Cathode-compensated amplifier
by Chunilal W Masand

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
Montana State University

Abstract:
This Thesis presents an investigation of cathode compensation as applied to the conventional amplifier. Though not unknown in the field of Radio Engineering, cathode compensation was only applied to D.C. amplifiers1 to overcome what is sometimes known as grid drift, which is an undesirable change in plate current due to uncontrolled conditions in the grid-cathode circuit.

Using Kirchhoff's laws and the equivalent plate circuit theorem, voltage equations are derived for the different circuit loops. From this, the expression for plate current for the amplifier section of the tube is used to give the expression for the gain, i.e. the ratio of output voltage to the input voltage. The condition of stability of the amplifier is derived from the gain expression by equaling to zero, the portion of the expression which varies as a function of the uncontrolled conditions in the grid-cathode circuit.

The conventional amplifier and Hartley oscillator circuits are selected and the compensation is applied to them for investigation. The circuit characteristics, as determined by experimental investigation, are then compared with theoretical calculations which are found to be in good agreement.

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CHUNILAL W. MASAND, B.Sc.(Eng)

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Approved:

R. C. Seibel

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Bozeman, Montana
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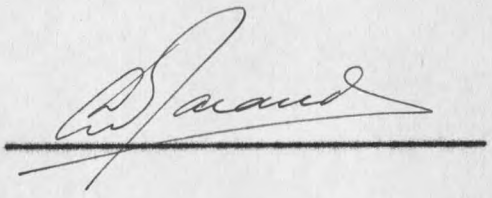

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ABSTRACT

This Thesis presents an investigation of cathode compensation as applied to the conventional amplifier. Though not unknown in the field of Radio Engineering, cathode compensation was only applied to D.C. amplifiers[1] to overcome what is sometimes known as grid drift, which is an undesirable change in plate current due to uncontrolled conditions in the grid-cathode circuit.

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1. Miller, Stewart, E., SENSITIVE D-C AMPLIFIER WITH A.C. OPERATION, Electronics, Vol. 14, Nov. 1941, pp. 27-31.

INTRODUCTION

In literature dealing with amplifiers, several abbreviations are used to conserve both writing space and time. Similarly, throughout this thesis the following abbreviations are used quite often, and they are listed below, in order of their occurrence, with their complete meaning.

g_2	Mutual transconductance of Section #2 of the tube
E_{c_1}	Steady voltage applied to grid of Section #1 of the tube
E_{c_2}	Steady voltage applied to grid of Section #2 of the tube
E_{bb}#1	Supply voltage to the plate of Section #1 of the tube.
E_{bb}#2	Supply voltage to the plate of Section #2 of the tube
A	Amplifier gain
Q-point	Quiescent operating point of the tube

The other accepted abbreviations, such as kc/s for kilocycles per second, as are used in the field of Radio Engineering are assumed to be well known to the reader.

The object of this thesis was to investigate in a thorough manner the effect of cathode compensation as applied to the conventional amplifier and to extend its application to any type of oscillator for the stabilization of its frequency so that any change in the loading of the oscillator does not produce any drift in the generated frequency. There has been

some work done on special application of cathode compensation, but to the author's knowledge no work of any investigational nature has been accomplished or any article written before.

In view of the possible wide application of cathode compensation and in view of some of its inherent merits, a systematic extensive investigation was taken up. This thesis deals with:

1. General theory and operation.

2. Frequency response characteristics and variation of gain with filament voltage, supply voltage, and grid bias voltage.

3. Phase shift characteristics.

4. Comparison of experimental results with theoretical calculations.

5. Stability of an oscillator for various loads.

The data used to plot curves, and for other comparisons, was obtained as a result of laboratory work on the particular circuits shown in Fig. 1, 2, 12 and 13.