Disc Brake Type of Braking System on Rear Shaft of Go-kart Daiho 7.5 HP

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Abstract. Go-kart is one of the four-wheeled racing vehicles with high speed at a speed of approximately 100 km/hour more depending on the type and specification of the machine. One of the types of kart machines uses 4-step and 2-step machines. It means that the 4-step machine works by rotating two rounds of the crank shaft and 4 times the downward piston. The result of the calculation of the T weight of the kart taken at the central point is 678.8 mm and the rear kart is 273.7 mm. Torque obtained from the disk brake system is 377.5 Nm. As well as from torque obtained retarding 0.102 m/s. Braking force Result is 895.965 N. As well as force press on the brake canvas is 3.318 N. As well as the flow rate of the brake system is 1.078 kg/cm. From this study, we can draw the conclusion that the braking disc brake is influenced by the flow rate, the radius inside and outside the wheels and center of gravity Central point karts at the time of installation of the disc brake system so that the braking system can be maximal. Vital braking has a function and purpose that can be used as the main equipment on the kart or other vehicles. In addition, the use of a disc brake system is mostly used both on two wheels and four wheels because of its ease to treat and use and replacement of the spare parts.

Keywords: Go-kart. Center of gravity, Torque

1. Introduction

"Go-kart is one of the four-wheeled vehicles that are designed according to the use of a straight or bending road with no ramp and the road that is passed must be flat and paved slippery. The development of the rapidly growing karts makes many people and the general people want to modify to each component/part of the kart material "]1]. Breakthrough and innovation in automotive field in the current era has been very good and spoil the consumers/users so that consumers feel safe and satisfied with the innovations that they use today. "The technological advancement of this current era is very rapidly because it is supported by the greater and the level of information and communication through the Internet and social media, so we will be able to see all the knowledge that is in this world". In principle of planning, go-kart may use the 2-step engine or even 4-step engine according to the character and speed of each driver/driver [2]. One of the main parts in the kart component is the braking system that is used to stop the vehicle's pace until it completely stops according to the...
desired place/destination. The braking system in both 2-wheels and 4-wheels is divided into two types namely drum-brake braking system and disc/disc brake [3].

In [4] to facilitate and understand the purpose of this research, it is necessary to make a restriction on the problem as follows: a) from the explanation above the researcher determines the type of braking safe and effective when it is used and comfortable when it runs, b) In this study, it is focused on obtaining stability in the braking process, c) use of the brake system (disc brake). Based on the formulation of the problem, it can be withdrawn from the research of the braking system of Go-kart Daiho 7.5 Hp [5] namely: A. Applying and choosing a kart braking system capable of supporting the performance of the Go-kart properly, B. To know and get the feasibility of a braking system designed for Go-kart Daiho 7.5 Hp [6].

Knowing how the brake system works and the effectiveness of the Hp Daiho 7.5. The two types of braking have the advantages and disadvantages of each of them when it is adjusted to the character of the kart machine and its speed. The selection and use of the brake system is the beginning to maintain the safety of the vehicle users especially karts because when the brake system is wrong and does not work according to the character, it will cause a very fatal accident. Braking system has the braking distance starting from early speed kart until there is a speed addition called acceleration and until the kart stops smoothly without any slip. The value effectiveness of the braking disc brake on the drum brakes is widely shot and used by nearly 75% of vehicles. Because this kart does not use suspension, braking results are widely influenced by several factors, such as the wheel priny on the road/asphalt, the engine capacity, torque, and speed of the kart [5]. Therefore, the components of the brake systems must be selected and use very good and durable materials.

2. Literature Review

Brake is a component of a mechanical machine that is very vital to its existence. "The brakes provide friction in a moving mass in order to decrease speed or to stop. The use of brakes is found in mechanical systems that have fluctuated speed movement as the wheels of the motor vehicle, shaft spinning, and so forth "[7]. Thus, it can be concluded that the main function of the brakes is to stop the spinning shaft, adjust the shaft rotation, and also prevent the undesirable rotation. The braking effect is mechanically obtained by friction, and electrically with the magnet powders, vortex currents, reversed phases, or exchange of pole, etc. "In brake planning, the most important requirement that must be fulfilled is the magnitude of the braking moment that needs to be fulfilled as it is required". Energy that is converted into heat should also be considered, especially in terms of its relationship with the materials. Excessive heating will not only damage the material of the brake lining, but it will also lower its coefficients. "With the braking system, the speed of the kart will be automatically slowed until the speed decreases and stop at last. Energy generated is the kinetic energy that increase the velocity two times faster than before (E = 1/2 M. V ²). It means that each speed of a vehicle will increase doubling then it will have four times more energy ". The brake system should be able to dump four times energy in order to stop the rotation and its consequences. " The main component/part in the brake system is the brake pedal that serves as the main press force, then disc brake that function as the clamped/swipes, brake canvas, brake caliper, piston and hydraulic hose as well as nipple ". One installation and use of the brake system on an automotive vehicle is in addition to reducing the vehicle's pace from initial speed to the end speed and it is also used as a balance on the time the vehicle runs as well as keeping the vehicle to keep it stopped. From the braking system, it will affect friction mechanically, magnetic powders, vortex currents, and reversed phases. In the book [8] a disc brake braking system is divided into 3 types of main drivers that work using wind pressure, working using fluid pressure, and working using wires/strings. Although it is different in terms of pressure sources used but the way it works is not much different from other brakes [9]. The work of disc brake system on 7.5 Hp Go-kart Daiho is done by stepping on the brake lever of the valve it will arise the future hydraulic pressure from the cylinder master that will be forwarded to the actuators brake/brake caliper. At the time of pressure is already in the brake caliper, then automatically the brakes caliper will move the piston found in the brake caliper and when the piston will be depressed then automatically the piston will directly drive two brake Gently to clamp the rotor or disc that is rotating until the rotation becomes sluggish [10]. "When the friction between the disc surface and the brake
canvas will certainly make the rotor rotation/movement will be slower and the surface condition will be hot" [11]. From the explanation above, it is known that the central disc brake system is at the pressure given on the hydraulic fluid/brake oil. According to [12] the advantage of using the disc brake (Disk Brake) is as follows: 1. Heat will disappear faster and has little tendency to disappear when the disk is opened. So that the influence of stable brakes can be assured, effective, and safe. 2. There will be no power like the main shoe brake when two-disc brakes are used, there will be no difference in braking force on both the right and left sides of the brakes. So, the motorcycle is not having trouble to be pulled in one side. 3. The same if the brakes have to move the heat, clearance (free distance) between the brakes and bearings will be slightly changed. The brake handles and pedals can operate normally., 4. If the brakes are exposed to water and wet, the water will be squeezed out in centrifugal force.

3. Research Model

The main requirement in the braking system is softness, it means there is no collision when there is press and release of the brakes. The release of the heat is caused by friction and readjustment. The smallest brake moment occurs when the shaft rotates rapidly. That is why, the brakes are mostly installed on rotating shaft.

| Table 1. Test Variable |
|------------------------|
| No | Distance (m) | Stop (m) | Duration (s) | Speed (km/jm) |
|----|-------------|--------|-------------|--------------|
| 1  | 35         | 5      | 5,34        | 20           |
| 2  | 50         | 8      | 8,47        | 30           |
| 3  | 100        | 18     | 11,50       | 45           |
| 4  | 180        | 25     | 13,23       | 55           |
| 5  | 230        | 34     | 14,34       | 70           |

In the research conducted, namely looking for calculation results from:
1. Regular straight-changing motion (GLBB)
2. Force tap on brake shoes
3. Friction force on the disc brake rotation
4. Value during braking torque
5. Braking power
6. Hydraulic system for disc brake braking
7. Pressing force on the brake Pad

4. Result

3. Calculation

Disc brake calculation

\[
T = \frac{1}{2} \mu (r_o + r_i) F_n
\]

\[
T = \frac{3}{2} \cdot 0.27 \cdot 100 = 377.5 \text{ Nm}
\]

if

\[\mu = \text{Coefficient of brake friction (0.14-0.27)}\]

\[r_o = \text{outside radius (15 cm)}\]

\[r_i = \text{inside radius (10 cm)}\]

\[T = \text{Torque}\]

\[F_n = \text{Normal Force (100N)}\]

The equation of the load borne by front wheel (Fz, F) and rear wheels (Fz, R) are:
F_{z,f} = \frac{1}{2} m \cdot g \cdot l

F_{zr} = \frac{1}{2} \pi n \cdot L \cdot \frac{E}{4}

On the rear shaft, it uses a screw iron material AISI 1045 with diameter of 30 mm with the following specifications:

Density = 0.284 lb/in²

Modulus of elasticity = 200 GPa

Ultimate tensile strength = 565 MPa

Yield strength = 310 MPa

Yield stress = 0.7

Shear stress = 0.58 x UTS (ultimate tensile strength)

Load = 124 kg \times 9.81 = 1,216.44 N

= 0.58 \times 565 Mpa = 327.7 MPa.

Safety number (N) = 5

\[ d^2 = \frac{4 \cdot N}{\pi \cdot t} \]

The application of the braking system of the disc brake in the go-kart is also the same as the use of other brake systems by means of emphasis using the brake pedal so that the brake piston presses fluid into the brake master in order to cause friction on the brake canvas and the brake disc [13]. In determining maximum traction force by the tire focus on the road can be determined from the coofisien of the road adhesion and the weight parameter of the vehicle. Braking using the disc brake system on the rear shaft of go-kart Daiho 7.5 Hp has a torque of 377.5 Nm where torque are influenced by the outer and inner radius of the wheel at 678.8 mm go-kart weight and braking force of the disc brake is 895.965 N disc brake and force press on the brake canvas obtained 3.318 N. Friction of the disc brake disc is 314 N and torque at the time of braking is 3.140 kg m.

Dimension Specification of Go-kart
The followings are Data of Go-kart Spesification:
1. Vehicle Length (p) : 1700 mm
2. Vehicle Width (l) : 800 mm
3. Vehicle Height (t) : 220 mm (from the ground level)
4. Wheelbase (L) : 980 mm
5. Vehicle Weight (W) : 124 kg
6. Distance of Pad to Shaft : 120 mm
7. Disc Diameter : 200 mm
8. Coefisient of breaking canvas friction (\(\mu_k\)) : (0.14, 0.27)
9. Wind Density (\(\rho\)) : 1.2 kg/m³

Calculation of Retarding
The initial speed specified maximum is (70 km/h) and breaking distance available is 56 m, then the braking distance is 50 m, the remaining 6 m is used for safety when there is no plan. GLBB (Straight-changing motion) is the motion in which its track is a straight line with regular-changing speed[14].

\[ V_f^2 = V_0^2 + 2 a \cdot s \]
\[ 70^2 = 20^2 + 2 \cdot a \cdot 50 \]
\[ d = \frac{400 + 100}{2 \cdot a} \]
\[ a = 0.102 \text{ m/s}^2 \]

Center of gravity Calculation
To look for the middle point of go-karts, it is used a weight comparison of front and rear weight. Wb (front frame weight with driver 74 kg + 50 kg = 124 kg)
In order to find the H value in the CG-making of a gokart, it is required go-kart weighing on a road condition that has an angle of θ = 8° - 15° (maximum slope power) we take 8° because the go-kart is made for a straight and flat road.

Beban Dinamis Roda
(E value is obtained from the value of retarding divided by gravity acceleration)

\[ W_{dD} = W_D + W_e (\frac{h}{L}) \]

\[ W_{dB} = W_B + W_e (\frac{h}{L}) \]

Breaking force required by the wheels

\[ B_{ID} = e \cdot W_{dD} \]

\[ B_{IB} = e \cdot W_{dB} \]

Breaking force on the disc brake.

\[ FR \times rr = F_p \times rp \]

\[ 60.95 \times 150 = F_p \times 100 \]

\[ F_p = \frac{100}{60.95 \times 150} \]

\[ F_p = 91,425 \text{ Kg.} \]

\[ F_p = 895,965 \text{ N} \]

Description:

\[ FR \] = Force on the wheels

\[ rr \] = wheels radius

\[ rp \] = disk brake radius

**Force tap on the brake canvas.**

The friction force on the brake and disc occurs depending on the coophysical friction and force press on the brake canvas.

\[ F_p = F_k \times \mu_k \]

\[ F_k = \frac{1.318}{338,61} \]

\[ F_k = 3,318 \text{ N} \]

**Friction force on disc brake rotation**

\[ F_g = \pi \times F_n \]

\[ F_g = 3.14 \times 100 \]

\[ F_g = 314 \text{ N} \]

**Torque value occurring at the time of braking**

\[ T = F_g \times rg \]

\[ T = 314 \times 10 \]

\[ T = 3,140 \text{ kg m} \]

**Braking power.**
The power of braking of disc brake on go-kart is:

\[ P = \frac{2 \pi N T}{4 \times 500} \]

\[ P = 0.438 \text{ hp} \]

Hydraulic system on disc brake braking

\[ F_p = \frac{P_e}{\frac{1}{4} \pi d^2} \]

\[ P_e = \frac{1}{4} \pi \times 14.20 \]

\[ P_e = 1.078 \text{ kg/cm}^2 \]

Force pressing on the brake pad (Fp)

\[ F_p = 1.078 \times 0.785 \times 20^2 \]

\[ F_p = 338.492 \text{ kgf} \]

5. Conclusion

The work of the go-kart braking system using disc brake is the same with the use of other brakes that are by stepping on the brake pedal so that the brake fluid flows and presses the brake master to the disc so that the friction will occur and reduce the rate of the kart. The use of the disc brake system on the rear axle kart is very maximal and effective due to the positioning of the DiSh/disc at the midpoint so that the load is given from both the kart and driver can be balanced according to the capacity of the machine of Daiho. The character of the disc brake system using the fluid system is the pressure given affected by the given flow rate and transmitted through a hollow hose to DiSh brake. The braking force required by the driver is 895.965 N as well as the force press against the braking canvas is 3.318 N.

Suggestion for further research in the process of braking the karts can use or adopt other braking systems such as the use of Drum Brake system. So we can compare the use of brake both disc brake and drum brake are very important in a vehicle because it is directly related to the level of user safety. Besides, to obtain good braking, periodically maintenance is required.

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