UNIT 6
ELECTRICITY

LISTENING: ELECTRICITY

Electricity is a phenomenon of SOME CHARGED SUBATOMIC PARTICLES called electrons WHEN THEY START MOVING FROM ATOM TO ATOM. An atom is the smallest particle OF WHICH ALL MATTER IS COMPOSED/*that all matter is composed of*. All atoms consist of a nucleus CONTAINING/*which contains* PROTONS AND NEUTRONS, AROUND WHICH ELECTRONS ORBIT; in fact, electrons orbiting farther from the nucleus ARE MORE EASILY DRAWN AWAY/*are easier to draw away* and therefore ~~are~~ more likely to move and CREATE AN ELECTRIC CURRENT

The different particles that make up an atom carry different electric charges; thus, AN ELECTRON IS NEGATIVELY CHARGED whereas a proton is positively charged and NEUTRONS HAVE NO ELECTRICAL CHARGE. Under normal conditions an atom is electrically neutral AS THERE ARE AS MANY PROTONS AS ELECTRONS IN ONE ATOM. However atoms of different substances DIFFER FROM EACH OTHER DEPENDING ON THE NUMBER OF ELECTRONS AND PROTONS that they contain.

Although*/IN SPITE OF THE FACT THAT THE NUCLEUS IS THE SMALLEST PART OF AN ATOM, *in spite of it/the nucleus being the smallest part of an atom

most of its weight is concentrated in its nucleus. A proton and a neutron each weigh approximately 1 atomic weight unit. An electron, ON THE OTHER HAND, weighs only about 1/1800 (one eighteen hundredth) OF THE WEIGHT OF A PROTON OR NEUTRON

Yet to produce the movement of electrons A DIFFERENCE IN POTENTIAL BETWEEN TWO POINTS must be created. Electric sources SUCH AS/*like* BATTERIES, CELLS, GENERATORS, etc., change chemical, mechanical or other types of energy INTO ELECTRICAL ENERGY
Aún así/sin embargo para producir el movimiento de los electrones

CONNECTORS

1.Electrons are very light –WHEREAS/WHILE-- protons and neutrons have most of the mass of the atom.
2.–INSTEAD OF/rather than-- using the common metric units, the amstrong is preferred to measure atoms.
Common metric units are not widely used to measure atoms; the amstrong is preferred INSTEAD. (en su lugar)
INSTEAD, the armstrong is preferred *(en su lugar, en cambio)*
3.Electrons orbiting farther from the nucleus move to other atoms –DUE TO THE FACT THAT/SINCE/AS--they are more easily drawn away.
4.Unlike charges attract each other; THUS/THEREFORE/HENCE/THEREBY/due to this , a positively charged atom will attract electrons from other atoms.
5.Electricity occurs DUE TO/BECAUSE OF/OWING TO the movement of electrons.
***6.* IN SPITE OF/DESPITE-- being the smallest part of an atom, the nucleus contains most of its mass.**
In spite of being the smallest part of an atom, the nucleus contains most of its/the mass (of the atom)
Despite its small size compared to the rest of the atom, the nucleus contains most of its/the mass.
Although the nucleus is the smallest part of an atom, it contains most of its mass.
In spite of the fact that the nucleus is the smallest part of an atom, it contains most of its mass
7.Electrons, protons and neutrons are called subatomic particles SINCE/DUE TO THE FACT THAT/AS they are smaller than an atom.
8.ALTHOUGH/WHEREAS-- the structure of atoms is similar for all elements, each element has a different number of electrons protons and neutrons.

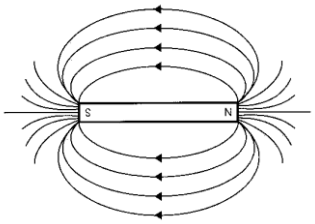
***Although** metals are normally solid at room temperature, mercury is (a) liquid*

9. **Unlike coal or solar energy, electricity is a secondary source of energy.**
10. **Research is underway to obtain superconducting properties at room temperature, WHICH is quite interesting for the field of telecommunications.**
11. **We can't classify electricity AS a renewable or nonrenewable form of energy.**
12. **The failure has certainly appeared DUE TO/OWING TO/BECAUSE OF impurities in the fuel.**
13. **With AC electricity, voltage can be readily changed, *(THUS)* making it more suitable for long-distance transmission than DC electricity**
14. ***ALTHOUGH* gold is the best conductor, it is very expensive. *THUS* copper is used *INSTEAD***
15. **An electron is two thousand times smaller in mass than a proton but its electrical charge is equal to *THAT/THE ONE* of a proton**

READING: ELECTROMAGNETISM

The generation of large amounts of electricity has been possible thanks to relationship that exists between electricity and magnetism. Magnetism is a property that occurs naturally in certain substances, especially iron with small amounts of carbon, and can be transferred to or induced in others. It consists of attracting and repelling other materials, and some materials can be magnetised quite easily just by placing them in contact with a permanent magnet.

The force of magnetism is dipolar; thus, a magnet always has two poles, namely North and South which are located at the ends of the magnet. When two magnets are placed side by side, like poles will repel each other whereas unlike poles will attract due to the forces of attraction and repulsion created between both magnets.



The area around a magnet where the magnetic forces are exhibited is called the magnetic field, represented by the lines of force. The lines of force indicate the strength and direction of the magnetic field; the ends of a magnet contain more lines of force and as a consequence of this, the field is stronger there. In addition, the lines of force always run from North to South and this phenomenon creates the attraction or repulsion between two magnets.

In the 19th century, scientists like Hans Oersted, Faraday or Ampere made discoveries about the relationship between electricity and magnetism. It was found that the forces between magnetic dipoles are identical to those between electrical dipoles and that electrical currents generate a magnetic field. Oersted discovered accidentally that the electric current possessed the property of magnetism. He had left a compass on the table where he was experimenting with an electric current. (A compass is a navigational device with a magnetised needle which points to the earth's North and South magnetic poles). Oersted observed that the needle moved whenever the current was turned on, attracted by the magnetic field created around the wire. Further research revealed that it was possible to generate an electric current in a conductor by changing the magnetic fields around it, a phenomenon known as electromagnetism, a discovery which has led to the development of many devices which make use of electromagnetism, including electric motors, generators and transformers. Without these devices, electricity could never have become a major source of power.

EXERCISES

A. Say whether these statements are TRUE or FALSE.

1- A magnet attracts mainly iron. T

2- A piece of iron can be magnetised by adding carbon to it.

3- In a magnet, the north pole is negatively charged and the south pole is positively charged.

4- The north pole of the earth is attracted by the north pole of a magnet.

5- The lines of force run from the North pole to the South pole.

6- Hans Oersted discovered the relationship between electricity and magnetism by chance.

7- In a magnet, the needle points to the geographic North pole.

8- Nowadays most electric motors are based on the principle of electromagnetism.

B. Find nouns for these words in the text

ADD**ition** **DIRECTion/or** STRONG-**strength** DEVELOP**ment** ABLE-**ability** ATTRACT**ion**
SCIENCE-**scientist** GENERATE-**generation-or** MAGNET**ism** REPEL**ant-repulsion** DISCOVER**y**
TRANSFORM**ation-er**

SCIENCE (noun)- SCIENTIST (noun)- SCIENTIFIC (adj)

TECHNIQUE (noun)-TECHNICIAN (noun)-TECHNICAL (adj)

VIDEO: ELECTROMAGNETS

1- What is a magnet? ***A piece of metal; one end is North and the other South***
2- What do we call this bar? ***Permanent magnet***
3- However it has what? ***disadvantages***
4- How does an electromagnet compare to a permanent magnet? ***It is exactly the same in some way***
5- How do we get the N and S in the electromagnet? ***By Passing the current through the coil***
6- What happens if I wrap it round? ***You'll get North at one end and South at the other***
7- And when I switch the current off? ***It becomes non magnetic/it turns off*** (I get no magnet)
8- Why is then it called an electromagnet? ***Because I get magnetism through/by means of electricity/***electricity creates the magnetism
9- Which are the differences between a permanent magnet and an electromagnet?
   a. **There's no metal in the electromagnet** (cardboard)
   b. If I put **some metal in the core/nucleus** (how much stronger? **10-20 times stronger**)
   c. A proper electromagnet contains **a soft metallic core** (soft means **easy to magnetise**)
10- Which is the advantage of an electromagnet? ***it can be switched on and off***

PREPOSITIONS

Movement

about	por (alguna parte)	**in(to)**	en, dentro de
across	a través de, de un lado al otro	**off**	a cierta distancia de
along	a lo largo de	**on(to)**	en, sobre, a
(a)round	alrededor de	**out of**	fuera de
as far as	hasta (un lugar)	**over**	por encima, durante, al otro lado
(away) from	lejos de, distante de	**through**	a través de, por
back from	de regreso de	**to**	a, hacia
between	entre (dos objetos o personas)	**toward(s)**	hacia
by	en, por medio de	**under**	debajo de
down	hacia abajo	**up**	arriba

Position

about	sobre, acerca de	**beside**	al lado de
above	por encima de, más arriba de	**between**	entre (2 cosas o personas)
against	contra	**in**	en, dentro de
amid(st)	entre, en medio de	**in front of**	delante de, ante
among(st)	entre (más de 2)	**inside**	dentro de
(a)round	alrededor	**near**	cerca de
at	en	**next to**	al lado de, junto a
before	antes de	**off**	de, separado de
behind	detrás de	**on**	sobre
below	debajo de	**opposite**	enfrente de
beneath	bajo, debajo de	**underneath**	debajo de (en la parte inferior)

Time

after	después de	**on**	el ... (día, fecha)
before	antes de	**since**	desde
by	para (fecha)	**to**	hasta
during	durante	**until / till**	hasta

ON – one day On 21st September-On New year's Eve
AT – at Christmas/Easter/Fallas/the weekend/a fortnight
IN – April/summer/1978/the 21st century/the Middle Ages

Other Prepositions

according to	según	**in favo(u)r of**	a favor de
against	contra	**in spite of**	a pesar de
because of	a causa de	**instead of**	en lugar de
by	Por (agente en la pasiva)	**on behalf of**	en nombre de (alguien)
by means of	por medio de	**versus**	contra
due to	debido a	**with**	con
except	excepto	**within**	dentro de
for	para	**without**	Sin

EXERCISES

A. Complete the following sentences with the corresponding preposition

1- Electromagnetism is responsible **FOR** practically all the phenomena encountered **IN** daily life, **WITH** the exception **OF** gravity

2- Ordinary matter takes its form **AS** a result **OF** intermolecular forces **BETWEEN** (ENTRE) individual molecules **OF** matter

3- Electromagnetism is also the force which holds electrons and protons together **INSIDE** (DENTRO DE) atoms

4- This governs the processes involved **IN** chemistry

5- Magnetic fields are the cause **OF** the force associated **TO** magnets.

6- Originally electricity and magnetism were thought **OF** as two separate forces

7- An electric current flowing **THROUGH** a wire creates a circular magnetic field **IN** the wire, its direction depending **ON** that **OF** the current.

8- A current is induced **IN** a loop of wire when it is moved towards or away **FROM** a magnetic field

9- While preparing FOR an evening lecture **ON** 21 April 1820, Hans Christian Oersted noticed that a compass needle deflected **TO(WARDS)** magnetic north when the electric current **IN/OF/FROM** the battery he was using was switched on and off

10- Oersted's findings resulted **IN** intensive research **OF** the scientific community **ON**/**ABOUT**electrodynamics

THE LANGUAGE OF INSTRUCTIONS

When giving instructions the IMPERATIVE tense is generally used. However, SHOULD is often used to give impersonal instructions to operators, etc. on the correct method of doing something.

Instructions usually consist of:

- The instruction itself (IMPERATIVE or SHOULD)
- The result (PURPOSE)
- The way of carrying out the instructions (METHOD)

Expressing purpose (WHAT FOR)

TO (NOT to) SO AS TO (so as NOT to) IN ORDER TO (in order NOT to)	+ INFINITIVE
FOR THE PURPOSE OF WITH THE AIM OF WITH THE OBJECTIVE OF	+ GERUND
SO THAT ***In ORDER THAT***	+ CLAUSE/sentence

I'm going to buy some eggs IN ORDER/SO AS TO make a Spanish omelette
I'm going to buy some eggs SO THAT/IN ORDER THAT you can make an omelette
The police blocked the door SO THAT no-one could get in

Expressing method (HOW), procedure, technique, how-to

BY + GERUND ***(by using)***
Alloying is done BY MIXING two or more elements, at least one of them metallic
BY (passive only)
Temperatures are measured BY a thermometer
*(~~We measure~~ ~~temperatures BY a thermometer~~=**NEXT TO**)*
BY MEANS OF
WITH + NOUN
THROUGH
WITH THE HELP/AID/ASSISTANCE OF
We can measure temperatures BY MEANS OF a thermometer
WITH
THROUGH
WITH THE HELP/AID/ASSISTANCE

BY USING

Examples:

- In order to generate electricity*, we need to use another form of energy*

- *Turn the lights off* ***so as not to*** *waste electricity*

- *Homes are equipped with meters* ***so that*** *it can be determined how much electricity each residence consumes*

- *Electricity is generated from water* ***by using*** *dams and* ***by capturing*** *the potential energy of water*

- *Generators produce electricity* ***by means of*** *a principle discovered in the early 1830's*

- *Energy savings* ***through*** *improved mechanical systems are the latest research advances*

Science – scientific (ADJ) – SCIENTISTS

Technical – technician

Some **scientists who worked/were working-WORKING on electromagnetism** (científicos que trabajaban sobre el electromagnetismo) discovered that the magnetic field of an electric current could **be strengthened by sending (the) current through a coil** (reforzarse =STRENGTHEN enviando la corriente a través de una bobina). **A higher/larger/bigger/greater number of turns/spins/laps in the coil** (Una mayor cantidad de vueltas en la bobina) strengthens the magnetic field **like/in the same way as** (como ~~también lo hace~~) a stronger electric current. Placing the coil **around** (alrededor de) a piece of iron also increases the magnetism **since/as/because iron magnetises/gets magnetic/becomes magnetic/is magnetised** (ya que el hierro se magnetiza.)

Not long after the **discovery** (descubrimiento) that **a magnetic field could be created by an electric current** (un campo magnético se podía crear por una corriente electrica), M. Faraday discovered that the reverse was also true. When a closed loop of wire is moved through a magnetic field, **an electromotive force (emf) is created** (se crea una fuerza electromotriz).

This makes a current of electrons/ an electron current flow through the wire/cable (Esto hace que una corriente de electrones fluya por el cable) and is the basis for **generating/producing** (generar) electricity. To generate e.m.f. the wire must cut the **lines of force** (líneas de fuerza) in the magnetic field; also **the faster the wire turns/spins/rotates** (cuanto más rápido se hace girar el hilo), **the higher/the larger the production of emf** (mayor) the production of e.m.f.

Generators contain a stationary magnet, the stator, with a rotor placed **between their** (entre sus) north and south poles. **As the rotor turns/spins** (A medida que gira el rotor), the wires in it **cut the lines of force** (cortan las líneas de fuerza) in the magnetic field of the stator. With each half turn the flow of current is reversed producing alternating current (a.c.). The rotor **is driven by a turbine** (es movido -*DRIVE*- por una turbina), a machine with huge blades moved by water or steam produced **when we burn/burning coal or oil** (al quemar carbón o petróleo) or by nuclear fission in power plants. *AC/DC alternating current/direct current*

Transformers **...** (también se basan en el electromagnetismo). They consist ..... (en) two ..... (bobinas) of wire ..... (enrolladas = WIND) around pieces of iron. Current is supplied to a transformer through the primary coil and taken from the secondary. When an .... (corriente alterna pasa por el primario) the constant reversal of electron flow produces a changing magnetic field that creates a current in the secondary coil. When the primary coil has .... (más vueltas que el secundario) voltage is decreased; when the secondary coil has more turns than the primary, the secondary voltage ..... (aumenta).

PREPOSITIONS

FARADAY'S EXPERIMENT

This is a paragraph about one of Faraday´s experiments. Complete it by putting the correct preposition from the list. You can use the same preposition more than once.

at in between of to on by

Let´s have a look __AT 1__ one of Faraday´s experiments, __IN 2 __ which he used a copper wheel and a horseshoe magnet. The wheel was located __BETWEEN 3 __ the poles __OF 4__ the magnet. Electrical contacts were applied __ TO 5__ the wheel, both __IN/AT 6__ the centre and __ON/AT 7__ the edge of it. These parts were connected __ TO 8__ an

ammeter __9 BY__ means of wires __10 IN__ order to detect the electrical current. Whenever the wheel rotated __11 BETWEEN__ the ends of the magnet, an electrical current was shown __ ON 12__ the ammeter´s display. When the wheel was made to turn __ON/TO 13__ the opposite direction, the needle __OF 14__ the ammeter was deflected __ON/TO 15__ the opposite direction, too. Therefore, according __ TO 16__ this experiment, the direction of the current depended __ON 17__ the turning of the wheel placed close __TO 18__ a magnetic field.

LISTENING: THE EFFECTS OF AN ELECTRIC CURRENT

The effects of an electric current are: THERMAL, LUMINOUS, CHEMICAL, MAGNETIC
- What happens when a current flows through a conductor? IT MAY HEAT THE CONDUCTOR
- Which devices contain a fan to reduce this undesirable effect? ELECTRIC MOTORS AND GENERATORS
- Is this effect always undesirable? NO. EG. DOMESTIC APPLIANCES (ELECTRIC COOKERS) AND MANY INDUSTRIAL PROCESSES
-What else does the passage of a current through a conductor produce? LIGHT
- What happens to a conductor when the current is great enough? THE CONDUCTOR BECOMES INCANDESCENT
- Which example does the listening give? THE FILAMENT OF A LIGHT BULB
- How is light also produced? WHEN A CURRENT IONIZES A GAS
- What colour do mercury vapour lamps give? GREENISH-BLUE LIGHT
- What is electrolysis? AN ELECTRIC CURRENT CAN SEPARATE A CHEMICAL COMPOUND INTO ITS COMPONENTS
- How is chlorine generated? BY ELECTROLYSIS OF SALT WATER
- Which is the second example of electrolysis given in the listening? TO BREAK DOWN WATER INTO HYDROGEN AND OXYGEN
- What substance is added to pure water and why? SULPHURIC ACID BECAUSE PURE WATER DOES NOT CONDUCT WELL
-What other effect does a current flowing through a conductor create? A MAGNETIC FIELD AROUND IT
This effect has three applications:
1-MAGNETIZE MAGNETIC MATERIALS AND ATTRACT THEM TO THE CONDUCTOR (e.g. = RELAYS)
2- IF THE MAGNETIC FIELD IS CUT BY ANOTHER CONDUCTOR, AND ElectroMotiveForce WILL BE INDUCED IN THAT CONDUCTOR (e.g.= TRANSFORMERS AND GENERATORS)
3-IF A CURRENT-CARRYING CONDUCTOR IS PLACED IN THE MAGNETIC FIELD, A FORCE WILL BE EXERTED ON IT (e.g.= MOTORS)

GUIDED WRITING

Write complete paragraphs by using the words given below. Remember that they are in the correct order. Add words as needed.

1. MATERIALS / DIVIDE / CONDUCTORS / INSULATORS / DEPEND /PERMIT / ELECTRONS / TO FLOW / EASILY.

   MATERIALS ARE/CAN BE DIVIDED INTO CONDUCTORS AND INSULATORS DEPENDING ON WHTHER/IF THEY PERMIT AN ELECTRIC CURRENT TO FLOW EASILY.

2. MOST / METALS / BE / GOOD / CONDUCTORS / BECAUSE / HAVE / LOW RESISTANCE

   MOST METALS ARE GOOD CONDUCTORS BECAUSE THEY HAVE LOW RESISTANCE

3. HOWEVER / COPPER / BE / COMMONLY USED / METAL / WIRES / DUE / LOW RESISTANCE. ADDITION / MALLEABILITY AND DUCTILITY / ENABLE / MAKE / COILS

   HOWEVER, COPPER IS A COMMONLY USED METAL IN/FOR WIRES DUE TO ITS LOW RESISTANCE. IN ADDITION, ITS MALLEABILITY AND CONDUCTIVITY ENABLE US TO MAKE COILS

4. CROSS SECTION / WIRE / BE / ALSO / IMPORTANT. THUS/ THICK WIRE / OFFER / LOW RESISTANCE / FLOW / ELECTRICITY / WHEREAS / THIN WIRE / INCREASES / RESISTANCE. THICK WIRES / BE / THEREFORE / USE / DISTRIBUTE / ELECTRICITY / POWER PLANTS / OUR HOUSES.

   THE CROSS SECTION OF A WIRE IS ALSO IMPORTANT; THUS, A THICK WIRE OFFERS LOW RESISTANCE TO THE FLOW OF ELECTRICITY WHEREAS A THIN WIRE

INCREASES (ITS) RESISTANCE. THICK WIRES ARE THEREFORE USED TO DISTRIBUTE/FOR DISTRIBUTING ELECTRICITY FROM/THROUGH POWER PLANTS TO OUR HOUSES

5. THE OTHER HAND / THIN WIRES / USE / LAMPS / BECAUSE / BE / HIGH RESISTANCE / ~~WHAT /~~ BE USED / MAKE / LAMPS / SHINE

ON THE OTHER HAND, THIN WIRES ARE USED IN LAMPS BECAUSE OF THEIR HIGH RESISTANCE, WHICH IS USED TO MAKE/FOR MAKING LAMPS SHINE

VIDEO: MAGNETIC CIRCUITS (O.U.)

MAGNETISM FIELDS(O.U.)

This is the well known display of **THE MAGNETIC FIELD** of a permanent magnet displayed **BY** the **DISTRIBUTION** of iron filings.

The whole of this programme is **ABOUT** displaying **MAGNETIC FIELDS** in one way or another. Of course the trouble with magnetic fields is that you cannot actually see them. So, what I'll try to do in this programme is to **DEMONSTRATE** them to you and to show **THAT THEY CAN BE SHAPED AND CONTROLLED** by showing their effects **RATHER THAN** the fields themselves.

This particular display of **THE MAGNETIC FIELD OF A PERMANENT MAGNET** shows the field very clearly because the iron filings distribute themselves **ALONG THE DIRECTIONS OF THE LINES OF FORCE**, if that's the **NORTH POLE** and that's the South pole, the **LINES OF FORCE RUN FROM THE N POLE TO THE S POLE** and the iron filings distribute themselves **ALONG** these lines pointing **TOWARDS** the pole pieces of the magnet. So in that particular instance the field is very clearly demonstrated.

I can represent this with a diagram. **HERE THERE IS A DIAGRAM OF A PERMANENT MAGNET**, N **AT** one end and S. **AT** the other, and the lines of force are running **FROM THE N POLE TO THE S POLE**, roughly along the same pattern as you saw in the iron filings demonstration. So, this is **A SIMPLE GRAPHICAL REPRESENTATION** of the kind of thing that happens with a permanent magnet.

Now, let's put two permanent magnets side **BY** side. **THIS IS THE DISTRIBUTION OF LINES OF FORCE THAT** you get. They're squeezed together **BETWEEN** these two magnets, when the N is **NEXT TO** N, and S. is **NEXT TO** S. What does this actually mean **IN PRACTICE**?

I can show this with some actual permanent magnets that I have here, **THEY ARE PERMANENT MAGNETS MADE OF STEEL** with N pole marked at each end so that this resembles the diagram you just looked at. So if I push the two together quite clearly **ONE IS REPELLING THE OTHER**; if I press the two together side by side, it is firmly pushed away. So, **THERE IS A FORCE OF REPULSION HERE**. Let's go back to the diagram to see how we might explain it.

You see here the lines are apparently compressed and they actually behave very much as though they are **ELASTIC AND COMPRESSIBLE** so when lines of force get compressed like that they do represent **A FORCE OF REPULSION** shown here by these white arrows.

If I I TURN THE MAGNETS ROUND so that N is now FACING S I'm sure you are very familiar with the fact they attract ONE ANOTHER like this. This again can be shown ON the diagram. Here the LINES OF FORCE now running FROM N TO S are pulling the magnets together, there's A FORCE OF ATTRACTION AS again shown by the arrows. That fact I'm sure is very familiar to you.

The first main point I want to get over is that actually THESE FIELDS CAN BE QUITE EASILY SHAPED BY USING PIECES OF IRON to do this.

Here I've got some pieces of iron. They ARE NOT MAGNETIC at all, they DON'T ATTRACT EACH OTHER, but if I put them along side these magnets like this, ALONG one side so the two magnets face again, the two N poles REPELLING,

the two N poles OPPOSITE each other, so they should repel EACH OTHER, what do you think will happen?

Let's see. NOTHING AT ALL. The FORCE OF REPULSION has been almost completely removed. So, what happened is that the MAGNETIC FIELD that was filling the gap BETWEEN the magnets has been shunted away down the iron; IRON IS A VERY MUCH MORE ATTRACTIVE route for magnetic fields than does air; so it's been shunted away and THE FORCE OF REPULSION IS REMOVED. Let's have a look of this at the diagram.

Here you see the magnetic lines which were in the gap BETWEEN them as they are still OUTSIDE the gap but now the lines have been shunted THROUGH the iron represented BY this light grey area, shunted through there, LINES AGAIN RUNNING FROM N TO S, in both magnets and the gap between them, you see, has no lines of force left, SO THERE IS NO FORCE OF REPULSION LEFT either.

Now I can demonstrate this effect rather more dramatically with a different pair of magnets. Here I have a ferrite magnet. IT IS A MEGNETIC MATERIAL, ceramic in nature and CAN BE MAGNETIZED quite strongly. Here you see there are two rings, one ABOVE the other, the upper one is being supported BY THE MAGNETIC FORCE exerted BY the lower one. All the magnetic forces intereact to be more exact. This kind of levitation of a body DUE TO magnetic field will be demonstrated in the next TV programme where the method is used to levitate a train ABOVE the track.

But I can show you how the field can be shunted away FROM these two by taking these pieces of iron again and slipping them between the magnets. As I put them in, THE MAGNETIC FIELD IS GRADUALLY REMOVED until there isn't any left and the upper magnet sinks DOWN onto the lower one, and THERE IS NO FORCE OF REPULSION left; removing these pieces of iron restores the levitation of the ring magnet.