How Radio Advanced

A Record of Progress

IMPORTANT progress was made during 1922 in the design and manufacture of radiotelephone and radiotelegraph apparatus both for commercial and amateur purposes. The sale of amateur equipment made a spectacular increase, due to the sudden aroused interest of the public in the new application of radio to broadcasting.

The line of standardized component parts which had been originally designed for commercial purposes was later produced for the amateur. Broadcast receivers were built, making use of these parts and a line of sectional units, such as the tuning unit, the 3-stage radio-frequency amplifier-unit and the detector-amplifier unit were developed. The main idea in these sets was the production of receivers, each of which would serve a definite function separately, and could also be easily combined.

The general tendency in receiving tubes was toward reducing the power consumption in the tube filaments. The first attempt resulted in a detector and amplifier tube using one-fourth of an ampere in the filament; superseding one previously using 1 ampere. Later, a tube using only 60 milliamperes for the filament was equally successful.

These new tubes made it possible to use dry cells for the filament excitation and two new receivers were produced. One, a portable set, contains a sensitive tuning system, a detector and single-stage audio-frequency amplifier. The other set is similar in its electrical characteristics to the first one, except that it has two stages of audio-frequency amplification instead of one.

New Sets That Receive from Foreign Lands

In the line of commercial equipments, new requirements were met, due in many cases to broadcasting. In one case, a power company sought a duplex radio telephone installation with which it could provide during times of storm against possible interruption of communication between several of its stations seventy-five miles apart. At the same time, signals from nearby broadcasting stations operating on 360 meters were not to interfere with operation of this station on the only available wave length of 400 meters. The set was to be operated through remote control from a desk-stand by the regular powerhouse switchboard operators and to require no attention except that usually given to such moving parts as motors and generators. This set was installed and is operating successfully.

For the use of amateurs and for installation on small boats and yachts, there was produced a small radiotelephone transmitter having an output of 20 watts in the antenna. It is built so that it may be operated either from a motor generator set or from a kenotron rectifier which was designed for this equipment. It also may be used on a telegraph transmitter, either continuous wave or interrupter continuous-wave.

A new tube attachment for converting spark transmitters into vacuum-tube continuous-wave transmitter makes it possible for owners of spark sets to realize the advantages of continuous-wave transmission at a minimum cost. It has an output in the antenna of approximately ½ kilowatt continuous-wave and a wavelength range from 200 to 2,400 meters. It utilizes the power equipment and high-potential transformer of the spark transmitter and includes necessary switching apparatus so that communication can be transferred from the spark set to the tube attachment.

This equipment makes it possible not only to carry on communication with stations now listening in on 2,200 meters, but to carry on communication over much greater ranges with a 2-kilowatt spark transmitter. During actual service tests conducted with one of these transmitters, a range of 1,500 miles daylight, over water, was realized.

An aircraft transmitter was constructed for telegraph communication only with a contiuous wave output in the antenna of 300 watts. Provision was also made for interrupted continuous-wave telegraphy. The transmitter was designed to operate from a double current stream line generator driven by an automatic speed regulating propeller.

A number of telephone and telegraph transmitters were built for installation on submarines of the United States Navy which include many novel features of construction and operation. They are designed for transmitting either on the flat-top antenna or a loop, and include a break-in system whereby the operator can listen-in between dots and dashes of the transmitted message. They are available for three methods of communication and have an output of 600 meters, continuous wave, in the antenna. The complete equipment was extremely restricted in dimensions on account of the service for which it was built.

New apparatus designed and manufactured for use with 200-kilowatt Alexanderson alternator equipments consisted of antenna-tuning inductances, remotely controlled antenna wave-change switches and remotely controlled antenna-variometers.

One of the antenna tuning-inductances designed for outdoor service installed at Radio Central Station has a coil composed of ten vertical supports on 82-foot diameter centers. These supports are of porcelain tubing, of 3½ feet outside diameter and are held semirigidly by copper rings on the inside of the vertical tubes. Attached to each of the ten vertical supports are fourteen spacing blocks which are so designed as to provide a maximum surface-creepage-distance between turns.

The conductor which is wound in grooves of the spacing blocks is of 686 strands of ten mil-diameter copper wire, each strand insulated with enamel. Varnished cambric and treated braid on the outside provide insulation and protect the conductor from the weather. The total inductance is 19 millihenries.

Ten of these coils were furnished with two 200-kilowatt alternator equipments for the new radio station near Warsaw, Poland, which is being built by the Radio Corporation of America.

Material for four coils of the same general design, except that six vertical supports on 65-inch diameter centers are used, is being furnished for the Radio Corporation's station near Bolinas, California.

Remotely controlled antenna wave-change switches are to be mounted adjacent to the tuning inductances described above, and will be used to change the number of active turns in the inductances.

Ten of these switches were furnished with the two alternator equipments for the Polish station. They will be located at various distances up to more than a mile from the generating station, the point from which they are to be controlled.

In the operation of remote controlled antenna variometers for indoor service, means for remote control from switchboard and hand control at the variometer were provided.

During the Year 1922

By John Liston

General Electric Company

These variometers are connected in series with 200-kilowatt Alexanderson alternator, feeding energy to multiple tuned antennae. They are used to maintain close adjustment of antenna tuning, particularly when antenna capacity is varied by wind and sleet. Porcelain supports are used throughout for all parts connected in circuit and the conductor is composed of 4,270 strands of five-mil copper wire, each strand insulated with enamel. Varnished cambric and treated braid form the outside insulation.

Due to the high-intensity high-frequency electromagnetic field produced by the windings, no metals of any kind are used inside the windings. The top supports of the framework are of brass. Iron pipes attained high temperatures at fractional load in the windings. Closed circuits in the pipe framework are broken up by suitable insulators to prevent circulating currents.

The stationary and movable windings may be connected in series or parallel. The average range of inductances in series connection is .19 to 1.1 millihenries. Maximum coupling averages 50 per cent.

A new method of recording and reproducing sound was developed, which is a distinct improvement in many ways over all previous methods used and opens up several entirely new fields of application. It is known as the pallophotophone.

There are two distinct devices in the pallophototone—one for recording and one for reproducing the sound—and either may be used independently. The recording device consists essentially of a tiny mirror on which is reflected a beam of light. This mirror is attached to a delicately vibrating diaphragm and when sound waves cause the diaphragm to vibrate, the mirror oscillates and the ray of light causes projection of corresponding oscillations upon a strip of photographic film which passes in front of the mirror in a continuous motion.

The film is then developed in the usual way and shows a succession of delicate dark markings which constitute the sound record.

In the reproduced device, the film passes in front of an arrangement of vacuum tubes which are sensitive to light so that the variations in the light falling on them caused by the lines recorded on the film produce electromotive force variations in the circuit in which they are connected. Therefore, as the film is moved in this device the electric current is actuated, which corresponds with great accuracy to the original sound wave. This electric current can be made to actuate a telephone loud speaker or to operate radio broadcasting apparatus directly.

The Largest Vacuum Tube and Its Wonders

Many interesting applications of this new device have already been made and a few possibilities can be briefly outlined as follows: It makes possible the talking motion picture, for on a film of the normal width both sound and action can be recorded simultaneously and projected with absolute synchronism. It is practically unlimited as to the length of record it can make and reproduce and is, therefore, suitable for recording speeches, debates, concert programs, in the taking of evidence and for any purpose where a lengthy record of sound is required. It can be duplicated and used as a film photograph and applied in radiotelegraphy in producing wireless signals and for audio-amplification. It has already been successfully applied in broadcasting.

The largest vacuum tube ever made consists essentially of a water-cooled cylindrical anode 30 inches long and 1¾ inches in diameter. In the axis of the anode is a tungsten filament 0.4 inch in diameter and 22 inches long. This filament is excited by a current of 1,800 amperes at 10,000 cycles, the filament excitation requiring about 20 kilowatts. The magnetic field produced by this large hearing-current is sufficient to cut off the electric current from the cathode to the anode during a portion of each cycle of the current passing through the cathode, this action taking the place of that of the grid in a 3-electrode tube. The electron current to the cathode is thus interrupted 20,000 times every second. By the use of properly tuned circuits, this may be used for the production of high-frequency power for radio or any other purpose.

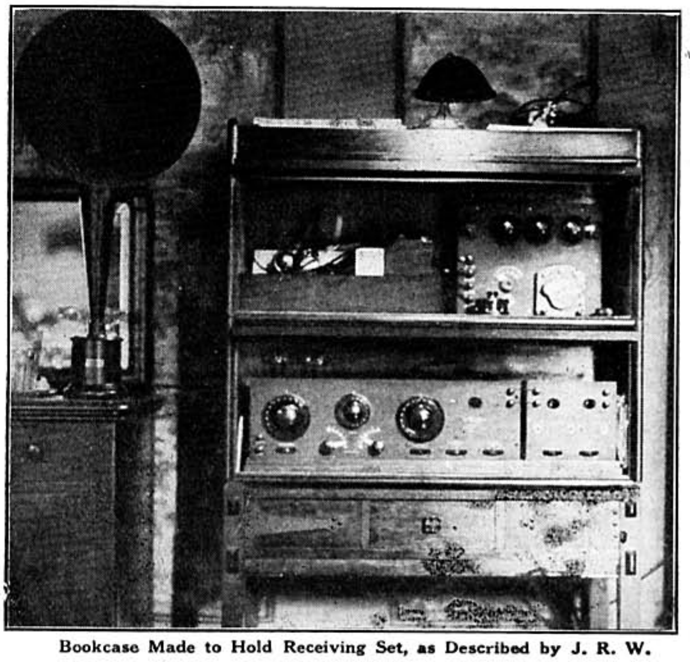
This particular type of tube, which is called the magnetron, will supply 1,000 kilowatts of 20,000 cycle power at an efficiency of 70 per cent., operating with an anode voltage of 20,000 volts direct current.

Complete carrier current equipment of telephone communication over the high tension transmission lines of power companies was developed and a number of tests were installed. The transmitter has an output of 50 watts and is rated at 75 miles, provided there are not a great number of "tie-ins" or transformer stations in this distance. The equipment includes a calling system whereby a bell is rung at the station called when the station calling actuates a push-button on the desk-stand forming part of the equipment.

Book Case for Receiving Set

By J. R. W., Louisville, Kentucky

I AM sending you what I consider an ideal arrangement for a receiving-set in the home. Sectional bookcases with glass doors keep the set dust proof and give a neat appearance. Many of my radio friends like the idea and, so far as I am aware, this arrangement is original. The large A batteries, battery charger, etc., are in the compartment below—out of the way.



Bookcase Made to Hold Receiving Set, as Described by J. R. W.