Design of Audio-Frequency Input and Intervalve Transformers*

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1. Introduction

IT is not intended in the present article to discuss all the theoretical considerations governing the performance of audio-frequency input and intervalve transformers. Several writers, notably Messrs. Willans[1], Koehler[2], and the late Dr. Dye[3] have already dealt with this aspect of the subject fairly conclusively.

Rather is it intended to deal with a method of practical design which reduces the labour of calculations to a minimum and takes account of the introduction of modern core materials. Furthermore, although much of the matter dealt with is applicable to the design of transformers carrying direct current, no attempt is made to consider specifically the design of this class of transformer.

For a given performance the problems which beset the audio-frequency transformer designer are, first, the calculation of the constants of the transformer which are necessary to fulfil the requirements of performance and, secondly, the determination of the method by which these constants are to be realised in practice.

In general the design of an audio-frequency transformer may be approached from two angles, namely, from the point of view of the performance at the lower frequencies, that is, from, say, 50 to 1,000 c/s, and from the standpoint of the operation over the upper audio-frequency band of 1 to about 10 kc/s; it remains for the designer to correlate the two designs which satisfy the conditions of performance in the two frequency bands.

In the lower frequency band some of the constants have a negligible effect upon the operation of the transformer, and can therefore be neglected. Notable amongst these are, of course, the leakage inductance, winding and mutual capacitances; whereas at the higher frequencies it is well known that these constants are all important.

2. The Performance over the Upper Frequency Band

Let the performance of an input or intervalve transformer over the higher frequency band be considered first.

It is generally recognised that for all practical purposes the transformer may be replaced at these frequencies by the circuit shown in Fig. 1. In this figure E represents the source e.m.f., R_1—the source impedance plus the transformer copper losses, both E and R_1 being transferred to the secondary, L_{LS} the secondary leakage inductance, C—the effective secondary capacitance of the transformer plus the input capacitance of the following valve, R_2—the secondary load resistance including the core and dielectric losses and V_2—the voltage developed across the secondary terminals.

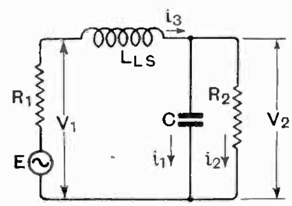

Fig. 1.

The capacitance C may also include a condenser to represent the effect of mutual capacitance, although the present tendency is to incorporate electrostatic screening between the primary and secondary windings,

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1 "Low Frequency Intervalve Transformers." P. W. Willans, M.A. *Journ.* (*Wireless Section*), *I.E.E.*, September, 1926.

2 "The Design of Transformers for Audio-frequency Amplifiers with Pre-assigned Characteristics." C. Koehler. *Proc. Inst. Rad. Eng.*, December, 1928.

3 "The Performance and Properties of Telephonic Frequency Intervalve Transformers." D. W. Dye. *Wireless Engineer*, Vol. I, page 691 *et seq.*