

quently it may require days for the electrons in a long dc circuit to drift from one end to the other. In an ac circuit when the voltage reverses 50 or 120 times per second the electrons cannot drift far in either direction, but swing back and forth through short distances in the circuit.

Fig. 7 and 8 give an elementary idea of how electrons flow in a circuit, and show they transmit an electrical impulse almost instantaneously. In Fig. 7, the circuit is open at A. Assume that the large black dots are the nuclei of copper atoms and that the inner dotted circle represents the three inner orbits with their 28 electrons, as in Fig. 1. The black dot in each outer dotted circle represents the 29th, or free, electron of each atom. For simplicity free electrons are all shown in the same position, even though when the circuit is open they drift at random in the conductor.

When the circuit is closed, as in Fig. 8, battery potential is applied to it and a mutual exchange of electrons occurs between the atoms as indicated by the dots with arrowheads: When atom 1 gives up an electron to atom 2, an electron from 2 goes to 3 and so on through the circuit to atom 18, which gives an electron to atom 1. Thus, when the circuit is closed an exchange of electrons between the atoms occurred at the same instant. In this way the effect of a comparatively slow flow of electrons is felt through the circuit at once.

This theory verifies to a degree the old belief that an electric current flows through a circuit at the speed of light. The chief difference in the old and new theory is in our conception of what happens in the circuit. The old conception assumed that when a circuit was closed to an electric power source an electric current flowed out of its positive terminal and traversed the circuit to the negative terminal almost instantaneously. The new conception assumes that electrons are caused to drift slowly through the circuit from the negative toward the positive terminal of the power source, but transmit an electrical impulse at the speed of light.

Electron flow through a circuit may be compared to water flow through a pipe. In Fig. 9, assume a centrifugal pump connected in a pipe circuit filled with water and the valve closed. When the pump operates it builds up pressure on the discharge side of the valve, as shown by the pressure gage, but water does not flow. If we open the

Positive, Negative Charges

Eight protons and eight neutrons in nucleus

11 Normal oxygen atom; 2 electrons inner orbit, 6 outer

12 If on oxygen atom loses one electron it becomes positive ion

13 Oxygen atom with an excess electron is a negative ion

14 After a glass rod is rubbed with silk it becomes positively charged and picks up bits of paper

15 Stick of sealing wax after being rubbed with cat's fur has a negative charge and picks up paper bits

valve water starts flowing in all parts of the circuit simultaneously, Fig. 10. That is, the instant water starts flowing from the pump's discharge, it also flows into the suction. Even though the water flow through the circuit may have a velocity of only a fraction of an inch per second its effects are felt in all parts of the circuit almost instantaneously. With water, its total volume moves in the pipe whereas in an electric circuit only the atom's electrons drift.

In Fig. 8 an electron flow is indicated through the battery solution as through the external circuit. This is not true; no electrons as such flow through the solution, but the effect is the same. Different actions occur in different batteries, some complicated and others quite simple.

One of the simplest actions is that of a copper and a zinc plate in a sulphuric-acid solution (electrolyte). The

electrolyte acts to give a negative charge on the zinc plate, and a positive charge on the copper plate. That is, the zinc plate is given an excess of electrons whereas the copper plate is deficient in electrons. Then, when the external circuit is closed the zinc plate gives up some of its excess electrons to the conductor and the conductor supplies some of its electrons to the copper plate to supply its deficiency.

While the circuit is closed the electrolyte reacts on the plates to give the zinc an excess of electrons and keep the copper deficient so flow is continuous from the zinc through the external circuit to the copper plate. Movement of electrons in a vacuum tube is different from that in a solid conductor as will be shown later in this series.

For simplicity, in Fig. 8, we show a current flow of a single electron.

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Dairy Company

"YARWAY Traps have been a life-saver here. Used many different makes before trying YARWAY a year ago. Haven't touched them since. Trying to get management to buy more."—Large Wisconsin dairy.

Laundry

"Ironer is so hot it sizzles after putting YARWAY trap on in place of a bucket trap. Run heavy spreads through ironer once and they are dry. Pulling our all bucket traps and will replace with YARWAYS."—Farina Laundry Co., Vancouver, British Columbia.

Florist

"Coal bill last winter was \$5,000 less than previous winter. Didn't know whether they could give YARWAY Traps all the credit, but they were entitled to a big share of it."—Meyers and Santman (Greenhouses), Wyndmoor, Pa.

Textile Plant

"One large press formerly equipped with a bucket trap wouldn't heat lower platen. A 3/4" YARWAY Trap was installed and since then full production has been maintained. This represents an increase of 20% in production."—Southern textile mill.

SPEAKING OF STEAM TRAPS

Company

"No doubt, YARWAY Traps are finest traps built. All trap replacement will be YARWAY traps."—Oil Company.

Cleaning Plant

"As soon as we installed the YARWAY trap our trouble ended. Since then, when other traps gave trouble, we put in YARWAYS and they always did a much better job. Now we use all YARWAY traps," says Maintenance Engineer of large mid-western cleaning firm.

Pipe Works

"We use many YARWAY Traps. They save them very much on dryers. They take little room and discharge steam as fast as it comes through them, causing coils to heat up faster and hold steady temperature."—Globe Works, Philadelphia, Pa.

Power Station

"We use many YARWAY Traps are here and have been very successful. Some of these traps have been in use since 1939 and have given absolutely no trouble."—Herkimer Municipal Power Station, Herkimer, N.Y.

Hospital

"Ten years ago replaced an old trap with a tiny 1/2" #60 YARWAY on an ironer. Never had such good results before. Trap has never been opened and is still going 100%. Since then have bought nothing but YARWAY Traps and will specify them for new addition."—Northern Wisconsin hospital.

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