RESEARCH DEPARTMENT

A New Programme Meter

Report No. L.025

Serial No. 1954/14

THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION

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A NEW PROGRAMME METER

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1. INTRODUCTION.

It has been realised for some time that the standard Programme Meter, being only a 3½ in. instrument, with a usable range of only 20 db (scale marks 1 to 6), is not ideally suited for the control of programme in which the range of signal level is large.

Detailed statistical analysis has shown that a meter with a range of 32 db (3 extra divisions on the standard scale) would allow an operator to observe the peak level both of the fortissimo passages and also of the softer, pianissimo, passages of music.

It is out of the question to insert three extra divisions in the small "0 to 1" interval on the standard meter. As a compromise the "7" instead of the "6" mark could be treated as representing 100% modulation; but two extra divisions would still be needed. A longer scale could accommodate them, but the added inertia of a correspondingly longer pointer would reduce the response time of the meter movement; doubling the pointer length quadruples the inertia.

In an optical projection system the inertia of the pointer is eliminated. A flat, horizontal 6 in. scale is needed, over which a bar of light representing the pointer can move without changing its definition or brilliance. Conventional reflecting instruments do not have flat scales unless the fore-and-aft depth is considerable, and even then the "spot" brightness varies considerably over the scale.

To meet these requirements the novel projection system* described in the next section was designed, and is shown in Fig. 1.

The scale is 6 in. long, although the fore-and-aft depth is only 3¼ in. The moving-coil movement of the standard 3½ in. instrument is used, a mirror being mounted on an extension of the shaft. To reduce the risk of lamp failure the 6·3 V. bulb is run at reduced voltage.

* British Patent No. 704150

2. OPTICAL PRINCIPLES.

In Fig. 1 the central ray of the light beam which forms the image on the translucent scale has been drawn in. The geometrical principle is illustrated in Fig. 2. The ray paths corresponding to various positions of the rotating mirror M_1 have been shown. It will be seen that the reflected rays are, as it were, "focused" on an area 20 in. to 30 in. away, so that an observer placed there would see a brilliant spot on the scale no matter what the deflection might be. At greater distances the centre of the scale is still brilliant and the extremes only slightly less so. The "spot" is a vertical bar of light about 1½ mm. wide, and is the image of a narrow slit in the lamp-housing on which the light is concentrated by a condenser lens. The focal plane of the optical system does not coincide strictly with the scale of the instrument, but this does not visibly affect the definition of the spot.

Practical advantages of this optical system are, first, that the "figure" of the concave mirror need not be high grade; a satisfactory image can be obtained even from a polished nickel-plated strip bent to shape by being pressed against a cylindrical surface. In the model used for the trials the mirror was of the inexpensive variety which is manufactured by bending glass, when hot, over a cylindrical surface. Secondly, the lenses in the lamp-housing can be made of perspex, which is relatively cheap: the loss of light in the perspex is small and can be tolerated because all the light which emerges is directed without serious loss to the observer's eye.

Although the deflection of the spot is not strictly proportional to the angle of rotation, the slight opening out of the top and bottom of the scale is an advantage, at least at the lower end, where the scale marks are closer together.

Figs. 3(a) and 3(b) show the rectangular-section scales used for the greater part of the field trials; most operators preferred the horizontal one. Figs. 3(c_1) and 3(c_2) show two versions of the triangular scale which greatly increase the angle of view by means of refraction. Scale C_1 was used for a few weeks and was preferred to the flat scales by most users. Scale C_2 is more practical as the frosted surface is protected from dirt, but it could not be fitted to the meter housing for the early experiments. A scale of this type is now being used for a trial of the instrument in Studio L.H.1 which started in February of this year; Fig. 3(d) shows the standard scale for comparison.

3. SCALE CALIBRATION AND CIRCUIT ARRANGEMENTS.

The meter was calibrated by applying a signal 8 db above reference level to the associated standard model PPM/2 unit and increasing the preamplifier gain by 4 db which brought the spot near the end of the scale; this defined the "6" mark. Eight additional scale divisions were added corresponding to successive 4 db reductions in input. To avoid confusing operators used to the "0" to "6" scale, this numbering was retained and the letters A, B, and C were used for the extra scale marks, inserted between "0" and "1", increasing the scale by 12 db.

Since the optical instrument is connected to the PPM/2 circuit exactly as the standard meter, the usual "extension meter" facilities are retained.

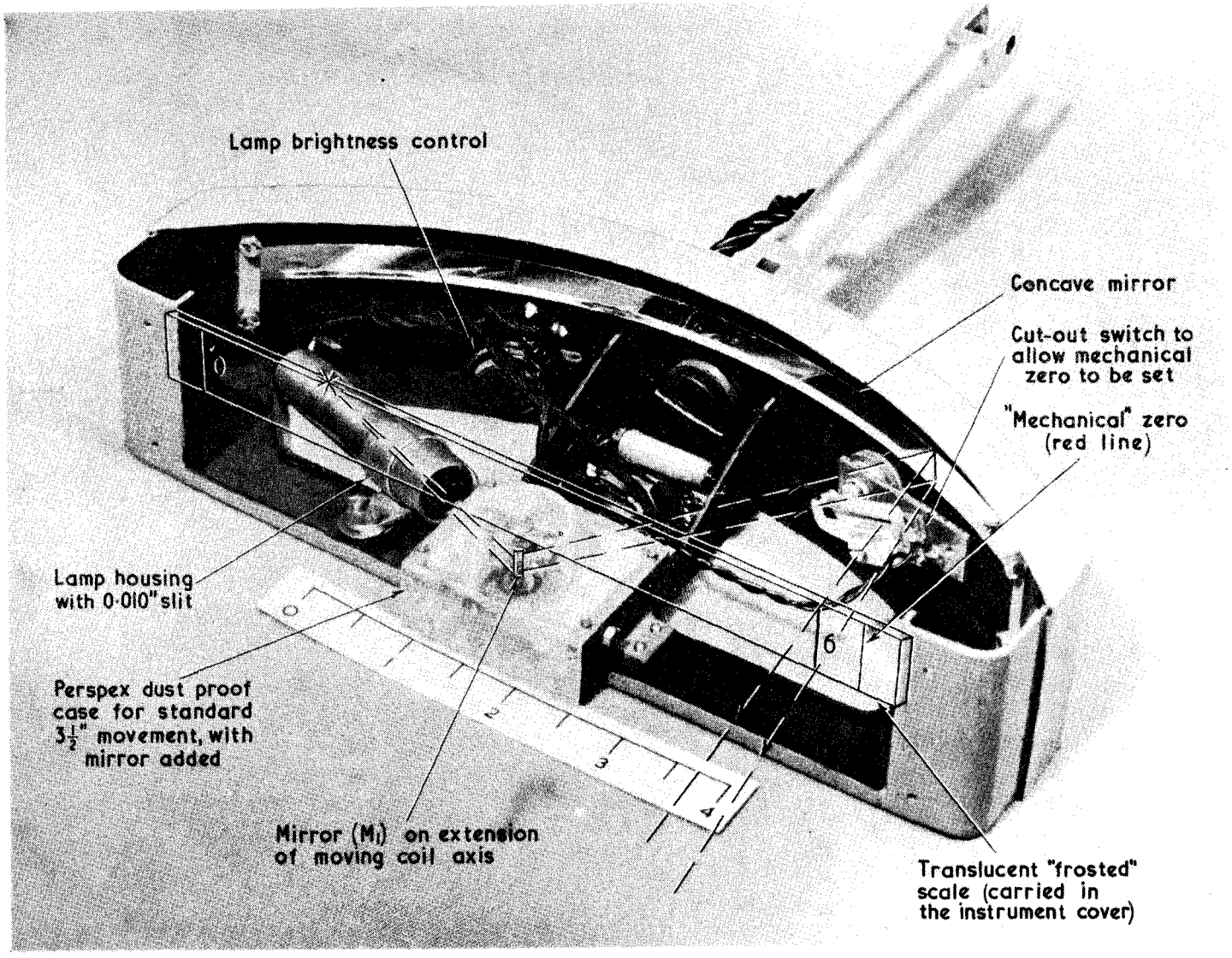


Fig. 1

Skeleton view: cover removed

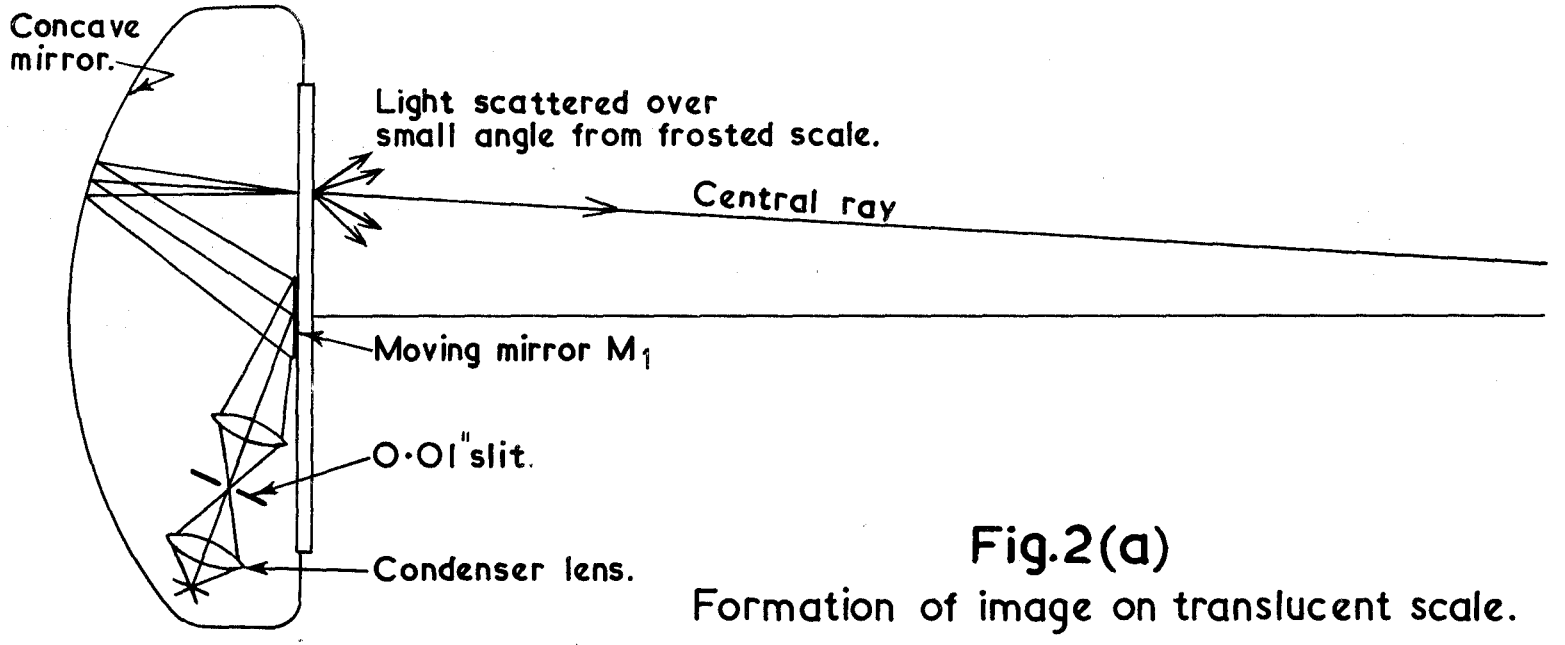
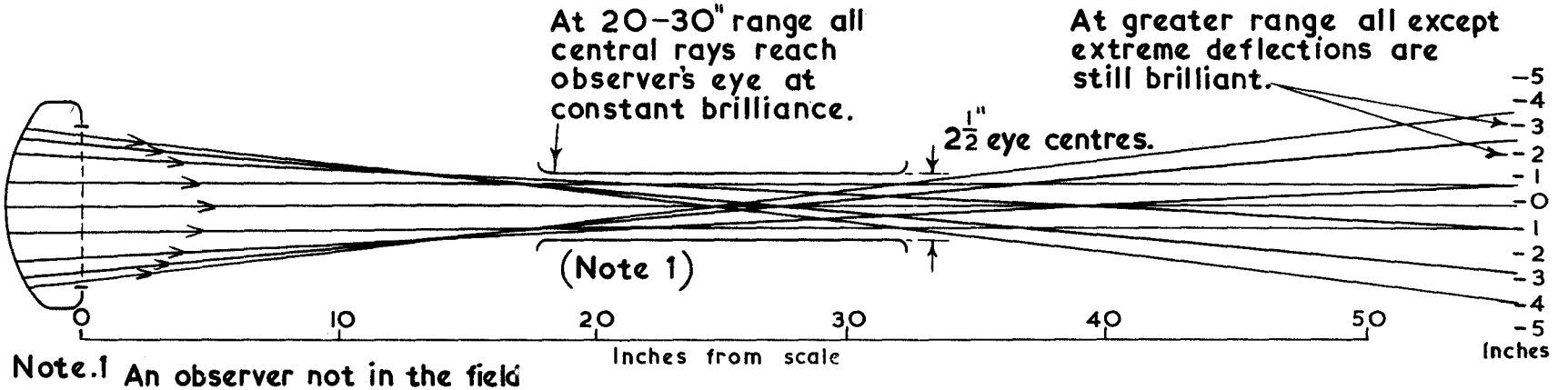


Fig.2(a)

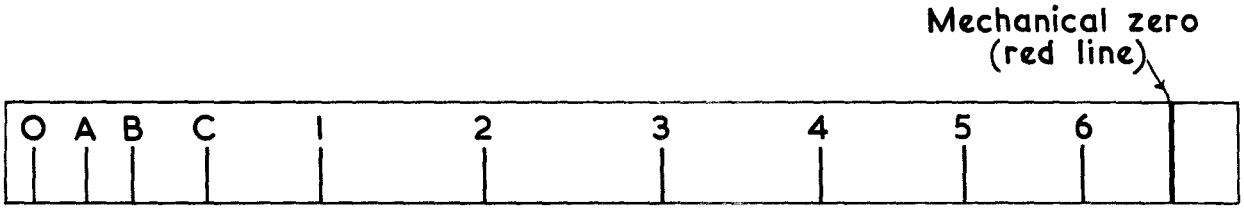
Formation of image on translucent scale.



Note.1 An observer not in the field of central rays sees a bright image from light scattered by the frosted scale.

Fig.2(b)

Path of central rays.



(Full size)

(a)

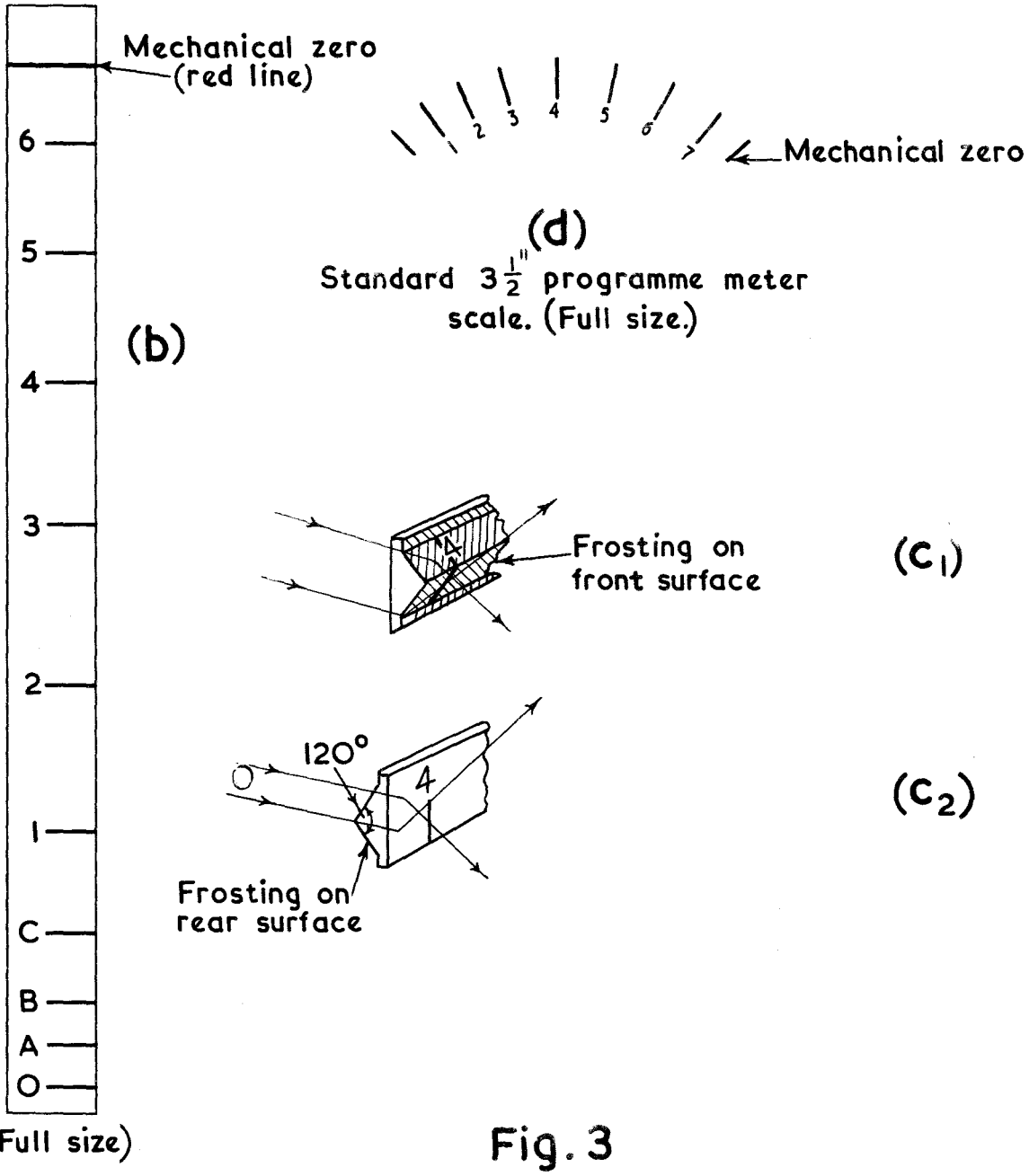


Fig. 3

4. RESULTS OF THE FIELD TRIAL.

The first trial was at the Albert Hall throughout the 1953 Promenade Concert Season, and the second at the Paris Cinema from 19th November 1953, to the end of the year. After consultations with Mr. E.W.S. Porter of Programme Operations Department, it was decided that the reactions of the users, on the whole favourable, had been sufficiently established to allow the modifications suggested by the trial to be incorporated in the instrument. The meter was then installed in L.H.1 to obtain the comments of Drama Department.

It should be noted that the test conditions were biased against the new instrument, because it could not be placed near the Standard Meter on the control desks, and was sometimes too near the operator for comfort. This occurred at the Albert Hall as shown in Figs. 4 and 5. The horizontal position (Fig. 4) was preferred. The arrangement of the instrument in the Paris Cinema and L.H.1 is shown in Figs. 6 and 7.

The following broad conclusions emerge:

4.1. The extension of the meter scale by 12 db is perfectly adequate for the control of symphonic music, and by inference, will be adequate for all programmes.

4.2. For the proper control of such music this extension is essential and for variety programmes such as those produced at the Paris Cinema, it is an advantage.

4.3. There is no valid objection to the use of a light "spot" in place of a pointer. Several users did not favour the increased velocity, although practically all demanded the extended scale divisions, for which increased velocity is essential.

4.4. The location of the instrument is important. It should be near the desk when scores and scripts are used, and in the line of sight when watching events such as variety shows in the studios.

4.5. To conform to the user's requirements, the instrument should have a horizontal scale about 5 in. or 6 in. long with a wide angle of view, and with provision for a wide range of spot brilliance.

5. CONSIDERATIONS ARISING IF THE OPTICAL METER WERE BROUGHT INTO GENERAL USE.

It has already been mentioned that the scale of the optical meter has been extended by increasing the gain of the associated PPM/2 preamplifier by 4 db, so that the 100% modulation mark on the scale of the standard instrument is 7 instead of 6. This is reverting to the procedure existing before 1st June 1944, when "line-up" was at "5" and 100% modulation of the transmitter corresponded to "7". At that time all programmes were maintained at the highest possible average modulation depth and therefore overmodulation was quite common. The extra 4 db gained by the new line-up enabled operators to avoid overmodulation more easily.

Now that we have reverted to pre-war conditions it would be possible to revert to pre-war line-up arrangements.

The simplest way to introduce optical PPM's into the service would, therefore, be to operate them on the "extension meter" jack of the normal PPM/2 and line up for 100% modulation at "7".

It has been shown that an optical meter offering a control range of 32 db in place of the existing 20 db can be built and integrated with existing P.P.M. equipment, and by field trials it has been shown that such a meter can offer improvements in various important respects on the standard 3½ in. instrument.

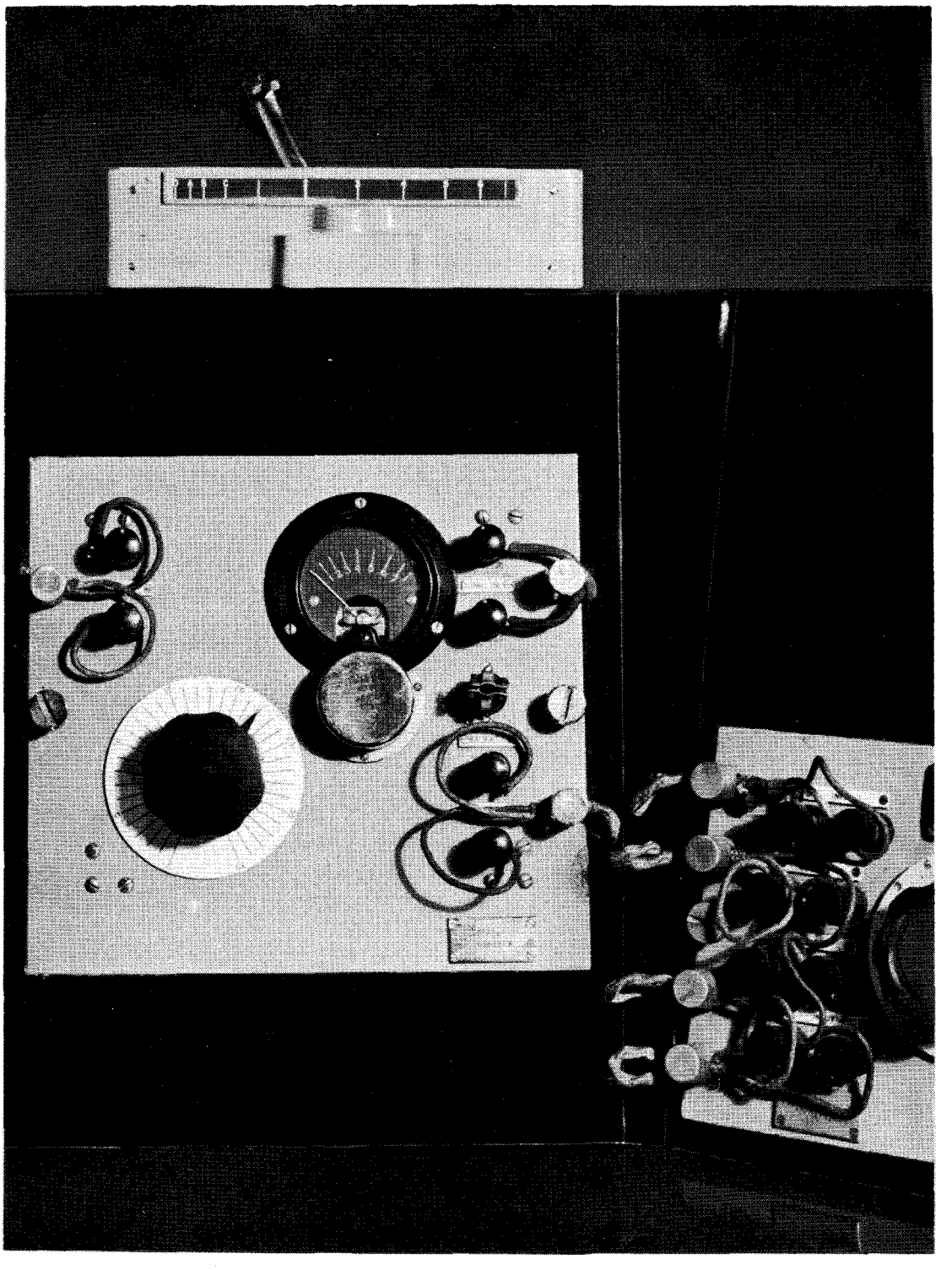


Fig.4
Albert Hall

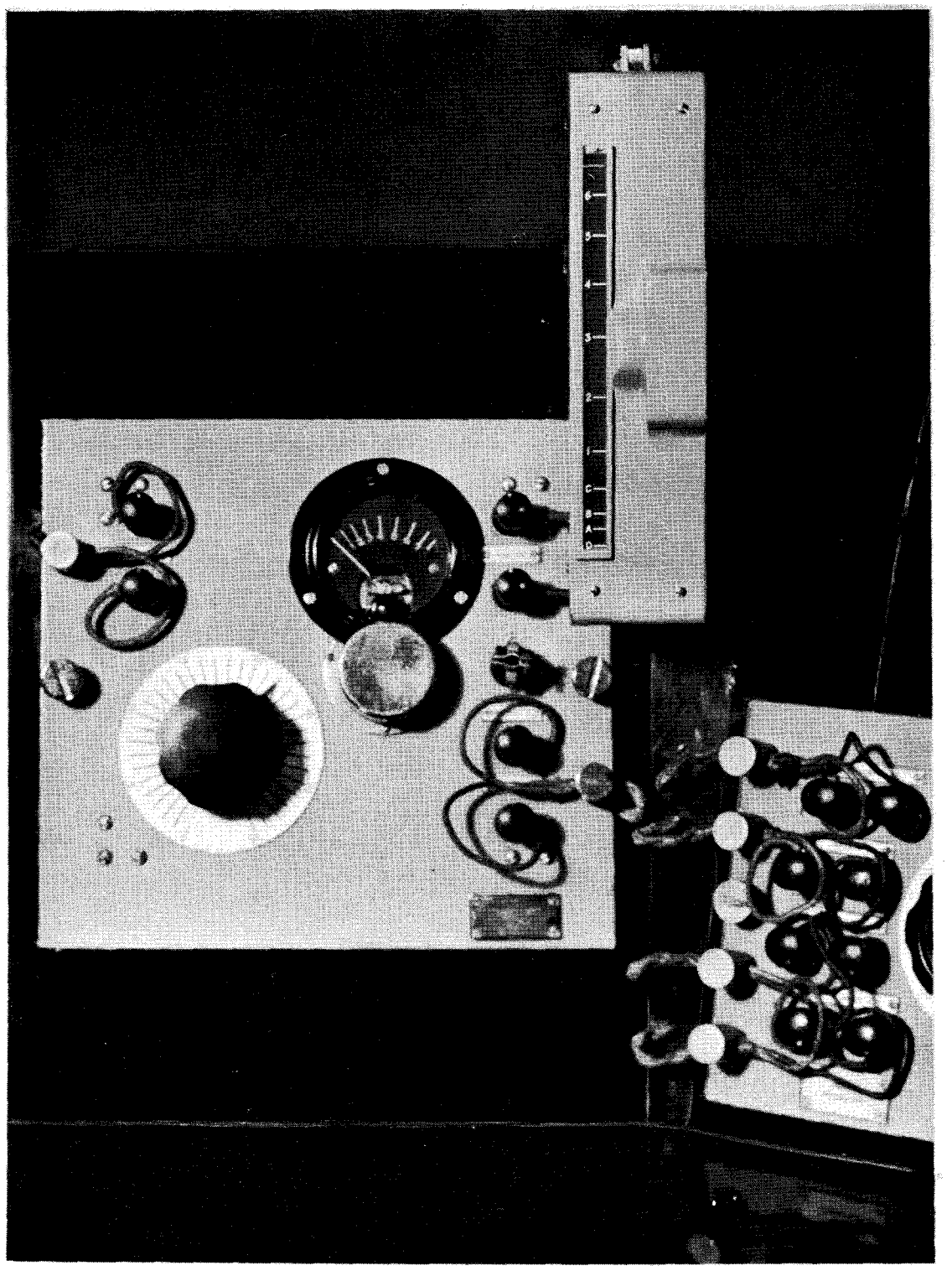


Fig.5
Albert Hall

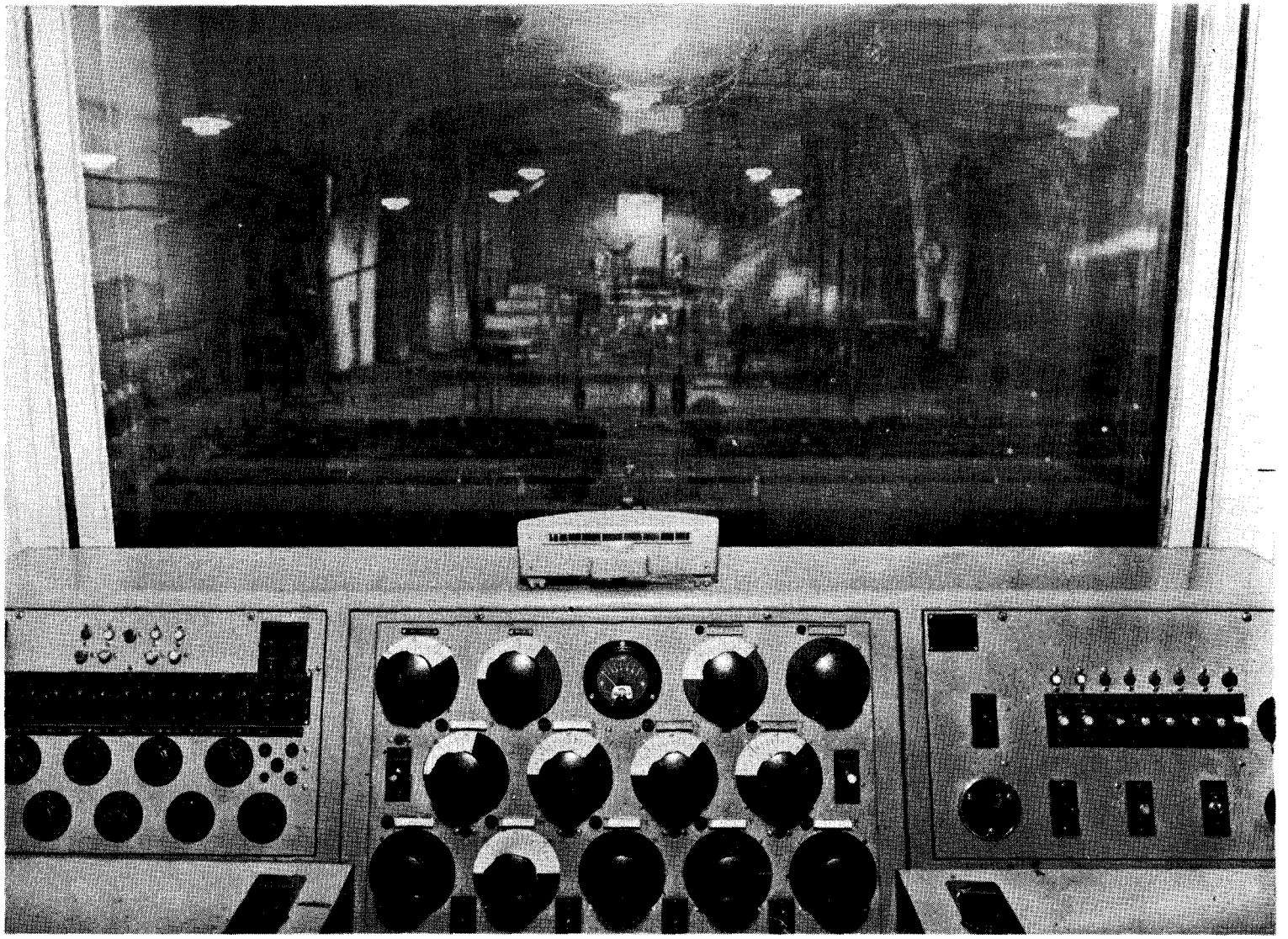


Fig.6
Paris Cinema

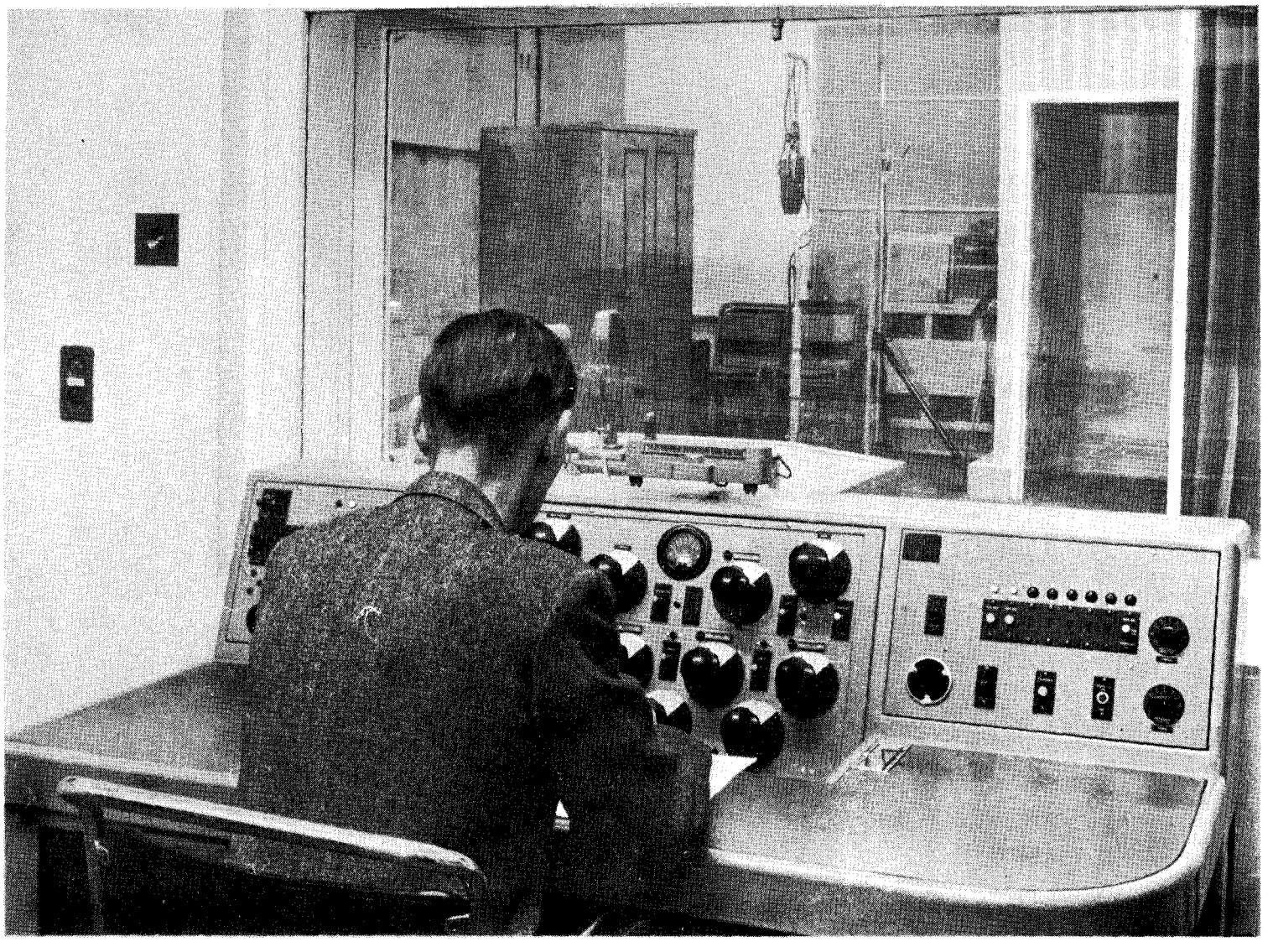


Fig. 7
Langham Hotel