RESEARCH DEPARTMENT

The Labor Tube Microphone Type MD 3 Studio

Report No. M.023

Serial No. 1954/32

THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION

RESEARCH DEPARTMENT

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TYPE MD 3 STUDIO

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SUMMARY.

The Labor type MD 3 Studio microphone is a moving-coil instrument in which the sound is transmitted to the diaphragm through a telescopic tube several feet long; the microphone is used occasionally for special purposes in television transmissions. Measurements of frequency response, sensitivity, impedance and susceptibility to interference from alternating magnetic fields have been made on a single specimen and the variation in characteristics with extension of the telescopic tube has been investigated. The microphone has a relatively low sensitivity and is suitable for use only at close range.

1. INTRODUCTION.

The Labor MD 3 Studio* microphone is a pressure-operated moving-coil instrument manufactured by the firm Labor W. Feingerätebau of Hanover. The construction of the microphone is unusual in that the moving-coil unit is housed in the base of the stand, sound pressures being transmitted to the diaphragm through a vertical tube a few feet long. This arrangement, the purpose of which is to reduce the size of the sound inlet and so to minimise directional effects, is not entirely novel; a similar microphone employing a pressure ribbon element was produced[1] in 1936 and a smaller version of this appeared in America[2] after the war. The application of the principle to moving-coil microphones was described in the literature in 1950[3]. The test results given in this report relate to a single sample of the MD 3 Studio microphone which has been in occasional use in television transmissions since September 1953. The price of the microphone in this country is £19.16s.0d.

2. DESCRIPTION OF MICROPHONE.

Fig. 1(a) shows the dimensions and appearance of the microphone. The position of the coil and magnet assembly A is indicated by dotted lines. The telescopic tube through which the sound is transmitted to the diaphragm consists of an outer section B and inner section C. At the upper end of section C there is a funnel-shaped mouth-piece D within which can be seen some gauze or similar material presumably intended to raise the acoustic impedance at this point to give an approximate match to the impedance of the tube.

* It should be noted that the "MD 3 Studio" is one of two models similar in essentials but differing in details of construction and in performance. The other model is known as "MD 3".

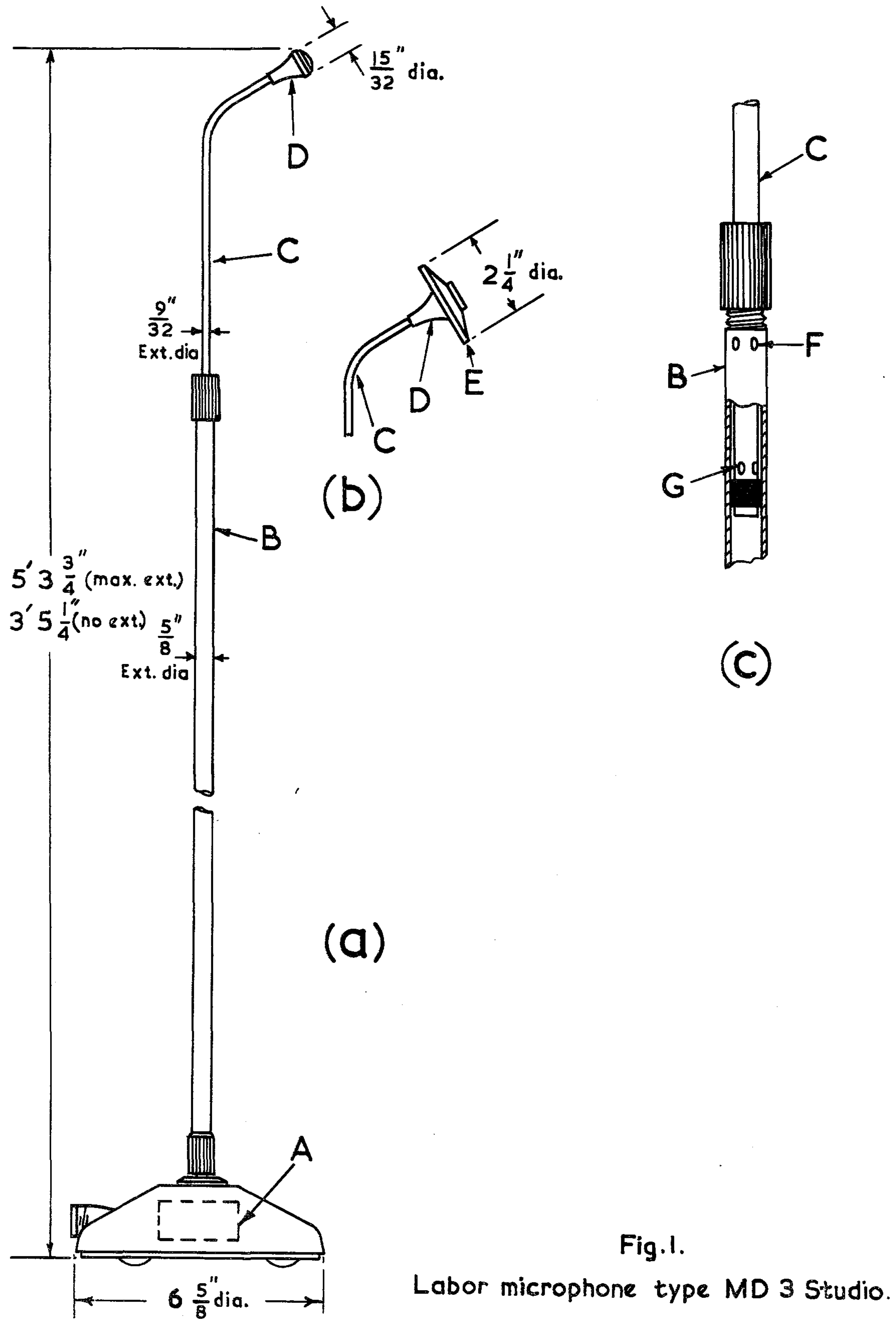

Fig. 1.
Labor microphone type MD 3 Studio.

Although the primary object of the design is to give an omnidirectional sound pick-up, provision is made for producing directional effects at high frequencies by attaching a circular baffle E of transparent plastic in the position shown in Fig. 1(b).

An air leak is provided at the junction of the two sections of the telescopic tube to prevent damage to the diaphragm by large changes in the pressure of the enclosed air when the inner section is suddenly raised or lowered; Fig. 1(c) shows the details of this arrangement. The interior of the telescopic tube is connected with the outside air through the holes F and G, and through the annular space between the inner and outer sections. It will be shown later that the presence of this air path can modify the frequency characteristics of the microphone.

A second air leak is provided in the base of the instrument between the lower end of the pick-up tube and the space at the back of the diaphragm. This leak has a very high acoustic impedance and is presumably intended to allow for slow changes in atmospheric pressure.

The weight of the microphone without the connecting cable is 3·2 lb (1·5 Kg).

3. METHOD OF MEASUREMENT.

The microphone characteristics were measured in the dead room by the method of substitution, using a calibrated pressure microphone. The accuracy of comparison with the standard is ± ½ dB, and the calibration of the standard itself is known to the same degree of accuracy.

4. FREQUENCY CHARACTERISTICS.

4.1. General.

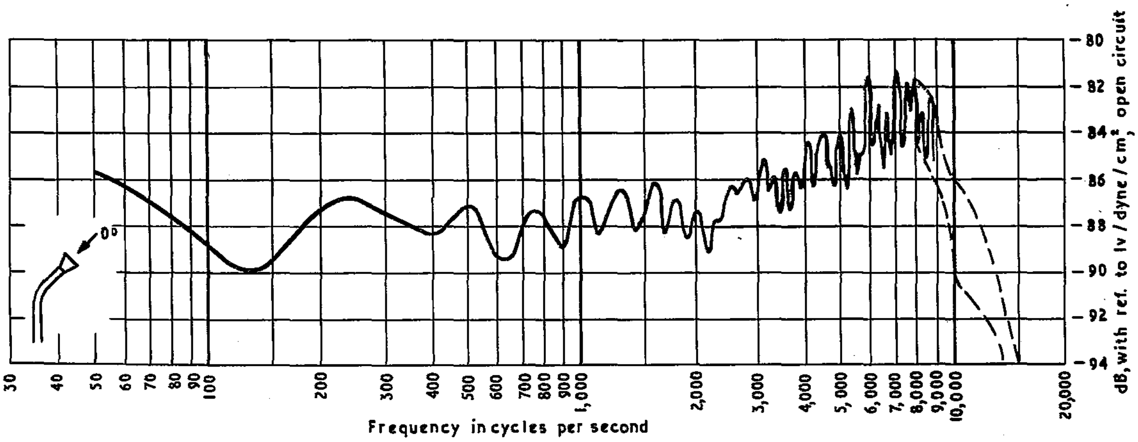

Fig.2 Axial frequency response of microphone without baffle. Height adjusted to 3'-5¼"

Fig. 2 shows the axial frequency response of the microphone with the telescopic tube fully closed, giving a height of 3 ft 5¼ in. (1·05 m). It will be seen that the response curve is very ragged; this is the result of imperfect termination of the microphone tubes causing multiple reflections and characteristic irregularities in the response curves. These irregularities become more closely spaced as the frequency is increased; in some cases it was impracticable to draw the whole of the curve in detail but dotted lines have been used to indicate the spread between the maxima and minima.

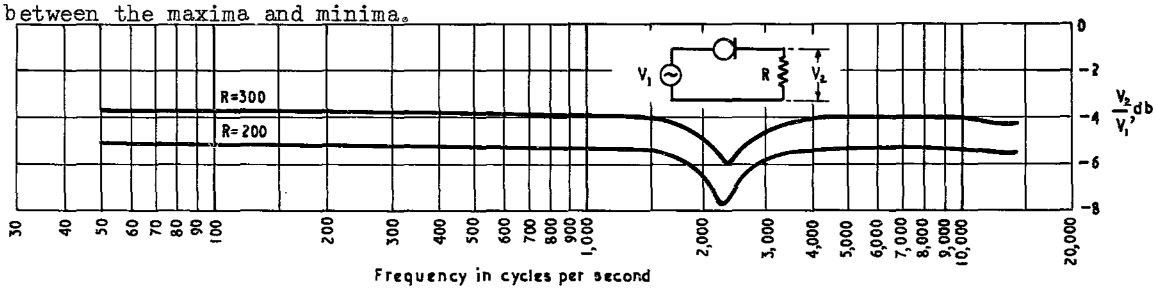

Fig. 3 Relationship between open circuit voltage and voltage across resistive load.

Fig. 3 shows the effect on the frequency response of applying resistive loads comparable with the microphone impedance. Apart from the dip in the 2300 c/s region the load has little effect on the frequency response, from which it would appear that the acoustic termination of the tube is not dependent on the electrical loading of the output. From the publication[3] referred to earlier, it appears that some form of acoustic damping may be incorporated in the moving-coil unit, but it was not possible without dismantling the microphone to obtain information on this point.

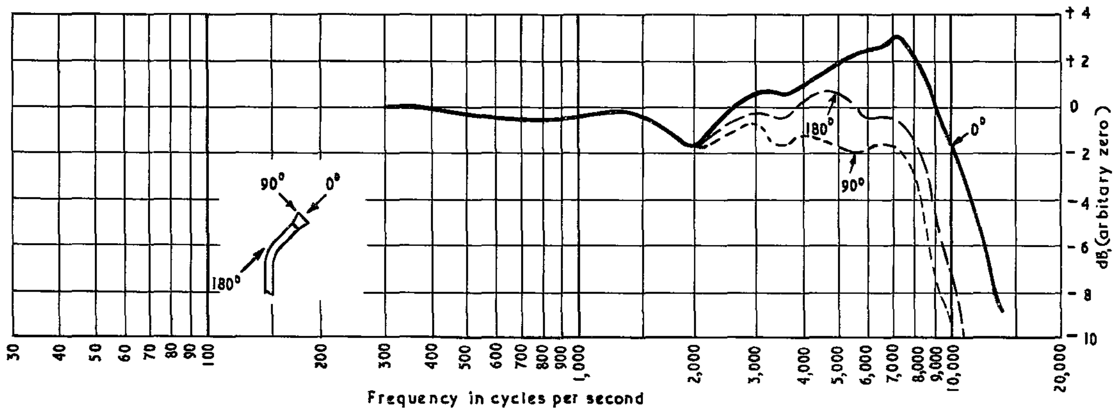

Fig. 4 Frequency response of microphone without baffle for various angles of incidence. Height adjusted to 4'-4" (smoothed curves)

Fig. 4 shows the variation of the frequency response with the angle of incidence of sound; to indicate more clearly the differences in the characteristics, smoothed curves have been drawn. It will be seen that the falling off in high-frequency response at oblique angles of incidence is less pronounced than in most moving-coil microphones.

4.2. Effect of Tube Extension.

Figs. 5 and 6 show the axial response of the microphone with the tube extended to give overall heights of 4 ft 4 in. (1·32 m) and 4 ft 10 in. (1·47 m) respectively. Fig. 7 shows the axial frequency response obtained with the tube extended to 5 ft 2 in. (1·57 m) which is approximately 1¾ in. (4·5 cm) less than the maximum possible height. In this condition the acoustic impedance of the annular

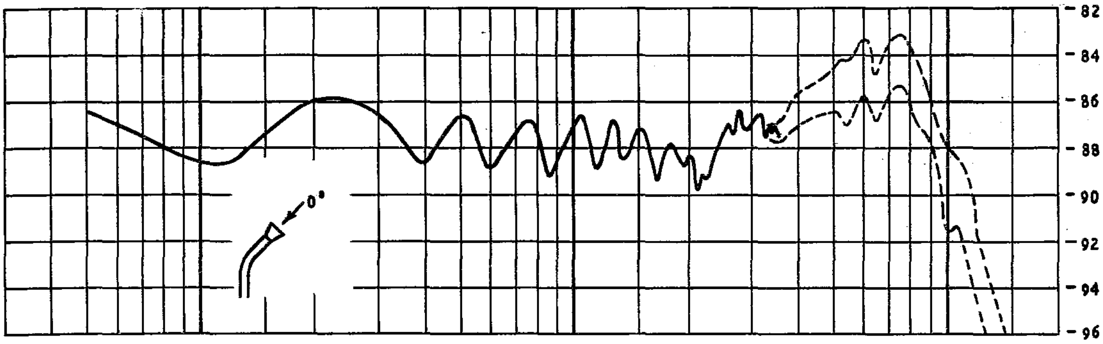

Fig. 5 Axial frequency response of microphone without baffle.
Height adjusted to 4'-4"

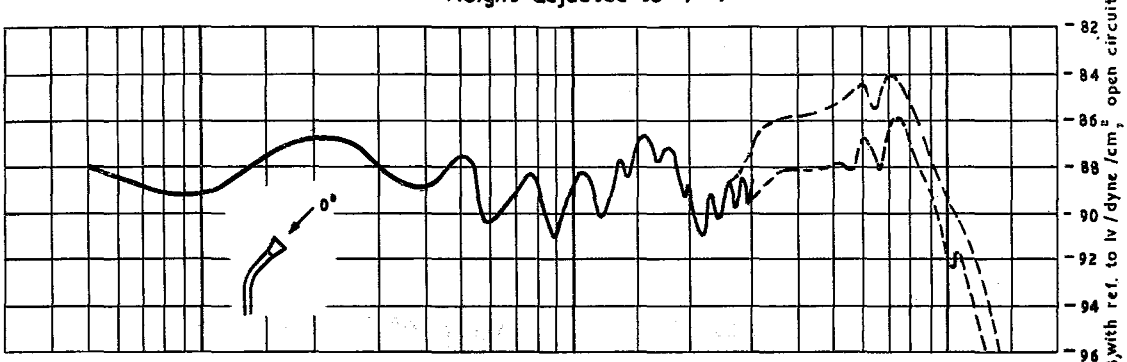

Fig. 6 Axial frequency response of microphone without baffle.
Height adjusted to 4'-10"

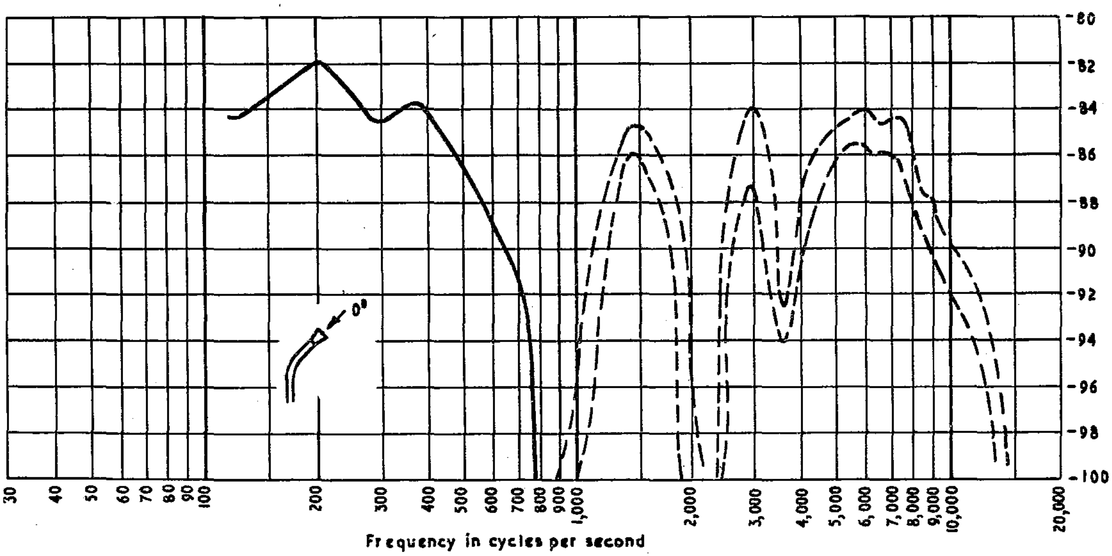

Fig. 7 Axial frequency response of microphone without baffle
Height adjusted to 5'-2"

space between the two sections is relatively low; the amount of sound admitted to the tube through the air leak is then comparable with that entering by the normal route and serious interference takes place. Similar effects are apparent to a small extent even in the curve of Fig. 6, and it is therefore suggested that the height of 4 ft 10 in., which is 5¾ in. (14·5 cm) less than the maximum possible extension, should not be exceeded in service.

4.3. Effect of Baffle.

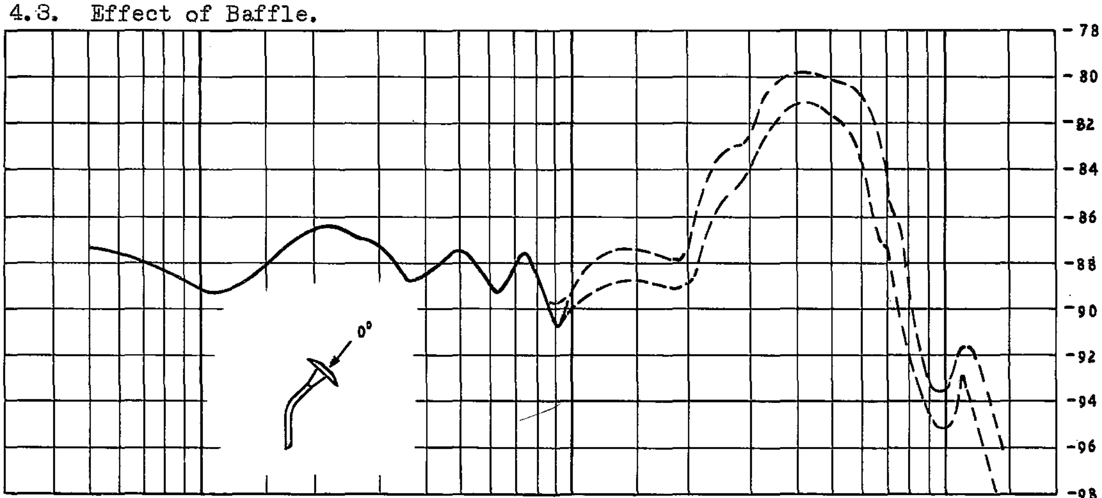

**Fig.8 Axial frequency response of microphone with baffle.
Height adjusted to 4'-4"**

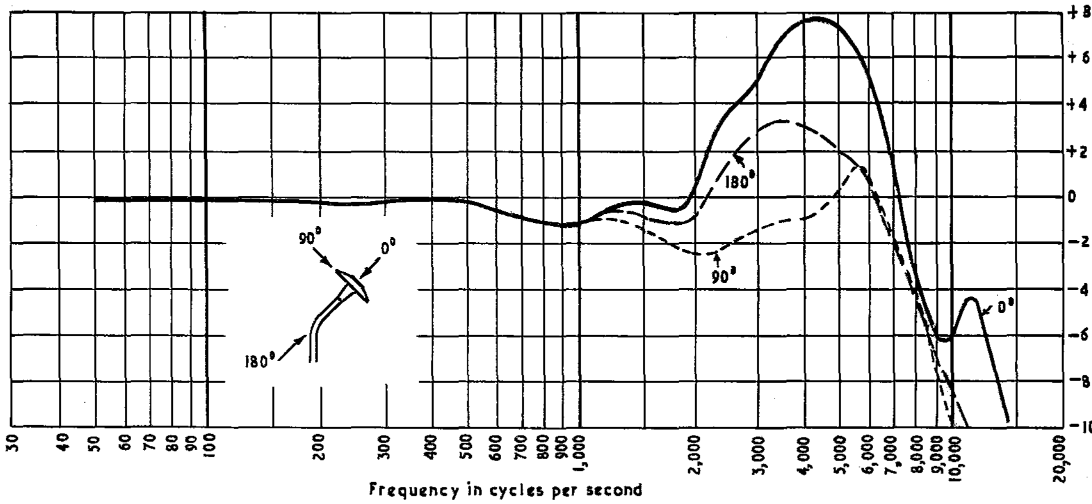

**Fig.9 Frequency response of microphone with baffle for various angles of incidence
Height adjusted to 4'-4"
(smoothed curves)**

Figs. 8 and 9 show that with the baffle in place there is a considerable increase in response in the 5000 c/s region. Fig. 9 shows the variation of response with angle of incidence of sound, smoothed curves being drawn. It will be seen that the directional effects produced by the baffle are most pronounced in the 3000 c/s to 5000 c/s region.

5. SENSITIVITY.

The open-circuit sensitivity in the mid-band region is approximately −88 dB relative to 1 volt/dyne/cm^2; the use of a 200 ohm/300 ohm transformer would raise the figure to −86 dB. The microphone is thus 10 to 15 dB less sensitive than the other types in current use in the B.B.C.

6. NOISE.

6.1. General.

In the absense of interference, the only noise output from the microphone is that due to the resistive component of its impedance. The r.m.s. open-circuit noise voltage in the band 0 to 10 000 c/s is approximately −136 dB relative to 1 volt unweighted and approximately −130 dB when weighted by an aural sensitivity network type ASN/3. The sound level in the mid-band region which would produce a microphone output equal to that due to the weighted noise is therefore +32 dB relative to 0·0002 dyne/cm^2.

The corresponding figure for an AXBT ribbon microphone is +18 dB.

6.2. Interference from Magnetic Fields.

The maximum open-circuit output of the microphone produced by induction in a uniform alternating magnetic field of one milligauss was measured at 50 c/s, 1000 c/s and 10 000 c/s; the results are given in the following table together with the sound level in the mid-band region required to give the same output. In the latter case, the corresponding figures for a typical AXBT microphone are given for comparison. It should be noted that no weighting is used.

FREQUENCY	I OPEN-CIRCUIT VOLTAGE AT MICROPHONE OUTPUT DUE TO MAGNETIC INDUCTION IN A FIELD OF ONE MILLIGAUSS	II SOUND LEVEL IN MID-BAND REGION TO GIVE OPEN-CIRCUIT OUTPUT SHOWN IN I	
	0 dB = 1 volt	0 dB = 2×10^{-4} dyne/cm^2	
	Labor MD 3 Studio	Labor MD 3 Studio	AXBT
c/s	dB	dB	dB
50	−120	+42	+12
1000	−130	+32	+24
10 000	−120	+42	+38

7. TRANSIENT RESPONSE.

The transient response of the microphone was investigated by driving the moving-coil with an interrupted tone in the manner described in Research Department

Report No. M.002. No resonance phenomena of the usual type were observed but internal reflections in the tube were apparent. At the low levels involved it was not possible to measure the attenuation between successive reflections, but from the extent of the irregularities in the frequency response curves this figure is estimated to be about 20 dB. Reflections may take place at the top or bottom of the tube and at the discontinuity at the lower end of the inner section. The greatest effect on the transient response of the microphone will occur when the reflected sound passes back and forth over the full length of the tube, which is approximately 5 ft (150 cm); in these circumstances, the time interval between reflections will be 9 ms and the time taken for the amplitude of the reflections to fall by 60 dB, i.e. the equivalent reverberation time of the system, will be only 27 ms.

8. IMPEDANCE.

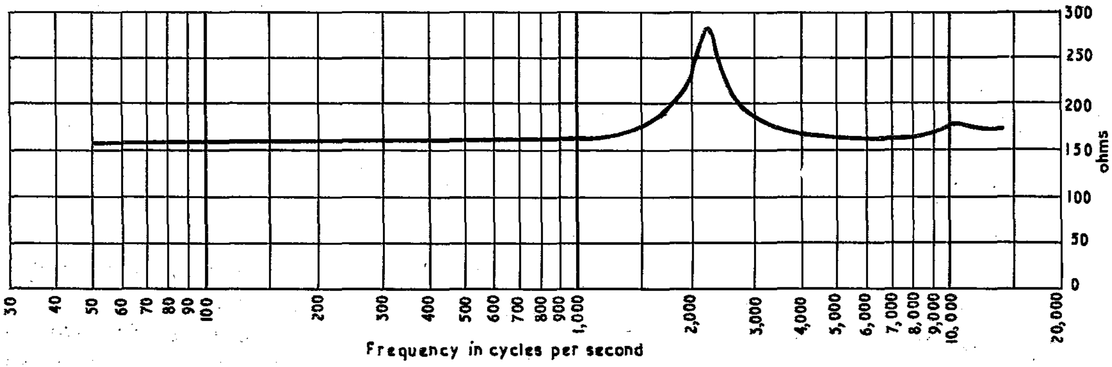

Fig.10 Modulus of impedance.

Fig. 10 shows the variation of microphone impedance with frequency; the rise in the region of 2300 c/s is probably due to the main diaphragm resonance.

9. LISTENING TESTS.

Listening tests were carried out and it was found that the effects of the closely spaced irregularities shown in the frequency response curves were not as obtrusive as might be expected, presumably since they are caused by interference rather than by resonances. The peak in the 7000 c/s region was however noticeable.

Further comments by S.E. Tel's Department on the performance of this microphone as judged subjectively are given in the Appendix.

10. CONCLUSIONS.

The Labor MD 3 Studio microphone is of particular interest because of its inconspicuous appearance. Its sensitivity is unfortunately low but proves adequate for speech at close range. The effect of the irregularities in frequency response arising from incomplete termination of the telescopic tube is not as obtrusive as might have been expected. The frequency response is adversely affected if the tube is extended to a height of more than 4 ft 10 in. (1·47 m) and it would be advisable to fit a stop to limit the travel.

The susceptibility of the microphone to interference from magnetic fields, while greater than in the case of the AXBT ribbon microphone, is not likely to lead to trouble under normal studio conditions.

11. REFERENCES.

1. Patent Specification No. 428,144. P.W. Willans. Application Dates 8/11/33 and 8/3/34.

   and

   Patent Specification No. 477,408. P.W. Willans and L.E. Currah. Application Date 26/6/36.

2. R.C.A. Microphone type BK-4A ("Starmaker").
   Research Department Technical Memorandum No. M.1006, May 1952.

3. H.J. Griese. "Das Rohrmikrofon".
   Arch. elekt. Ubertragung, 4, pages 259-66, July 1950.

APPENDIX

The following comments on the performance of the MD 3 Studio microphone have been received from S.E. Tel's Department:

"The MD 3 Studio microphone is nominally omnidirectional. It is however supplied with a clear plastic baffle which when attached to the mouth of the tube causes the microphone to be directional above about 1000 c/s with accentuation of treble frequencies, a characteristic which is not desired for broadcasting purposes. Without the baffle the quality is good, being rather better than that of most other 'non-directional' moving-coil microphones, provided that the telescopic tube is not at maximum extension.

The low sensitivity of the MD 3 Studio microphone limits its use to very close working to avoid the risk of background noise arising through operation of the programme chain at abnormally high gain. For this reason, it is not suitable for general use in the television service although the sample obtained for test is useful for occasional special purposes."