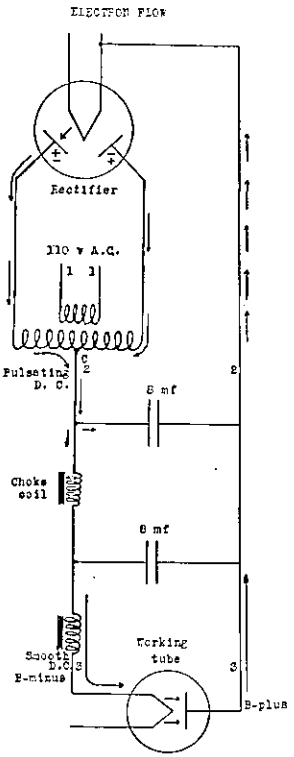
SHOWING FILTER ACTION WITH A NEON LAMP

W. L. FENNER
Hirsch High School, Chicago, Illinois

The "B-supply" used in radios and amplifiers can be effectively presented at the high school level. As an invention, it involves admirable strategy. The filtering is a first-class application of the storage function of condensers, in the unit on electrostatics.



An ordinary neon lamp (Edison base) can show to the class the result of the rectifier tube, and the *smoothing* that the filter accomplishes.

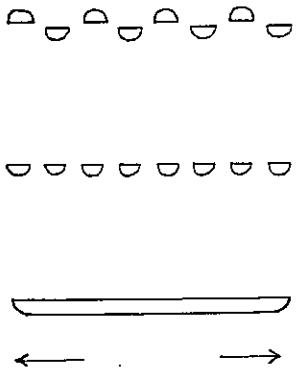
Extreme respect for high voltages should be observed and taught during this demonstration. The secondary of the power transformer may have 700 volts. Use regular radio test prods, connected carefully to a pendant socket, preferably the porce-

lain kind used in basements. Explain your precautions to the class, in order to discourage careless imitation on a home radio. It would be still better to use an A.C.-D.C. set; since there is no power transformer, the highest voltage is about 110 v.

Explain that the "B-supply" is a substitute for expensive B batteries, which give smooth D.C. for the plates of radio tubes.

On a real radio or amplifier, identify to the class the power transformer, the rectifier tube, and the filter, consisting of two or three condensers of perhaps 8 mf each, in a block. Then turn the chassis up on one side to show the numerous connections.

APPEARANCE OF THE WAVING NEON LAMP DURING THE TESTS



1 1

When the test prods are touched to the original A.C.

2 2

When the test prods touch the center tap C and the B-plus. The current is rectified, but is pulsating and can cause hum.

3 3

When the test prods touch the B-plus and the B-minus. A smooth streak of light shows suitable plate supply.

The numbers refer to reference points in the circuit.

Observe the safety precautions explained in the third paragraph. Each test should be quick, to avoid high voltage injury to the neon lamp.

Identify the same items. When the test prods explore certain contacts, to be specified below, the neon lamp is to show the progressive steps in changing the original A.C. into smooth D.C.

First attach the test prods to the line voltage. The alternating nature of the current is obvious, because the two electrodes flash alternately. In a partly darkened room, wave the lamp in order to see the alternating flashes.

Next touch the test prods to the B-plus and the center tap, labeled C in the circuit. Now only one electrode glows, showing that the current has been rectified. But this current still has bad pulsations, as the class can see when the lamp is waved. Explain why this pulsating D.C. is unsuitable for the plates of the tubes. (If the set has no power transformer, the test prods can touch the rectifier cathode and the rectifier plate.)

Finally touch the test prods to the B-plus and the B-minus, or across the last filter condenser. Now the neon lamp shows *smooth* D.C. When waved, the lamp shows a steady streak of light. The pulsations have been filtered out.B-batteries will produce the same steady glow. Explain why this smoothed current for the plates helps make a radio free of hum.

After seeing this demonstration, the class can see that the negative side of each filter condenser acts as a temporary waiting room for electrons that come from the rectifier in pulses. When too many electrons come at each pulse, many of them squeeze into the condenser. *Between pulses*, these same electrons are expelled because of the back pressure in the condenser. Thus a steadier flow is achieved. Analogy may be drawn to the air dome of a force pump, or to reservoirs that store river water during flood time and let it out during a dry season, thus maintaining steady supply. Filter paper in a funnel passes a smooth stream of water, even though the water may come from a pulsating faucet.

The action of the full-wave rectifier can be made vivid. When the A.C. causes either plate to be positive, electrons are attracted and extracted from the tube. The instructor may like to recall how two hands milk a cow alternately. Then the center tap *C* is the "bucket."

The electrons that are fed smoothly into the B-minus are heading for the filaments, or cathodes, of the various working tubes in the radio. These filaments are giving away electrons, and need to have their supply constantly replenished. The plate of a working tube takes these electrons, and they return through the B-plus to the filament of the rectifier tube, where they are again given off.

In your blackboard diagram, let the working tube now have a control grid, connected perhaps to an antenna. Put headphones in the plate circuit.

If an *A.C.-D.C.* radio is used, the voltages are harmless to neon lamps. Three neon lamps could be connected, perhaps with solder, if a museum piece is desired.

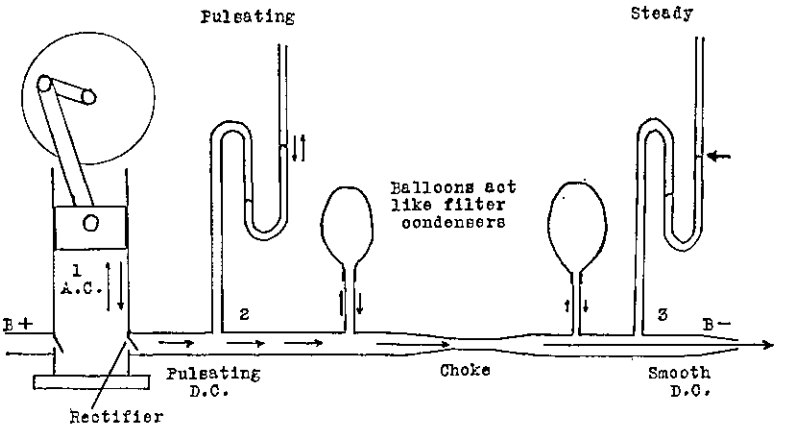
The first connection to show A.C. should be to the 110-volt line wires. The second connection to show pulsating D.C. should be to the rectifier cathode and the rectifier plate. The third connection to show smooth D.C. should be to the B-plus and the B-minus, or across the last filter condenser.

For the purpose of this demonstration, there is a special nov-

elty glow lamp that could be substituted. Each electrode has the shape of a Scottish terrier.

An extra project is feasible with the safer voltages in the A.C.-D.C. type of set. By using test prods connected properly to a headphone, the audio signal can be traced. Compare the loudness of the signal coming from the audio detector with the final loudness of the amplified signal going to the voice coil of the loud speaker. For safety, use tape over the terminals of the phones.

How Mercury Manometers Imitate the Neon Lamp



A two-cylinder pump (or two tire pumps) could imitate a full-wave rectifier.

The sizes of the "choke" and of the delivery nozzle must be adjusted so that the balloons will fill slowly.

The same equipment can show fall of potential. Instead of the balloon assembly, put in a long length of gas hose.

THE NATION'S SCHOOLS

One fourth of the Nation's population—32 million persons—are regularly enrolled in public schools and colleges. In addition, United States schools offer their facilities and personnel to hundreds of thousands not regularly enrolled.

Half a million persons, for example, took part last year in public forums sponsored by public schools to talk over problems of their communities and the Nation.

A quarter million CCC enrollees were helped to fit themselves for jobs and responsibilities of citizenship through instruction in the country's 1,500 camps and in nearby schools.

The Educational Radio Script Exchange has in the 4 years of its existence made loans of 240,000 scripts to 1,200 small producing groups from coast to coast.