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An Investigation on Generation of Electricity Using Foot Step

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Abstract

Nowadays energy and power are the one of the basic necessities regarding this modern world. As the demand of energy is increasing day by day, so the ultimate solution to deal with these sorts of problems is just to implement the renewable sources of energy. But these renewable energy sources must have to be adopted in practical manner by keeping an eye on all aspects regarding the research work. So then these techniques should be applied in order to get the desired output. The objective of this work is power generation through footsteps as a source of renewable energy that we can obtained while walking on to the certain arrangements like footpaths, stairs, plate forms and these systems can be install elsewhere specially in the dense populated areas. The basic working principle of 'footstep power generation system' is based on the crank shaft and gear arrangement and fly wheel. So in order to implement this foot step power generation system we adjust the wooden plates above and below the sensors and moveable springs, when we walk on the mat than automatically force is applied and as a result magnet fixed under the top wooden sheet and moves into the cavity. As this cavity is fixed at bottom wooden sheet of mat so between the moveable springs adjusted between the top and bottom sheets. As a result of completing the above procedure or technique we made ourselves able to design such compatible system through which we could run our home appliances through AC output. As our main purpose was to charge the battery through DC output and then by inverting it into AC for normal common usage. Thus as a result we have concluded that these types of designs and techniques of power generating systems are very useful and handy in order to match the supply and demand of energy globally as well.

Keywords: Footpaths, Stairs, Plate forms, and Footstep power generation system.

Introduction

Proposal for the utilization of waste energy of foot power with human locomotion is very much relevant and important. Man has needed and used energy at an increasing rate for his sustenance and well-being ever since he came on the earth a few million years ago. With further demand for energy, man began to use the wind for sailing ships and for driving windmills, and the force of falling water to turn water for sailing ships and for driving windmills, and the force of falling water to turn water wheels. Till this time, it would not be wrong to say that the sun was supplying all the energy needs of man either directly or indirectly and that man was using only renewable sources of energy. This process involves number of simple setup that is installed under the walking platform. When people walk on this platform their body weight compresses the setup which rotates a dynamo or Sanyo coil and current produced is stored in dry battery. To reduce the external compression, a responsive sub-flooring system is installed. And while the power producing platform is over crowded with moving population, energy is produced at larger levels. Greater movement of people will generate more energy. This whole human energy being wasted if can be made possible for utilization it will be great invention and power producing platform will be very useful energy sources in crowded countries.

Literature Review

There are few methods to generate electrical energy from footsteps. Power would generated by footsteps of crowd on the floor. Piezo plate scheme is located beneath the floor then the then there will be sheet covering the piezo plate and also spring will be there for vibration force on piezo. The piezo plate will be in chunks in the floor. This plate will generate power in the type of electric current. The power produced by pedestrians can also be used as additional features such as to lightning up street light

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or the light that used at that place for pedestrians. So the pedestrians should give credit the energy which produced by their movement of crank shaft and Gear wheel and fly wheel are techniques to generate electrical power. This method also work on this principle and in it mechanical part are used because it is placed on where the number of peoples are more and energy produced by their movement on the floor.

To generate electrical power using footsteps one step will be enough at this level to produced electrical energy. As studied few methods from which power is generated. Following are the steps of fly and gear wheel method. First step is by proper arrangement of electrical system. After the arrangement of electrical system which transforms mechanical energy to electrical energy, When a human steps on the device due to his/her body weight the iron plate moves downwards and drives the crank shaft which further drives the gear arrangements which further drives fly wheel. Then there is another gear arrangement which is connected to the commentator of the dynamometer. When load using the power then this spring is used to vibrate the step by force then power is produced. Then the voltage that produced through steps is rectified and after battery charger circuit this D.C voltage is stored in the lead acid battery of 12 volt.This lead acid battery is further attached to the inverter. The invert is such designed that it inverts the voltage from battery which is 12 volt D.C to 230 volt A.C. So this A.C voltage is used in different appliances such as for charging the laptop battery and also to charge the handset, it can also be used to lightening up through energy saver. If we need more power from this technique then used more steps for more electric current and also then ability of battery and inverter should be increased then output power will be increased.

Foot step power generation resources

This type of power generation can be done through various techniques and methods like piezoelectric sensors, through mechanical arrangement like fly wheel and gear wheel, rack & pinion and chain sprocket arrangement. Pedal and springs type arrangement, staircase energy generating system by rotating the generator, then also by implementing the faraday's law of electromagnetic induction by moving magnet into the coil through spring system. This paper is based on crank shaft; fly wheel and gear arrangement .This type of footsteps power generation system are eligible to be installed in crowded places and rural areas cities in the places like railway stations, airports, footpaths where there is a rush of pedestrians.

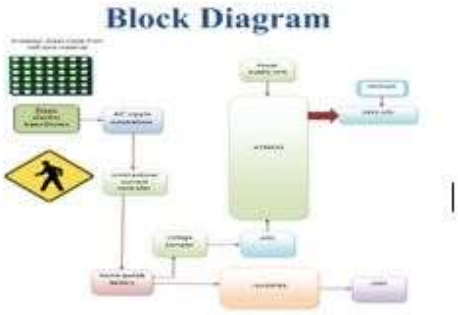

Fig-1 shows block digram for generation of electricity

Principle Of Generation Of Electricity By Foot Step Using Rack And Pinion Assemble And Chain Drive Mechanism

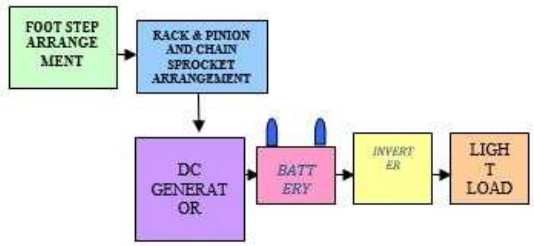

Fig 2 Shows Block Diagram For Generation Of Electricity Using Foot Step

Working Principle

The complete diagram of the foot step power generation is given below. Only one step is inclined in certain small angle which is used to generate the power. The pushing power is converted into electrical energy by proper driving arrangement. The rack & pinion, spring arrangement is fixed at the inclined step. The spring is used to return the inclined step in same position by releasing the load. The pinion shaft is connected to the supporter by end bearings as shown in fig. The larger sprocket also coupled with the pinion shaft, so that it is running the same speed of pinion. The larger sprocket is coupled to the small cycle sprocket with the help of chain (cycle). This larger sprocket is used to transfer the rotation force to the smaller sprocket. The smaller sprocket is running same direction for the forward and reverse direction of rotational movement of the larger sprocket. This action locks like a cycle pedaling action. The fly wheel and gear wheel is also

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coupled to the smaller sprocket shaft. The flywheel is used to increase the rpm of the smaller sprocket shaft. The gear wheel is coupled to the generator shaft with the help of another gear wheel. The generator is used here, is permanent magnet D.C generator. The generated voltage is 12Volt D.C. This D.C voltage is stored to the Lead-acid 12 Volt battery. The battery is connected to the inverter. This inverter is used to convert the 12 Volt D.C to the 230 Volt A.C. This working principle is already explained the above chapter. This 230 Volt A.C voltage is used to activate the light, fan and etc. By increasing the capacity of battery and inverter circuit, the power rating is increased. This arrangement is fitted in shopping complex, college and wherever the large people walking on the footsteps simultaneously.

Diagramatic Representation Of Rack And Pinion Assemble And Chain Drive Mechanism

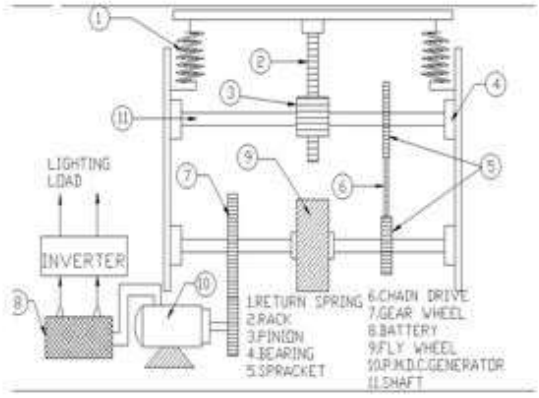

Fig 3 shows digramatics represenation of rack and pinion assembly

Staircase based electricity generation

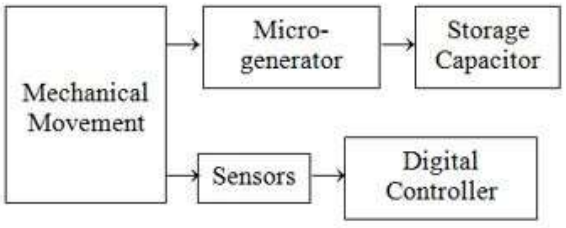

Fig 4 shows block diagram for stair case based electricity.

Mechanical Movement

This part mainly involves the staircase itself and the gears inside the staircase that are used to rotate the generator. The staircase has to be specially designed that can achieve a small displacement when being stepped on. The gears ratio and flywheel are optimized to get the maximum possible power out by driving the micro-generator. Alternatively, we can use a spring action with magnets and coils triggered by the staircase action to generate electricity.

MICRO-GENERATOR

The generator is the main component to convert mechanical movement into electricity. It works by induction, which means that when a conductor moves through the magnetic field, electricity is generated and stored in the next stage.

STORAGE CAPACITOR

At the end of the line is the storage capacitor which explains itself very much. Electricity generated by the micro-generator can be stored by charging up the capacitor, which can be stored for a period of time and extract anytime.

SENSORS

Sensors are needed to monitor the speed of the gears and flywheel of the mechanical movement in order to avoid wear and tear and to ensure proper engagement of the gears.

DIGITAL CONTROLLER

Information from the sensors is processed here and feedback control is executed under certain conditions such as the rotation speed of the flywheel. It will control the engaging and disengaging of the gears to control the speed to avoid overheating of the circuit.

Performance Requirements

- Be able to generate about 1W of power for each step of staircase.
- Be able to store significant power that can be used for basic lighting for at least one day.
- People should not spend too much energy in order to activate the system.
- Be able to fit into small compartments like under the stairs.

Testing Procedures

To ensure proper operation that meets the performance requirement, we will:

Determine the voltage the micro-generator can generate from various rotation speeds.

This can be done by using a motor to drive the generator and using multimeter to measure the voltage.At the same time we will need to use sensors to determine the rotation speed of our gears and flywheel and adjust them in order to obtain optimum speed.Determine the capacitance and number of capacitors we will use for the storage.

An oscilloscope can be used to see how long does average traffic charges up different capacitors.

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Monitor the temperature of the circuit to set the speed limit of the flywheel.We can use a temperature sensor and input the data to the microprocessor as well, then we can use the data to control the engagement of the gears.

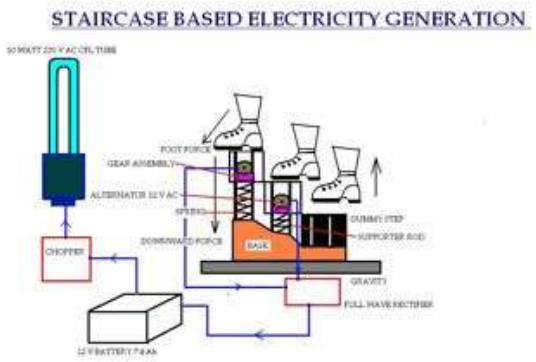

Fig 5 shows staircase based electricity generation

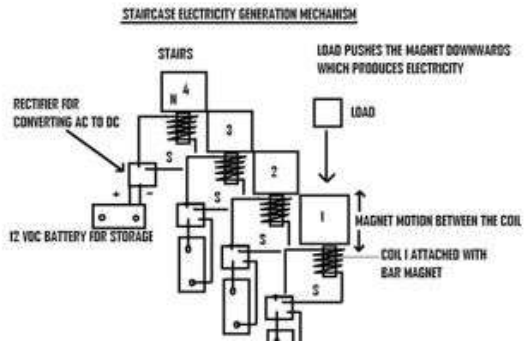

Fig 6 shows staircase electricity generation mechanisms

Detailed explanation

It consists of many steps, as the steps of stair case unit. All the steps are are connected with the connecting rod which links with the gear drives and the dc generator which are coupled with one shaft. When any person is stepping on the individual step, then that gears on the gear drives rotates thus the main shaft rotates at that instant. Thus the summation of the total rotational energy accumulation takes place in a single main shaft. The single main shaft is which is coupled with the generator which keeps on rotating with high velocity. The generator pulley rotates the generator field rotor and the emf is generated in the stator winding.the generation of the un-conventional energy is stored in the battery.Then the dc current is converted into ac current using inveter.Then the low voltage ac is converted into high voltage ac by using step up transformer. The bulb coupled to the stator winding glows up as a indication of the generation of the Un-conventional energy.

The summation of all the rotational energy will keep on adding to have collective rotation of the main or common shaft. The gear shaft is coupled with the generator to generate the power. This power can be stored in the lead acid battery set ELECTRICAL ENERGY. This project will work on the principle of "POTENTIAL ENERGY TO ELECTRICAL ENERGY CONVERSION" Potential energy can be thought of as energy stored within a physical system. This energy can be released or converted into other forms of energy, including kinetic energy. It is called potential energy because it has the potential to change the states of objects in the system when the energy is released .If h is the height above an arbitrarily assigned reference point, then Kinetic energy of an object is the extra energy which it possesses due to its motion. It is defined as the work needed to accelerate a body of a given mass from rest to its current velocity. Having gained this energy during its acceleration, the body maintains this kinetic energy unless its speed changes. Negative work of the same magnitude would be required to return the body to a state of rest from that velocity. The kinetic energy can be calculated using the formula: In this project a mechanism to generate power by converting the potential energy generated by human going up on a staircase into kinetic energy. When the peoples moves over the inclined plates, it gains height resulting in increase in potential energy, which is wasted in a conventional rumble strip When the steps come down, they crank a lever fitted to a ratchet-wheel type mechanism (a angular motion converter). This in turn rotates a geared shaft loaded with recoil springs. The output of this shaft is coupled to a dynamo to convert kinetic energy into electricity. A person weighing 80 kg going up a height of 7 cm on such a rumble strip produces approximately 10.6 kilowatt power. So one such staircase on busy malls, where about 100 peoples pass every minute, about 160 watt of electricity can be produced every single minute.

The rotor (rotating shaft) is directly connected to the prime mover and rotates as the prime mover turns. The rotor contains a magnet that, when turned, produces a moving or rotating magnetic field. The rotor is surrounded by a stationary casing called the stator, which contains the wound copper coils or windings. When the moving magnetic field passes by these windings, electricity is produced in them. By controlling the speed at which the rotor is turned, a steady flow of electricity is produced in the windings. These windings are connected to the electricity network via transmission lines.

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Flooring System

When the mechanical setup is used as it is, every single setup will compress separately and give an awkward feeling while walking over that. To prevent this, a flooring system is installed over the mechanical setup. The purpose of installing this flooring system is provide required compression and at the same time to prevent the people to feel uncomfortable when walking over it.

As every block over the setup is connected to one another using hinge arrangement, the compression will not be felt as the weight of the person walking over that will be distributed. But the pressure required to compress the setup will be conveyed as the person's weight acts on the particular setup only depending upon the average weight over a locomotive area, the strength and number of hinges are used.For the area where average weight is more, the numbers of the hinges are increased. This along with the primary spring provides the required compression for the setup.

This hinge arrangement distributes the weight of the person and prevents them from feeling the compression. But about 95% of the pressure applied due to the weight is conveyed for the compression.

Mechanical Stress

Here the mechanical stress is consider as the weight of the foot steps per unit area.The weight of the foot steps due to gravity is coverted into mechanical rotation. stress is a physical quantity that expresses the internal forces that neighboring particles of a continuous material exert on each other. For example, when a solid vertical bar is supporting a weight, each particle in the bar pulls on the particles immediately above and below it. When a liquid is under pressure, each particle gets pushed inwards by all the surrounding particles, and, in reaction, pushes them outwards. These macroscopic forces are actually the average of a very large number of intermolecular forces and collisions between the molecules in those particles.

Stress inside a body may arise by various mechanisms, such as reaction to external forces applied to the bulk material (like gravity) or to its surface (like contact forces, external pressure, or friction). Any strain (deformation) of a solid material generates an internal elastic stress, analogous to the reaction force of a spring, that tends to restore the material to its original undeformed state. In liquids and gases, only deformations that change the volume generate persistent elastic stress. However, if the deformation is gradually changing with time, even in fluids there will usually be some viscous stress, opposing that change. Elastic and viscous stresses are usually combined under the name mechanical stress.

Crankshaft

The crankshaft is the part of an engine that translates reciprocating linear piston motion into rotation. To convert the reciprocating motion into rotation, the crankshaft has "crank throws" or "crankpins", additional bearing surfaces whose axis is offset from that of the crank, to which the "big ends" of the connecting rods from each cylinder attach.

It is typically connected to a flywheel and gear arrangement to reduce the pulsation characteristic of the system and sometimes a torsional or vibrational damper at the opposite end, to reduce the torsional vibrations often caused along the length of the crankshaft by the gear farthest from the output end acting on the torsional elasticity of the metal.

Gear Arrangements

There are two gear arrangements in our system. One is connected between crankshaft and fly wheel and another is connected between fly wheel and dynamo. When two gears of unequal number of teeth are combined, a mechanical advantage is produced, with the rotational speeds and the torques of the two gears differing in a simple inverse relationship.

In transmissions which offer multiple gear ratios, such as bicycles and cars, the term gear, as in first gear, refers to a gear ratio rather than an actual physical gear. The term is used to describe similar devices even when the gear ratio is continuous rather than discrete, or when the device does not actually contain any gears, as in a continuously variable transmission.

Fly Wheel

A flywheel is a rotating mechanical device that is used to store rotational energy. Flywheels have a significant moment of inertia and thus resist changes in rotational speed. The amount of energy stored in a flywheel is proportional to the square of its rotational speed. Energy is transferred to a flywheel by applying torque to it, thereby increasing its rotational speed, and hence its stored energy. Conversely, a flywheel releases stored energy by applying torque to a mechanical load, thereby decreasing its rotational speed.

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Common uses of a flywheel include:

Providing continuous energy when the energy source is discontinuous. For example, flywheels are used in reciprocating engines because the energy source, torque from the engine, is intermittent.

Delivering energy at rates beyond the ability of a continuous energy source. This is achieved by collecting energy in the flywheel over time and then releasing the energy quickly, at rates that exceed the abilities of the energy source.

Controlling the orientation of a mechanical system. In such applications, the angular momentum of a flywheel is purposely transferred to a load when energy is transferred to or from the flywheel.

Dynamo

A dynamo is an electrical generator that produces direct current with the use of a commutator. Dynamos were the first electrical generators capable of delivering power for industry, and the foundation upon which many other later electric-power conversion devices were based, including the electric motor, the alternating-current alternator, and the rotary converter. Today, the simpler alternator dominates large scale power generation, for efficiency, reliability and cost reasons. A dynamo has the disadvantages of a mechanical commutator. Also, converting alternating to direct current using power rectification devices (vacuum tube or more recently solid state) is effective and usually economic.

We have used two 6V AC dynamo as the power generator for this project. The main advantage this provided was the small rated speed required to produce power of 6 watts and a current of 1A in each of the dynamo.

The total current accounted for the two dynamo was 2A and this was rectified and stored in a 6W dry battery. This battery will get charged fully within 3 hours when charged using power producing platform. This time will be considerably reduced when we use number of dynamos to charge a single 6W dry battery. A single power producing platform can accommodate 4 dynamos and when the battery is charged using all the current from these 4 dynamos, time taken to charge completely reduces below 2 hours. The battery can be used to supply the requirement as from then and there or it can be ported to place of requirement. For example if this project is used in railway platform, all the batteries powered by several setups in the daytime can be used to supply the way lights across the platform during the night time.

Instead of dynamo sanyo coils are used to produce power. Sanyo coil is also similar to dynamo. The dynamo accommodates thick copper coils whereas sanyo coil uses very thin aluminium coils. Single sanyo coil produces 24 volts whereas a dynamo can produce only 6V or 12V.

This increases the efficiency of the project to greater extent hence we prefer sanyo coil to dynamo. More than one battery can be charged using one setup when sanyo coils are installed in it. Apart from this, we can also use generators having less rated speed to increase the efficiency of the project.

Rectifier

A rectifier is an electrical device that converts alternating current (AC), which periodically reverses direction, to direct current (DC), which flows in only one direction. The process is known as rectification. Physically, rectifiers take a number of forms, including vacuum tube diodes, mercury-arc valves, copper and selenium oxide rectifiers, semiconductor diodes, silicon-controlled rectifiers and other silicon-based semiconductor switches. Historically, even synchronous electromechanical switches and motors have been used. Early radio receivers, called crystal radios, used a "cat's whisker" of fine wire pressing on a crystal of galena (lead sulfide) to serve as a point-contact rectifier or "crystal detector".

Rectifiers have many uses, but are often found serving as components of DC power supplies and high-voltage direct current power transmission systems. Rectification may serve in roles other than to generate direct current for use as a source of power. As noted, detectors of radio signals serve as rectifiers. In gas heating systems flame rectification is used to detect presence of flame.

Because of the alternating nature of the input AC sine wave, the process of rectification alone produces a DC current which, although unidirectional, consists of pulses of current. Many applications of rectifiers, such as power supplies for radio, television and computer equipment, require a steady constant DC current (as would by produced by a battery). In these applications the output of the rectifier is smoothed by an electronic filter to produce a steady current.

Rectification is the process in which input signal is being clipped or removed after passing through the arrangement of diodes. This process is known as rectification.

There are two types of rectification:

1. Half wave rectification.
2. Full wave rectification.

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Battery

Battery consists of electrochemical cells to store electricity house in a single unit. In battery stored chemical energy is transformed into electrical energy. Some batteries are used once and some of them are rechargeable. Large batteries also provide stand by operation i.e. mobile, laptops etc.

Inverter

A inverter is an electrical power converter that changes direct current (DC) to alternating current (AC).[1] The input voltage, output voltage, and frequency are dependent on design.

Static inverters do not use moving parts in the conversion process. Some applications for inverters include converting high-voltage direct current electric utility line power to AC, and deriving AC from DC power sources such as batteries.

Voltage Regulator

A voltage regulator is designed to automatically maintain a constant voltage level. A voltage regulator may be a simple "feed-forward" design or may include negative feedback control loops. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

Electronic voltage regulators are found in devices such as computer power supplies where they stabilize the DC voltages used by the processor and other elements. In automobile alternators and central power station generator plants, voltage regulators control the output of the plant. In an electric power distribution system, voltage regulators may be installed at a substation or along distribution lines so that all customers receive steady voltage independent of how much power is drawn from the line.

Future Aspects

In future aspects we can use this principal in the speed breakers at high ways where are rushes of the vehicles too much thus increase input torque and ultimate output of generator. If we are used this principle at very busy stairs palace then we produce efficient useful electrical for large purposes.

Conclusion

Thus this is a promising technology to provide efficient solution to power crisis to affordable extent. This will be the most acceptable means of providing power to the places that involves difficulties of transmission. Moreover walking across a power producing platform then will be a fun for idle people who can improve their health by exercising in such platforms with earning. The electrical energy generated at such farms will be useful for nearby applications.

This technology would facilitate the future creation of new urban landscapes, athletic fields with a spectator area, music halls, theaters, nightclubs and a large gathering space for rallies, demonstrations and celebrations, railway stations, bus stands, subways, airports etc. like capable of harnessing human locomotion for electricity generation.

References

[1] S. WHALEY, D. ENGLISH, E. HU, P. BARBARA,AND A. BELCHER, "NATURE", PP 665, 2000.

[2] S. BROWN, PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES 89, PP 8651 1992.

[3] C. M. KACHER, I. M. WEISS, R. J. STEWART, C. F. SCHMIDT, P. K. HANSMA, M. RADMACHER, AND M. FRITZ, EUROPEAN BIOPHYSICS JOURNAL 28,PP 611, 2000.

[4] MARC A. ROSE, "ENGINEERING HEALTH AND SAFETY MODULE AND CASE STUDIES", VOL. 1, PP. 1-9, JULY 2004.

[5] PAIVIHAMALAINEN, JUKKATAKALA, KAIJALEENASAARELA, "GLOBAL ESTIMATES OF OCCUPATIONAL ACCIDENTS", VOL. 1,PP. 2-3, 2005

[6] MARCEL SIMARD, ALAIN MARCHAND, "A MULTILEVEL ANALYSIS OF ORGANISATIONAL FACTORS RELATED TO THE TAKING OF SAFETY INITIATIVES BY WORK GROUPS" VOL. 1, PP. 5-9, 1995.

[7] BYHAM, WILLIAM C., PH.D., AND JEFF COX, HEROZ: EMPOWER YOURSELF, YOUR COWORKERS, YOUR COMPANY. NEW YORK: HARMONY BOOKS,

[8] WWW.PATENTONLINE.COM