Design and construction of an experimental radio transmitter for Montana State College
by Robert Bertrand Edwards

A THESIS Submitted to the Graduate Committee in partial fulfillment of the requirements for the Degree of Master of Science in Electrical Engineering
Montana State University

Abstract:
The problem set in this thesis is the design and construction of a radio transmitter for Montana State College. The transmitter complies with the Federal Radio Commission's regulations, and is suitable for general experimental use.

Through this instrument the writer was enabled to experimentally attack the problem of negative regeneration and carrier control.

No given design is copied in the construction of this transmitter.

The circuits and arrangement of equipment are governed by the material available, the appropriations allowed, and the plans for carrier control and negative regeneration.

The design follows only the fundamentals of circuit theory and design practice and involves some original ideas on carrier control.

Part II of the thesis gives a brief description of the transmitter.

The description covers the general characteristics and the special features involved in the operation of the instrument.

Part III gives a discussion of carrier control and negative regeneration and explains the theory and assumptions that governed the. experimental work.

Part IV takes up a discussion of the experimental work and gives the results of the tests that were made on the carrier control and negative regeneration equipment.

DESIGN AND CONSTRUCTION OF AN EXPERIMENTAL RADIO TRANSMITTER FOR MONTANA STATE COLLEGE

by

ROBERT B. EDWARDS

A THESIS

Submitted to the Graduate Committee in
partial fulfillment of the requirements
for the Degree of Master of Science
in Electrical Engineering at
Montana State College

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June, 1933

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PART I

INTRODUCTION

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PART II.

DESCRIPTION OF TRANSMITTER

The transmitter here described, operates under the call letters W7XB and was redesigned and rebuilt primarily for telephone communication. It can be used as a telegraph transmitter, however, if it is desirable. The transmitter is a crystal controlled, 100% modulated, short wave machine and is made to operate from a 110 volt, 60 cycle, single phase, A. C. power supply.

The transmitter was designed principally to operate on 8,655 and 17,310 kilocycles frequency, but can be operated at any of the assigned frequencies if a suitable antenna, crystal, and coils are substituted for the ones now in use.

The normal power output as a telephone transmitter is from 20 to 25 watts at 8,655 kilocycles frequency and from 15 to 20 watts at 17,310 kilocycles frequency. At 100% modulation the instantaneous peak power is four times the above given values. These values are for unmodulated carrier power.

The carrier control, power output of the transmitter is about one fourth of the normal power output.

A complete schematic wiring diagram of the transmitter is shown in Figure 1. A description of the various parts, shown in Figure 1, is given in the appendix. A simplified, schematic, wiring diagram of the carrier control and negative, regeneration circuits is shown in Figure 3. The notation on parts is the same in both Figure 1 and Figure 3.

When the switch, S_1, (Figure 1 or 3) is thrown to the ground position, the carrier wave of the transmitter is "off the air", except when the transmitter is modulated. This provision allows the transmitter to be used as an i. c. w. telegraph transmitter and also serves as a means of carrying on a two way, break in, telephone conversation. When S_1 is thrown to the resistance position, the transmitter emits a continuous carrier, the same as any normal telephone transmitter.

The transformer, TR_2, and the resistance, R_{21}, (Figure 1 or 3) serve as distortion correction devices. When carrier control is used, their use is very necessary, if satisfactory telephone communication is desired. Their use is beneficial in normal telephone modulation, but is not necessary in telegraph communication.

If the primary winding of TR_2 is disconnected, R_{21} can be used for noise suppression and secondary, emission correction. These uses of R_{21} are only necessary when a faulty filter is used in the power supply or a defective tube is used in the power amplifier stage. A more complete discussion of carrier suppression, negative regeneration, noise suppression, and secondary emission correction is taken up in Part III and Part IV.

A study of the modulated amplifier diagram of Figure 3 will disclose that simultaneous screen and plate modulation is used. This method of modulating a screen-grid tube, is the only one that gives good quality at 100% modulation. The writer assisted Mr. R. J. Kircher at the Bell Telephone Laboratories in some experimental work on modulation of screen-grid tubes. The use of the screen-grid potentiometer gave the most satisfactory results.

H. A. Robinson (4) obtained good results using a series screen-grid resistance. The potentiometer method is incorporated in the transmitter, being described, as it is believed to be the superior method.

The use of a screen-grid tube is not necessary in carrier control modulation, but was used in this transmitter because the materials available, and the associated equipment, made its use desirable. This method of modulating a screen-grid tube is not well known, but it is believed that the method will become more popular in the future.