HIGHER TECHNICAL INSTITUTE

MECHANICAL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

DESIGN AND CONSTRUCTION OF A BELT-DRIVE SPEED-REDUCTION SYSTEM

by

ERACLEOUS ERACLES (M/732)

JUNE 1995

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INTRODUCTION

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The purpose of this project, was to Design and construct a Belt drive speed-reduction system for demonstration purposes.

To understand the importance of Mechanical systems for varying the speed consider the case of machine tools. In fact, most machine tools are so constructed that the speed of the cutting tool or of the part being operated upon can be varied, the range or extent of the variation depending upon the type of machine. These changes are desirable in order to cut different kinds of metal at the most efficient speed; for example, soft brass may be turned, drilled, or planed at a much higher speed than cast iron or steel, and, by using the fastest speed that is practicable obviously the rate of Production is increased. Another important reason for speed variation is to secure the proper surface speed for revolving parts, regardless of the diameter, and the correct cutting speeds for rotating tools of different sizes. Similarly , drilling or boring machines are so designed that the speed of the drill or boring bar can be varied in accordance with the diameter of the hole being drilled or bored. The design of this part of any machine tool involves determining the minimum and maximum speeds that would ordinarily be required, the total number of variations, the amount of increment by which each step or change varies, and the design of the mechanical device for securing speed changes and transmitting them to the work-spindle or tool.

When speed variations are essential to the operation of machines such, for example, as are used for some kinds of manufacturing work, the changes are usually obtained by hand-controlled speed-changing devices. If such variations are seldom required, it may be necessary to stop the machine and make an adjustment, or replace one or more gears with others of different diameters. When changes of speed are frequently needed, the machine is generally equipped with some mechanical device enabling one or more variations to be obtained rapidly, by simply moving a wheel, lever, or rod which controls the Combination or velocity ratio of the mechanism through which the motion is transmitted. If the machine is of the automatic type, the speed may be regulated according to varying conditions by the mechanism of the machine itself, which is constructed or adjusted beforehand to give the proper changes. The exact arrangement of the details depends, in any case, upon conditions such as the speed variation required, the importance of rapid changes, the relation of the speed-controlling mechanism to other parts of the machine, etc.

When a variation of speed is obtained by changing the velocity ratio of two or more parts forming a train of mechanism, one of the following methods is generally employed:

1. By means of conical pulleys connected by a belt or cone-pulleys having "steps" of different diameters upon which a connecting belt may be shifted.
2. By the use of cone-pulleys in conjunction with one or more sets of gears.
3. By means of toothed gears exclusively, with an arrangement that enables the motion to be transmitted through different ratios or combinations of gearing.
4. By employing a friction transmission consisting of driving and driven disks, pulleys, or wheels so arranged that one member (or an intermediate connecting device) can be shifted relative to the axis of the other for varying the speed.

These different types or classes of speed-changing mechanisms are constructed in various ways.

If it is unnecessary to maintain an accurate phase relationship between two shafts a belt can frequently be used. The Power which a belt can transmit is limited by the facts that, having to be flexible, a belt cannot easily be made of extremely strong material, and that the power has to be transferred through frictional forces. There are many types of belts which may have "flat", "V" or "circular" cross section. A belt of V form is much more effective than a flat belt and the use of the latter, for anything other than light or "casual" purposes, has diminished rapidly. Belts have many advantages, however, such as cheapness, silence, and flexibility in use, and we shall have to consider how to design a belt drive to transmit a given amount of power without excessive slipping. We might also note in passing that belts are sometimes made with internal "teeth" which engage with teeth on the pulleys, thus providing, within the limits of the force they can transmit, a positive drive.

Flat belts are usually made of leather or rubberized fabric, but can't , for instance, be made of steel. V-belts usually contain longitudinal textile strands to carry the load, impregnated and covered with "rubber" to provide a high coefficient of friction but the construction varies considerably. Circular belts' can be made of leather, but are usually fabric ropes or wire ropes: The former normally run in contact with the sides of V-grooved pulleys and can be treated as V-belts, the latter (i.e. wire ropes) normally run on the bottom of the grooves and can be treated as flat belts.

Among the advantages offered by belt drives are that they can be used when the distance between the axes of the driving and driven shafts is large, can operate smoothly and without knocking, can transmit only a definite load which, if exceeded, will cause the belt to slip over the pulley thus protecting the other parts of the drive against overload, are simple in design and have a rather low initial cost.

The principal shortcomings are: large dimension certain inconstancy of the velocity ratio due to belt slippage, heavy loads on the shafts and bearings, and the resultant considerable loss of power, a comparatively short service life of the belt (from 1000 to 5000 hr).

Belt drives are employed for powers of several hundreds of kilowatts and their maximum velocities are 25-50 m/sec (depending on the type of belt). The maximum velocity ratio i=10-15. Such drives are mainly used in electric motors, automobiles, machine tools and conveyors.