Positive and Negative

Direction of Current Flow

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ELECTRONS really exist. J. J. Thomson and others showed by experiment that electrons really do "shoot off" from hot bodies. Furthermore, it has been shown that if the carbon rod of a battery is connected to a plate and the zinc to a heated cathode, both being contained in an evacuated envelope, the electrons are "encouraged" to cross the space between. Then in any circuit including a valve it is an easy matter to draw an arrow showing the direction of electron flow from cathode to anode. The direction of flow through any other component follows.

As an example consider the rectifier supply unit of Fig. 1. First draw an arrow between cathode and anode of the rectifier valve, then as many more arrows as you like round the circuit, all the same way. Thus, in the resistance shown to represent the rest of the receiver electrons must flow from A to B.

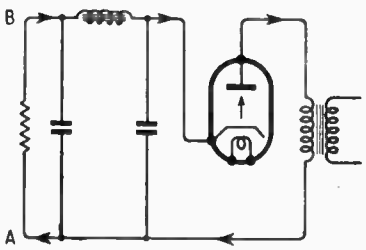

Fig. 1. The direction of electron-current flow in a half-wave rectifier.

In this way the direction of flow in any part of any circuit containing a valve can be found. If a battery is part of the circuit it must be remembered that the red end—the carbon of a dry battery—"sucks" electrons and the black end "pushes" them out. Hence it is as easy to find the direction in a circuit containing a battery as in one with a valve.

Gremlins have a language of their own. A gremlin riding round a circuit on the back of an electron calls all the joys to come "positive" and all those already passed "negative." These words are borrowed from the mathematicians who use "negative" to mean the opposite way to the direction it has been agreed to call "positive," or a quantity of opposite kind to that called positive. If a plug is called "positive" in Gremlin it is certain that its socket is called "negative."

Some parts of the tour on electron-back are specially important and are to be remembered. The coil of a moving-coil meter is such a part. The terminal to which electrons go, as seen from *inside* the meter coil, is marked +. Of course, it is not + from the point of view of an electron that has already passed through it, but as it is those now in it that make the pointer move (or burn out the coil!) it is their point of view that labels the terminals. A battery's job is to cause an electronic commotion outside itself, so it gets labelled from the point of view of electrons *outside* it.

Now consider the circuit of Fig. 2. The arrows show the direction of flow; there can be no argument about that. As seen from "ground level" the cathode is labelled + because electrons are going towards it. The grid is connected to ground level, so is entitled to no label. However, the electrons just leaving the cathode find the grid is trying to push them back, so from their point of view it is negative. If the labels + and − are permanently left on the diagram it must be obvious from what point of view each one was put in.

If something makes the grid go a little negative (as seen from the earth line) fewer electrons flow to the anode, but since the suck of the battery is unchanged electrons must be drawn from the upper plate of C towards the battery. More electrons then flow to the lower plate in an effort to fill the void. As a result there is an increase in potential difference between the plates; that is, the upper plate becomes more positive

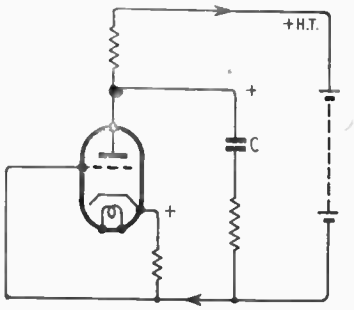

Fig. 2. The electron flow in an RC amplifier stage.

(as seen from the earth line). It is thus labelled +. Nevertheless, the upper plate of C in the diagram has become *less* negative when viewed from the point usually marked "H.T. +."

Moral: Beware of plus and minus, but the direction of electron flow cannot go wrong.

BOOK REVIEW

F.M. Radio Handbook, 1946 Edition. Edited by Milton B. Sleeper. Pp. 149. Published by F.M. Company, Great Barrington, Mass., U.S.A. Price $2.

There are fifteen chapters devoted to the history and theory of frequency modulation. Chapter 2, Theory of Frequency Modulation, is the important one and consists of a very good elementary explanation of F.M. and of the circuits peculiar to it.

Many of the other chapters, such as those on Audio Distortion, High Fidelity, Antennas and so on, might well be considered out of place. The matters dealt with are quite independent of the form of modulation used and apply equally to A.M. They contain much useful information, but of a kind for which one would not turn to a book entitled F.M.