting, the main links (D) pivot on points (H) and (J) without moving the clutches. At any setting other than zero, the clutches (E) transfered the linear motion back into rotary motion and drive the output shaft (F). A control link (G) swing through arc (K) when the control lever is moved. At any point along arc (K) a different output speed is produced because the direction of throw of the connecting rod is altered from vertical (Figure 1.1 zero RPM position) toward horizontal (Figure1.2 maximum speed position), varying the length of the strokes the main links deliver to the overrunning clutches

II. LITERATURE SURVEY

Gerald Rothenhofe.et.al.[1] presented an analytical approach to the robust design of mechanisms, to achieve motion and accuracy requirements given a desired transmission ratio and allowable geometrical variations. The focus is on four-bar and slider-crank mechanisms, which are common elements for the transmission of rotary motion, especially over distances, which are too big for the use of conventional elements such as gears, and motion along a predefined guide-curve, which often is a straight line. For many power transmission applications, a constant relation between the motions of an input and corresponding output element is required. For a four-bar linkage, a value of 1 is the only possible constant transmission ratio—achieved when the mechanism has a parallelogram configuration. In the case of a slider-crank linkage a constant transmission ratio can be achieved with a properly designed circular guide-curve, which makes the slider crank essentially equivalent to a four-bar. In practice, however, as a result of variations in link lengths due to manufacturing tolerances and load-induced or thermal deformations, the transmission ratio for a parallelogram four-bar linkage will deviate substantially from its ideal theoretical value of 1. Even small changes in link lengths due to deformations or joint backlash can cause unacceptable instantaneous transmission ratio variations. The concepts presented are not limited to the design of four-bars and slider-cranks but can also be applied universally in the design of other mechanisms.

Avinash A. Kawale and Dr. F.B.Sayyad[2] presented the synthesis, analysis, and experimental validation of a variable displacement four-bar crank-rocker-slider mechanism that uses low friction pin joints instead of planar joints. The synthesis technique develops the range of motion for the base four-bar crank-rocker and creates a method of synthesizing the output slider. Kinematic Linkage Transmission is a mechanical adjustable speed drive. The speed range is infinitely adjustable from 0 to ¼ of input speed under full rated load. Speed Adjustments are easily made by moving a lever control through an arc. Precise speed control settings are possible.

Kailash Chaudhary and Himanshu Chaudhary[3] highlighted the usefulness of Altair HyperWorks in kinematic and dynamic analysis of multibody (MBD) systems such as mechanisms. A mechanism in motion transmits forces and moments to the ground known as shaking force and shaking moment which are responsible for vibrations and fatigue. From the design point of view, these quantities are very important and variations in them for a complete cycle of motion can be easily found out using HyperWorks. A MBD simulation with rigid bodies was carried out for Stephenson six bar mechanism using Motion Solve whereas Motion View was used for modeling the mechanism. The results were generated by HyperGraph.

Sebastian Nickolai Bellisario [4] explained of this paper was to explore the characteristics of kinematic quick return devices, and characterize the major differences between quick return and other kinematic machines. These differences would allow us to develop a demonstration device which would be used to help future students understand how quick return machines function, and how to produce a specified motion with them. Our machine is a crank-shaper quick return mechanism designed to run at low speed, to highlight the differences between front and back strokes. Additionally, the device allows for easy changing of the time ratio.

A.N. Kulkarni and Arvind Bansode[5] explained the advantage of six bar mechanism as against the existing four bar mechanism used in articulation of the missile launcher system and how self-replenishment of missile container from ground was made possible is brought out. The application has been designed, and development in this paper has a requirement of having a dual role of not only articulation from the 00 to 900 but also to act as self replenishment system for the missile container thus avoiding usage of external crane. Replenishment system means to place the missile container in horizontal condition from the ground on to the vehicle platform at a height of around 1500 mm (from ground). Articulation means to articulate the same missile container on the vehicle platform from 00 to 900 (Horizontal to Vertical). In this paper the comparison of the four bar mechanism and the six-bar mechanism has been evolved for such type of application. Here the main requirement is to quickly reload and articulate the missile container on the vehicle platform avoiding the usage of external crane. As there is no real reference material on this subject the first step has been the description of the kinematics of the articulation cum reloading mechanism of the mobile missile launcher system. The six bar mechanism has been manufactured and realized and also the functionality tests have been carried out

III. METHODOLOGY

DESIGN OF ZERO - MAX DRIVE:-

In our attempt to design a special purpose machine we have adopted a very careful approach, the total design work has been divided into two parts mainly;

- System design
- Mechanical design

System design mainly related with the various physical constraints and people's efficiency, space requirements, arrangement of various components on the main frame of machine no of controls position of these controls comfort of maintenance scope of further improvement, height of m/c from ground etc. In design the components Mechanical design are categorized in two parts.

- Design parts
- Parts where to be purchased.

For design parts detail design is done and dimensions thus obtained are compared to next highest dimension which are freely available in market this simplifies the assembly as well as production servicing work. The various tolerances on work pieces are specified in the manufacturing drawings. The process charts are prepared & passed on to the manufacturing stage. The parts are where to be purchased directly are specified & selected from standard catalogues.

System Design:-

In system design we mainly focus on the following points.

1. System selection based on physical constraints:-

Before selecting any m/c it must be checked whether it is going to be used in which industry. In our case it is to be used in small scale industry so focus on space requirement. The system is to be closed packed. The mechanical design has direct standard with the system design hence the primary job is to control the physical parameters.

2. Arrangement of various components:-

Taking into account the space restriction the components should be place such that their easy removal or servicing is possible moreover every component should be easily visualise & no part should be hidden every possible space is utilized in component arrangement.

3. Components of system:-

As described earlier system should be closed enough so that it can be hold at a corner of a room. All the moving parts should be well closed & compact. A closed and compact system gives a better look & structure.

Following are some example of this section

- Design of machine height
- Energy draining in hand operation
- Sufficient light conditions for m/c

4. Chances of failure:-

The losses induced by owner in case of failure of a component are important criteria of design. Factor of safety while doing the mechanical design is kept into mind that there are less chances of failure. Constant maintenance is required to keep the m/c trouble free.

5. Servicing facility:-

The layout of components should be such that easy servicing is possible especially those components which required regular servicing, can be easily disassemble.

6. Height of m/c from ground:-

For operator point of view the height of m/c should be properly decided so that he may not get difficulty during operation. The m/c should be slightly higher than that the level for cleaning purpose.

7. Weight of machine:-

The total wt of m/c depends upon material components as well as dimension of components. A higher weighted m/c is difficult for transportation & it becomes difficult to repair.

IV. CONCLUSION

From the review of various papers on kinematic linkages 6 bar and 4 bar respectively, following conclusions can be highlighted – The zero to max drive is probably the most widely used in industry because of its variable speed and low operating cost. With the use of infinitely variable drive we can save the operating time. This paper presents a kinematic analysis and a kinematic synthesis of an adjustable six-bar linkage which is proposed as variable-speed transmission mechanism.

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