International Journal of Engineering, Science and Mathematics
Vol. 8 Issue 6, June 2019,
ISSN: 2320-0294 Impact Factor: 6.765
Journal Homepage: http://www.ijesm.co.in, Email: ijesmj@gmail.com
Double-Blind Peer Reviewed Refereed Open Access International Journal - Included in the International Serial Directories Indexed & Listed at: Ulrich's Periodicals Directory ©, U.S.A., Open J-Gage as well as in Cabell's Directories of Publishing Opportunities, U.S.A

DESIGN AND MANUFACTURING OF AN ALTERNATE ENERGY CONVERTER FOR MATERIAL HANDLING SYSTEM

Dr Viswa Mohan Pedagopu*
Mr. Tsegaye Alemayehu Atiso**
Mr. Mebratu Markos Woldegiorgis*

ABSTRACT

Today, the world is going to explore new technologies. However, today's technology is to laugh at tomorrow. As a part of it an energy conversation system is ever green latest trends due to globalization. No matter how much new skills are always in demand for low cost items. In this paper, an energy convertor is designed and manufacturedto convert mechanical energy into electrical energy at reasonable cost. The device consists of mechanical chain drives run by power motor used for some particular purpose. A specialized Magnetis attached to the disc at one side of crank shaft and a copper coil is placed exactlyparallel to the disc half-inch distance and entire setup encapsulated in a frame. A general motor bike rechargeable battery has been used to store the electrical energy. During crank rotation with magnetic an induced current opposes the copper coil generates eddy-current and electrical energy. Finally the whole process is examined and tested to be the best of it.

KEYWORDS:

Electrical Energy,conversion, crank shaft, eddy current, chain drive and power motor

Author correspondence:

First Author*, Professor[A], Department of Mechanical Engineering
Second Author** Dean - College of Engineering
Third Author *** HoD - Department of Mechanical Engineering,
Wolaita Sodo University, SNNP Region, Sodo City, Ethiopia

1. INTRODUCTION

Now days, the mostly used device to transmit mechanical power are chain drives.In addition it is often used to convey power to the wheels of a vehicle, particularly bicycles and motorcycles. It is also used in a wide variety of machines besides vehicles. Most often, the power is conveyed by a roller chain, known as the drive chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system. Another type of drive chain is the Morse chain, invented by the Morse Chain Company of Ithaca, New York, USA. This has inverted teeth.Sometimes the power is output by simply rotating the chain, which can be used to lift or drag objects. In other situations, a second gear is placed and the power is recovered by attaching shafts or hubs to this gear. Though drive chains are often simple oval loops, they can also go around corners by placing more than two gears along the chain; gears that do not put power into the system or transmit it out are generally known as idler-wheels. By varying the diameter of the input and output gears with respect to each other, the gear ratio can be altered, so that, for example, the pedals of a bicycle can spin all the way around more than once for every rotation of the gear that drives the wheels.

The oldest known application of a chain drive appears in the Polybolos, a repeating crossbow described by the Greek engineer Philon of Byzantium (3rd century BC). Two flat-linked chains were connected to a windlass, which by winding back and forth would automatically fire the machine's arrows until its magazine was empty. Although the device did not transmit power continuously since the chains "did not transmit power from shaft to shaft", the Greek design marks the beginning of the history of the chain drive since "no earlier instance of such a cam is known and none as complex is known until the 16th century. It is here that the flat-link chain, often attributed to Leonardo da Vinci, and actually made its first appearance."

The first continuous power-transmitting chain drive was depicted in the written hierological treatise of the Song Dynasty (960–1279) Chinese engineer Su Song (1020-1101 AD), who used it to operate the armillary sphere of his astronomicalclock tower as well as the clock jack figurines presenting the time of day by mechanically banging gongs and drums. The chain drive itself was given power via the hydraulic works of Su's water clock tank and waterwheel, the latter which acted as a large gear.S. Butterworth, in the

year 1916 had worked On the Coefficients of Mutual Induction of Eccentric Coils to achieve higher efficient [1]. In the year 1946 Frederick Grover, released some Inductance Calculationsand working formulae, Tables, for various Inductance round wire like rectangle, regular polygons, an ellipse, single layer coils on rectangular winding form, mutual inductance of circular filaments, coaxial circular coils, self-inductance of circular coils with rectangular cross section, inductance of flat spiral high frequency effects and presented and comparative statement. [2].

In continuation of research same year H. Dwight, Electrical Coils and Conductors, mutual inductance of filamentary circles, mutual inductance of two thin disk coils, magnetic field from round coil of small rectangular cross section also presented and strengthen the research of Frederick Grover [3].In 1982 M. El-Markabi and E. Freeman both worked on an electromagnetic properties of a circular cylindrical coil in a set of planar ferromagnetic regions can be used to convert the desired electrical energy [4]., An unique mathematical model of a solenoid for energy and force calculationswas applied by M. El-Derini in the year 1984 [5]. J. Ferreira, worked on Improved Analytical Modeling of Conductive Losses in Magnetic Components, Later on Upper Saddle River, N J Pearson Prentice Hall Young, Hugh D. Fundamentals of Applied Electromagnetic theoretical analysis and presented *Inductance* Calculations and Alliance N-42 neodymium iron boron magnetic material was studied 1994, 2004 and 2008 respectively. [6, 7 and 8].

2. PROPOSED APPROACH

The experimental set-up requires a simple copper coils/windings of different gauges i.e., 19, 23,24,26,28, 29, 31and 35 at equal number of turns. Wind the copper wire into coils of equal number of windings with different gauges. Take individual copper winding & remove the insulation over the wire at its ends up to an inch. Now, terminals are attached to the multi-meter.Next, draw diagonals over the circular disc and attach magnets over it. The copper coil windings & magnets are attached to two separate wooden discs and place parallel to each other with maintaining small gap inbetween.When the magnet disc is made to rotate over the copper coil the eddy currents are produced in the coil &are digitally indicated in amillimeter.Similarly same experiment/procedure is done with changing different gauges of wire.The readings in the millimeter for different gauges.Finally identified that a maximum of 28 wire gauge to be suitable for our experimental

conductance through this procedure as it is producing more voltage from it when compared to other wire gauges.

Table: 1 Wire Gauge Calculations:

S.NO	WIRE GAUGE	NUMBER OF TURNS	VOTAGE(mv)
1	19	150	76.31
2	23	150	82.02
3	24	150	88.01
4	26	150	129.99
5	**28**	**150**	**✓ 160.2**
6	29	150	72.03
7	31	150	45.98
8	33	150	32.75

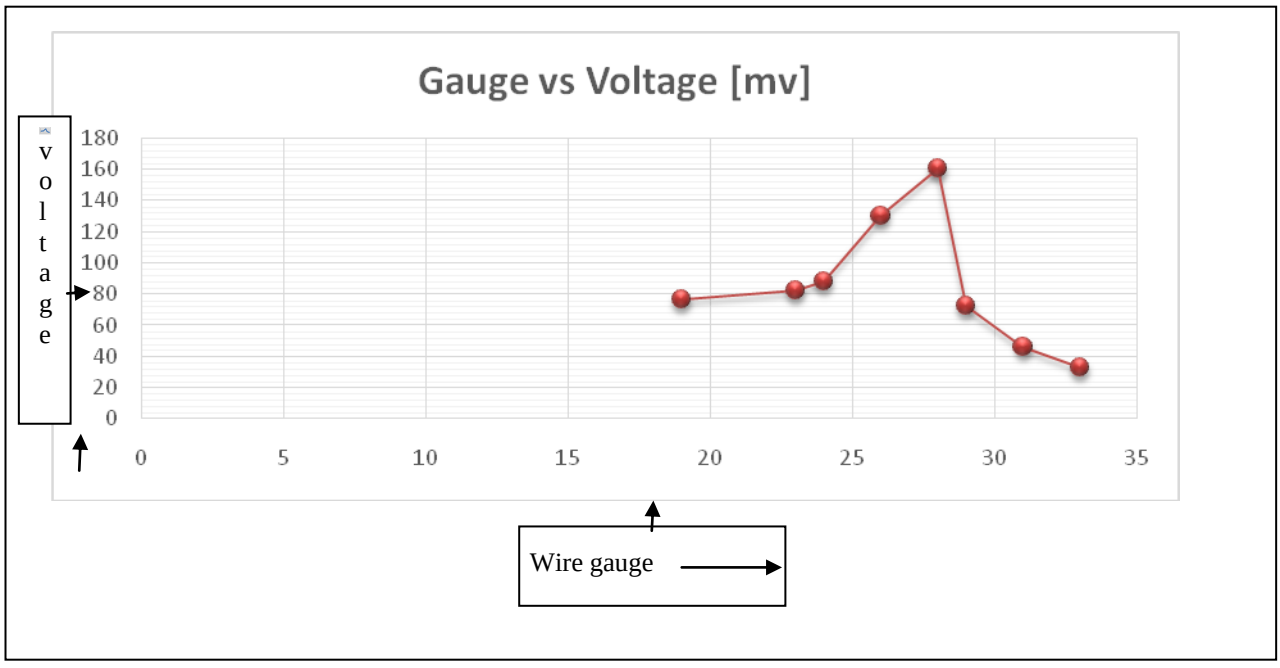


Fig: 1. Graph between Wire gauge and Voltage

Take the voltage on the ordinate and vary the wire gauge on the abscissa. Experimentally the voltage increases up to certain gauge and then decreases.

Table: 2 Wire Gauge Calculations:

TYPE	MEASUREMENTS (mm)	Degrees	Numbers
Plane	45 × 10× 400	---	#5
Shaft	400 length, @ Diameter 0.2	---	#3
Angular	25×5×1000	90^0	#3
	25× 5× 400	90^0	#6

3. EXPERIMENTAL DESCRIPTION

The angular barsthreeof length 1000mm and six of 400mm are taken and arranged into a rectangular frame/pattern using tri-square device.These are joined by means of arc welding.Now flats are taken along with bearings which are already arranged in it. Flats are made to stand vertical by spacing of length equal to the chain arrangement and it is welded to the rectangular frame outer to it by means of arc welding.Now the bigger & smaller wheels which are tightly fixed with shafts through them are kept inside the bearings of the vertical flats with chain all along its length.This is placed in a special casing outer to the rectangular frame at its height equal to the height of the front shaft by means of an iron support.The shaft of motor (output)is made in contact with the shaft of the biggerwheel (input) by means of a metallic coupler. The device is supplied with the power source and the motor is made to rotate. This rotates the crank which is arranged over the front shaft.The device consists of chain drives driven by electric motor, magnets attached to the disc which are placed at one side of crank shaft and copper coil placed on a parallel disc at a distance of half-inch from it. The experimental set-up of chain drive, Magnets, crank shaft and copper coil are placed on shaft mounted on frame. The electrical energy produced in copper coils can be stored in a rechargeable battery of a motorbike.When the crank with magnets on its side is allowed to rotate, the induced current generally produced by the copper coil opposes the passage of magnets through it, thus generating the eddy current, which is the required output and is further converted into electrical energy.The entire process works on the statement of Lenz's law, the output produced by this phenomenon is collected from the copper coils .The voltage and current can be displayed using the voltmeter and ammeters and tested by connected it to a LED light.

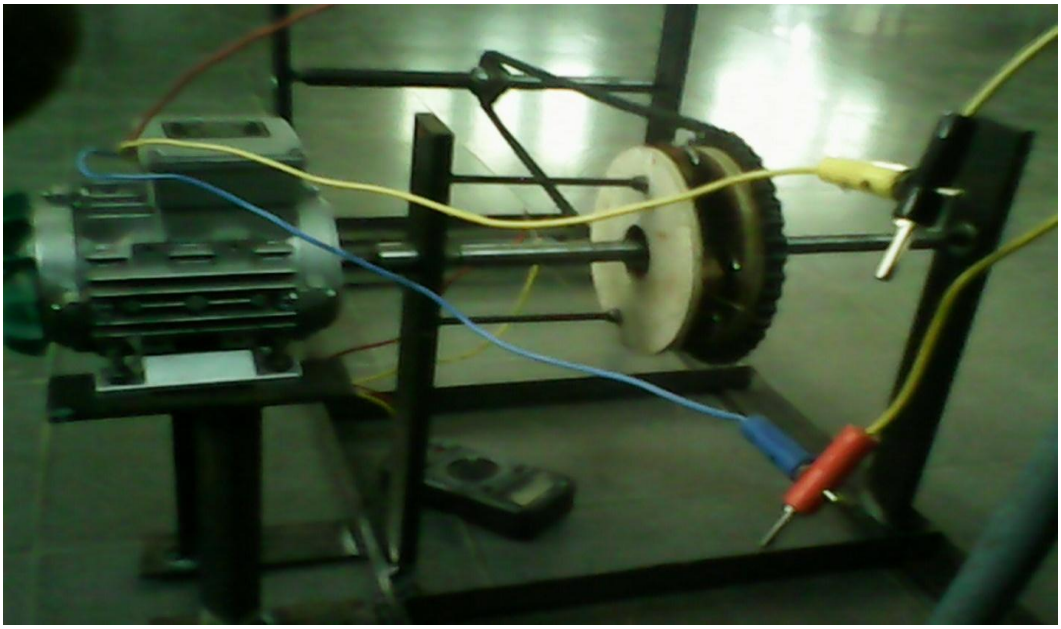


Fig: 2. Working of the Hybrid Energy System Set-Up

Fig: 3. Process of EMF Generation between Magnets & Coils

4. RESULTS AND DISCUSSION

As per the experiment, the voltage values are taken on the basis of theoretical and experimental analysis and tabulated as below.

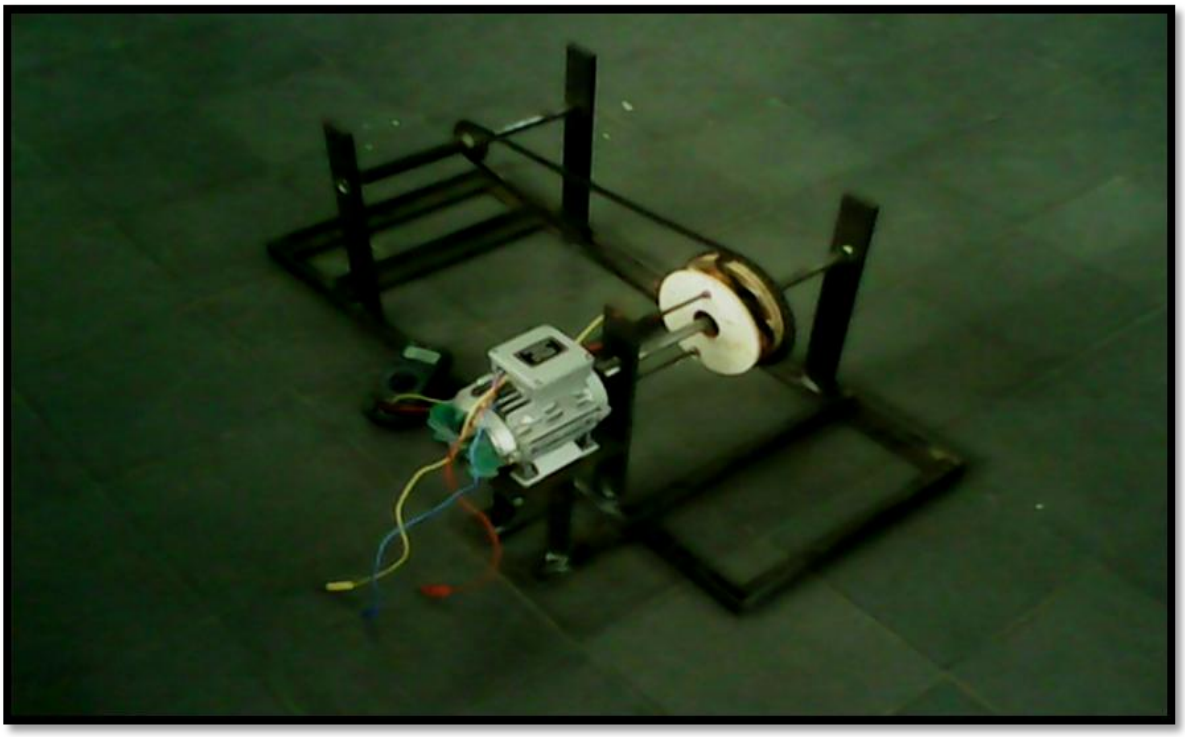


Fig: 4. Experimental set-ups

Table 3. Voltage Values for Various Speeds:

Serial No	No. of Turns	Speed	Voltage(Volts)	
			Theoretical	Practical
1	500	200	3.52	3.43
2	500	300	4.61	4.21
3	500	600	9.10	7.12
4	500	900	13.51	10.31
5	500	1200	17.53	12.22
6	500	1500	22.16	14.12

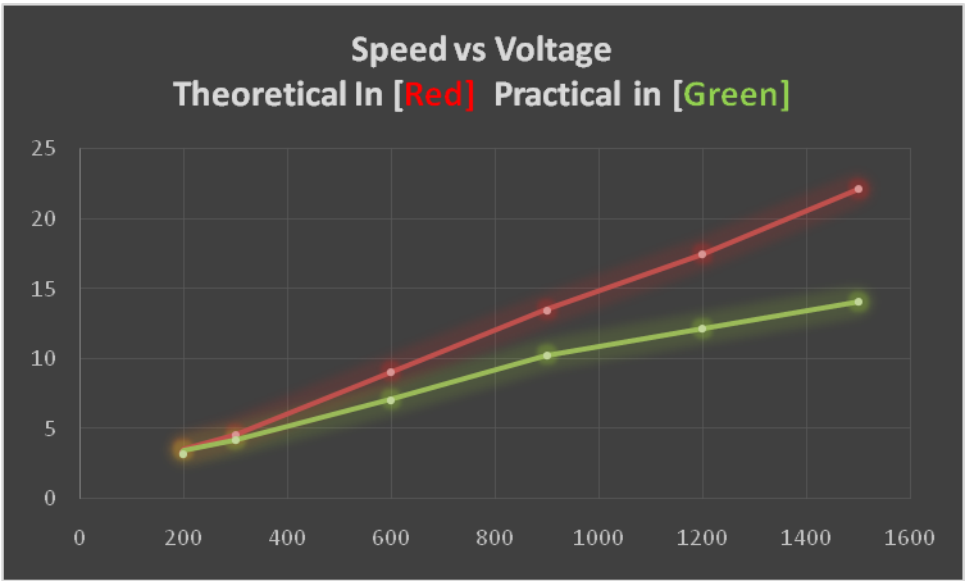


Fig 5. Graph between voltage and speed.

Table 4. Voltage Values For Various Coil Turns:

Serial No	Speed	No. of Turns	Voltage(volts)	
			Theoretical	Experimental
1	1200	100	5.8	2.96
2	1200	200	6.6	3.22
3	1200	300	9.6	6.67
4	1200	400	13.3	9.58
5	1200	500	15.2	12.21
6	1200	600	17.32	13.97

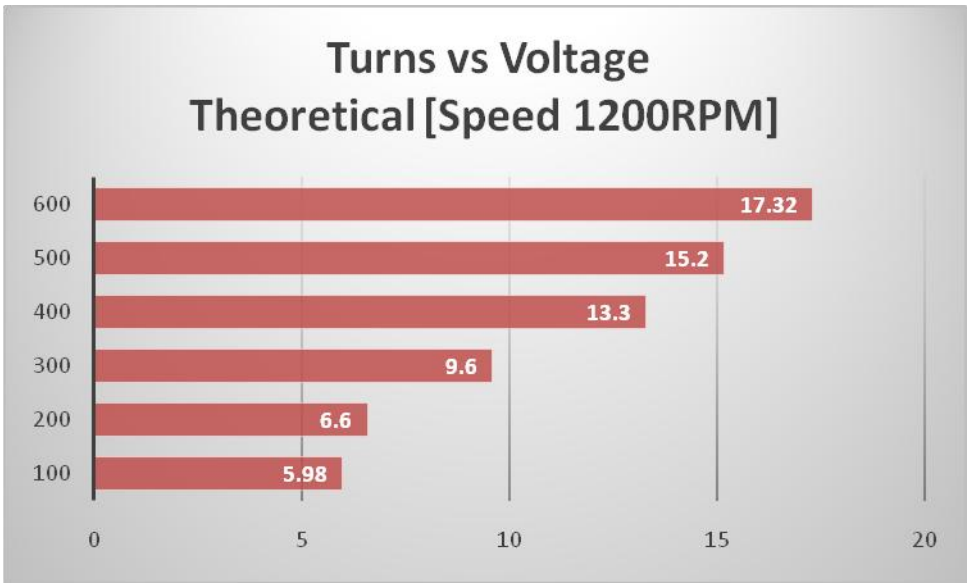


Fig 5. Graph between turns and voltage at speed 1200RPM [Theoretical]

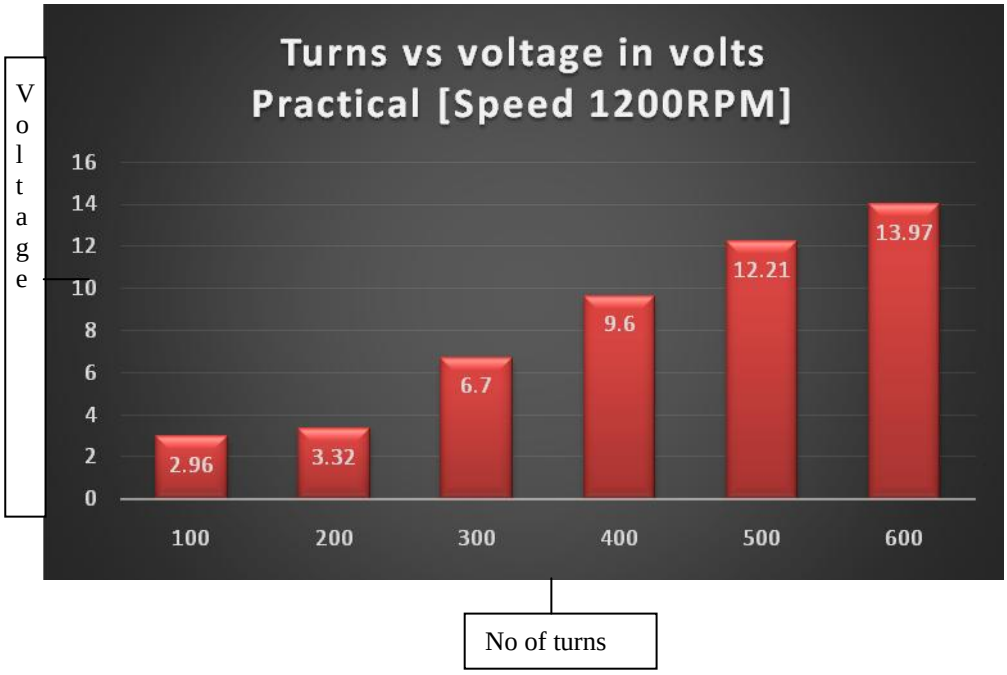
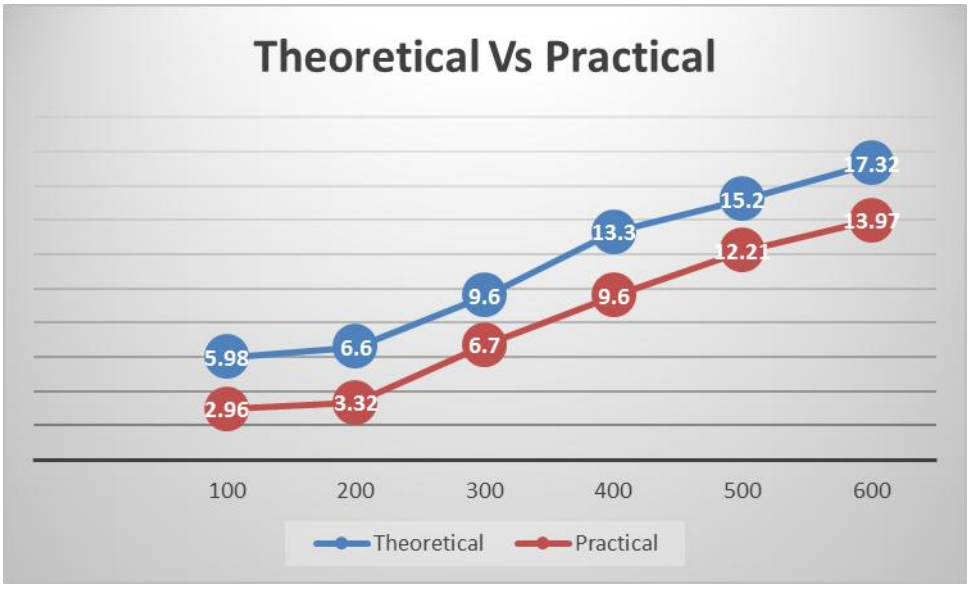


Fig 6. Graph between turns and voltage in volts [Practical]

The graph gives the information of how the voltage is varying with respect to the speed or velocity. Take the voltage on the ordinate and vary the speed on the abscissa. Experimentally the voltage varies linearly with respect to the variation of the speed/velocity. Theoretically the voltage also increases linearly with increase in speed. The above graph gives the information of how the voltage is varying with respect to the no. of turns. Take the voltage on the ordinate and vary the no. of turns on the abscissa. Experimentally the voltage varies linearly with respect to the variation of the no. of turns. Theoretically the voltage increases with increase in no. of turns. As per the result the loss comparison is high at 400 turns [3.70] .



S.NO	LOSS DIFFERENCE
100	3.02
200	3.28
300	2.90
400	3.70
500	2.99
600	3.35

5.CONCLUSION

The accurance of experimental results are depends on deflections and speed reduction. This idean can be implemented in large scale industries like ash and coal mine material handling system. This system can be adopted where is chain drive is available. It is suitable to utilize the exhaust energy for supplemental applications. There would be a lot of future scope for this project depends on the availabity of sources to demonstrate the conversion of chain drive moment from mechanical to electrical energy. In accordance with the result the output voltage of 12v and current 1.5amps the battery of 1000amph can be charged within one day. The eddy currents produced in it are collected from the copper terminals and are connected to the rechargeable battery. The process can be adopted to the belt drives are moved by means of pulleys or wheels.

6.REFERENCES

[**1**] S. Butterworth, "On the Coefficients of Mutual Induction of Eccentric Coils," Philosophical Magazine, series 6, vol. 31, (1916) pp. 443-454

[2] Frederick Grover, Inductance Calculations: Working Formulas and Tables, Dover Publications, Inc., New York 1946. Inductance of a rectangle of round wire, pp. 60; inductance of regular polygons of round wire, pp. 60; inductance of an ellipse of round wire, pp. 65; inductance of single layer coils on rectangular winding form, pp. 70; mutual inductance of circular filaments, pp. 77; coaxial circular coils, pp. 88; self-inductance of circular coils with rectangular cross section, pp. 94; inductance of flat spiral, pp. 167; high frequency effects, pp. 261.

[3] H. Dwight, Electrical Coils and Conductors, McGraw-Hill, Inc., New York 1946 (QC645.D991). Proximity effect in wires, pp. 192, 224; mutual inductance of filamentary circles, pp. 228; mutual inductance of two thin disk coils, pp. 253; magnetic field from round coil of small rectangular cross section, pp. 292.

[**4**] M. El-Markabi and E. Freeman, "Electro magnetic properties of a circular cylindrical coil in a set of planar ferromagnetic regions," IEE Proceedings, vol. 129, pt. A, no. 8, November 1982, pp. 582-589

[5] M. El-Derini, "Mathematical model of a solenoid for energy and force calculations," Journal of Physics D: Applied Physics, 17, (1984) pp. 503-508

[6] J. Ferreira, "Improved Analytical Modeling of Conductive Losses in Magnetic Components," IEEE Transactions on Power Electronics, vol. 9, no. 1, January 1994, pp. 127-13

[7] Upper Saddle River, NJ: Pearson Prentice Hall Young, Hugh D. (2004) *Fundamentals of Applied Electromagnetic*. *University Physics vol.2*. Upper Saddle River, NJ: Addison Wesley. Inductance Calculations

[8] Alliance N-42 neodymium iron boron magnetic material. Retrieved November 1, 2008, from Mat web Material Property Data Website: http://www.matweb.com/search/Data

Dr. Viswa Mohan Pedagopu has vast experience in both teaching and industry. He has worked in central government, private universities in India and abroad. He has many national and international publications with double blinded peer reviewed, UGC approved and Scopus indexed reputed journals. He attended many conferences in national and international conferences in India and abroad.He is an editor, guest editor, and reviewer for many journals. His research interests not limited to but in Computer Integrated Manufacturing, CAPP, advanced manufacturing technologies and flexible manufacturing systems. He has fellow and senior membership in many outstanding institutions like ASME, CSME, MCS, IACSET, FIE, IAEME, FIRAJ and MISTE.