Transmission System of Go-Kart

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Abstract

Go-kart, by definition, has no suspension and no differential. They are usually raced on scaled down tracks, but are sometimes driven as entertainment or as a hobby by non-professionals. ‘Go Karting’ is commonly perceived as the stepping stone to the higher and more expensive ranks of motor sports. Kart racing is generally accepted as the most economic form of motor sport available. Kart racing is usually used as a low-cost and relatively safe way to introduce drivers to motor racing. Many people believe that this sport is associated with young drivers only but adults are also very active in karting. Karting is considered as the first step in learning and racing career of any individual. It can prepare the driver for high-speed wheel-to-wheel racing by helping him develop guide reflexes, precision car control and decision-making skills. In addition, it brings an awareness of the various parameters that can be altered to try to improve the competitiveness of the kart that also exist in other forms of motor racing.

Keywords: Transmission, Go-Kart, Final Drive Sprocket, Gear

I. INTRODUCTION

A transmission is a device or machine that consists of power source and power transmission system, which provides controlled application of the power. Often the term transmission refers simply to the gear box that uses gears and gear trains to provide speed and torque conversion from a rotating power source to another machine device. The most common use is in motor vehicle, where the transmission adapts the output of the internal combustion engine to the drive wheels. Such engines need to operate at a relatively high rotational speed, which is inappropriate for starting, stopping, and slower travel. The transmission reduces the higher engine speed to the slower wheel speed, increasing torque in the process. Often, a transmission has multiple gear ratios (or simply "gears") with the ability to switch between them as speed varies. This switching may be done manually (by the operator) or automatically.

II. OBJECTIVE

- To achieve maximum possible speed using gears.
- To achieve maximum torque at the starting and continues.
- To reduce the major and minor power losses.

III. METHODOLOGY

![Diagram](image)

IV. ENGINE

An engine of a go-kart is usually a small one. About 100-200cc. So this kart, we use a Suzuki Access 125, Single Cylinder 125cc, 4-stroke petrol engine, which produces about 8.58 BHP of power at 6500 rpm. We used this engine because we had volume restrictions regarding the engine usage and a 4-stroke engine because it is generally used for racing and can give us good mileage as well.
Table 1
Comparison

<table>
<thead>
<tr>
<th></th>
<th>Suzuki Access</th>
<th>Honda Activa 125</th>
<th>Mahindra Rodeo R2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement</td>
<td>124cc</td>
<td>124.8cc</td>
<td>124.6cc</td>
</tr>
<tr>
<td>Max Power</td>
<td>8.58bhp@6500 rpm</td>
<td>8.5bhp@6500 rpm</td>
<td>7.9bhp@7000 rpm</td>
</tr>
<tr>
<td>Max Torque</td>
<td>9.8Nm@5000 rpm</td>
<td>10.1Nm@5500 rpm</td>
<td>9Nm@5000 rpm</td>
</tr>
<tr>
<td>Mileage</td>
<td>64 KMPL</td>
<td>60 KMPL</td>
<td>60 KMPL</td>
</tr>
<tr>
<td>Transmission</td>
<td>CVT</td>
<td>CVT</td>
<td>CVT</td>
</tr>
</tbody>
</table>

As per above comparison of other available varieties of scooters with Suzuki Access 125, "Suzuki Access 125 engine suites best regarding to its specifications like availability, power, Torque, mileage etc.

V. TRANSMISSION

Transmission means the whole of the mechanism that transmits the power from the engine crankshaft to the rear wheels. In this vehicle, the power from the engine is transmitted to the sprockets using chain, i.e. this is chain drive. The driver sprocket has 10 teeth and driven sprocket has 40 teeth. Usually go-karts do not have differential and so is that in our vehicle as well. Also, this go-kart has no clutch and gears because this is automatic transmission. Belt and pulley type CVT is used in this kart. The power from the engine is transmitted to the rear two wheels using chain drive. We use chain drive because it is capable of taking shock loads.

A. Calculations

Taking No. of teeth on front sprocket (z1 = 10 teeth)
Taking No. of teeth on rear sprocket (z2 = 40 teeth)

1) For Top Speed:
   1) Gear Ratio at high speed (g_cvt):
      \[ g_{cvt} = 0.98 \]
   2) Gear Ratio of chain sprocket (g_int):
      \[ g_{int} = 4 \]
   3) Final Gear Ratio (g_f):
      \[ g_f = 0.98 \times 4 = 3.92 \]
   4) Output Torque at Sprocket:
      \[ T_{sprocket} = T_{In} \times g_f \]
      \[ = 9.8 \times 3.92 = 38.416 \text{Nm} \]
   5) Output Speed:
      \[ N_{out} = N_{In} / g_f \]
      \[ = 5000 / 3.92 = 1275.510 \text{rpm} \]
   6) Vehicle Velocity:
      \[ V_c = \left( \frac{r_{wheel} \times 2 \times 3.14 \times N_{out} \times 18}{60 \times 5} \right) \]
      \[ = 67.175 \text{Kmph (or) 18.659 m/s} \]
   7) Maximum Acceleration:
      \[ t = \left( \frac{m \times v^2}{2 \times p} \right) \]
      \[ t = 5.4283 \text{sec} \]
   8) Maximum Force on Rear Axle:
      \[ F_{shaft} = \frac{T_{sprocket}}{r_{sprocket}} \]
      \[ = 38.416 / 0.085 = 451.952 \text{N} \]
   9) Maximum Torque on Rear Axle:
      \[ T_{shaft} = F_{shaft} \times r_{shaft} \]
      \[ = 451.952 \times 0.016 = 7.23 \text{Nm} \]
10) Maximum Torque at Rear Wheel
    \[ T_{wheel} = F_{shaft} \times r_{wheel} \]
    \[ = 451.952 \times 0.1397 = 63.137 \text{Nm} \]
2) For Starting Speed:
   1) Gear Ratio at Low Speed
      \[ g_{cvt} = 2.27 \]
   2) Gear Ratio of chain sprocket (g_int)
      \[ g_{int} = 4 \]
   3) Final Gear Ratio (g_f)
      \[ g_f = 2.27 \times 4 = 9.08 \]
4) Output Torque at Sprocket
\[ T_{\text{sprocket}} = T_{\text{in}} \times g_f \]
\[ = 32.66 \times 9.08 = 296.5528 \text{ Nm} \]
5) Output Speed
\[ N_{\text{out}} = N_{\text{in}} / g_f \]
\[ = 1500 / 9.08 = 165.198 \text{ rpm} \]
6) Vehicle Velocity
\[ V_v = (r_{\text{wheel}} \times 2 \times 3.14 \times N_{\text{out}} \times 18) / (60 \times 5) \]
\[ = 8.7 \text{ km/h} \text{ (or) } 2.4167 \text{ m/s} \]
7) Maximum Force on Rear:
\[ F_{\text{shaft}} = T_{\text{sprocket}} / r_{\text{sprocket}} \]
\[ = 296.5528 / 0.085 = 3488.856 \text{ N} \]
8) Maximum Torque on Rear Axle:
\[ T_{\text{shaft}} = F_{\text{shaft}} \times r_{\text{shaft}} \]
\[ = 3488.856 \times 0.016 = 55.821 \text{ Nm} \]
9) Maximum Torque at Rear Wheel:
\[ T_{\text{wheel}} = F_{\text{shaft}} \times r_{\text{wheel}} \]
\[ = 3488.856 \times 0.1397 = 487.393 \text{ Nm} \]
Maximum force acting on the rear shaft \( F_{\text{max}} = 3488.856 \text{ N} \)
Minimum force acting on the rear shaft \( F_{\text{min}} = 451.952 \text{ N} \)

**B. To Determine Shaft Diameter**

By using mechanics concept:

![Diagram](image)

By calculating bending moment at all points shown above the following maximum results were obtained.

1) Bending Moment (maximum) = \((3488.856 \times 1066.8) - (3488.856 \times 914.4)\)
\[ = 531701.65 \text{ N-mm (or) 531.7 Nm} \]
2) Twisting Moment (maximum) = \((9550 \times 1000 \times 5.131) / 1500\)
\[ = 32,667.366 \text{ N-mm (or) 32.66 Nm} \]

By using Maximum Principle Shear Stress Theory
\[ D = \left( \frac{16}{3.141} \times 233.33 \times \left( \frac{1.5 \times 531701.65}{2} + 32667.366 \right)^2 \right)^{0.51} \times 0.33 = 25.92 \text{ mm} \]

So, by considering all parameters and knowing the fact that the entire load comes onto the rear axle, we select Diameter of shaft = 32 mm.

Factor of safety = 1.5

<table>
<thead>
<tr>
<th>Gear Ratio / Speed</th>
<th>1500 rpm</th>
<th>3500 rpm</th>
<th>5000 rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low = 9.08</td>
<td>8.7 Km/h</td>
<td>20.3 Km/h</td>
<td>29.0009 Km/h</td>
</tr>
<tr>
<td>Medium = 4</td>
<td>19.74 Km/h</td>
<td>46.08 Km/h</td>
<td>65.832 Km/h</td>
</tr>
<tr>
<td>High = 3.92</td>
<td>20.15 Km/h</td>
<td>47.022 Km/h</td>
<td>67.175 Km/h</td>
</tr>
</tbody>
</table>
VI. CONCLUSION

The conclusion of this paper is that to select an appropriate transmission for a go kart and also help to enhance the stability of the vehicle. The idea behind this transmission system is that to get a maximum speed with minimum load on the engine.

As the design component of the paper, various, mathematical formula was derived from the fundamental to calculate the various parameters needed under assumption of some basic values of the vehicle. It was seen that the choice of engine selected was appropriate and was serving the purpose of our cart.

REFERENCES