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Design of Transmission System for Go-Kart Vehicle

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Abstract:

Transmission means the whole of mechanism that transmits the power from engine crankshaft to the rear wheels. In Go kart vehicle, the power from engine is transmitted to the sprocket using chain i.e. chain drive. UsuallyGokarts do not have a differential, so it is eliminated. The power from the engine is transmitted to the rear two wheels using chain drive which is capable of taking shock loads. Objective of this work is to design the transmission system which can transfer power from engine of vehicle to the wheels. Several different methods are considered while designing power transmission of Go kart.

Keywords — **transmission system, chain drive, Power, Go kart vehicle.**

I. INTRODUCTION

In a vehicle, the mechanism that transmits the power developed by the engine to the wheels is called the power train.In a simple application, a set of gears or a chain and sprocket could perform this task. However, automobiles are not designed for such simple operating conditions.

Power train is designed to provide pulling power, to move at high speeds, to travel in reverse as well as forward, and to operate on rough terrain as well as smooth roads. To meet these varying conditions, vehicle power trains are equipped with a variety of components. Transmission system or power train is composed of clutch, gear box, propeller shaft, universal joints, rear axle, wheel and tyres.

The transmission can provide torque needed to move the vehicle under a velocity of road and loadcondition. It does this by changing the gear ratio between the engine crankshaft and drive wheel.

There are two basic types of transmission: manual and automatic. Manualtransmission is shifted manually, or by hand. Automatic transmission shiftautomatically, with no help from the driver.

Basic requirements of transmission system are, it provides for disconnecting the engine from the driving wheels.When the engine is running, to enable the connection to the driving wheels to be Made smoothly and without shock. It enable the leverage b/w the engine and driving wheels varied. Speed reduction b/w engine and the drive wheels. It enables power transmission at varied angles and varied lengths. Drive the driving wheel at different speeds when required. Enables diversion of power flow at right angle.

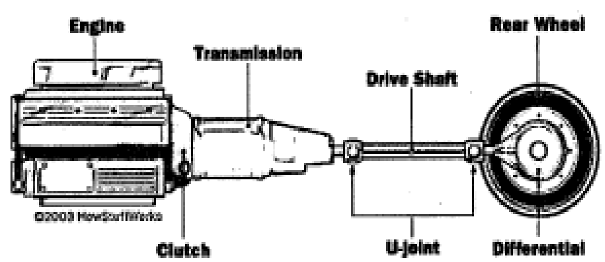

Fig. 1. Drive train system

The transmission location is among clutch and drive shaft as a figure 1.Transmission is a sub system in drive train except clutch and drive shaft. Thetransmission is connected to the engine through the clutch. The input shaft of thetransmission therefore turns at the same rpm as the engine.

A. Purpose of Transmission System

There are three reasons for having a transmission in the automotive power train or drive train. The transmission can:

• Provide torque needed to move the vehicle under a velocity of road and loadcondition. It does this by changing the gear ratio between the engine and crankshaft and vehicle drive wheel.

• Be shifted into reverse so the vehicle can move backward.

• Be shifted into neutral for starting the engine and running it without turningthe drive wheels.

B. Transmission System

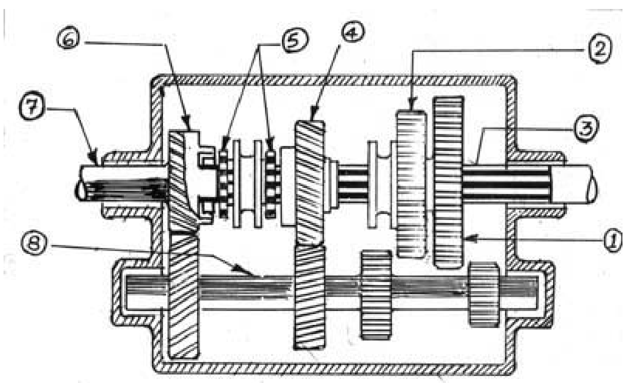

Fig. 2. Transmission system

To understand the basic idea behind a standard transmission refer figure 2. Shows a very simple five-speed transmission in neutral. There are three forkscontrolled by three rods that are engaged by the shift lever. Looking at the shift rodsfrom the top, they look like this in reverse, first and second gear. The five-speed manual transmission is fairly standard on cars today. Internally, it looks something like figure 3.

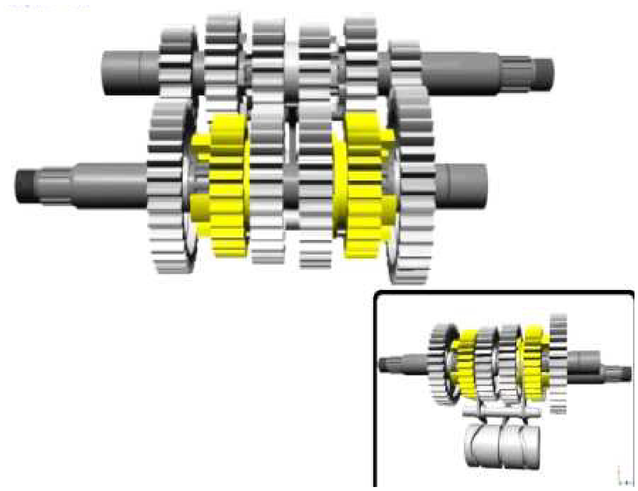

Fig. 3. Manual Transmissions

Choice of Top Gear Ratio for Maximum SpeedWhen the engine power available is plotted on the same graph as the powerrequired to a common base of vehicle speed the gear ratio will position the maximumengine power condition relative to the vehicle speed. The low gear or high gear willposition the engine maximum power condition at a high vehicle speed and viceversa.

To obtain maximum speed on level road and still air from a given engine thepower required curve must intersect the power available curve at its maximum valuedVehicle speed

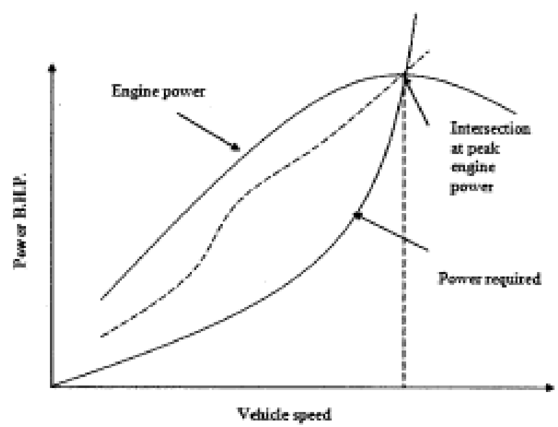

Fig.4. Graph gear ratio for maximum speed

Figure 4. Graph gear ratio for maximum speedThis however is rarely chosen, as maximum speed has now become of littleimportance for cars due to speed limits.

C. Under-Gearing (Gear Ratio Large or Low Geared)

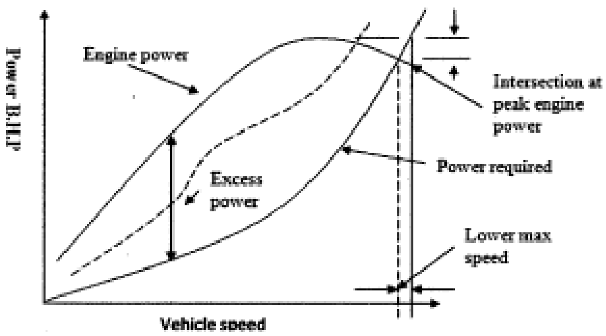

Figure 2.5.: Under gearing

Fig.5. Under gearing

Under gearing is the case where the power required curve intersects thepower available curve at a speed above engine maximum power.For the small to medium ear Vmcan be limited to 75 mph to 85 mph(120km/h - 137 km/h) i.e. 10 % in excess of maximum legal speed.The advantages, of under gearing are to increase the excess power availableat low speed. This excess power is used for acceleration and acceleration isbecoming more and more important as traffic density increases. Better hill climbingperformance is also obtained by this type of gearing.

Note: excess power is the power available over the power required for steadyuniform speed on level road.

D. Over Gearing (Gear Ratio Small or High Geared)

Overgearing is the case where the intersection of the power required andpower developed curve intersect at a speed below engine maximum power

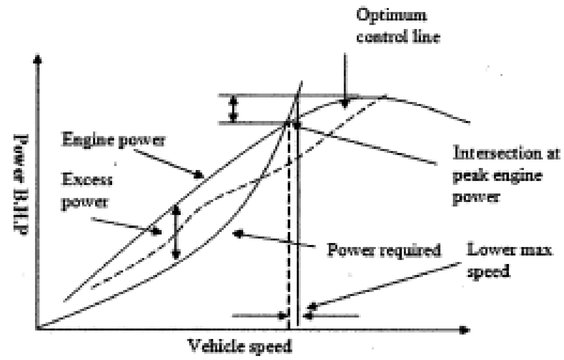

Fig. 6. Over gearing

The advantages of gearing of overgearing are bring the power required curveclose to the optimum control line, i.e. improve fuel consumption.Gearboxes the maximum speed on level road is virtually the same forboth 4' and 5' gear. In some cases the maximum speed in 5th gear is less than that in4th gear.The disadvantages are that the power available for acceleration and hillclimbing is very much reduced.Example of overgearing is 5th gear in 5 speed gearbox. When cars are fittedwith five speed

E. Requirements of transmission system

To provide for disconnecting the engine from the driving wheels. When the engine is running, to enable the connection to the driving wheels to be made smoothly and without shock.To enable the leverage b/w the engine and driving wheels varied. Speed reduction b/w engine and the drive wheels in the ratio of about 5:1. To enable power transmission at varied angles and varied lengths. To drive the driving wheel at different speeds when required. To enable diversion of power flow at right angle.

In Go kart vehicle, the power from engine is transmitted to the sprocket using chain i.e. chain drive.Usually G karts do not have a differential gear box so it is eliminated from vehicle. The power from the engine is transmitted to the rear two wheels using chain drive. In Present work chain drive is used because it is capable of taking shock loads.

II. DESIGN OF TRANSMISSION SYSTEM

Fig. 7. Chain Drive

F. Available data for engine tractive effort calculation:

Engine Power: 7.4 bhp = 5.51818 KW

G. Engine output shaft angular speed

N = 2600 rpm
Ωo = 2πN/60
= 2*3.14*2600/60
Ωo = 272.27rad/sec

H. Resistances to vehicle

i) Air or wind resistance:

R=A*V2 *KAR
A= Frontal Area, V=Velocity of Vehicle, KAR= Coeff. of Air Resistance
=0.02*073*452
=29.56N.m

ii) ROLLING RESISTANCE
TRR = KRR*W
= 0.0314 *1500
= 47.1 N.M

I. Tracking effort produced byengine

TEngine= Torque at Wheel/ Radius of wheel
= P*60/2π*N G*ηtranss*1/radius of wheel

Available data is
P = 5.51818KW N=2600 G=3.25
Htranss = 85% for chain drives eff. In lower gear
Tengine=5.51818*103*60/2π*2600
3.25*0.85*1/0.1397

Tengine= 400.76 N.M

Total Tavailable = Tengine – TRR - TAR
= 400.76 -29.56 -47.1
= 34.1 N.m

Vehicle will accelerate to attained Max.speed

J. Tractive effort available for accn

Tractive force required = RRolling +RAir + Raccn
= W* KRR + (KAR*A*V2/2)
= 29.56 + (47.1/2) +(1500/9.81) * (33.7*1000/3600)
= 29.56 + (47.1/2) +143.13
= 196.24 N.m

K. Gradient resistance:

As the track is without any gradient the gradient resistance will be considered as negligible.

III. DESIGN OF CHAIN AND SPROCKET

I)The driving sprocket teeth by considering the practice limitations like, min. number of on pinion, noise, moderate shock condition & moderate wear is 13
˜ Z1= 13

II) Number of teeth on Driven Sprocket
By using the condition of maximum speed of 45km/hr.For gear ratio 3.25 providing maximum torque for better acceleration and better power for top speed.
G=Z2/Z1
Z2= 13*3.25
Z2 = 39

II) Type of chain from standard tables available

As out engine rpm is 2600
Max 7.4bHp
= 5.51818kW

This condition satisfied by the power rating of our drive

(a) Calculating power rating:

Service factor = 1.4
Single strand = 1
Teeth modifying factor = 0.8
Power rating = (kW to be transmitted) *1.4/1*0.8
= 5.51818*1.4/1*0.8
= 9.08kW

Therefore, chain selected is 08A
(i) Reduction ratio from top speed consideration

Nengine=2600rpm (for max torque)
Ntyre=V/2pi*r (v=12.33m/s)
=12.333*2/2*3.14*0.2794
=14.05rps
Ntyre=14.5*60
= 843rpm

Therefore ratio
G = Nengine/Ntyre
=2600/843
=3.084

Which is approx. same as that of considered G.this assures the top speed as 45km/hr

ii) Angular speed of driven sprocket

Ωdriven = 2πNtyre
= 2*3.14*843
Ωdriven=88.27rad/sec

i) Calculating the number of links in the chain for the selected 08A type of chain.

ii) Referring to standard tables 08A

P = 12.7mm
A = 400mm
The distance between the driving & driven shaft is
Allowable 30p<a<50p
381<400<635
Hence our design is safe for operation.
Z1=13 , Z2=39

a)Calculating number of links on the chain:

$\text{Ln}=2\left(\frac{a}{p}\right)+\left(\frac{Z1+Z2}{2}\right)+\text{Sq}\left(\frac{Z2-Z1}{2pi}\right)(\text{p/a})$
=2(400/12.7) +(13+39/2) +Sq.(39-13/2pi) (12.7/400)
=90.15~
= 90 as no of liks should be EVEN

ii) Calculating the correct center distance:
[Ln-(Z1+Z2/2)] = [90-(13+39/2)]
=64
a=p/4[Ln(Z1+Z2/2)]
$+\sqrt{[\text{Sq}\left[\text{Ln}-\left(\text{Z1}+\frac{\text{Z2}}{2}\right)\right]-8\text{Sq}[\frac{Z2-Z1}{2pi}]]}$
$=12.5/4[64+\sqrt{[Sq64-8sq[39-\frac{13}{2pi}]}$
= 408.65mm
Is the correct centre distance?

i) DIAMETER OF THE SPROCKETS:

D1=p/Sin (180/ Z1)
=12.7/Sin (180/13)
=53.05mm
D2=p/Sin(180/Z2)
= 12.7/Sin (180/39)
=159.31mm

IV. CONCLUSION

Present work concentrate on design and manufacturing of appropriate transmission system for Go kart vehicle and also helps to enhance stability of vehicle and to obtain maximum speed.

V. FUTURE SCOPE

Multi fuel system can be designed for Go Kart vehicle. Bio-Fuels which are of low cost can be used in place of petrol. Solar Energy can also be used by using solar panels which is pollution free with moderate cost. Suspension system can also be improved to reduce vibrations and shocks.Vehicle body can be designed by ergonomics criteria's.

REFERENCES

1. *Bhandari, V. B.* Design of machine elements*. Tata McGraw-Hill Education, 2010.*

2. *Spotts, Merhyle Franklin.* Design of machine elements*. Pearson Education India, 1971.*

3. *S. Zhang, C. Zhu, J. K. O. Sin, and P. K. T. Mok, "A novel ultrathin elevated channel low-temperature poly-Si TFT," IEEE Electron Device Lett., vol. 20, pp. 569–571, Nov. 1999.*

4. Sharma, C. S., and Kamlesh Purohit. *Design of machine elements*. Prentice-Hall of India, 2003.

5. Kiencke, Uwe, and Lars Nielsen. "Automotive control systems: for engine, driveline, and vehicle." (2000): 1828.

6. Ko, Young Dae, and Young Jae Jang. "The optimal system design of the online electric vehicle utilizing wireless power transmission technology." *IEEE Transactions on intelligent transportation systems* 14, no. 3 (2013): 1255-1265.

7. Happian-Smith, Julian, ed. *An introduction to modern vehicle design*. Elsevier, 2001.

8. Ren, Qinglian, D. A. Crolla, and Adrian Morris. "Effect of transmission design on electric vehicle (EV) performance." In *Vehicle Power and Propulsion Conference, 2009. VPPC'09. IEEE*, pp. 1260-1265. IEEE, 2009.