ELECTRICITY AT HOME

VINOD PRAKASH

"CITIZENS OF TOMORROW" SERIES

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AUTHOR : VINOD PRAKASH

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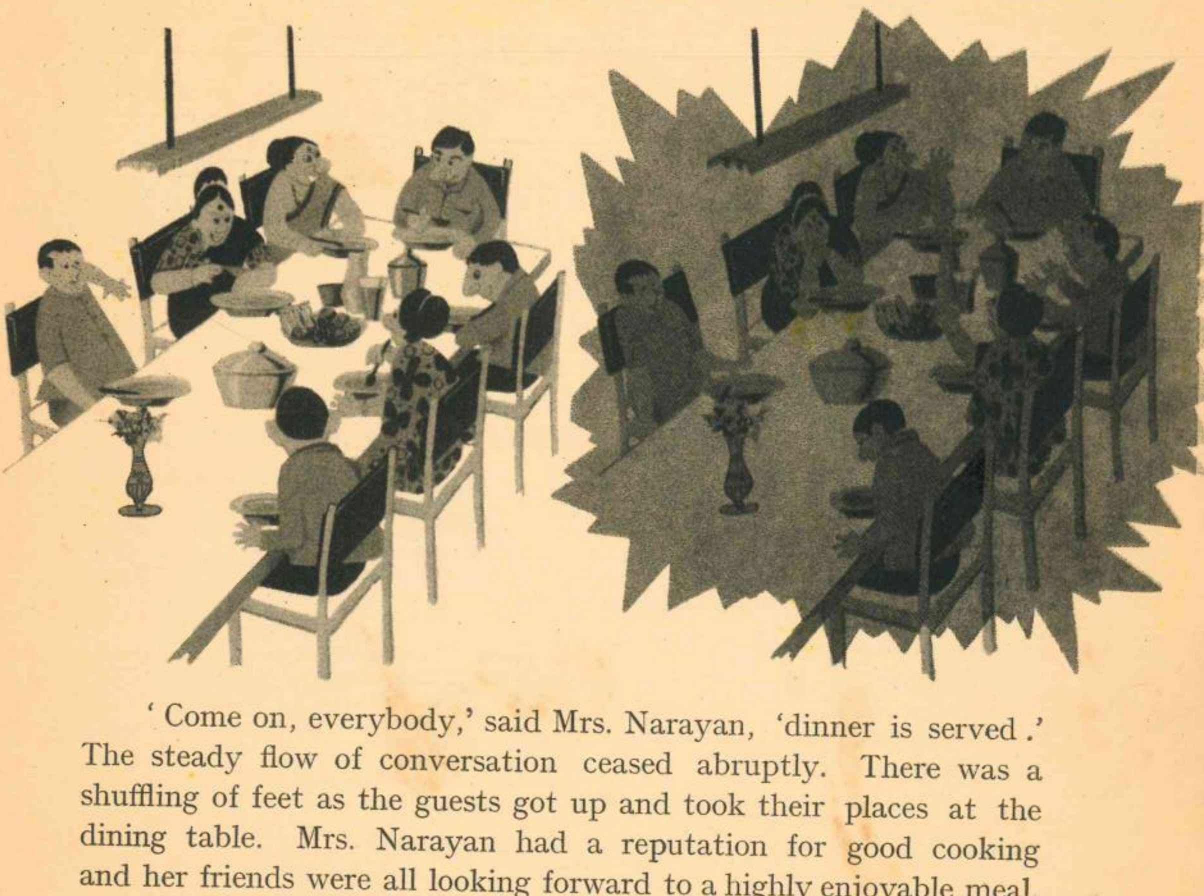
1 DINNER IN THE DARK



'Come on, everybody,' said Mrs. Narayan, 'dinner is served.' The steady flow of conversation ceased abruptly. There was a shuffling of feet as the guests got up and took their places at the dining table. Mrs. Narayan had a reputation for good cooking and her friends were all looking forward to a highly enjoyable meal. But fate, it appears, was against them, for they were hardly half way through the first course when the whole house was plunged into darkness.

‘Oh, bother!’ muttered Mrs. Narayan in the ensuing hubbub. ‘Of all the times, the lights **would** choose this moment for playing truant!’

Mr. Narayan got up to phone the electrician, while Mrs. Narayan went to look for some candles to keep the dinner going. But, as is the way of candles, none was to be found when most needed. Well, there was no help for it and the dinner had to await the arrival of an electrician to repair the fuse and restore the lights. By then, however, nearly an hour had passed and, as was to be expected, the food had gone cold and the dinner was a complete failure.

‘If only,’ sighed Mrs. Narayan later, ‘if only we hadn't had to wait for the electrician to restore the lights, the dinner would not have been spoilt. But then, I suppose, all this business of fuses and electricity is so confusing and difficult that there is no help for it.’

One wonders whether Mrs. Narayan could not have avoided such a situation. ‘How?’ you might ask and add, ‘By keeping the candles at hand?’

Well, that is only a partial solution. How useful it would have been had Mrs. Narayan known some more of the basic things about electricity and how it works for us in the house!

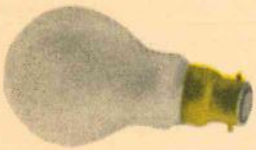
We are all familiar with the electric light, bell or chimes, heater, fan, toaster, hot plate, and many other things besides, all of which work by electricity. In fact, electricity is a wonderful magician who beams with a smile and you have light; who perhaps gets excited and generates heat and your food is cooked; who just keeps spinning and makes the room cool on a hot summer day. The magic wand that the magician uses is, of course, the switch. It is the flick of the switch that brings light, heat, or motion to your service.

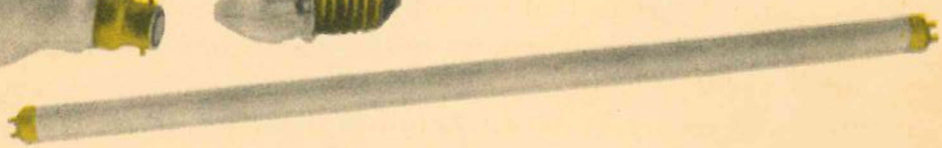
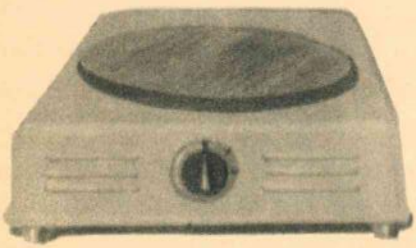
Electrical appliances appear very different from one another. But if you take a closer look you will observe that all these electrical devices can in general be put into the following three classes:

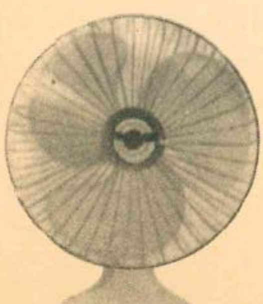
1. Those that produce light, e.g., the light bulb and the fluorescent tube.

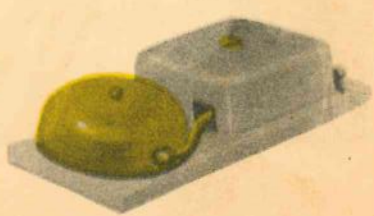
2. Those that produce heat, e.g., the iron, the electric heater, and the hot plate.

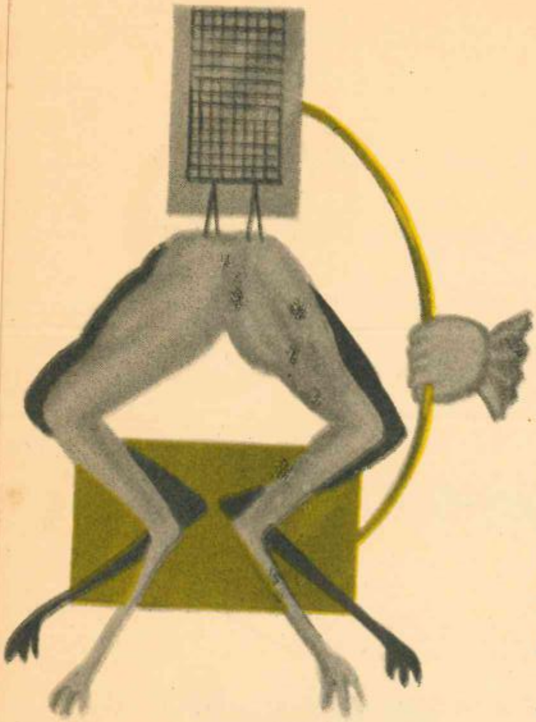
3. Those that produce motion, e.g., the electric fan and the door bell or chimes.









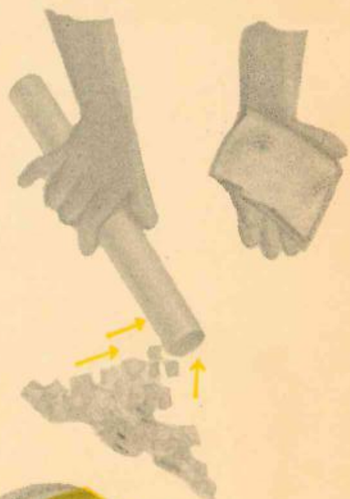
It may not be very clear to you perhaps what motion has got to do with the sound of the bell—actually there is no sound without motion—but if you take a close look at your bell you will observe that it gives out a ringing sound because a small metal ball **moves** to and fro striking a gong, and it is here that we need the help of electricity. For electricity produces the required motion.

We generally say that all these devices work only when electricity 'flows' through them. But what is electricity ? Is it some kind of liquid or gas that flows ? No, it is neither a liquid nor a gas.

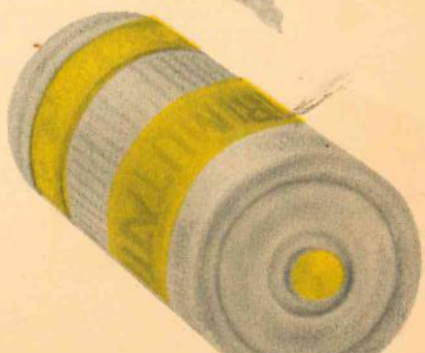
Let us have a peep into history. Way back in 1790, very interesting experiments were performed by a doctor. The doctor was no other than Galvani. He took a couple of dead frogs, and, after skinning them, hung them up on copper hooks with the legs dangling in the air. There was an iron railing below and, whenever the dangling legs happened to touch the railing, the legs gave a jerky motion as if the frogs had been alive. He wanted to find out whether this movement had anything to do with lightning in the atmosphere. But when he conducted further experiments he

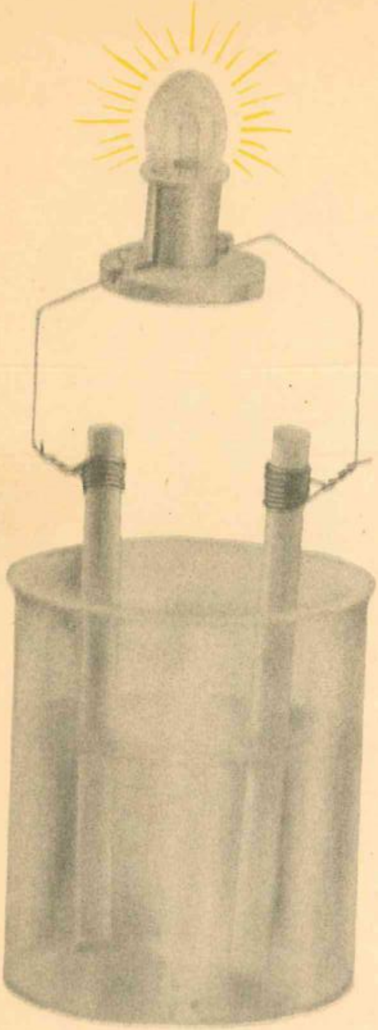
came to another conclusion. He thought that the cause of the motion of the legs lay in the animal itself. Ultimately it was left to another scientist, Volta, to discover that the cause of the motion lay in the energy that was produced when different metals like copper and brass were connected through the body of the frog. This energy was nothing but electricity.

Actually, the word electricity comes from the word **elektron** — a Greek word for a substance called amber. About 2,500 years ago the Greeks found out by accident that if amber is rubbed against a goatskin, the amber begins to have certain properties of attracting light particles. Since then a lot of experimental work has been done to learn more about electricity. How about learning how to produce electricity? We have already read how the Greeks stumbled upon it. Here is how we can produce it.



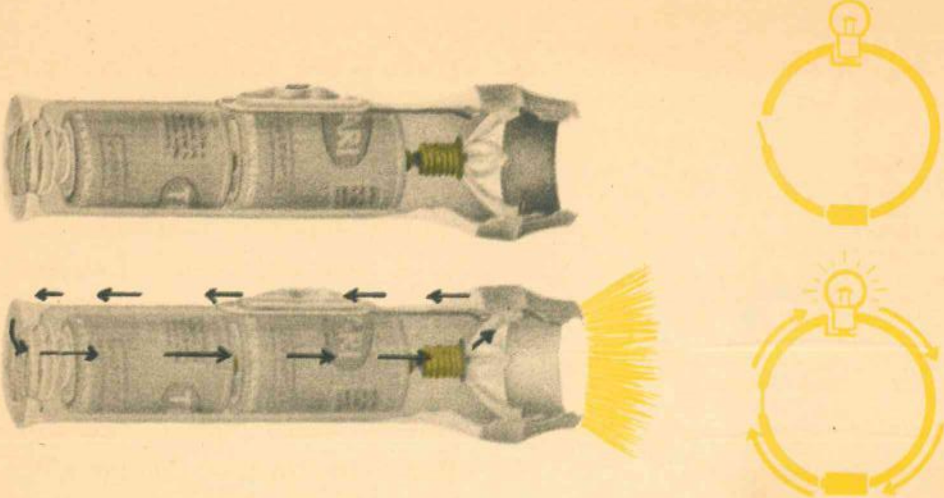
1. By rubbing a glass rod with a piece of silk. If you then bring the rod near very, very small bits of newspaper, you'll attract them towards the rod.
2. You all know that the cells we use in torch give us light. Here we get electricity from the cells.





3. There is yet another interesting way of producing electricity. Take a glass tumbler and put some water into it. Add some diluted sulphuric acid and insert in it two rods, one of copper and the other of zinc. If the ends of these two rods are connected with a copper wire, you will notice bubbles, showing that something is happening. We call it a chemical reaction. If you were to breach that wire and insert a bulb as shown, you would get light. The important thing to remember is that, if you loosen the contact at the end where the wire is connected to the rod, the bulb will not be lit. Or again, if you disconnect the wire and bulb, then too the bulb will not be lit.

What does all this show ? Whatever is produced within the tumbler has the effect of producing light only when there is no break anywhere. There has to be continuity. Starting from the zinc rod, we say that the zinc rod is in contact with sulphuric acid, the acid is in contact with the copper rod, the copper rod is in contact with the copper wire, and the



copper wire is in contact with the bulb. The bulb, through the remaining portion of the copper wire, is in contact with the zinc rod. Thus starting from the zinc rod we come back to it, completing what is known as the circuit. In other words, only when the circuit is complete does the current flow.

The same is illustrated in the case of a torch, shown above. When the switch is off, the circuit is incomplete. Consequently there is no current and hence no light. But when the switch is on, the circuit is complete, as shown in the second diagram. Consequently, the current flows and we have light.

Now if, in the experiment we performed above, instead of a copper wire we take or use an ordinary string, we find that there is no light, indicating that there is no current flowing through the string. The reason ? It is very simple. An electric current can flow only through certain materials like copper wire. It cannot flow through cotton thread. Materials like copper wire, through which the current flows, are known as **conductors** and materials through which the current does not flow are called **non-conductors** or **insulators.** Common examples of good conductors are metals, moist wood, the earth itself, and even the human body. Perhaps this will make you understand why we get shocks sometimes when we unwittingly place a finger on a live point. The current from the live wire enters the body. From there it goes to the earth and, the earth being a good conductor, the circuit is completed. We get the jittering shock. On the other hand you must have seen electricians perched on an electric pole repairing the outside lines. They do so with rubber covered instruments or rubber gloves. They do not get a shock, for rubber, being a non-conductor, does not allow the circuit to be completed. Other examples of non-conductors or insulators are dry wood, glass, porcelain, and plastic.

'What makes a substance an insulator or a good conductor ?' you might ask. To answer this question, we will have to divert our attention a little to something else. We live in the age of the atom. I suppose you know what an atom is. It is a very small particle of matter. All things in this world, including you and me, are made up of atoms. The atom is much too small to be seen and yet it contains other particles smaller still. One of them is called the electron, which carries a **negative charge.** The core of the atom is called the **nucleus,** which itself is tightly packed with other

particles known as **protons** and **neutrons.** The protons carry a positive charge. The neutrons, as the very word suggests, carry no charge at all. The electrons revolve round the nucleus like the earth moving round the sun. All these particles together make up the atom.

Now, in some atoms, a few of the electrons are rather loosely attached to the atom and easily jump from one atom or molecule to the next, if given a slight push. In others all the electrons are very strongly attached and are not free to move away.

Materials made up of atoms in which the electrons are strongly attached to the atom and so do not move about from atom to atom are called insulators. Dry wood, glass, plastics are insulators.

In the other type of materials, called conductors, some of the electrons have no great attachment to the atoms and are free to roam about. Iron, copper (the metal of which most wires are made), and metals in general are good conductors.

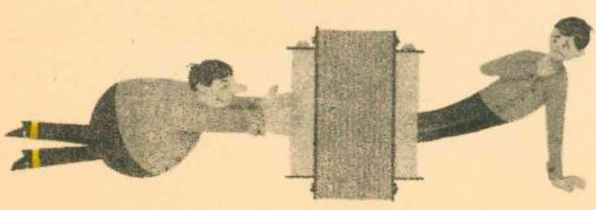
Thus we see that in good conductors the electrons move freely, while in the insulators they do not. Actually the free movement of the electrons has a lot to do with the flow of electricity, and an electric current is nothing but a flow of electrons.

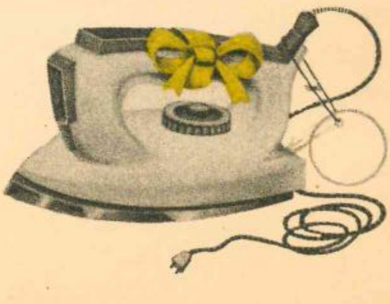
2 ELECTRIC CIRCUITS

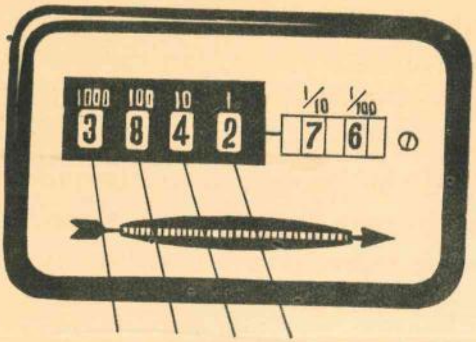
Now that we know something of the nature of electricity, we come to the point of the 'path' along which it flows. For anything to move, there must be a sort of a path or course, along which it is to travel, and the path along which electricity flows is called an **Electric Circuit**.

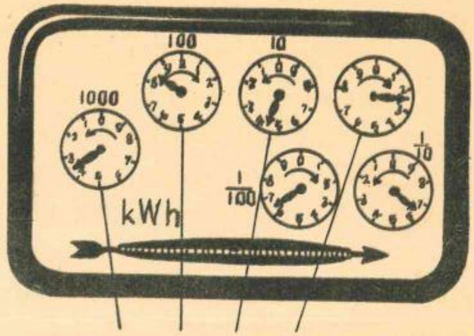
Let us take the analogy of water flowing through a pipe and electricity flowing along a wire. It is common sense to know that the higher the water pressure, the stronger the flow of water. The same is true of electricity. The greater the electrical pressure, the stronger the current. Scientists measure this pressure in terms of volts. Electric supply can be at different pressures. In India, we have the 440-volt electric supply used in industry and the 220-volt supply used in homes. The number 250 with the letter V on electric bulbs shows that the maximum electrical pressure that the bulb can stand is 250 volts. In homes in America and other countries the domestic electric supply voltage is lower and their appliances allow a maximum electrical pressure of 110 volts. This is so, partly, because 110 V is safer to use. Anyway, a bulb with 110 V marking (which means that the maximum electrical pressure it can tolerate is 110 V) is bound to fuse in an electrical circuit of 220 V, such as in our homes. Electrical appliances with a lower voltage marked on them will be damaged in the same way for if current under this pressure is made to flow through them, the wires inside will melt and break. But if your uncle or a friend returning from America presents you with an electric iron with 110 V marked on it, how are you going to use it ? By the use of a very simple electrical device known as a transformer. As the very word suggests, it transforms or changes the voltage of the main supply—in this case from 220 V to 110 V. Needless to add that the transformer is connected between the main supply and the appliance.

So now we understand what V stands for. But if you examine the bulb carefully there is another marking such as 60 W. What is









this W ? W indicates the electrical power that the bulb consumes. Just as electrical pressure is measured in terms of volts the consumption of electrical power is measured in terms of watts. A thousand watts are called a Kilowatt (KW). But what is registered in domestic meters is kilowatt-hours. In the illustration are shown two different designs of dial faces of electric meters generally used. One is the window type, i.e. in which the numbers to be read off are seen at small rectangular windows in the dial face. The numbers are read left to right and in the illustration the meter is seen indicating **3842.76** Kilowatt–hours (three thousand eight hundred and forty–two, point seven six Kilowatt–hours). The point seven six – .76 – stands for 76/100 of a Kilowatt–hour; which has to be added to the Three thousand eight hundred and forty–two Kilowatt–hours. One Kilowatt–hour is known as a **Unit** of electrical energy, and this is the Unit generally used in electricity bills. The other is the pointer type in which the numbers to be read off are indicated by pointers. If the pointer is in between two numbers then read the number which the pointer has just passed over. In our illustration the extreme left hand pointer is in between 3 and 4. The number to read is 3. The meter is shown indicating **3842.66** Kilowatt–hours. Now you can easily read the electric meters in your homes and find out the amount of electricity that has been consumed.

When electricity passes along a wire, the latter becomes a part of the circuit. Similarly, a device like an electric bulb, or a meter, or for that matter even the earth and the human body, become parts of the circuit when the electric current flows through them.

Before we go further, there is one more point regarding the nature of electricity (or rather the types of electric currents) which should be cleared up. You may have heard perhaps the phrases DC and AC. Well, what do they mean ? DC stands for **direct current** and AC stands for **alternating current.** To understand this better, let us compare the electrons to a car and the wire along which they flow to a road or street. Consider a one-way street full of cars. Now all the cars will be moving in one direction only on this one–way street. Similarly, in direct current or DC all the electrons move in the same direction along the wire as the current is flowing. It is most important to note here that the electrons move at a terrific speed. The speed of the electrons can approach the speed of light, under certain conditions. It is impossible for one to travel at the speed of light. But to get an idea of this speed, we might say that if a spaceship were to travel at this speed it would hardly take about eight minutes to reach the sun.

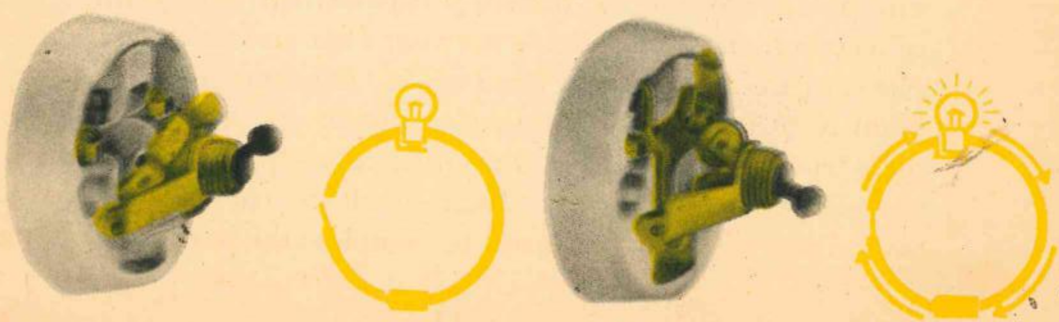
To understand the characteristics of AC, however, you will have to use your imagination a bit. We are all familiar with some of our rash young drivers who perform stunts with their cars. Imagine a batch of such crazy drivers moving fast along a path in one direction for some time. Then all of a sudden they all decide to reverse their cars and go backwards. After some time again they go forward, and then once again they go in the reverse. This is exactly what the electrons do in alternating current. The electrons go forward and backward, forward and backward, again

and again. Thus they are said to alternate their direction, and hence this type of current is known as alternating current. Of course, as in DC, the electrons move at a terrific speed. However, this backward and forward movement is so frequent that it takes hardly a second to perform as many as fifty cycles—a cycle being one forward and one backward movement. This is the current that we use in our houses, whereas a thing like an electric torch which uses cells works on direct current. It is hardly necessary to repeat that both kinds of currents require a complete circuit.

If a car has to move from Bombay to Poona, it can only do so if there is an unbroken (complete) road, between Bombay and Poona. In the same way, an electric current can flow from one point to another only if there is an unbroken path (i.e. unbroken wire or other conductor material) between the two points. There is, however, one big difference between a car and an electric current. The car can come back to Bombay by the same road or go from Bombay to Poona and stop there. But the electric current cannot come back along the same wire, it needs a separate path, which is provided by another wire. Hence in all electric appliances we see two wires, which are required to complete the path of the electric current. This path, made of two wires, is called a **circuit**.

If this circuit is broken anywhere, the electricity will stop flowing all over it immediately. The circuit is said to be 'broken' or 'open' or 'incomplete' if there is a break in it anywhere. It is said to be 'closed' or 'complete' if it is continuous, that is to say, unbroken all through.

Now why does a circuit break? Generally, there are two reasons. Either we deliberately break it to stop the flow of electricity (this is what we do when we switch off the electric lamp), or it breaks because too heavy a current is flowing in it, or, in other words, too many electrons are flowing through it. Every wire can carry a certain maximum number of electrons safely at any one time. If much more than that number are flowing through it, then it is liable to break. In fact, when the electrons are too many, the current is so strong that the wire gets heated and melts, thereby causing a break. Just imagine if such a break were to occur in a wire going from Bombay to Poona! Imagine how long it would take to search and find where exactly the break has taken place, before we could mend it. To avoid this we deliberately provide certain weak points in the circuit. This is done by inserting bits

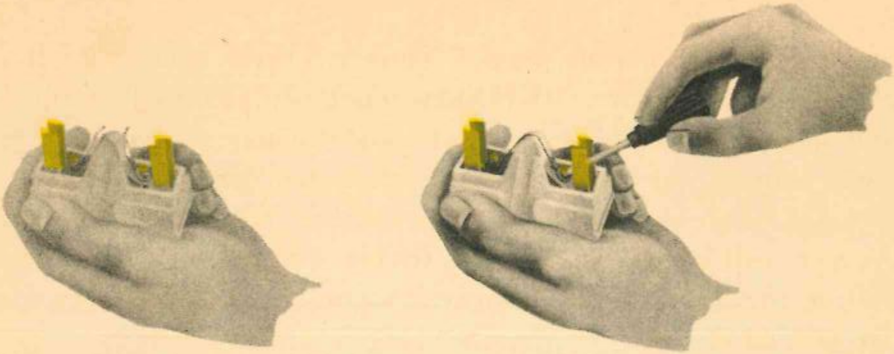


of wire of a low melting point. Thus, if a break occurs, it will occur at these weak points. It is then much simpler to find the break and mend it, because we already know where we have put in the weak points. Such weak points in the circuit are called **Fuses.**

Let us go back to the little incident we related in the beginning. As you will remember the electrician had to repair the 'fuse' to restore the lights in Mrs. Narayan's house. It is this very fuse we are talking of now.

To understand what makes the fuse work you must remember that whenever electricity flows in a wire, it produces heat, making the wire hot, i.e. raising its temperature. Sometimes the wire is made so hot that it actually melts. Now ordinarily the current which is allowed to flow in a circuit (which, as we know, is made up of wires) is not enough to heat up the wire to its melting temperature. But sometimes, because of some fault in the circuit or the appliance used, the flow of current increases. If this happens, then the wire will melt and break at some point along its length where the highest temperature has been reached. This, apart from breaking the circuit and stopping the flow of electricity, also poses another danger. The danger is that the covering of the wire may catch fire and this fire may spread. In fact, there have been cases when there has been immense loss due to a fire which started in this manner.

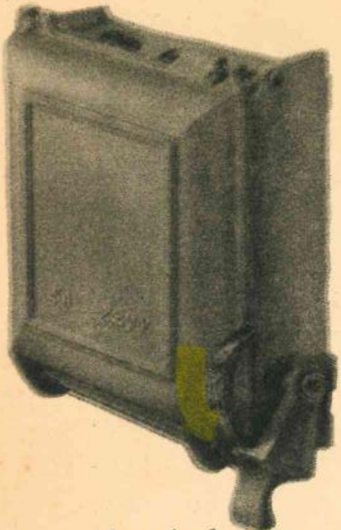
The purpose of the fuse is to prevent such an accident. The fuse is able to do this because it is a piece of wire made out of a silvery white alloy with a melting point a good bit lower than that of the rest of the circuit. A flow of current which is near the danger level but still not enough to heat up the circuit wiring to its melting point will heat up the fuse wire to its melting temperature. The fuse wire breaks. This results in breaking the circuit. The flow of current is stopped and a dangerous situation avoided. A fuse therefore restricts the maximum current that flows in a circuit and

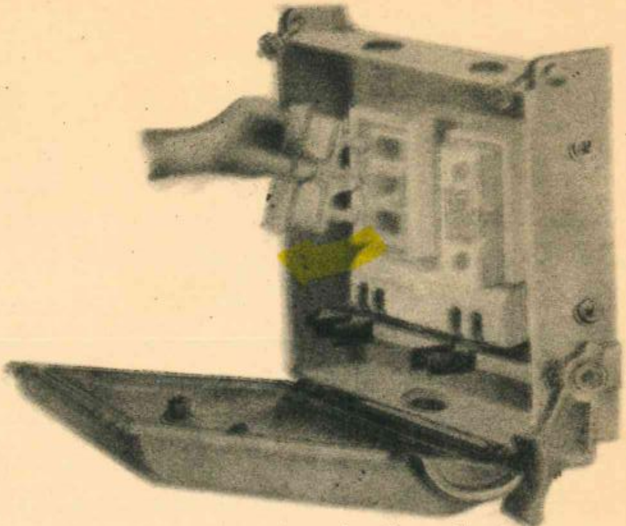


protects it. Moreover protection is also given to the instruments and appliances that may be in the circuit. For an excess current may also harm these appliances and put them out of order. When a fuse wire melts we generally say, ' The fuse has blown.' So, whenever a fuse is blown it is always advisable to ascertain the cause. If you had put on any electrical appliance just before the fuse blew, then it should be immediately disconnected from the power plug or switched off before you repair the fuse.

Well then, how is this fuse repaired? The repair of the fuse consists of replacing the fuse wire which has melted away with new piece. But care must be taken to see that it is of the proper type. It is very important that we use a fuse wire of the correct rating or capacity. The rating of a fuse wire denotes the maximum current that can flow through it without blowing the fuse. The rating is given in **Amperes.** An ampere is a unit for measuring the flow of electricity.

At this stage we would like to clarify one more point. We have all along been talking about the flow of electricity, which we have said is a movement of the very minute particles called electrons. You can well imagine that there must be some force which is pushing these electrons, or else why should they move. This pushing force or electrical pressure is called **Electromotive Force** (EMF) and it is measured in the units we call Volts. This pushing force or



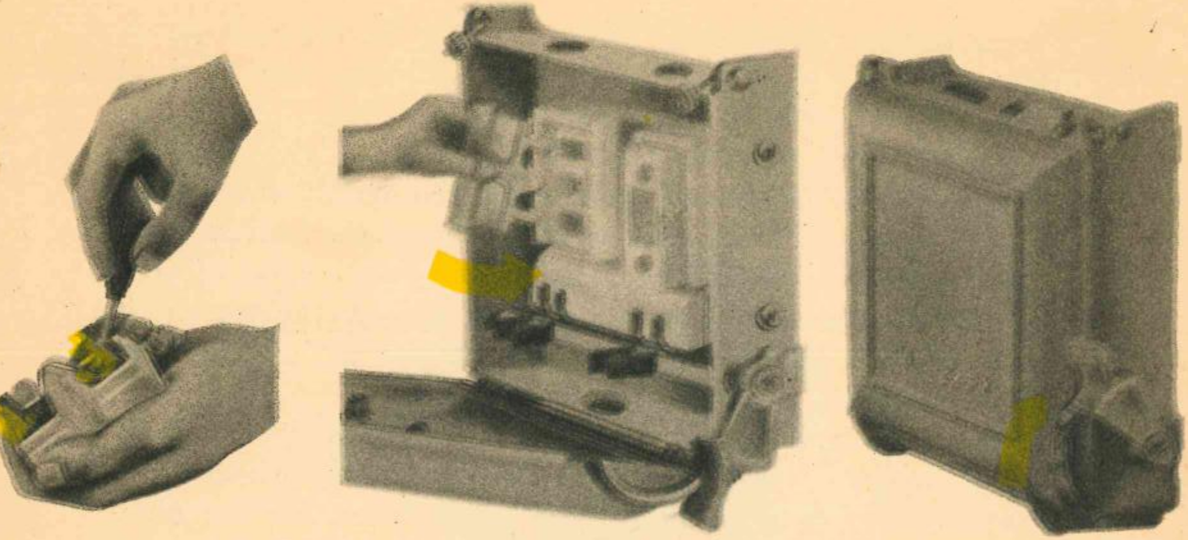


electrical pressure is generated with special machines in the electric power house, and from there the current is supplied to your house.

There are wires connecting the wiring in your house to the power house. These wires—called cables because of their large size—are generally underground in cities. The greater the electrical pressure the larger is the current that flows. The electricity in our houses flows under a pressure of 220 Volts.

To come back to the fuse, we should take the following steps to repair or replace it :

1. Put off the main switch. You will probably find it near your electric meter. By doing so, you break the main circuit from the power house to your house, so that no electricity can come into any wires in your house.
2. Pull out the fuse holder (see picture) from its socket.
3. You will see two screws. They are at the ends of the broken wire and so are called the terminals. These terminals are at each end of the holder. Loosen the screws and the small bits of burnt fuse wire will drop out. Now



take a fresh fuse wire of the correct type and just long enough to loop one terminal to the other. Tighten down the terminal screws after the ends of the fuse wire have been looped. The fuse wire should be put along the special groove provided in the holder.

4. Place this repaired fuse in the fuse holder, and push it in.
5. Put on the main switch.

While doing this work make certain that :

(a) Your hands are absolutely dry. Never touch any electrical device with wet or moist hands or feet. Can you guess why? You'll say you may get an electric shock if you do. Right, because a wet substance is a good conductor of electricity. This precaution must be taken even before you put off the main switch.

(b) Stand on a wooden board or rubber or plastic mat while pulling out the fuse. Again, you know the reason why don't you? Of course, the board or mat MUST be dry.

(c) Before putting on the main switch, all electrical appliances such as toster, electric iron, fan etc. should be switched off or, better still the plugs should be pulled out from the electrical line sockets, wherever this is possible.

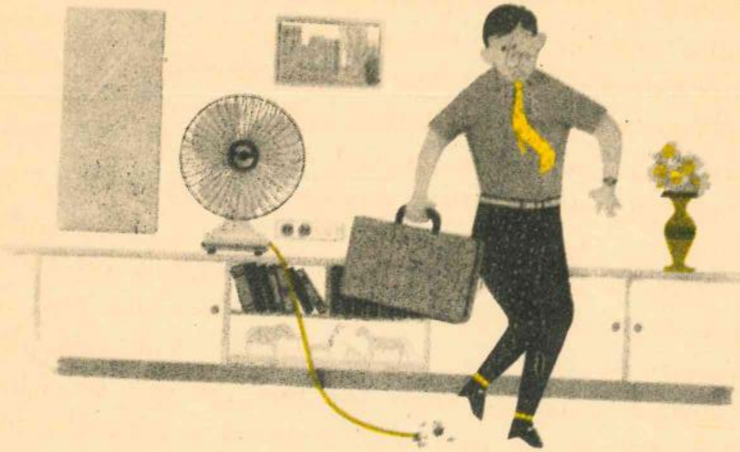
(d) Never use a wrong type of fuse, for this involves the danger of a fire. The correct thing to do is to consult once and for all any qualified electrician, who will guide you in the matter.

It is also possible that the fuse blows because one of your electrical appliances, such as the electric iron or the toaster, is defective. You will know that this is the case if the fuse blows immediately after you switch on that appliance.

The fuses in house-lighting circuits are generally of 5 to 10 ampere capacity. For circuits to which electrical appliances are connected may be of higher capacity, depending on the appliances. It is best to call in an electrician once and find out the correct capacity of each fuse in your house. You can also find out the correct capacity from the fuse holder, on which the correect capacity of the fuse wire required is generally marked.

Finally, if a fuse blows repeatedly, call an electrician to check over the entire circuit. Remember, any repairs or changes in your house wiring must be done by an electrician who is licensed to do so. This is required by law.

3 SWITCH, SOCKET AND PLUG



It seems our friends, the Narayans, are in for a bad time. Only a few pages back their dinner party got all spoilt, and now we find Mr. Narayan fretting around on a hot and humid evening. To begin with, the table fan is not working. This by itself is bad enough on a sticky evening, but to make matters worse, it has been Mr. Narayan himself who was responsible for this sad state of affairs. This morning he got up a bit late, and, being in a hurry to get ready and leave for his office, he had accidentally stepped on the plug fitted to the electric cord of the fan, which happened to be lying on the floor. Well, a plug is not designed to take that sort of treatment and had suddenly broken into a few jagged pieces.

Troubles, they say, never come singly and this particular occasion was no exception. The telephone and the electric light in Mrs. Narayan's kitchen had joined the strike. The bulb of the light was all right—Mr. Narayan had checked that—and so was the fuse. Apparently, the trouble lay with the switch. To top it all, Mr. Narayan has forgotten to call the electrician from his office in spite of Mrs. Narayan's specific instructions.

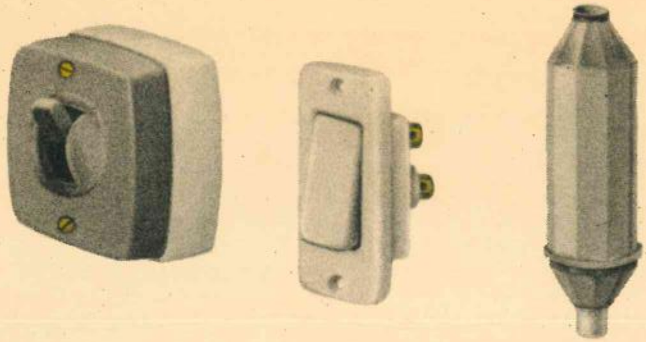
I am sure none of us would like to be in Mr. Narayan's shoes at this moment. But can't we avoid such a situation ? Is it really necessary to call an electrician to replace a broken plug or a frayed cord ? Let us see how we can do some minor repairs ourselves.

SWITCHES

As we have learned, any electrical device at home works only when electricity flows through it. Naturally, we do not want it to be working all the time. The way to stop it working is to stop the flow of electricity through it. We also know that electricity stops flowing if the circuit is broken anywhere. Well, this is exactly what we do when we want the flow of electricity to stop. We break the circuit deliberately. To do this, we use a switch. A switch is used to break and remake the circuit at our convenience.

The simplest switch is called a knife-switch. It is so called because its blade and handle resemble a knife. When you push it down the terminals A and B get joined by the blade. This completes the circuit and electricity starts flowing, and the electric lamp lights up. When you switch it off, that is push up the blade so that it no longer touches B, the circuit is broken, the electricity stops flowing and the light is off.

Every switch has this function of making and breaking the circuit, by joining two terminals or disconnecting them from each other. ' We do not see such a switch in the house, ' you might say.

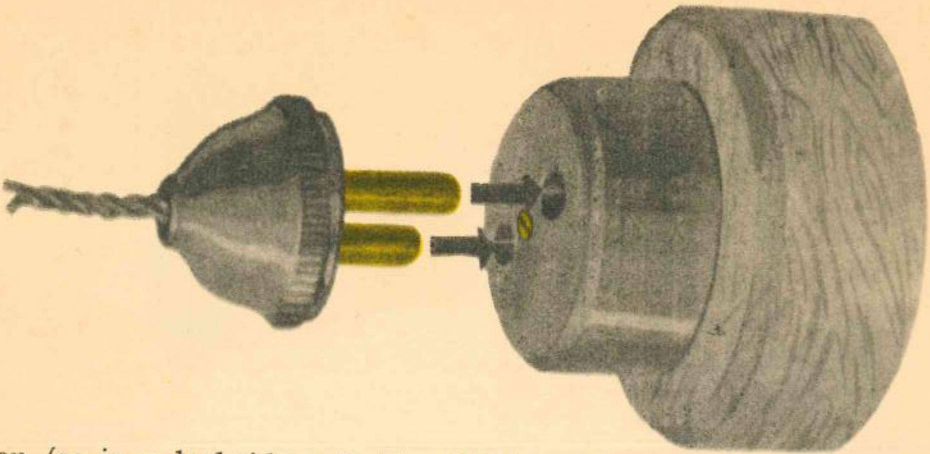


Well, that is true. It is because the knife switch is not so useful at home. It is an open switch, so if you happen to touch the blade you will get a dangerous shock. It is inconvenient and risky to handle it, as it produces a spark.

To avoid these dangers, the switches used in the house are shock proof. Besides, the switches that we use in the house have a spring-like arrangement which helps us to put the current on and off.

The different types of switches you see in your house all have the same basic principle of operation described above. The most common type is shown in the illustration.

The push-button switch that we find on lamps also works in the same manner as the ordinary switch, only its construction is a little different. These switches are small in size and are compact since they are generally embedded in a lamp base. Sometimes they have the terminals of the contacts **outside** the switch body. These should be covered with insulation tape after joining the wires to them. But before doing any repair work, please remember to remove the plug from the socket. In the illustration here you see yet another type of switch. Here the switch is a part of the electric cord, like our bed-switch, and the terminals of the contacts are inside the switch body. In this case the cover will be screwed



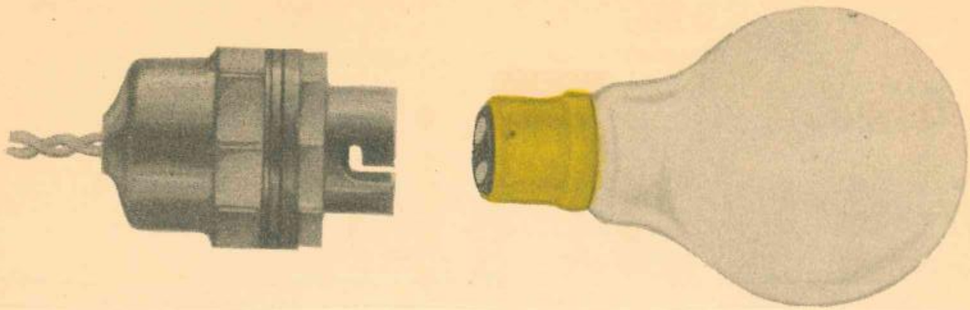
on (as in a bed-side switch). While replacing such a switch you must take care to see that the two bare wires inside the switch do not touch each other anywhere or any other part except the contact block to which they are screwed. The different types of switches are shown in the illustration. You should not try to repair a broken or defective switch. It is better to replace it.

SOCKETS AND PLUGS

The socket and the plug work in pairs. What this pair does is to separate the wires of the electrical appliance in your house from the wires bringing the current from the electric supply company.

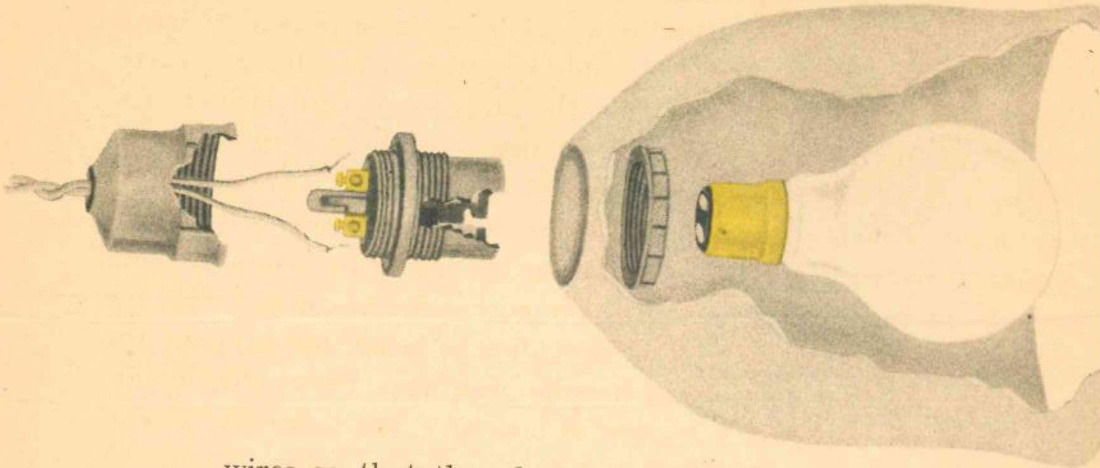
The socket is fitted on a wooden board on the wall of the room. The wires carrying the electric current from the electric supply company are connected to the two metal contacts (called 'jacks' because a metal pin of the plug can be inserted in them) as shown in the picture. These metal parts of the socket are covered to protect us so that we may not touch them. The cover is held in place by screws and has two or three holes to allow the pins of the plugs to enter it.

There is also one other type of socket—the one used in your lamp and electric light. The electric bulb is fitted into this socket. This socket does not have jacks but has metal pins in their place.



These pins touch two metal pieces (the greyish white eyes) in the black coloured base of the electric bulb. This enables the current to flow in the bulb and light it up. Sometimes the electric cord going into the socket gets frayed and has to be replaced ; sometimes the wire breaks where it is joined to the contacts inside the socket. The connection of the wire in the cord to the socket has to be made again in both cases. To do this, proceed in the following manner :

1. Remove the plug of the lamp service cord from the socket on the wall.
2. Remove the electric bulb from the lamp socket.
3. Remove the lamp shade, if any, from the lamp socket. This is generally attached to the socket with a threaded ring on the shell as shown.
4. Remove the shell of the socket. This is attached to the cap of the socket with a threaded ring. Rotate the ring to unscrew it.
5. On its removal, the body of the socket will be exposed. It is made of porcelain and is white in colour. The metal pins and terminals are fitted in this.
6. Take the end of the electric cord and strip the rubber insulation up to about three-fourths of an inch from the end on both the wires. Twist the thin strands of the



wires so that they do not spread out.

7. Pass the cord through the cap and tie a knot in it as shown in the illustration.
8. Loop the bare twisted wire-ends one under each terminal screw and tighten the screws.
9. Fit the porcelain body with the cap. It will fit in snugly only in one position. Assemble the shell and cap with the body snugly fitted into it. Screw on the ring which keeps them together.

The lamp socket (sometimes called lamp holder) is now ready for use. Some sockets—in both the lamp-holding type and the wall type of plugs—have a built-in switch. This saves the extra expense and labour of putting a separate switch in the circuit and there is an economy of space.

PLUGS

We shall now learn a little more about plugs. You know how we use water in our houses. We have water taps at different places, e.g. in the kitchen, bathrooms, wash basins, and closets. Why do we have water taps at these different places? As the very word suggests, we **tap** water whenever we want. Of course, we could do with one tap of water. But it would be so inconvenient to have only one place from where we could tap water and so have to carry it to different places in buckets. The same is the case with electricity. We need electricity in the kitchen. We need it in the bathroom and so on. To tap electricity, therefore, at various places we have sockets, also called plug points. The plug is used to connect electrical appliances to the socket where the wires carrying current from the electric supply company come in contact with the wires of the appliances, thus providing a point for tapping the current. In fact, a good housewife welcomes these plug points as she would welcome her guest of honour. The housewife is also ready with her garlands for various appliances. But her act of garlanding is plugging these appliances into the plug points. One garland may give her light, another may heat the oven, and a third may fill her room with sweet music and so on.

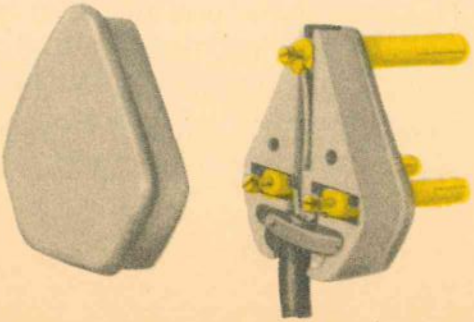
In the plug there are metal pins sticking out which fit into the jacks in the plug-point. Certain electrical appliances like electric washing machines and even some electric irons have plugs with three pins as shown in the illustration. You'll be wondering why this kind of plug has three pins instead of the usual two. The additional pin, generally the thicker one, serves as shock saviour, since this thick pin does what is known as earthing, that is, conveying the current straight to the earth in case of leakage.

It is quite simple to attach a plug to an electric cord. The following instructions show how to do it :

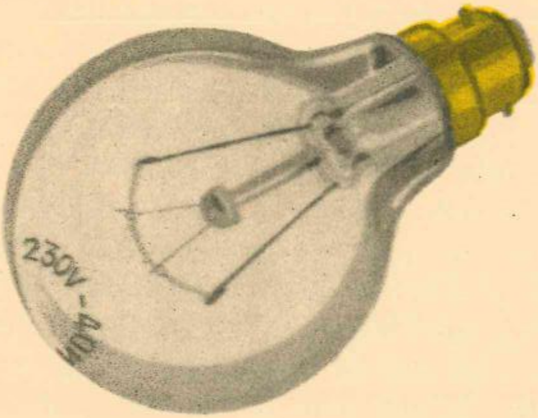
1. We first remove the cap of the plug which is either screwed on to the base or held in place with a small screw in the base. The screw will be generally in the middle of the base between the metal pins which are sticking out of it.
2. We now take the electric cord and insert it through the cap.

Next, we strip the ends just enough to loop the bare wire (after twisting) under the serews on the terminals. For each pin there is one terminal and one wire should be connected to each terminal.

3. We screw down tight the screws on the terminal to hold the wire in place.
4. Finally we put the cap back in place and the plug is now ready for use.



4 BULBS AND TUBES



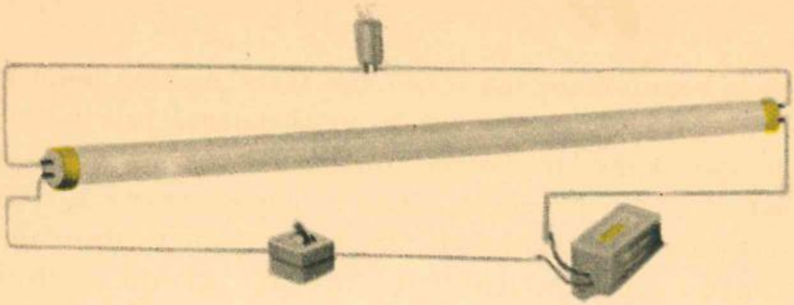
We are all quite familiar with electric lights, both the ordinary bulb lights and the fluorescent tube lights. We take it for granted that they produce light when electricity flows through them, but how does that happen ? Have you ever thought of that ? Well, in general, light is produced when something becomes hot enough. You have seen glowing coals. Well, they glow only when they are red hot. This is the basic principle used in the conversion of electricity first into heat and then into light.

When electricity flows through a wire, it makes the wire hot. The greater the current which flows, the hotter the wire. Ultimately it becomes white hot. In the process, of course, it might melt before becoming white hot if its melting point is low. So we use a special wire made of the metal called tungsten. It can become white hot without melting. When the wire becomes white hot, it gives white light. This is how electricity is converted ultimately into light in the electric bulb which is also called the incandescent lamp, ' incandescent ' meaning ' glowing with intense heat '. The bulb also produces a lot of heat, which is of no use and thus wastes quite a lot of electricity. But, as yet, no electric bulb has been invented which can produce light without heat.

If you look at an electric bulb (take one with a transparent glass so that you can see the inside as well) you will observe that it is made up of a glass bulb which is closed at one end with a brass base. On the sides of the base are two pins. These pins help not only to hold the bulb in the lamp socket but also to keep it in such a position that the grey eye-shaped metal contacts at the base touch the two pins in the socket. Inside the bulb you will see a glass stem rising from the base. At the top of this stem there are a few spidery arms and on these is suspended a very thin coiled wire. This thin coiled wire is the **filament** which is made of tungsten. It is this filament which becomes white hot and glows with a white light when electricity passes through it. The electricity enters and leaves the filament by means of the two wires embedded in the stem, the ends of which are in contact with the grey eyes at the bottom of the base.

When anything becomes white-hot it ought to burn away. Now burning needs air and particularly oxygen. To prevent the filament from burning away all the air inside, the bulb is removed and in its place there is a mixture of some gases — generally nitrogen and argon — which do not allow things to burn in them.

The power of an electric bulb is given in watts, such as 100 W, 60 W, and even 0 W. It is a general misconception that a zero



watt bulb, such as we use in a night lamp uses no current. This is wrong. We know that a filament of a lamp will give off light only when it is heated. To produce heat, current must flow through the filament. So although it is popularly known as 'zero watt', actually the rating of this bulb is not zero. It does consume some power, although it is very little ; but even the little electricity it uses does cost money.

FLUORESCENT TUBE LIGHTS

In the incandescent lamp, light is produced by the glowing of heated wire. In a fluorescent tube, light is produced by the glowing of a material called phosphor, when ultra-violet rays fall on it. These ultra-violet rays are invisible and are produced owing to the presence of mercury vapour in the tube.

When electrons flow through this 'mercury vapour' they collide with the mercury atoms and produce the invisible ultra-violet rays practically without producing any heat. This is good because absence of heat means no wastage of electrical energy. The phosphor material absorbs the ultra-violet radiations and gives out visible light of different colours, white, blue-white, green, etc., depending upon the type of phosphor material used. For example, magnesium tungstate gives blue-white, calcium tungstate gives blue, zinc silicate gives green, and so on. This type of glowing is called fluorescence. Hence the lamps in which this fluorescence takes place are called fluorescent lamps. When they are in the shape of a tube, they are called fluorescent tube lights.

The fluorescent light is made up of a glass tube with a filament type of wire (called electrode) at each end. The electrodes are coated with a substance which when heated gives off a lot of electrons. Those electrons collide with the mercury atoms of the mercury vapour which fills the tube. The inside of the glass tube is coated with the phosphor material. It is this phosphor material that gives off the visible light when the invisible ultra-violet rays from the mercury vapour fall on it. A little argon gas is also contained in this tube.

The electric wires from the electric supply company cannot be directly connected to the fluorescent lamp as they can be to an incandescent lamp. To operate it we need two other electrical devices called the 'starter' and the 'ballast', popularly known as the 'choke'. The 'starter' does exactly what its name implies. It starts the lamp. The 'starter' acts as an automatic switch to make and break a circuit which starts the current flowing in the fluorescent tube electrodes. The flow of electrons through the tube from one electrode to the opposite one is established with the help of the 'choke'. The starter, the choke, the tube light, the switch and the manner in which they are connected is shown in the illustration on the previous page.

In the figure we have shown the wires directly connected to the pins of the fluorescent tube light. Actually, the ends of the tube light fit into special sockets made for them, and the wires are connected to the terminals of the contacts in these sockets.

Now a word of caution about tube lights. The mercury and the phosphor material inside them are poisonous. For this reason it is dangerous if a tube light breaks and these poisonous materials come out. We must, therefore, be very careful not to break a tube light even when it is burned out. Children must never be allowed to play with then.

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