PRIVATE AND CONFIDENTIAL

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The Goodmans 'Maxim' loudspeaker

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D. Maurice

H.D. Harwood, B.Sc.

for Head of Research Department

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SUMMARY

Tests have been carried out on a wide-range loudspeaker of unusually small dimensions marketed by Goodmans Industries under the trade name 'Maxim'. The small size of this loudspeaker has been achieved at some sacrifice of efficiency and of power output capacity at low frequencies; however, given sufficient amplifier power and some degree of electrical equalisation, the performance, judged by the specimen tested, would be adequate for a number of applications in which high sound levels are unnecessary.

1. INTRODUCTION

The 'Maxim' loudspeaker is a two-unit assembly made by Goodmans Industries of Wembley and is claimed to cover a wide frequency range. The external appearance is shown in Fig. 1. For a wide-range loudspeaker the device is very small, the

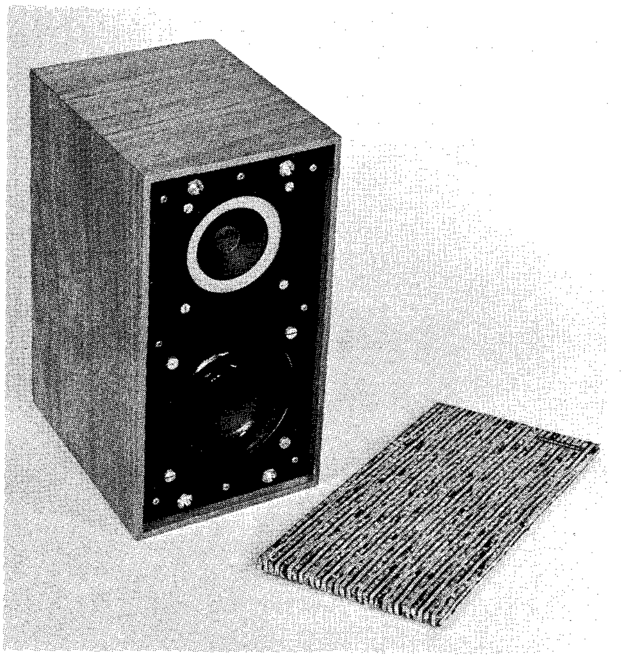

Fig. 1

External view of loudspeaker

outer dimensions being 5½ inches wide × 10½ inches high × 7 inches deep (14 cm × 27 cm × 18 cm); the weight is 8¼ lbs (3·7 kg). The diameter of the low-frequency unit is 4½ inches (11 cm) and of the high frequency unit, 3¼ inches (8 cm). An electrical dividing network of the 12 dB/octave type is provided; this gives an acoustical crossover frequency of 2 kc/s.

The price, to the BBC, is £13. 0s. 6d.

2. FREQUENCY CHARACTERISTICS

The tests were carried out in the larger of the two dead rooms at Kingswood Warren, under conditions simulating free-field radiation at all frequencies above 50 c/s.

Measurements of the frequency characteristics with constant applied voltage were taken at a distance of 4 feet 6 inches (1·37 m) on the axis and at various angles to it. The results are shown in Figs. 2 and 3 for angles in the horizontal and vertical planes respectively.

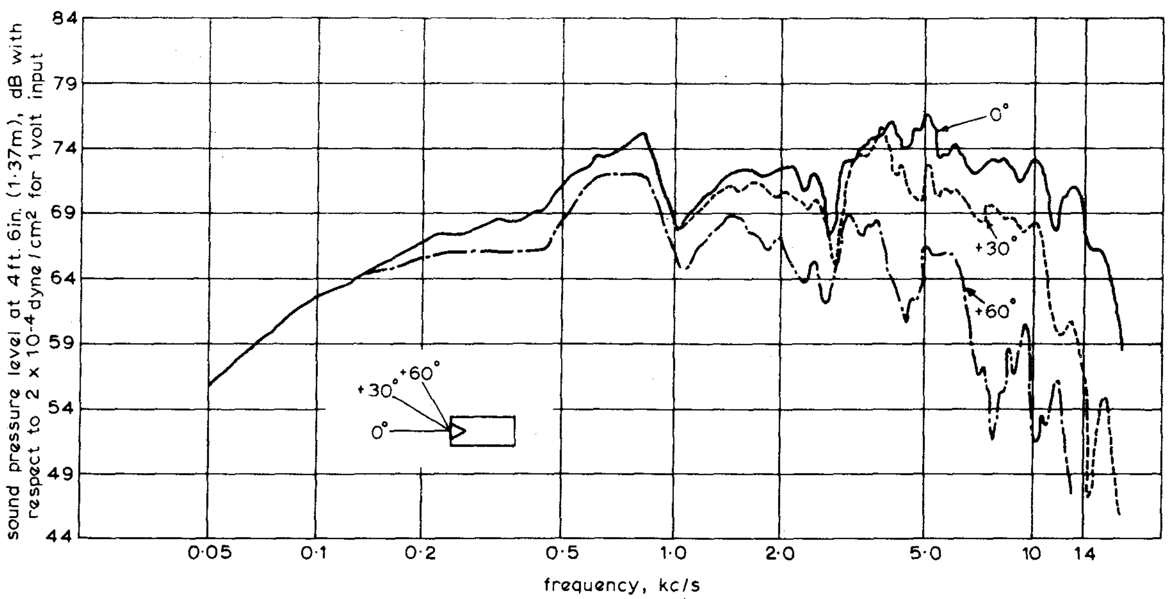

Fig. 2 - Frequency characteristics at 0°, 30° and 60° to the axis in horizontal plane

It will be seen that the axial frequency characteristic extends to high frequencies and in this region is fairly smooth for a low-priced loudspeaker; in addition the angular distribution is fairly wide. The response begins to fall below 500 c/s, but there is no well-defined low-frequency cut-off, so that electrical equalisation could be effected by simple circuits.

The large irregularity which is evident in the frequency characteristic around 1 kc/s was found to be associated with the low-frequency unit. To see if

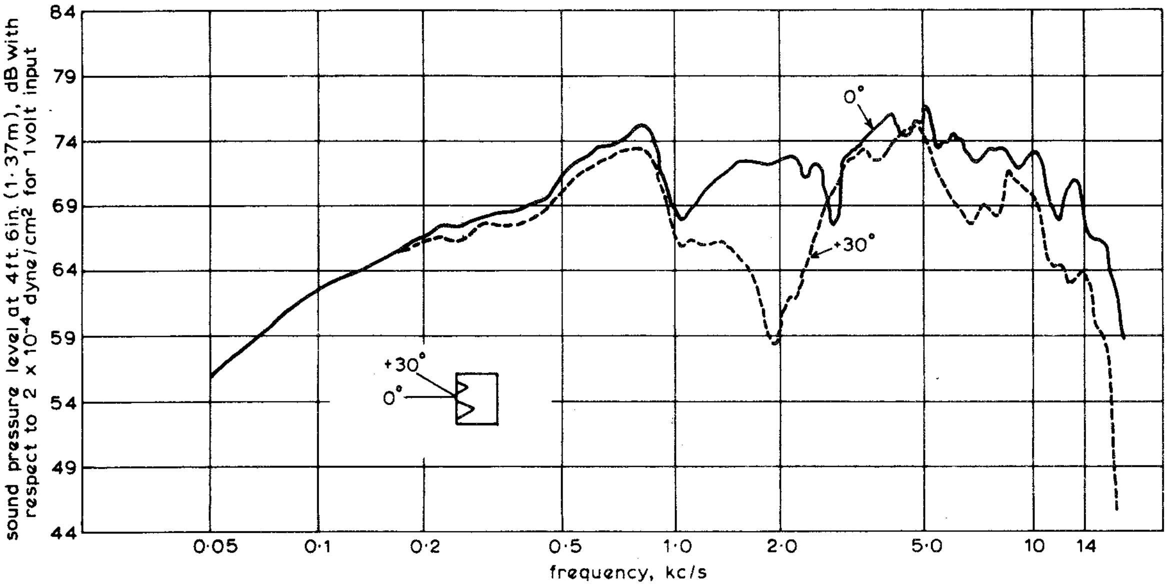

Fig. 3 - Frequency characteristics at 0° and +30° to the axis in vertical plane

the sample tested is representative in this respect, six more specimens of the low-frequency unit were obtained and tested in a separate cabinet. Fig. 4 shows the spread in axial response in the frequency region 200 c/s to 2 kc/s, from which it may be deduced that the curves shown in Figs. 2 and 3 are somewhat smoother than the average.

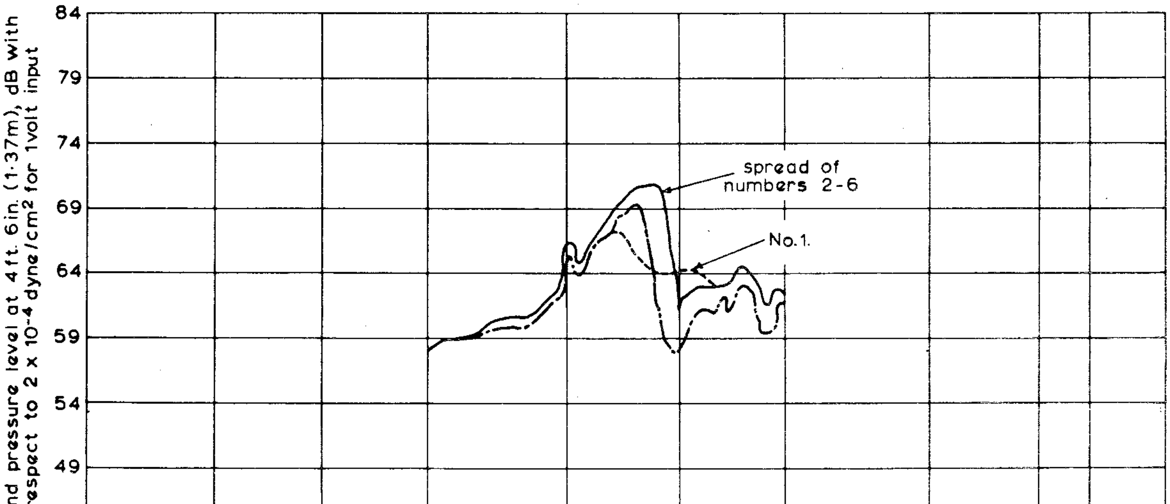

Fig. 4 - Spread in axial response of 6 low frequency units

Fig. 5 shows the modulus of the impedance of the loudspeaker from which it will be seen that the fundamental resonance of the system is at 70 c/s.

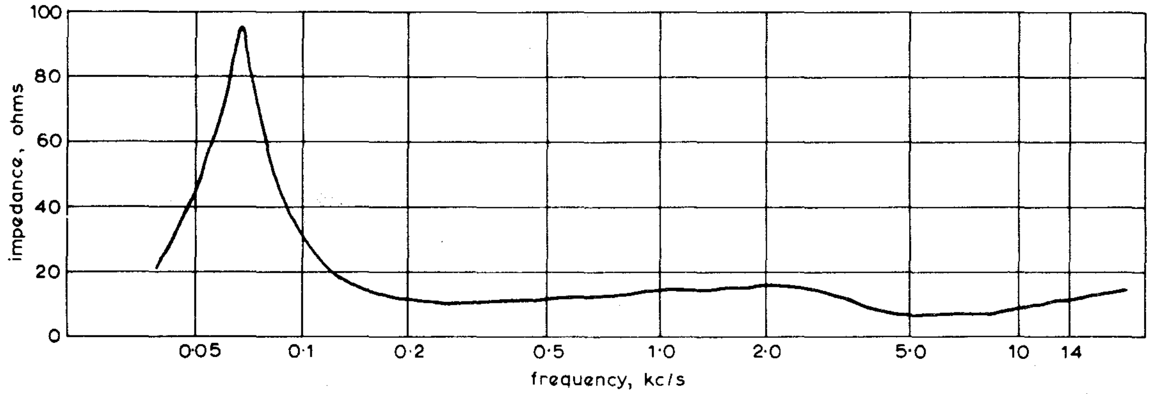

Fig. 5 - Modulus of impedance

3. EFFICIENCY

The efficiency of the 'Maxim' loudspeaker is low; in the frequency range 500 c/s to 3 kc/s the sound pressure produced at a distance of 4 feet 6 inches (1·37 m) on the axis is only 72 dB with reference to 2×10^{-4} dyne/cm^2 for 1 volt across the nominal 12 ohm input impedance. Since small loudspeakers are of particular interest for O.B. work, it is appropriate to use as a standard for comparison the O.B. loudspeaker type LS3/1. Fig. 6 shows, as a function of frequency, the sound pressure produced on the axis at 4 feet 6 inches (*a*) for the 'Maxim' loudspeaker tested and (*b*) for a typical type LS3/1 loudspeaker provided with an ideal transformer to reduce its nominal impedance from 25 ohms to 12 ohms. It will be seen that from 600 c/s upwards, the sound level from the 'Maxim' loudspeaker is on the average about 5 dB less than that from the type LS3/1 for the same electrical input; at lower frequencies the divergence increases, reaching about 15 dB at 100 c/s. The low efficiency of the 'Maxim' loudspeaker arises in part from the large diaphragm movement necessary to give adequate sound output from a small radiating area; to allow of a large excursion without introducing distortion through non-uniformity of the magnetic field, the speech coil has been made so long that an appreciable part of the winding lies outside the field.

4. MAXIMUM SOUND OUTPUT

The power-handling capacity of the 'Maxim' loudspeaker is rated by the manufacturer at 8 watts; the specimen tested is capable of accepting the full un-

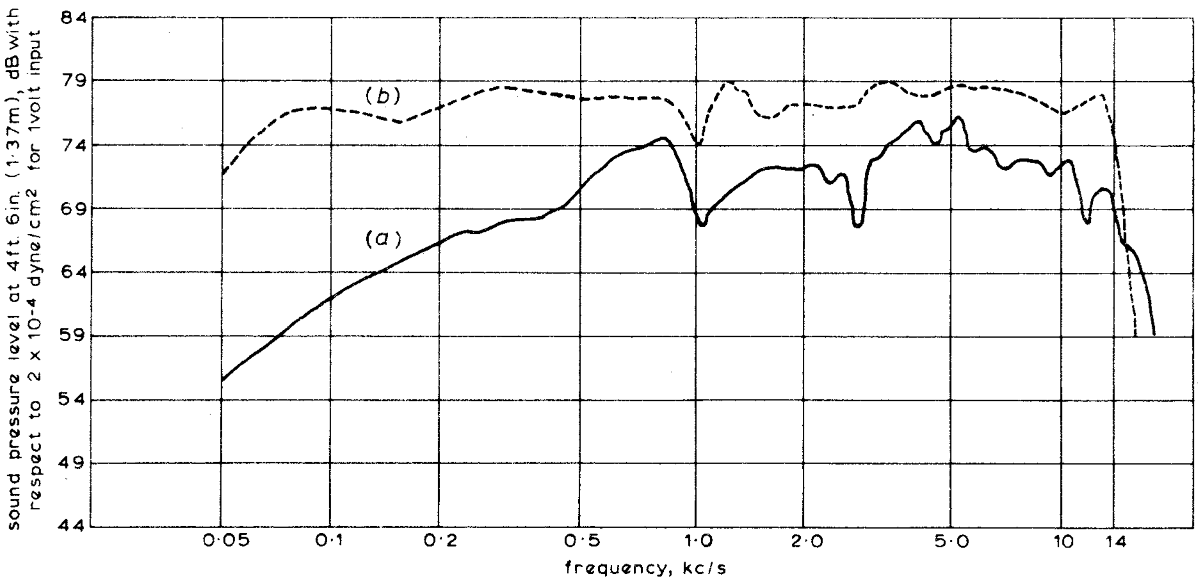

Fig. 6 - Axial frequency response characteristics

(*a*) 'Maxim' loudspeaker
(*b*) LS3/1 loudspeaker with 12Ω/ 25Ω transformer

distorted output from an 8 watt amplifier on steady tone at frequencies down to 100 c/s without obvious non-linear effects and a sound pressure, averaged over the mid-band region 500 c/s to 3 kc/s, of +93 dB with reference to 2×10^{-4} dyne/cm^2 was obtained at 4 feet 6 inches on the axis. The sensitivity of the loudspeaker at 100 c/s is 9 dB below the mean mid-band sensitivity; if, therefore, the low-frequency characteristic were equalised down to 100 c/s by networks ahead of the amplifier, the maximum mid-band sound pressure at 4 feet 6 inches would be limited, assuming equal energy at any one frequency, to +84 dB with reference to 2×10^{-4} dyne/cm^2. At frequencies below 100 c/s, the undistorted sound output obtainable was limited by failure of the loudspeaker diaphragm to execute the required excursion, and the pressure waveform exhibited severe distortion before the full output of the 8 watt amplifier was reached; the maximum undistorted output at 70 c/s was about +78 dB with reference to 2×10^{-4} dyne/cm^2.

For comparison it should be noted that the O.B. loudspeaker type LS3/1, used in conjunction with its normal amplifier of 15 watts rating, will produce at 4 feet 6 inches sound pressures of +100 dB with reference to 2×10^{-4} dyne/cm^2 at single frequencies down to 70 c/s without obvious overload.

In the foregoing it is assumed that the 'Maxim' loudspeaker is required to reproduce all types of programme; it is then necessary, in order to allow for the worst cases, to postulate equal signal energy at all frequencies down to 100 c/s. With many programme items, conditions will be more favourable and the maximum sound output obtainable with bass equalisation will be higher than that estimated above; in particular, if speech only is to be reproduced, bass equalisation extending to 100 c/s is unlikely to reduce appreciably the overload point of the system.

5. SUBJECTIVE ASSESSMENT

The loudspeaker was listened to on a variety of programme material.

The subjective assessment was consistent with the results given in Sections 2, 3 and 4; with some electrical equalisation at low frequencies, reasonably well-balanced reproduction was obtained above 70 c/s. At domestic listening levels, no non-linear effects were evident, but attempts to produce the highest sound levels sometimes demanded of O.B. monitoring loudspeakers led to distortion on loud passages.

6. PRODUCTION VARIATION

In the 'Maxim' loudspeaker, no provision is made for adjusting the relative level of signal applied to the low- and high-frequency units; production variations in the sensitivities of these two units can therefore affect the overall frequency characteristics of the system. The manufacturers, in a private communication, stated that the spread in axial frequency characteristic between ten production specimens had been found to be ± 1 dB from 40 c/s to 600 c/s and ± 2 dB from 600 c/s to 10 kc/s; however, in view of the difficulty experienced in the past in inducing manufacturers of more expensive loudspeakers to conform to agreed tolerances, the prospects of maintaining this degree of consistency in a low-priced article are somewhat doubtful.

7. CONCLUSIONS

The small size of the Goodmans 'Maxim' loudspeaker has been achieved at some sacrifice of efficiency and of power output capacity at low frequencies. However, with appropriate electrical equalisation, the frequency range and sound output should be adequate for a number of applications in which the normal requirements imposed on a monitoring loudspeaker can be relaxed.

If, however, any widespread use of this loudspeaker in the Corporation is contemplated, it will be necessary to decide whether to accept any variations in performance that the normal commercial tolerances may allow or whether to impose closer limits which would involve a process of selection. In the latter case, it would be advisable, before proceeding, to carry out tests on a sufficient number of production samples to enable the likely proportion of rejects to be predicted.

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