

An Eco-friendly Hybrid Power Generation system from Non-Conventional Energy Sources

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Abstract

This paper describes a new hybrid Electrical Power Generation System by integrating simultaneously Solar Energy, Rains Energy, Wind Energy and Lightning Energy as non-conventional energy sources. All the natural wastage energies are used for production of Electricity. Thus, the Electrical Power or Electricity is available with a minimum cost and pollution free to anywhere in the world at all times. This process reveals a unique step in electricity generation and availability from natural resources without hampering the ecological balance. We can have an uninterrupted power supply irrespective of the natural condition without any sort of environmental pollution. This process yields the least production cost for electricity generation. Utilization of lightning energy for generation of electricity reveals a new step. It will bring a pollution and accident free homogeneous nature to safe guard the world in a unique way.

1. Introduction

In Modern-days it is very necessary to find out the renewable energy or power sources for domestic and small commercial purposes. At present in World, more than 60% of people and in India 70% of people are not getting electricity in their daily life. For electricity such as lighting, cooking, moderate machine operating etc, they are extremely depending on oil like kerosene, diesel, petrol, bio-oils and other bio-materials like trees, extracts of food grains etc. These firing of oils or bio-materials cause extreme pollution to nature [1-3]. Secondly our conventional power generating station like thermal power generation plant [3-10], hydro-electric power plant [9-10], nuclear power generation plant [10] etc are causing heavy pollution to nature and living world. The dust, ashes and disposals (outcome) of these power stations are extremely harmful to us, the radio-active ashes of the nuclear power plant (stations) are not only rejecting immediate harmful materials, but it has a long lasting action also, since it emits radio-active radiation for a long time. The coal and other burning materials ashes, numerous poisonous gases like CO, CO₂, methane and hydrocarbons etc are the disposals of thermal power stations which are the most popular and highly power generation method adopted throughout the world at present. Thus, the thermal power stations are causing extreme pollution to our mankind and nature. Lot of diseases and handicapped affect are the fruit of these powerstations. Also natural resources like coal, oil, radio-active materials etc will come to shortage stage or an end in near future. The other power generating systems like Hydro- Electricity power generating plant cannot afford much power, although it causes less pollution. Therefore, it needs urgent invention to go for non-conventional energy resources. The most popular non-conventional power resources are solar energy power plant which converts solar energy or solar heat to electricity. Solar power generation system has some draw back, that is, it cannot generate power in cloudy or rainy days. Therefore, people using this solar system have to remain without electricity (power) after battery gets discharged during the rainy season or the sun's shortcomings, since it is totally depended on appearance of the sun in the sky. Moreover, it has very much limited capacity and we can not take all available solar energy, because it is urgently required in all other fields also e.g. biological body or health care, agriculture, chemical reactions, industries etc.

2. Wind Power Generation System

The wind energy [7, 10] is a renewable source of energy. It is used to run a windmill which in turn drives a wind generator or wind turbine to produce electricity. Practically it is observed that the flexible three blades propeller about 35 m in diameter, in a 60 Km/hr wind pressure with a rotation speed of 47 rpm produce maximum power 12 MW.

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For small wind power generation system, multiple bladetype (3 to 5 number blades) or Darrieus type (Curved Blade 3 to 5 numbers) is highly suitable. The main drawback of this system is that as the wind speed or velocity is not constant with respect to time i.e. fluctuating, hence the electric power thus obtained is also not having predetermined value i.e. varying nature.

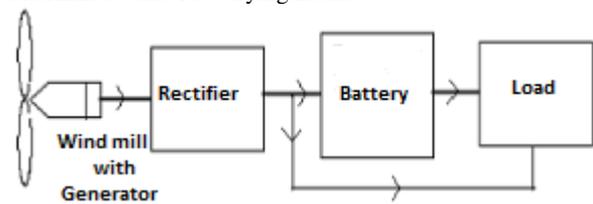
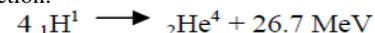


Fig. 1. Block Diagram of Windmill Power System

Thus, it is better to feed the wind electricity to the battery or any power storage device i.e. accumulator circuit which supply the load accordingly, rather directly supply to the load as shown in Fig.1. In wind power system, the power generation increases in proportion to the cube of the wind speed. Thus it is highly affected in rainy and stormy period when the wind speed is formidable to produce electricity. This will be under sweet temperature with smooth environment power generation system is pollution free pure ecologically balanced one. Small size wind mill with generator either horizontal or vertical or inclined at a certain angled blades can be placed on the wall, the sunsets etc of a building for utilizing the maximum power of wind in all directions. In this event, inside of the building.

3. Solar Power Generation System

The sun is a continuous fusion reactor in which hydrogen combines to form helium and evolving huge amount of heat energy as per the following reaction:



This heat energy from the sun [8-10] is emitted in the universe and the earth by transmission of tiny bundles of energy particles called photons which move with finite speed (almost speed of light) and energy. When photons strike an atom, they interact with the electrons by transferring their energy and hence they are absorbed. The Sun rays are composing of different wavelength spectrum from the low to the very high ranges, but UV (ultra-violet) radiation, other low and very high range wavelength radiations are absorbed by ozone, oxygen, nitrogen, water vapour etc., lying above the earth's atmosphere. Thus, the sun rays consist of wavelength (λ) radiation between 0.29 μm to 2.3 μm (approximately). A solar cell [2, 8] consists of a basic element, named photovoltaic (PV) generator, usually as doped semiconductor materials e.g. photodiode, phototransistor etc. Photovoltaic (emf) generation is caused by the sun light radiation i.e. the photons absorption that separate positive and negative charge carriers in the absorbing

semiconductor materials. These charges, constitute an electric voltage, can afford a current for use in external circuit or load. Different type of solar cell materials is single crystal, polycrystalline and amorphous silicon and compound of thin film semiconductor materials. Variety of semiconductor compounds such as CuInSe₂, Cd, S, Cd, Te, Cu₂S, In P etc., are used to manufacture thin film solar cells. The combination of different band gap (E_g) material lead to photovoltaic generator of much higher efficiencies.

The Solar Power Generation System is planned accordingly Fig. 2. The solar cell array or panel consists of an appropriate number of solar cell modules connected in series or parallel to provide the required current and voltage.

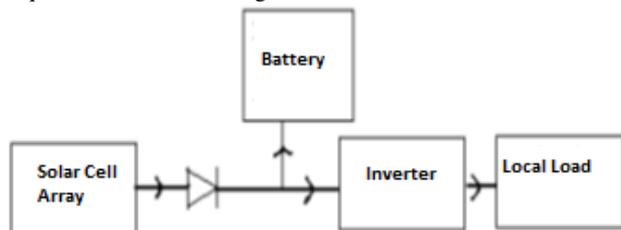


Fig. 2. Basic Solar (Photovoltaic) System

Storage batteries as shown in Fig. 2 provide the backup power during no sun shine period by storing the excess power or some portion of power from the solar arrays. This solar power generating system is used for private power consumption, meteorological stations, radio or TV relay stations, entertainment places like cinema, hotel, restaurant etc., villages and islands. The small size solar array or panels are fitted in addition on the roof to the wall, the sunsets, the balcony etc., of a building or a structure, such that full solar energy falling on the building can be utilized. In this arrangement, inside of the building will remain in very moderate temperature even in hot summer times.

4. Rains Power Generation System

In this system the energy of water is utilized to drive the turbine [1-10] which in turn runs the power generator to produce electricity. Rain falling on the earth's surface has potential energy relative to the oceans level. This potential energy is converted to shaft work or rotate, in which the water falls through an appreciable vertical distance (9 feet to 15 feet minimum). The hydraulic power obtained from the rains water is thus a naturally available renewable energy source. It is expressed as

$$P = \rho g Q H \text{ Watt,}$$

Where P is the hydraulic power in Watt, g is 9.81 m/s² (the acceleration due to gravity), ρ is the water density ($\rho = 1000 \text{ Kg/m}^3$), Q is the flow or discharge in m³/s and H is the height of fall of water or head in m. The electrical energy produce in Kwh is written like this,

$$W = 9.81 \times 1000 \times Q \times H \times \eta \times t$$

Here, 't' is the operating time in hours and 'η' is the efficiency of the turbine generator assembly which varies between 0.5 to 0.9. The rains power developed thus depends on Quantity (Q) and Head (H) of water. The circuit diagram of the rains power generation system is the same as that of the solar system as shown in Fig. 2, the only difference is that in place of the solar array, we apply the rains power generator having turbine assembly. In rainy times, the rains water are collected in a tank or reservoir which are kept at a certain height like roof of a building or on a hill or above usual water tank etc, this collected water is allowed to fall from that height (at least 9 to 15 feet or more) to the blades of small turbine whose shaft fed to a dynamo (small type). The current, develops in the dynamo due to rotation of light turbine blades, is supplied to the local load as well as charging the batteries or storing in the accumulator circuit consisting of capacitors and inductors or IC chips etc. While the sun appears, the local load and the batteries can be fed by the solar panel.

Therefore, the electric power from these renewable energy sources like the solar or the rains is available all times in a day, also in the night period when the rain falls. This power generation system does not produce any kind of environmental pollution.

5. Lightning Power Generation System

Lightning Source possesses huge amount of electricity only. We are designing the method or the process to use this renewable lightning energy source first time for human use. Generally during raining and storming time, lightning is a daily affair which causes casualties and natural disasters. We fit large number of lightning arrestors or catchers in a locality at the top of high rise buildings, trees and structures for antenna mounting (tower) etc. Each of the lightning arrestor is connected to a common collection resources or transducer placed at a central location by good and sufficient thickness (gauge) conducting wire like copper or any alloy made. At the time of lightning, the lightning arrestors catch lightning which is ac nature mixed with sufficient quantity dc also i.e. huge amount of electricity flows through the conducting feeder wire or cable and associated circuitry. The electric energy captured by lightning arrestors is passed through rectifier circuit to convert completely in dc form, then dc electric voltages are passed to the capacitors as marked C1, C2, C3 having very high capacitance range which are generally used in high tension line as shown in Fig. 3 or charge set of storage batteries kept in parallel, such that this parallel capacitors or the batteries are charged to equal amount of voltages (dc) from the rectifier output. Hence this charged capacitors or the batteries act as a dc voltage source and they are fed to the load or the battery (storage circuit) as an electric power or voltage source.

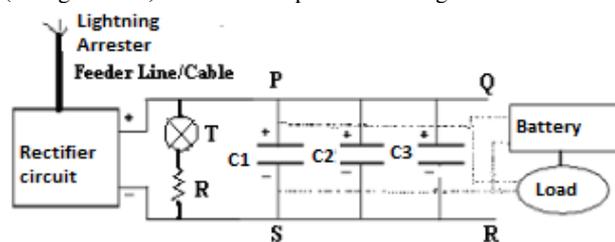


Fig. 3. Circuit Diagram for Lightning Electricity Power Stored in Parallel Capacitors and Supplied to Load or Battery

Another procedure for deriving electricity from lightning source is achieved by any electric power transducer circuit i.e. converting electric energy to the other form of energy e.g. heat energy or mechanical energy or any other form of energy etc. then this transformed energy (heat or mechanical or other form energy) is converted to electrical energy.

The transducer, using for lightning electric power storing, converts this huge amount of electrical energy either to heat energy by suitable metal or alloy plates e.g. Nichrome (Ni-Cr) alloy, Ceramic alloy, thermocouple etc. or to mechanical energy by motor, rotor etc. Subsequently this heat energy or mechanical energy or the transformed energy is converted to electrical energy as power resources. In Fig. 4, I is the total current received from the lightning source after rectifying as dc which is subdivided into three or more current quantities like I₁, I₂ and I₃ etc. to supply three or more transducer plates for converting these currents to heat or mechanical or any other energy. Thereafter these heat or mechanical or changed energy quantities are further converted to electricity by suitable transducer as shown in Fig. 4. Finally, the output electric power as derived from lightning source is employed for use in variety of purposes from domestic to commercial.

T is a lightning indicator either lamp or bell (ringer) type fed with very high resistance (R) to the rectifying output as shown in figure 3 and figure 4. This lightning indicator glows or operates only after catching a lightning resource which indicates presence of the lightning power in the circuit.

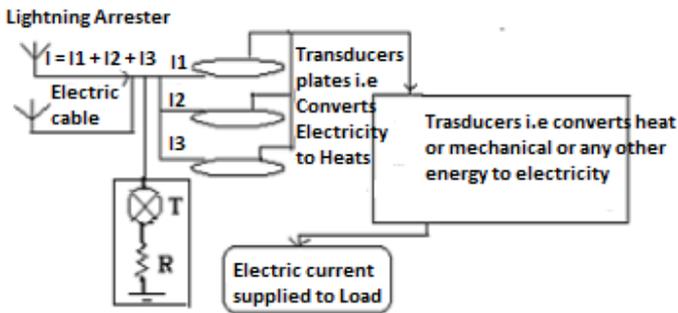


Fig. 4. Block Diagram of Electricity Generated from Lightning Source with Parallel Plate Transducers

The capacitors in the panel PQRS as shown in Fig. 3 or transducer circuit in Fig. 4 for conversion electric energy to heat or mechanical or any other form of energy are fully charged or transformed after arresting one lightning source and not completely discharged or converted in the other form in very short time (the rate of discharge depends on our requirement). Thus for further picking up lightning source by the same circuit, the rectifier circuit is switched over or connected to another set of fully discharged capacitors or activate transducer circuit. As a result the same lightning plant is safely used for any number of the lightning occurrence in that area.

For use of feeder line or cable with a stipulated distance to bring forth the lightning source to the lightning plant located at a central place, the high tension commercial electric power supply line can be used after disconnecting from commercial generator or transformers, especially in rainy and thunderstorm times when the lightning is highly predicted.

6. Hybrid Power Generation System

To eliminate the above drawbacks of individual renewable power generation system like Solar or Rains or Wind or Lightning etc. we design a new electricity or power generating system by integrating all the renewable power sources available from natural resources simultaneously, so that power supply remains continuous without any sort of interruptions or load shedding. This Solar-Rains-Wind-Lightning energy integrating power generation system can offer requisite amount of power suitable for household as well as commercial purposes in all times. Thus, we have not to depend on certain environmental (natural) condition i.e. the sun or the rains or the wind speed or the lightning appearance at all. We see, if the sun does not appear throughout a day or appear for lesser time in a day, then the probability of appearing rains with lightning and thunderstorm etc. are too much high in that day and most of the cases the rains fall in that day with or without lightning obviously.

Therefore, we consider that there are two conditions of environment in a day, i.e. either the sunny times or the rainy times. Also in the rainy times, generally wind flow i.e. speed of the wind is increased and probability of the lightning is higher. Therefore, these four natural nonconventional sources are intelligently used for power generation. So, we integrate all the resources in the nature like Solar, Rains, Wind and Lightning in a unique way. If we take average of two consecutive days, [generally, at present solar power system, full charged battery or storage circuit may not supply the requisite power to the load more than two consecutive days], then these two conditions i.e. the sunny time or the rainy time will appear in major time period and in between these two conditions, cloudy time remains very short period i.e., cloudy time (when there is no sun or no rains) can be overlooked in a day. If we able to supply electricity to the load or charge the battery or store electrical power during the rainy times, we have the power sources without interruptions [9-11]. This is explained elaborately in this paper.

Similar to the construction of individual non-conventional power system as described above, this Solar-Rains-Wind- Lightning Power Generation System is designed as shown in figure 5. The only difference is that it has some special equipment to charge the battery or the power storage (accumulator) circuit by rains, wind and lightning etc. This is clearly described in the block diagram of Fig. 5. Control circuit ad-joint with electric power generating system

provides necessary control functions such as adding or summing up electric power derived from more than one sources at a time i.e. solar and wind power simultaneously, rains-wind power simultaneously, rains-wind-lightning power simultaneously etc., over voltage protection, amount of electric power directed to the load and the battery etc.

Thus by implementing Solar-Rains-Wind-Lightning Integrating Power Generation System in a compact package, we have an uninterrupted power supply at the minimum cost to all places at all times. Moreover, we can avoid the accidental risk and causes by lightning to human and nature both. This method ensures a highly practical oriented pollution free and accident free inventory for electric power generation system. The electric power afforded by this system is completely pure and secured form without any sort of environmental pollution. Also it does not produce any greenhouse effect or acid rain or emit any kind of poisonous gases or radiation etc.

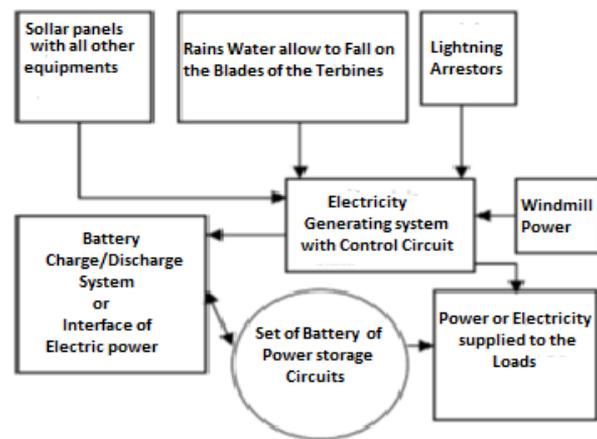


Fig. 5. Electricity Generating System Integrating Solar-Rains-Wind-Lightning Energy Sources.

7. Conclusions

This Integrating Solar-Rains-Wind-Lightning Energy Power Generation System will be highly effective in all places, especially in rural areas where the commercial electricity has not reached or undelivered. It causes no effect on nature i.e. pollution free, at the same time not proneness any kind of accident due to lightning and highly suitable for domestic purposes. It is also useful to urban and city areas, simultaneously with the commercial power supply to minimize power supply load i.e. cut short power charge. By using this system, people can save electricity charge and very less maintenance charge to this equipment is required. The designing of this equipment is done in such a way that it is very compact and acts as user friendly. When it is manufactured in a large scale, cost of this integrated natural resources power generation system is affordable. Moreover there is no power failure or load shedding situation at any times. Therefore, it is the most reliable renewable power or electricity resources with the least expenditure in the globe.

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