DESIGN OF FLUID COUPLING FOR EFFICIENT TRANSMISSION FOR MOPEDS.

Tanaji Balawant Shinde[1], Aditya Arvind Yadav[2], Anamika Mahadev Pol [3], Apeksha Baburao Kamble[4]

[1]Assistant Professor Sau. Sushila Danchnad Ghodawat Charitable Trust's Sanjay Ghodawat Institutes, Atigre, Kolhapur.
[2-4] B.E. (Mechanical Student) Sau. Sushila Danchnad Ghodawat Charitable Trust's Sanjay Ghodawat Institutes, Atigre, Kolhapur

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Abstract*— In automatic transmission we generally use the centrifugal clutch which gives us the transmission efficiency of 76%. In recent practice it does not make any difference to travelling but in other way there are some losses in it. Of course, it is not major but we losses 24 % of engine power. In actual practice it is not possible to get 100 % efficiency, but we can reach nearer to it. By using fluid coupling it will extracted up to 85%. So that we can minimize the losses of engine power, this is justified experimentally, we get the efficiency up to 82% at higher load. The efficiency increased by 5 %. Fluid coupling uses the rotation which is loosed during the start up of centrifugal clutch that is first 1000 rpm. Hence, with little modification of centrifugal clutch with fluid coupling we can increase the efficiency of transmission up to 82 %. As we used a standard type of fluid coupling and we get this efficiency. With proper design and manufacturing will result up to 87 % transmission efficiency.*

Index Terms—Clutch, fluid coupling, automatic transmission

1. INTRODUCTION

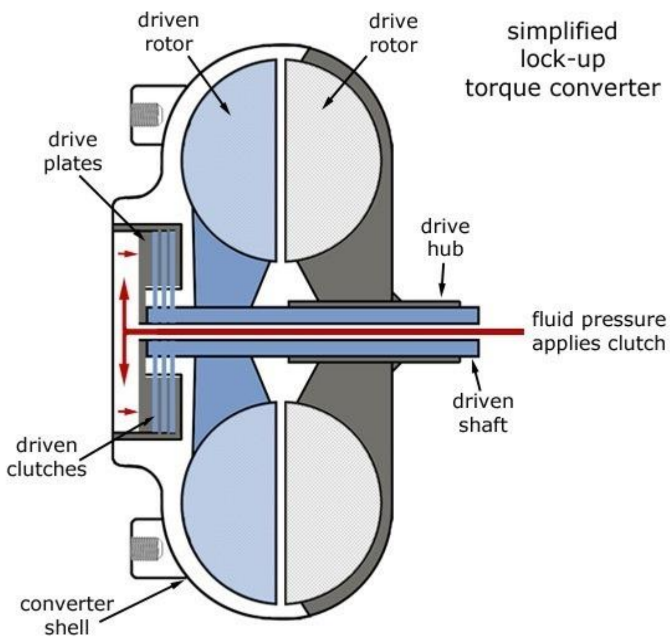
A coupling is a device used to connect two shafts together at their ends for the purpose of transmitting power. Couplings do not normally allow disconnection of shafts during operation, however there are torque limiting couplings which can slip or disconnect when some torque limit is exceeded. A fluid coupling or hydraulic coupling is hydrodynamic device used to transmit rotating mechanical power. It has been used in automobile transmission as an alternative to mechanical clutch.

The fluid coupling consist of the following important parts as mentioned below:

1. Pump: Driving impeller which will be mounted over the input shaft.
2. Turbine: driven impeller which will be mounted over the shaft output.
3. Housing: Cover with an oil tight seal.

The working of the fluid coupling is as follows:

Impellers will act as hydraulic turbine and also act as centrifugal pump. Input energy source will be either electric motor or diesel engine. Electric motor will be connected with the driving impeller i.e. Pump. Mechanical energy (Kinetic energy) will be transmitted to the oil with the help of the pump in coupling. Due to the centrifugal action, Oil will move around the turbine blades in the direction of outside of coupling. Turbine will absorb the kinetic energy and will produce a torque which will be always equal to the input torque. Hence, output shaft will be rotated.



In automotive applications, the pump typically is connected to the flywheel of the engine The turbine is connected to the input shaft of the transmission. While the transmission is in gear, as engine speed increases torque is transferred from the engine to the input shaft by the motion of the fluid, propelling the vehicle. So, the behavior of the fluid coupling strongly that of a mechanical clutch driving a manual transmission.

The field of applications for fluid coupling is as follows:

1. Fluid couplings are used in many industrial application involving rotational power,-especially in machine drives that involve high-inertia starts or constant cyclic loading.

2. Rail transportation

3. Fluid couplings are found in some Diesel locomotives as part of the power transmission system. Self-Changing Gears made semi-automatic transmissions for British Rail, and Voith manufacture turbo-transmissions for railcars and diesel multiple units which contain various combinations of fluid couplings and torque converters.

4. Automotive fluid couplings were used in a variety of early semi-automatic transmissions and automatic transmissions.

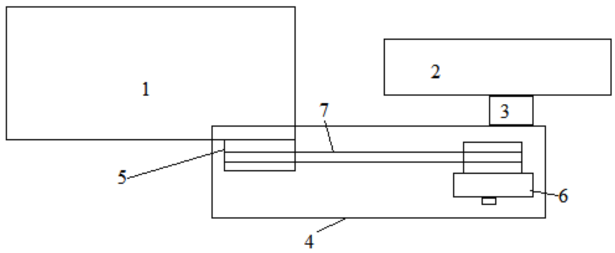
5. Fluid flywheels, as distinct from torque converters, are best known for their use in Daimler cars in conjunction with a Wilson pre-selector gearbox. Daimler used these throughout their range of luxury cars, until switching to automatic gearboxes with the 1958 Majestic. Daimler and Alvis were both also known for their military vehicles and armored cars, some of which also used the combination of pre-selector gearbox and fluid flywheel.

2. VARIOMETRIC TRANSMISSION SYSTEM

A Variometic Transmission system is also known as continuously variable transmission (CVT) is an unconventional type of transmission system which can change steplessly through continuous & infinite no. of effective gear ratios b/w max and min values. This contrasts with other mechanical transmission systems that only allow a few different distinct gear ratios. The flexibility of the CVT permits the driving shaft to maintain a particular angular velocity over a specified range of O/P velocities. This can provide better fuel economy than other transmission systems by enabling the engine to run at its most efficient RPM for a range of vehicle speeds. With a specific end goal to tolerate new regulations for auto efficiency and emanations, the CVT keeps on developing as a key innovation for enhancing the fuel effectiveness of autos with Internal Combustion (IC) engines. CVTs utilize vastly flexible commute proportions rather than discrete riggings to attain ideal motor execution. Since the motor dependably runs at the most proficient RPM for a given vehicle speed, CVT-prepared vehicles attain preferred gas mileage and quickening over autos with conventional transmissions.

The CVT is a compact system and as will be described, it does not require the use of bulky gear sets or as many components as in the conventional transmission. A CVT system is comprised of two conical pulleys and a belt. As the sheaves of each pulley move closer or farther away from one another, their conical shape causes the belt to rise and fall b/w the sheaves of each pulley. Depending upon the state of the belt, the active gear ratio is changed. Instead of switching between bulky fixed gears which only supply a limited number of gear ratios, the CVT pulleys create a continuous exchange of gear ratios by constantly altering the state of the belt b/w the pulleys.

3 .EXPERIMENTAL METHODOLOGY



Modified Transmission System Experimental Setup.

1- Engine.
2- Rear wheel.
3- Epicyclic gear box.
4- Casing.
5- Pulley.
6- Fluid coupling.
7- Flat belt
8- Dynamometer.

Experimental Setup

4 . SPECIFIACTION OF COMPONENTS

VEHICLE AND ENGINE:-

Sr. No	Content	Description
1	Type of vehicle	Scooter
2	Engine displacement	113.5 cc
3	Engine type	4 stroke petrol engine
4	Maximum power	702 bhp at 7500 rpm
5	Maximum torque	707 Nm at 5000 rpm
6	Transmission	Variomatic

5 .FLUID USED IN FLUID COUPLING

Servo Super Multi grade Oils are blended from highly refined base stocks and balanced additive package containing shear stable VI improver, metallic detergent dispersant and anti-oxidant. These oils are formulated to meet lubrication requirements of both gasoline and diesel engines. Servo Super Multigrade Oils are red in colour and suitable for all seasons.

Properties of fluid -20 W 40

Sr. No.	Content	Description
1.	Kinematic viscosity @ 100^0 C N-sec/m	13.5-15.5
2.	Viscosity index (Min)	110
3.	Flash point (^{0} C)	200
4.	Pour point (^{0} C)	-21

6. DESIGN OF FLUID COUPLING

Specific charge of the working place is taken as, q = 0.72.
Speed of shaft np = 1500 rpm,

Pump head (Hp) = ρ ((P* η)$^{1/2}$/ np)
= 0.899 ((472*0.66)$^{1/2}$
= 0.01 mtr

Shaft speed (^{mrad}/s) = 157.7 rad/s.
Discharge flow = P*η / P*G*Hp
= 472*0.66 / 472 * 9.81 *0.01
= 675.7 m^3/ s.

Velocity of meridian component = √ (2 * g *Hp)
= √ (2 * 9.81 *0.01)
= 0.44

Inlet and outlet areas of impeller= Q/ cm
= 672.78/0.44
=847.22 mm

Diamenter of turbine = √(g *Hp/ ω^2 (1 - m^2))
=√ (9.81 * 0.01 / 157.7^2(1- 84))
= 0.224 m

Impeller inlet & outlet width = Q/ 2* 3.14 *re
=672.7/ 2*3.14*0.112
=0.0095m

No of blade on impeller Z_1 = 8.65(0.224*1000)$^{0.279}$ = 40
no of blade on turbine Z_2= Z_1+2 = 40 + 2 = 42

7. TEST ON FLUID COUPLING

Sr. No.	Speed input (RPM)	Speed output (RPM)	Load (kg)	Torque (N-m)	Power (KW)
1	500	450	0	0	0
2	490	410	2	4.72	0.202
3	460	380	4	8.21	0.326
4	450	360	6	12.36	0.0.465

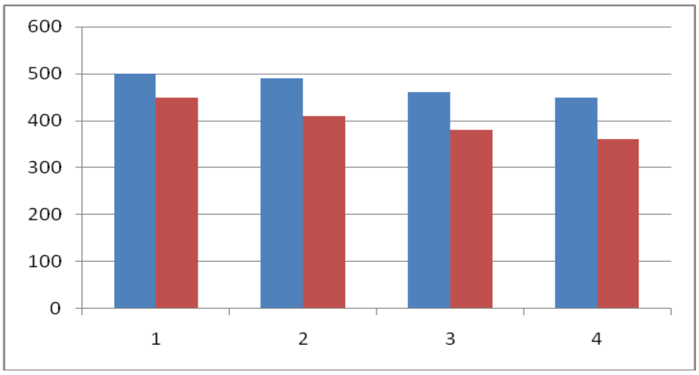
Sample calculation of torque :

Torque = force due to mass X radial diance of force application
= F X R
Whre, F= force due mass = mg.
R = distance of force application = 0.21 m

Therefore Torque = F R
= m*g*R
= 2*9.81*0.21
= 4.12 N-m

Power transmitted= 2*π * N* T/60
= 2* π *410*4.72/60
= 0.202 KW.

8. RESULT OF FLUID COUPLING

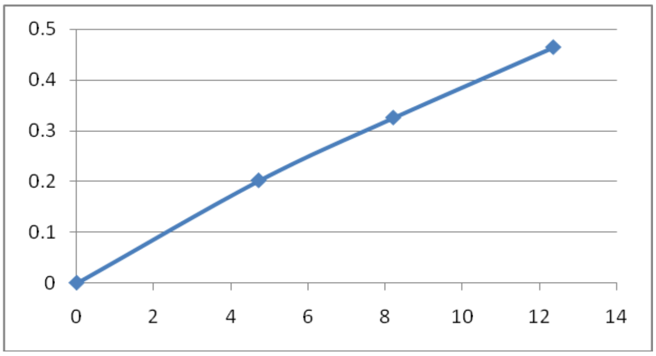


Input and Output speed

The above fig shows the relationship between input and output speed of the fluid coupling. From the graph we can conclude as follows,

- As there is motion of fluid so at the start we get some losses in speed at no load condition.
- When we increase the speed, we get the maximum speed
- For example at the load of 2 kg, when we supply 490 rpm, the output speed is get is 410 rpm which is near about 80 % of input speed.

The following graph shows the load and it's output power for fluid coupling.

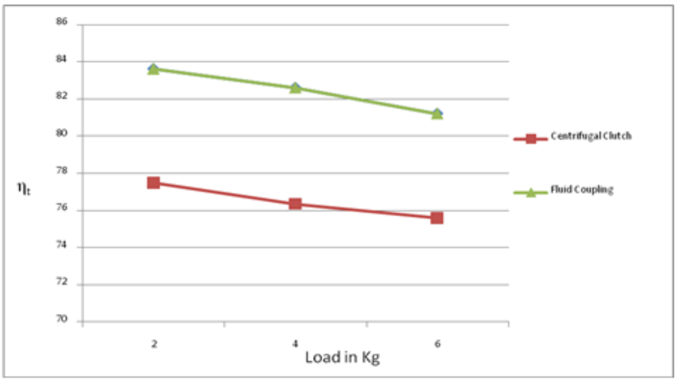


Load vs Output power

9. TRANSMISSION EFFICIENCY

Sr.No.	Centrifugal clutch		Fluid coupling	
	Load (Kg)	Trans. Eff.(%)	Load (Kg)	Trans. Eff.(%)
1	2	77.5	2	83.62
2	4	76.36	4	82.60
3	6	75.6	6	81.20

Transmission efficiency = [(Output torque/Input torque)*100]



Transmission efficiency of centrifugal clutch Vs fluid coupling

10. CONCLUSION

In automatic transmission we generally use the centrifugal clutch which gives us the transmission efficiency of 76%. In recent practice it does not make any difference to travelling but in other way there are some losses in it. Of course, it is not major but we loss 24 % of engine power. In actual practice it is not possible to get 100 % efficiency, but we can reach nearer to it. By using fluid coupling it will extracted up to 85%. So that we can minimize the losses of engine power, this is justified experimentally, we get the efficiency up to 82% at higher load. The efficiency increased by 5 %. Fluid coupling uses the rotation which is loosed during the start up of centrifugal clutch that is first 1000 rpm. Hence, with little modification of centrifugal clutch with fluid coupling we can increase the efficiency of transmission up to 82 %. As we used a standard type of fluid coupling and we get this efficiency. With proper design and manufacturing will result up to 87 % transmission efficiency.

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