BBC

ENGINEERING DIVISION

MONOGRAPH

NUMBER 20: **AUGUST 1958**

The BBC's Mark II Mobile Studio and Control Room for the Sound Broadcasting Service

by

L.E.H. O'NEILL

(Planning and Installation Department, BBC Engineering Division)

BRITISH BROADCASTING CORPORATION

PRICE FIVE SHILLINGS

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FOREWORD

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This series should be of interest and value to engineers engaged in the fields of broadcasting and of telecommunications generally.

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THE BBC's MARK II MOBILE STUDIO AND CONTROL ROOM FOR THE SOUND BROADCASTING SERVICE

SUMMARY

The BBC's first Mobile Studio and Control Room, Mark I, commissioned in June 1956, provided the facilities which had been specified for the sound broadcasting service. When a second unit was proposed, however, a careful survey was made in the light of the operational experience which had been gained with the first vehicle to see what improvements it would be desirable to incorporate in the Mark II version.

To give the greatest flexibility in the layout of the equipment in the original unit, a chassis having Ackerman-type steering was chosen. This decision meant that a low floor level was possible, with only the wheel boxes interrupting the flat floor. The length was legally restricted to twenty-two feet.

For the second vehicle a semi-trailer chassis was decided upon. Tractors with suitable coupling facilities already existed in the BBC's vehicle fleet and the extra body length of just over five feet, together with the improved manœuvrability offered by this arrangement, were attractive features. Moreover, the two floor levels associated with this class of trailer, at first regarded as a disadvantage, were usefully incorporated in the layout to give improved visibility from the producer's desk, over the head of the control engineer, into the studio.

This Monograph details the requirements laid down for the second vehicle and describes the design and equipment provided to implement them.

1. Introduction

In 1956 the BBC commissioned, for its sound services, a Mobile Studio and Control Room built as an independent four-wheeled trailer. This represented the first serious attempt to provide in one vehicle all the facilities required for a complex outside broadcast, including a studio for interviews or to accommodate a local announcer.

The design of the vehicle began with the proposal to provide a caravan having a division, one portion of the body being fitted out as a studio and the remaining area housing portable amplifiers, mixers, and similar equipment

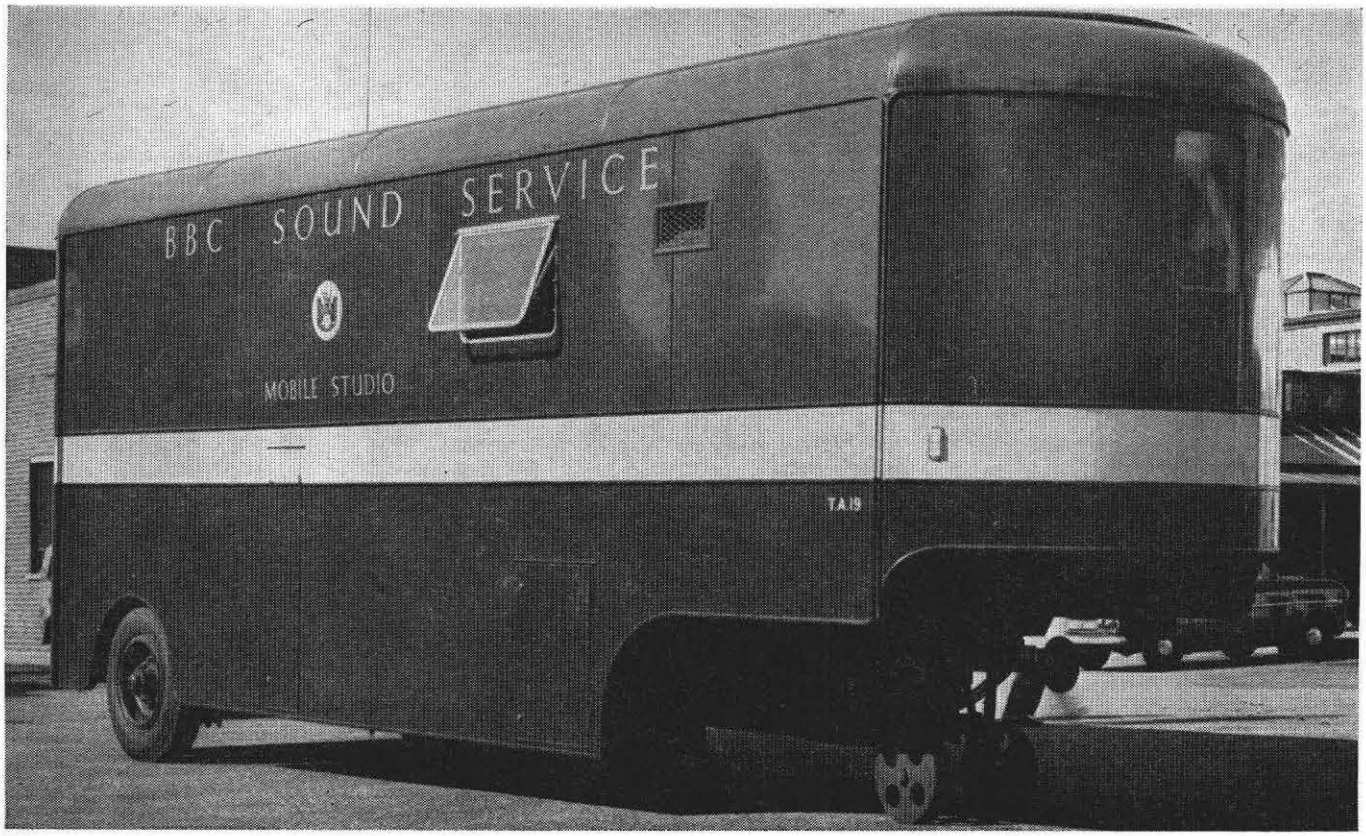

Fig. 1 — *Mobile Studio and Control Room, Mark II, external view*

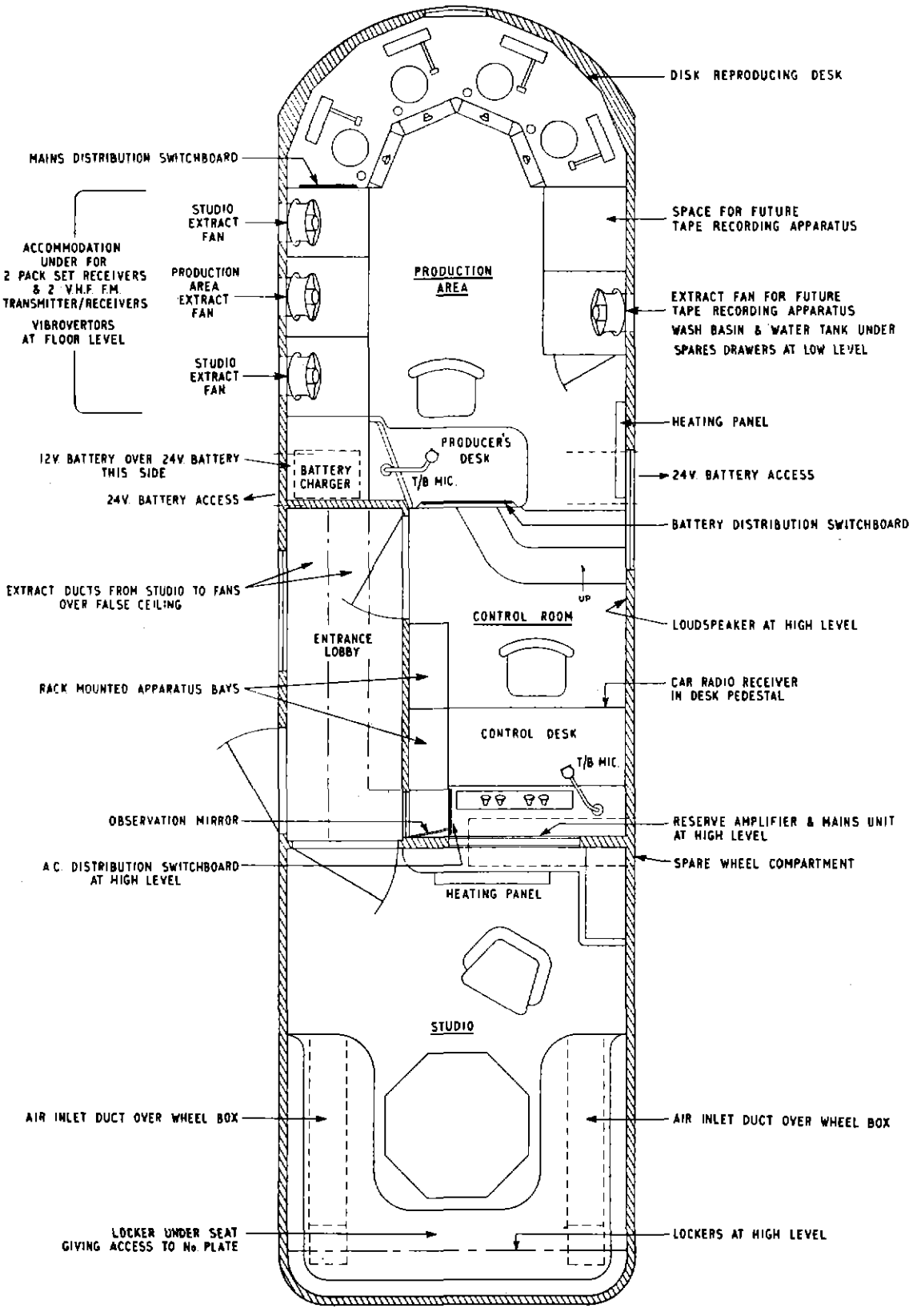

Fig. 2 — Plan showing layout of the vehicle

of the standard type used on outside broadcasts, and thus to satisfy the need for a temporary studio at party political conferences, agricultural shows, and similar events.

Consideration of the problems made it clear that if the vehicle could include a control room with adequate facilities provided by built-in apparatus, a greater field of usefulness would result. Many complicated outside broadcasts, not necessarily needing local studio facilities, could be dealt with more economically on this basis than by installing portable equipment in whatever space could be obtained.

As a result a body was specially built by Berkeley Coachwork (Sales & Export) Ltd, who co-operated with the BBC's Planning and Installation Department in the design and constructional details. It was mounted on a four-wheeled chassis, twenty-two feet long, and fully equipped. The unit was put into service in June 1956 with so much success that it was decided to build another. Differing in many respects from the original, the second mobile studio and control room was first used in October 1957, and is described in detail in the following sections. An external view of this vehicle is shown in Fig. 1.

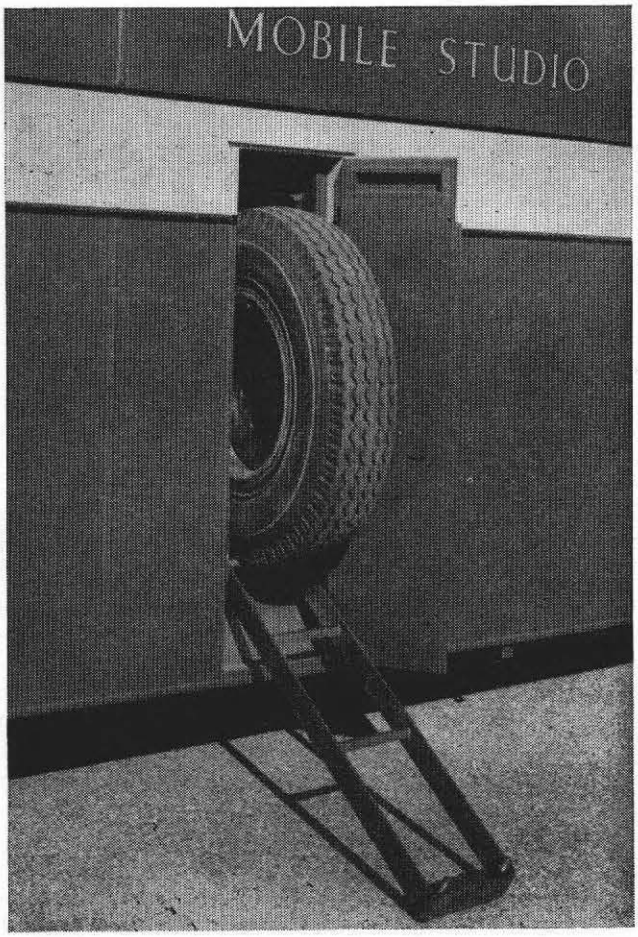

Fig. 3 — Exterior view showing spare wheel compartment and ramp

2. Chassis and Layout of Equipment

2.1 *Chassis—General Description*

The chassis (specially built by Messrs Hands (Letchworth) Ltd to BBC requirements) has a nominal load-carrying capacity of six tons. With the full complement of equipment the complete trailer weighs rather less than six and a half tons. The rear wheels are equipped with 8·25-in. × 20-in. single 12-ply tyres and the beam axle is carried on semi-elliptic springs. When fully loaded the height of the top of the chassis is 2 ft from road level with a 2-ft rise at the front end; the overall length is 27 ft 4 in. When coupled to the tractor a total length of 35 ft results.

2.2 *Body—General Description*

The body, together with all the interior fittings, was built by Berkeley Coachwork (Sales & Export) Ltd, who co-operated in the design. It is framed in ash and the external panels are 16 s.w.g. aluminium. Internal panelling is carried out in laminated boards faced with polished hardwood veneers. The side, roof, and floor cavities are insulated with glass-fibre blankets. The floor, with the exception of the studio, is covered with light-grey rubber tiles which finish at a black rubber coving.

Aluminium tubes passing through holes drilled in the floor joists provide wiring ducts between the various equipment areas.

The floor to ceiling height is 6 ft 6 in. in the front end and 8 ft 6 in. elsewhere. False ceilings reduce this to 7 ft 5 in. in the studio and 7 ft 2 in. in the entrance lobby. The internal body width is 7 ft 2 in.

It will be noticed from Fig. 2 that the main operational area is divided by the three steps which give access between the high and low floor levels. As far as is possible the higher floor level is devoted to programme production, and the remainder to engineering control. The studio is built at the rear end of the body.

Two twenty-eight-foot telescopic masts to support the aerials associated with transmitters and receivers accommodated in the vehicle are carried in a locker built under the floor on the off side. Access to this is obtained from the front end of the vehicle after the tractor has been uncoupled. The body incorporates sockets into which fittings may be screwed to permit the masts to be clamped to the body sides.

The partition between the studio and the control room is increased in thickness between the observation window and the floor. Part of this increase is concealed in the joinery which houses the mixer panel in the control room, whilst the remainder protrudes in the studio. By this means accommodation is provided for an angle iron-framework to house a spare wheel. This framework is fixed to the chassis and provided with external access by means of a door which, when opened, allows a frame to be released from its normal function of retaining the wheel, and become a ramp on which the wheel may be rolled. This is illustrated in Fig. 3.

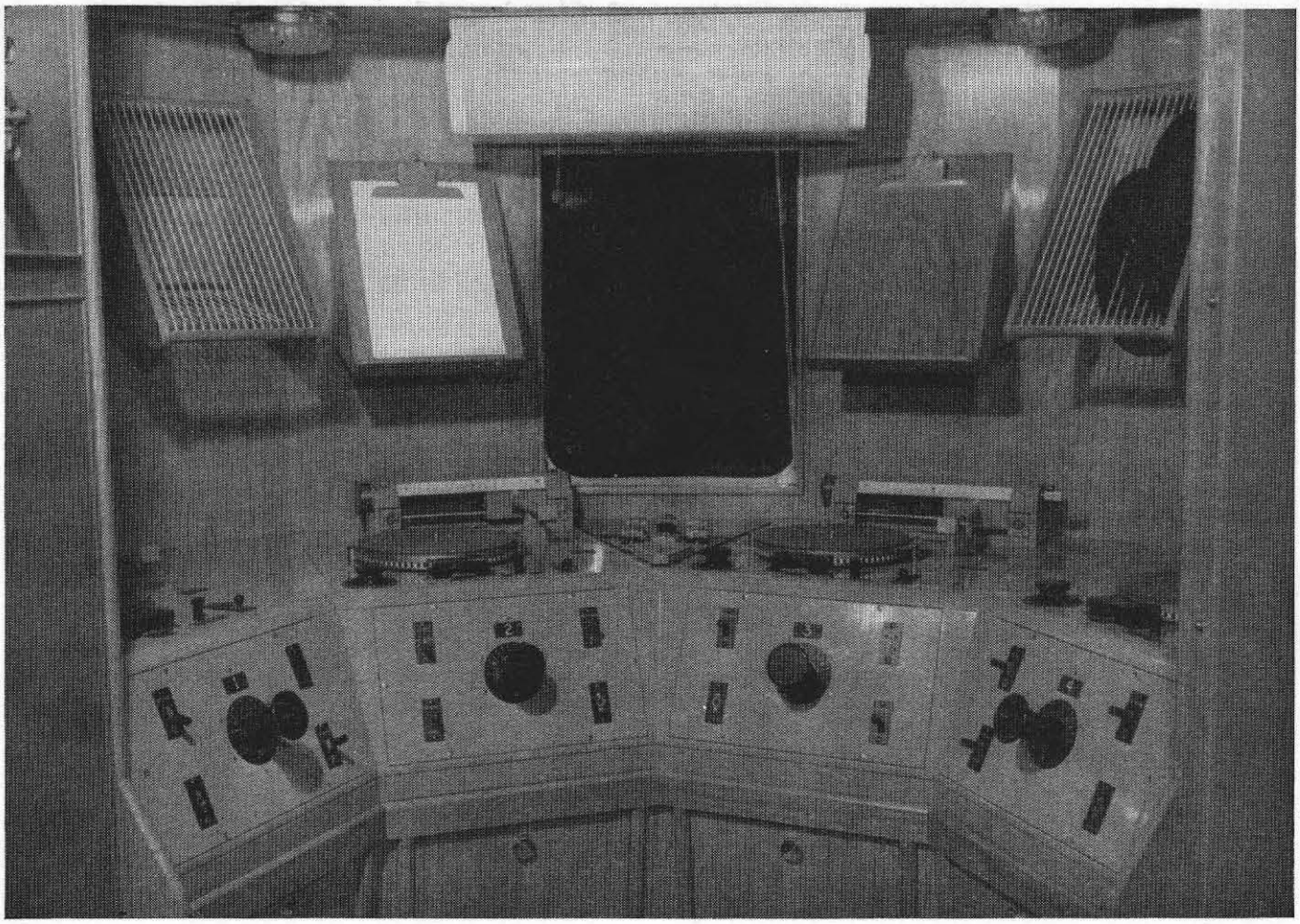

Fig. 4 — The bank of four specially-designed gramophone turntable units

2.3 *Production Area—General Description*

The production area contains a bank of four disk reproducing turntables, shown in Fig. 4, built into the rounded front end of the body. Lockers are constructed over this at ceiling level.

The nearside of the area is occupied with cabinet work which includes a clothes cupboard, three ventilation fan cubicles, recesses to house two f.m. v.h.f. transmitter/receivers for providing programme and control links, together with two additional receivers for a commentator's pack-set transmitter.

Two 300-VA vibratory convertors are enclosed in additional cupboards at floor level. Switch-fuses forming the mains distribution switchboard are mounted at the end of the cabinet overlooking the disk reproducing desk. Behind this switchboard is a cupboard in which the auto-transformer, tapping switch, kilowatt-hour meter, and earth-leakage relay are fitted.

A desk for the producer is installed at the end of the production area and is positioned with its back edge coinciding with the end of the high level floor. The position of this desk permits good visibility into the studio over the head of the operator seated at the control desk on the lower floor level, as can be seen from Fig. 5.

The steps which connect the two floor levels are built into the space which remains between the end of the producer's desk and the side of the body.

On the offside of the production area a space has been left for the future installation of tape recording and reproducing equipment, the necessary air extract fan having been built in initially. As an interim measure, a shelf supports a portable tape equipment which is used for rehearsals. The remainder of the cabinet work on this side of the production area is devoted to lockers for housing microphones, headphones, and spares, together with a small wash-basin having a water supply available from a pump connected to a water storage tank, and mounted on the adjacent draining board.

To provide rear access without space wastage, the battery distribution switchboard is built into the rear supporting framework of the producer's desk. This arrangement places the controls in a position where they may be operated from the control desk chair. A removable panel covers the back of the switchboard underneath the producer's desk.

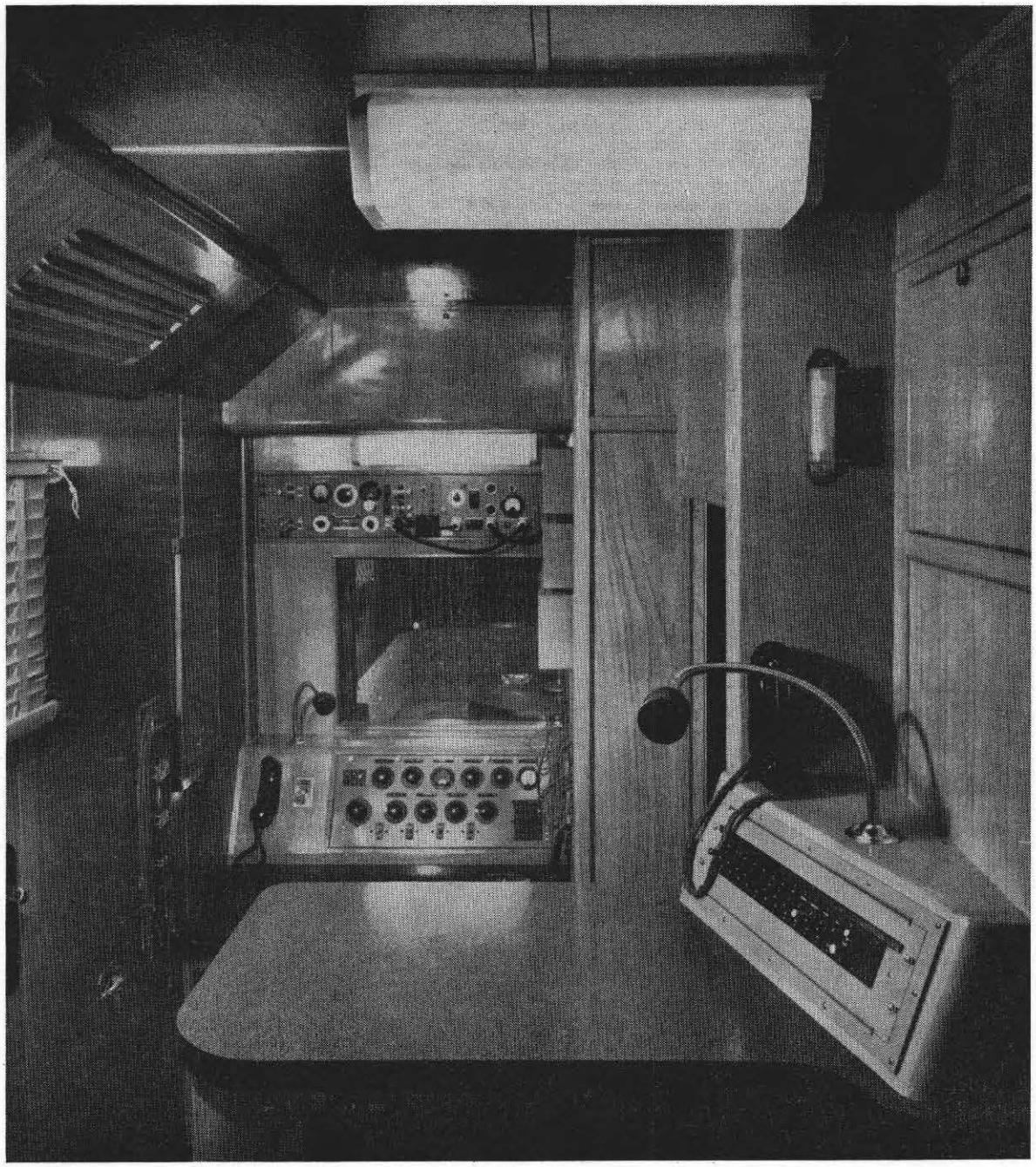

Fig. 5 — View from producer's desk over the control position into the studio

The upper part of this switchboard can be seen in Fig. 6.

A pedestal seat, of the type marketed primarily for the driver in coaches or commercial vehicles, is provided for the producer. The seat, which incorporates provision for rotation, adjustment to height, reach, and back-rest angle, is fixed permanently to the floor.

2.4 *Control Room and Entrance Lobby—General Description*

On the lower floor level the engineering control desk, shown in Fig. 7, is installed and to the right of this are two apparatus bays on which the rack-mounted amplifiers, jackfields, and associated equipment are fitted. Most of this apparatus can be operated from the seated position. A pedestal seat of the type used at the producer's desk is provided.

The two apparatus bays form the greater part of the division between the entrance lobby and the control room. This is a convenient arrangement because it permits rear access to the equipment by removing panels in the entrance lobby, seen in Fig. 8, without sacrificing any space for the sole purpose of rear access.

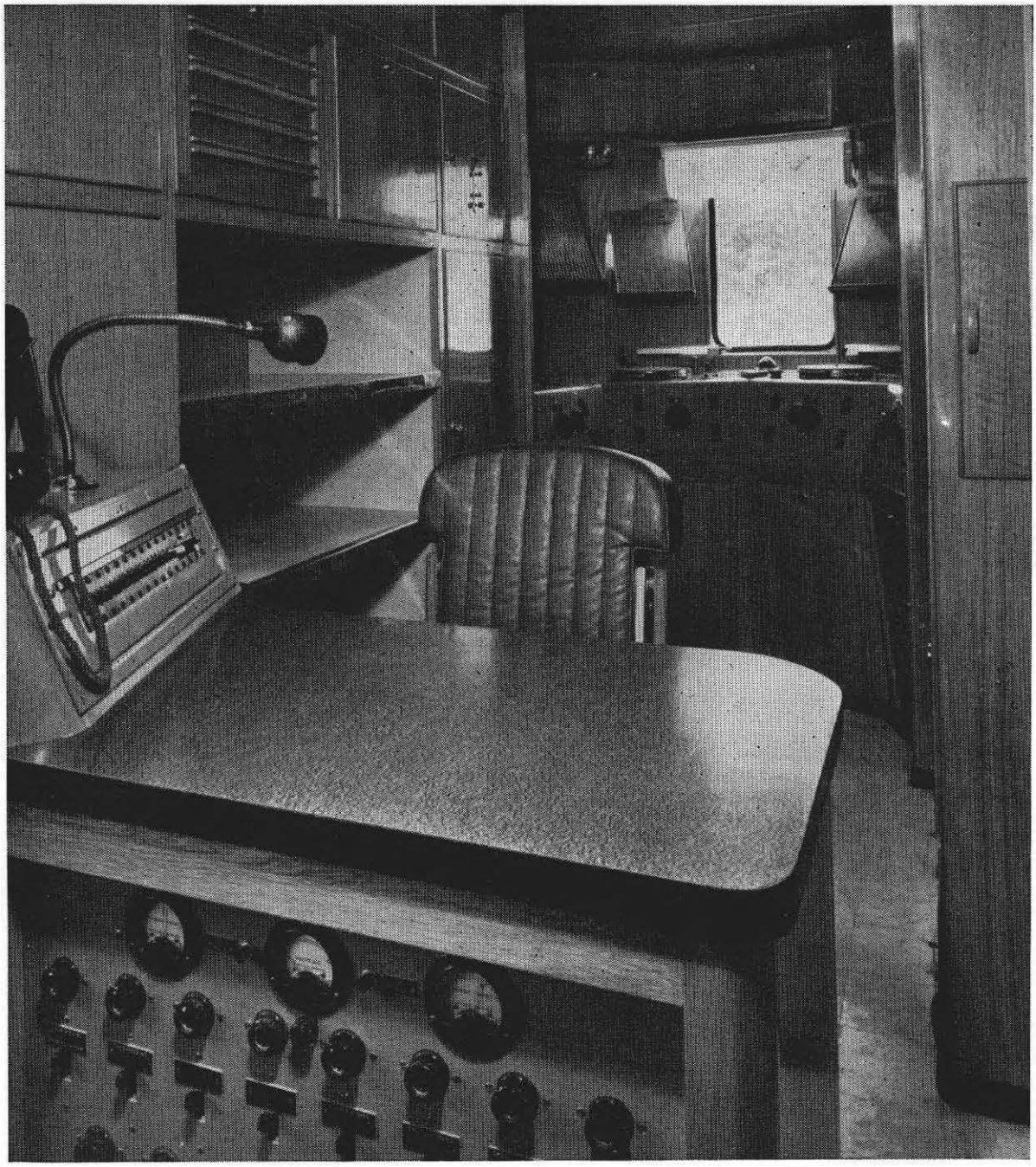

Fig. 6 — View from control position level showing upper part of battery control panel

The provision of the entrance lobby had one disadvantage in that the vehicle and studio entrance doors were not within the direct vision of the control engineer, thus leaving open the possibility of unauthorized entry to the studio. This was overcome by the provision of a window, with a mirror suitably positioned in the space between the apparatus bays and the studio division, which brought the entrance door into view from the control position. This feature may be seen in Fig. 7 where the reflection shows part of a person standing in the lobby.

A pedestal supporting the left-hand side of the control desk incorporates an Ekco car radio receiver, type CR227, the control room loudspeaker amplifier, and a drawer for miscellaneous items. The aerial for the receiver is a Smith's Radiomobile unit, which incorporates a 12-V motor operating through a flexible shaft, to extend it to 4 ft 6 in. above the roof. Lockers are provided above the apparatus bays to house line equalizing equipment when required.

An outside broadcast amplifier, BBC type OBA/8, to-

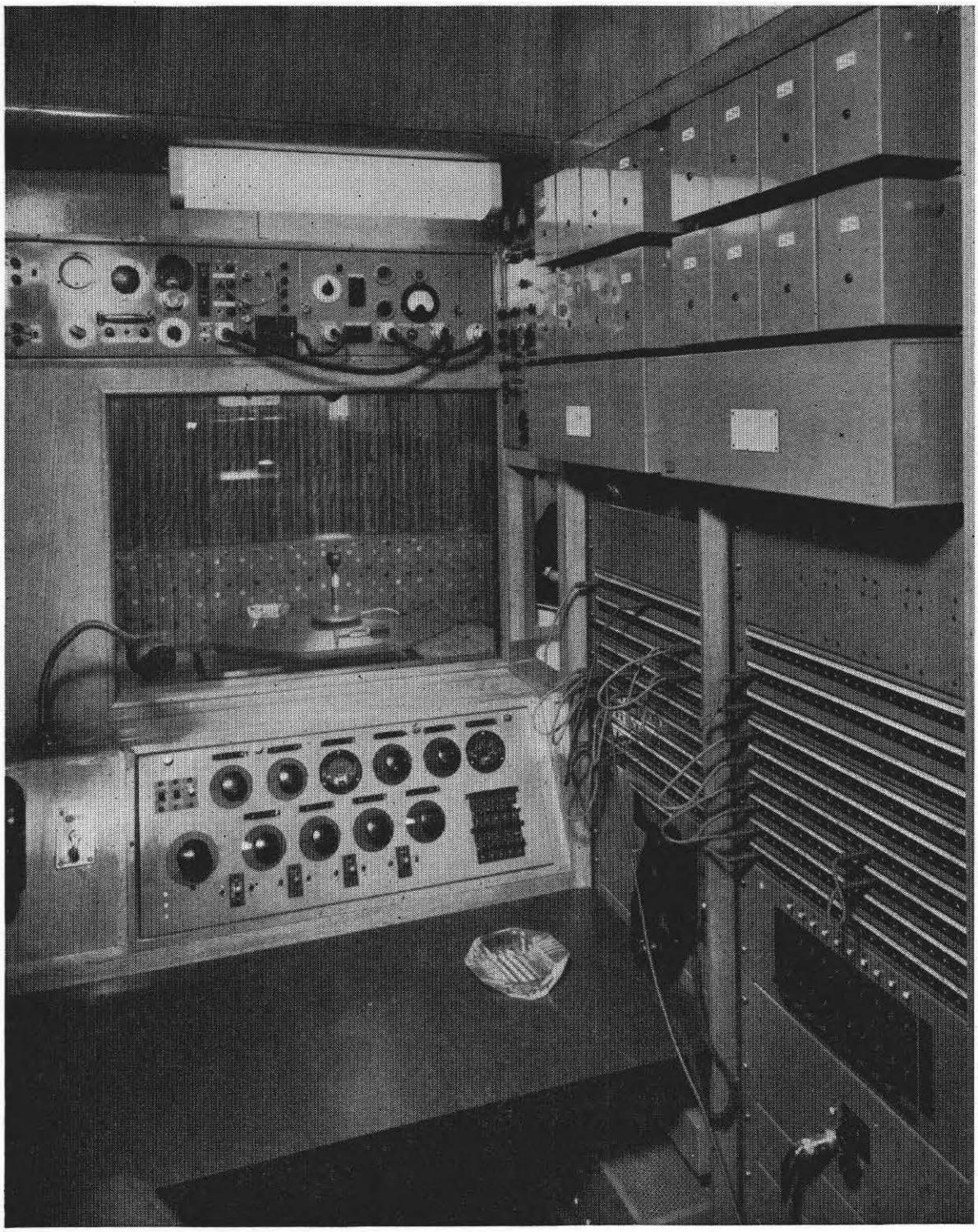

Fig. 7 — The engineering control position showing desk, rack-mounted equipment, and the studio beyond. Note reflection of man in entrance lobby in mirror to right of studio observation window

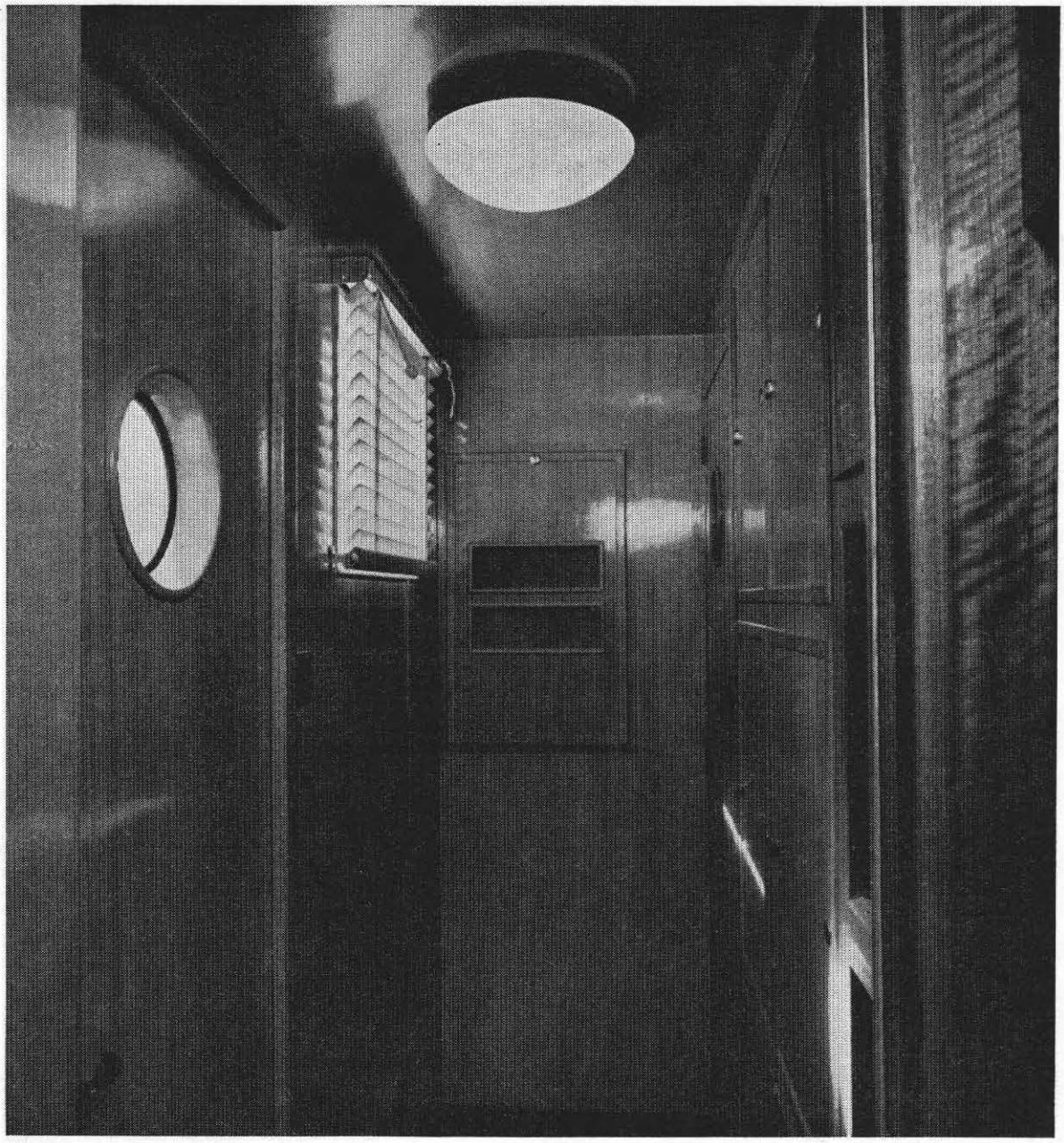

Fig. 8 — The entrance lobby showing removable covers to rear of racks and to rectifier panel

gether with the associated mains unit, is built in flush above the control desk over the studio observation window. This provides an additional channel when required and also adds to the reserve equipment which is available as, in the absence of a mains supply, the amplifier is arranged to derive its supplies from a dry h.t. battery housed in a locker in the studio and the 12-V lead-acid battery through a dropping resistance.

A schematic diagram of the power and programme circuits is framed and fixed at the left-hand side of the control desk.

2.5 *Studio—General Description*

The studio is 7 ft 2 in. wide and 9 ft 8 in. long. A fixed table, supported on a hollow pedestal, through which wiring is carried, is positioned centrally in relation to the fixed seating which extends over part of each side and the rear end of the room. Under each of the side seats an inlet air duct connects a suitably baffled opening in the floor to a slatted aperture formed in the end of the joinery which supports the seat cushions. The wheel boxes are concealed by the side seats and the air ducts pass the boxes before terminating in the openings. Under the end seat a locker is

provided giving access to a hinged panel which carries slides to accommodate the number-plate and its associated illumination. When the panel is restored to its normal position the number-plate is visible through a perspex panel fitted in the outer skin of the body. The need to tow the trailer with any one of the several available tractors brings about the necessity for convenience in the display of alternative plates.

An octagonal shape was chosen for the table top in order to reduce the difficulty of access to the end seat. The presence of the flats opposite the corners of the seating is of considerable assistance in achieving easy ingress and egress, as can be seen from Fig. 9.

Sockets are provided in the rails on the underside of the table for the reception of headphone, microphone, and cue push-button leads. Bushed holes exist in the table top through which the leads may pass and thus present a much tidier appearance than would otherwise be the case.

The seat cushions are reversible and, together with the squabs, are trimmed in a light-blue patterned fabric.

A pocket, designed to accommodate two spare 4-ft fluorescent tubes, is built into the void behind the squab on the nearside, the end being covered by a fabric flap extending from the squab covering and secured by press studs.

In one corner of the studio a cabinet is built into the full height. The loudspeaker is housed at the top and the associated amplifier below it, as shown in Fig. 10. The remaining space forms a hospitality cabinet.

Three storage lockers are built in at high level in the angle between the partition and the ceiling. The first of these is for general use, the second houses the chokes and other apparatus associated with the fluorescent lighting, while the last contains the dry h.t. battery for the standby amplifier. Two additional lockers, for general storage purposes, are fitted at ceiling level at the opposite end of the

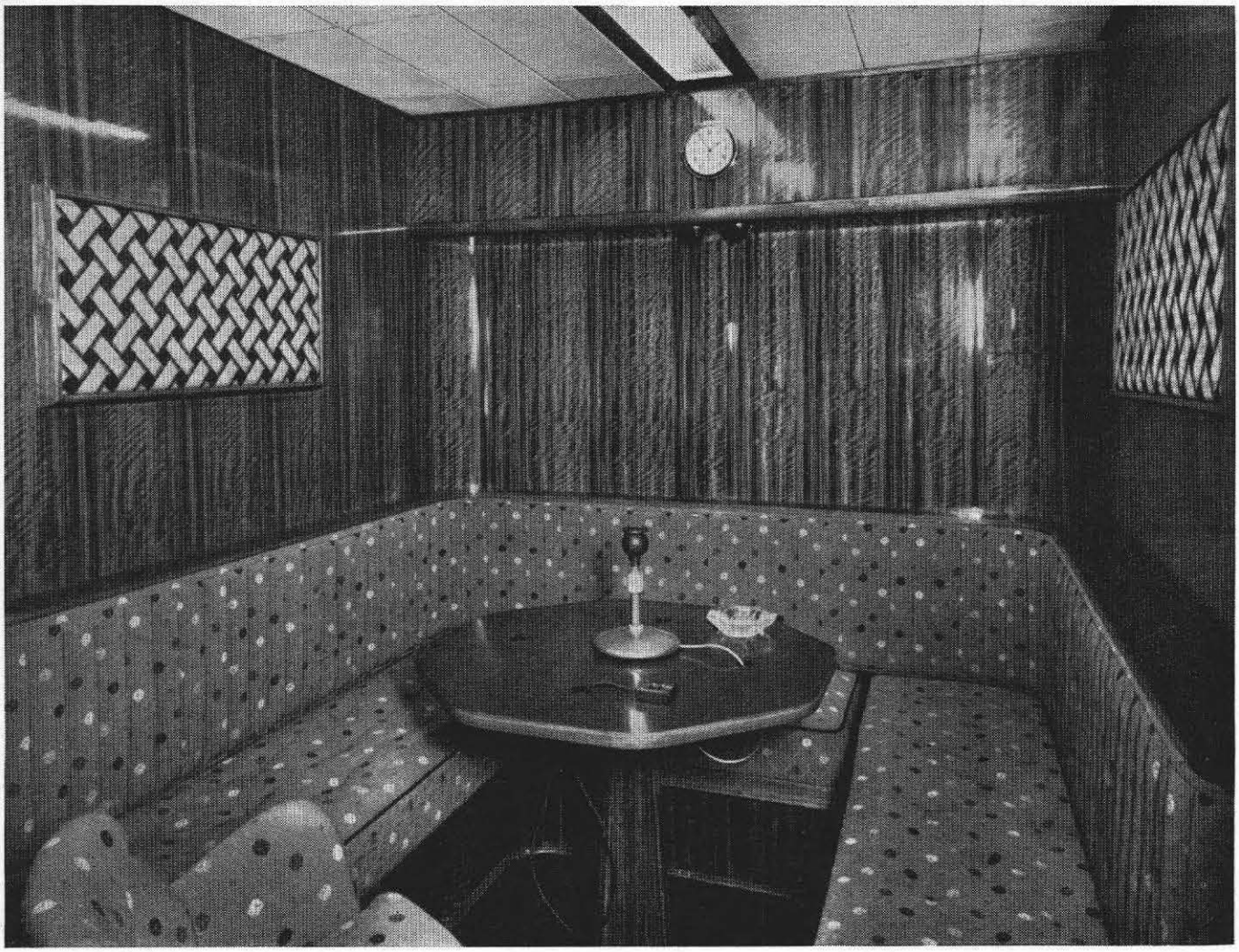

Fig. 9 — View of rear end of studio

studio, the space between them being occupied by the 6-in. spring-driven clock.

The false ceiling is made up with acoustic tiles carried on battens. At each side in the void, air ducts, which extend over the full length of the studio, are formed, air access to these ducts being provided by omitting the filling from alternate acoustic tiles in those rows underneath the ducts.

The two ducts are extended, one directly and the other above the control desk, over the false ceiling in the entrance lobby to separate extract fans installed in cubicles formed in the joinery fitted on the nearside of the production area. Access to the fans is obtained through doors on the facing of the joinery. The fans are mounted at an angle of about 45° and discharge through ducts leading to grille-covered apertures on the outside of the body. This arrangement provides good weatherproofing with a greater free area than would have been possible with louvres in the space available. There is also a third fan, installed in line with the studio fans and having its access door provided with a grille, which extracts air from the production area and control room. Air is admitted to this region by opening the window.

The studio lighting trough, finishing with glazed frames flush with the ceiling, is formed in the void on the centre line. Four 4-ft fluorescent tubes for normal lighting and eight 24-V metal-filament lamps for emergency use are fitted in the trough.

The floor is covered with a sponge rubber underlay and close-carpeted in dark blue. Until required for service a canvas drugget, fixed with glove-type fasteners to a surrounding batten, protects the carpet. When not in use the drugget is stored in the locker under the rear seat.

Fig. 10 — View of front end of studio showing observation window to control area and door to entrance lobby

3. Programme Facilities

Fig. 11 shows the schematic diagram of the programme facilities provided in this Mobile Studio and Control Room.

3.1 *Programme Chain*

The control desk incorporates an eight-channel mixer which may be fed from any of the following sources:

1. Eight incoming low-level source lines, through repeating coils or microphone transformers, if necessary.
2. Eight incoming high-level lines (through attenuator pads of 70, 45, or 20 dB, eight of which are available on the jackfield). Apart from three 50-ohm shunts, which will normally suffice for the short local ends likely to be encountered, no equipment is provided for the equalization of these lines.
3. Two radio-link receivers (f.m. v.h.f. transmitter-receiver sets housed inside the vehicle).
4. Two radio receivers associated with commentators' pack-sets.
5. Two microphones in the adjoining studio, through appropriate transformers if required. (One S.T. & C. 4021H and one S.T. & C. 4038B[1] are provided. For these, and for the incoming low-level source lines when used with low-impedance microphones, four transformers, having an impedance ratio of 30:300 ohms, are available on the jackfield.)
6. The output from the four-turntable disk reproducing desk.

Constant impedance mixing at high level is employed and there are eight channel amplifiers of BBC type AMC/5.[2]

The mixer is split into two groups (1A, 2A, 3A, 4A, and 1B, 2B, 3B, and 4B). These are normally combined by plugging both outputs into the two-channel star mixer input of the main control fader. For 'Grade 1' outside broadcasts one group may be fed to the main control fader and the other through the standby O.B. amplifier installed above the control desk.

The main control fader, set to give a loss of approximately 20 dB, is followed by the main amplifier, BBC general purpose type GPA/4A, a spare for which is provided and terminated on the jackfield. This amplifier raises the programme to zero level.* At this point the main monitoring amplifier, BBC type MNA/3, is bridged across to provide visual and aural monitoring.

The programme is then fed to the input of four BBC type C/9 line sending amplifiers (Nos. 1–4), which, with their associated impedance correction networks, are provided for feeding the output to any of the following destinations.

1. *Eight outgoing high-level lines* through the necessary repeating coils and attenuators. For this purpose, eight repeating coils and eight attenuators are available. Four of the coils have an impedance ratio of 600:600 ohms and the other four 600:75 ohms. The attenuator pads have losses of 14 dB (1 off), 10 dB (1 off), 6 dB (2 off), and 4 dB (4 off). For normal O.B. use a C/9 amplifier is fed to the line via a 4-dB attenuator and a 600:75-ohm repeating coil. The power level delivered to the line under these conditions will be +4 dB ±2 dB for any line impedance between 600 ohms and 75 ohms.
2. *Two Radio Transmitters* (the transmitter-receivers already referred to).

   These transmitters are used to carry the main programme where no outgoing line is available, or to feed cue programme or talk-back to a commentator in the field.

   In the former case the transmitter is fed from one of the C/9 amplifiers, in the same manner as a line, via an input jack which introduces the necessary attenuation. An alternative jack is provided for the latter case where the appropriate cue/talk-back line jack is plugged to the transmitter input.
3. *A portable Tape Recorder* accommodated in the space ultimately to be occupied by fixed equipment.

No relay contacts are employed anywhere in the programme chain.

The external lines are connected to a terminal panel mounted at the rear of the apparatus bays. A short duct is provided underneath the body of the vehicle to carry the incoming and outgoing cables to the panel.

3.2 *Pre-fade Checking Circuits*

By operating the appropriate 'Pre-fade/Talk-back' key, on either the control panel or the producer's desk, the mixer channel input selected is connected through the associated relay to the input of the pre-fade amplifier (BBC type GPA/4A) and thence, via the comprehensive checking keys—described in Section 3.4—to headphone jacks on the desks and the loudspeaker in the control and production area.

A second monitoring amplifier (BBC type MNA/3) designated 'PF/TB' is normally connected across the output of the pre-fade amplifier. The programme meter associated with this amplifier is thus available for visual pre-fade checking purposes.

The circuit arrangement is such that only one pre-fade relay can be energized at a time.

3.3 *Talk-back Circuits*

Talk-back facilities are provided to any or all of eight remote points as well as to the local studio. For this purpose two microphones are installed (one at the control desk and the other at the producer's position) either or both of which may be connected on the jackfield to the input of the talk-back amplifier (BBC type GPA/4A).

The output from this amplifier is multipled to the eight relays 'ITB1A', 'ITB1B', 'ITB2A', etc. whence it is fed to any of the eight external programme sources, via the associated control lines, by throwing the appropriate 'PF/TB' key at either of the desks to the 'TB' position. Keys 1A, 2A, 3A, and 4A are associated with control lines Nos. 1–4 respectively and 1B, 2B, 3B, and 4B with lines Nos. 5–8.

* Zero level = 1 mW in 600 ohms

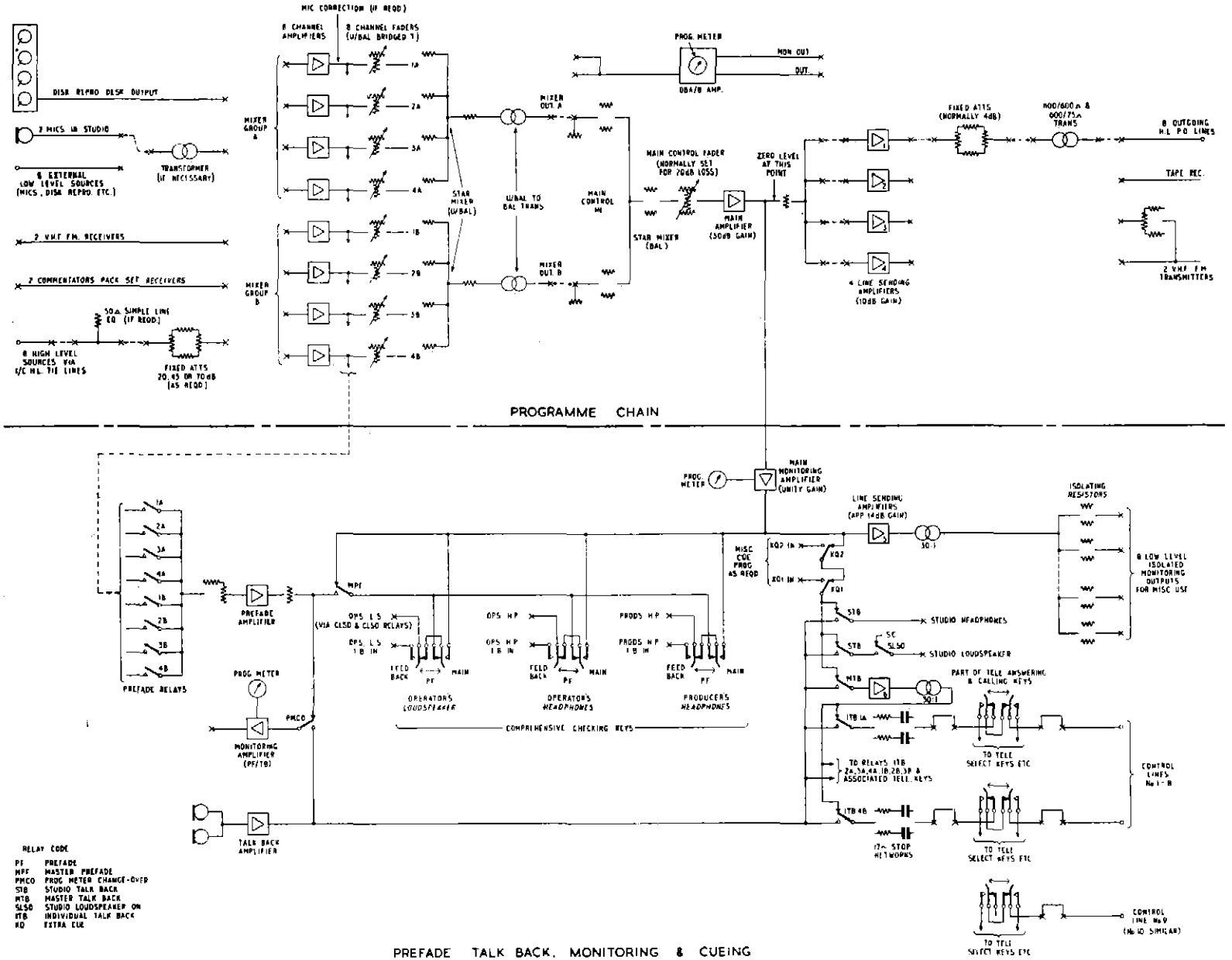

Fig. 11 — Schematic diagram of programme input equipment

Operation of the 'Master Talk-back' key on either the control or the producer's panel connects the output of the talk-back amplifier to the input of line amplifier No. 6 and thus to the eight control lines in place of the cue programme which that amplifier would otherwise send. This is described in Section 3.4 under 'Monitoring and Cueing'.

At the same time, the output of the talk-back amplifier is fed to the headphone circuit in the studio, as a result of the operation of relay STB which also connects the loudspeaker.

By virtue, however, of a short circuit on the coil of relay SLSO, established through sleeve circuits associated with the two studio microphone jacks and auxiliary contacts on the channel faders, the loudspeaker feed is interrupted if any channel fader having a studio microphone connected to it is faded up.

A separate key is provided on each panel for normal talk-back to the studio, and operation of either key connects the output of the talk-back amplifier to the headphone circuit in the studio. The studio loudspeaker is also available in the 'transmission' condition, subject to the same restrictions as have already been described for master talk-back. In the 'rehearsal' condition, the short circuit on the coil of relay SLSO is removed by the operation of the studio talk-back keys and the output of the talk-back amplifier is then available on the loudspeaker, irrespective of the setting of the faders.

The combination of individual pre-fade and talk-back facilities permits two-way briefing conversations with remote sources to be carried out without affecting the main programme chain.

3.4 *Monitoring and Cueing*

The main monitoring amplifier, the input to which has already been referred to in connection with the programme chain, provides a source for both internal monitoring and internal or external cue purposes.

Cue programme is made available internally by feeding line amplifier No. 5, the output of which is connected directly to a transformer with an impedance ratio of 30:1. This presents at its secondary an impedance of approximately 4 ohms and the output is taken in eight branches, via 100-ohm isolating resistors, to the jackfield for subsequent distribution as required.

A system for the external distribution of cue programme is provided by feeding line amplifier No. 6, the output of which is connected through a transformer to the first eight of the ten control lines. This cue programme is interrupted by the operation of the associated relay when a control circuit is required for talk-back, or by the operation of the answering key when the line is required for its normal function as a telephone circuit.

For internal monitoring, comprehensive checking keys are provided on both the control and producer's desks. Each key has three positions, 'Main', 'Pre-fade', and 'Feed-back'.

The key fitted to the producer's panel, when in the 'Feed-back' position, permits the associated headphone jacks to be fed from any source previously plugged to 'PRODS HP FB IN' on the jackfield. In the 'Pre-fade' position, the headphones are supplied with the programme output from the main monitoring amplifier unless one of the pre-fade keys is operated on either desk, in which case the headphones are connected to the channel that has been selected. In the 'Main' position programme output is available without interruption.

Two comprehensive checking keys are fitted to the control desk. One is associated with the operator's headphone circuit and the operation is similar to that on the producer's desk, the related feed-back being designated 'OPS HP FB IN'.

The second key controls the input to the control and production area loudspeaker, selecting, as in the case of the headphone circuit, 'Main', 'Pre-fade', or 'Feed-back'. The associated feed-back input jack is designated 'OPS LS FB IN'.

The loudspeaker is provided with a 'LS DIM' key to attenuate the output if required during telephone conversations. The necessary control of the loudspeaker, when using the talk-back microphones, is exercised automatically by relays.

The studio headphone jacks are normally supplied with the programme from the main monitoring amplifier. This ceases to be so when either of the 'Studio' or the 'Master' talk-back keys is operated, or when advantage is taken of facilities provided for distributing special cues. These cues may be fed into jacks designated 'XQ1 IN' and 'XQ2 IN' and they then become available on the studio headphone circuit and, via line amplifier No. 6 and the control lines, to the eight external programme sources as alternatives to the main programme if the appropriate 'XQ' key on the producer's desk is operated.

The studio loudspeaker provides the same facilities as those described for the headphone circuit except that it is dependent upon the operation of relay SLSO as described in detail in Section 3.3.

A circuit designated 'GRAM EXT. MON. CCT.' originates on the jackfield and terminates on the reproducing desk. Into this may be plugged cue programme or any required alternative.

The output from the car-type radio receiver is available on the jackfield and may thus be distributed for cue purposes if required.

3.5 *Disk Reproducing Desk*

The disk reproducing desk consists of a bank of four 78-r.p.m. units. Each unit consists of a turntable and motor assembly (BBC type TTU/6), a Drop Start Editing Unit (BBC type DETU/1), and a parallel tracking Groove Locating Unit (BBC type GLU/9B). As the turntable motor is hung from soft suspension rubbers, a hydraulically-operated support is provided to relieve the suspension when the vehicle is travelling.

A sloping panel is associated with each unit, the panel carrying a fader (BBC type P/23M), a headphone jack, a key to introduce equalizers for either direct recordings or

pressings, and a key to select 'pre-fade' or 'external monitoring' for the headphone jack.

To avoid the necessity for four separate amplifiers for pre-fade listening, an additional key is fitted to each of panels 2 and 4. The key on panel 2 allows the output from either pickup No. 1 or pickup No. 2 to be fed to one pre-fade amplifier, whilst that on panel 4 selects the output from pickup No. 3 or No. 4 to feed a second amplifier.

Headphones plugged into the jack on either panel 1 or panel 2 will be connected to the output of the first amplifier when the key on the same panel is in the 'pre-fade' position. Thus, without removing the headphone plug, operation of the additional key on panel 2 allows the operator to listen to the output from either pickup 1 or 2. Similar facilities are available on panels 3 and 4 for listening to the output from the associated pickups by operating the additional key fitted to panel 4.

Dwarf apparatus bays are installed in the space underneath the desk. These bays carry a chain of three equalizing units for each pickup together with the two pre-fade amplifiers and their associated supply unit. The cables from the sloping panels on the desk terminate in plugs which engage in sockets incorporated in the apparatus mounted on the bays. This allows a panel to be removed either for servicing or to improve access to the underside of the turntable panel.

The motor clamping arrangement consists of a plate to which are fitted three wooden blocks with sponge rubber facings. The plate is mounted on a vertical central shaft which is carried in a bearing supported from the motor panel. An upward movement of the shaft brings the rubber-faced blocks up to the motor, which they are shaped to fit. A short additional upward movement supports the motor and relieves the suspension rubbers. Each assembly is provided with the upward movement by a small standard hydraulic ram. The four rams are actuated from a car-type clutch operating cylinder, which incorporates the fluid reservoir and to which a pedal has been fitted. Internal springs ensure the retraction of the rams and the return of the fluid to the operating cylinder when pressure is removed from the pedal. When a clamp has been raised sufficiently to support the motor, a spring-operated catch is arranged to engage with a groove in the carrying shaft. By this means the hydraulic pressure is applied only for the lifting operation, the support being retained in position by the mechanical lock. The volumes of the operating cylinder and the rams are such that the four motors are locked with one pedal stroke.

Each turntable panel is provided with a plunger which, when depressed, pulls back the spring-operated catch and allows the motor support, assisted by a built-in coil spring, to fall away. When this has been done the plunger remains almost flush with the panel face thus serving as an indication that the motor support has been released. Operation of the pedal will lock all the motors which have been released as, if any support is already in position, its ram merely makes an abortive stroke. A switch, operated by the support assembly, ensures that the motor cannot inadvertently be used in the clamped position.

3.6 *Signalling Circuits*

The following signalling facilities are provided:

Red (transmission) and green (cue) lights in the studio, operated from the control panel.

A green cue light on the disk reproducing desk, operated from the studio.

A return buzzer circuit from the studio.

Provision is also included to permit the use of two remote visual signalling units connected to the vehicle by cables.

3.7 *Telephone Circuits*

Calling and answering equipment is provided for the ten control lines, with visual and aural alarms. The control position is equipped with two telephone instruments, one on each side of the desk. The normal ringing supply for both is derived from a 'Syncycle' static convertor, but the left-hand instrument also incorporates a magneto for emergency use.

One telephone instrument is fitted at the producer's desk and keys, connected to form a small cordless exchange, are provided by means of which the control engineer may extend the producer's telephone to any of the ten lines, or establish connections between them.

3.8 *Test Equipment*

A six-frequency tone source, mounted on a panel, is fitted to the apparatus bays. To avoid the necessity for switching off the associated mains unit when the tone source is not required, the h.t. and l.t. supplies thereto are taken through the contacts of a relay which is operated via the auxiliary spring set on the output jack on the tone source panel.

4. Power Supplies

4.1 *General Description*

The equipment in the vehicle is normally supplied through a 3-core flexible cable from the public supply mains. A 24-V lead-acid storage battery is, however, provided and is capable of supplying the apparatus for several hours through the vibratory convertors in the event of a mains failure. Charging equipment is incorporated to recharge the battery as soon as the mains supply is restored. A 12-V battery of the same capacity is also installed, together with similar charging facilities. The main purpose of this battery is to provide a supply for the f.m. v.h.f. transmitters and receivers.

4.2 *Mains Supply Circuits*

The incoming supply is taken through an earth-leakage relay, which serves also as a main circuit breaker, and a kilowatt-hour meter to an auto-transformer tapped at 205, 225, 240, and 250 volts.

A selector switch, marked 200/210, 220/230, 240, and 250 allows a voltage of 240 to be supplied to the equipment from any source between 200 and 250 volts. A schematic diagram of the power distribution circuits is shown in Fig. 12.

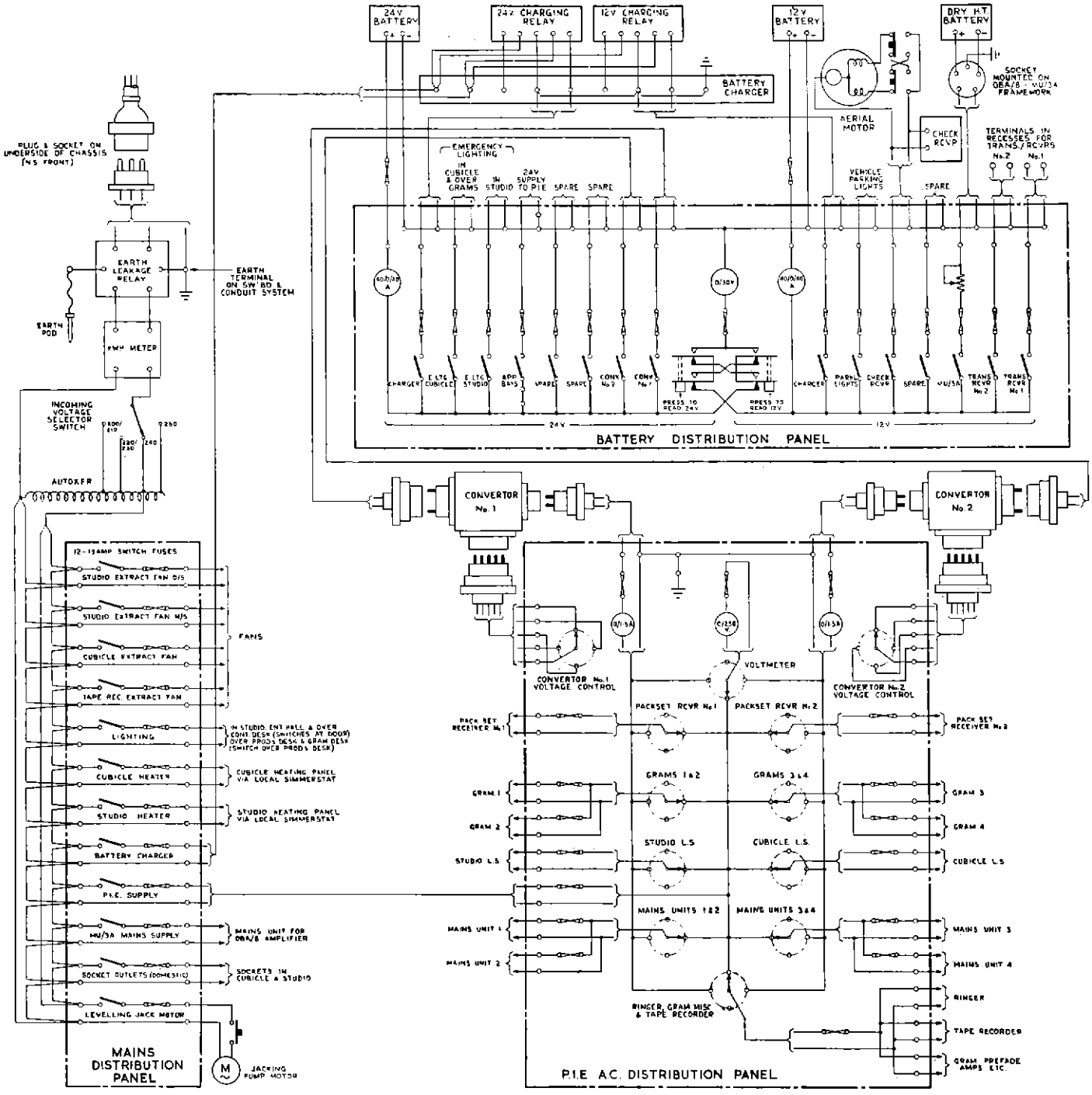

Fig. 12 — Schematic diagram of power distribution system

As the kilowatt-hour meter and the earth-leakage relay are unsuitable for visible surface mounting, they are accommodated behind an enclosure door, with push rods mounted as an assembly on the door, to operate the relay from outside.

An earth rod and a separate flexible cable are provided for the earth-leakage relay.

The supply is then taken to a bank of twelve switch-fuses forming the mains distribution panel. To provide a compact assembly, flush 13-A fused and switched spur boxes mounted on a sheet metal box are used. The ability to unscrew and withdraw each unit renders it unnecessary to provide rear access to the panel.

The following outlets are taken from this distribution panel:

Four to ventilation extract fans.
Two to 'Thermovent' space heaters.
One to lighting points via local switches.
One to battery charger.
One to mains unit of reserve amplifier (OBA/8).
One to programme input equipment (via P.I.E. distribution switch panel).
One to levelling-jack pump motor.
One to general-purpose socket outlets.

4.3 *Power Supplies to Programme Input Equipment*

The P.I.E. distribution switch panel, through which the supply is taken to the programme input equipment, is provided primarily to enable the various items of equipment to be fed from the mains or, in the event of mains failure, from the vibratory convertors, with as much flexibility of switching as is consistent with simplicity.

The programme input equipment imposes a load of approximately 600 VA. It was convenient, therefore, to install two standard vibratory convertors each having an output of 300 VA and a 24-V input.

The distribution panel, incorporating a mimic diagram, is installed on the left-hand side of the rack-mounted apparatus. The layout of this panel is shown in Fig. 13 and the arrangement is such that a failure of one of the convertor units could coincide with a mains failure and still leave half the equipment serviceable. The panel includes a voltmeter, ammeters to indicate the loading on the convertors, and tapping switches to correct the output voltage of either convertor for the load imposed. Panel-mounted, screw-type fuses are provided to protect the convertors and the outgoing circuits.

H.t. and l.t. supplies are provided by two duplex mains units; that is, four supply sources. One of these sources supplies the eight channel amplifiers; another the main, spare, talk-back, and pre-fade amplifiers; and a third, the line and monitoring amplifiers. The remaining one supplies the tone source.

A plug and socket is interposed between each mains unit and the apparatus which it feeds. The four sockets are mounted on a panel and the plugs are on flexible cables. This arrangement allows the mains unit, which normally supplies the tone source and which is only required for test purposes, to be released and used to replace any one of the remaining units in the event of a failure.

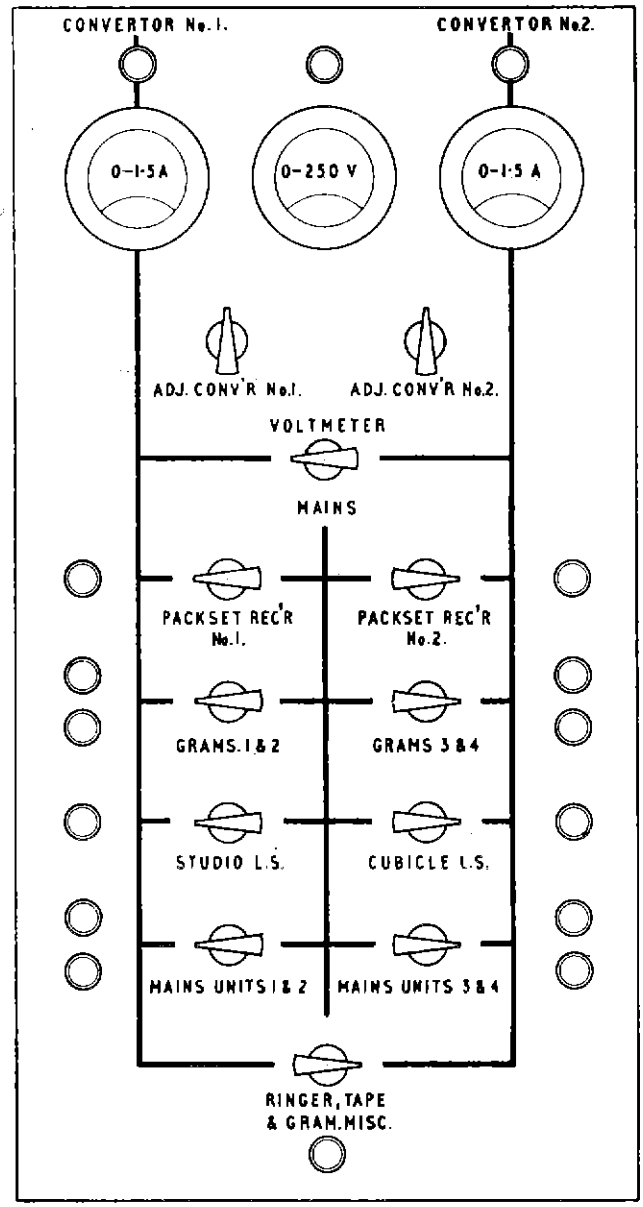

Fig. 13 — Programme input equipment a.c. power supply switchboard

4.4 *Battery Supplies*

The 24-V and 12-V batteries, each with a capacity of 260 Ah at the 10-hour rate, are fused locally and the outputs are distributed from the switch and fuse panel located on the rear supporting framework of the producer's desk; see Fig. 6. The charger outputs are wired to switches on this panel.

Feeds are taken from the 24-V system to the two vibratory convertors, the programme input equipment (via a separate fuse panel distributing to relays, telephone circuits, etc.), and to an emergency lighting system through-

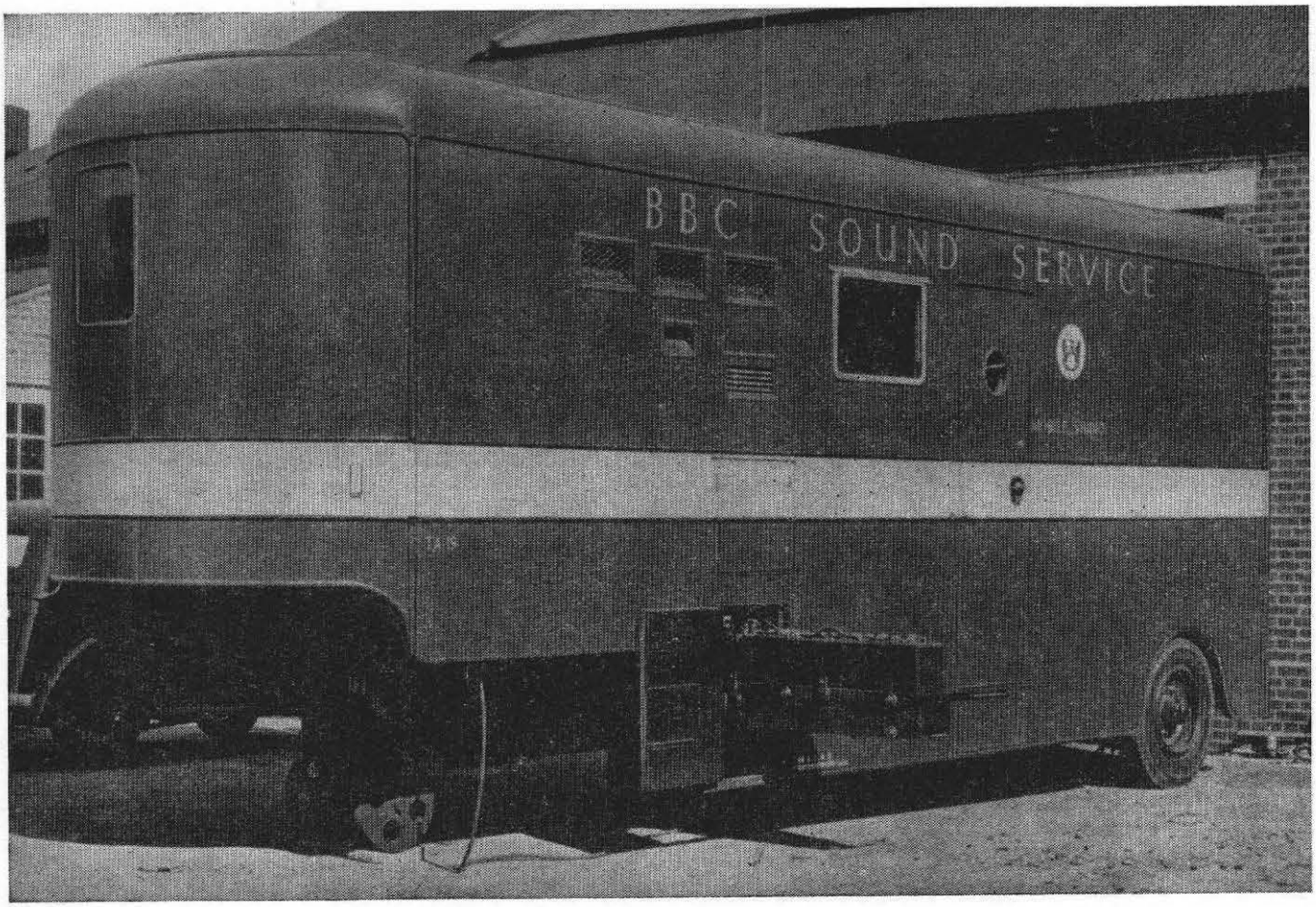

Fig. 14 — External view of near side showing two units of 24-V battery withdrawn for inspection

out the vehicle. From the 12-V system supplies are taken to the two f.m. v.h.f. transmitter-receivers, parking lights on the vehicle, the car radio receiver, and, through a dropping resistance, to the heaters of the reserve OBA/8 amplifier.

The chargers for the two batteries are in one unit, the components being assembled on to the back of a hinged panel. This equipment is installed at the end of the entrance lobby and covered by a detachable wooden panel, fitted with ventilating grilles. The panel can be seen in Fig. 8, to the right of the venetian blind.

To permit the batteries to be left on charge with the vehicle unattended, and to avoid overcharging at any time, a relay is associated with each battery to terminate the charge when a pre-set period of up to six hours has expired after the battery has reached the equivalent of 2·35-V per cell.

To house the 24-V battery a special carriage has been provided and is fitted to the chassis immediately behind the drop from the high level, the drop in the body having been made correspondingly farther back to accommodate this feature. As the four 6-V units, placed in the carriage end to end, occupy rather less than the 7 ft 6 in. overall width of the vehicle, the arrangement provides good weight distribution and allows access to one pair of 6-V units by withdrawing the carriage through a door on one side of the body and to the other pair from the opposite side. For the withdrawal of the carriage a pivoted handle is provided at each end. Dropping the handles from the vertical to the horizontal position, as a preliminary to pulling out the carriage, releases the lock which otherwise exists between the carriage and the rails upon which it runs.

The access door to the 24-V battery carriage on the near side of the body, shown in Fig. 14, also serves the shelf upon which the incoming mains supply cable is transported.

The two 6-V units which make up the 12-V battery are housed in a separate compartment with an external access door. Withdrawal of these batteries is facilitated by a metal shelf which hinges outwards after the external door has been opened. Both the fixed and hinged portions of the battery shelf are equipped with rollers which assist in withdrawing the 6-V units.

5. Jacking

To permit the disk reproducing desk to be levelled, and to ensure that it will remain so when the vehicle is entered, or when movement of personnel takes place, an hydraulic jacking system has been incorporated in the design to support the chassis from the ground in a level condition with the weight clear of the road-springs after the trailer has been released from the tractor.

The motor driving the pump operates from the mains supply as the jacking is not required until the trailer is at the site and no inconvenience results from having first to connect the supply.

Six needle valves, a motor push button, an indicating lamp, and a 'T' level are grouped on the central triangular fill-up panel on the disk reproducing desk. The fluid circuit is indicated by lines engraved on the panel in the form of a mimic diagram which can be seen in Fig. 15. The system is operated by first delivering the fluid to the rear jacks with the interconnecting valve ('EQUALIZE REAR JACKS') open. When these are fully extended a small quantity of fluid is released through the 'LOWER REAR' valve, in order that the jacks may be clear of their maximum extension position and able to behave in a manner comparable with that of a single central jack.

Fluid is now delivered simultaneously to the two front jacks through the appropriate valve until both have reached the fully extended position. By now releasing fluid from either of the front jacks a condition can be reached where the level across the vehicle is correct, fluid transfer between the two front jacks being prevented by a non-return valve in each of their delivery lines. This condition

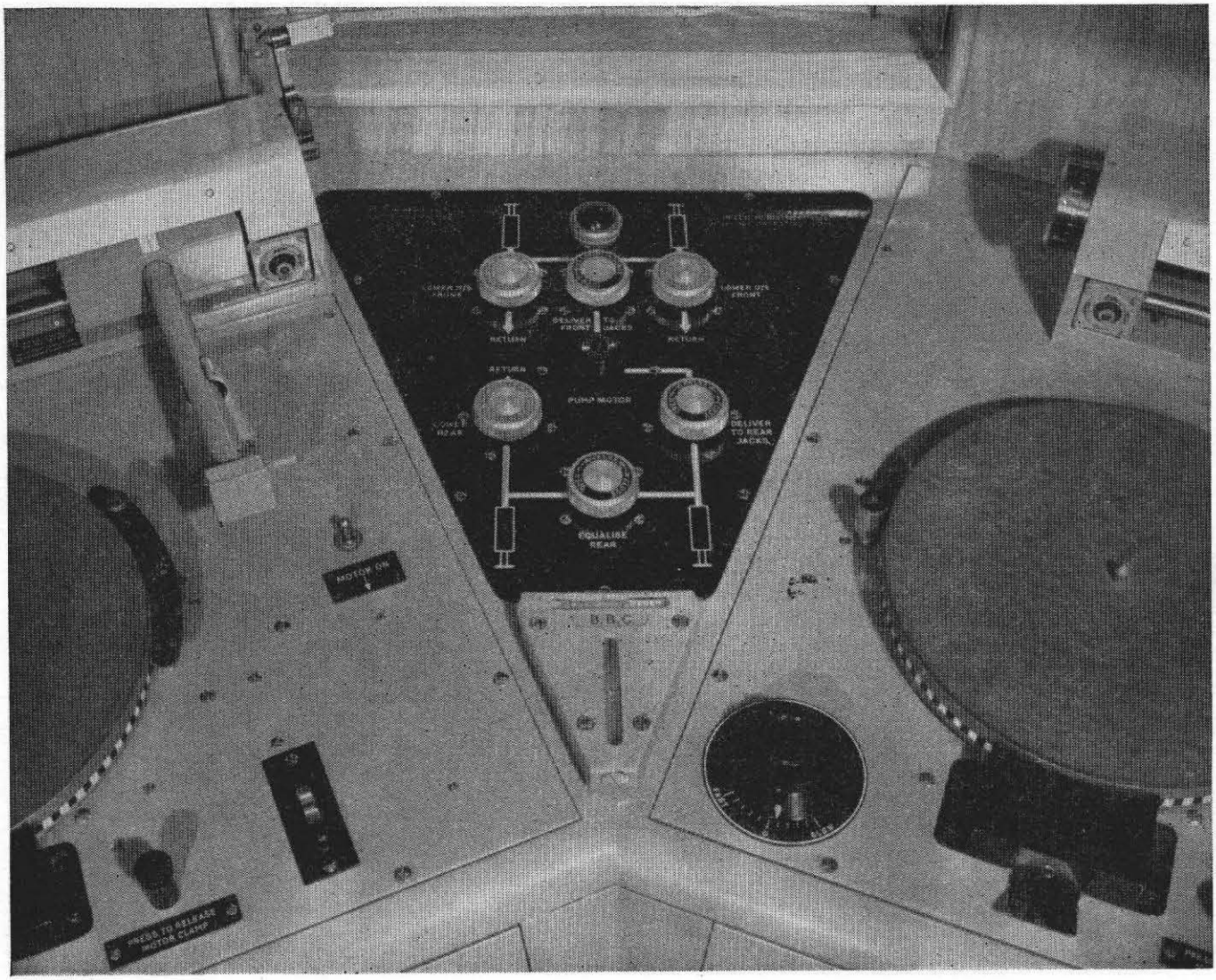

Fig. 15 — The control panel for the hydraulic jacking system

can be maintained while the front jacks are lowered until a level is established on the other axis. When this adjustment is complete, the equalizing valve which forms the connection between the two rear jacks is closed and a rigid four-point support is established.

The procedure takes advantage of the greater sensitivity which is available by utilizing the release of fluid, as opposed to the control of the fluid delivery, for the levelling adjustment.

Full extension of either pair of jacks is indicated by a lamp operated from a flow-switch fitted in a tank return pipe from a pressure release valve appropriately adjusted. The pump and motor units, together with the fluid tank, are housed in the space underneath the disk reproducing desk.

It should be noted that, although most of this equipment has been installed and tested, the entire system has not been fully commissioned at the time of going to press, owing to unforeseen delays in obtaining the special rams.

6. Conclusions

The vehicle has now been in service for some six months and has proved a useful addition to the BBC's outside broadcast fleet. One of its more interesting assignments was at Brussels where, for the first two weeks of the Universal and International Exhibition, it formed a working exhibit. During its stay in Brussels the vehicle handled some forty-seven programme contributions. Five of these were for the Canadian Broadcasting Corporation, and twenty-seven were used in the BBC's Home, Light, and Television Services. The remainder formed part of the BBC's overseas programmes in the Czech, French, Hebrew, and Russian Services.

When free from broadcasting commitments the vehicle was opened for inspection by visitors to the exhibition.

7. Acknowledgments

The author would like to place on record his appreciation of the assistance he received from his colleagues in the Planning and Installation Department. In particular, he would like to thank Mr K. S. Beavins, who was responsible for the programme input equipment and gave assistance in the preparation of this Monograph. Tribute is also due to Messrs G. W. M. Daymond and E. P. Evans for their contributions in the early stages of the design of the programme input equipment in the first Mobile Studio and Control Room.

In addition, the author would like to thank the staff of Equipment Department for their counsel and assistance in connection with the design of the chassis and the installation and wiring work throughout the vehicle.

8. References

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2. Berry, S. D., **Newly Developed Amplifiers for the Sound Broadcasting Chain,** BBC Quarterly, Vol. 9, No. 2, Summer 1954.

CORRECTION TO ENGINEERING MONOGRAPH NO. 16

The following corrections should be noted to pages 13 and 14 of Monograph 16:

PAGE 13:	for figure	3(f)	3(c)	3(e)	3(b)	
	read	4(f)	4(c)	4(e)	4(b)	
PAGE 14:	for figure	4(c)	4(c)	4(d)	4(d)	4(e)
	read	5(c)	5(c)	5(d)	5(d)	5(e)

BBC Television—A British Engineering Achievement

This is the title of a new booklet recently published by the BBC.

The booklet is written for readers who already have some technical knowledge, though not necessarily in the specialized subject of television. It contains a chapter describing briefly 'How Television Works'.

The booklet gives an up-to-date picture of the television facilities that have been built up and which are now in use by the BBC and goes on to describe the new Television Centre now under construction near Shepherds Bush, including an illustration in full colour.

There is also a BBC television coverage map in five colours and advice on receiving the BBC television service.

The booklet includes a résumé of the history (with a list of important dates) of the development of BBC television from 1936 and of the international exchange of television programmes (Eurovision) which was pioneered by the BBC and RTF (Radiodiffusion-Télévision Française). There is an up-to-date map of the Eurovision network.

Although not written for the layman, the booklet is so copiously illustrated that no one could fail to find it of interest.

Obtainable through newsagents and booksellers, price 2s. 6d., or post free (by crossed Postal Order) from BBC PUBLICATIONS (BRITISH ENGINEERING), 35 MARYLEBONE HIGH STREET, LONDON W.1.

Published by the British Broadcasting Corporation, 35 Marylebone High Street, London, W.1
Printed on Basingwerk Parchment in Times New Roman by The Broadwater Press Ltd, Welwyn Garden City, Herts. *No. 3832*