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Design and development of a model to measure velocity ratio of different drive systems

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ABSTRACT

It is necessary to provide energy in different areas of use such as Cars, rice mills, flour mills, which use different transmission systems such as belts, chains and gear, it is found that the more power can be transmitted in gear drive than the other two, power transmitted by gear drive provides 100% efficiency, due to less slip occurs it is used in gearbox and in different machines. Belt drive can transmit the same power ratio, but the slip occurs in due course of time and there is the stretch in the belt, which may need replacement. Chain drive gives the better performance than the belt drive in this respect. So according to the requirement and the distances between the drivers to driven different methods can be used. In shorter distance gear drives gives the best result as the less slip occurs. The speed ratio of gear drive generally; driven/driver=T2/T1. More modification is required in belt drive than the chain and gear drive. In this work a model has been developed where three types of transmission systems have been placed in a single base. The purpose of this work is to calculate the velocity ratio of different drive systems with single input.

Keywords - Drive system, velocity ratio, transmission system, designed model, power

1. INTRODUCTION

Industries around the world, including energy, construction, food and beverage, agriculture, and others, rely heavily on the mechanization and automation of their processes and operations. What drives these processes on production lines is the energy transfer mechanism. All machines require a power source, be it an electric motor, a gasoline engine, or something similar. The end patrons of this energy are the moving parts of the machine, and power must be transferred in several ways, including gears, chains, belts, pulleys, and more, each with its own style of power transfer. Anwar et al. [1] studied on power transmission by both mechanical and electronic system, they developed a model to measure the velocity ratio and power transmission system, they presented the advantages of that system that the solar-powered electromechanical transmission is efficient and reliable. This makes it easier to control the three-wheeled vehicle. Therefore, anyone can easily drive a geared electromechanical vehicle. The time it takes to shift gears is less; due to the complex gearshift mechanism is not used. Achieved forced engagement gears when switching. There is no jerk when shifting, no temporary loss of power, and the manual shift system cannot be known. Raul et al. [2] have studied the power transmission system by considering belt pulley and gear pair system at different load and speed using two inertia (motor and load) connected by a compliant transmission. They have investigated motor and load speed feedback schemes by utilizing the singular perturbation method and designed an adaptive feed forward action to reject load torque disturbances. The control algorithms are implemented on an experimental platform that is typically used in roll-to-roll manufacturing of different power transmission system. Jian Li et al. [3] have studied the accuracy in the power transmission system by studying error modeling process which can not reflect the error formation mechanism of the system; the other is the influence of maintenance cost is ignored in the process of establishing the optimal allocation model of motion accuracy. Then, based on the motion error model of mechanical transmission system, a multi-objective optimal allocation model of motion accuracy is established. The Pareto non-dominated solution set is

solved by intelligent algorithm, and the optimal solution is selected by fuzzy set method to realize the allocation of motion accuracy of mechanical transmission system. Puneet Sharma et al. [4] have studied automatic transmission is a multi-speed transmission used in motor vehicles that does not require any input from the driver to change forward gears under normal driving conditions. Automatic control of the clutch is the key development in the improvement of electronic control and mechanical automatic transmission. The system decreases the drivers work power satisfactorily and improves the vehicles idea of force starting and moving. Freeman et al. [5] have studied the design of Vehicle power transmission system which leads the detailed assessment of machine performance. General power transmission system is difficult to design the components which leads several years based on their study of vehicle power trains. The formulation and solution of the governing equations are discussed, and the ability of the approach in addressing critical design related issues is demonstrated through an example system simulation. Till now, the most frequently used MPT elements in engineering include coupling, screw, gear, belt, chain. However, when adopting these elements in some special situations, such as the mixing of medicine solutions or the stirring separation of nucleic acid of COVID-19, the requirements of ultra-clean and zero-leakage cannot be fulfilled very well. The MPT components must penetrate the stirring container with the accompany of bearings and seals .So Xu,J et al. [6] have studied contactless MPT in Medicine, It makes the stirring container with the driven part inside that can be totally isolated from the external environment. Giberti et al. [7] have studied. the servo-actuated machines, the choice of the electric motor required to handle a dynamic load, is closely related to the choice of the transmission. This research aims to identify those constraints like transmission ratio and mechanical efficiency.. A knowledge of these reciprocal influences is use critically to analyze the methods used to select motor-reducer units and to identify the boundary conditions of the problem. Guidelines for a correct choice of motor and gearbox are suggested. Hedman et al. [8] have studied different power transmission system including ., geartransmissions, planetary gear trains, clutches and input shafts. (2) How the shafts of those units are connected. Then, the computer program formulates and arranges the relationships. After that, a commercial program, “Maple”, performs the algebraic eliminations. Relationships between the speeds and/or torques of two arbitrary shafts can be derived, e.g. an algebraic relationship for the overall efficiency. Different power flows are possible in split-power transmissions. Special algorithms handle that. The method is a useful tool. It saves time and eliminates the risk for human errors. Hlebanja and Hlebanja [9] have studied different types of power transmission systems like gears, belt, chains used in different place of applications like aircrafts, vehicles, machine tools ,turbines etc. Gears were simple wooden aids at first, but the evidences of complex mechanical devices of antiquity exist. Now the technologies are developed for the improvement of gears used in different place of applications.

2. EXPERIMENTAL SET UP AND RESULTS:

The conventional drives’ design model has been fabricated physically. The line diagram of the above said model with the detail of each component assembled has laid out underneath.

The figure 1 shows the experimental set up, which consists of driver shaft, driven shaft, handle, gears, chain, belt, sprockets. The arrangement of the drive system is placed on a single frame.

Frame: A rigid cubic compact structure serving as a foundation/support where the whole system is mounted.

Lever: Two numbers of separated solid units fabricated in a bell crank shape for the making of a handle where input effort/rotation is applied.

Driving shaft: One end of the circular cross-sectional shaft confirmed against the frame constraint with bearing where other end extended to facilitate a handle.

Driven shaft: Both the end of the circular cross-sectional shaft unit supported against the frame constraint with bearings.

Revolving unit: A wheel mounted upon the driven shaft for registering the output rotation produced at this end.

Spur gear: Two numbers of spur gears of different sizes mounted upon the driving and driven gears mesh with each other for showcasing its effectiveness/productivity through this model.

Pulley: Two numbers of massive v-grooved pulleys operated through a belt drive and supported against the bearings bring out its operational significance via this model.

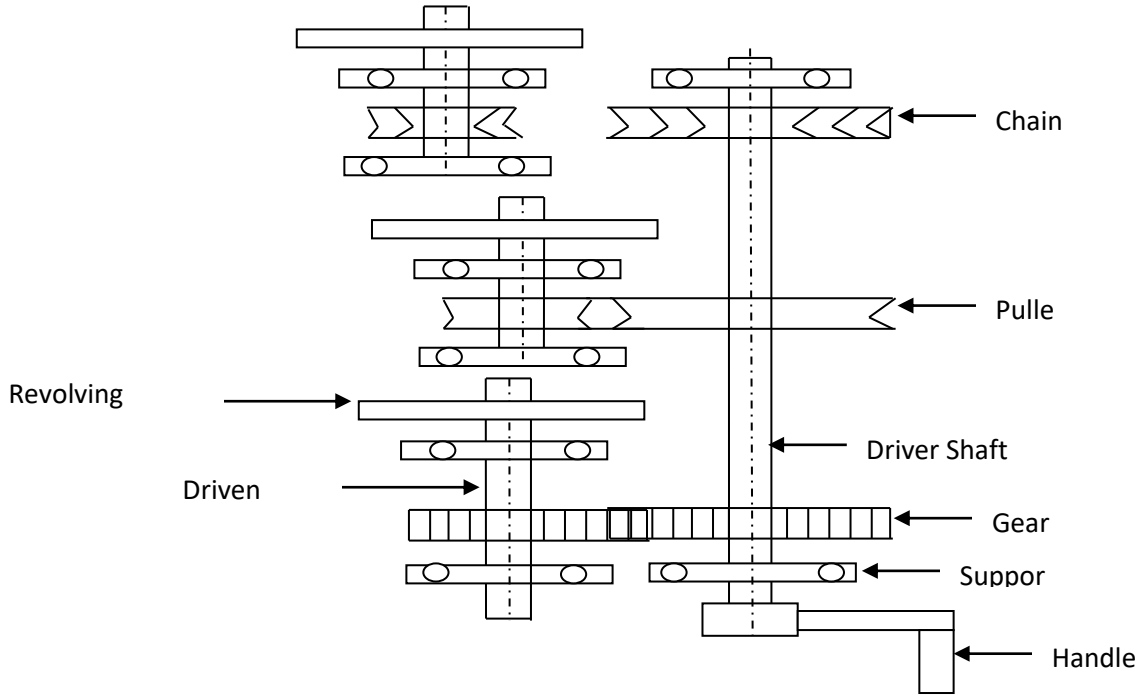

Fig.1. Experimental set up for Gear, Belt, Chain drive systems

Sprocket: Two numbers of sprockets propelled by a chain drive constraint with bearings at two ends establishes its effectiveness through this comparison model.

Belt: It wraps over the v-grooved pulley to establish its operation and comparison with the other two conventional gear and chain drives.

Chain: It surrounds over the two sprockets producing a specific output rotation and speed against a particular corresponding input.

3. WORKING PRINCIPLE

The fabricated model has a sturdy, compact foundational frame to facilitate the installation as well as simultaneous movement of individual drive mechanisms i.e. gear, belt, and chain drive. At first the fabricated extended lever handle was chosen for giving input effort manually. The basic intention against the very model is to demonstrate the rotational significance of conventional drive mechanisms. Henceforth output rotation against individual drive mechanisms has to register for the same unit input rotation.

The details of the individual drive mechanism has been summarized as follows.

Gear drive mechanism

There are two spur gears meshed with each other having the following quantitative data.

Diameter of driver gear: 30 cm = 300 mm

Diameter of driven gear: 10 cm = 100 mm

Belt drive mechanism

There are two pulleys connected with each other having the following quantitative data.

Nominal Diameter of driver wheel: 30 cm = 300 mm

Nominal Diameter of driven wheel: 10 cm = 100 mm

Chain drive mechanism

There are two sprocket wheels connected with each other having the following quantitative data.

Pitch circle diameter of driving sprocket: 30 cm = 300 mm

Pitch circle diameter of driven sprocket: 10 cm = 100 mm.

Table-1: Comparison of rpm value of the three mechanisms for a unit complete rotation given at the driver shaft through handle

Sl. No.	Driver input rotation	Gear drive unit	Belt drive unit	Chain drive unit
1	1	4	2	3

The table 1. shows the output rotation available at driven shaft due to one complete rotation of the driver shaft. It is found that due to gear drive mechanism, maximum rotation is possible.

Table-2: Comparison of velocity ratio for all the three drive mechanisms for a unit rotational input applied at the driver shaft through handle

Name of the drive system	Velocity ratio achieved
Gear	**4**
Belt	**2**
Chain	**3**

The table 2 shows the velocity ratio available for individual drive systems. It found that gear drive provides more velocity ratio then other drive systems.

CONCLUSIONS:

Generally three types of systems are used like gear, belt and chain drives which are used to transmit different types of motion from driving to drive shaft. The arrangement is taken practically by considering the dia. of driving and driven shaft. It is found that for the same diameter ratio to teeth, the gear drive gives the best result than the belt drive, because it has the less slip occurs on the normal power transmission, but in case of belt drive the length of belt increases in course of time due to flexible in nature. The chain drive can give the best result but it is being used for intermediate shaft and in course of time its length increases. Therefore gear drive used in automobiles and other transmission sectors. It may produce less noise and effective power transmission. The designed model provides the clear idea to measure velocity ratio of different drive systems and also by using this model students can understood the basic working principles of drive systems.

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