DESIGN &ANALYSIS OF TRANSMISSION SYSTEM OF HYBRID VEHICLE - EFFICYCLE

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ABSTRACT

Any innovation or technology cannot be possible until and unless the work is not done by a team. In such a manner members of Team PRAVARA HAWKS (participants of SAE-NIS 2019), who are highly motivated individuals are recklessly working towards the realization of this goal since its very inception. This paper provides in detail, about the transmission design considerations, and methodology used in designing and developing it. The designing of transmission of vehicle has done with the fundamentals of automotive aspects

Key word:- *SAE, Efficycle, Hybrid Vehicle, Electric Drive, Green Technology, Tri-Wheeler*

1.INTRODUCTION

Since the evolution of human beings, mankind has always been trying to make life easier and vehicles have helped a lot in this process. Due to rapid growth in population and increasing number of vehicles, car designers are required to not only build small and fuel efficient vehicles but they need to inspire the next generation engineers to take interests in rewards from this sector of automotive engineering. In this regard, a lot of small cars are coming into existence and for instance, three wheeled vehicles are gaining popularity for city commuting because of their lower fuel consumption, ease of driving and easy parking in countries. Regardless of the popularity, three wheeler has a major drawback i.e., stability in harsh terrains A lot has been written to modify its stability but among them, only two methods tilting the system and cambering are found to be useful.

In this report, three wheeled vehicle of tadpole design (two wheels at the front and one in the rear) is introduced which is more stable dynamically, while braking, simple in design and power train selection than the delta design (one wheel at the front and two at the rear). Given that this is a passenger vehicle. The objective is not limited to design but in such a way that it can revolutionize the way cars are made. This tadpole design of the chassis eliminates a lot of complexities involved in vehicle design which includes transmission system, front and rear axles, differential to name a few. To aid all the processes involved in designing, a mathematical approach to few critical components has been provided.

With conventional fossil fuel consuming rides posing a threat to the existence of life on earth, it is high time to develop alternate and greener modes of transportation for a sustainable future. The Effi-cycle was designed to be an electrically assisted, dual-human powered tricycle. Different topologies were analyzed and based on the factors such as turning radius, stability, handling and ease of maneuvering, tadpole design was adopted with 2 wheels at the front and one at the back. The vehicle has an innovative tadpole design which is ergonomic, highly engineered and easy to manufacture. The design has been laid on the simplicity in design, high performance, easy maintenance and safety at very reasonable prices.

2. SELECTION OF TRANSMISSION DRIVE

Chain One of the first things that a designer should consider is whether a chain or a belt drive is right for their project. Chains can be used with a wide selection of sprocket ratios to help the designer achieve the desired speed. The demand for torque gives chains an advantage because of the mechanical ratios and the need for a positive drive. Chain are made of metal, which makes them more durable and stronger compared to a belt. It is also more dependable to use and easier to repair. Moreover, it is easier to change gears in the instance when the chain is broken. The metal chain is designed to have a design that corresponds to the other side. On the other hand, the belt drive is made of synthetic materials, and it is also flatter and smoother. The surface of the belt can more easily show evidence of the mentioned imperfections and can be an indication that purchasing a replacement may be necessary. The bad thing about belt drives is the fact that they often expire earlier compared to the chain drive. Belt drives can also slip or snap if the belt isn't maintained or at least inspected for signs of damage and wear. drives, unlike belt drives, do not slip or creep. There is no power loss due to slippage; therefore, chain drives are more efficient than belt drives. Chains can operate effectively at high temperatures. Chains are usually easier to install than belts on power transmission drives. Chains withstand chemicals and abrasive conditions. Chains require less take-up adjustment than belts. Chains can be used with varying shaft center distances, whereas gears usually cannot.

3.DESIGN OF TRANSMISSION ELEMENTS

A transmission system for an electric vehicle includes a gearbox which produces different rotation ratio between a drive motor and drive wheels during running of the electric vehicle.

Assuming no slip condition is maintained between drivers and motor total power

P= (373+50*2) WP=473W.

Assuming efficiency of drive train to be 65%=473*0.65=307.45

Traction force=307.45/v

Rolling resistance=rolling resistance coefficient*m*g=0.005*348*9.81=17.0694 N

Rolling resistance coefficient=0.005

Drag resistance=0.39*0.5*1.1455*0.626*(v^2) =0.13983*(v^2)Cd=0.39.

density of air=1.1455 g/cm^3Area of vehicle=0.626 m^2Dv/dt=0.04905v + 0.0004019(v3)-0.883477At maximum velocity, dv/dt=0Hence, solving we get V=9.94 m/s= 35 kmph

3.1 shafts

It is a mechanical component used for transmitting torque and rotation. Transmission shafts are rotating members and transmit power and torque from one location to another while spindles are short shafts and axles are nonrotating

shafts. Shafts can be solid or hollow.Shafting materials can be steel, cast iron, stainless steel, or hardened steels depending on the required application.

From manufacturers catalogue
P = 600watt
N = 500rpm
Output power :-P = 2πNT/60T = 11.459*10^3N-m
Torsional equation :-T/J=Gθ/L
(11.459*10^3)/(π*d^4/32)=(84*10^3*4.363*10^-3)/(1219)d^4 = 388200.5714
d = 24.96mmApprox 25mm

3.2 Bearing

It is used to provide support for a rotating shaft. Pedestal bearing also called plummer block or pillow block. It used to support for a rotating shaft with the help of compatible bearing and various accessories. Housing material for a pillow block is typically made of cast iron or cast steel.

Inside the pillow block the bearing accessories are fitted. Bearing accessories includes sleeve (adapter or withdrawal) , lock nut, lock washer, dust seal, locating ring

RS Article no.	Bearing unit No.	Shaft Dia. d (mm)	Dimension (mm)										Bolt used (mm)	Bearing No.	Housing No.	Weight (kg)
			h	a	e	b	s_2	s_1	g	w	Bi	n				
7508933	UCP201	12	30.2	127	95	38	16	13	14	62	31.0	12.7	M10	UC 201	P 201	0.63
7508936	UCP202	15	30.2	127	95	38	16	13	14	62	31.0	12.7	M10	UC 202	P 202	0.63
7508949	UCP203	17	30.2	127	95	38	16	13	14	62	31.0	12.7	M10	UC 203	P 203	0.63
7508952	UCP205	25	36.5	140	105	38	16	13	15	71	34.0	14.3	M10	UC 205	P 205	0.79
7508977	UCP207	35	47.6	167	127	48	20	17	18	93	42.9	17.5	M14	UC 207	P 207	1.60
7508974	UCP208	40	49.2	184	137	54	20	17	18	98	49.2	19.0	M14	UC 208	P 208	2.00
7508983	UCP209	45	54.0	190	146	54	20	17	20	106	49.2	19.0	M14	UC 209	P 209	2.20
7508986	UCP210	50	57.2	206	159	60	23	20	21	114	51.6	19.0	M16	UC 210	P 210	2.80
7508999	UCP211	55	63.5	219	171	60	23	20	23	126	55.6	22.2	M16	UC 211	P 211	3.40
7508992	UCP212	60	69.8	241	184	70	23	20	25	138	65.1	25.4	M16	UC 212	P 212	4.80
7509009	UCP213	65	76.2	265	203	70	28	25	27	151	65.1	25.4	M20	UC 213	P 213	5.70
7509002	UCP214	70	79.4	266	210	72	28	25	27	157	74.6	30.2	M20	UC 214	P 214	7.00
7509006	UCP215	75	82.6	275	217	74	28	25	28	163	77.8	33.3	M20	UC 215	P 215	7.60

3.3 Sprocket

It is a profile wheel with teeth that meshes with the chain. sprocket or sprocket-wheel is a profiled wheel with teeth, or cogs, that mesh with a chain, track or other perforated or indented material. A sprocket or sprocket-wheel is a profiled wheel with teeth, or cogs, that mesh with a chain, track or other perforated or indented material. The name 'sprocket' applies generally to any wheel upon which radial projections engage a chain passing over it. It is a profile wheel with teeth that meshes with the chain

3.4 Chain

It is a way of transmitting mechanical power from one place to another place. Chain drive is a way of transmitting mechanical power from one place to another. It is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. Chain drive was a popular power transmission system from the earliest days of the automobile

Pitch (p) =0.5 inches

T=teeth on bigger sprocket,

t=teeth on smaller sprocket and K=centre to centre distance of the two sprockets.

Chain length (CL) = p {(t + T)/2 + (cosec (180/T) -cosec (180/t)) ^2/4K +2KTotal

chain length =2*46.1143+61.585+76.06+40=269.8736inch

4. ELECTRIC SPECIFICATION OF VEHICLE

Maximum 600W electric motor may be considered for power train design. A suitable battery-pack should be designed and specifications (voltage and capacity) should be included in the report/presentation. Additionally, solar power system, energy regeneration system (ERS) or any other non-conventional/renewable energy sources may be included.

Energy storage - Battery bank of 48V and 18Ah

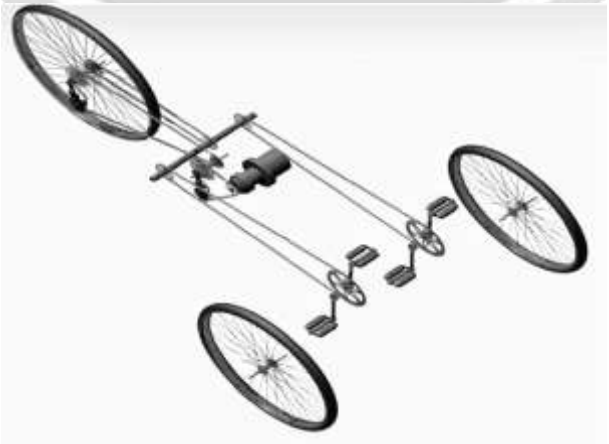
Driving motor - BLDC of 600 watts, 48 V, 300rpm.

Kill switch= The battery will be disconnected from the motor as soon as kill switch is passed and rendering the completely electric system dead.

5. WORKING & OVERVIEW

Both the passengers has provided with individual power train to power the vehicle in both single passenger and dual passenger mode. The front driver and the rear wheels by the co-driver powered the front wheels. The aim of the drive train model is to deliver the power produced by the drivers to the driving wheel most efficiently. Now, here the objective is to reduce the weight of drive train also. Conventionally, the mode of power transmission in effi-cycle is through chain drives (where in the power from prime mover is transmitted to wheels by a system of sprockets (on prime mover and the wheel hub) connected through a metallic chain, in its simplest form.

Vehicle must have option to run on electric power. we must use BLDC motor of maximum power output 600 watts for this purpose. Direct mounting of the motor to the wheel hub amd its direct coupling to axle.



6. CONCLUSION

The Efficycle was designed for the benefit of the humanity. It is an eco friendly human powered vehicle with a compounded electric drive system. The focus has been laid on the simplicity of design, high performance, easy maintenance and safety at very reasonable prices .The concept used in the innovation is programmable position control of gear shifter using stepper motors. Position of motors is controlled with respect to speed by programming which in turn controls the position of gear shifter. This technology is used in robotics & position controlling of robotic arms. It has got a wide scope in automotive industry as it reduces the efforts of driver & provides more automatic control of the vehicle. Hence it makes the vehicle more efficient. Human powered hybrid vehicle present the new milestone in the realm of "Green Technology".

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