General-Purpose CMCRs in the BBC

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Summary: This article traces the development of CMCRs (Colour Mobile Control Rooms) in the BBC and describes in some detail the latest model (Type 4) which entered service in 1976. It also includes brief information about the design of the Type 5 CMCR which is due to enter service in 1978.

The author describes only general-purpose vehicles and does not deal with those made for specific applications, such as drama or news, or those which have limited facilities.

1 Introduction
2 Type 1 CMCR — 1967
3 Type 2 CMCR — 1969
4 Type 3 CMCR
5 Type 4 CMCR — 1976
5.1 Production Control Room
5.1.1 Vision Mixer
5.1.2 Flexible Cue System
5.2 Vision Engineering Control
5.3 Sound Control
5.4 Talkback System
5.5 Power Distribution
6 Type 5 CMCR — 1978
7 Conclusion

1 Introduction

A CMCR has to accommodate all necessary personnel and control equipment in a vehicle of acceptable (and usually minimal) overall dimensions. There are two alternative basic arrangements.

a) Personnel are seated in rows across the vehicle (crosswise layout). If the rows of seats are on different levels, monitors may be shared.
b) Personnel are seated side-by-side in line along the vehicle (in-line layout).

In both cases the vehicle may be divided into areas separated by semi-glazed partitions to facilitate the operations of the various sections of the production team whilst reducing acoustic crosstalk between areas.

Disadvantages of the crosswise layout are:

i) A maximum of four operators in any one line.
ii) The number of monitors in a stack is limited by the height and width of the vehicle, so putting a limit on complex productions.
iii) It is difficult to provide satisfactory visibility between areas without having uncomfortable viewing angles for the operators.

The main limitation of the in-line layout is set by the vehicle width (maximum 2·5 m in the United Kingdom) which restricts access behind operating positions. If precision slimline colour monitors ever become a reality more space will be available, although it is likely that equipment for additional facilities will fill some of it at least.

Especially on sports and multi-location programmes the sound operator needs to see the vision mixer panel in order to anticipate picture location changes and synchronise the sound accordingly. This requirement is particularly important on outside broadcasts as it is usual for the producer to do the vision mixing and not unusual for shots to be called after the event.

2 Type 1 CMCR — 1967

This type of CMCR, of which three were built on BBC premises, opened the BBC colour television service in July 1967 with outside broadcasts of the Wimbledon Tennis Championships.

Reflecting the lack of operational experience the vehicles were designed to use any of several types of camera but were eventually equipped with Philips PC60 cameras which were judged to be the most suitable for outside broadcast use at that time.

The equipment was capable of 625/PAL and 525/NTSC standards of operation, the latter to facilitate programme production for the United States market as there were no colour standards converters available at the time. All the equipment was built into demountable frameworks (subracks) to permit a complete de-rig into a theatre or other building — a technique which has since proved too expensive in time to be practicable for colour operation although it was routine at some venues in the monochrome days.

The crosswise vehicle layout (figure 1) shows strong evidence of its monochrome ancestry, having a shared operational area in front of an economical monitor stack which included only two (later augmented to three) colour

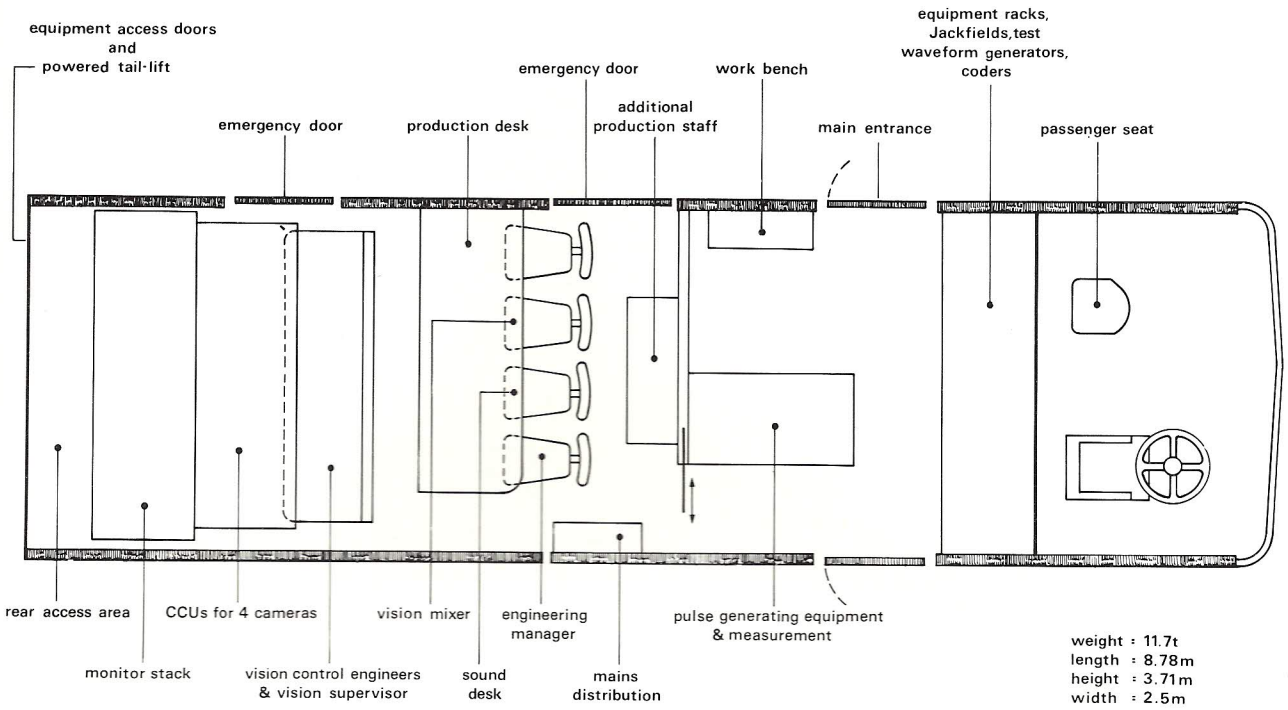

Fig. 1 Layout of Type 1 CMCR

monitors. The camera control units were heavy console units which could be removed through large rear doors through a powered tail lift. Such rear access is, however, unsatisfactory in wet or cold weather.

Experience with the Type 1 CMCRs led to a major review of the design before construction of the fleet of nine CMCRs of Type 2 which were still in service when this article was published.

3 Type 2 CMCR — 1969

The rapid growth in the complexity of colour outside broadcasts soon made the limitations of the crosswise layout unacceptable. The in-line layout (figure 2) was therefore adopted for Type 2 and all subsequent large vehicles. The Type 2 CMCR, of which nine were built under contract by Pye TVT Limited, became the main fleet vehicle.

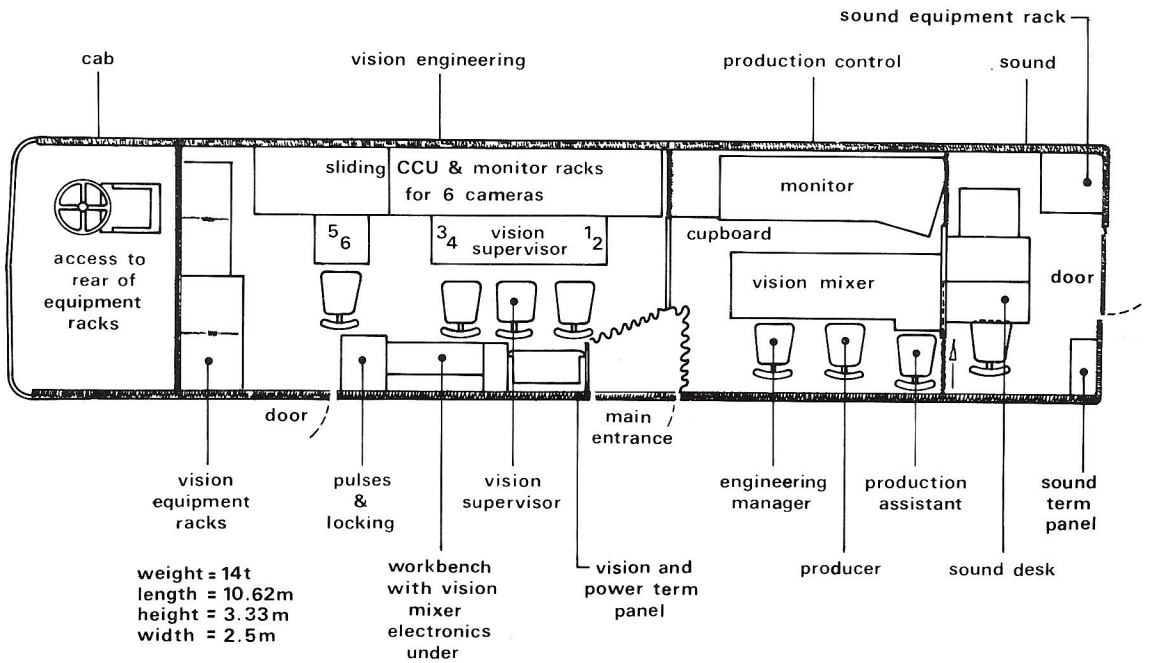

Fig. 2 Layout of Type 2 CMCR

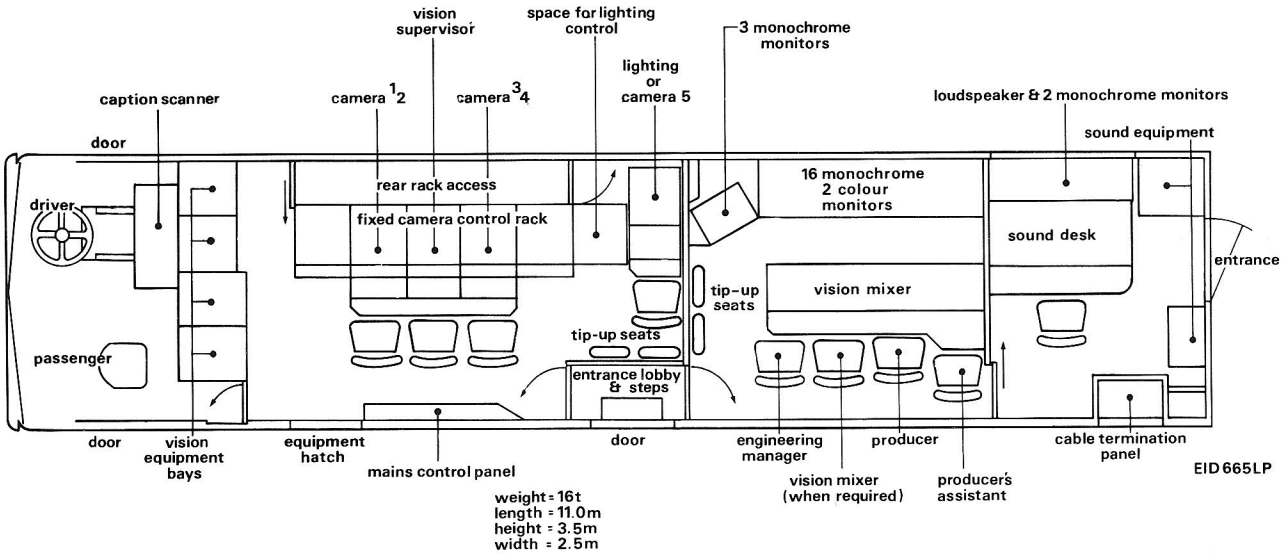

Fig. 3 Layout of Type 4 CMCR

Among other innovations were the use of the driving cab to give access to the rear of the main vision equipment racks and the installation of lighting control equipment. Access to the rear of the camera control units is obtained by sliding them forward on runners. This arrangement gives maximum area for personnel under operating conditions.

4 Type 3 CMCR

The Type 3 CMCR was a design concept which was not implemented. It was to have been a two-channel vehicle offering full facilities but preliminary costing showed that it would have been too expensive to justify the benefits envisaged from the design. As the proposal has been superseded, no details are given here.

5 Type 4 CMCR — 1976

The Type 2 CMCRs were generally well liked although the design did have some weaknesses and so in 1975, when it became necessary to replace two of the Type 1 vehicles, comprehensive discussions between operational and engineering departments resulted in a BBC Specification for Type 4 vehicles. Two vehicles, CMCRs 16 and 17, were built by Pye TVT Limited and entered service in Wales and Scotland respectively in 1976. The design brief for Type 4 included the following improvements or additional facilities.

i) An entrance lobby to reduce draughts and light from outside. Its doors to close quietly and securely.

ii) A layout which should preclude the need for sliding equipment racks, especially where there is frequent need for rear access to camera control units and monitors. Such access has contributed to some reliability troubles and has impeded access to racks at the far end of a row.

iii) A lighting control position, which would double as a fifth camera position.

iv) Comprehensive termination panels including more tie-lines to enable on-site cables to be easily connected outside the vehicle. Appropriate services to be connected on jackfields within the vehicle.

Fig. 4 General view of Type 4 CMCR

Fig. 5 Type 4 CMCR: Production Control Room

v) New communication facilities with improved quality and greater versatility. Communication to be direct between relevant operators without need for special arrangements (add-on boxes) for unusual programmes. Most outside broadcasts are unusual in some way.

vi) Enough monitors for large and complex shows to be permanently built in, so that the need for supplementary racking was obviated.

Consideration was given to the use of an articulated vehicle, but it would have had serious disadvantages. The coupling arrangements between tractor and trailer would add about 2 m dead space to the overall length and this would make parking and garaging more difficult. The coupling also results in a high floor level. Instead, a rigid chassis of the maximum legal length (11 m) was chosen and a second steered axle was added to achieve a uniform weight distribution. (A rear axle with four wheels may carry 10 tonnes while a single steering axle with two wheels is limited to 6 tonnes, assuming appropriate tyre and suspension ratings. Adding a second steered axle allows a 16-tonne vehicle to be uniformly loaded.) Experience shows that the normal load of a CMCR should not exceed 80 per cent of the suspension rating. This is because the load is permanent, unlike that of a transport lorry, the suspension of which can recover whenever the load is removed.

Figure 3 shows the layout of the two Type 4 CMCRs and a general view of CMCR 17 is in figure 4. The flaps above the cab are raised to ventilate the air-conditioning equipment supplying the operational areas. Technical equipment is ventilated with fresh air only; extra air-conditioning equipment to cool it would impose an additional load of 25 A on the mains supply.

The following description applies to both vehicles although the photographs are mainly of CMCR 17.

5.1 Production Control Room

A general view is in figure 5 and the personnel are, in order from the foreground, the Engineering Manager, the Producer and the Producer's Assistant. The control desk is adjustable in position to allow optimum viewing distance (within the constraint set by the vehicle width) of the monitor stack which houses two 17-inch colour monitors and up to nineteen 11-inch monochrome monitors. These can be allocated as required but a typical arrangement would be as follows.

Colour	transmission
	switchable preview
Monochrome	12 vision mixer channels
	2 radio check (both BBC networks)
	caption
	engineering preview
	video tape
	2 vision mixer auxiliary outputs

The Engineering Manager's control panel has, at the left, controls for ten lighting dimmers which are used direct for simple productions or could be used as master controls working with auxiliary dimmer systems where the requirements are more complex. The other panel assists the Manager to exercise his responsibility for the technical quality of the production. It enables him to preview the outputs from the picture sources and to communicate with the other members of the team, outside sources, the studio centre, etc.

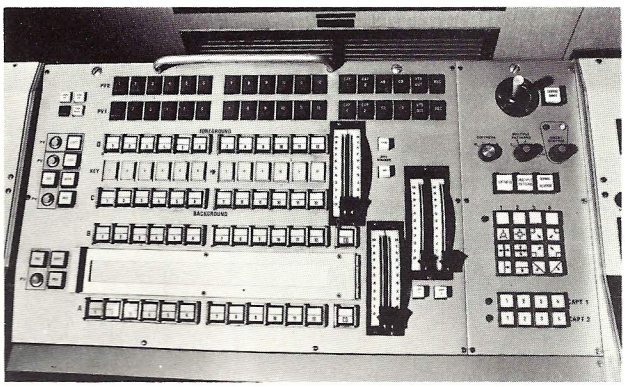

Fig. 6 Type 4 CMCR: Close-up of Vision Mixer Control Panel

On outside broadcasts the vision mixer panel is often operated by the Producer, as shown in figure 5. The mixer is described in the next section. The other member of the team shown, the Producer's Assistant, calls the shot numbers and keeps a close check on the timing of the production.

5.1.1 Vision Mixer (figure 6)

Although BBC studios usually use 'knob-a-channel' mixing which, as the name implies, provides a control for each source connected to the mixer, for the unscripted conditions which are typical of outside broadcasts the two-bank A-B mixer is ideal and this is the type used in the CMCR. Inter-camera cutting on either bank is possible as well as mixes, wipes and other effects between the banks. A second pair of banks added above the A-B banks increases the capacity available for special effects to a level not far short of that required for full studio operation, while retaining the basic simplicity of allowing the operator to cut along a bank. At the same time this configuration makes available a second mixer which can either be kept as a reserve or used to feed an independent output. An example of the latter occurs when interviews are recorded during a sports event for transmission during an interval or after the event.

In the mixer in CMCRs 16 and 17, only the upper (C and D) banks are equipped with Colour Separation Overlay or Chroma-Key. The keying waveform may be selected by the KEY row of buttons or may automatically follow the foreground selection by using the FOREGROUND key.

The design of the mixer allows captions to be added after the fader controls. A monochrome caption scanner is installed in the CMCR and the mixer can provide synthetic colouring of the lettering and background and the selection of all-round-black or coloured edging if required.

Pairs of faders are provided for mixing; these can be operated separately to provide fades to black or to allow non-proportional mixing. The white paper strip between the A and B banks is for source identification.

Each mixer channel is provided with synchronous/non-

synchronous colour monitoring and a Natlock synchronism comparator. The associated logic and sync stabilising amplifiers ensure full broadcast performance at all times, regardless of input signal and fader states.

5.1.2 Flexible Cue System

On-air cues are correctly produced by the vision mixer, regardless of its mode of operation. For example, the cues are correct when the upper (C-D) bank is re-entered into the lower (A-B) bank when both the A-B and C-D banks are producing transmission outputs. They are also correct when, in an emergency cut mode, the mixer is replaced by the preview system.

Cues are fed to appropriate cameras, whether working with the CMCR or to other contributing CMCRs. Cameras are not rigidly allocated to mixer channels but may be numbered in a logical 'production' pattern on the outside broadcast site, the cues being allocated via a pin matrix.

5.2 Vision Engineering Control

Figure 7 shows the vision supervisor sitting between the two camera engineers. The supervisor is responsible for colour balance and overall picture quality. The racks in the background of the photograph house the vision mixer, pulse generators and test and measurement equipment.

Each camera engineer normally controls the alignment and exposure of two cameras, and views their outputs, and the CMCR output, on a single colour monitor. Monochrome monitors are provided above to facilitate the adjustment of camera registration using colour difference signals.

The supervisor's headset and microphone is an alternative to the open microphone and loudspeaker.

5.3 Sound Control (figure 8)

The sound control desk is a 24-channel 4-group modular desk manufactured to the BBC's requirements by Rupert Neve and Co. Ltd. Each channel has an input sensitivity range from −70 dB to +10 dB and is fitted with a response selection amplifier. Channels can be routed to any of the four groups or to four sub-groups. The main groups can then be routed to the Main Output or to the Main Clean Feed or independent outputs.

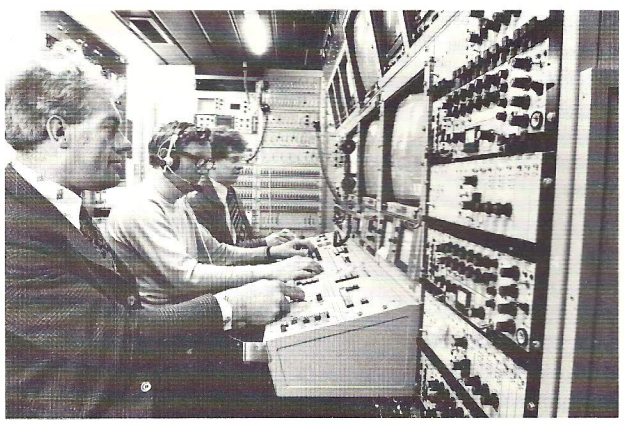

Fig. 7 Type 4 CMCR: Vision Engineering Control

A comprehensive insert jackfield is incorporated in the desk to allow limiter-compressors to be used where necessary. Echo, public address and four foldback outputs are available from the desk in addition to outputs from individual channels and groups. Groups and sub-groups can also be combined in a matrix to form four outputs for recording purposes.

Comprehensive peak programme meter and loudspeaker monitoring facilities are provided.

5.4 Talkback system

The equipment rack shown in figure 9 is the heart of the talkback system of a Type 4 CMCR. Operators' control panels in the CMCR are fitted with microphones and loudspeakers only and these operate through remotely controlled amplifiers in the rack. Each amplifier is fitted with a limiter-compressor. A system of peak programme meter monitoring and tone injection permits full checking of the system without recourse to jackfields and external test equipment.

The matrix shown alongside the peak programme meter in figure 8 allows external positions to be fed with the specific mixture of talkback required.

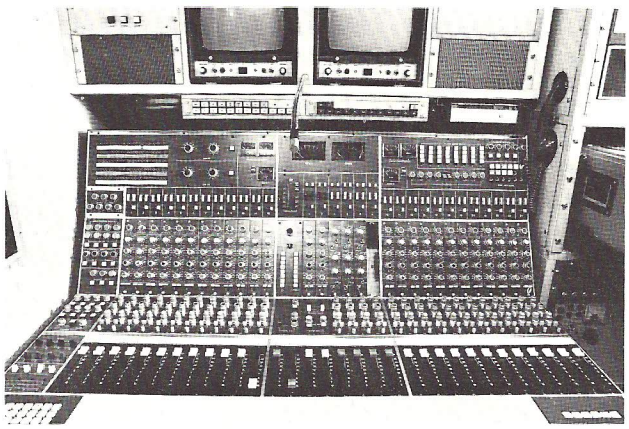

Fig. 8 Type 4 CMCR: Sound Control Desk

5.5 Power distribution

The panel shown in figure 10 controls the power distribution. The left-hand section houses magnetic circuit-breakers for 240 V a.c. distribution, from two incoming 80 A supplies; metering is on a subsidiary panel.

The CMCR relies on an external earth for safety and an installed line earth loop tester enables the earth impedance to be checked before a broadcast. The white earth-leakage circuit breakers in a row near the bottom of the panel protect supplies for commentators and other external facilities.

The right-hand section of the panel controls the distribution of 24 V d.c. supplies. Batteries are used to power the CMCR lighting, communications and sound facilities during a mains failure and the facility is also invaluable during rigging, before mains supplies are established. The 250 A h batteries get their main charge from automatic mains-powered chargers but also get a top-up charge from the vehicle's alternator.

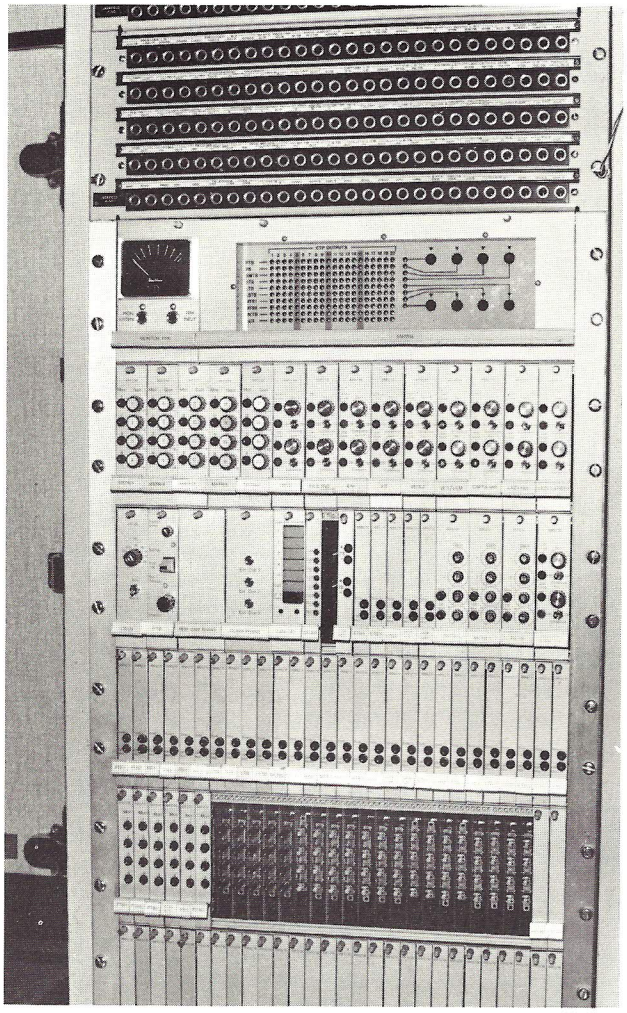

Fig. 9 Type 4 CMCR: Talkback equipment

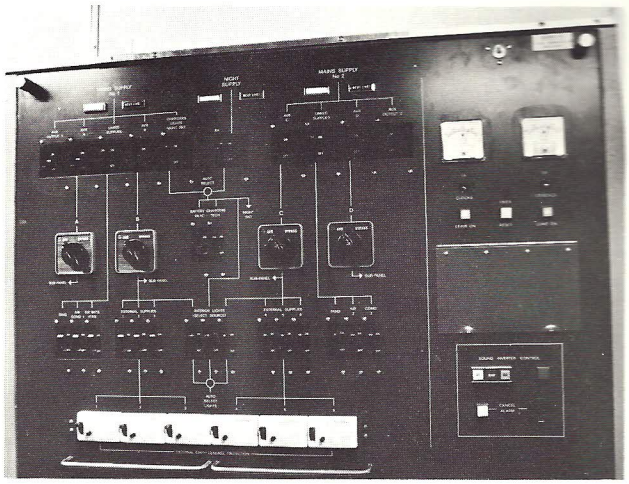

Fig. 10 Type 4 CMCR: Power Distribution Control Panel

6 Type 5 CMCR — 1978

Planning is now in progress for CMCRs to replace the Type 2 vehicles which are showing signs of old age even though they continue to give good service. The new units will continue the trend toward greater flexibility so that they can cope with complex productions without an excessive need for special arrangements. Each vehicle will accept up to eight installed camera control units. They will use lightweight (tri-ax) cables and their control units will be capable of accepting inputs from standard or lightweight cameras.

It is planned to minimise on-site cabling by using multicore cables for the video and communication channels and multiplexed signalling to allow video selection from commentary positions. Cues to truly remote cameras can be multiplexed over production talkback using rapid bleeps of tone within the audio band (Selcue). Thus all cameras receive accurate 'on-air' information.

Telephone and talkback facilities will be improved and will allow the comprehensive selection of any of 100 sources to any operator, using proportional mixing to the talkback loudspeakers. The telephone system will allow automatic access between operators in separate vehicles on a common site without recourse to a numerical system which would require some form of directory.

Since this article was written, a contract has been placed with Link Electronics Ltd for five Type 5 vehicles. They will be the subject of a detailed description in a forthcoming issue of *BBC Engineering*.

7 Conclusion

A CMCR is an essential part of any outside broadcast, from the simple interview to a major sporting event. The facilities it provides set a limit to the complexity of a production. For this reason the main demands influencing the design have been the requirements of a vehicle, restricted in size and shape by the United Kingdom Road Traffic Acts, which will provide the maximum flexibility of operation together with minimal on-site rigging and complexity.

From the first CMCRs in 1967, as this review has indicated, there has been steady evolution in design. New techniques, especially the miniaturisation of electronic equipment and the development of cameras using lightweight cables, will contribute significantly to the improvements which will be realised in the Type 5 vehicles.