High Power Frequency Modulation

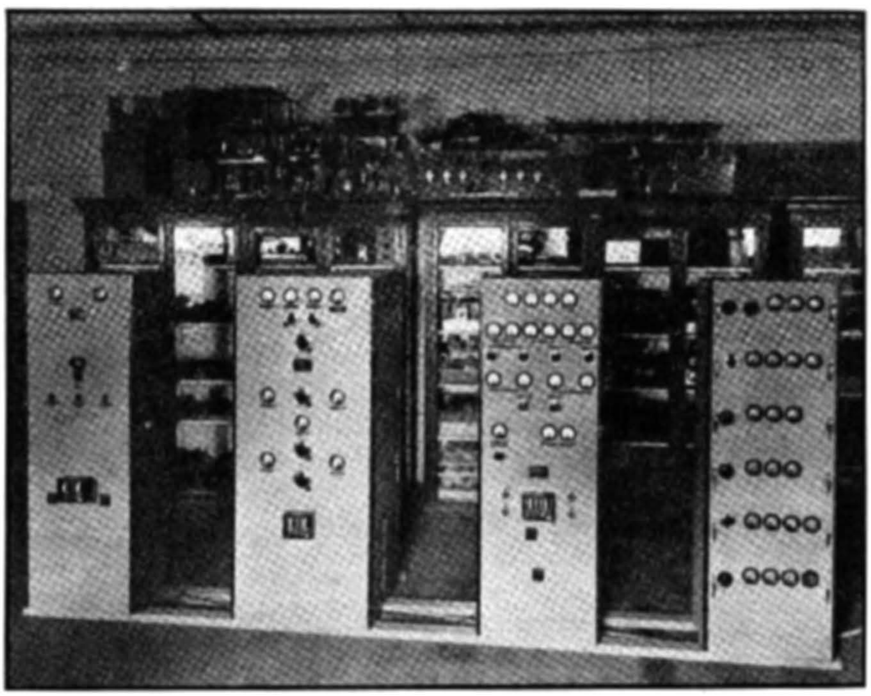
Major E. H. Armstrong applies for license for 40-kilowatt frequency-modulated transmitter to operate in vicinity of 40 megacycles. Tests on 2½ meters indicate noise-voltage reduction of 20 to 50 times

SINCE the announcement several months ago of a successful system of frequency modulation by Major E. H. Armstrong, and the subsequent demonstration of its noise-reduction capabilities, a considerable amount of testing and development has been undertaken by its inventor toward the ultimate goal of commercial operation. On the 30th of April it was announced to the Editors that this development program had progressed to the point where really high power transmissions were not only possible, but advisable in order to demonstrate the extreme range of the frequency modulated signals. Accordingly Major Armstrong has applied to the Federal Communications Commission for permission to operate under license a forty-kilowatt frequency-modulated transmitter. The frequency of operation applied for is above 40 mc., and the band-width required for the full swing of the signals is 200 kilocycles.

All of the apparatus of the transmitter is now in readiness, with the exception of a high-power rectifier of conventional design, for supplying the plate voltage for the final amplifier, which will be ready in July. The master oscillator frequency (see *Electronics*, November 1935, page 17 for a complete description of the transmitter principle) is 200 kc. The voice frequencies are mixed with the 200 kc. output through a balanced modulator and side-band amplifier; the two are then multiplied at low level from 200 kc. to approximately 16,000 kc. In this frequency multiplication process, the necessary wide frequency swing is attained. A further stage then triples the frequency to approximately 48 mc. (the exact central frequency being adjustable according to the frequency assignment). The output of this tripler is approximately one kilowatt. Two additional stages of amplification follow the one kilowatt level, but this amplification is completely linear and involves no frequency changes of any sort. The final stage (type AW-200 tube) supplies 40 kw. to the antenna.

The receiver used in the tests contains a total of 21 tubes, including four acorn pentode tubes for the 2½ meter r-f and heterodyne circuits. The bulk of the receiver is composed of i-f amplifiers and limiters, 12 tubes in all, followed by the double-detector conversion stage and the audio output.

Although the noise-reducing ability of the f-m system is by now well accepted, if any additional proof was necessary it was given in a demonstration witnessed by the Editors, in which station W2AG, in Yonkers, N. Y., eleven miles air-line from the receiving apparatus, transmitted 2½ meter f-m signals, with an antenna power of approximately 350 watts. The transmitter had provision also for transmitting the same program by amplitude modulation, on the same frequency with equivalent power (corresponding to half the carrier power of the f-m signal, whose amplitude does not vary). The program was switched back and forth from f-m to a-m transmission. The noise was then balanced by ear in a potentiometer circuit; the setting of the potentiometer showed that equivalent noise was produced in the f-m system only when the over-all gain was approximately fifty times as great as that of the a-m receiver, giving a power ratio of 2500 to 1. According to Major Armstrong, this is probably the upper limit of improvement, especially under conditions of high ignition interference, but noise voltage reductions of from 20 to 30 occur under any practical condition.



The exciter stages (up to 1 kw. level) of the new f-m transmitter, which will drive the final stage to 40 kw. output. The original f-m equipment may be seen on the shelf above and behind the new units