

Theory of Pulsed Power Transmission in Mechanical Engineering

The Law of Impulsive Power Transmission

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ABSTRACT: Everywhere in the automobile industry, power generation systems and other mechanical systems, generally we are dealing with the uniform power transmission. Here in this research paper I tried to explain the new type of the power transmission in mechanical engineering with the help of mathematical illustration i.e. pulsed power transmission system. It is observed that when the power is transmitted suddenly or impulsively, the magnitude of the gravitational force becomes twice at the instant of transmission which results into excess power output as compare to input given.

KEYWORDS: Pulsed power, Impulsive power, Mechanical, Transmission, Gradually, Suddenly.

I. INTRODUCTION

The power transmission is the process in which the power is transmitted from one mechanism to another mechanism or from one shaft to the other shaft through power transmission drives like belt drive, chain drive couplings, gears etc. This type of power transmission is uniform power transmission where the magnitude of the input power is equivalent to the output power. This is the conventional type of power transmission we are using. Also due to losses the efficiency is always found to be less than 100%. Continuous

The pulsed power transmission system process in which the power is transmitted from one mechanism to another mechanism or from one shaft to the other shaft impulsively, overcomes the demerits of losses in conventional power transmission by adding gravitational energy which is available everywhere on earth, in actual power input. This results in excess power output as compare to input power given. Also this results in the increase in overall efficiency of the system.

II. BACKGROUND OF THE IMPULSIVE POWER TRANSMISSION

In the process of finding Strength of Material (SOM) of any component, the calculation and analysis of stress developed on the component when the load is applied is one of the most important step. And I observed that, when the load W is gradually applied on the metal bar which is vertical in position and its upper end is fixed rigidly, and then the resultant stress σ developed in the metal bar is given by $\sigma = \frac{W}{A} (N/mm^2)$, but again when the same load W is applied on the metal bar suddenly then developed stress σ is given by $\sigma = \frac{2W}{A} (N/mm^2)$. Both equations shows that stress developed during the sudden application of load is twice than that of the stress developed during the gradual application of load.

This same terminology I applied on the shaft supported by bearings and performing mathematical calculation, it is found that the impulsive power transmission gives excess power output and can help in enhancing the performance of the mechanical power transmission systems.

III. SCOPE OF THE RESEARCH

This theory of impulsive power transmission will help in the enhancement of the present power transmission systems. Also due to increase in the output torque due to addition of gravitational energy the efficiency of the system

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

increases, and can cross the 100%. This is just a starting of the era of the impulsive power transmission system and will help in designing of the devices or the mechanical components to obtain the pulsed power transmission between two shafts.

IV. MATHEMATICAL ILLUSTRATION

In the process of finding Strength of Material of any component, the calculation of stress applied or developed on the component is one of the most important step. There are three methods of applying load on the component for testing stress, these are:

- (01) Gradually applied load.
- (02) Suddenly applied load.
- (03) Load applied from certain height i.e. impact load.

The equation for the calculation of the all three above mentioned methods are different. The method (03) will consume much more time in practical application of load when the action is to be performed repeatedly, because weight has to travel Height “h” during each impact. Hence keeping feasibility in mind for practical application, here we will analyse the equations of method (01) and method (02):

(01) When the load is applied gradually, then stress is given by the equation-

$$\sigma_{gradually} = \frac{P}{A} \text{ or } \frac{W}{A} \text{ N/mm}^2 \quad \dots\dots\dots (1.1)$$

(02) When the load is applied suddenly, then stress is given by the equation-

$$\sigma_{suddenly} = \frac{2P}{A} \text{ or } \frac{2W}{A} \text{ N/mm}^2 \quad \dots\dots\dots (1.2)$$

Where,

P = W = Load or Weight in Newton
A = area in mm²

In the both the equations W is in Newton, which is the product of mass M and gravitational constant “g” i.e.

$$W = m * g$$

The ratio $\frac{W}{A}$ shows that, the mass “m” is exerting the load on the unit area A with the gravitational force “g”. The magnitude of the gravitational constant “g” is 9.81 m/sec².

As shown in Fig: 1 considering the bar in vertical direction of which one end is fixed to the rigid support and another end is free.

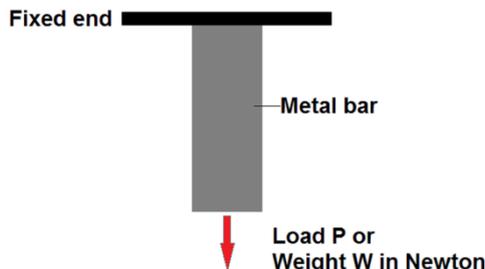


Fig: 1 vertical bar fixed at one end

At the free end of above bar, for easily understanding of theory we will apply the mass “m” of 0.102 kg in a downward direction with gradual manner and suddenly.

$$m = 0.102 \text{ kg}$$

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Vol. 5, Issue 6, June 2016

$$\text{Weight or Load } W = m * 9.81 \text{ i.e. } W = 0.102 * 9.81$$

$$W = 1 \text{ N}$$

Case 1:

When load of 1 N is acting at free end in the downward direction where the load is applied in gradual manner then the equation of the developed stress is given as -

$$\sigma = \frac{W}{A} = \frac{m * g}{A} \text{ N/mm}^2$$

Substituting the value of $\frac{W}{A}$ from equation (1.1), we get

$$\sigma_{\text{gradually}} = \sigma_{\text{actual}} \dots\dots\dots (1.3)$$

The obtained equation (1.3) shows that, the magnitude of the resultant actual stress is equal to that of the applied stress

Case 2:

When load of 1 N is acting at free end in the downward direction where the load is applied suddenly i.e. impulsively then the equation of the developed stress is given as -

$$\sigma = \frac{2W}{A} = \frac{2 * m * g}{A} \text{ N/mm}^2$$

Substituting the value of $\frac{W}{A}$ from equation (1.1), we get

$$\sigma_{\text{suddenly}} = 2 \sigma_{\text{actual}} \dots\dots\dots (1.4)$$

The above obtained equation (1.4) shows that the magnitude of the resultant stress is twice than that of the applied actual stress. In both the cases the acting mass “m” was kept constant, only the manner by which it is applied on the free end of the bar is different, which shows that,

When the mass is applied suddenly on the object, the magnitude of the gravitational constant “g” acting on the mass which is 9.81 m/sec² becomes twice at that instant i.e. 9.81 * 2 = 19.62 m/sec²

..... (Result-1)

NOTE: It should be note that stress is developed in the bar, because it is fixed at the one of its ends.

Now,

To calculate the power of the shaft, we have

$$\text{Power, } P = \frac{2\pi * N * T}{60} \text{ Watt} \dots\dots\dots (1.5)$$

Where-

- N= speed in RPM
- T= torque in Nm
- 2π= constant

Also, the relation between HP, Torque and the RPM is given by the equation,

$$\text{Power (HP)} = \frac{T * \text{RPM}}{5252} \dots\dots\dots (1.6)$$

Where-

- RPM= speed of the (engine) shaft
- T= torque developed by the (engine) shaft in lb-ft
- 5252= constant

When the mechanical energy is converted into electrical energy i.e. for the purpose of electricity generation, generally the power output of the generator is calculated by-

$$\text{Power} = \text{Volt} * \text{Ampere}$$

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..... (1.7)

Where-

Volt is depend upon speed delivered the generator shaft
Ampere is depend upon Torque delivered to the generator shaft
Power is in Watt

To increase the overall power output of the shaft we have to increase both *constituent of the power i.e. Speed and Torque* of the shaft. Since we are dealing with the gravitational energy hence the magnitude of the RPM cannot be increase but the magnitude of the torque can be. Let us consider the shaft supported by the help of bearings, having an arm of radius “r” m and to maintain uniform speed and to store energy a flywheel is provided on same shaft. Shaft, flywheel and the arm are fixed with help of key to avoid the relative motion between them and the load is applied uniform manner, as shown in Fig: 2

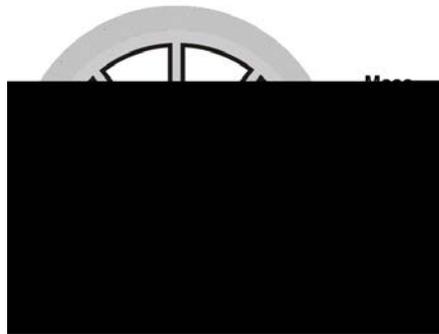


Fig: 2 Arm keyed to the rotating shaft

The general equation of torque T is given by,

$$T_{actual} = W * r$$

Where,

W = Weight or load in Newton

r = Radius in meter

$$T_{actual} = m g r$$

i.e.

$$T_{actual} = \text{mass} * 9.81 * \text{radius}$$

..... (1.8)

When the mass is applied suddenly i.e. impulsively the magnitude of the acting gravitational energy becomes twice at the instant [ref. Result-1], then the torque T is given by

$$T_{suddenly} = \text{mass} * 2 * 9.81 * \text{radius}$$

$$T_{suddenly} = 2 * [\text{mass} * 9.81 * \text{radius}]$$

..... (1.9)

Comparing equation (1.8) and (1.9) we get

$$T_{suddenly} = 2 T_{actual}$$

..... (1.10)

The above obtained equation shows that resultant magnitude of the torque is twice, when the mass “m” is applied suddenly at the distance of radius “r” than that of the actual magnitude of the torque.

Putting the value of the torque T *suddenly* in the equation (1.5) of the power, we get

$$\text{Power} = \frac{2\pi * N * 2 * T}{60}$$

$$P = 2 \left[\frac{2\pi * N * T}{60} \right]$$

..... (1.11)

Comparing equation (1.11) and (1.5), we get

International Journal of Innovative Research in Science, Engineering and Technology

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$$P_{\text{suddenly}} = 2 P_{\text{actual}}$$

$$\text{i.e. } P_{\text{impulsive}} = 2 P_{\text{actual}}$$

..... (Result-2)

It is proved that the magnitude of the power becomes twice than that of the actual power, when the power is transmitted impulsively or suddenly.

Similarly,

By substituting the value of torque $T = 2T$ in equation (1.6) we get, $P = 2 P$

Also, in case of electricity generator if the magnitude of the input Torque becomes twice due to impulsive power transmission, then the output ampere of the generator becomes twice and it will result in increase of the overall power output of the generator.

NOTE: This phenomena is based on the gravitational force, hence during study it should be taken into consideration that the transmission of the power to the output shaft is in vertical downward direction.

The newly invented pulse mechanism as shown in Fig: 3, there is a mechanical component pulse wheel/flywheel which can be used as a principle component in the process of impulsive power transmission in near future.

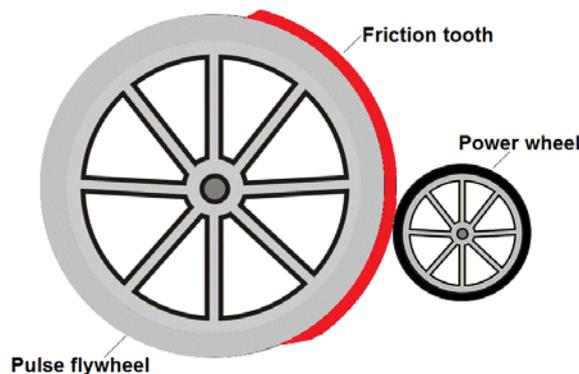


Fig: 3 Pulse mechanism

Due to characteristic design of pulse wheel/flywheel the power is transmitted from input shaft to the output shaft through friction tooth(s) fixed on the circumference, only when the friction tooth(s) and the wheel mounted on input shaft comes in contact with each other, hence the power is transmitted intermittently. This results in the impulsive power transmission and it gives excessive power output.

VI. CONCLUSION

“When the power is transmitted from one mechanism to second mechanism or from one shaft to other shaft in vertical downward direction impulsively through intermittent contact in purpose to maintain the continuous motion of energy receiving mechanism to the design values and to obtain excess power output, then the process of power transmission is to be called as pulsed power transmission or impulsive power transmission.”

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International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 6, June 2016

BIOGRAPHY



Saurabh Vikas Chaudhari studying in last year of mechanical engineering in J.T. Mahajan College of Engineering, Faizpur (Maharashtra). He is working on gravity based power generation systems and has applied for Patent. He researched and collaborate the gravitational theories of Sir Isaac Newton and Mr. Lawrence Tseung to generate energy. He invented the pulse mechanism based on I.C Engine working phenomena (applied for patent) and using mathematical calculation he proved, that the efficiency of machine due to use of the pulse wheel/flywheel exceeds 100% and can be unbound.

His main areas of research interest are designing machineries for the best performance, enhancing electric car's fuel mechanism and improving the efficiency of present power generating systems.