Spark gap generators

An electric arc produces tremendous energy at both harmonic and non-harmonic spurious frequencies. For example, any AM receiver will pick up noise from lightning. Similarly, arcs from motors or ignition systems also produce large amounts of wide-bandwidth RF noise. Figure 1 shows a simple spark-gap RF power generator. Until 1938, when they were declared illegal, circuits like these were used to make crude radio transmitters. Some early experimenters stole

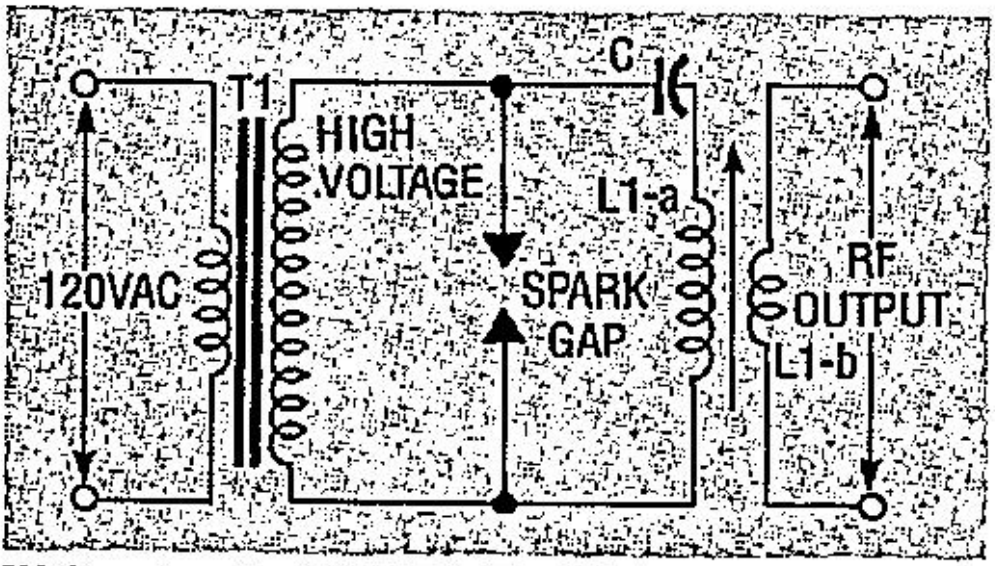

FIG. 1—A SIMPLE SPARK-GAP RF POWER GENERATOR used as a crude transmitter; they were declared illegal in 1938.

anodes wouldn't work in BKO mode. Both anode and cathode were negative, while the grid was positive.

Figure 4-*b* shows BKO operation. Cathode electrons were attracted by the positive grid toward the anode, but its negative bias repelled them. Since the cathode was negative, a similar effect occurred there. Electrons traveled circularly about the grid, with the operating frequency set by the rotation rate. Output power was taken from the grid, a principal limitation of the BKO. The small grid size limited RF power, so it normally ran white hot.

Other approaches

Later devices used magnetic fields to control current, instead of the electric field of the BKO. These included the magnetron, an "M-type" crossed-field device invented by Hull in 1921, the parallel-field "O-type" device invented by both the Heil's in 1935, and the Varian brothers in 1939. Next month, we'll examine the magnetron in depth. R-E

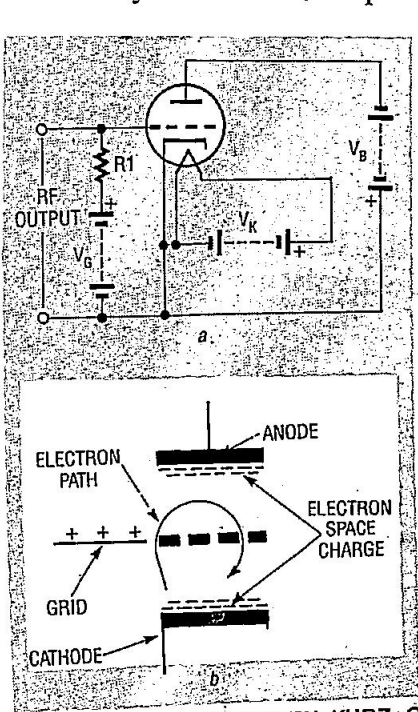

FIG. 4—THE BARKHAUSEN-KURZ OSCILLATOR (BKO) used transit time to increase bandwidth. In (*a*), both cathode and anode are negative; the grid is positive. In (*b*), cathode electrons are alternately attracted toward and repelled from the anode, traveling circularly about the grid with rotation rate setting operating frequency. The small grid porduced only limited RF output power, so it ran white hot.

the stator is related to the number of poles on the magnet, the number of coil pairs in the stator, and the speed of rotation. If a magnet were spun at 1 rev/s inside a two-pole stator, a 1-Hz signal would be generated. By increasing the number of magnets, the number of stator poles, and the rotation speed, frequencies up to 1 MHz could be generated, although most alternators produced 30–200 kHz.

The alternators in communications use an electromagnet to generate RF. Telegraphy was possible, by interrupting the coil current with a telegraph key. In 1916, engineers from the *Naval Research Lab* (NRL), Washington, D.C., used the U.S. Navy radio station at Arlington, VA (call sign NAA), to produce the world's first voice transmission over radio. NAA, also known as Radio Arlington, had a 100-kW, 113-kHz alternator, and dominated voice radio before World War I. NAA engineers varied the electromagnet current using a voice signal, to create AM. Because of its low operating frequency, the Alexanderson alternator was of limited microwave value.