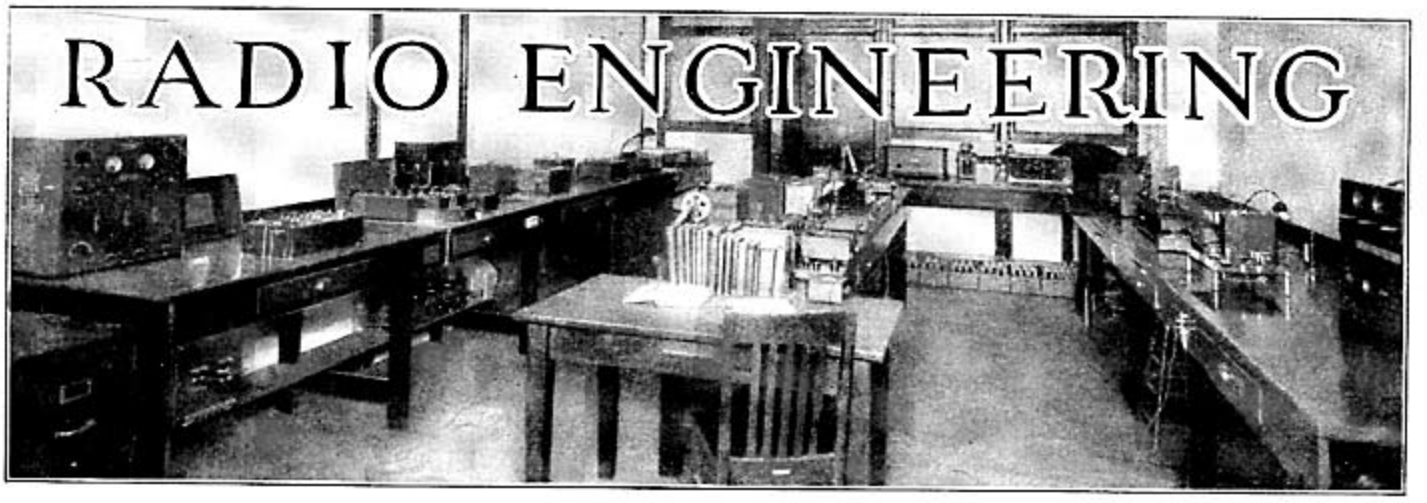

Resume of G. E. 1930 Developments

DEVELOPMENT of airport and airplane radio transmitters has made great strides in the past year, according to a review of radio in 1930, made by John Liston, of the General Electric Company. A new 2-kw. telephone and telegraph set for communication between airports and between ports and planes is especially notable as well as smaller sets of 50 watts output for use on planes.

Mr. Liston's review of General Electric radio follows:

Aviation

A major improvement in high-power short-wave transmitters was the development of a power amplifier (Fig. 93) using two UV-858 especially designed short-wave tubes in a push-pull circuit. The output is 30 kw. at 14 meters, increasing to 40 kw. at 100 meters. Two of these units are normally used at one end of a short-wave communication channel, with a double-throw switch to transfer operation from one unit to the other. One unit is adjusted for a wavelength suitable for night communication and the other for day communication. The design is such that any wavelength between 14 and 100 meters may be obtained. Each unit is connected to a separate directive antenna. This arrangement obviates the necessity of switching high-frequency circuits and results in higher efficiency and improved operation. A rectifier supplies power to either unit. Either amplifier is driven by a crystal-controlled exciter which incorporates improvements in the methods of mounting and operating the crystals to produce a high degree of frequency stability.

An improved short-wave transmitter having an output of 1 kw. (Fig. 94) covers a wavelength band of 15 to 50 meters and is designed for use either on ship or shore, and for operation into a variety of antenna systems. The transmitter is crystal controlled and utilizes four-element vacuum tubes, thus assuring a high degree of frequency stability.

A new 2-kw. intermediate-frequency telephone and telegraph set for terminal airports (Fig. 95) is used for communication between airports, and between these ports and planes. The transmitter supplies an output of 2 kw. for telegraphy or 1.2 kw. for tone telegraphy or telephony, and is designed to minimize harmonic radiation. The wavelength range is 545 to 1580 meters. Power is obtained from a motor-generator.

A relatively low power (200 to 350 watts) transmitter for communication between airports, also between airports and planes has a wavelength range of 17½ to 150 meters. High-voltage direct-current is obtained from a rectifier integral with the set. The modulator is a separate unit, capable of completely modulating an output of 200 watts.

Radio equipment for airplanes was developed along two rather distinct lines, for commercial and for military use. In the commercial class, the telephone and telegraph set has a nominal rating of 50 watts output. In the military class, there was included a low-power high-frequency telephone set, a low-power high-frequency telegraph set, a high-power combined intermediate and high-frequency set.

Broadcasting

A power amplifier nominally rated 10 kw. and a suitable rectifier were developed to permit an increase of the output of existing low-power stations.

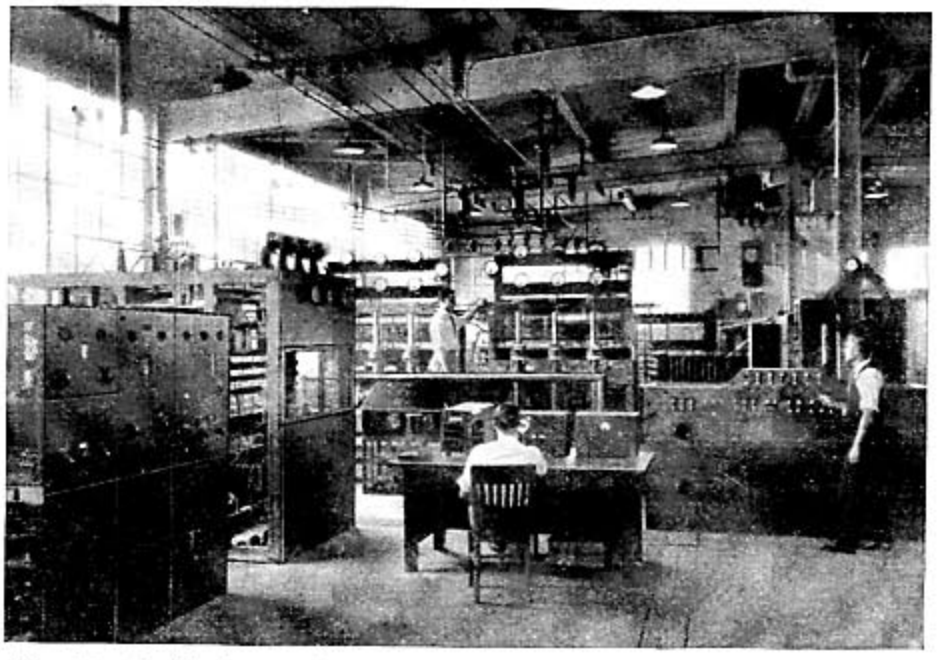

Fig. 100. In this view may be seen the 100 kilowatt developmental transmitter of the General Electric at Schenectady

Two UV-858 tubes are used as linear amplifiers in a push-pull circuit. These operate normally with 18,000 volts obtained from the rectifier.

An improved design of 5-kw. transmitter was produced (Fig. 96) and a number were placed in operation. The main improvements provided a high degree of frequency precision and stability, and reduced the harmonic radiation to a minimum.

A low-power transmitter rated 100 watts to cover the broadcast band was developed (Fig. 97) in which crystal control and four-element tubes were used to insure extremely good frequency stability. Complete modulation is obtainable which produces peak power output of 400 watts. A modulation indicator is provided to enable the operator to obtain the best possible performance from the equipment.

For use in connection with sound pick-up of events occurring outside of broadcasting studios, a portable amplifier (Fig. 98) was produced. This class of apparatus is subject to rough usage and, for this reason, the design incorporates features that several years of experience have shown to be necessary for reliable performance.

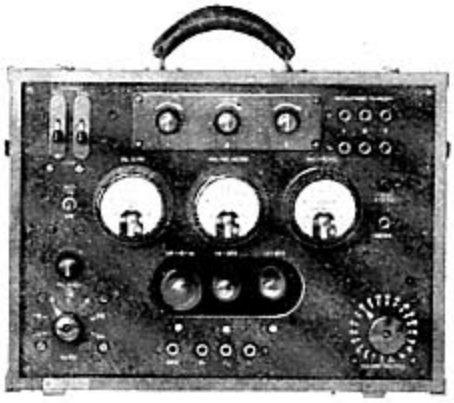

Fig. 98. A portable amplifier for pickup work outside of the studio

For installation in broadcasting studios, a variety of amplifying, monitoring, switching, and other forms of control units are required. A new line of these units (Fig. 99) was introduced during the year. An improved design of condenser microphone stand was also developed.

Developmental Transmitter

The major accomplishments at this station were in connection with providing increased output from the various broadcasting transmitters. Transmitter W2XAG was operated regularly for a considerable period of time at 200-kw. normal output on WGY's regular wavelength of 379.5 meters. The peak power when fully modulated was 800 kw. The output stage of this transmitter (Fig. 100) contains six UV-862 water-cooled tubes each nominally rated at 100 kw. High-voltage direct-current for this

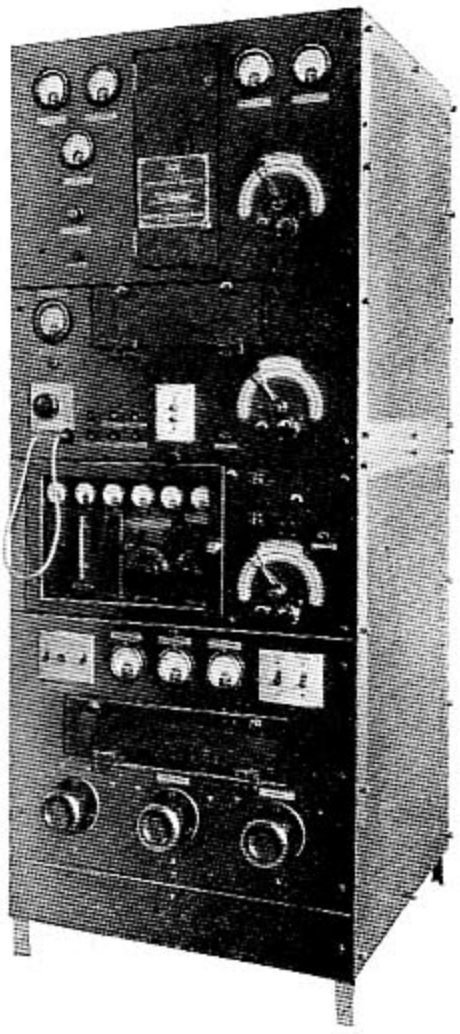

Fig. 97. Using crystal control and four element tubes this 100 watt broadcast transmitter is quite compact

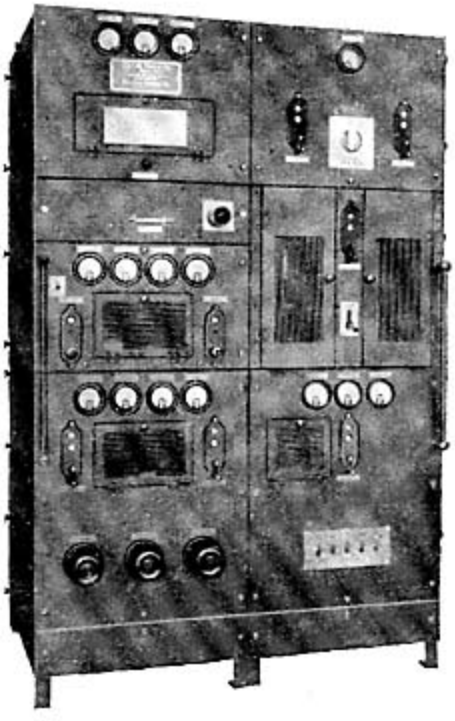

Fig. 94. A short wave 1 kilowatt transmitter covering a range of 15 to 50 meters is seen in this photograph

amplifier was obtained from a hot-cathode-type rectifier nominally rated 750 kw. This accomplishment provides the basis for the design of broadcasting transmitters of still higher ratings.

Transmitter W2XAF was operated on its regular wavelength of 31.48 meters with an output of 25 kw. fully modulated; peak power 100 kw. Six UV-858 short-wave tubes are used in the final amplifier stage. This transmitter was used with different types of antennas depending upon requirements. A vertical half-wave radiator is normally used for broadcasting since the radiation pattern is uniform in horizontal directions. A highly directive antenna pointing toward South America, Antarctica, and another radiator pointing toward Australia were used. These directive antennas increased the efficiency of transmission in a given direction and, in combination with high power, provided transmission facilities of an unusually high order.

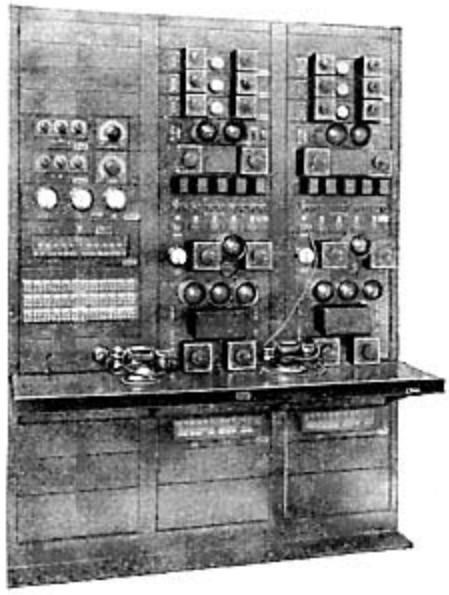

Fig. 99. For stations with two studios this two-studio control room equipment is used

Further improvements were made in the audio characteristics of the various transmitters at this station to give practically uniform audio response through the entire range from 25 to 50,000 cycles, essential for transmission of television and highly advantageous for broadcasting.

Developmental Receiving Station

In equipping this station, to enable continuing in a comprehensive manner the investigations pertaining to the performance of short-wave communication channels, three highly directive receiving antennas were constructed, directive on California and Australia, and another group of three, directive on Europe. Fading was materially reduced by receiving a given

signal on two or more separate antennas and combining the outputs in a single circuit. This necessitates a receiver for each antenna, and combining apparatus.

The new building at this station was equipped with two groups of three-channel receivers, one group for a wavelength range of 14 to 85 meters and the other group for a wavelength range of 17.5 to 50 meters. With these added facilities, data of great value were obtained. The combined facilities of this and the Developmental Transmitting Station made possible a number of telephone conversations with several foreign countries.

Apparatus was also installed at this station for measuring, with a high degree of accuracy, the operating frequency of broadcasting stations in the eastern part of the United States.

Automatic Volume Control Systems

(Continued from page 51)

of 60,000-ohm resistors, the last one of which is in the grid return circuit of the detector tube. If a signal is received of sufficient strength to cause grid current to flow in the detector circuit, a voltage drop is set up across the resistor in that circuit, and this drop is then added to the normal grid bias of the r-f tubes and reduces the r-f amplification, thereby reducing the volume output of the receiver. Of course, this system becomes effective only when the received signal is of sufficient intensity to cause grid current to flow in the detector circuit, and does not respond below these values.

A Symposium on Receiver Sensitivity

(Continued from page 37)

put, of the order of 30-40 kilocycles band width at 1000 times signal as the minimum requirement.

"The maximum requirement without special band pass characteristics, is that shown by some of the modern superheterodynes, which is, roughly,

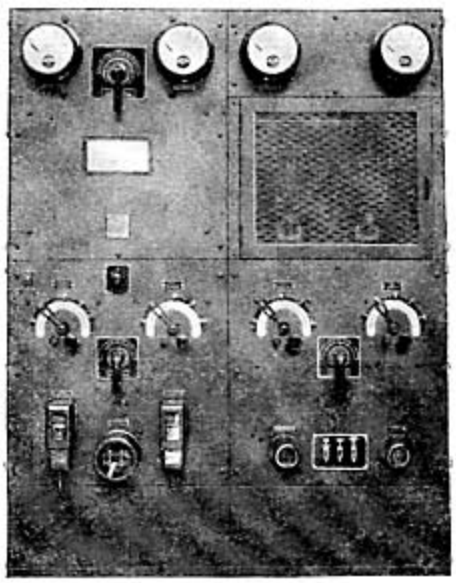

Fig. 95. This is a 2 kilowatt control station transmitter for intermediate frequency telephone and telegraph service

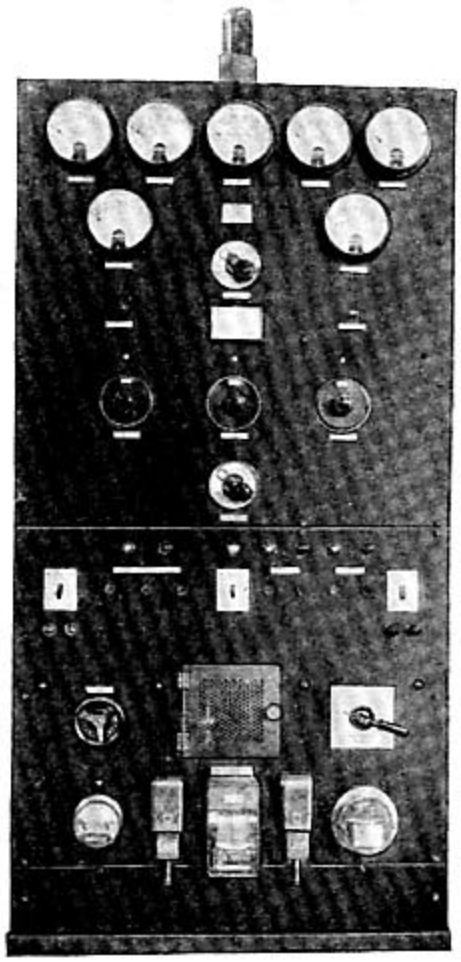

Fig. 93. Power amplifier unit with a frequency range from 3,000 to 21,400 kilocycles

20 kilocycles band width at 1000 times signal.

"In conclusion, I might say, that in my experience, which covers some field surveys, the average noise level of the high frequency end of the broadcast band was found to be between five and twenty-five microvolts, which is the basis for the above figures."

B. B. MINNIUM

Chief Engineer Stewart-Warner Corp.

"THE question as to the maximum allowable sensitivity in a radio receiver is obviously not a simple one, since it involves a number of variables—some of them in the receiver itself, and others external. The problem is in many ways analogous to the question of what maximum speed should be built into an automobile. When an automobile is run over a rough road, or in heavy traffic, common sense dictates that its speed should be decreased over that which would be comfortable and safe on a smooth vacant highway. Similarly, when a radio receiver is operated in a region of high noise level, its sensitivity, for enjoyable entertainment, must be reduced to the point where the noise is unobjectionable.

"However, in view of the erroneous impression which seems to exist in the minds of some, it should be understood at the outset that this lower operating sensitivity, made necessary by certain external operating conditions, has nothing to do with the maximum possible sensitivity of the receiver. Stated in another way, if receiver 'A' has ten times the maximum sensitivity of receiver 'B,' and if they have exactly similar audio transmission characteristics, they will give equal noise outputs when both are adjusted to the same sensitivity. (We assume, of course, that 'line pick-up,' fluctuation noise, and other disturbances within the receiver are of the same magnitude.) This is in direct contradiction to the popular belief that a receiver is noisy because it has high *maximum* sensitivity.

"When road conditions are ideal, the car having highest top speed will out-perform one of lower top speed. Similarly, when the noise level is very low, receiver 'A' mentioned above will out-perform receiver 'B.' Therefore, we must conclude that a receiver of high maximum sensitivity can *equal* the performance of a receiver of lower maximum sensitivity under *all* conditions; and, under some conditions, it can *out-perform* it.

"In addition to the condition (i. e.,

(Continued on page 82)

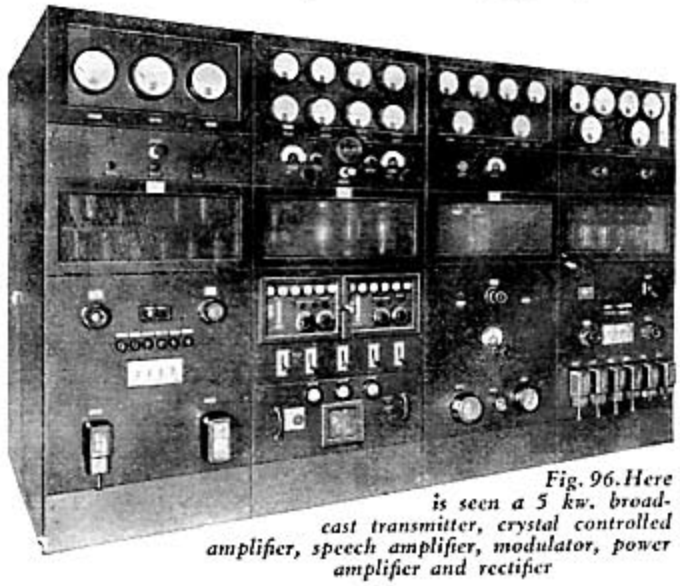

Fig. 96. Here is seen a 5 kw. broadcast transmitter, crystal controlled amplifier, speech amplifier, modulator, power amplifier and rectifier