An Experimental Study of Dual Mass Flywheel on Conventional Flywheel on Two stroke petrol engine.

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Abstract-The Dual Mass Flywheel (DMF) is primarily used for dampening of oscillations in automotive power trains and to prevent gearbox rattling. We explained detailed initial model of the DMF dynamics is presented. This mainly includes the two arc springs and two masses in the DMF and their behavior. A experimental the DMF model is compared to convention flywheel. Finally the observation of the engine torque using the DMF is discussed. For this purpose the DMF is manufactured and done experiment or testing to see the results. And then results are compare with the conventional flywheel.

Keywords-Spring mass flywheel, concept, experimental study, techniques.

INTRODUCTION

There are two schools of thought concerning light flywheels. The first is that they do not contribute to power output. The second is that they do. Which thought is correct? In fact both, in a way, are correct.

If we measured the power output of an engine first with light flywheel and then again with the standard part on an engine dyno, no change in power will be seen to occur. At first it appears that the light flywheel has done nothing and was a total waste of cash. This is not the case. A dyno that shows max power at constant revs does not demonstrate what happens to an engine's power output in real life situations - like acceleration. If an engine is accelerated on a dyno (we are talking about a rate of around 2000rpm a second) it would show a power output of around 20%-25% less than at the constant rev state.

The reason for this is that when accelerating a vehicle the engine not only has to push the total mass of the car but the internal components of the engine need to be accelerated also. This tends to absorb more power as the extra power is used accelerating the internal mass of the engine components and is why a motor accelerating on a dyno will produce less power than at constant revs. Also it must be remembered that the rate of acceleration on the engine internals is much greater that the rest of the car. This would then suggest that by lightening the flywheel, less power would be required to accelerate it and therefore more power would be available to push the car along.

All engines have flywheels or weighted crankshafts that balance out compression and power strokes, maintain idle, aid starting and reduce component wear. If the flywheel is too light the motorcycle requires more effort to start, idles badly, and is prone to stalling. Weight is not the important factor here, but inertia. Inertia is stored energy, and is not directly proportional to flywheel weight. It's possible to have a light flywheel with much more inertia than a heavier flywheel. Any power the motor develops must accelerate the flywheels before leaving the sprocket shaft, and any used in bringing the flywheel up to speed is not available at the rear wheel. This will not show up on a steady-state or rear wheel dyno or simple desk-top dyno program, but is detectable in a transient dyno that accelerates the engine at a specific rate (300 or 600 RPM per second are common).
Flywheel inertia is stored when you rev the engine slightly before letting the clutch out - this small amount of extra power helps in getting the motorcycle underway with minimal effort. By "borrowing" power for a few seconds, the engine has to develop less to move from a standing start. Once the clutch is completely engaged, inertia can no longer be borrowed - the motorcycle can only use what it produces in "real time".
In any event, except for when the clutch is slipped all flywheel weight reduces acceleration.

Thus it is safe to interpret from above discussion that the flywheel inertia plays a major role in vehicle optimized performance and by suitable modifying the flywheel mass of flywheel can be reduced by still maintaining the inertia.

The arrangement of the dual mass flywheel is an suitable answer to the above problem statement where in the inertia is increased using two set of masses phased opposite to each other .

LITERATURE REVIEW

1. Ulf Schaper, Oliver Sawodny, Tobias Mahl and Uti Blessing

They explains the DMF along with its application and components. Afterwards a detailed model of the DMF dynamics is presented. This mainly includes a model for the two arc springs in the DMF and their friction behaviour. Both centrifugal effects and redirection forces act radially on the arc spring which induces friction. The numerical method is used to measure model validation.[1]

2. Bjorn Bolund, Hans Bernhoff, Mats Leijon

This paper explains the use of flywheel. Nowadays flywheels are complex construction where energy is stored mechanically and transferred to and from the flywheel by an integrated motor or generator. The wheel has been replaced by a steel or composite rotor and magnetic bearings have been introduced. By increasing the voltage, current losses are decreased and otherwise necessary transformer steps become redundant.[2]

3. Jordan Firth, Jonathan Black

This paper explains the vibration interaction in a multiple flywheel system. Flywheels can be used for kinetic energy storage. In this paper one unstudied problem with vibration interaction between multiple unbalanced wheel. This paper uses a linear state space dynamics model to study the impact of vibration interaction. Specifically, imbalanced induced vibration inputs in one flywheel rotor are used to cause a resonant whirling vibration in another rotor. Vibration is most severe when both rotors are spinning in the same direction.[3]

PROBLEM STATEMENT

The engine‘s ignition-induced rotational speed irregularity causes torsional vibration in the vehicle‘s driveline. At a given speed the ignition frequency is equal to the natural frequency of the driveline so that extremely high vibrations amplitudes occur that causes transmission rattle and body boom. Also more mass increases the cost of DMF.

FINDING

In the planetary dual mass flywheel, the planetary gear and the torsional damper are incorporated into the flywheel. For this purpose, the flywheel is divided into a primary and a secondary mass, hence the name exists planetary “dual mass flywheel”. Rattle and booming noise are now a thing of the past which is rectified by DMF. Again By reducing the mass and keeping the Inertia factor same we will be able to optimize the Dual mass flywheel giving the better results than that of conventional flywheel.

EXPERIMENTAL TECHNIQUES

Effect Of Increased Inertia Of Dual Mass Flywheel-

The effect of inertia augmentation can be seen by the difference in the fluctuation of energy in the Dual mass flywheel and the Conventional flywheel

Let, Maximum fluctuation of energy of Dual mass flywheel = $\Delta E_{dmf} = m R^2 \omega_{dmf}{}^2 Cs$

Where , m =mass of flywheel =1.9 kg

R= Mean Radius of rim = 68 mm =0.068

ω_{dmf} = mean angular speed of dual mass flywheel

$= 2\pi (N1 + N2)/2 = 2\pi (1430 + 930)/2$

ω_{dmf} =7414 rad/sec

Cs = Coefficient of fluctuation of speed = N1-N2 /N

Where N= (N1 +N2)/2 = 1180

Cs = 1430-930 /1180 =0.423

$\Delta E_{dmf} = m R^2 \omega_{dmf}{}^2 Cs$

$= 1.9 \times 0.068^2 \times 7414^2 \times 0.423 = 204.27$ KJ

Maximum fluctuation of energy of Conventional flywheel = $\Delta E_{cnv} = m R^2 \omega_{cnv}{}^2 Cs$

Where , m =mass of flywheel =1.9 kg

R= Mean Radius of rim = 68 mm =0.068

ω_{cnv} = mean angular speed of dual mass flywheel

$= 2\pi (N1 + N2)/2 = 2\pi (1315 + 910)/2$

ω_{cnv} =6990 rad/sec

Cs = Coefficient of fluctuation of speed = N1-N2 /N

Where N= (N1 +N2)/2 = 1112

Cs = 1315-910 /1112 =0.364

$\Delta E_{cnv} = m\, R^2 \omega_{dmf}{}^2\, Cs$

$= 1.9 \times 0.068^2 \times 6990^2 \times 0.364 = 156.25$ KJ

Effectiveness (έ) = $\Delta E_{dmf} / \Delta E_{cnv}$ = 204.27 /156.25 =1.30

Thus the Dual mass flywheel is 1.3 times effective than the Conventional flywheel.

Observations:

a) Conventional mount

ENGINE SPEED = 1300 rpm

Engine Power = 205 watt

Sample calculations:

a) Output Torque = W x 9.81 x Radius of dyno- brake pulley

   Top = 4 x9.81 x 0.032 =1.26 N-m

b) Output power = 2 π N Top / 60

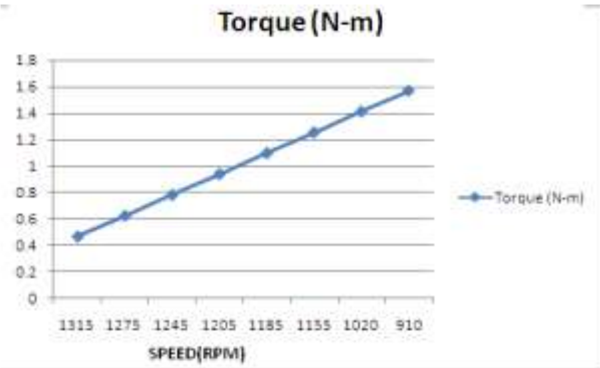
   Pop =2 π x 1155 x 1.26 /60 = 152.39 watt

c) Efficiency = (Output power/ Input power) x 100 = (152.39 /205) = 74.33

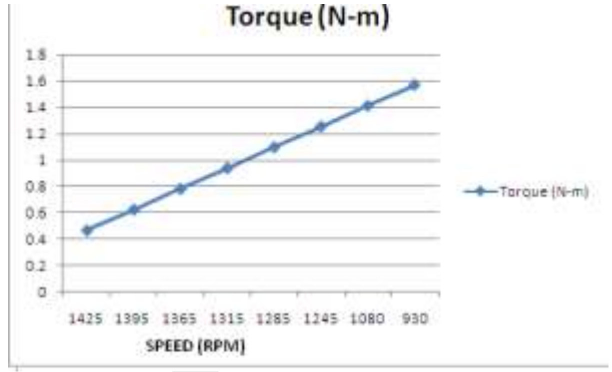
RESULT TABLE

Sr. No	Load(gm)	Speed	Torque	Power	Efficiency	Acceleration(m^2/s)
1	1500	1315	0.47088	64.85163408	31.63494345	31.5
2	2000	1275	0.62784	83.8386144	40.89688507	40
3	2500	1245	0.7848	102.3324264	49.91825678	50
4	3000	1205	0.94176	118.8535651	57.97734884	63
5	3500	1185	1.09872	136.3610405	66.51758072	80
6	4000	1155	1.25568	151.8958426	74.09553296	100
7	4500	1020	1.41264	150.9095059	73.61439313	125

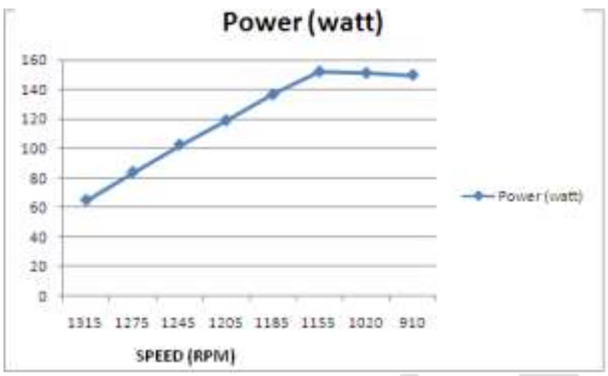
Graph of Torque Vs Speed for Conventional Flywheel



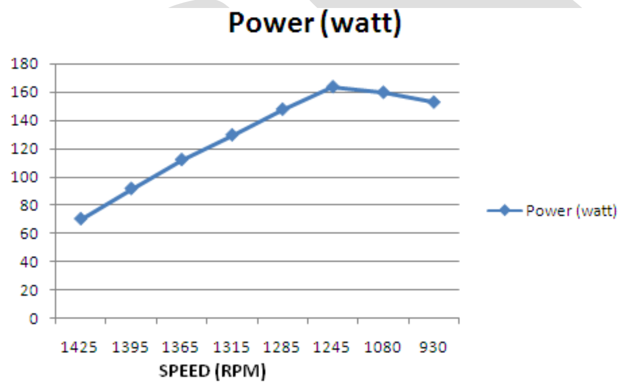
Graph of Torque Vs Speed for Dual mass Flywheel



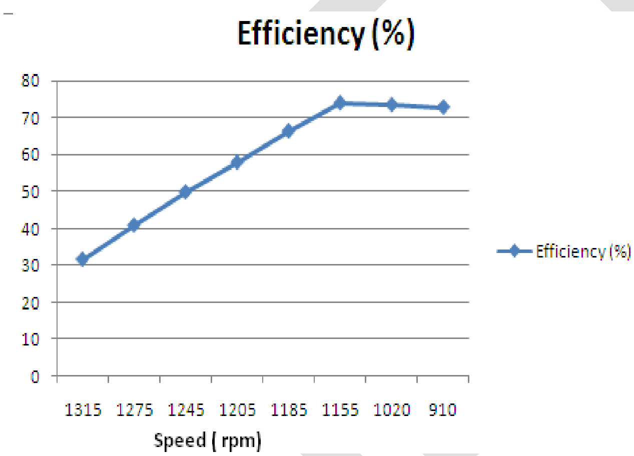
Graph of Power Vs Speed for Conventional Flywheel



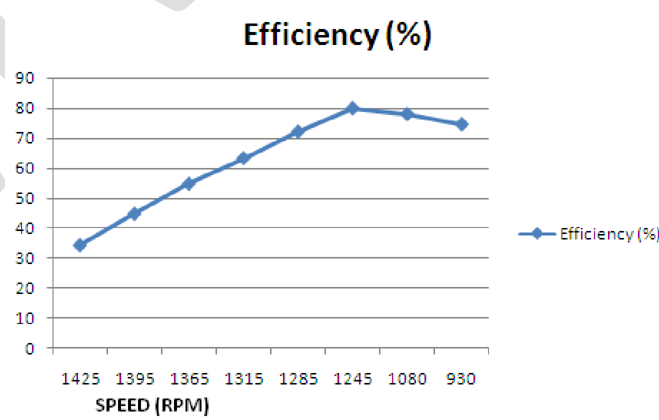
Graph of Power Vs Speed for Dual mass Flywheel



Graph of Efficiency Vs Speed for Conventional Flywheel

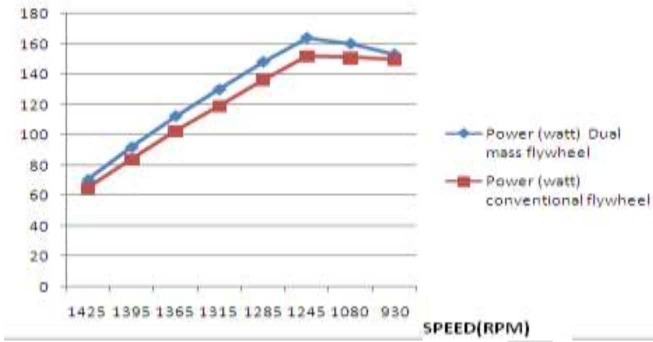


Graph of Efficiency Vs Speed for Dual Mass Flywheel



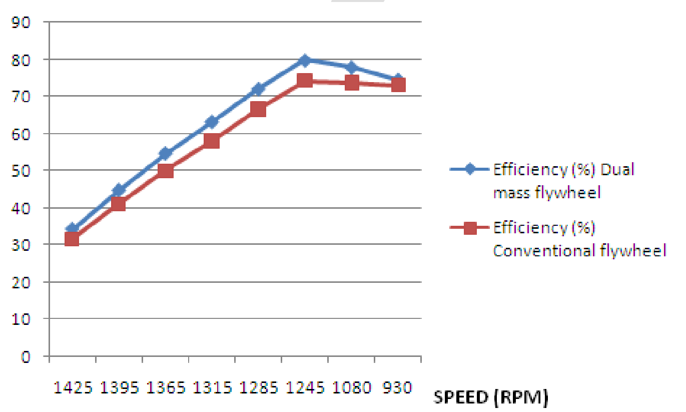
CONCLUSION

1)Comparison of Power output of Conventional and Dual mass flywheel-



i)It is observed that there is approximately 7 to 8 % increase in power output by using the Dual mass flywheel.

2)Comparison of Efficiency of Conventional and Dual mass flywheel-



ii)It is observed that the Dual mass flywheel is 5 to 6 % efficient than the conventional flywheel which will also result in increasing fuel economy of the engine.

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