

Pulsebridization: Hybridization of Current Power Generating Systems With Pulsed Power Transmission System for Amplification of the Power Magnitude Generated

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ABSTRACT: We are generating energy by using fossil fuels like coal, petroleum, and natural gas, also renewable energy in the form of wind energy and the solar energy at greater extent. But the devices and systems we are treating with have very low efficiency, this results into the wastage of our energy resources, land, environment and money. To overcome such problems, the current power generating systems are hybridized with the pulsed power transmission system. The power generated by the power generating systems is used as input power for pulsed power transmission system, where due to impulsive power transmission process the magnitude of power get amplified. This results into excess power output as compare to input power given. This type of hybridization i.e. pulsebridization will save lots of our energy resources by increasing the efficiency of the power generating systems and will fulfill our energy demand by lowering the increasing graph of carbon emission.

KEYWORDS: Pulse wheel, Amplification, Efficiency, Multiple pulsebridization, Fuel saving, Pollution control.

I. INTRODUCTION

Due to high rate of industrialization in developing and developed countries, demand for electricity is increasing continuously day by day with high rate. Many types of electronics products, e-vehicles are arriving in market which puts the load on available power generating sources. Current power generating plants are not sufficient to fulfill this increasing demand, hence new power plants are need to be setup. In world, maximum power is generated through coal powered thermal power plants which adds hazarding pollutants to the air and pollutes the environment tremendously. The efficiency of the thermal power plants powered by the coal and radioactive materials is near about 35% to 45% and 33% to 35% respectively. Due to tremendous use of fossil fuels, they will get exhaust in next few decades, also the generation of electricity by wind energy, water energy, and solar energy needs to pay more cost and also the power plants depending on these energy sources cannot install anywhere, due to their geographical limits.

For fully utilization of these energy resources, we have to increase the efficiency of current power generating systems. This is very difficult and costly to replace low efficient power generating systems with high efficient power generating systems, but the output power of the low efficient systems can be amplify by hybridizing them with the pulsed power transmission system. This research papers includes the research, where effect of hybridization of the pulsed power transmission system with current power generating systems i.e. pulsebridization is illustrated by performing mathematical calculations.

II. RELATED WORK

The working of pulsed power transmission mechanism is completely opposite to that of continuous power transmitting mechanism, this is based on impulsive power transmission phenomena, where the power is transmitted

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from input shaft to the output shaft discontinuously i.e. impulsively. The pulsed power transmission system has two backgrounds,

- Pulsed power transmission based on Internal Combustion Engine.
- Pulsed power transmission based on gravitational energy i.e. $P_{impulsive} = 2P_{actual}$.

2.1 Pulsed power transmission based on Internal Combustion Engine:

It describes that, When I.C. engine is in running state, it works on four strokes which are suction stroke, compression stroke, expansion stroke, and exhaust stroke. During the expansion stroke of a single cylinder engine, due to fuel blast in blast chamber (cylinder), thrust is produced and this produced thrust pushes the piston downward. The reciprocating motion of piston in downward direction pushes the crank for certain degrees during every 720 degree rotation. This process tends to add a power pulse indirectly to the flywheel which is fixed on the engine shaft. By replacing the cylinder and crank arrangement with flywheel mounted with single friction tooth on its circumference, we can directly add 2 power pulses (power equal to expansion stroke) to the flywheel in every 720 degree of its rotation. In internal combustion engine, the power added during the expansion stroke due to fuel blast in combustion chamber in the engine shaft is impulsive in nature.

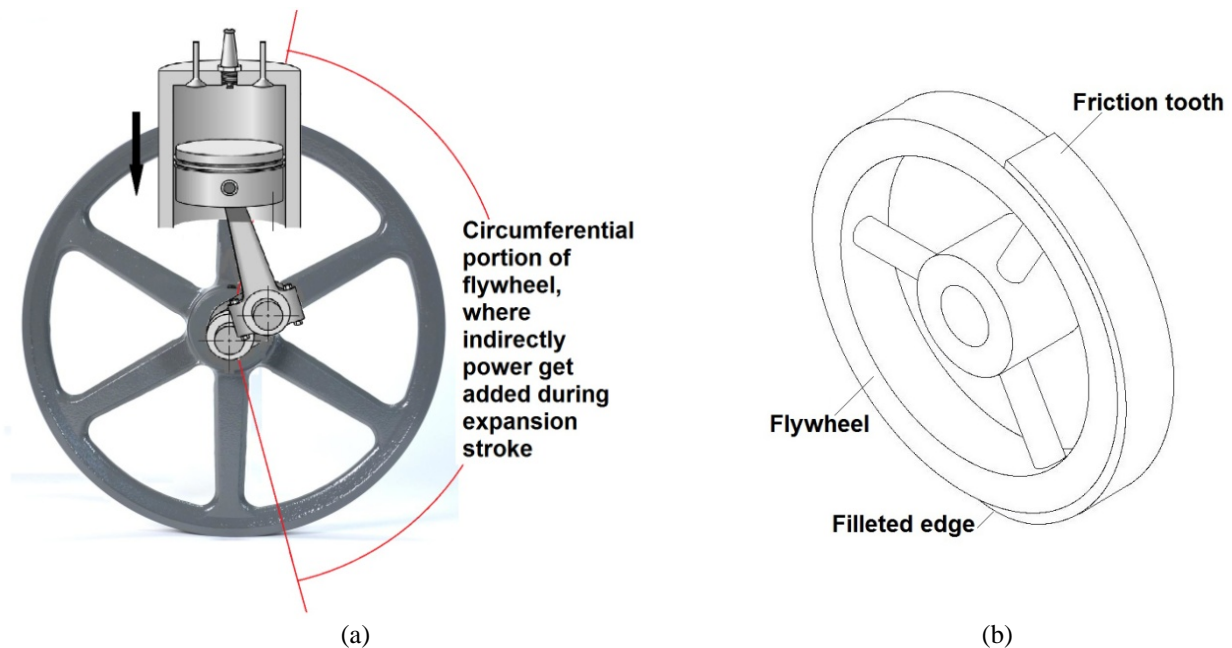


Fig. 1. (a) piston crank arrangement with flywheel and its downward motion during expansion stroke.
(b) 3D view of pulse wheel/ flywheel.

Fig. 1 (a) shows expansion stroke of 4 stroke single cylinder internal combustion engine. During expansion stroke crank shaft and crank travels circular path of 150° from the vertical axis due to thrust power produced by fuel blast, and remaining 30° out of 180° is due to momentum gained by engine components. During this 150° movement of crank, the flywheel keyed on the crank shaft also travels the same 150° angular distance with same direction and power. In Fig. 1 (b) piston crank arrangement is replaced by one friction tooth which are fixed on the circumferential surface of flywheel or wheel by keeping gap between them. All these modifications structured a mechanical component pulse wheel/flywheel. The component name pulse wheel/ flywheel is collaborated name describes pulse wheel or pulse flywheel. There is difference of only weight between the pulse wheel and pulse flywheel; pulse wheel is light in weight

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and consist of base wheel and friction tooth(s), while pulse flywheel is heavy in weight and consist of base flywheel and friction tooth(s). Due to light weight, pulse wheel is used when there is need to transmit power only and due to heavy weight, pulse flywheel is used when there is need of power transmission as well as energy storage. Pulse wheel/flywheel can transmit the power discontinuously i.e. impulsively through surface contact from one shaft to another shaft using intermediate power transferring component mounted on that another shaft and this forms pulse power transmitting mechanism. To make the smooth contact with the surface of intermediate power transmitting component in the mechanism, the contact starting edge of each friction tooth is filleted. Material of friction tooth(s) is selected such that it posses higher friction grip with the surface of intermediate power transmitting component, and high wear resistant property at high working temperature.

2.2 Pulsed power transmission based on gravitational energy:

It describes that, 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. This means that when the mass is applied suddenly on the object having mass, the magnitude of the gravitational constant “g” acting on that mass which is 9.81 m/sec^2 becomes twice at that instant i.e. $9.81 * 2 = 19.62 \text{ m/sec}^2$. This results into increase in overall output power which is near about twice in magnitude of actual given input power i.e. $P_{\text{impulsive}} = 2P_{\text{actual}}$. According to this methodology the magnitude of the torque becomes twice due to power transmission in sudden manner from input shaft to output shaft, and this results into increase in overall power output.

These both methodologies has given birth to power transmitting component pulse wheel/ flywheel. Due to friction tooth(s), it transmits the power in sudden manner i.e. impulsively.

III. PULSEBRIDIZATION

In pulsebridization, pulsed power transmission system is connected with the another power generating system to amplify the magnitude of power generated by that power generating system. The system of which output power is used to run connected pulsed power transmission system is called as primary power generating system in pulsebridization process. For pulsebridization the power generated by the primary power generating system or any other available power source is used as a input power for the pulsed power transmission system, where the impulsive power transmission takes place between pulse wheel/ flywheel and corresponding intermediate power transmitting component mounted on another shaft i.e. power wheel or power flywheel. Power wheel is light in weight and performs the function of power transmission only, while power flywheel is heavy in weight and performs the function of power transmission as well as energy storage. Material for circumferential surface of power wheel and power flywheel is selected such that, it posses higher friction grip with contacting surface of friction tooth(s) and posses resistant to wear and tear at high working temperature. Impulsive power transmission between pulse wheel/ flywheel and intermediate power transmitting component, results into amplification of the magnitude of the power received from primary power generating source. For pulsed power transmission one of the following pair can be used for power transmission between input and output shaft,

- Pulse wheel & power flywheel,
- Power wheel & pulse flywheel,
- Power wheel & pulse wheel.

Some arrangements of pulse wheel/ flywheel and intermediate power transmitting components for pulsed power transmission are described below:

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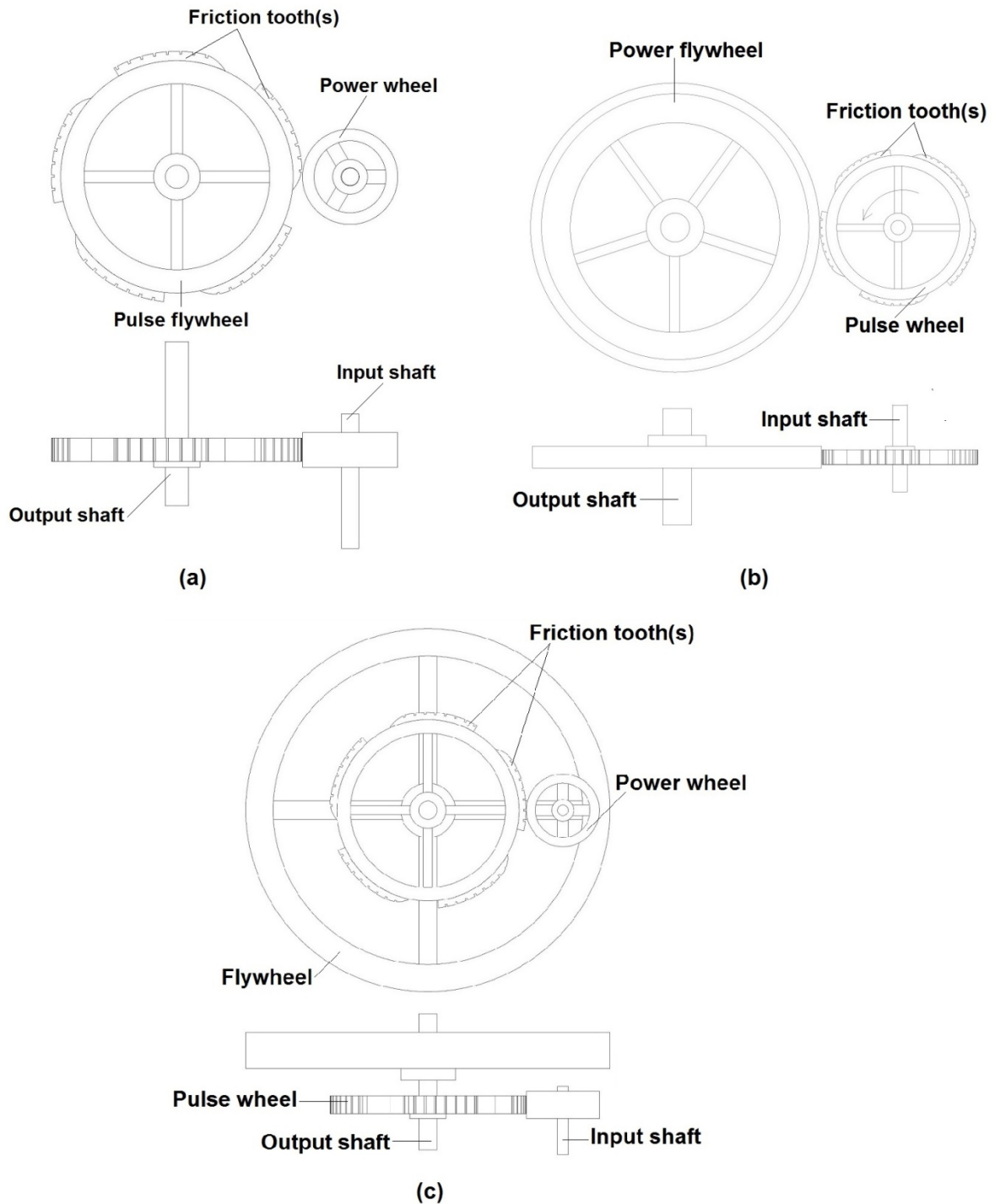


Fig. 2. various arrangements of pulse wheel/ flywheel and intermediate power transmitting components power wheel and power flywheel, to obtain pulsed power transmission

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As shown in Fig. 2, figure (a) describes the arrangement for pulsed power transmission in which power wheel is mounted on input shaft and pulse flywheel is mounted on output shaft. Pulse flywheel is heavy in weight, hence it performs the function of power transmission as well as energy storage. Power wheel transmits power impulsively to the pulse flywheel from input to output shaft through friction tooth(s) fixed on circumferential surface of pulse flywheel. Figure (b) describes the arrangement in which pulse wheel is mounted on input shaft and power flywheel is mounted on output shaft of the mechanism. The heavy weight power flywheel transmits power as well as stores developed excess energy. Pulse wheel transmits power to the power flywheel impulsively from input to output shaft through friction tooth(s). Since pulse wheel is provided on input shaft in this arrangement, mechanism is capable to transmit large number of power pulses in single rotation as compare to other arrangements. Figure (c) describes the arrangement to obtained pulsed power transmission in which power wheel is mounted on input shaft and pulse wheel is mounted on output shaft provided with extra flywheel to store energy. This arrangement is feasible to use when the power is need to be transfer with different radial ratio, and hence it does not restricts the radius of energy storing component in mechanism. But as compare to other arrangements described earlier, prime mover to be used for this arrangement requires high starting torque because of large radius of flywheel.

The difference between pulsed power transmission mechanism and pulsed power transmission system is that, pulsed power transmission mechanism consists only pair¹ of pulse wheel/ flywheel and power wheel or power flywheel, while pulsed power transmission system consists generator and a prime mover with the pair of pulse wheel/ flywheel and power wheel or power flywheel.

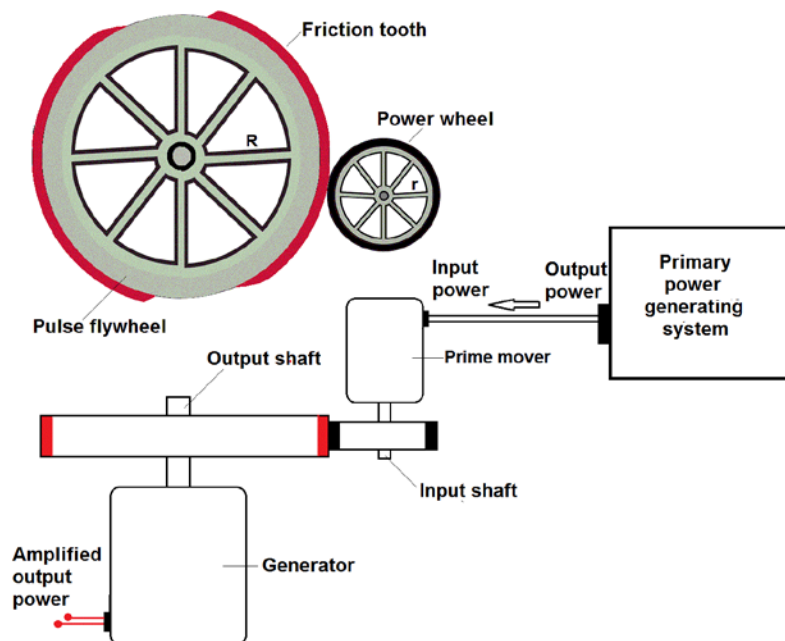


Fig. 3. general structure for pulsebridization of power generating system

As shown in Fig. 3, the power wheel is mounted on input shaft and the pulse flywheel is mounted on the output shaft, where generator is connected to the output shaft. Input shaft rotated by means of prime mover. Prime

¹ In this research paper, for pulse power transmission pair of power wheel and pulse flywheel is used and calculations are performed according to it. One can use pair of pulse wheel and power flywheel or pulse wheel and power wheel to obtain pulsed power transmission, this system is very flexible to construct.

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mover receives power from primary power generating system. Energy gained by power wheel is impulsively transmitted to pulse flywheel through friction tooth(s). Pulse flywheel consists 2 friction tooth(s), it means that in complete 720° rotation of output shaft, power wheel will deliver 4 power pulses to the pulse flywheel. The power wheel act as the intermediate power transmitting component between pulse flywheel and input shaft. The pulse flywheel is heavy in weight, thus it performs the function of power transmission and energy storage. Each friction tooth posses high frictional grip with contacting surface of power wheel. To increase the frictional grip, friction tooth(s) are provided with grippers which works as the traction edges .

For pulsebridization, solar panel (PV cells) and wind turbine are considered as the primary power sources and electric motor, gas turbine, steam turbine, hydro turbine, and I. C. engine are taken as prime movers because these mechanical devices consist rotating shafts.

Table 1. Considered values for performing all the mathematical calculations in this research paper.

Speed of generator shaft (4 pole, 50 Hz)	1500 RPM
Radial ratio between Pulse flywheel (R) and power wheel(r) i.e. R: r	3: 1
Speed of input shaft	4500 RPM
Number of friction tooth(s) on pulse flywheel	2
Number of power pulses in 720° rotation	4

Pulse flywheel having 2 friction tooth(s), is considered for power transmission. This means that, in complete 720° rotation, power wheel will transmit 4 power pulses to pulse flywheel i.e. power equal to 4 power strokes.

3.1 Pulsebridization of solar power generation system:

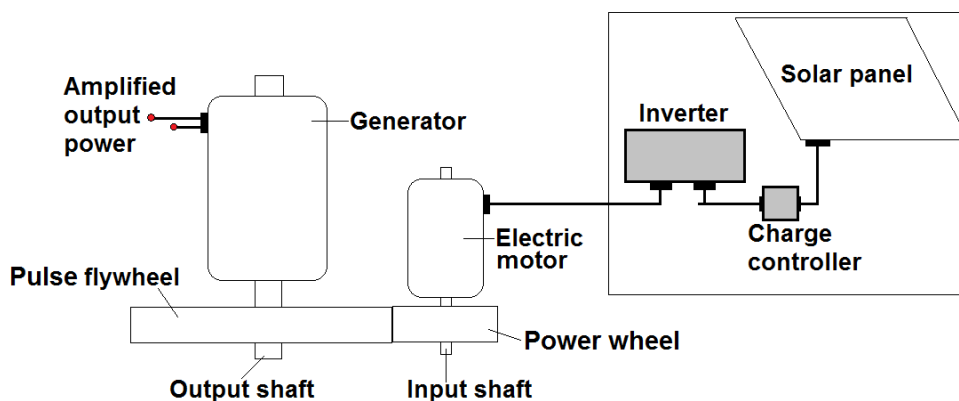


Fig. 4. pulsebridized photo voltaic cells (solar panel)

As shown in Fig. 4, in pulsebridization of photo voltaic cells i.e. solar panel, electric motor is used as prime mover to rotate power wheel. Power wheel is mounted on the shaft of electric motor. The solar panel converts the solar energy into electrical energy and transmits it to the electric motor through charge controller and inverter. Rotational motion of the electric motor tends power wheel to rotate. The energy gained by the power wheel is impulsively transmitted to the pulse flywheel through friction tooth(s). Due to impulsive power transmission between pulse flywheel and power wheel, excess energy get developed in output shaft. The generator connected with the output shaft converts the developed mechanical energy into electrical energy. The output power obtained from the generator is amplified output power.

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Table 2. Technical specification of the solar panel, as a input power source,

Output power	100 KW
Energy generation	1,55,000 Units per Annum
Floor area	1000 Sq. m.
Cost as per 70 RS/ Watt	70,00,000 Rs.
Speed of electric motor	4500 RPM

To find torque T, generated at the shaft of electric motor,

$$\text{power} = \frac{2\pi * \text{speed} * \text{torque}}{60} \text{ Watt}$$

substituting values,

$$100000 = \frac{2\pi * 4500 * T}{60}$$

$$T = 212.206 \text{ Nm}$$

the radial ratio between power wheel and pulse flywheel i.e. r: R is 1:3 hence, torque induced at output shaft when power wheel and pulse flywheel comes in contact through friction tooth is,

$$212.206 * 3 = 636.62 \text{ Nm i.e. } 469.54 \text{ lb-ft}$$

the power developed in output shaft during single power pulse at 1500 RPM with 469.54 lb-ft torque is, using torque to HP conversion formula,

$$\text{output power} = \frac{\text{speed} * \text{torque}}{5252}$$

substituting values,

$$\text{output power} = \frac{1500 * 469.54}{5252}$$

$$\text{output power} = 134.10 \text{ HP}$$

power developed through 2 friction tooth(s) i.e. during 4 power pulses is,

$$134.10 * 4 = 536.4 \text{ HP}$$

$$\text{i.e. } 536.4 * 746 = 400154.4 \text{ Watt} = 400.15 \text{ KW}$$

From the above result we can see that, the magnitude of the power is amplified from 100 KW to 400.15 KW by hybridising solar panel with pulsed power transmission system.

theoretical efficiency ² after pulsebridization is,

² The power losses takes place during power transmission through surface contact and the energy conversion are not considered, to avoid the complexity in mathematical calculations performed in this research paper.

Torque to HP conversion formula is also used to measure the power of 4 stroke engine. Hence to show the conceptual relationship between pulsed power transmission system and internal combustion engine, this formula is used in calculations.

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$$\text{efficiency } \eta = \frac{\text{output power}}{\text{input power}} * 100$$

substituting values,

$$\eta = \frac{400.15}{100} * 100$$

$$\eta = 400.15 \%$$

Performing theoretical calculation efficiency is going beyond 100%, but even after subtracting the losses takes place during each power pulse and the energy conversion up to 40 % i.e. $400.15\% - [4 * 40\%] = 240.15\%$, still efficiency will stand beyond 100%.

Table 3. Results after pulsebridization,

Excess amplified power	300.15 KW (Excluding input power)
Excess energy generation	4,65,233 Units per Annum
Saving in land area	3000 Sq. m.

3.2 Pulsebridization of wind power generation system:

Structural arrangement for pulsebridization of wind turbine is similar to that of used for solar panels, only the difference is that solar panel is replaced by the wind turbine. If the wind turbine having output power capacity of 100 KW is pulsebridized using pair of pulse flywheel having 2 number of friction tooth(s) and power wheel with radial ratio R: r = 3: 1, then it will give approximate amplified power output of 400.15 KW as same as pulsebridized solar panels. Because of same considerations used in pulsebridization of solar power system, there is no need to perform separate calculations.

Due to generation of excess output power from pulsebridized wind power generation system, we can save more land space and that land space can be utilise for tree plantation, this methodology and ideology will save and beautify our environment.

3.3 Pulsebridization of coal powered, nuclear powered, Gas powered, Hydro powered and I. C. Engine powered power generation systems:

Steam turbine, gas turbine, hydro turbine and I. C. Engine are the mechanical devices comprises high speed rotating shaft. These devices converts mechanical energy into electrical energy using generators. Due to high speed rotating shaft, turbines can be used as prime mover for pulsebridization. By considering turbines and I. C. engines as a prime mover, pulsebridization is parted into two types:

- *Collaborated pulsebridization:*

Here, the prime mover directly transmits the power impulsively to the shaft of generator, to amplify the magnitude of received power by means of pulsed power transmission mechanism. In this pulsebridization, prime mover used in system directly takes part in pulsed power transmission.

- *Separated pulsebridization:*

Here, the power generated by the primary power generation system is used as a input power for the pulsed power transmission system, where received power is amplified. In this pulsebridization, pulsed power transmission system used as secondary power generation system; which is depend upon the functionality of primary power generation system.

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3.3.1 Collaborated pulsebridization:

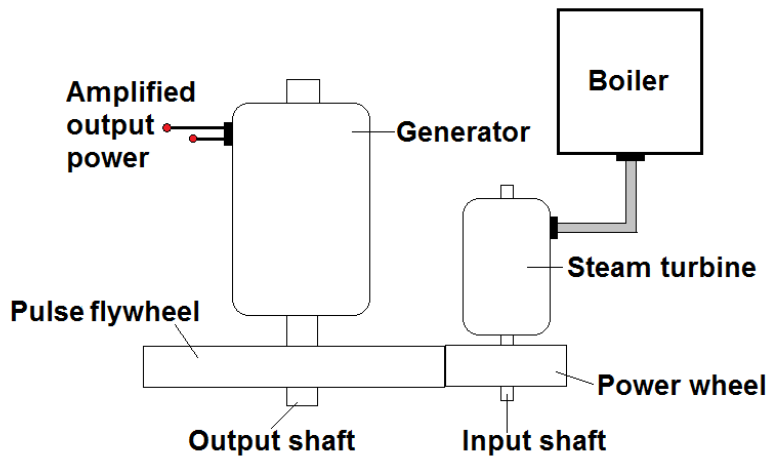


Fig. 5. collaborated pulsebridized steam turbine system

As shown in Fig. 5, in collaborated pulsebridized steam turbine system, the power wheel is mounted on rotating shaft of the turbine. Boiler is connected to the steam turbine and supplies steam. the central axis of rotation of the power wheel and the turbine shaft is same. Pulse flywheel is in contact with power wheel through friction tooth(s) with high frictional grip. Pulse flywheel consist 2 friction tooth(s) is mounted on the output shaft. The central axis of rotation of the input shaft of the generator and the pulse flywheel is same, where generator is connected to the output shaft. This system consists only one generator.

Boiler in the system delivers high saturated pressurized steam to the turbine. Turbine converts the energy of steam into mechanical energy and the shaft of the turbine starts to rotate, this results into rotation of the power wheel. The power wheel transmits energy to the pulse flywheel impulsively through friction tooth(s), due to impulsive power transmission, excess energy get developed at the output shaft. The energy developed in pulse flywheel mounted on output shaft, is then transmitted to the generator where it is converted into electrical energy.

Table 4. Technical specification of steam turbine as a prime mover,

Power output	110 KW
Speed of turbine shaft	4500
Diameter of turbine blades	400 mm
Fuel consumption rate (24 hr)	1544 kg/day (D grade coal)

torque T, generated in turbine shaft is,

$$110000 = \frac{2\pi * 4500 * T}{60}$$

$$T = 233.427 \text{ Nm}$$

the radial ratio between power wheel and pulse flywheel i.e. r: R is 1:3 hence, torque induced at output shaft when power wheel and pulse flywheel comes in contact through friction tooth is,

$$233.427 * 3 = 700.28 \text{ Nm i.e. } 516.50 \text{ lb-ft}$$

the power developed in output shaft during single power pulse at 1500 RPM with 516.50 lb-ft torque

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using torque to HP conversion formula,

$$\text{power} = \frac{\text{speed} * \text{torque}}{5252}$$

$$\text{power} = \frac{1500 * 516.50}{5252}$$

$$\text{power} = 147.51 \text{ HP}$$

power developed through 2 friction tooth(s) i.e. during 4 power pulses is,

$$147.51 * 4 = 590.04 \text{ HP}$$

$$\text{i.e. } 590.04 * 746 = 440169.84 \text{ Watt} = 440.17 \text{ KW}$$

From the above performed calculations we can see that 110 KW capacity steam turbine can generate 440.17 KW i.e. nearly 4 times excess than its actual capacity when pulsebridized using collaborated pulsebridization with 2 toothed pulse flywheel.

theoretical efficiency of collaborated pulsebridized system is,

$$\text{efficiency } \eta = \frac{\text{output power}}{\text{input power}} * 100$$

$$\eta = \frac{440.17}{110} * 100$$

$$\eta = 400.15 \%$$

now,

$$\text{saving of coal per day: } 440.17 - 110 = 330.17 \text{ KW}$$

We generate 330.17 KW of excess power using pulsebridization, hence approximate saving in coal consumption,

$$330.17 / 110 = 3$$

$$1544 * 3 = 4632 \text{ Kg/ day approximately.}$$

3.3.2 Separated pulsebridization:

As shown in following Fig. 6, separated pulsebridized steam turbine system consists of primary power generation system and secondary power generation system. Primary power generation system comprises primary generator, steam turbine and boiler, and secondary power generation system i.e. pulsed power transmission system comprises secondary generator, electric motor and pair of power wheel and pulse flywheel. The boiler is connected to the steam turbine, wherein the shaft of the turbine is coupled with the generator. The electric motor is connected to the output terminals of the primary generator. Power wheel is mounted on the shaft of the electric motor. The input power capacity of electric motor is same as that of output power capacity of primary generator. Pulse flywheel consisting of 2 friction tooth(s) is mounted on the shaft of the secondary generator. Pulse flywheel is connected with the power wheel through friction tooth(s) with high frictional grip.

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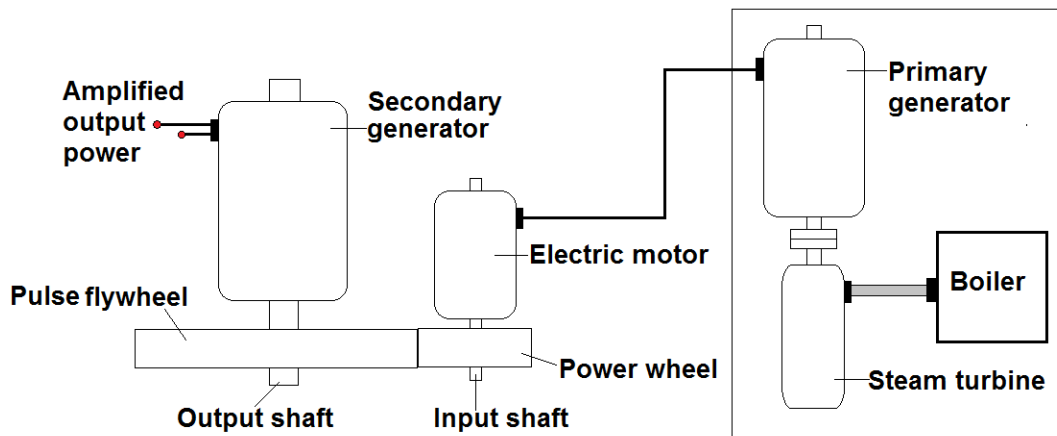


Fig. 6. separated pulsebridized steam turbine system

Boiler delivers saturated high pressurised steam to the turbine, this results into rotation of the turbine shaft. The turbine shaft transmits its mechanical energy to the primary generator through coupling, where primary generator converts received energy into electrical energy. The output terminals of the primary generator are connected with the electric motor where again the electrical energy is converted into mechanical energy. The power wheel transmits the energy to pulse flywheel impulsively using surface contact through friction tooth(s). Secondary generator converts the energy gained from pulse flywheel into electrical energy again, where the output power obtained from the secondary generator is amplified output power.

Table 5. Technical specification of system for primary energy source,

Power output from primary generator	110 KW
Speed of turbine shaft	4500
Input power to the electric motor	110 KW
Fuel consumption rate	1544 kg/day (D grade coal)

Here,

The turbine having power capacity 110 KW converts mechanical energy into equivalent electrical energy using primary generator. 110 KW power is again converted into mechanical power by means of equal capacity electric motor. This means that in separated pulsebridized steam turbine system, power 110 KW is feed into pulsed power transmission system after mechanical- electrical- mechanical energy conversion, hence as similar to collaborated pulsebridized steam turbine system, the amplified output power from secondary generator will be 440.17 KW with an system efficiency of 400.15% and the saving of the burning coal will be 4632 Kg/ day approximately.

The both systems, collaborated pulsebridized steam turbine system and the separated pulsebridized steam turbine possesses advantages over each other due to their constructional and functional characteristics:

- [01] Cost of installation for collaborated pulsebridization is less than the separated pulsebridization because it does not require secondary generator and separate electric motor to run pulsed power transmission mechanism.
- [02] Cost of installation of separated pulsebridized system is near about twice, than the cost required to install collaborated pulsebridized system.
- [03] The separated pulsebridized system requires high maintenance.
- [04] Floor area required to install collaborated pulsebridized system is half than the floor area required to install separated pulsebridized system.
- [05] The separated pulsebridized system possesses one huge advantage over collaborated pulsebridized system, is that

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the pulsed power transmission system can be disassembled from the primary generator, and remaining system can be used as thermal power generation plant when required but, it is not possible or very complex to disassemble pulsed power transmission mechanism in collaborated pulsebridized system.

- [06] High capacity power generating devices and systems can be manufactured in compact size by using collaborated pulsebridized system.
- [07] The overall system efficiency of the collaborated pulsebridized system is higher than the separated pulsebridized system, because in separated pulsebridized system energy losses takes place during frequent energy conversion .
- [08] Multiple pulsebridization is possible in both collaborated pulsebridized steam system and the separated pulsebridized system. (*it has a limit.*)

Similarly, using I. C. engine, gas turbine and hydro turbine as a prime mover in pulsebridization, we can save our available natural energy resources, fossil fuels on large scale and also we can minimise carbon emission by increasing efficiency of the power generating systems.

IV. MULTIPLE PULSEBRIDIZATION

Multiple pulsebridization is the continuous amplification process of the electrical power received from the primary generator or other available energy source, using two or more pulsed power transmission systems. According to arrangement of the pulsed power transmission systems, multiple pulsebridization is parted into two types:

- Series multi-pulsebridization.
- Parallel multi-pulsebridization.

4.1 Series multi-pulsebridization:

In series multi- pulsebridization energy has to go through continuous electrical- mechanical- electrical energy conversion, because of two or more pulsed power transmission systems are connected in series.

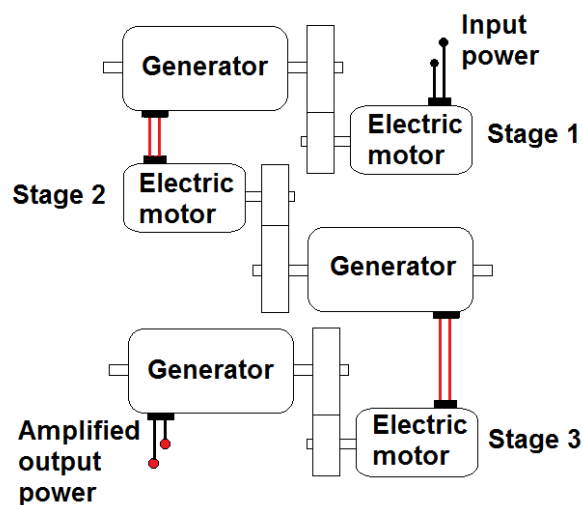


Fig. 7. series multi-pulsebridized system

In above Fig. 7, 3 stage series multi-pulsebridized arrangement is shown. The input power required to run series multi-pulsebridized system, is gained from available energy source or from primary generator. Series multi-

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pulsebridized system consist of at least 2 stages for power amplification process. Each stage is consist of electric motor, generator and pair of pulse flywheel and power wheel i.e. pulsed power transmission system. Power wheel is mounted on the shaft of electric motor, while pulse flywheel is mounted on the shaft of generator. In this type of arrangement, the electric motor present in next stage receives the input power from the generator present in previous stage, hence the power capacity of electric motor is equal or slightly greater than the output power capacity of generator present in previous stage. The components of the 3 stage series multi- pulsebridized system are,

Table 6. Components in series multi- pulsebridized system,

Components in stage 1	first electric motor, first generator, first pair of power wheel and pulse flywheel
Components in stage 2	second electric motor, second generator, second pair of power wheel and pulse flywheel
Components in stage 3	third electric motor, third generator, third pair of power wheel and pulse flywheel

Stage 1:

In this stage, first electric motor receives the input power from primary energy sources and impulsively transmits it to the input shaft of the first generator through first pair of power wheel and pulse flywheel.

Stage 2:

In stage 2, the second electric motor receives amplified output power as a input power from the first generator, and impulsively transmits it to the input shaft of the second generator by using second pair of power wheel and pulse flywheel.

Stage 3:

In this stage, third electric motor receives amplified output power as a input power from the second generator, and impulsively transmits it to the input shaft of the third generator by means of third pair of power wheel and pulse flywheel. The last generator in this type of arrangement, gives overall amplified power output since it is present in last stage of system.

Table 7. Primary technical specifications for the components in series multi-pulsebridized system,

Input power to first electric motor	2 HP
Speed of electric motor	4500 RPM
Speed of generator shaft	1500 RPM
Number of friction tooth(s)	2

Now,

[01] For stage 1:

first electric motor receives 2 HP = 1492 Watt power from the available energy source,
the first electric motor transmits the power 1492 Watt impulsively to the pulse flywheel at 4500 RPM.
torque T, developed at the shaft of first electric motor is,

$$1492 = \frac{2\pi * 4500 * T}{60}$$

$$T = 3.17 \text{ Nm}$$

the radial ratio between power wheel and pulse flywheel i.e. r: R is 1:3. Hence, torque induced at the shaft of first generator when power wheel and pulse flywheel comes in contact through friction tooth is,

$$3.17 * 3 = 9.51 \text{ Nm i.e. } 7.01 \text{ lb-ft}$$

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Now,

power developed in first generator shaft during single power pulse, at 1500 RPM with 7 lb-ft torque is,

$$\text{power} = \frac{\text{Speed} * \text{Torque}}{5252}$$

$$\text{power} = \frac{1500 * 7}{5252}$$

$$\text{Power} = 1.99 \text{ HP} = 2 \text{ HP}$$

total power developed in first generator during complete 720⁰ rotation i.e. during 4 power pulses is,

$$2 * 4 = 8 \text{ HP} = 5968 \text{ Watt}$$

amplified output power from the first generator is 5968 Watt

[02] For stage 2:

input power received by second electric motor = 5968 Watt
torque T, developed in the shaft of second electric motor at 4500 RPM is,

$$5968 = \frac{2\pi * 4500 * T}{60}$$

$$T = 12.66 \text{ Nm}$$

the radial ratio between power wheel and pulse flywheel i.e. r: R is 1:3. Hence, torque induced at the shaft of second generator when power wheel and pulse flywheel comes in contact through friction tooth is,

$$12.66 * 3 = 37.98 \text{ Nm i.e. } 28.0 \text{ lb-ft}$$

Now,

power developed in second generator shaft during single power pulse, at 1500 RPM with 28 lb-ft torque is,

$$\text{power} = \frac{\text{Speed} * \text{Torque}}{5252}$$

$$\text{power} = \frac{1500 * 28}{5252}$$

$$\text{Power} = 7.99 \text{ HP i.e. } 8 \text{ HP}$$

total power developed in second generator during complete 720⁰ rotation i.e. during 4 power pulses is,

$$8 * 4 = 32 \text{ HP} = 23872 \text{ Watt}$$

amplified output power from second generator is 23872 Watt

[03] For stage 3:

input power received by third electric motor = 23872 Watt
torque T, developed in the shaft of third electric motor at 4500 RPM is,

$$23872 = \frac{2\pi * 4500 * T}{60}$$

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$$T = 50.65 \text{ Nm}$$

the radial ratio between pulse wheel and power flywheel i.e. r: R is 1:3. Hence, torque induced at the shaft of third generator when power wheel and pulse flywheel comes in contact through friction tooth is,

$$50.65 * 3 = 151.95 \text{ Nm i.e. } 112.07 \text{ lb-ft}$$

Now,

power developed in third generator shaft during single power pulse, at 1500 RPM with 112.07 lb-ft torque is,

$$\text{power} = \frac{\text{Speed} * \text{Torque}}{5252}$$

$$\text{power} = \frac{1500 * 112.07}{5252}$$

$$\text{Power} = 32 \text{ HP}$$

total power developed in third generator during complete 720° rotation i.e. during 4 power pulses is,

$$32 * 4 = 128 \text{ HP} = 95488 \text{ Watt}$$

gross theoretical amplified output power from last generator is 95.49 KW

hence, theoretical efficiency of series multi-pulsebridized system is,

$$\text{efficiency } \eta = \frac{\text{output power}}{\text{input power}} * 100$$

$$\eta = \frac{95.49}{2} * 100$$

$$\eta = 4774.5 \%$$

We can observe that, theoretical output power obtained from the calculations performed for series multi-pulsebridized system is very higher than the input power given to it. It is very easy to construct such a system but, practically it is impossible to run such high efficient system under load condition. *This system and its arrangement is a theoretical concept only.*

Table 8. Required technical specification of the components in series multi-pulsebridized system according to performed calculations, with safety allowance,

First electric motor	2 HP
First generator	6.5 KW
Second electric motor	9 HP
Second generator	24.5 KW
Third electric motor	33 HP
Third generator	96 KW

4.2 Parallel Multi-pulsebridization:

One set of pulsed power transmission is consist of electric motor, generator and pair of power wheel and pulse flywheel i.e. pulsed power transmission system. In parallel multi-pulsebridization, such sets are arranged parallel to each other and the electric motor present in each set receives input power of same magnitude from common energy source separately. The output power of any set is not depend upon functionality of other working sets, present in the same system.

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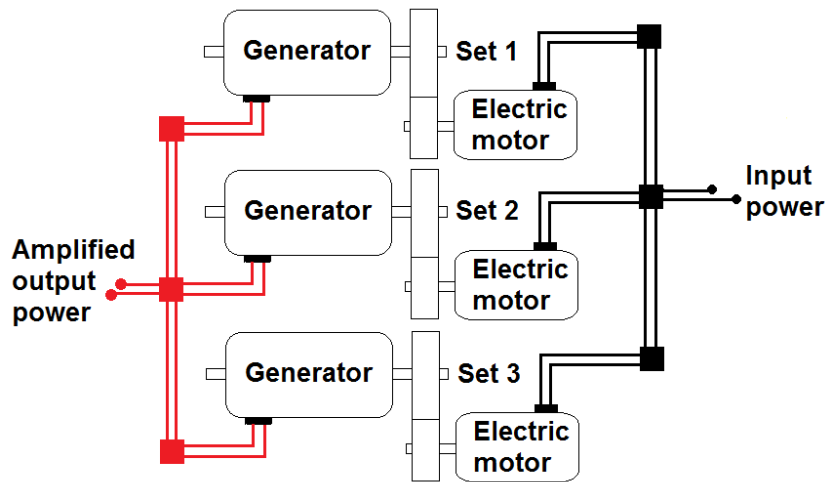


Fig. 8. parallel multi-pulsebridized system

Fig. 8, shows the construction of parallel multi-pulsebridized system having 3 sets. As shown, electric motor in each set receives input power separately from common source, hence even when one or more sets are kept shut down, it will not affect the functionality of remaining sets working in same system. Electric motor in each set receives input power and transmits it impulsively to the corresponding generator through separate pair of power wheel and pulse flywheel. The power wheel is mounted on the shaft of electric motor and the pulse flywheel is mounted on the shaft of generator. Due to impulsive power transmission between power wheel and pulse flywheel, excess energy get induced at the shaft of generator, where generator converts excessive energy into electrical energy. The amplified power developed in each generator present in system is delivered to the common point or can be delivered at separate points.

Table 9. Technical specifications of the components in parallel multi-pulsebridized system,

Input power to each electric motor	2 HP
Speed of electric motor shaft	4500 RPM
Speed of generator shaft	1500 RPM
Number of friction tooth(s)	2

electric motor in each set receives 2 HP = 1492 Watt power from the common power source,
each electric motor transmits the power 1492 Watt impulsively at 4500 RPM.
hence, torque T developed at the shaft of each electric motor is,

$$1492 = \frac{2\pi * 4500 * T}{60}$$

$$T = 3.17 \text{ Nm}$$

the radial ratio between power wheel and pulse flywheel i.e. r: R is 1:3. Hence, torque developed at each corresponding generator shaft when power wheel and pulse flywheel comes in contact through friction tooth is,

$$3.17 * 3 = 9.51 \text{ Nm i.e. 7 lb-ft}$$

Now,

power developed in each generator shaft during single power pulse at 1500 RPM with 7 lb-ft torque is,

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$$\text{power} = \frac{\text{Speed} * \text{Torque}}{5252}$$

$$\text{power} = \frac{1500 * 7}{5252}$$

$$\text{Power} = 2 \text{ HP}$$

power developed in each generator during complete 720° rotation i.e. during 4 power pulses is,

$$2 * 4 = 8 \text{ HP} = 5968 \text{ Watt}$$

gross amplified output power generated by all sets present in system is,

$$5968 * 3 = 17904 \text{ Watt} = 24 \text{ HP}$$

hence, theoretical efficiency of parallel multi-pulsebridized system is,

$$\text{efficiency } \eta = \frac{\text{output power}}{\text{input power}} * 100$$

$$\eta = \frac{24}{(2 * 3)} * 100$$

$$\eta = 400\%$$

From the above performed calculations we can observed that parallel multi-pulsebridized system is less efficient than the series multi-pulsebridized system, but practically parallel multi-pulsebridized system is seems to be feasible to run under load conditions. Parallel multi-pulsebridized system posses advantages over series multi-pulsebridized system due to their constructional difference:

- [01] Installation cost of the series multi-pulsebridized system is higher than the parallel multi-pulsebridized system, because series multi-pulsebridized system needs high power capacity generators and electric motors.
- [02] Series multi-pulsebridized system requires more maintenance than parallel multi-pulsebridized system.
- [03] In parallel multi-pulsebridized system, one or more sets can be shut down for the repairing or any other purpose, but in series multi-pulsebridized system whole system need to be shut down.
- [04] Under load conditions series multi-pulsebridized system has to face the problem of high speed reduction in generator speed, but in parallel multi-pulsebridized system load get uniformly distributed on each working set due to which problems of speed reduction will not occur.
- [05] Parallel multi-pulsebridized system is more flexible than series multi-pulsebridized system, since all sets present in system are not depend on each other's functionality.
- [06] Practically we cannot run series multi-pulsebridized system having more than 2 stages of pulsed power transmission, but in parallel multi-pulsebridized system we can include more than 3 sets in one system.
- [07] In series multi-pulsebridized system, the maximum load comes on first electric motor present in first stage of pulsed power transmission and have to suffer from heating damages, but in parallel multi-pulsebridized system each electric motors shares the whole load acting on a system.

V. REQUIREMENTS FOR PULSEBRIDIZATION

- [01] Prime mover used in system must be capable to run under load conditions with constant speed and torque.
- [02] There must be higher frictional grip between friction tooth(s) and the contacting surface of intermediate power transmitting component.
- [03] Material of friction tooth and surface of intermediate power transmitting components should posses high

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resistant to wear and tear.

- [04] There should be appropriate arrangements for cooling the driving electric motors in the system.
- [05] Presence of gravitational energy is mandatory to obtain excess output.

VI. ADVANTAGES OF PULSEBRIDIZATION

- [01] It increases the efficiency of current low efficient power generating systems.
- [02] Compact and high power generating systems can be construct using pulsebridization.
- [03] It will help to reduce increasing pollution and carbon emission.
- [04] It gives excessive output power as compare to input power given, this makes feasible to construct the systems having efficiency more than 100%.
- [05] Due to high efficiency power generating systems, wastage of energy resources will reduce, this results into saving of energy resources and environment.
- [06] Maintenance of pulsed power transmission mechanism used in pulsebridization process is less costly.
- [07] Construction and arrangement used for pulsebridization is simple and requires less maintenance.
- [08] There is no geographical limits for pulsebridization, except presence of gravitational energy.
- [09] Cost of pulsebridization is less, hence it is better to pulsebridize old power generation system than to install another new one to fulfil energy demand.
- [10] Multiple pulsebridization gives ability to engineers to build high capacity power plants by providing less amount of energy in minimum budget.

VII. CONCLUSION

The "pulsebridization" is new methodology which can be easily and effectively used with the current power generating systems. Efficiency of the current power generating systems can be fetch beyond 100% by using pulsebridization. After observing the results obtained from performed calculations for pulsebridized systems, it get clear that even considering various losses takes place during power transmission and energy conversion, we can obtain efficiency more than 100% in actual working conditions. To construct multiple pulsebridized systems, parallel multi-pulsebridization is practically more feasible to run system under load conditions.

Pulsebridization process is presently theoretical concept base on working of I. C. engine, but if practically constructed and tested then definitely the world we see the new highly efficient technology, the new energy source, which posses the ability to save environment and to fulfill the human demands for which we are looking for.

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BIOGRAPHY



Saurabh Vikas Chaudhari, Mechanical Engineer and 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 is the first, who puts the pulse mechanism based on I. C. Engine working phenomena and using mathematical calculation he proved, that the efficiency of the system can exceeds 100% by using the mechanical component pulse wheel/flywheel for power transmission. He mathematically illustrated the first pulsed power transmission theory in Mechanical Engineering.

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 and transmission systems.