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DESIGN OF SELF PROGRESSIVE GEARBOX

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ABSTRACT

This paper deals with the design of a self- progressing gearbox. Assembly of gears that's know as gearbox used for controlling the speed, has many applications widely, even in automobiles gearbox is implemented and various improvements and changes are done day by day. One of the modifications done in the gearbox is auto changing. In our paper, we design a gearbox for auto changing application for gears with the help of a governor mechanism. In assembly consist set of gears connected to the motor through the governor. The governor is connected to the driver's shaft. At the initial position, there will be no engagement of gears for power transmission. When the speed is increase, in the driver shaft the initial height reduces due to presence of governor and the shaft moves and engages with the first gear. Power transmission is start to the driven shaft. As speed, further increases in speed will cause the second gear to engage. And vice versa when the speed start reducing and the drive shaft will return to the initial position with the help of the spring. The study detail and design procedures are given below.

KEYWORDS: Gearbox, Progressive gearbox, Governor, centrifugal governor, Module etc.

I. INTRODUCTION

We know that machine tools like lathe, milling machine, etc., require a wide range of spindle speeds. Because a machine tool is adaptable for cutting different types of metals having different properties using varying grades of cutting tools on work pieces of different diameters. Thus, the provision of variable spindle speed is necessary in order to meet different requirements. The various methods used for obtaining different speeds of machine tool spindle are as follows–

- By using a gearbox mechanism,
- By using a cone pulley arrangement,
- By hydraulic operation.

Among these methods, the gearbox method is very popularly used.

Speed Gearbox Advantage -

- It provides the designed series of spindle speed.
- It transmits the required amount of power to the spindle.
- It provides operation of the transmission smoothly and silently
- It should have a simple construction.

Mechanism of speed gearboxes easily accessible so that it is easier to carry out preventive maintenance.

Gearbox Necessity -

- To control torque by selecting the acceptable speed range
- To manage vehicle speed at which maximum torque is out there.
- To balance the tractive effort with the sum of the varied forces tending to oppose the motion.

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TYPES OF GEAR TRANSMISSION

Gear Boxes are generally classified as -

- Selective type
- Progressive type
- Epicyclic or Planetary type

Selective type is further classified as -

- Sliding mesh
- Synchro mesh
- Constant-mesh

Other special classifications are

- Overdrive
- Chrysler semi-automatic
- Automatic
- Hydromantic drive
- Torque converter gearbox.

A. Sliding Mesh Gearbox

It is the oldest and simplest sort of the gearbox. Sliding- type gearboxes are quite commonly utilized in general-purpose machine tools. so as to attach gears on the most shaft with appropriate gears on the spindle shaft for obtaining different speeds, they're moved to the proper or the left. It derives its name from the very fact that the meshing of the gears takes place by sliding of gears on one another.

B. Constant-Mesh Gearbox

It derives its name from the fact that each one the gears of the most shaft are in constant mesh with one another. it's also referred to as a silent or quiet gearbox. It gives quieter operation and makes gear changing easier by employing helical gears for the constant mesh. so as to attach the specified gearwheel by means of teeth on the side of the gear, a separate sliding member is used.

Governor

The function of a governor is to automatically maintain the speed of an engine within a specified limit whenever there's a variation in load. If the load on the engine increases its speed decreases. So, it becomes necessary to extend the fuel supply by opening the accelerator. On the opposite hand, when the load on the engine decreases, its speed increases and therefore the fuel supply is to be decreased by closing the accelerator. Thus, the governor keeps the speed of the engine within a particular limit by regulating the fuel as per load requirements.

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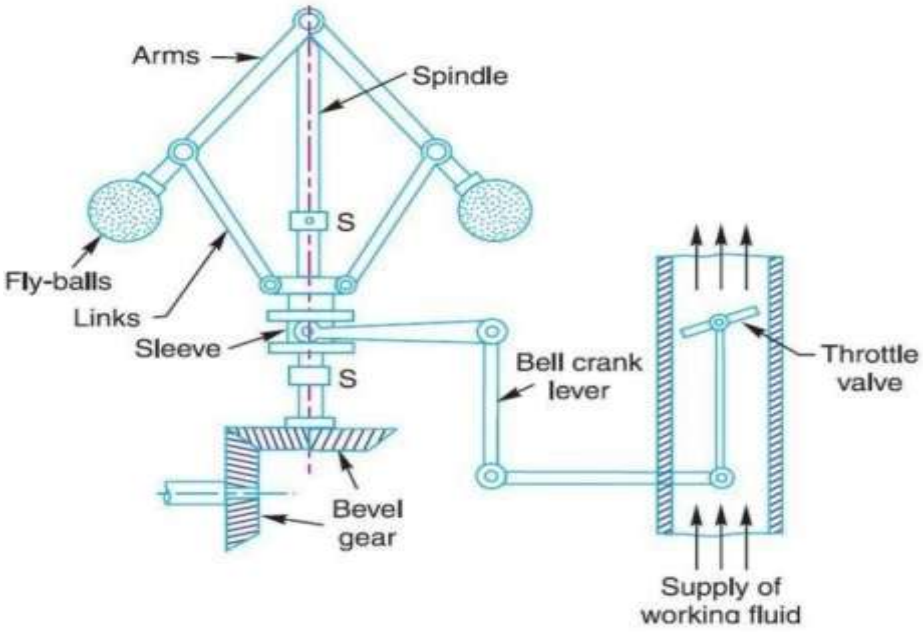

Fig-1: Centrifugal governor

Working Principle –

- The working of this gearbox is that the same as a standard gearbox apart from the gear shifting automatically because the speed increases.
- As initial in the rest position, no gears will be engaged and hence no power transmission for the driving to the driven wheel is obtained.

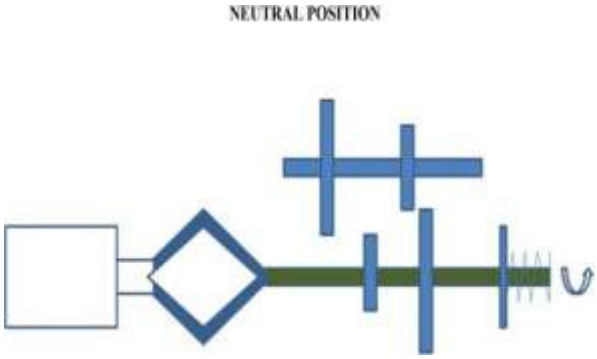

Fig-2

- Then when the driving shaft begins to rotate due to the centrifugal force the governor begins to expand.
- Since the governor is attached to the driving shaft the sliding shaft also slides towards the governor.
- Because the driving shaft attains a specific speed the primary set of gears will begin to interact and power is transmitted to the driven shaft.
- Even further improvement in speed will cause the 2nd set of gears to interact Then because the speed reduces due to the spring force the sliding shaft will move far from the governor. And it finally disengages from all gears and involves the neutral position.

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FIRST GEAR ENGAGEMENT

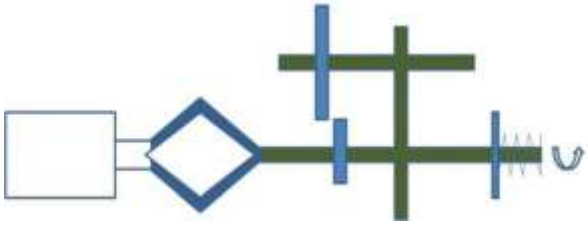


Fig-3

SECOND GEAR ENGAGEMENT

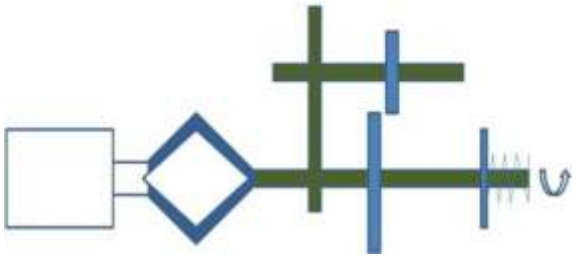


Fig-4

II. CALCULATION

To design a gear drive with no teeth on pinion as 27 and no of teeth on gear 33 the Centre distance between two shafts are 60mm.

Pinion teeth (Z_1) = 27 Gear teeth (Z_2) = 33 Centre distance a = 60mm

Calculate module (m):

a = m ($z1$ + $z2$)/2 => 60= 2 m (27 + 33) => m = 2mm Calculation of face width:

Face width (b) = 5m = 5*2 = 10mm Pitch circle diameter & velocity:

Pitch circle diameter of pinion (D1) = m*z1 = 2*27 = 54mm Pitch circle diameter of gear (D2) = m*z2 = 2*33 = 66mm

Velocity (v) = $\pi * D1 * N1$ 60 = $\pi * 0.054 * 200$ 60 = 0.57 m/s.

Clearance c = 0.25 * m = 0.25 * 2 = 0.5mm Addendum = D1+2*m =54+2*2 = 58mm Dedendum = D1 - 2(m+c) = 54-2(2+0.5) = 49mm

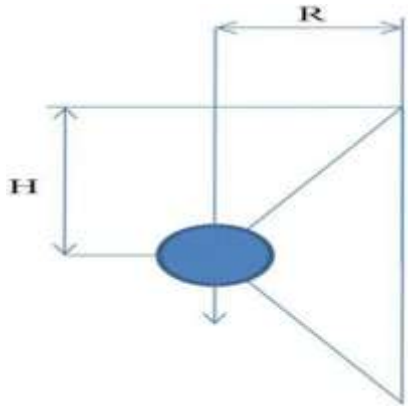
Specification of Governor:

The arm length l = 80 mm

The initial height of the governor h = 61.28mm Initial radius at rest r = 51.42mm

Initial angle = 40°

The mass attached m = 0.5kg



For 1st gear: value of h=53.78mm, r = 59.22mm Stiffness value of spring = 50N/m

Fc*h = $(m*g+s)/2$ * r Fc = m*w^2 *r

0.5 * $(2*\pi*N$ 60) 2 *0.059*0.054 = $(3*9.81+50$ 2) * 0.05

N = 366.24 rpm

For 2nd gear: value of h=41.28mm, r = 68.53mm Stiffness value of spring = 50N/m

Fc * h = $(m*g+s$ 2) * r Fc = m*w 2 *r

0.5 * $(2*\pi*N$ 60) 2 *0.069*0.041 = $(3*9.81+50$ 2) * 0.069

N = 420.31 rpm

Operation Specification:

Position	Input speed (rpm)	Height of governor (mm)	Radius of governor (mm)	Output Speed (rpm)
Neutral	0	61.28	51.42	0
1 st gear	366.22	53.78	59.22	300
2 nd gear	420.31	41.28	68.53	514

III. CONCLUSION

A brief explanation a few progressive gearboxes is given within the above. A progressive gearbox that changes the gear consistent with speed variation. This movement for the gears supported speed is completed with the assistance of the governor. Its main function is to shift the gears in forward as speed increases and the other way around when the speed decreases. The governor plays an important role in changing gears. By employing a motor and governor mechanism the forward and reverse motion of the driving shaft is achieved.

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