LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

F.M. Receiver Design

Mr. RUSSELL's letter (your February issue) contains two criticisms: (i) on the choice of 10.7 Mc/s as an intermediate frequency for f.m. receivers and (ii) on the "cloak and dagger" attitude of manufacturers' organisations.

Taking the former, there is no secret about the choice of 10.7 Mc/s. Our Association adopted it as a standard intermediate frequency (with the G.P.O.'s knowledge and approval) because, first, investigation showed it to be the most satisfactory taking into account all technical and economic factors known to industry at the time the f.m. sound broadcasting service began; second, the early adoption of a standard was an essential feature of planning the broadcasting services (even if such a standard does not eliminate interference, at least it helps to minimise it). Mr. Russell unfortunately only selects one element of the interference aspect; i.e., that of possible interference between f.m. receiver oscillators and Band III reception and avoids making any constructive proposals on even this single issue. That we have chosen 10.7 Mc/s does not mean this will stay "for ever and a day". Work on the subject of intermediate frequencies and standards of many kinds affecting the radio industry is a continuous process which we undertake in co-operation with many other organisations.

The derogatory remarks about manufacturing organisations scarcely call for comment as they bear no relationship to the principal point in Mr. Russell's letter. We must, however, point out that his particular statement about the proportion of "confidential" documents is incorrect, at least in application to B.R.E.M.A. We reserve "confidential" as a classification mainly for information confided to this Association by outside organisations and the number of documents bearing it is relatively small. We would add that, although B.R.E.M.A.'s prime function is to serve the radio manufacturers who created it, in practice the Association goes a great deal further; the results of much of its work are made known to non-member manufacturers and to many other interested national and international organisations. In addition, a great deal of our work forms the basis of British standards which are, of course, public. We also endeavour, whenever possible, to keep the technical press informed of work in progress.

Secretary, S. E. ALLCHURCH,
British Radio Manufacturers' Association.

Electrostatic Loudspeakers

IN the article on "Distortion in Electrostatic Loudspeakers" (February issue) it is claimed that distortion-free operation is obtained only if the two sides of the diaphragm are insulated from each other and fed through independent resistances. This state of affairs is shown in Fig. (4) of the article with the statement that the charges on each side of the diaphragm will remain constant and that the voltages V_1 and V_2 will adjust themselves to satisfy this condition.

Now any potential difference between V_1 and V_2 will give rise to charges on the insides of the conducting surfaces. Since the two inside charges are opposite in sign, there will be a redistribution of charges resulting in unequal charges on the outside surfaces. It can be shown that if the capacitance through the diaphragm is large compared to the capacitance of C_1 and C_2 then the conditions will approach those of a single conducting diaphragm fed through a high resistance, Fig. (3).

The force on the diaphragm *due to the signal* is completely independent of the position of the diaphragm both for the case of constant total charge and for a theoretical case of constant independent charges.

The author points out that if, with constant total charge, the diaphragm is moved mechanically then a force appears on the diaphragm. He states this force is linear with displacement, but is not due to the signal and is therefore a distortion. The force is indeed linear

with displacement and acts away from the central position. This is a negative stiffness. It causes no distortion, but it does of course require the introduction of positive stiffness in order to avoid diaphragm collapse to one or other of the fixed plates.

In spite of the above, a diaphragm conducting along its surface will introduce distortion, but for a different reason. Since the diaphragm requires supporting, there will effectively be forces acting at these supports in the opposite direction to the electrical forces. The diaphragm will not be a truly flat piston and the charge per unit area will not remain constant. The time constant of each small unit area (small compared to support spacing) must be made large for distortionless operation.

P. J. WALKER,

The Acoustical Manufacturing Company,
Huntingdon.

May I draw attention to what I believe to be an incorrect conclusion in the article on "Distortion in Electrostatic Loudspeakers" (February issue)? I refer to Fig. 4 (page 55) where two conducting faces of the diaphragm carry each a constant charge Q. In the formulæ given the field between the layers due to the inequality of their potentials V_1 and V_2 is neglected. This is not warranted.

When the distances between the faces and the fixed electrodes are again $d-x$ and $d+x$ the correct potentials are given by:

$$V_1 = \frac{Q}{\varkappa A}(d-x)\,\frac{d+x+\frac{1}{2}\delta}{d+\frac{1}{2}\delta}$$

$$V = \frac{Q}{\varkappa A}(d+x)\,\frac{d-x+\frac{1}{2}\delta}{d+\frac{1}{2}\delta}$$

where δ is the thickness of the diaphragm.

One concludes that when δ approaches zero the potentials reduce to the value for a single layer with total charge 2Q. This can be easily understood by noting that the infinite capacity between the layers makes V_1 and V_2 equal.

Calculation of the net force on the diaphragm yields:

$$F = \left(\frac{V_1}{d-x} - \frac{V_2}{(d+x)}\right) Q = \frac{Q^2}{\varkappa A}\,\frac{2x}{d+\frac{1}{2}\delta}$$

This formula shows that separation of the charge on the diaphragm into two equal parts still results in a force when the diaphragm is moved away from its equilibrium position. The situation is thus similar to that pictured in Fig. 3 of the article. The separation of the charge according to Fig. 4 has no advantage over the situation shown in Fig. 3.

For constant-charge operation the force is linear in x. In order to maintain stability the diaphragm needs to be stretched. When the suspension is linear the loudspeaker will operate without distortion. This is so because the signal force is exactly proportional to the signal voltage (even when the latter is fed asymmetrically to the fixed electrodes).

Amsterdam. E. DE BOER.