

AMPLIFIERS

THE WHY AND HOW OF
GOOD AMPLIFICATION

By

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"SOUND REPRODUCTION"
"PIANOS, PIANISTS AND SONICS"

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*..... but hearing oftentimes
The still, sad music of humanity,
Nor harsh nor grating, though of ample power
To chasten and subdue.*

Wordsworth.



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ABBREVIATIONS AND SYMBOLS

C	= Capacitance or Capacity in <i>Farads</i> (Units).
c/s	= Cycles per second.
δ	= Delta = Small change.
EMF	= Electro-motive force—Units <i>Volts</i> .
E or V	= Voltage—Units <i>Volts</i> .
I or i	= Current—Units <i>Amperes</i> .
K or K Ω	= Kilohms, <i>i.e.</i> ohms \times 1,000, or ohms \times 10 ³ .
Kc/s	= Kilocycles per second, <i>i.e.</i> cycles \times 1,000.
L	= Inductance—Units <i>Henries</i> .
m	= Milli (one-thousandth).
mu or μ	= Micro (one-millionth).
mA	= Milliamps, <i>i.e.</i> $\frac{1}{1,000}$ of an ampere or 1 amp \times 10 ⁻³ .
mH	= Millihenries (Henries \times 10 ⁻³).
mV	= Millivolts, <i>i.e.</i> $\frac{1}{1,000}$ of a volt or 1 volt \times 10 ⁻³ .
M or M Ω	= Megohms, <i>i.e.</i> ohms \times 1,000,000 or ohms \times 10 ⁶ .
Mc/s	= Megacycles per second, <i>i.e.</i> cycles \times 1,000,000.
μ A	= Microamps, <i>i.e.</i> $\frac{1}{1,000,000}$ of an amp or 1 amp \times 10 ⁻⁶ .
μ F or Mfd	= Microfarads (Farads \times 10 ⁻⁶).
μ H	= Microhenries (Henries \times 10 ⁻⁶).
μ V	= Microvolts, <i>i.e.</i> $\frac{1}{1,000,000}$ of a volt or 1 volt \times 10 ⁻⁶ .
Ω	= Ohm.
pF	= Picofarads (Farads \times 10 ⁻¹²).
R or r	= Resistance (Units <i>Ohms</i>).
RMS	= Root mean square.
Z	= Impedance.
ω	= 2 π f.

ABBREVIATIONS applied to VALVE CIRCUITS

μ	= Amplification factor of a valve.
a	= anode, <i>e.g.</i> r_a = Internal resistance, R_a = Anode resistance.
k	= cathode, <i>e.g.</i> R_k = Cathode resistance.
f	= filament, <i>e.g.</i> V_f = Filament volts.
g	= grid, <i>e.g.</i> V_g = Grid voltage.
	g_1 Control Grid.
	g_2 Screen Grid.
	g_3 Suppressor Grid.
h	= heater, <i>e.g.</i> V_h = Heater volts.
R _L	= Load resistance.
g _m	= Mutual conductance of a valve.

INTRODUCTION

When the second edition of *Sound Reproduction* was published, I sent a copy to Major Garner with the usual gesture of generosity, but in reality fishing for the odd word of praise. He replied in appropriate vein, but added a word of regret that the field of Amplification had not been covered and suggested that there was a gap which might with advantage be filled. I replied that in my opinion he was just the man for the job, and we finally came to the conclusion that we should have to put our heads together and produce a joint effort. The result of our work now makes its appearance.

I naturally do not mind admitting that my colleague has done all the donkey work, but I have also had to work very hard in order to preserve some continuity of style—whether good or bad—throughout the book.

As usual, the main problem has been what to leave out. I have been appalled at the vastness of the subject; an enormous amount of the original copy and scores of diagrams have been jettisoned, much to the chagrin of their hard-worked producers, in order to keep the volume down to a reasonable size and price.

I must acknowledge help from many directions. This is the fourth time that Mr. F. Beaumont, Chief Engineer of Ambassador Radio, Brighthouse, has acted as my technical sub-editor; as he has succeeded in keeping me out of serious trouble, he *must* be good. Major Garner joins me in acknowledging the immense value of the corrections and suggestions which he has contributed to the present work. It is also the fourth occasion on which my old friend F. Keir Dawson has designed the cover and done the drawings. In this case, some of the diagrams have involved the burning of much midnight oil. I think all readers will agree on their general excellence—particularly for an amateur.

Mr. E. M. Price, M.Sc.Tech., has again helped in technical and oscillographic tests, and for final commendation there is my Secretary, Miss E. Isles, who not only transcribes illegible manuscripts but corrects mistakes in grammar at the same time.

G. A. BRIGGS

FOREWORD

This book is intended to supply the missing link between the previous volumes, *Loudspeakers* and *Sound Reproduction*, which described in considerable detail the equipment used before and after the process of amplification. It should furnish ideas for the experimenter so that he may obtain the best result from the amplifier and associated circuits, with his available resources. For those who are blessed with the necessary cash, there are several well-known designs for home construction of amplifiers which give superb results, and commercial amplifiers are now available which are a delight to use and hear. Such readers may well be able to assess and appreciate their equipment all the better after a perusal of this book. Many of us (the writer included) have to think twice before we buy what we want, and if we achieve good results by judicious and economic buying, we are all the more pleased, and value our masterpiece so much more highly. It is hoped, therefore, that the man who "makes one of his own", who is not content to put in 40K and 0.5 mfd just because it says so in the book but wants to know why he does it, will find most of the answers in the following pages.

No doubt this book will be considered by some to insult their intelligence by explaining a circuit in too great detail in words with too few syllables, whereas others may complain that there are too many technicalities; yet it is felt that a good foundation and appreciation of basic principles is necessary to build the finished article. Professional engineers may boggle at some of our short cuts to arrive at a general conclusion, but we plead that the means justify the end—that of giving some guidance and pleasure to the many amateurs striving to build or buy that elusive thing, the perfect reproducer, and to obtain therefrom the maximum performance.

H. H. GARNER