WIRELESS ELECTRICITY (WITRICITY)

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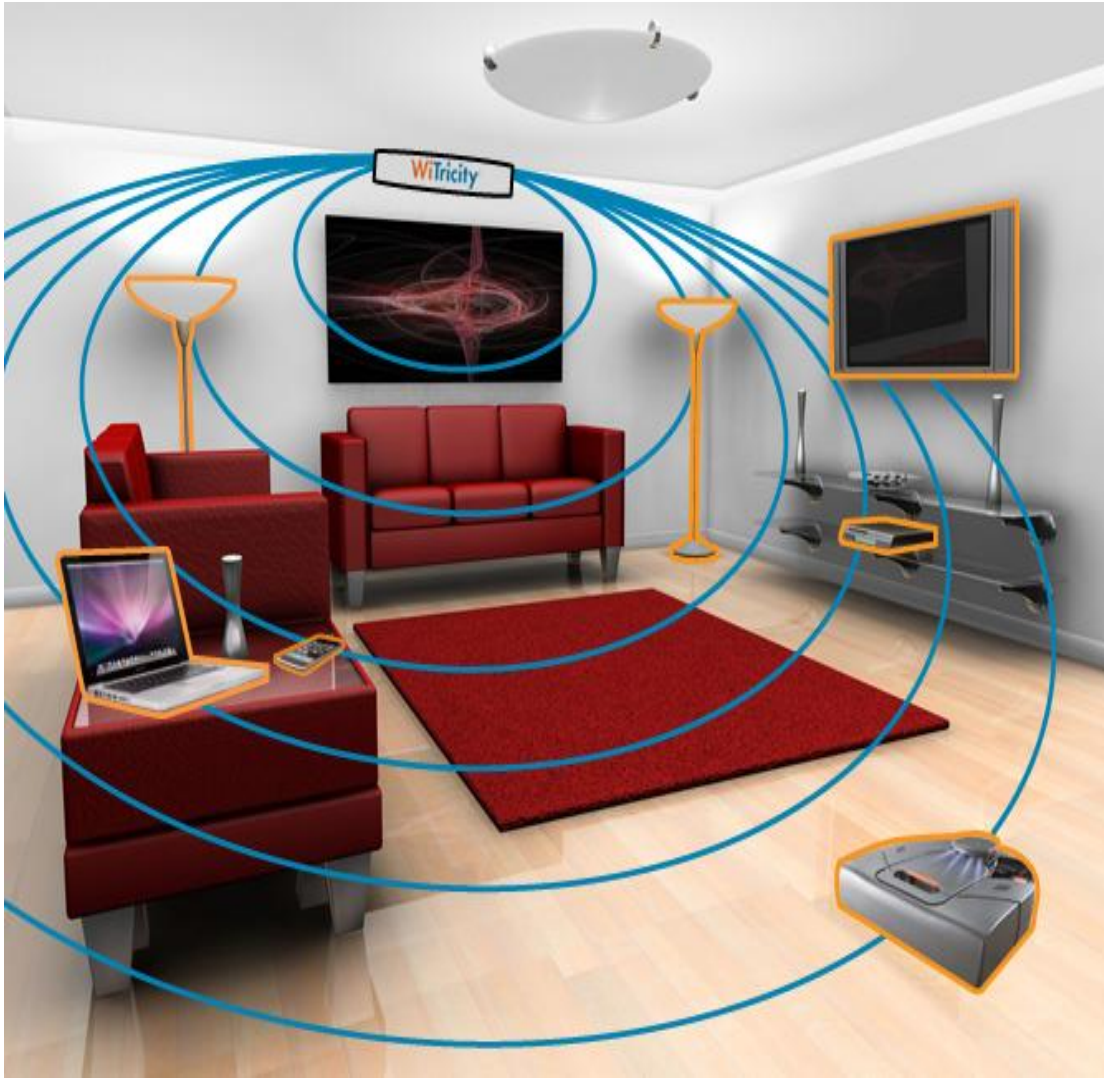
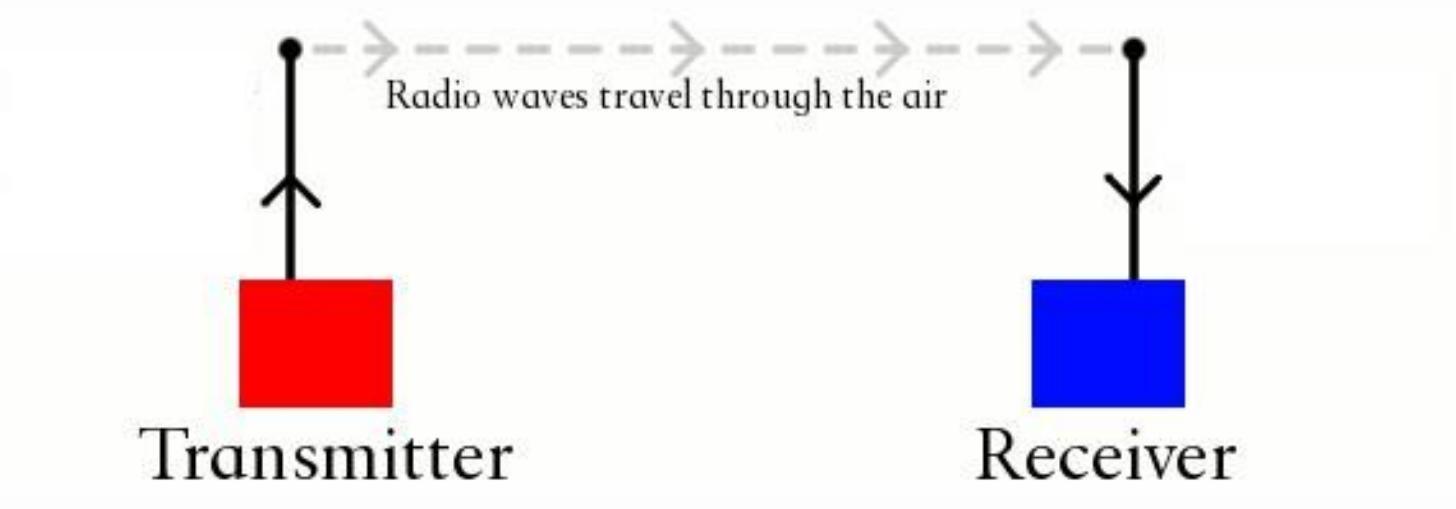
CONTENTS

What is Wireless Electricity

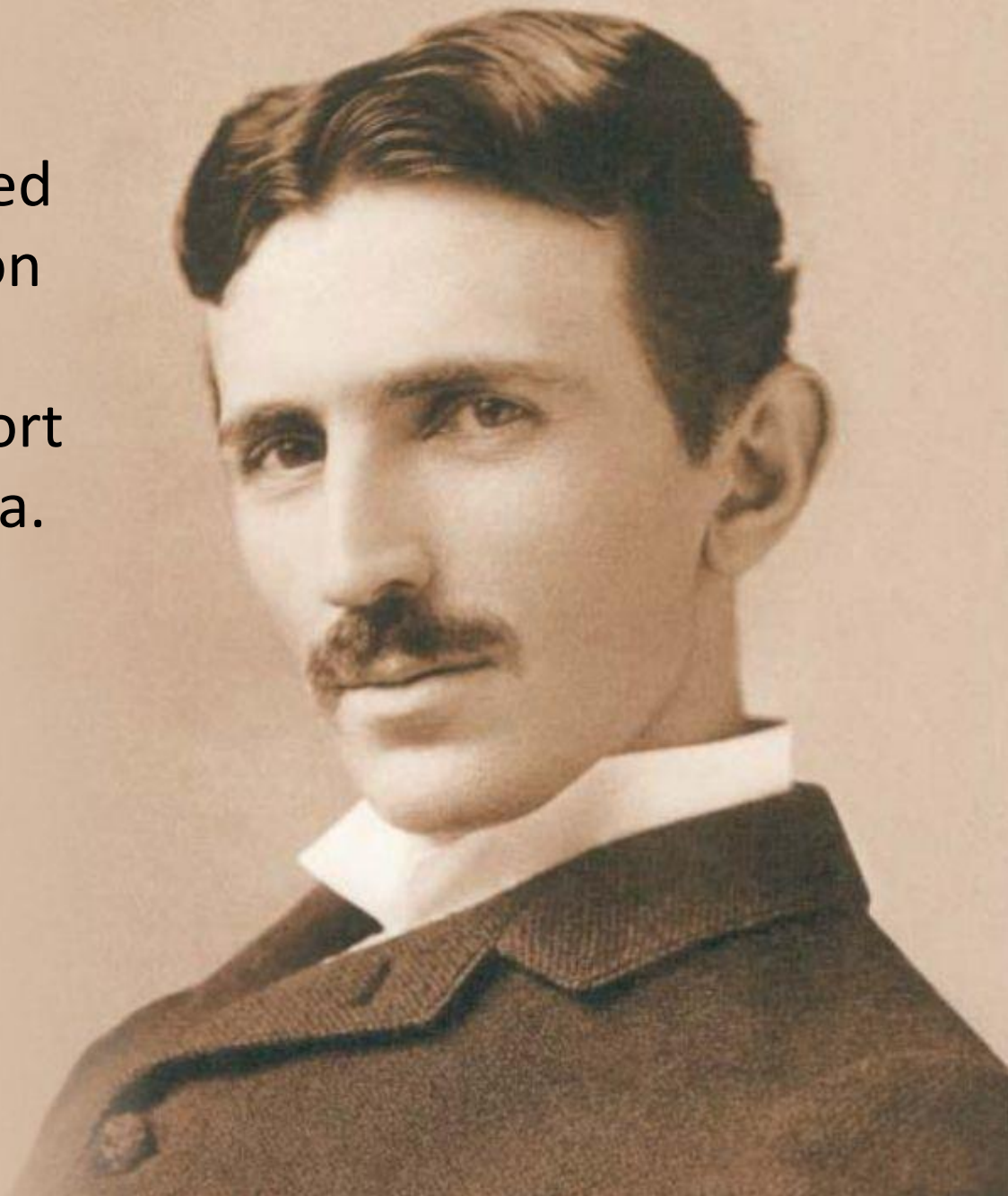
- Transmission of electrical energy from power source to an electrical load without using wires.
- Different from cellular transmission of signals

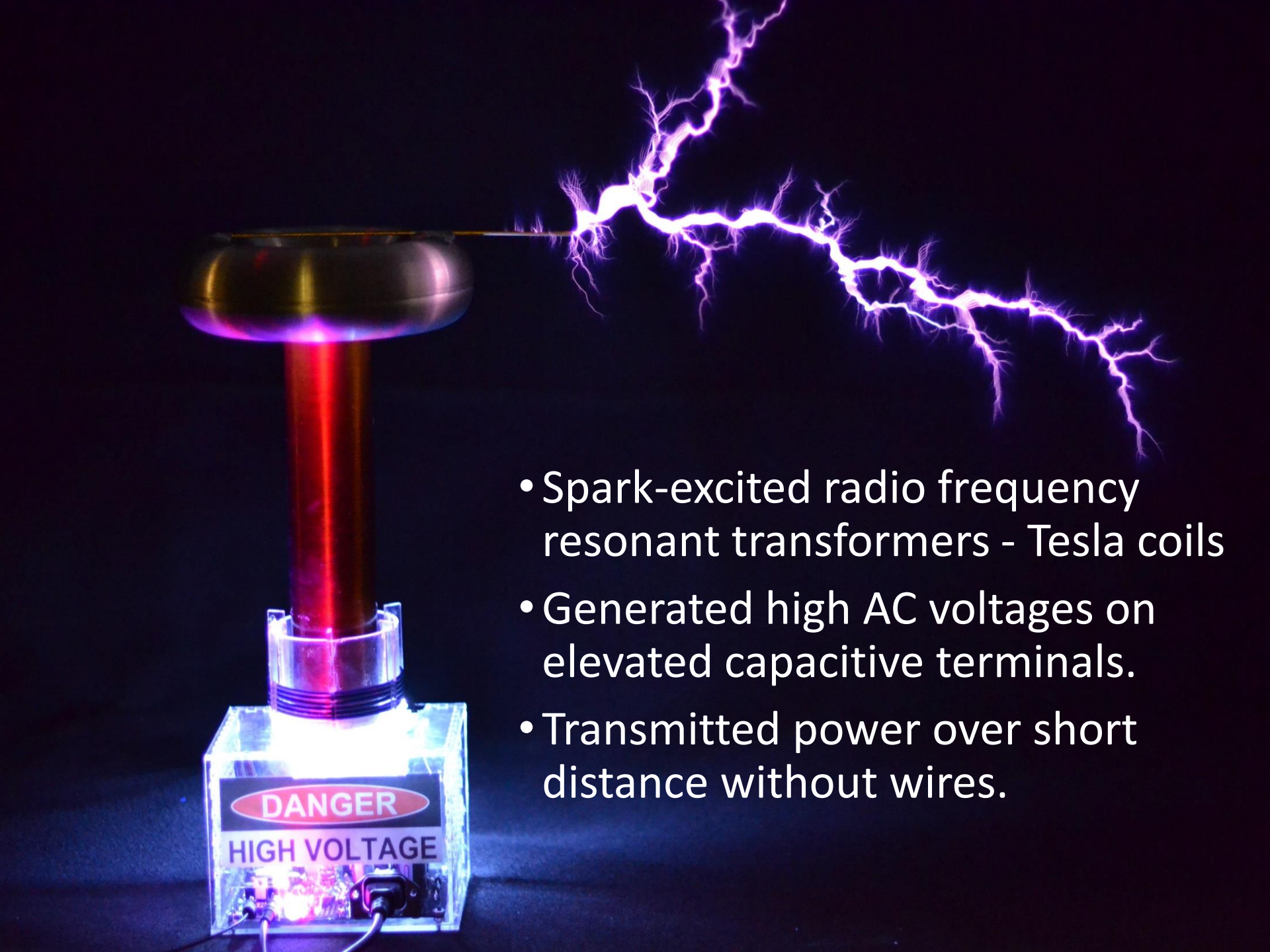




- Cell transmission of signals - radio waves
- Wireless mode of transmission - oscillating magnetic pulses.

- Nikola Tesla - performed the first experiments on wireless electricity.
- He had put a great effort in popularizing the idea.





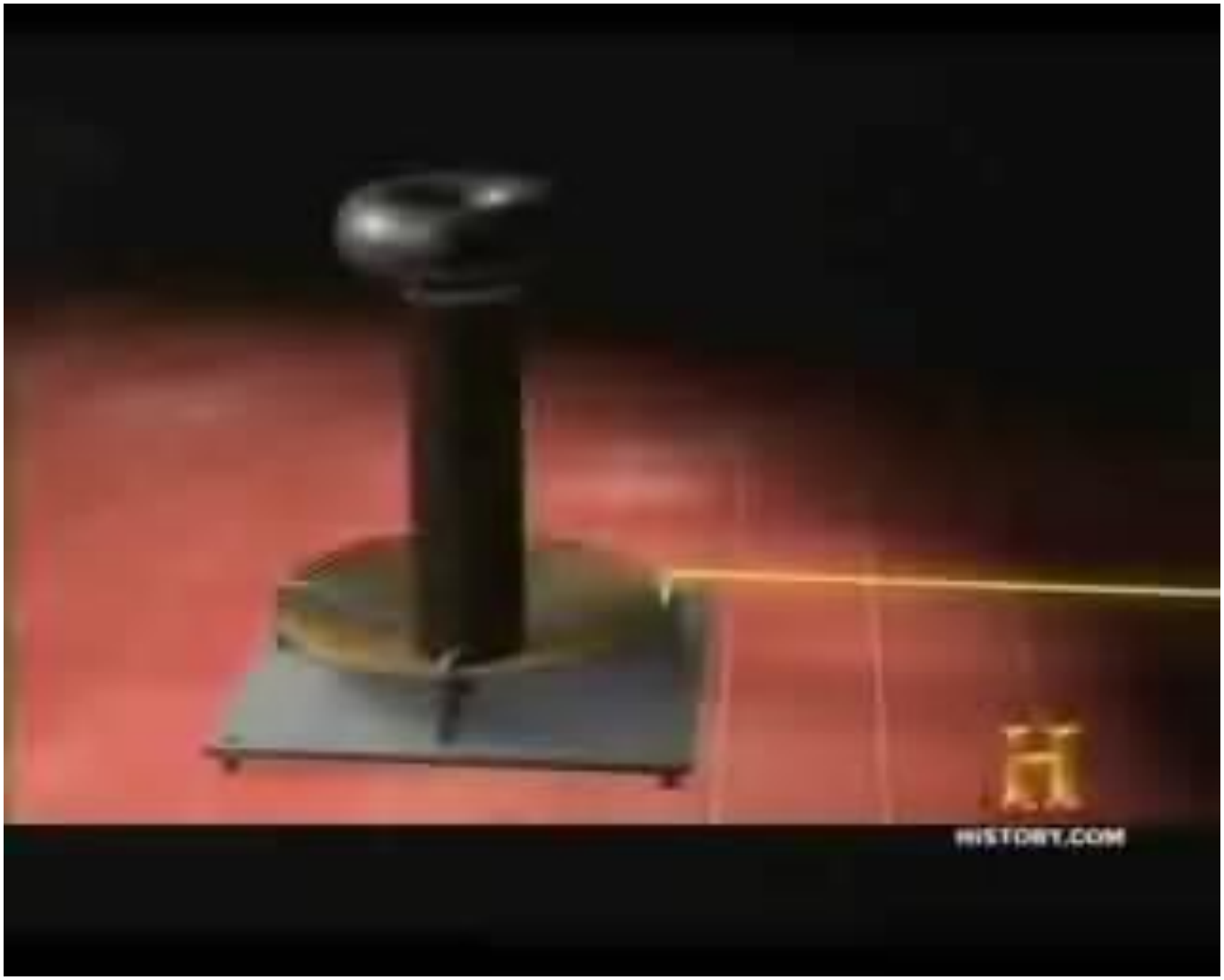
- Spark-excited radio frequency resonant transformers - Tesla coils
- Generated high AC voltages on elevated capacitive terminals.
- Transmitted power over short distance without wires.

Water – Current Analogy

Water – Current Analogy

- Pumping of water through a host
- The flow of water- current
- Pressure – Voltage
- Nozzle –Capacitive terminals

Tesla Coil



Tesla Coil

- Similary, when current is passed through a small primary coil to a larger secondary coil
- As a result, the voltage steps up tremendously.
- This makes the Tesla Coil a Transformer.

Tesla Coil

- The transmission distance was increased by using a receiving LC circuit ,tuned to resonance with the transmitter's LC circuit.
- Using voltages of the order of 20 megavolts generated by an enormous coil,

✓He was able to light three incandescent lamps by resonant inductive coupling

✓Distance -100 feet (30 m).

Wireless Electricity

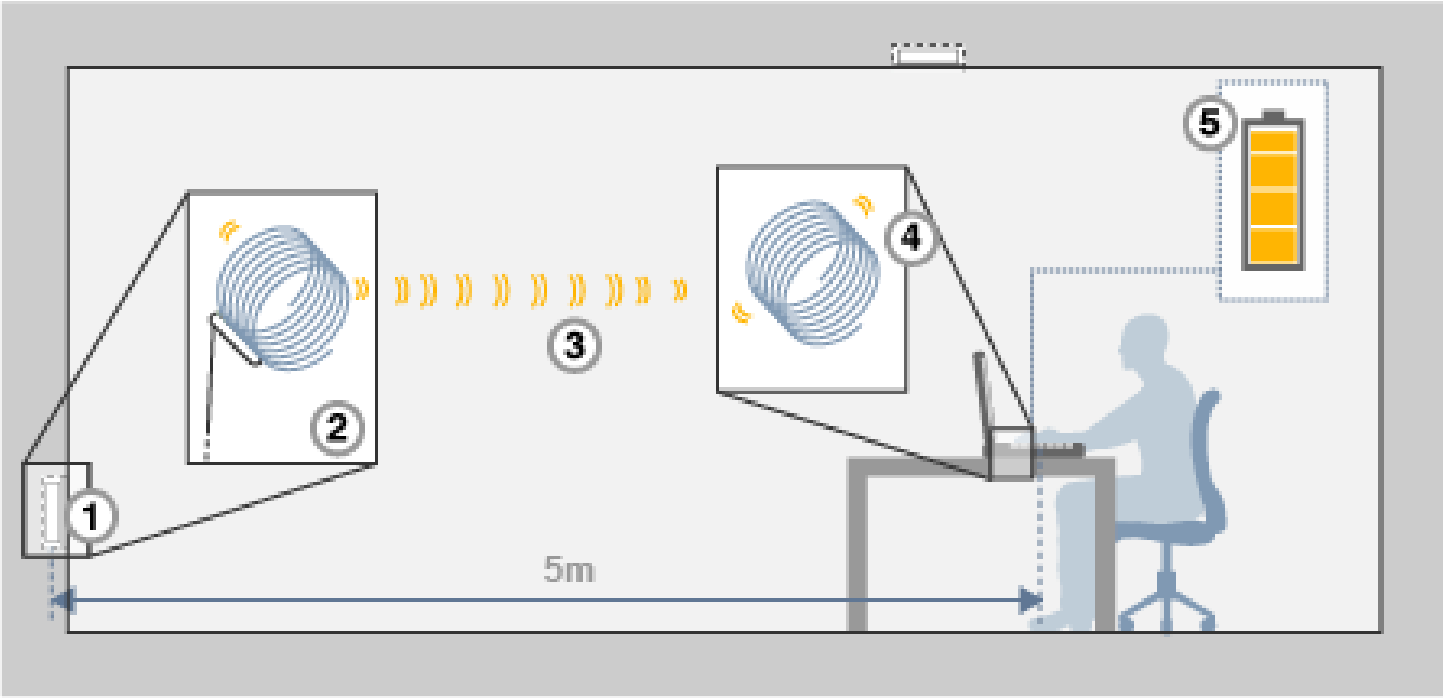
- Now-a-days there is a rapid increase of electronic goods like cell phones ,laptops ,I-pods etc., which rely on the chemical storage of energy by the battery which need to be recharged frequently As these are becoming daily needs to the present generation wireless energy transfer i.e, witricity would be useful for many applications as these things need mid range energy.

How it Works

- Wireless Electricity uses the principle which involves the usage of inductively coupled objects with same resonant frequency.
- The principle Electromagnetic Induction states that a coil generating magnetic field induces a current in another coil as it is being placed in the field of the former coil.
- On the usage of resonance, the energy is well transferred between coils having same resonant frequency without any interruption.

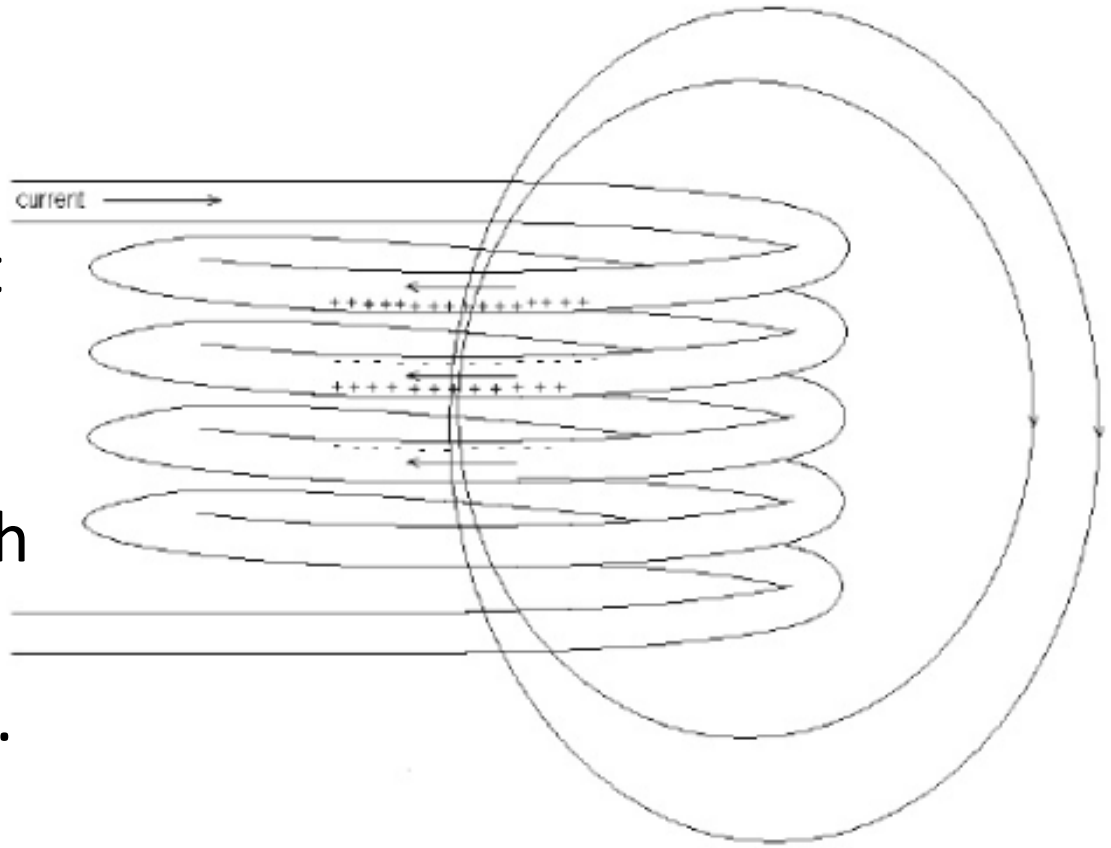
- There are two copper coils arranged.
- One at the sender end and the other at the receiver end.

1. Power Supply
2. Transmitting Coil
3. Magnetic field
4. Receiving Coil
5. Status of Battery



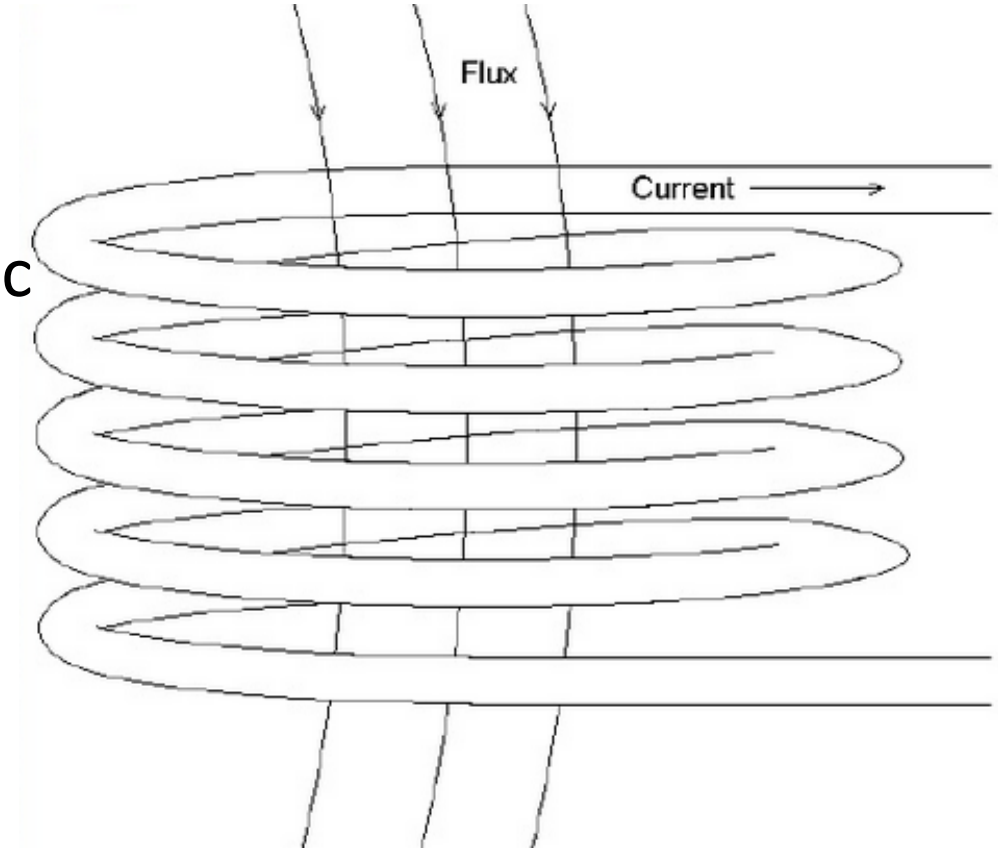
Primary Coil

When the power is switched on the first coil converts the electricity into magnetic field, which is oscillating at a particular frequency.

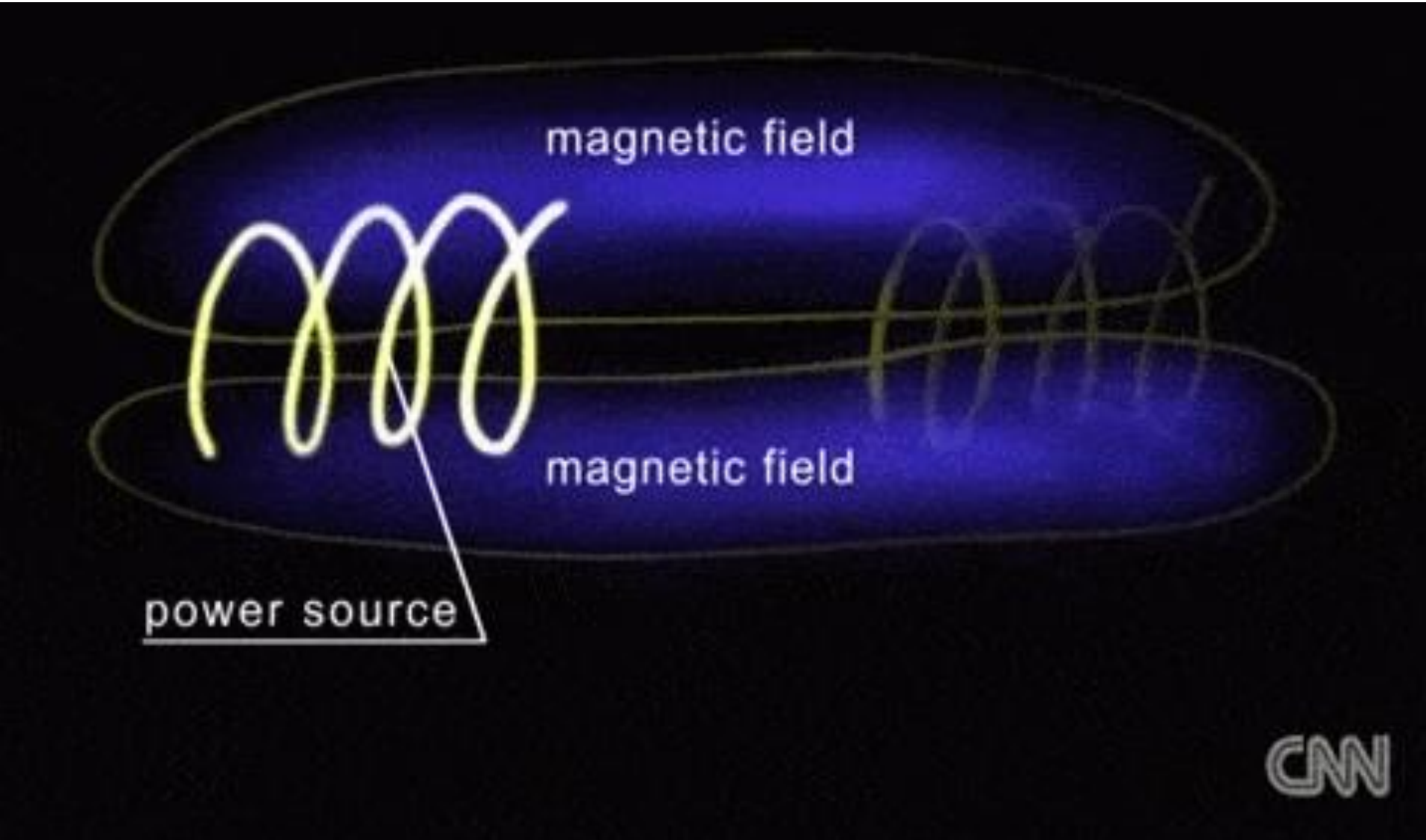


Secondary Coil

The second coil at the receiving end converts the oscillating magnetic field into electricity. The surrounding environment remains unaffected.



Magnetic coupling

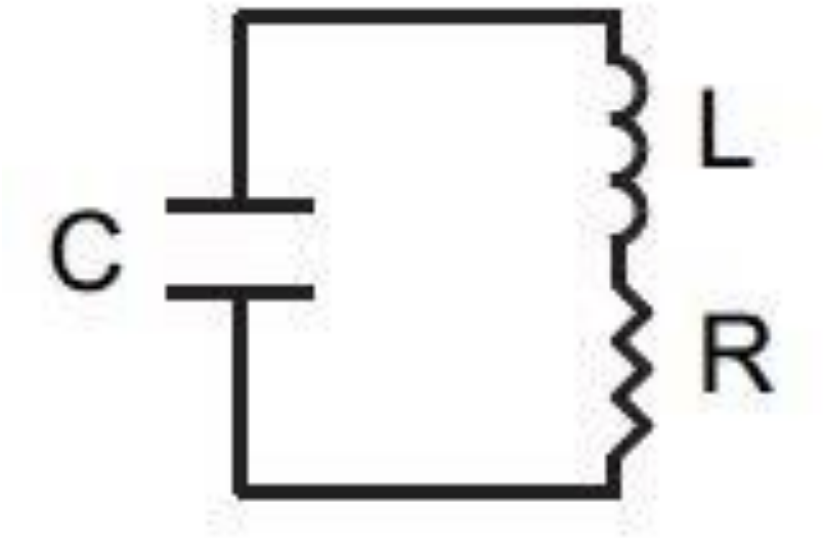


PHYSICS BEHIND WIRELESS TECHNOLOGY

Resonance:

- Resonance involves energy oscillating between two modes.
- The resonant factor for this resonator:

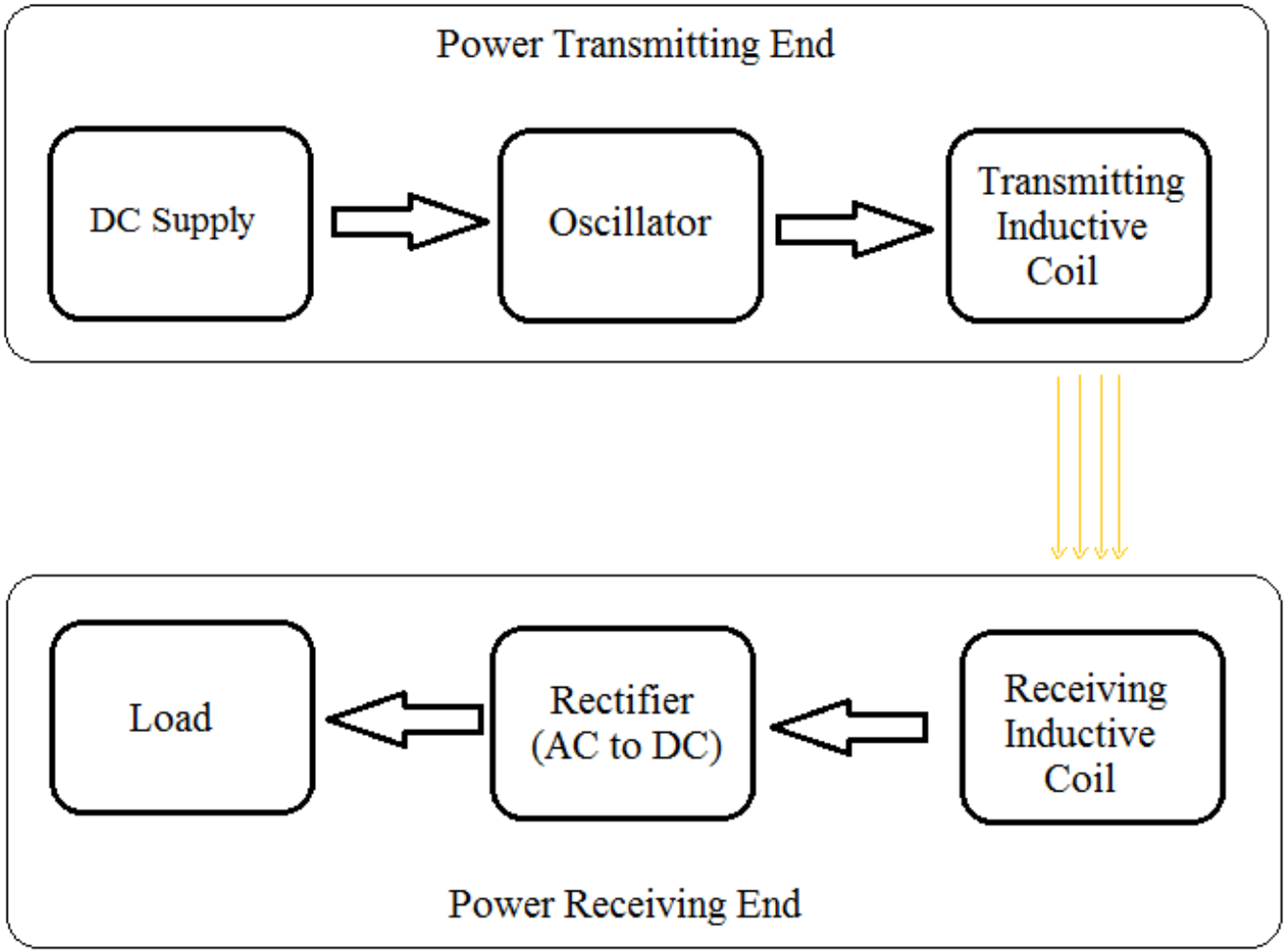
$$\omega = \frac{1}{\sqrt{LC}}$$



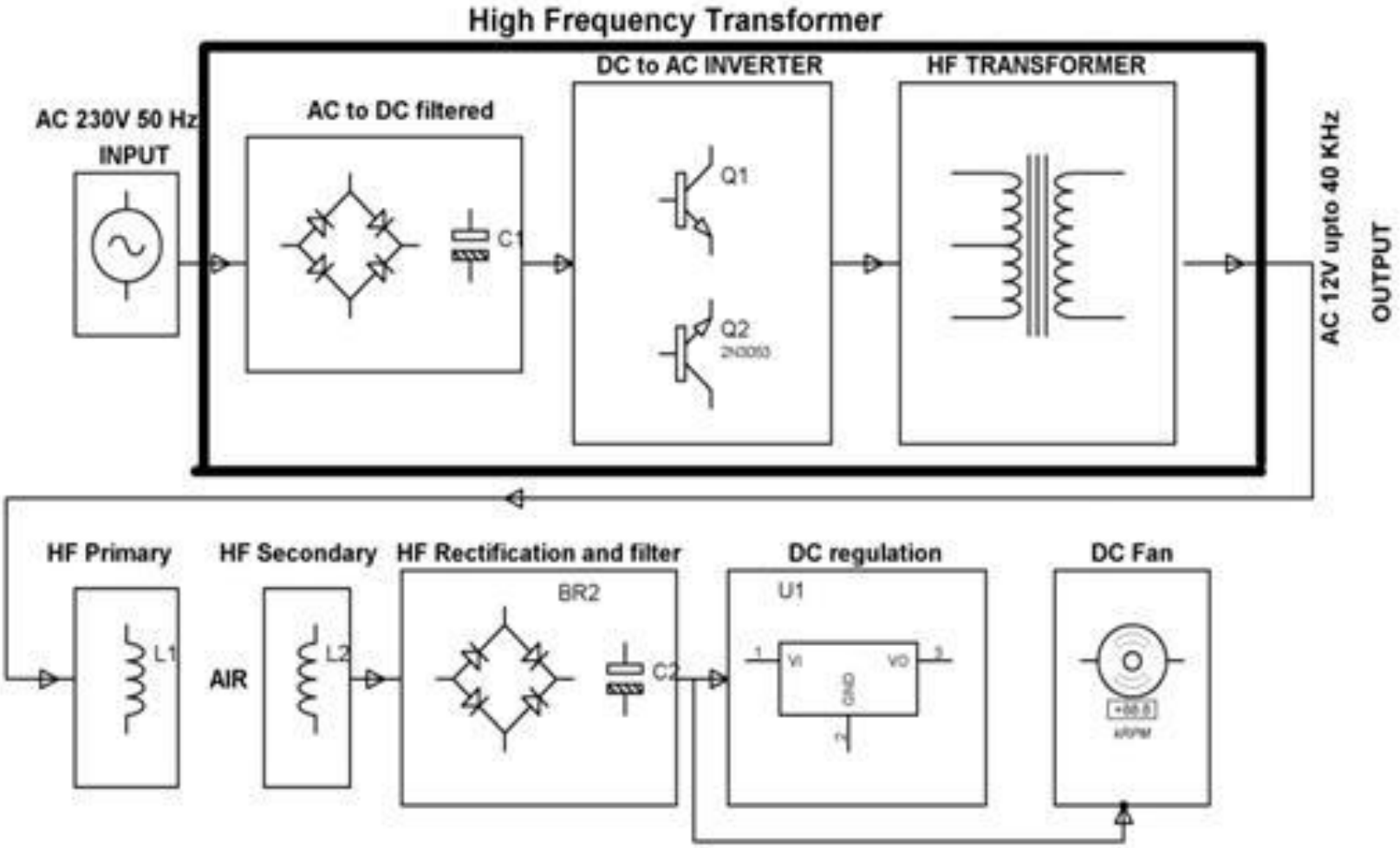
PHYSICS BEHIND WIRELESS TECHNOLOGY

- Two objects having similar resonance tend to exchange energy without causing any effects on the surrounding objects.

Basic block diagram



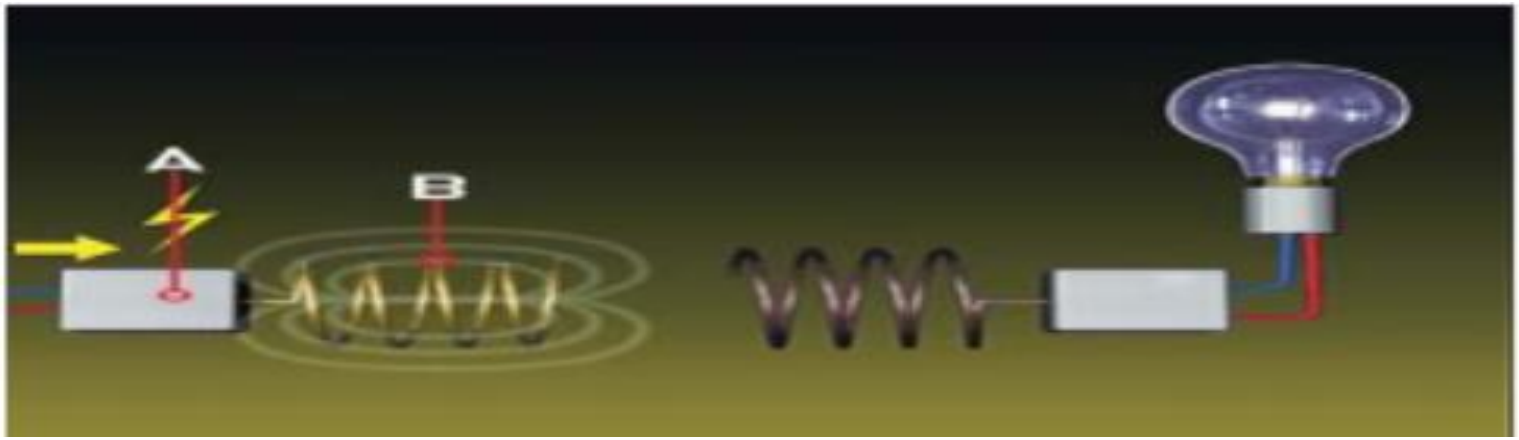
Wireless supply to a DC Fan



Sequence of flow of Power

Step 1

- A circuit [A] attached to the wall socket converts the DC current to 2 megahertz and feeds it to the transmitting coil [B].
- The oscillating current inside the transmitting coil causes the coil to emit a 2 -megahertz magnetic field



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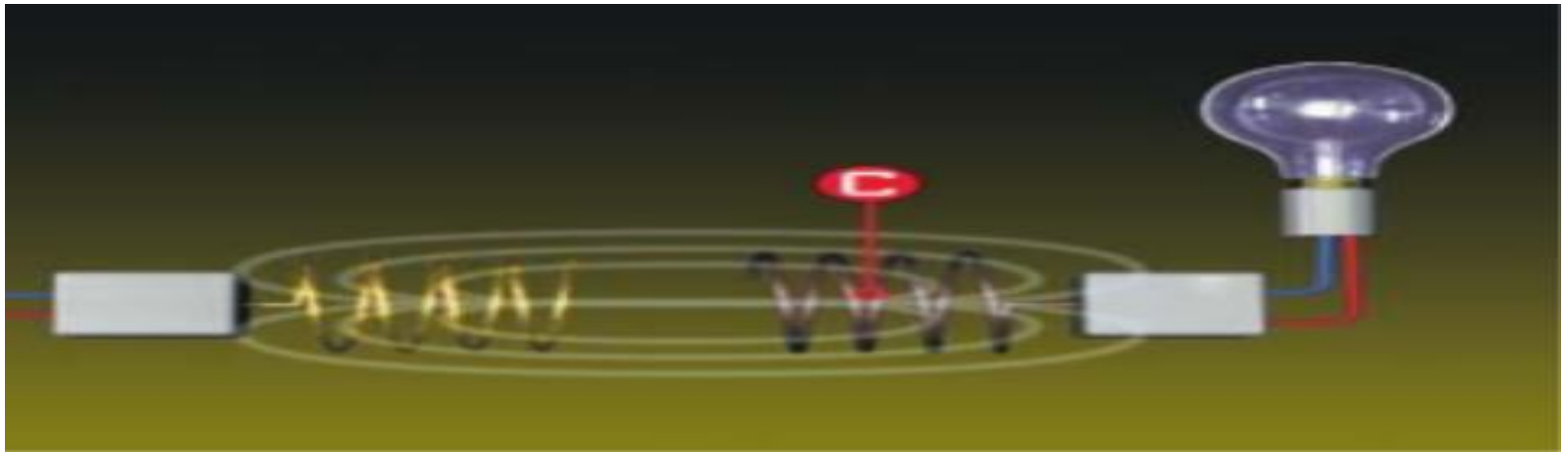
Step 2

- The receiving coil [C] is designed to resonate at the same frequency
- Magnetic induction takes place.
- Receiving coil picks up the energy of the first coil's magnetic field.



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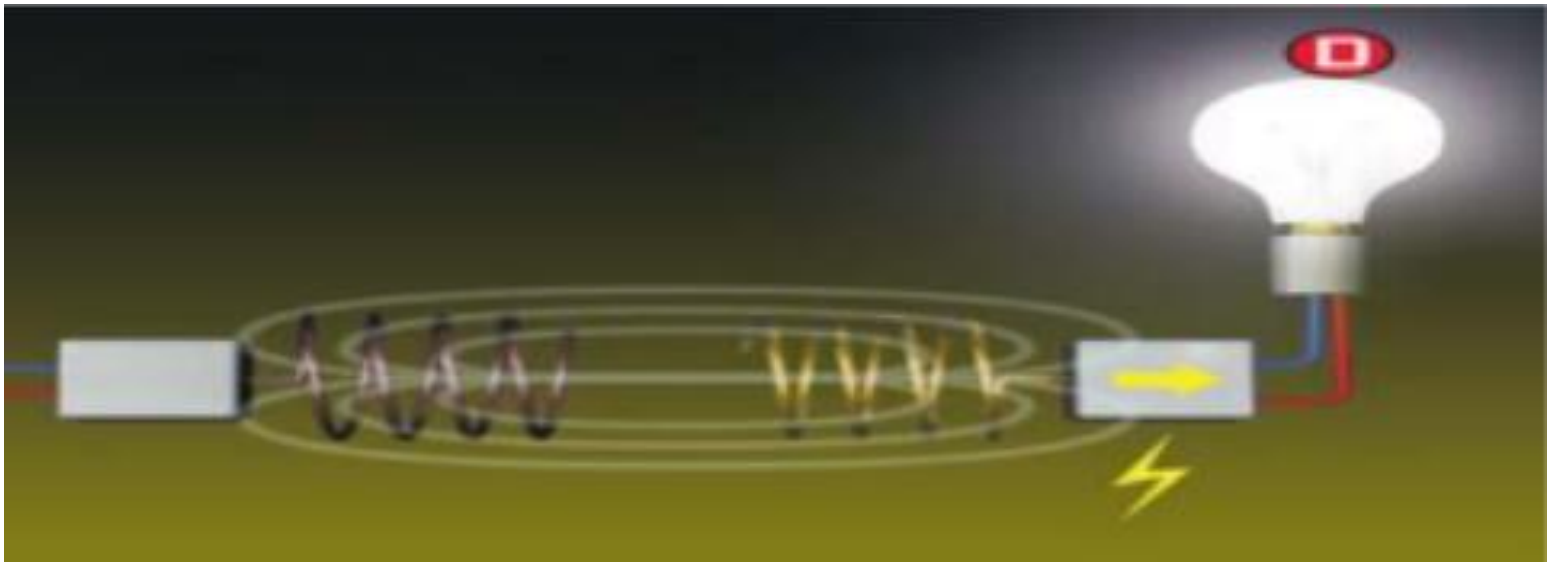
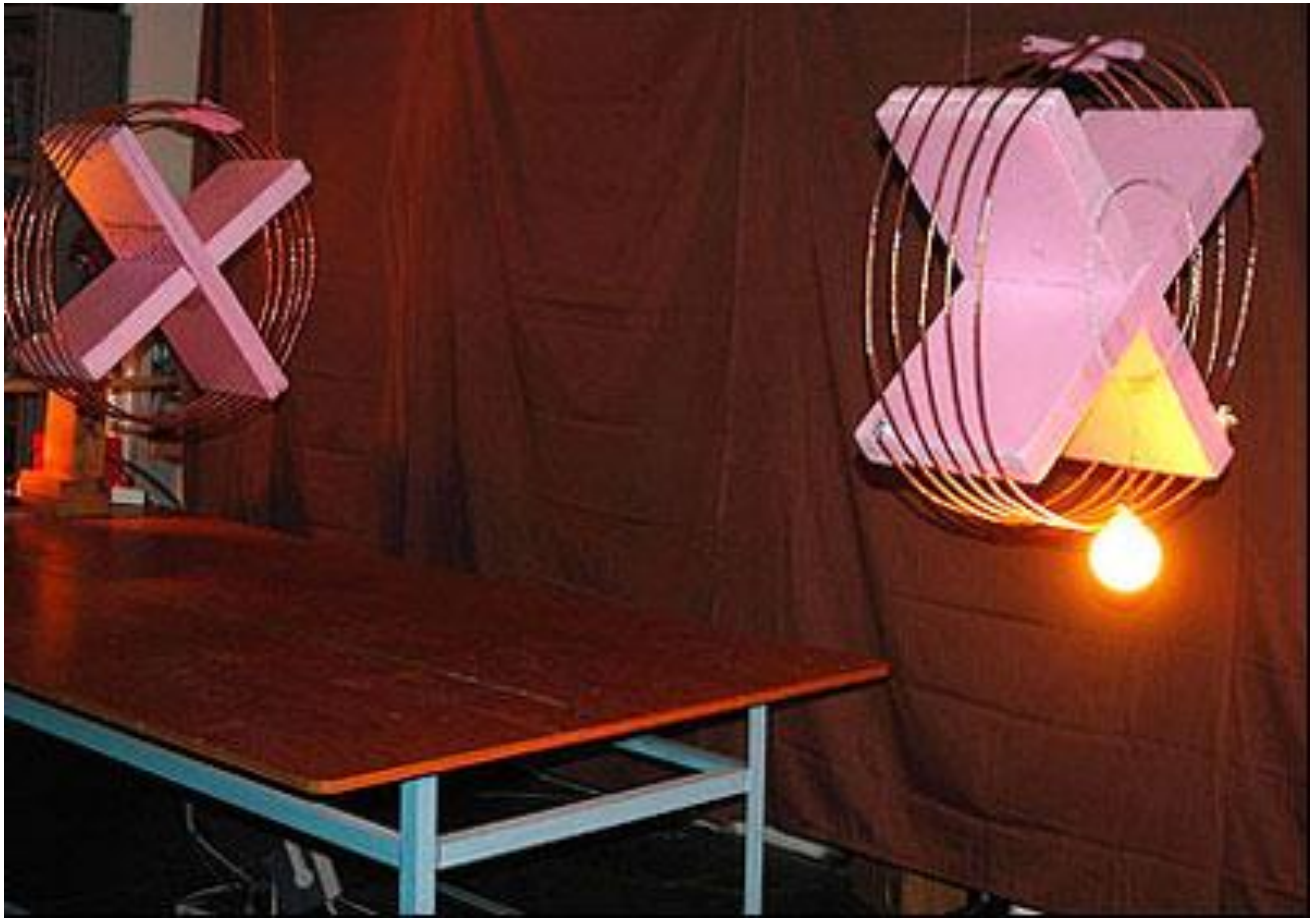
Step 3

- The energy of the oscillating magnetic field induces an electrical current in the receiving coil, lighting the bulb [D].



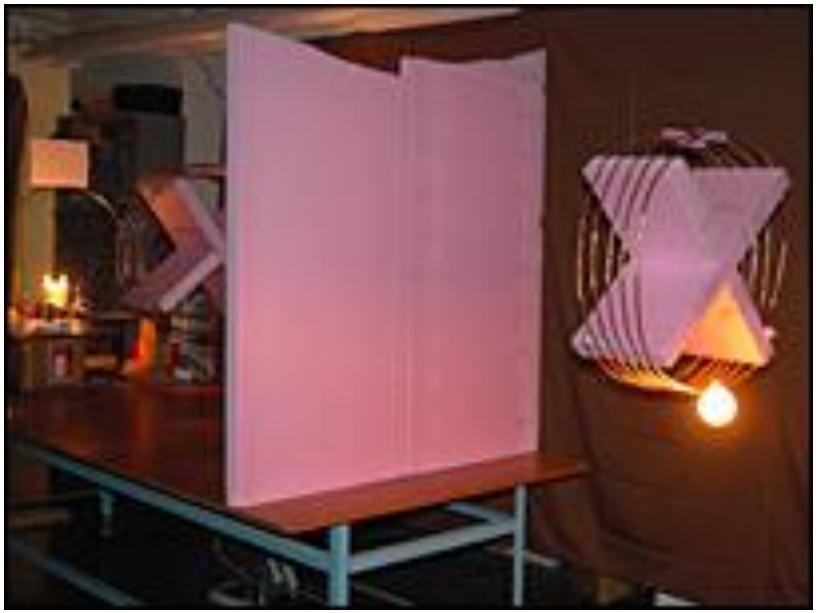
Experiment conducted by MIT Researchers

- At MIT, 2007,Project ‘Witricity’
- Powered a 60 watt light bulb wirelessly, using two 5-turn copper coils.
- Diameter: 60 cm (24 in)
- Distance :2 m (7 ft)
- Efficiency : 45%



Experiment conducted by MIT Researchers

- Resonating frequency : 9.9 MHz (≈ wavelength 30 m)
- Primary coil - connected inductively to a power source
- Secondary Coil - to a bulb (load).
- The setup powered the bulb on, even when the direct line of sight was blocked using a wooden panel.
- Researchers were able to power a 60 watt light bulb at roughly 90% efficiency at a distance of 1 m.



- The research project at MIT was spun off into a private company, called by the same name, WiTricity.

- It is an American engineering company

- Manufactures devices for wireless energy transmission using resonant energy transfer based on oscillating magnetic fields.

Applications

- Totally replaces the wires
- Electronic gadgets like laptops, mobiles, iPod etc. can be charged wirelessly
- Charging is automatic, without human intervention

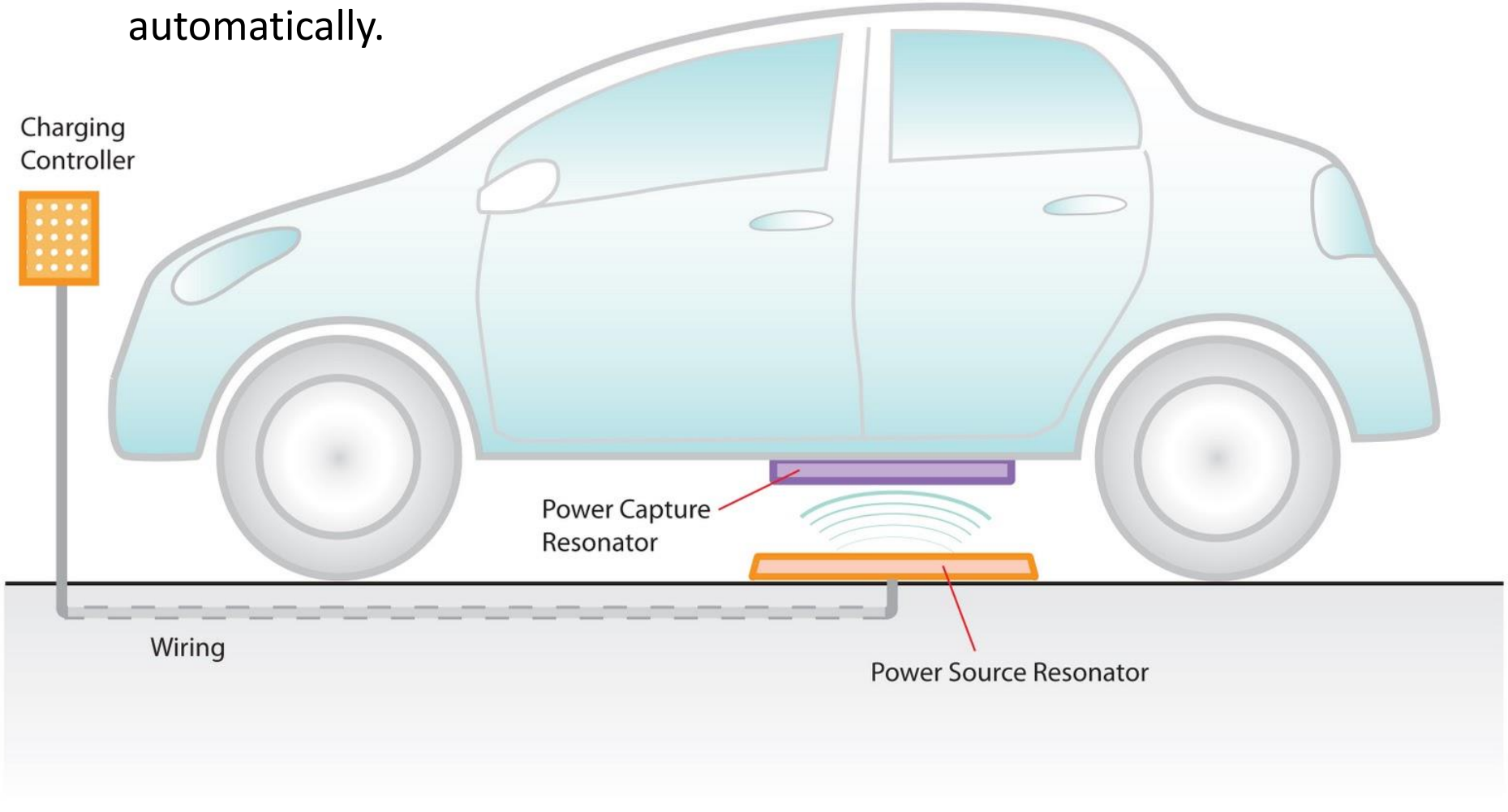
DISTANCE PARAMETER

- Diameter of the coil ought to increase proportionately with the frequency of operation.

- An outsized diameter of supply coil with an outsized range of turns will increase the space of the operation.

- **Limitation:** we have a tendency which can’t increase the potential unit age of the operation higher than fifty to sixty volt as a result of its dangerous for a frame and might be caused by electrical shock.

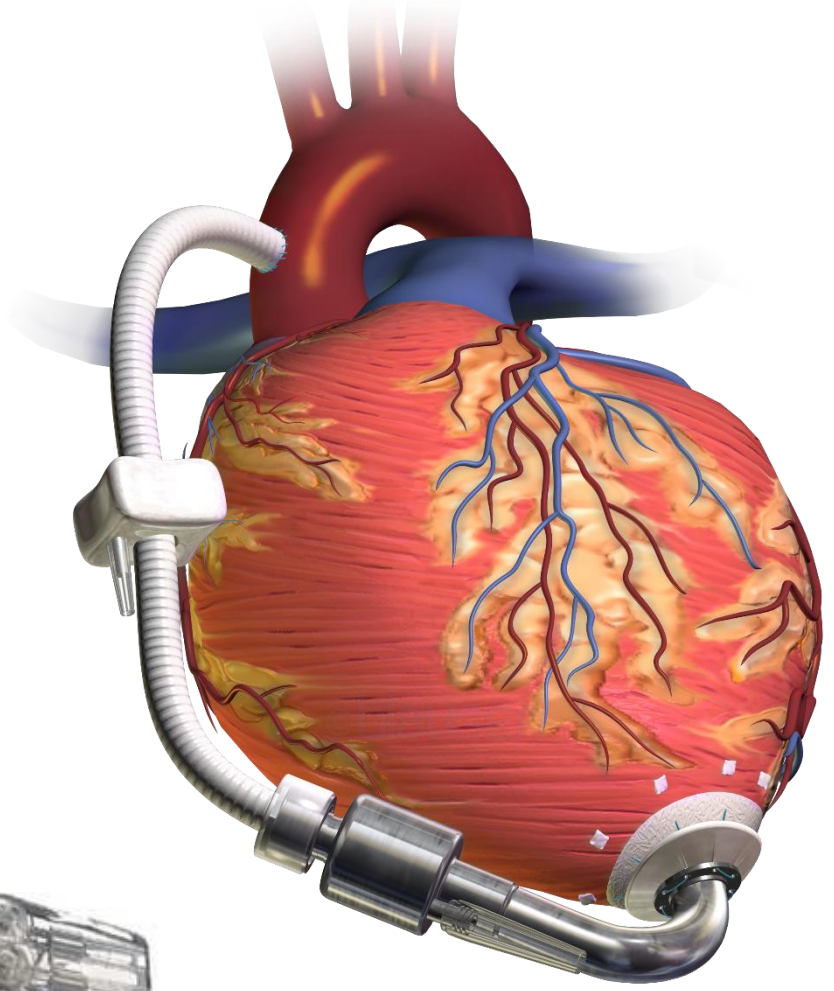
- The entire lighting system can be powered wirelessly.
- The car can be charged automatically.



Medical Field

Wireless charging of

- Ventricular assist devices
- Pacemakers
- Defibrilators



Advantages

- It doesn’t require line of sight.
- It doesn’t require batteries and power cables.
- It doesn’t interfere with radio waves.
- In this, wastage of power is in a small quantity.
- It is highly efficient when compared with electromagnetic induction.
- It is affordable.

Limitations

- Size
- Cost
- Range and
- Efficiency

Future of Wireless Electricity

Conclusion

- Non-radioactive mode of energy transfer.
- Magnetic fields interact very weakly with biological organisms—people and animals and are scientifically regarded to be safe.
- It can transfer the power through walls and any metal obstacles.
- Transmission efficiency is maximum over short range of distance (mm).
- Wireless Electricity technology is based on sharply resonant strong coupling.
- It is able to transfer power efficiently even when the distances between the power source and capture device are several times the size of the devices themselves

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THANKS