Research in Radio

Radio

E. P. EDWARDS, in *The Radio Industry* (Shaw):

While the radio industry that we know today started its rapid growth with the conclusion of the World War, its genesis considerably antedates this period. In the design of radio receiver and loud speaker combinations, for instance, we have been able through the medium of organized research to take advantage of the contributions of such workers as Hertz, Maxwell, Faraday, Heaviside, Helmholtz, Rayleigh, and others.

In order to better understand the character of the foundation upon which we are building, let us consider the more important, conscious engineering contributions to the radio art which have become available in this present century.

The first practical high-frequency alternator was developed by Alexanderson in 1906; it was of the induction rotary disc type, having an output of two kilowatts at 100,000 to 200,000 cycles, and marked the beginning of the end for those systems of transmission employing damped waves. This little machine with its associated equipment was the forerunner of the 200-kilowatt generator which now links this country, through radio, with Great Britain, France, Germany, Sweden, Norway, Holland, Belgium, Italy, Poland, Turkey, Venezuela, Dutch West Indies, Dutch Guiana, Colombia, Porto Rico, Argentine, Brazil, Hawaii, Japan, Dutch East Indies, French Indo-China, and the Philippines.

At the time of this development we had the Fleming valve, or two-element tube, capable of detecting radio signals. The use of this tube marked the transition from detectors of the coherer, electrolytic, and crystal types to the present three-element tube. Subsequently, DeForest added a third element, the so-called "grid," which materially broadened the functions of the Fleming valve and provided not only a more sensitive detector, but also a tube capable of functioning as an amplifier and oscillator.

With the high-frequency alternator at the transmitting end and the three-element tube at the receiving end, there resulted a more dependable system of radio communication, employing Morse and similar codes, but as yet this system was not flexible enough to transmit speech effectively and practically. The coming of the power tube is an outstanding instance of the far-reaching effect of pure science on all industrial development. It has proved to be one of the most important factors in the radio art to date. Its future applications may be of even greater value to mankind.

Edison, in his early work on the incandescent lamp, observed a phenomenon which has since been known as the "Edison effect"; he noticed a blue glow in some of his lamps which rapidly disintegrated the filament near its terminals; he guessed that a current was passing through space between the terminals and proved that to be so by placing an electrode in the bulb and passing current between the filament and the electrode. He found that this current would pass in one direction only and that the tube was therefore a rectifier.

These experiments of Edison's were the basis for Fleming's inventions, which were followed by that of DeForest. The Fleming and DeForest tubes were low vacuum tubes. Only very low voltages could be used with these tubes. Prior to Langmuir's invention of the high vacuum tube, the special treatment necessary to the production of a high vacuum, hot cathode tube was not known; nor was it appreciated, apparently, that there would be any particular advantage in such a tube. Langmuir found how to produce a high vacuum, hot cathode tube and found that with such tubes very high voltages and large currents could be used. As a result of these discoveries we were able to produce power tubes of a commercial type with outputs up to 100 kilowatts.

The power tube is the heart of the broadcast transmitter. The broadcast transmitter enabled us to supplement signal transmission by voice transmission, and has become the "tail that wags the dog," in an industrial sense.

In a radio sense, there has been no more important problem than that of transmitter development. While there is little probability that transmitter design and manufacture will result in mass production, it is an outstanding fact that this development is the basic reason for mass production of receiving and reproducing equipment. Consequently, continuous scientific research and development must be employed if we are to hold the interest of the listener-in, and expand our field of endeavor.

The history of radio is like that of any other extension of knowledge, either physical or mental; it is the union of independent, partial contributions of discovery or interpretation, which are found to be interrelated parts of one harmonious, comprehensive whole.

The invention of the tungsten filament and thoriated tungsten filament are outstanding contributions of research, and constitute an important step in our endeavor to secure minimum current consumption and better overall performance. These advances are of particular interest, as they indicate the economic effect of research.

The list of different-purpose tubes is large, embracing the rectifier tube used for many purposes, the various types of tubes capable of using alternating current for filament excitation, amplifier tubes, and the four-element screen grid tube, which is assuming greater and greater importance in the solution of amplification problems.

Facsimile telegraphy, television, radio beacons, carrier current communication, are all special applications, centering around the transmission of radio signals. In addition, there are "other purpose" applications of radio transmission such as telemetering, remote control, and synchronization. These by-products of radio development may become important factors in our everyday life when their development is completed and their value realized.

The so-called by-products are not limited to applications involving radio transmission. Even today, devices and equipment resulting from radio research are utilized in the automatic selection and grading, by color, of cigars, pearl buttons, coffee and breakfast foods. Many other interesting applications, such as high-frequency furnaces and automatic elevator leveling equipment, give promise of industrial expansion along lines that had not been thought of until present-day radio made its appearance.

Take one little device as an outstanding example—magnetic pick-up—this, coupled with a method for the electrical cutting of phonograph records and electrical reproducing equipment (all products of radio development), has rejuvenated the phonograph industry, which for a time appeared to have suffered a death blow as the result of radio competition this competition, through the good offices of research, has been converted into an ally.

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