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Design and Fabrication of Reverse Gear System for Handicapped Person Vehicle

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Abstract – In fast growing modern world many types of vehicles are being innovated. But until now it is a major problem for the physically challenged people to move back the vehicles. Even to a small distance they cannot move the vehicles backside. So to eliminate this problem we designed the reverse gear mechanism in moped. The challenged people can easily reverse the moped without getting down from the vehicle by easily operating hand lever. The main objective of our project is to facilitate comfort and safety to the challenged people.

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1. INTRODUCTION

Nowadays, the intensity of traffic on Indian roads is increasing at high pace. As in this date there are many options for transportation available for physically challenged persons like, Motorized wheel chair, Hand powered tri-cycle, Scooters, etc.

The problem associated with motorized wheel chair is that it way too costly and is not suitable for commuting. Hand powered tri-cycle requires heavy human effort and in Moped there is Continuous Variable Transmission (CVT) system for power transmission purpose. With the help of CVT we only obtain forward motion. There is no provision of reverse motion in moped. To overcome this drawback, we have designed and fabricated reverse gear box in moped to make physically challenged person self-dependent.

2. CONTINUOUS VARIABLE TRANSMISSION

Mainly the CVT has Primary and Secondary clutches which are connected by belt in which the primary clutch is connected with engine. In scooty, there is CVT arrangement for speed variation. Hence there is no provision of reverse gear in scooty.

A figure (2) shows how the variation of speed ratio can be achieved in CVT. At staring when the speed of the engine is minimum, the belt is at minimum diameter in primary clutch and at maximum diameter in secondary clutch so have maximum speed reduction, which is shown in Fig.2.2 by minimum position.

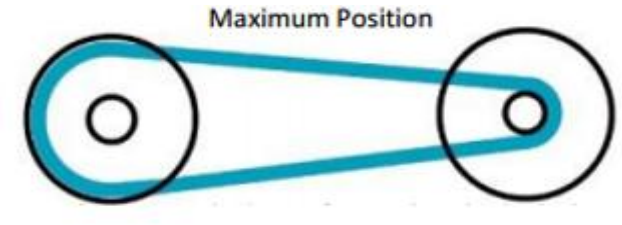

Figure 2.1 Maximum output speed position

Figure 2.2 Minimum Speed Position

Now when the speed of engine increased due to throttling the belt shifts in clutches such that have contact at maximum diameter in primary clutch and minimum diameter in secondary clutch so have minimum speed reduction, which is shown in Fig.2.1 by maximum position.

3. EPICYCLIC GEAR TRAIN

In reverse gear system, we mainly used Epicycle gear train for providing reverse motion in the moped. An epicyclic gear train consists of two gears mounted so that the center of one gear revolves around the center of the other. A carrier connects the centers of the two gears and rotates to carry one gear, called the planet gear, around the other, called the sun gear. The planet and sun gears mesh so that their pitch circles roll without slip. A point on the pitch circle of the planet gear traces an epicycloid curve. In this

simplified case, the sun gear is fixed and the planetary gear(s) roll around the sun gear.

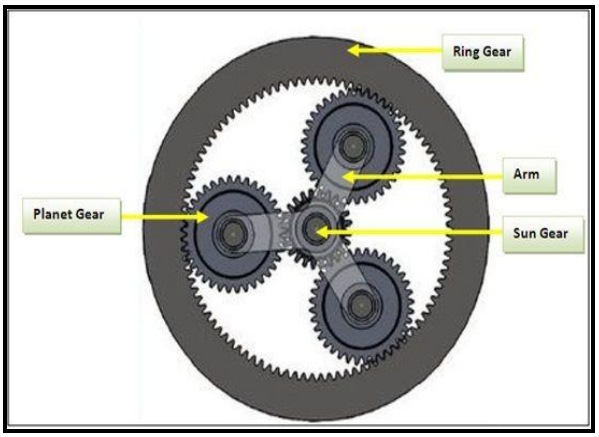

Figure 3.1 Epicyclic gear train

An epicyclic gear train can be assembled so the planet gear rolls on the inside of the pitch circle of a fixed, outer gear ring, or ring gear, sometimes called a ring gear. In this case, the curve traced by a point on the pitch circle of the planet is a hypocycloid.

The combination of epicycle gear trains with a planet engaging both a sun gear and a ring gear is called a planetary gear train. In this case, the ring gear is usually fixed and the sun gear is driven.

4. DESIGN MODIFICATION REQUIRED IN PRESENT SCOOTY

- In Scooty there is Continuous Variable Transmission (CVT) system for power transmission purpose. With the help of CVT we only obtain forward motion.
- There is no provision of reverse gear in scooty or any other mopeds.so handicapped person wants to take help of others for taking their vehicle back from parking.
- The project is mainly aimed for Mopeds of handicapped person.
- We have effectively used the epicyclical gear train for providing reverse motion in mopeds.
- The point of research is to provide reverse motion which is not present in mopeds which operates on Continuous Variable Transmission (CVT).
- The gear box which we have designed is compact and easily attachable to the system
- It is expected that our project will provide Reverse gear system in Mopeds which help handicapped person to take their vehicle back from parking easily without help of others

5. SELECTION OF MATERIAL

Most important mechanical properties usually encountered in material selection process are fatigue strength, tensile strength, yield point, hardness, stiffness, toughness, creep resistance and density. After analysing above concepts we have chosen 30C8 as material for the gear. It is one of the suitable material that can be used for the production of gear and has good manufacturability.

6. DESIGN OF GEAR BOX

The engine drive provides the power to the gear box and the gear gives out the power to the rear wheel in two directions. When output in clockwise direction the vehicle moves forward and when the output is in counter clockwise direction vehicle moves backward. Thus reversing of the vehicle can be achieved.

The design parameters are as follows-

Moped	-	TVS Pep Plus
Power	-	3.6 kw
Max. Speed	-	6500 rpm
Max. Torque	-	5.8 N-m
Speed ratio	-	1:1 (forward)
		2:1 (reverse)

6.1 Design of sun gear-

Design of sun gear is based on the beam strength of gear. Gear used in this drive is spur gear.

Planet gear is smaller than sun gear. so we design smaller planet gear.

We design for 20▫ full depth system.

Material = 30C8

Power = 3.68 kw.

Minimum no. teeth on planet gear = 18

Minimum no. teeth sun gear = 27

Minimum no. teeth ring gear = 63

Module of gear based on beam strength can be calculated as follows,

$$M = \frac{(60 \times 10^6 \times p(kw) \times C_s \times F.S \times m)^{1/3}}{(3.142 \times z \times n_p \times c_v \times b \times S_{ut} \times Y)^{1/3}}$$

For Z = 18

Cs = 1.5

Cv = 3 ÷ (3 + v)

= 0.375

M = 2.05 mm

6.2 Dimension of other gear as follows (mm)

i. Pitch diameter of sun gear - 54

ii. Pitch diameter of planet gear - 36

iii. Pitch diameter of ring gear - 126

iv. Addendum of gear (m) - 2

v. Deddendum of gear (1.25m - 2.5

vi. Pressure angle - 20

vii. Working depth (2m) - 4

viii. Whole depth (2.25m) - 4.5

ix. Tooth thickness - 3.14

x. Fillet radius (0.4m) - 0.8

6.3 Design Input Shaft –

Input shaft is designed on the basis of torsional stress induced in the shaft.

$$Tmax = \frac{16\ Mt}{3.142 \times d^3}$$

D = 16.77

6.4 Diameter of hollow shaft

$$Di + Do = 0.6$$
$$Di = 23$$
$$Do = 45$$

6.5 Splined Shaft Dimension

Shaft is designed on the basis of permissible bearing pressure.

Torsional moment is as follows

$$Mt = \left(\frac{1}{8}\right) \times Pm \times A \times n \times Rm$$

Mt = 5.8 N-m

N = 8

Di = 17 mm

Mt = P * Rm

Rm = (Di+Do) /2

$$Mt = \left(\frac{1}{8}\right) \times Pm \times 10 \times 8 \times Rm$$

Do = 22 mm

6.6 Sliding sleeve

Di = 18

Dm = 22

Do = 26

6.7 Planet carrier

Di = 44

Do = 58

6.8 Selection of Bearing

For input shaft (dia.=17) – 6003

For output shaft (dia. = 45) – 6009

Table 6.1 Gear Dimensions

Sr. no.	Gear	Module (mm)	PCD (mm)	Material
1	Sun gear	2	54	30C8
2	Planet gear	2	36	
3	Ring gear	2	126	

Table 6.2 Shaft Dimension

Sr. no.	Shaft	Diameter (mm)	Length (mm)	Material
1	Input Shaft	17	195	30C8
2	Fixed Shaft	22	140	
3	Output Shaft	45	130	

7. WORKING OF GEAR BOX

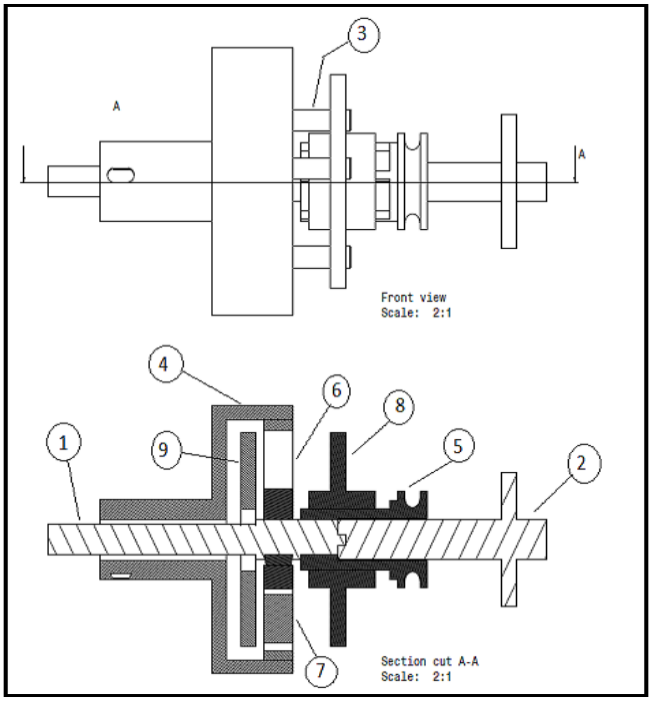

Figure 7.1 2D Drawing

1- Input shaft

2- Fixed shaft

3- Planet shaft

4- Ring gear with output shaft

5- Sliding sleeve

6- Sun gear

7- Planet gear

8- Planet carrier

9- Support plate

7.1 Working Principle-

A. For forward motion-

The sun gear is fixed on input shaft. Planet carrier is fixed on input shaft using sliding sleeve to make planet gear fix so that there is no relative motion between sun, planet and ring gear. Now sun, planet and ring gear will rotate as single entity. Thus the vehicle will get forward motion.

B. For reverse motion-

The planet carrier is fixed on fixed shaft using sliding sleeve so that planet gear will rotate about its own axis. Then motion transferred from sun gear to ring gear is in reverse direction. Thus the vehicle will get reverse motion.

8. 3D MODEL IN CATIA SOFTWARE

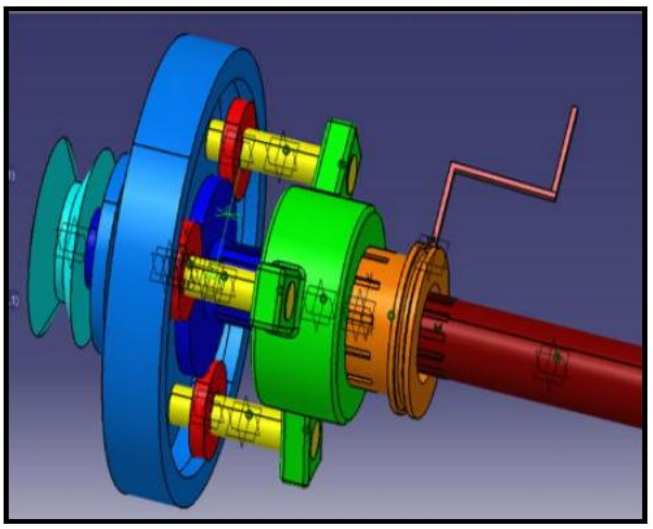

Figure 8.1 CATIA Model

9. GEAR BOX ATTACHMENT IN MOPED

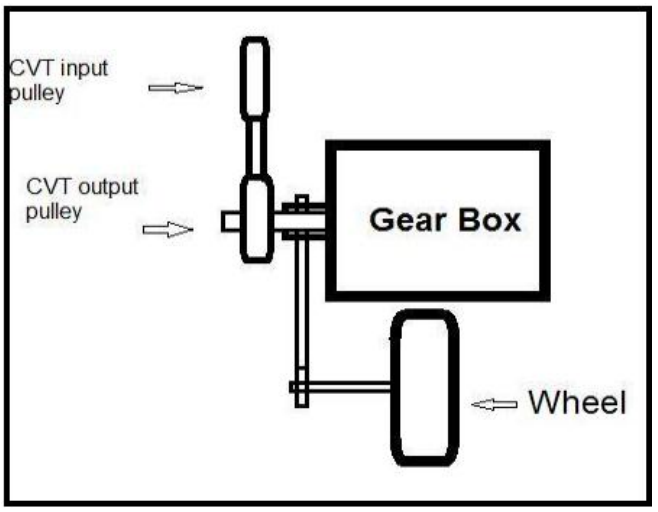

Figure 9.1 Gear Box attachments in moped

10. CONCLUSION

The inclusion of our project in moped vehicles will not reduce the speed of the vehicle; hence the performance of the vehicle is not affected. Since no

complex structure is used in our design, it is easy to use for physically challenged people.

By doing this, we recognize that this system will be very helpful to the handicapped people. Designed gear box is portable and easy to fix in the mopped vehicle. The reverse gear box is compatible with all mopped vehicles. Mechanism is simple and constructed according to the convenience of handicapped peoples. By this we have introduced a new idea in automobile industry with future modification favourable to physically challenged people.

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