How Daily Programs Are Broadcast from KDKA

By Peter Kerr

THERE are thousands of radio fans with well-equipped receiving sets who would like to know just how the daily programs are sent forth from a big broadcasting station. KDKA, the Westinghouse station at Pittsburgh, which has been broadcasting since 1920, is presumed to be one of the most thorough stations in the world. The path of a speaker's voice from its studio to your receiving set is an interesting journey. When everything is set and ready, the engineer in carge of the station tests all filament and plate batteries before each program. He then starts the transmitting set and checks the wave length by means of a wave meter. He then lights the signal light in the studio notifying the announcer that the transmitter is in operation. The announcer turns on the studio amplifier which lights the signal light in the operating room notifying the engineer that the audio circuits are in operation. He then watches the modulation meter and adjusts the amplification of the speech amplifier to give the desired amount of modulation. A loud speaker in the operating room serves as a check on the quality of the transmission.

Figure No. 1, shows in diagrammatical form the path of the speaker's voice from the studio to the receiving station. A voice picked up by the transmitter in the studio, theater or church is amplified and transmitted by means of a telephone line to the radio station where it is further amplified and used to control the output of the radio transmitter. The radio transmittting set is supplied with power directly from the work's power plant, through a step down transformer for the vacuum-tube filaments and through a special motor-generator set which changes the 220 volts D. C. to 2,000 volts D. C. for the tube plates. The radio transmitter changes this power from 2,000 volts D. C. to alternating current power at a frequency of 833,000 cycles per second (360 meters wave length) which is supplied to the radiating system consisting of antenna and counterpoise. This high-frequency power in the antenna system sets up waves in the ether which travel outward in all directions and, intercepting the receiving antennae set up voltage and currents which operated the receiving set.

Figure 2 shows the circuit diagram. For convenience in studying the circuits represented by Figure 2, which carry a wide variety of frequency, this diagram has been divided into four sections by means of the dotted lines at right; the lower section, which may be considered as the power supply, carries only direct current at 2,000 volts and low voltage alternating current at 25 cycles. This 25-cycle current is used only for heating the filament. To prevent any of the 25-cycle voltage being impressed on the grid fiilament and plate filament circuit, the return of the grid circuits and of the 2,000 volts circuit is connected to the mid-point of the resistor which is shunted across the filament, each half of the resistor being shunted by a condenser for by passing the radio and audio frequency.

In the next section of Figure 2, in addition to the power circuits described, audio-frequency voltage is impressed upon the grids of the modulator tubes varying the potential of these grids with respect to their filaments according to the voice waves, by means of the pick-up transmitter and amplifiers.

The four 250-watt power tubes in the upper part of the set are the oscillators, which, in conjunction with the condensers and oscillation transformer, change the 2,000-volt direct-current power into alternating-current power at 833,000 cycles (360 meters) generating the so-called carrier wave, which is pressed on the antennae through a remote controlled double throw switch, which allows the same antennae to be used for receiving when the station is not broadcasting. The amplitude of the radio frequency wave thus generated is constant so long as the plate voltage on the oscillator tubes remain constant, and fluctuates with the plate voltage when the latter is varied. Thus the upper section of Figure 2 carries only modulated radio-frequency waves, while the third section carries both radio frequency and audio frequencies, in addition to the 2,000 volt direct-current and the 25-cycle alternating-current power circuits.

The function of the five modulating tubes, also rated at 250 watts each, is to vary the voltage on the plates of the oscillator tubes according to the voice frequency impressed upon their grids by the speech amplifiers.

This system of modulation is known as constant current or power modulation and is accomplished by means of the constant-current choke coil in series with the positive lead of the modulator and oscillator tube plates. The modulator tube grids are held at a static potential of 60 volts negative with respect to their filaments by means of a battery. The audio frequency voltage from the speech amplifier then adds to or subtracts from this 60 volts grid potential. At an instant when the modulator tube grids have impressed upon them by the amplifier a small negative or zero, potential with respect to their filaments, the tube impedances from plate to filament are low and a large plate-current flows from the 2,000 volt direct current circuit to the modulator tube plates. Because of the large inductance (50 henrys) of the audio frequency choke coils in series with the plate supply, the total generator current can change very little in a brief interval of time. Hence part of the generator voltage occurs across the choke coils, thus lowering the voltage impressed on the oscillator tube plates and

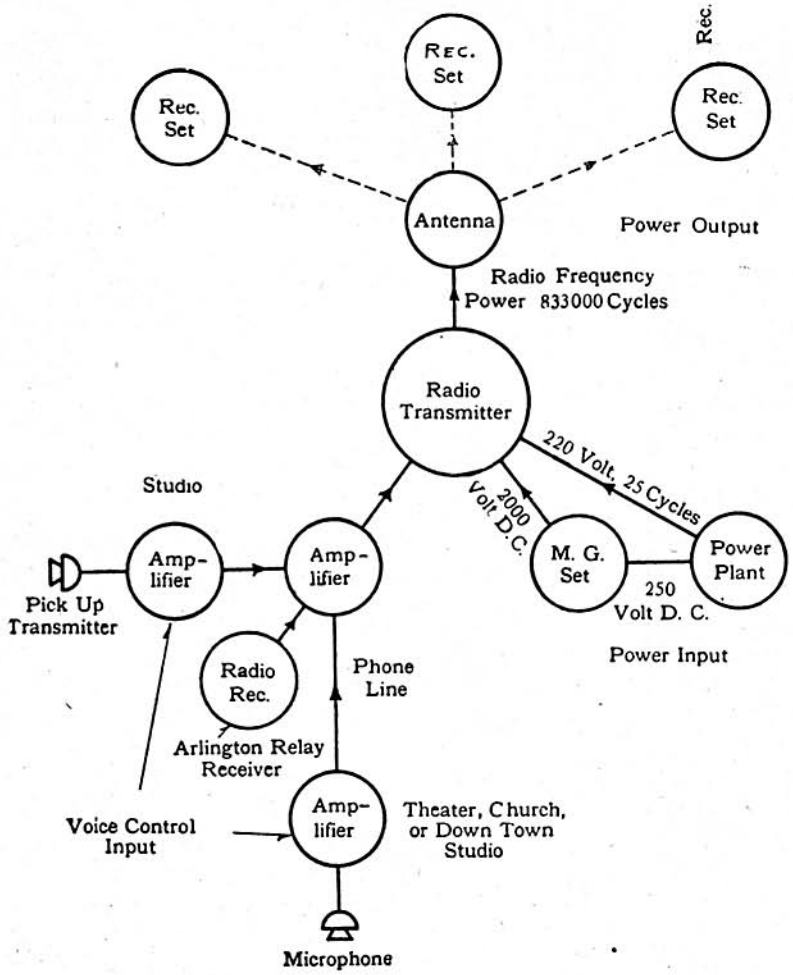
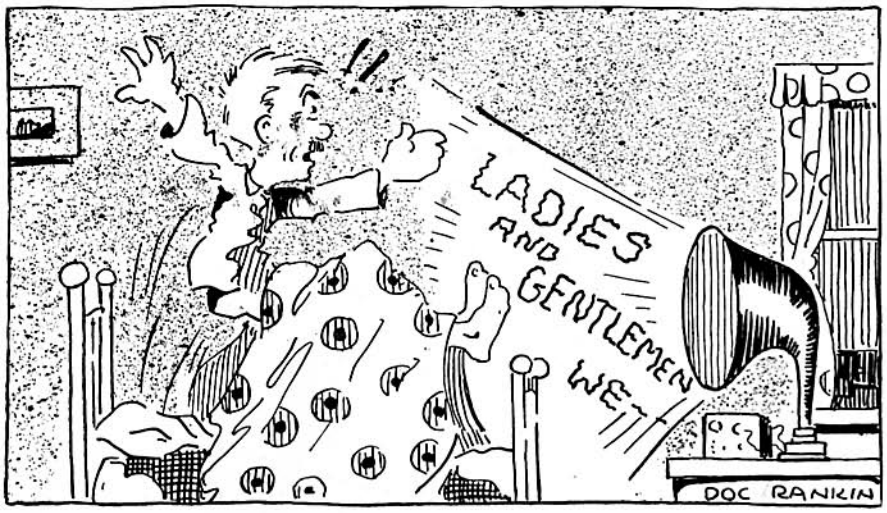


Figure 1. Diagrammatical form of the path of the speaker's voice from the studio to the receiving station. A voice picked up by the transmitter in the studio, theater, or church, is amplified and transmitted by means of a telephone line to the radio station, where it is further amplified and used to control the output of the radio transmitter.

He Forgot to Shut Down!



An original radio cartoon
Drawn specially for "Radio World"
By Doc Rankin

(*Continued from preceding page*)
hence the radio frequency output of the set.

The next instant when the modulator tube grids have a high-negative potential with respect to their filaments the plate impedance is high and little or no current flows through the modulator tubes. The choke coils tending always to keep the total generator current constant creates a voltage which adds to the generator voltage and this forces most of the current into the oscillator tubes which increases the radio frequency or antenna output accordingly. In this way the audio frequency choke coils cause the voltage applied to the oscillator tube plates to fluctuate in proportion to the speech voltage impressed on the grids of the modulator tubes by the speech amplifier. As the amplitude of current in the antenna varies directly with the plate voltage on the oscillator tubes and as this voltage varies from nearly zero to 4,000 volts the antenna current varies accordingly.

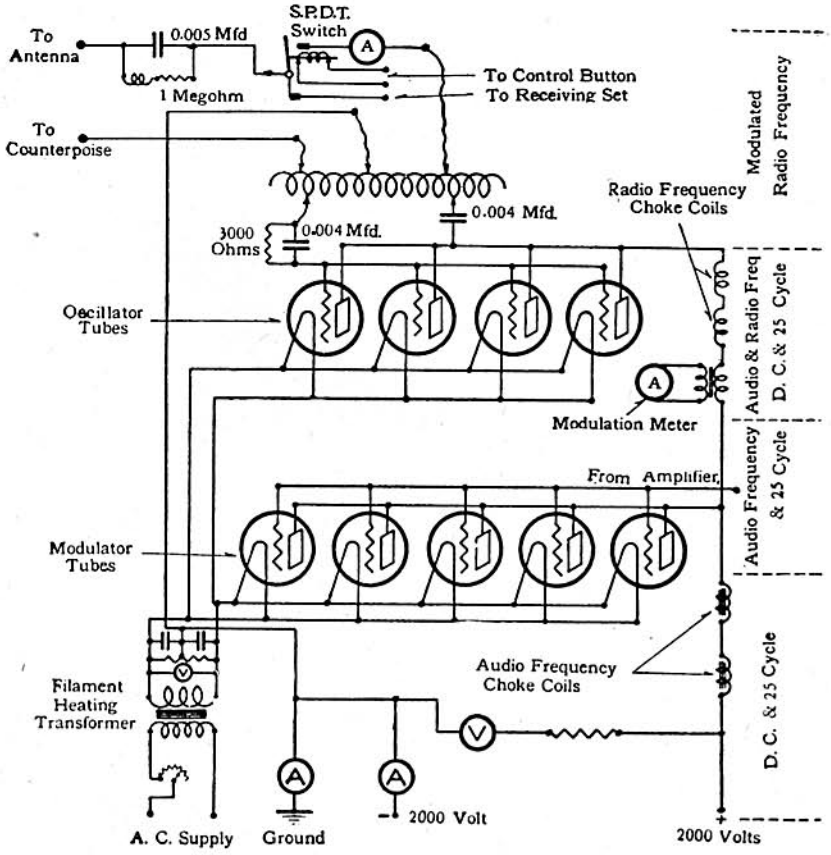


Figure 2. The circuit diagram. For convenience in studying the circuits represented by this schematic diagram—which carry a wide variety of frequency—it has been divided into four sections, indicated by the dotted lines at right. These four sections provide an interesting study for the radio constructor.

Radio Terms Stump Court

THE first radio litigation to come before the Boston courts went on trial before Judge O'Connell and a jury in the Suffolk superior court, says *The Tribune,* New York and aroused, first interest and then bewilderment, when highly technical terms were broadcast about the courtroom.

The suit was brought by Lloyd Green, of Everett, against the Radio Time Service, Inc., of Boston, for recovery of $726 for work done. Green stated he was contracted with by the defendant to devise and develop loop antennae and other apparatus for the receipt of time signals from the Arlington, Va., government station without the use of outdoor antennae.

On the stand, Mr. Green plunged into a mass of radio phraseology which puzzled judge, jury and counsel to the extent that the court requested Mr. Green to explain just what was meant by antennae of both the plain and loop variety, radio-activity, ether and the like. Four o'clock came before the messages were decoded, and Judge O'Connell ordered a postponement until Monday to give the jury a chance to study radio technicalities.

A Homemade Grid

THE grid leak is a small filament of carbon in a glass tube; but the equivalent of this device, so important to radio, may be constructed at home very easily. How this is done is described by the *Sunday Call,* Newark:

Cut a piece of cardboard about two inches long and about half an inch wide, or just the size of the grid condensor. If the grid condenser is used, make the cardboard just as long as the condenser so that the two binding-posts will pass through the holes in the condenser and hold down the cardboard. Under each binding-post rub off some of the pencil carbon so that when the binding-posts are tightened down some of the pencil mark will show around the edge of the post.

Do this on both ends of the cardboard so that there will be contact enough for a pencil mark across the cardboard between the two binding-posts.

Turn on the tube filament and adjust the set. If a point is reached where the adjustment will cause a loud howling, or the signal tuned in is not clear, start rubbing the pencil back and forth between the binding-posts until the howling just stops or the signal is made clear.

If there is too much pencil carbon and the set appears dead, simply erase the marks and start all over again until the proper resistance is reached. The grid leak resistance need not be changed unless a different tube is inserted in the socket. Sometimes the grid leak made in this manner may be covered in hot paraffin so as to exclude moisture and it will remain in permanent adjustment.

Another method of making a grid leak is to soak a small piece of blotting-paper in drawing ink and dry it thoroughly. Then pass two binding-posts through the ends as with the other type mentioned above. A blotter inked in this manner cut down to ½ inch wide and 2 inches long will save a resistance of approximately one megohm, and is suited for the majority of tubes. However, the adjustable leak is to be preferred, for critical and efficient adjustment.