Michael Faraday

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Hakan Atalay

Dr.Faruk Berat


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What I will gain from this presentation if I listen carefully Haaa !!

1)Biography

2)Theories

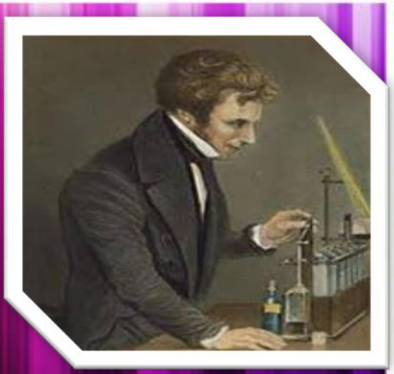
3) Contributions to Physics and Chemistry

4)Application's of his theories

1

Next Virtual Slide

Biography



- He was born on 22 September 1791 in south London to relatively poor parents
- he left school and started an apprenticeship at a local book binder
- In his spare time he was an avid reader, teaching himself many scientific concepts
- His early work centred on chemistry

Biography #2

- Faraday worked more with chemistry. However, none of his findings in chemistry can compare with his discoveries in Physics specifically in electricity
- Faraday's greatest achievement was in the development of electro-magnetism and electricity *generator
- Received a Doctor of Civil Law degree in 1832 by the University of Oxford granted Faraday, elected as a foreign member of the Royal Swedish Academy of Sciences in 1838 and the French Academy of Sciences in 1844.

- He died on 25 August 1867 at Hampton Court

MICHAEL FARADAY TIMELINE

1791 : Born in Newington Butts, England

1804 : Served as an errand boy

1805 : Apprenticed with George Riebau for a period of seven years

1812 : End of apprenticeship; Attended four lectures

1813 : Was appointed as Chemical Assistant at the Royal Institution

1821 : Was appointed as the acting superintendent of the house of the Royal Institution; Married Sarah Barnard

1824 : Was elected as a member of the Royal Society

1825 : Was appointed director of the laboratory

1832 : University of Oxford granted Faraday a Doctor of Civil Law degree (honorary)

1833 : Was awarded the position, Fullerian Professor of Chemistry, for life

1838 : Was elected a foreign member of the Royal Swedish Academy of Sciences

1839 : Conducted a series of experiments to examine the fundamental nature of electricity

1844 : Became one of eight foreign members elected to the French Academy of Sciences

1847 : Researched that the optical properties of gold colloids differed from those of the corresponding bulk metal

1848 : Was honoured a grace and favour house in Hampton Court in Middlesex

1867 : Michael Faraday left for the heavenly abode

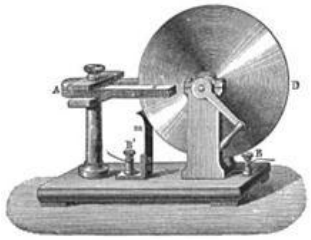
But still try, for who knows what is possible...

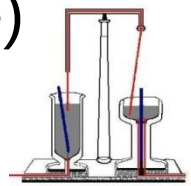
(Michael Faraday)

izquotes.com

❖World's greatest experimental physicst

- ❖ Father of motor, generator, transformer, electrolysis
- ❖ Two units in physics named in his honor
  - ❖ Farad(capacitance)
  - ❖ Faraday(charge)
- ❖ (Law of induction, Faraday effect)





*ONE FARAD IS THE VALUE OF CAPACITANCE THAT PRODUCES A POTENTIAL DIFFERENCE OF ONE VOLT WHEN IT HAS BEEN CHARGED BY ONE COULOMB

*ONE FARADAY OF CHARGE IS THE MAGNITUDE OF THE CHARGE OF ONE MOLE OF ELECTRONS

What is Electro-Magnetism !!

- **Electromagnetism:** production of a magnetic field by current flowing in a conductor.
- In More Details :

  Coiling a current-carrying conductor around a core material that can be easily magnetized, such as iron, can form an electromagnet.
- The strength of the electromagnet depends upon the amount of current passing through the conductor.

Illustration Of Iron ring

Some Laws Based on his Concepts

* His math problems

$$B = \frac{\mu_0}{2\pi} \cdot \frac{I}{r}$$

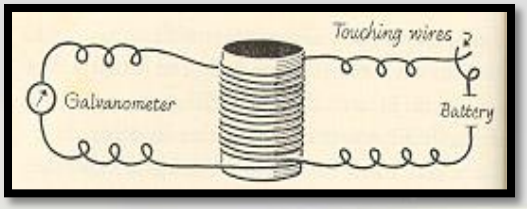
Magnetic field due to an infinitely long straight wire

$$B = \mu_0 \cdot n \cdot I$$

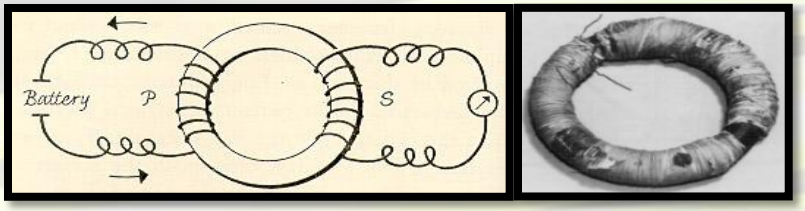
Magnetic field of a solenoid

The Main schemes

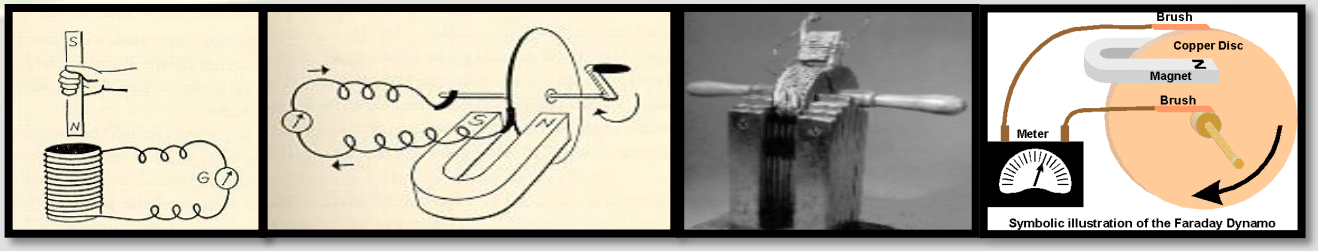
- The First scheme (Magnet)



- The second scheme
  (Transformer)



- The third scheme (magnetic force line)
  Or more specifically Generator and motor



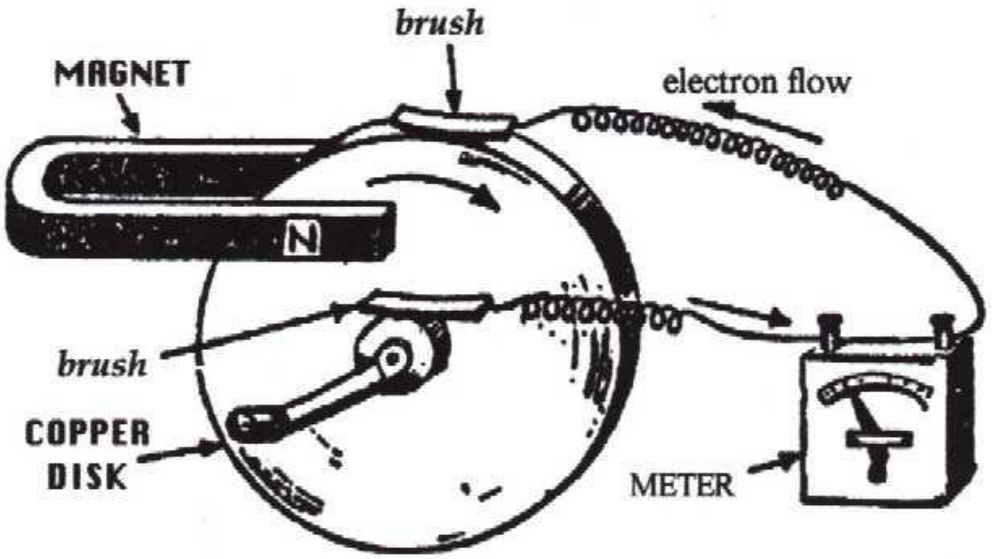
What is The usage of those schemes ??

- We use motor in thousands of applications: disk drive, video machine, fan, pump, washing machine, refrigerator, air conditioner…
- We need generator to produce electricity
- We need transformer for long-range electricity delivery and in some devices
- We need electronic magnet in recycling factories etc

Importance of the generator

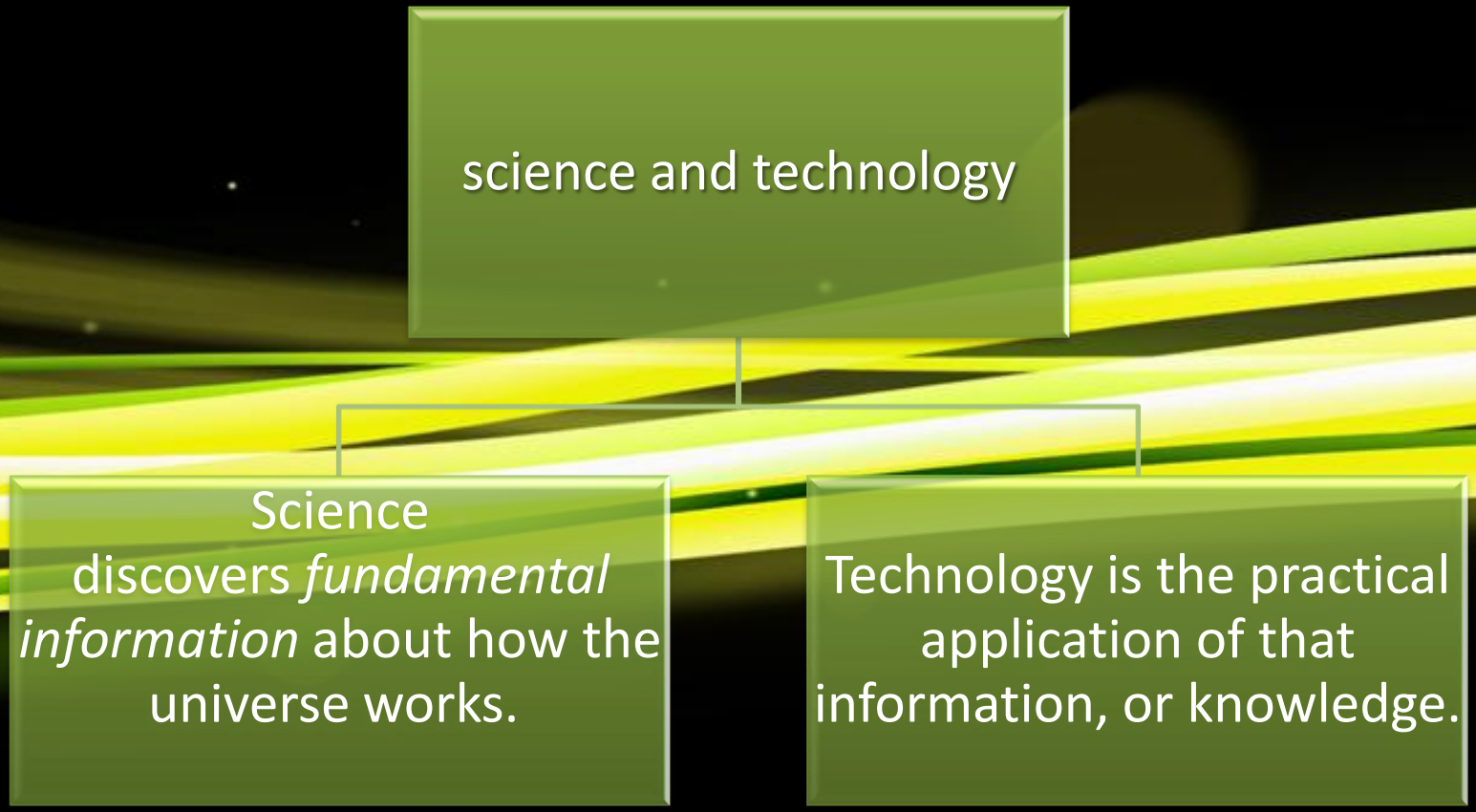
- The electric generator allowed for electric energy to be produced without the consumption of chemical energy
- Using turbines to produce electricity
- Using water, steam, coal, oil, wind to power turbines
- Electricity on a larger scale

Faraday's electric generator

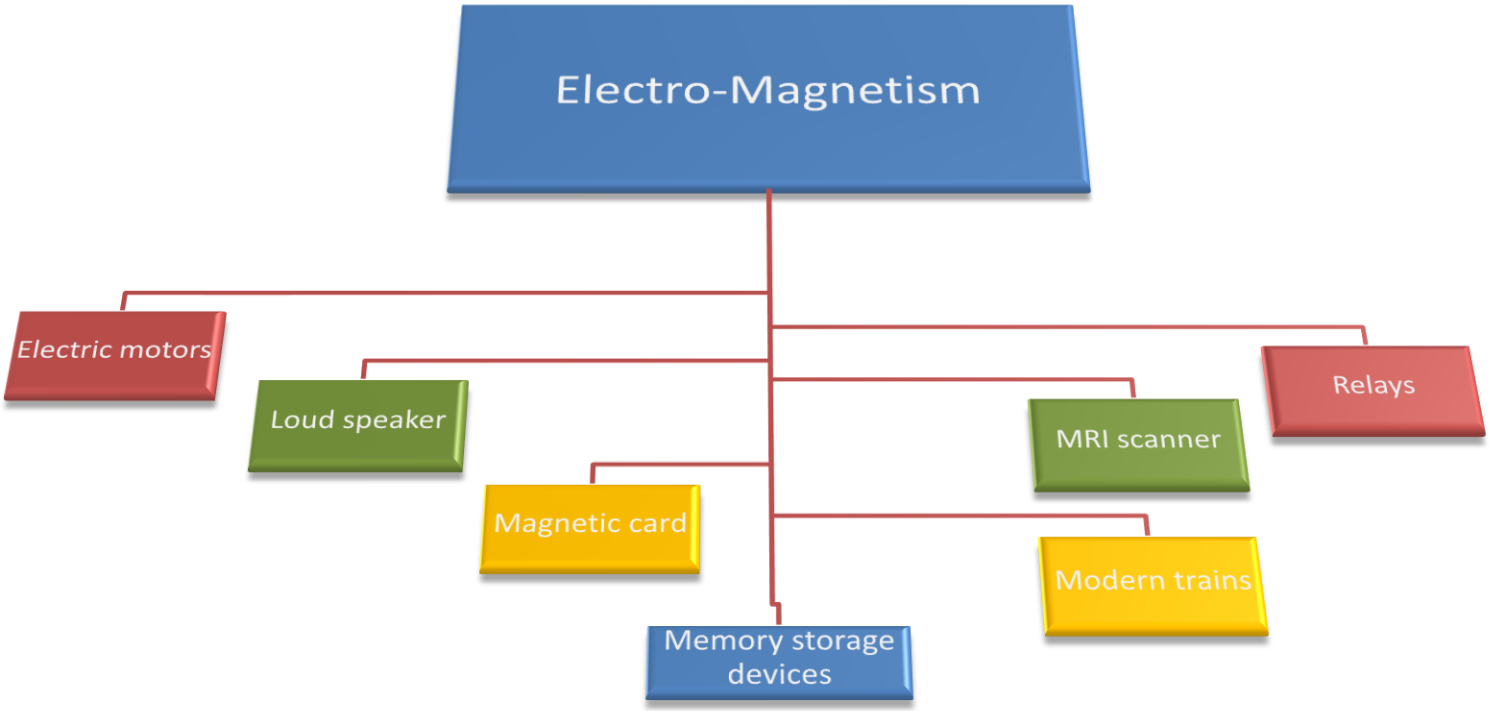


Faraday's disk dynamo - for producing continuous (pure) dc voltage. This was the world's first electrical generator.

Relation to science and technology !

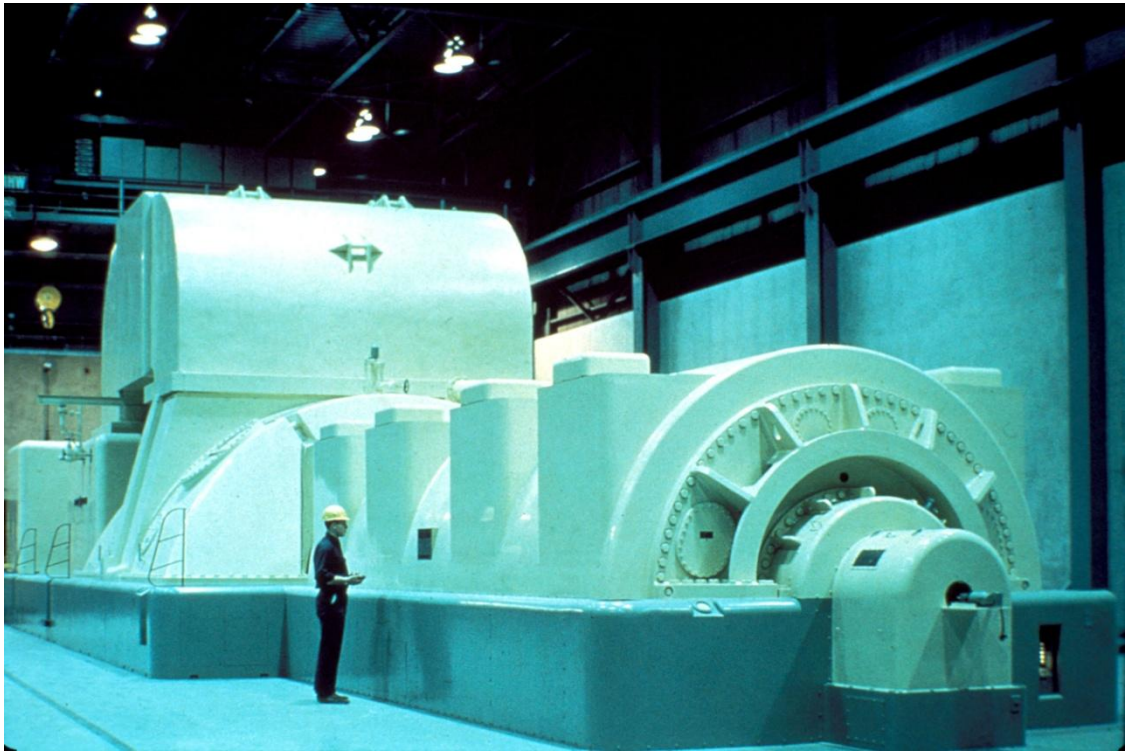


Well Since Electro-Magnetism is our science what is the technology for it

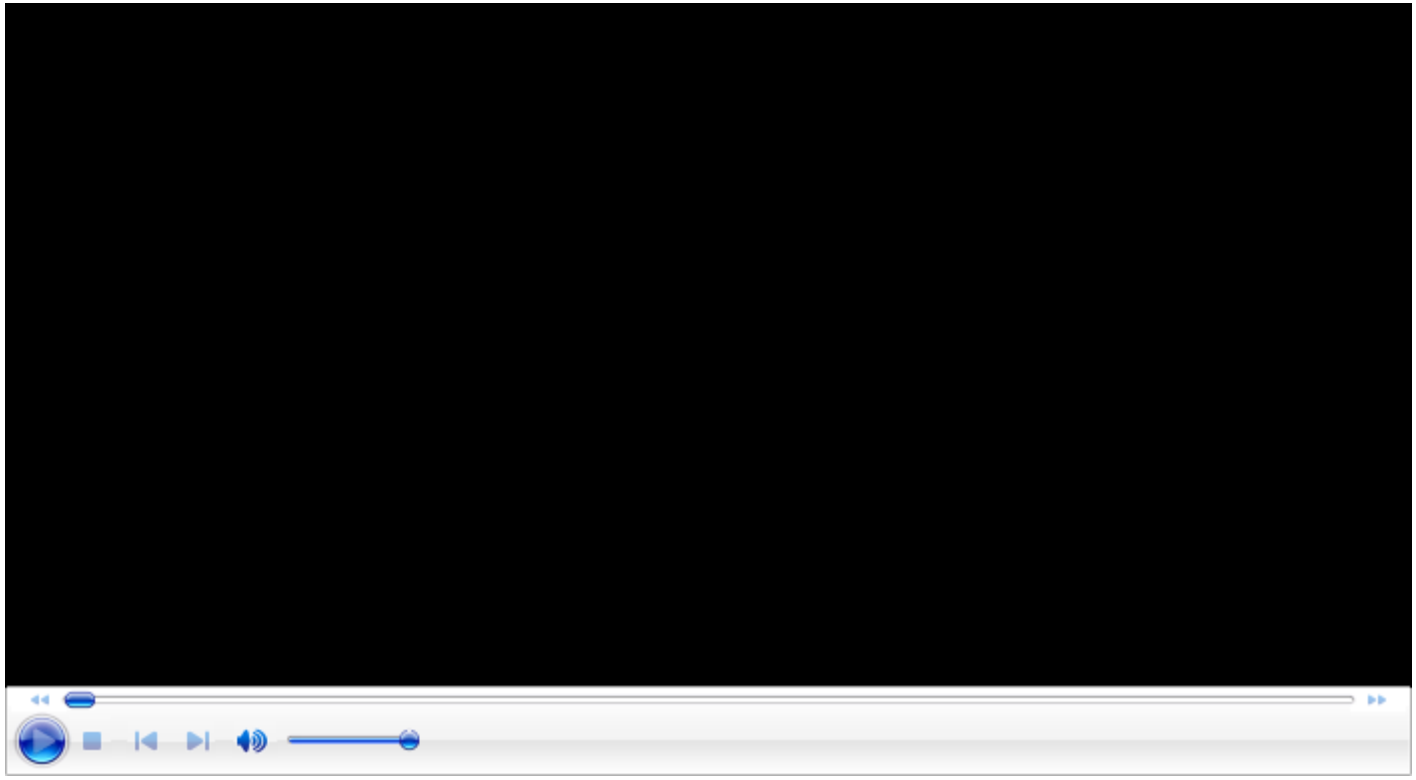


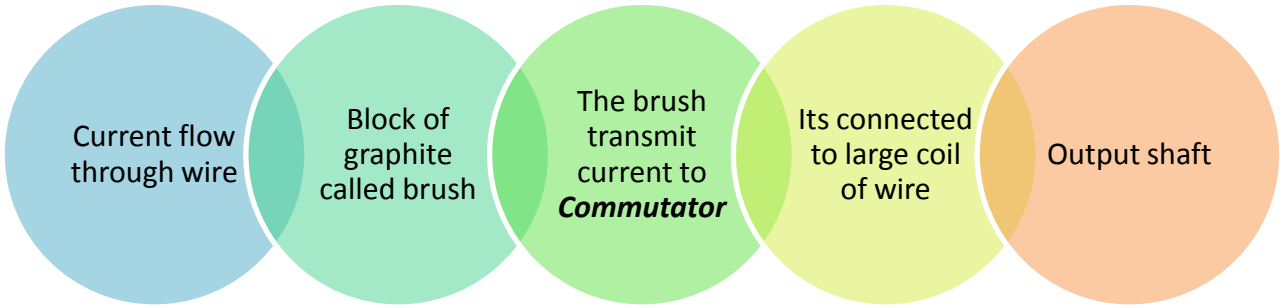
And A lot more !!

Modern electric turbine

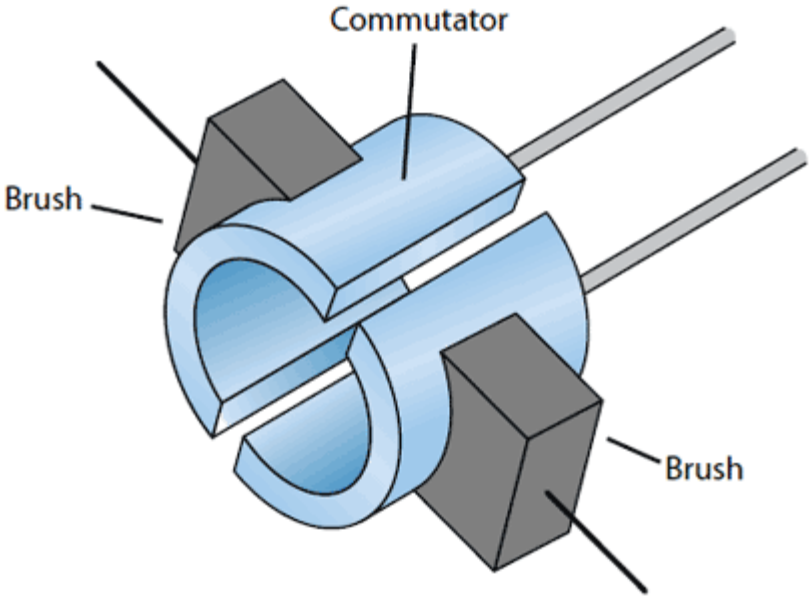


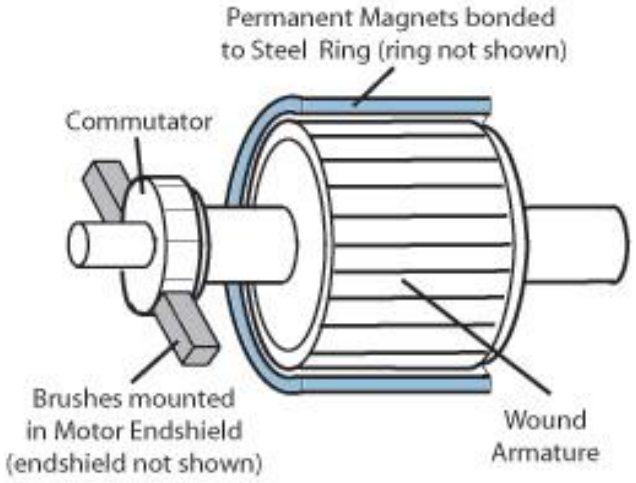
How Motors work ,and how they depend on electromagnetism



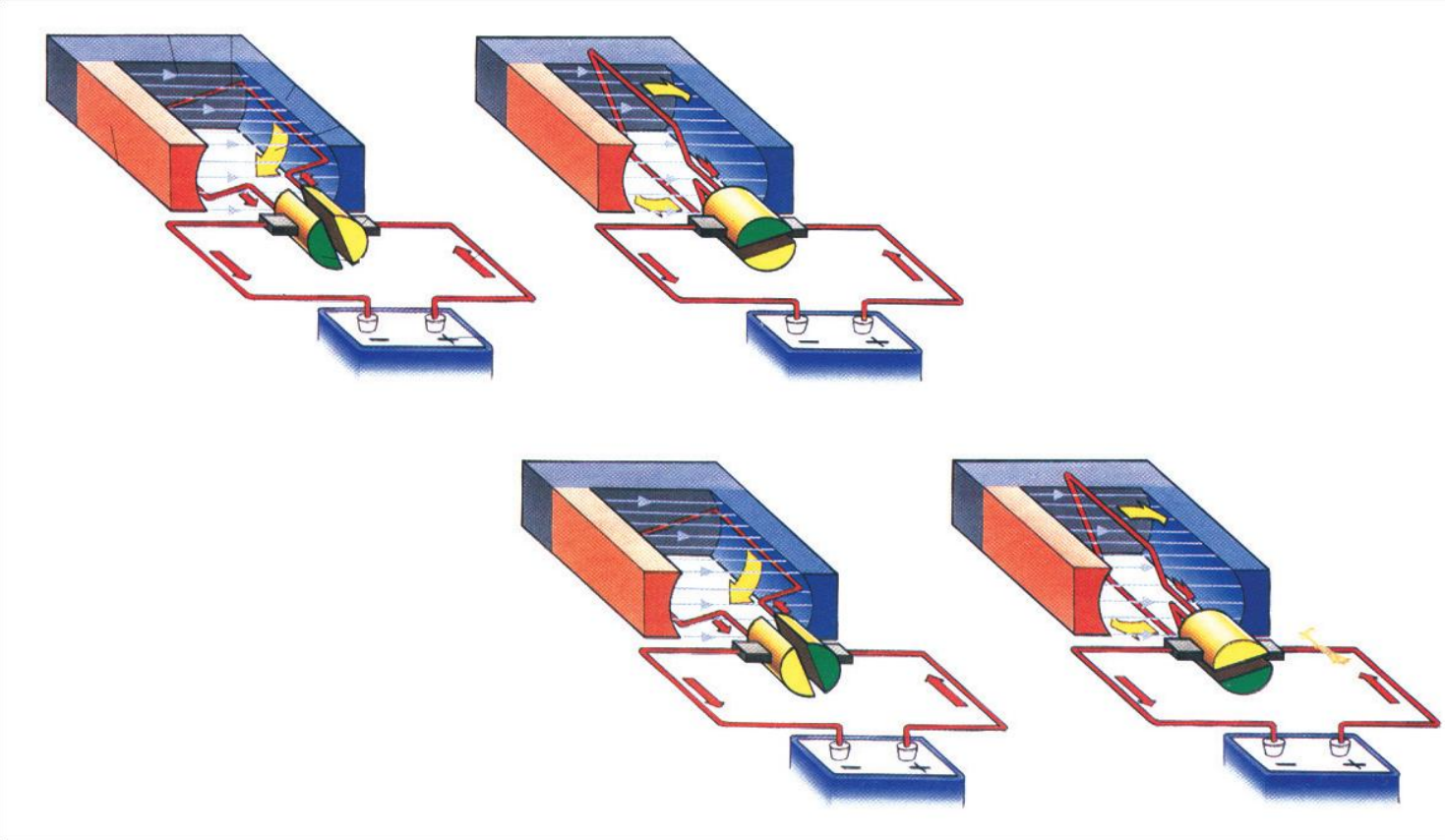


Diagrams of motors parts



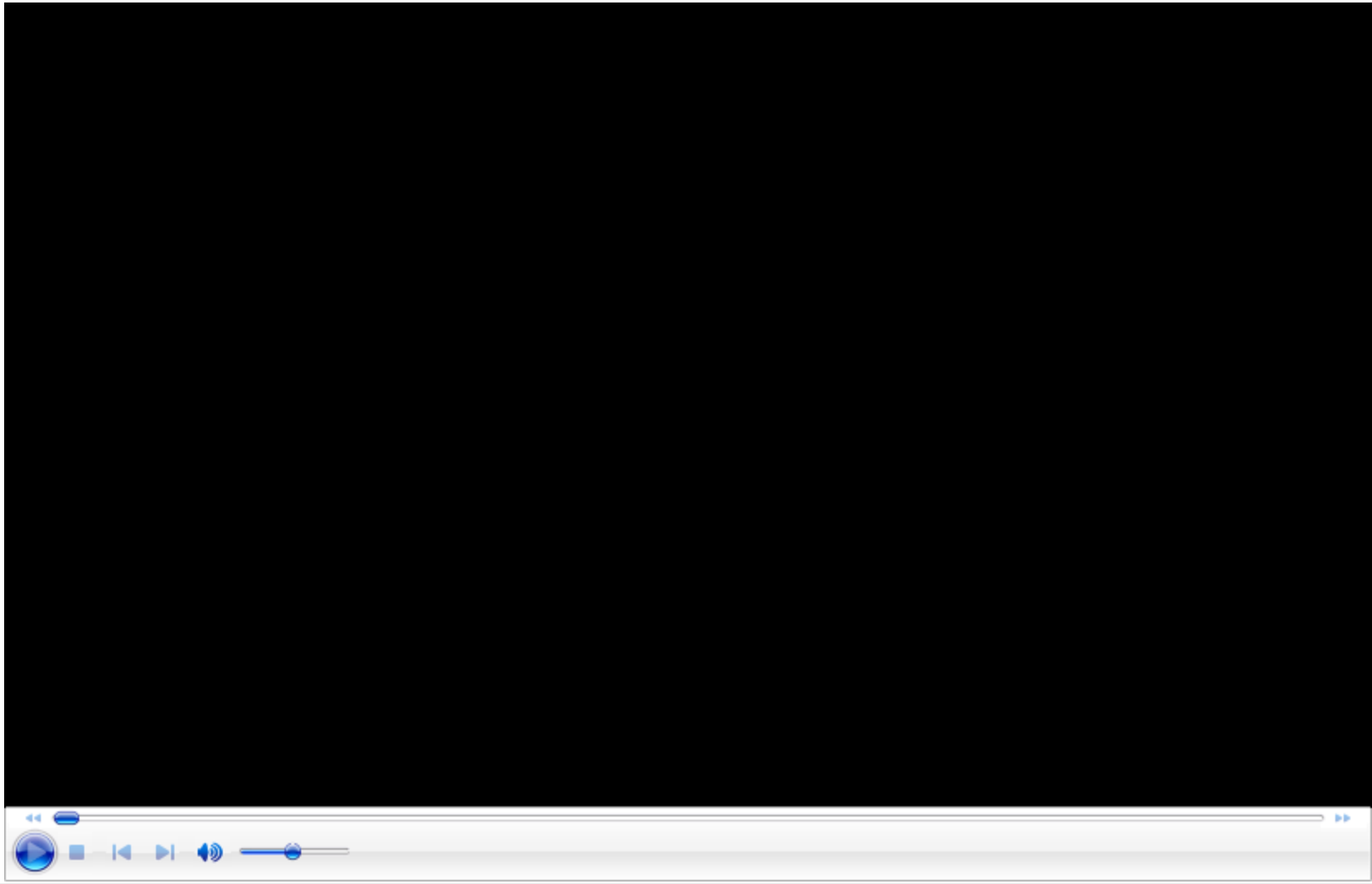


How motor work in the slow motion

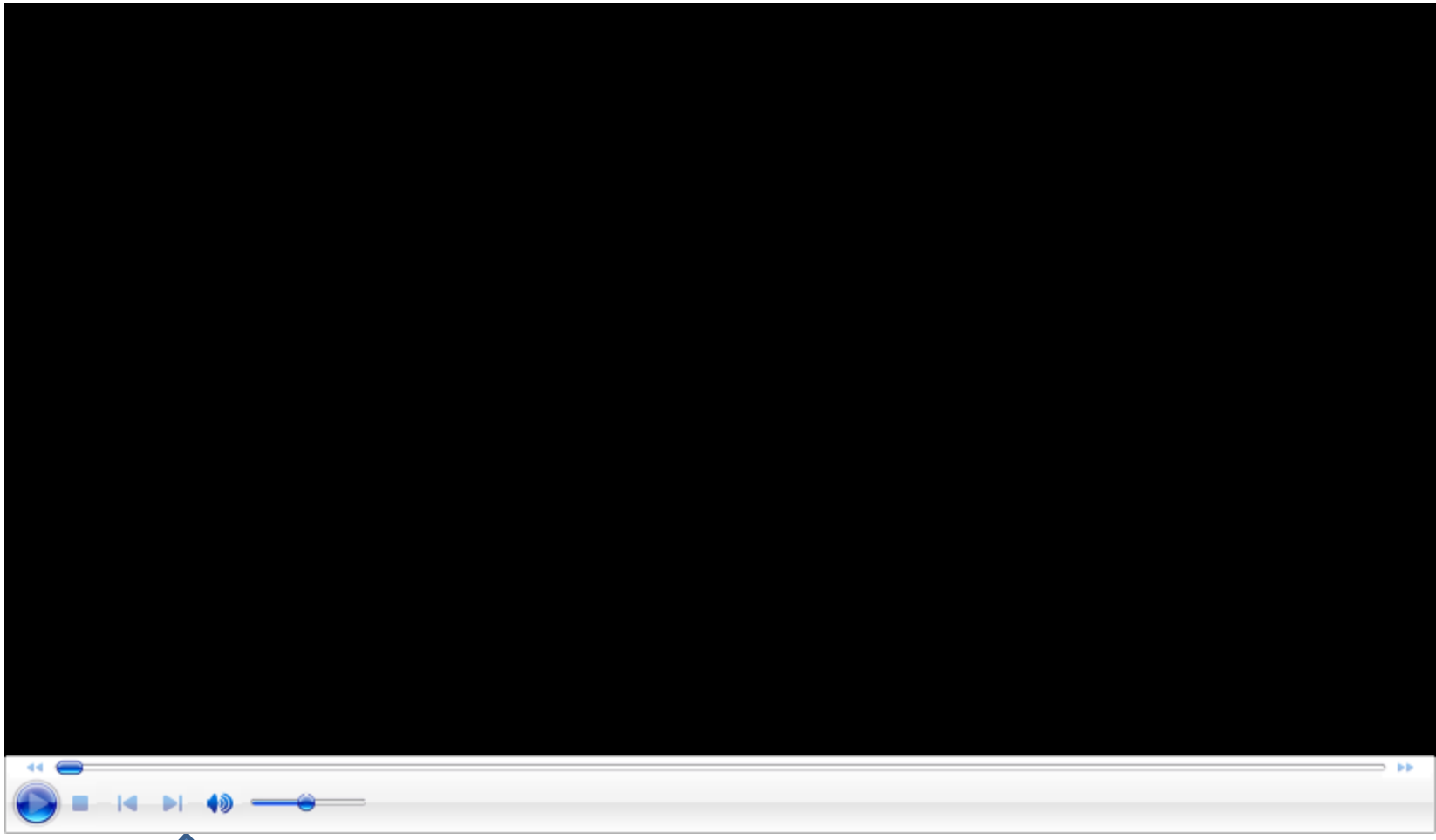


explain

What is Induction ?



How Speaker work ,and how they depend on electromagnetism ?



Next Slide MC Cage

The Invention of Faraday Cage

Michael Faraday invented the “cages” in 1836, and they were named after him, but Benjamin Franklin also made a great contribution to “Faraday Cage” development and application.

Faraday noticed that the conductor charge (on a charged conductor) did not influence anything that was enclosed within; the charge resided only on the exterior. Faraday constructed a room, coated the entire room with metal foil, and used an electrostatic generator to create high-voltage discharges that stroke the outside of his metal foil-coated room. He found no electric charge on the inside walls. Faraday used an electroscope to prove this.

In 1755, Benjamin Franklin discovered what we now call “A Faraday Cage”, in his own experiment. He used a cork ball and a can. The cork was suspended on a thread and put into the can through a small opening. Franklin found that the cork wasn’t attracted to the inside, although it did touch the bottom; when drawn out, the cork was not electrified. If it touched the outside, it would have been electrified.

How Does It Work?

An external electrical field leads to rearrangement of the charges, and this cancels the filed inside. Electric fields (applied externally) create forces on electrons in the conductor, creating a current, which will further result in charge rearrangement. The current will cease when the charges rearrange and the applied field inside is canceled.

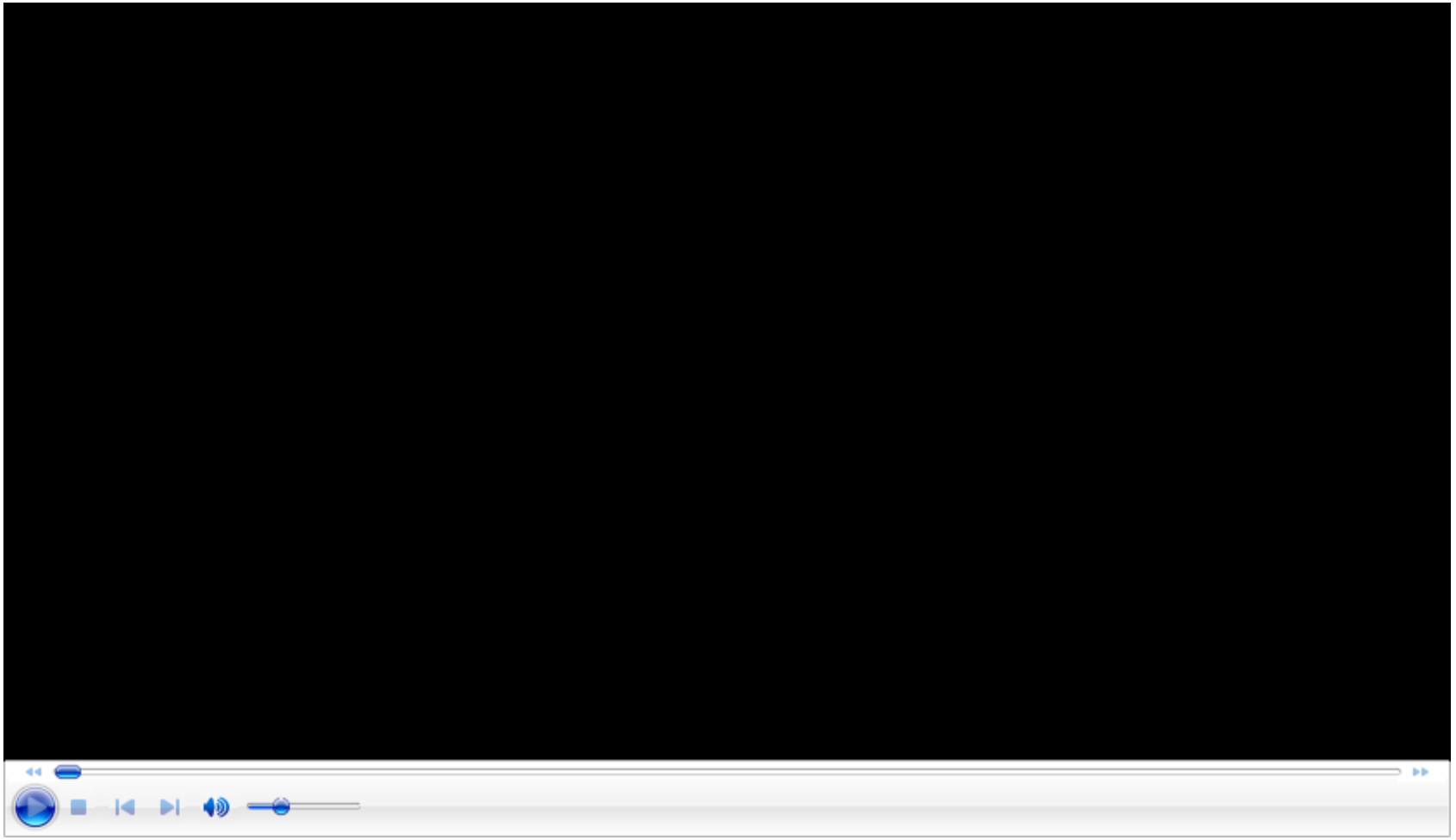
Applications of the Faraday Cage

- **Safety against lightening**: The cage protects the interior of the vehicle from the strong electric fields. Cars and aircraft act as Faraday cages / shields to protect people when the vehicle is struck by lightening.
- **Microwave**: the microwaves inside the oven are trapped and used for cooking. The metal shell of the microwave acts as a Faraday cage.
- **Protections for electronic goods**: Electronic equipment can be shielded and protected from stray electromagnetic fields by using coaxial cables that contain a conducting shell that acts as a Faraday cage.
- **Protective suits for linemen**: linemen often wear protective suits that act as Faraday cages while working with high voltage power lines. These suits protect them from getting electrocuted.
- **MRI** (Magnetic resonance imaging) scan rooms are good examples of a Faraday cage. External radio frequency signals are prevented from interfering with the data coming from the patient.

Daily life examples

Do you know that your fragile computer chips need protection from the Electro Magnetic Pulse (EMP)? To prevent them from getting disrupted by the EMP, we can build our own Faraday cages. There are also other numerous examples of the Faraday cage. Here is how to construct your own Faraday cage.

Video Of Faraday Cage In action



The Chemist

Michael Faraday

Early Research

- Mainly with chemical problems
- In 1820, produced C_2Cl_4 and C_2Cl_6
- In 1823, discovered a method of liquefying chlorine and other gases
- In 1825, successfully isolated a new compound, benzene

Faraday Discovered:

- Benzene:

  a colorless volatile liquid hydrocarbon present in coal tar and petroleum, and used in chemical synthesis. Its use as a solvent has been reduced because of its carcinogenic properties

He invented:

1- An early form of the Bunsen burner:

A small adjustable gas burner used in laboratories as a source of heat

2- The system of oxidation numbers:

A number assigned to an element in chemical combination which represents the number of electrons lost (or gained, if the number is negative), by an atom of that element in the compound

Faraday Popularized:

terminology such as:

anode :is an electrode through which positive electric charge flows into a polarized electrical device

cathode : is an electrode through which electric current flows *out of* a polarized electrical device

electrode : is an electrical conductor used to make contact with a non-metallic part of a circuit

ion

Faraday's Main Contributions

1- Faraday's laws of electrolysis

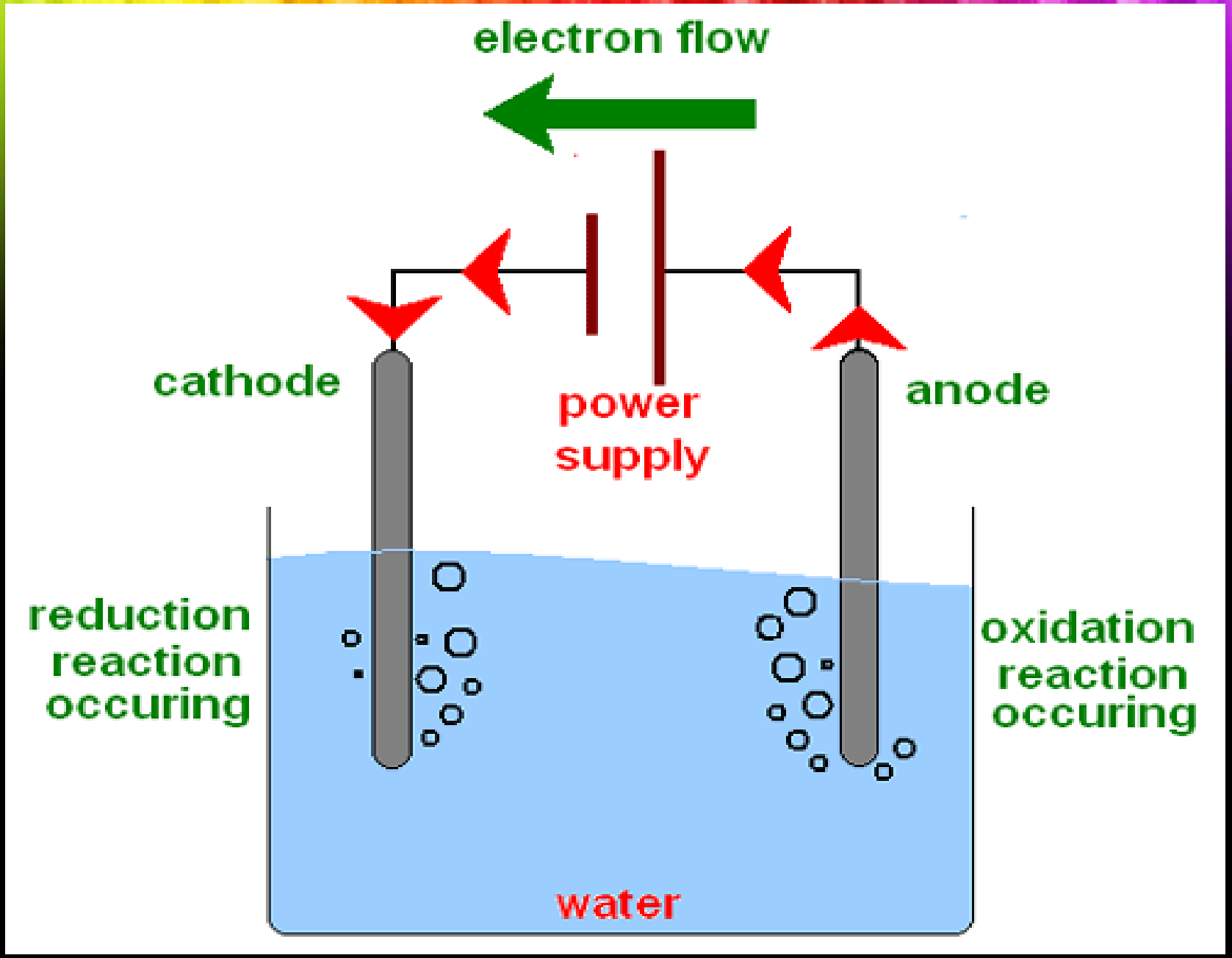
2- Faraday's law of induction

His Theories

- Faraday's laws of electrolysis:

. Faraday's 1st Law of Electrolysis - The mass of a substance altered at an electrode during electrolysis is directly proportional to the quantity of electricity transferred at that electrode. Quantity of electricity refers to the quantity of electrical charge, typically measured in coulomb

. Faraday's 2nd Law of Electrolysis - For a given quantity of D.C electricity (electric charge), the mass of an elemental material altered at an electrode is directly proportional to the element's equivalent weight

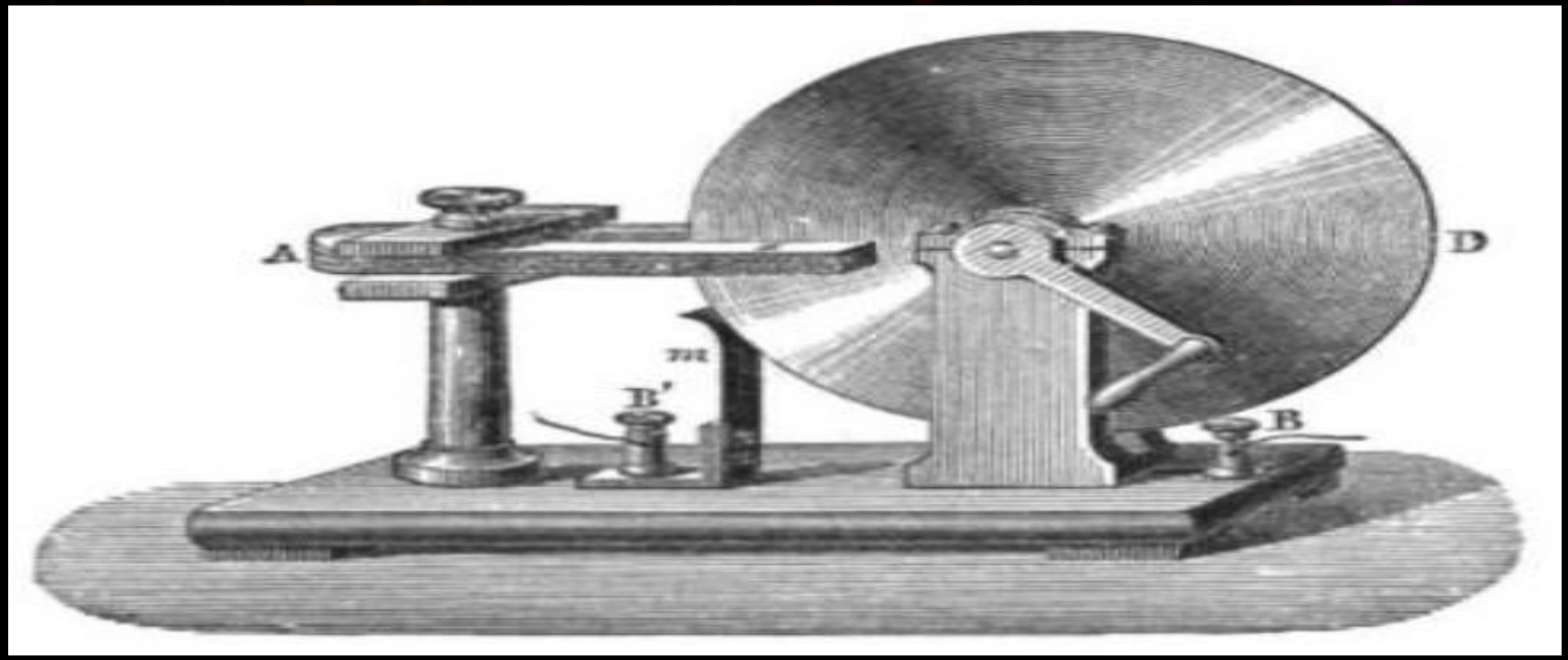

electron flow
cathode
power supply
anode
reduction reaction occuring
oxidation reaction occuring
water

Faraday's law of induction:

Electromagnetic induction is the production of a potential difference across a conductor when it is exposed to a varying magnetic field. Michael Faraday is generally credited with the discovery of induction in 1831 though it may have been anticipated by the work of Francesco Zantedeschi in 1829

Electromagnetic induction (or sometimes just induction) is a process where a conductor placed in a changing magnetic field (or a conductor moving through a stationary magnetic field) causes the production of a voltage across the conductor. This process of electromagnetic induction, in turn, causes an electrical current - it is said to induce the current.

The process of electromagnetic induction works in reverse as well, so that a moving electrical charge generates a magnetic field. In fact, a traditional magnet is the result of the individual motion of the electrons within the individual atoms of the magnet, aligned so that the generated magnetic field is in a uniform direction. (In non-magnetic materials, the electrons move in such a way that the individual magnetic fields point in different directions, so they cancel each other out and the net magnetic field generated is negligible.)



- **The principles of electromagnetic induction are applied in many devices and systems, including:**
  - Current clamp
  - Electrical generators
  - Electromagnetic forming
  - Graphics tablet
  - Hall effect meters
  - Induction cookers
  - Induction motors
  - Inductive charging
  - Inductors
  - Magnetic flow meters
  - Mechanically powered flashlight
  - Pickups
  - Rowland ring
  - Transformers
  - Wireless energy transfer

Faraday's Caricature:

FARADAY GIVING HIS CARD TO FATHER THAMES:

And we hope the Dirty Fellow will consult the learned Professor.

References

1) www.bbc.co.uk/history_figures/faraday_michael.html
2) www.extranet.kinnick.pac.dodea.edu
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8) http://www.biographyonline.net/scientists/michael-faraday.html
9) http://en.wikipedia.org/wiki/Faraday_cage

The End
Any Question ??