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WIRELESS POWER TRANSFER

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Abstract -- *At first Wireless power transfer concept is given by Nikolas Tesla. This technique is generally for transmitting the electrical power wirelessly up to certain distance with the help of transmitter and receiver coil in which copper coil is having "n" number of turns. An AC supply is given to the HF transformer (which consists of inverter, rectifier, transistor, capacitor etc inside).The output of HF transformer is given to the primary coil which is called transmitter coil in the form of AC with high frequency up to kHz. Further secondary coil which is also called as receiver coil is kept near and parallel with the transmitter coil. As a result emf is induced in the secondary coil due to passage of flux in secondary coil by the principle of electromagnetic induction. Due to this induced emf an alternating current starts flowing in the receiver coil. This AC current is further rectified by the bridge rectifier and we get pulsating DC voltage which is further filtered out with the help of capacitor. At last we get output from this technique as DC which is given directly to the voltage regulator from where it is given to the DC load which is usable power.*

Key Words: **HF transformer, Transmitter coil, Receiver coil, Rectifier, Voltage regulator etc.**

1. INTRODUCTION

Wireless power transfer concept was introduced by Nikolas Tesla. By using this technique we can transmit power wirelessly up to certain distance with the help of transmitter and receiver coil. This technique can make a dramatic change in the field of Electrical Engineering in future. This technique can eliminate the use of physical wire, different cables, connectors, power cords, etc. which are used to transmit the power up to large distance. We can also use this technique to charge the battery of pace makers wirelessly which is fitted inside the body of heart patient which requires periodically replacement. This project is basically designed to run the electrical equipments which needs 5V or 12V DC supply to operate. So, here we are providing a 5V led bulb as indicator and a 12V DC fan which is connected in the output of this project. Power cord is connected to AC supply having 230V and 50Hz frequency which is given to primary coil of air core HF transfer as input. The secondary coil of HF transformer develops a high frequency 12 volt AC. This 12V AC is given to transmitter coil and further emf is induced in secondary coil which is placed in the vicinity of primary coil. In this way the power is transmitted wirelessly from primary coil to secondary coil up to certain distance say(3-5cm). Basically this technique can also be used for different applications like charging of mobile battery, laptop battery, iPod, aviation, wind turbine, automation etc.

2. BLOCK DIAGRAM

Below figure shows the block diagram of wireless power transfer. In this block diagram we can see that different electronic devices are connected in series with each other which performs specific function in the circuit. Basically for transmitting maximum power through the transmitter coil, It is necessary to have in resonance with the receiver coil. For making the resonance condition in both the coil there must be the value of *XL* equal to *XC*..

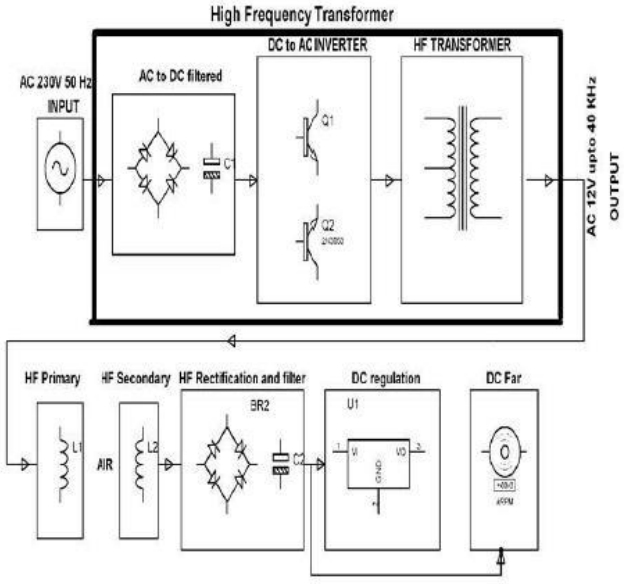


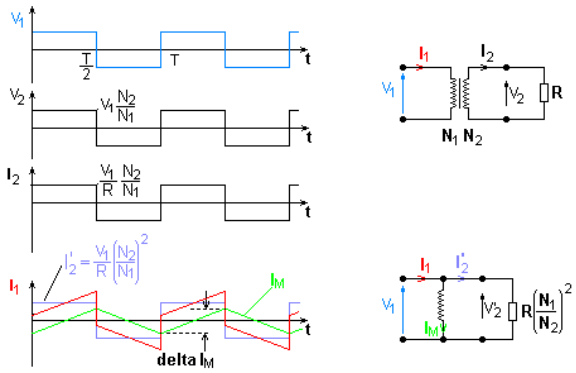
Fig 2.1 :-Block Diagram

In this block diagram we convert AC current into DC current with the help of rectifier and further DC into AC with the help of inverter .These all process takes place inside the HF transformer.

In above diagram, AC single phase 230V with 50 Hz frequency supply is given to the HF transformer as input from where we get 12V AC with very high frequency up to kHz as output from HF transformer. There are different blocks which are connected to each other in the form of electronic devices inside the HF transformer. These devices are rectifier, capacitor, transistor, inverter etc. Rectifier is connected to rectify or convert AC supply into DC. After that capacitor is connected to filtered out the pulsating DC and make it smooth and constant DC. Capacitor basically make DC ripple free. Further transistor is connected in the circuit to amplify the frequency signal. Inverter is connected here to convert DC to again AC of 12v which comes out from HF transformer as output. After that this 12v AC with 25khz frequency goes to the transmitter coil through which flux is generated around the coil. Further when we place receiver coil near to the transmitter coil then emf is induced in the receiver coil due to the principle of electromagnetic induction. Due to this induced emf in receiver coil,currentstarts flowing in the circuit which is AC with high frequency. Further this AC current is rectified through the bridge rectifier by converting AC to DC, which is connected next to the receiver coil. After that capacitor is connected to filtered out the pulsating DC into smooth DC which comes out in the form of output. Further voltage regulator is connected for giving the constant DC supply of 12V through which DC fan is connected as load.

3. HF TRANSFORMER DESIGN

It is an electrical device which is developed and designed to fulfill the need of high frequency. It gives output as high frequency having range up to kHz. It comes in different sized and rating according to requirement. The physical size of transformer depends upon the power that has to be transferred and the operating frequency. For getting higher frequency as output the size of the transformer gets reduced and becomes compact. Generally it generates frequency range between 20 and 100 kHz. The material which is used to make transformer core is ferrite. For calculating the high frequency transformer we have to choose appropriate core of the transformer with the help of databook provided in the table. After that in second step we have to calculate the primary number of turn which determines the magnetic flux density within the core. After that wire diameter is calculated which is responsible for primary the primary and secondary current in the coil.



In the above figure we can see observe that there is a square wave having voltage*V*1 at the primary side of transformer. Due to this voltage input current *I*1 due to which secondary transformer current*I*2 and the magnetizing current *I*M. This magnetizing current *I*M is proportional to the magnetic flux (Φ). In transformer core, magnetic flux is determined by voltage *V*1 corresponding to Faraday law's law which is $V = N \cdot d(\Phi)/dt$. This transformer transmites the power by purely magnetic coupling where rotation is not required. Power transformer is made up of many thin laminated silicon steel. Each layer is insulated to reduce the energy loss due to eddy current heating of the core with the adjacent layer. Basically typing of laminated core is "E" type or "I" type due to this reason name of transformer is "EI transformer".

4. FUTURE SCOPE

We can make devices more reliable by eliminating the most prone components in most electronic systems like cords and connectors. These cords like power cord and different connecters which we use these all are made up of iron parts or conducting materials which starts rusting after some years which overall loss our money. We can make devices more convenient and more desirable to purcharsers, by eliminating the need of battery replacement. In future we can transfer power without battery. As we know that grid power is much less expensive and more environmentally sound than manufacturing, transporting and using batteries. We can also make it more safer by making them watertight and explosion proof by eliminating connector headers and wires.

FORMULAS:-

The average and root-mean-square output voltages of an ideal single phase full wave rectifier can be calculated as:

$$V_{dc} = V_{av} = \frac{2V_p}{\pi}$$

$$V_{rms} = \frac{V_p}{\sqrt{2}}$$

Where:

V_{dc},V_{av} - the average or DC output voltage,

V_p - the peak value of half wave,

V_{rms} - the root-mean-square value of output voltage.

π = ~ 3.14159

FOR CALCULATING DIFFERENT PARAMETERS:-

Inductance of a circular coil = $N^2\mu_0 r (\ln(8r/a) - 1.75)$

Resistance of the Winding (R) = $\rho l/A$

Length of the coil (l) = Circumference of coil x N

Resonant Frequency : -f = $1/2\pi$ sq.rt of LC

5. RESULT TABLE

[1] Component	[2] Input	[3] Output
[4] HF transformer	[5] AC [6] 230V,50Hz	[7] AC [8] 12V,25KHz
[9] Transmitter coil	[10] 12V,25KHz	[11] 12v,25khz
[12] Receiver coil	[13] 8-10V, [14] 20kHz	[15] 8-10V, [16] 20kHz
[17] Voltage regulator	[18] 8-10V [19] DC	[20] 12V,5V [21] DC [22]
[23] DC Fan	[24] 12V,0.25A	[25] ---------

6. CONCLUSION

The goal of this project is to extend my knowledge of transferring the power wirelessly with the help of two tesla coils which works as transmitter and receiver. There are great scope of this technique in the field of electrical and electronics engineering in future. We can generate high voltage with high frequency and it can be used for testing the apparatus of switching surge. It can transmit the electrical power up to certain distances depending upon its rating. By using this technique we can charge the rechargeable battery of mobile phone, laptop, iPod, etc. Wirelessly. The great disadvantages of this technique is we can not run AC equipments because its output is in the form of DC. Second disadvantages is for transferring power upto large distances we needs high rating of HF transformer and related equipments which governs more cost.

7. REFERENCES

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