A PORTABLE COLOUR CAMERA

J. R. Crook

INTRODUCTION

Portable television cameras have been used by the broadcasting industry for some years to provide coverage of events in situations not readily accessible to standard studio or outside broadcast cameras. The picture quality from these early cameras was often not to normal broadcast standards, but their use was justified by the immediacy of the pictures. With the advent of colour the requirement for portable cameras has increased and at the same time picture quality indistinguishable from standard cameras is being demanded.

The portable camera is beginning to displace the film camera in areas of operation which hitherto have almost exclusively made use of film. For news coverage, for example, the delay due to film processing can be eliminated and the television camera can often operate at lower lighting levels than the film camera.

The use of a portable camera in conjunction with a video tape recorder to provide 'on location' inserts into studio drama productions is becoming increasingly popular, having the advantage over the film camera that the colour balance can be matched more easily to the studio picture and the director can see the result of his shooting immediately without having to wait for the film to be processed.

DESIGN PHILOSOPHY

In designing a portable camera the designer has to consider several conflicting factors in order to arrive at the most useful result. Having a colour camera channel in current production, and many cameras in use throughout the world, it is attractive to design a new camera head which can be used with existing camera control units and channel power supplies.

To reduce the weight of the camera in order that it may be carried on the shoulder or mounted on a lightweight tripod it was decided to split the unit into two parts, a camera head and an auxiliary pack. Having made this split it is very desirable that the camera head should be capable of operation at as great a distance from the auxiliary pack as possible. This may often avoid having to move the auxiliary pack during an outside broadcast and in some situations it may not be necessary even to unload the auxiliary pack from the outside broadcast vehicle. The distance between the two is limited by the voltage drop in the conductors in the cable providing power for circuitry mounted in the camera head.

The camera power supply which is a high input voltage dc to dc converter is mounted in the auxiliary pack. A lightweight camera cable fitted with connectors at each end is used for interconnection between the auxiliary pack and the camera control unit and avoids the necessity for stocking a special cable. The added weight of a connector at the

J. R. Crook is with Marconi Communication Systems Ltd.

www.tvcameramuseum.org

camera head was felt to be justified on the grounds that breakage of a wired in cable could render the camera unusable for several hours.

The Mark VIII Portable Camera thus comprises a standard Mark VIII channel power supply and camera control unit together with an auxiliary pack which can be up to 900 metres from the camera control unit, and a portable camera head which can be up to 50 metres from the auxiliary pack.

FACILITIES

A portable camera should include as many of the operational facilities of the standard camera as possible within the limitations imposed by the requirement for low weight and small size. Notable facilities which have been retained are auto-registration, auto-colour balance, standard talkback system, servo iris, viewfinder picture source selection and an optional power driven zoom. In addition communication between the camera head and auxiliary pack has been provided.

Camera

The size and shape of the camera head is basically dictated by optical considerations. The optical splitter block takes a fairly conventional form with the green image taken off first and the three yokes mounted in the same plane on the optical block housing. A quick release bayonet coupler on the front of the optical block housing enables a variety of different zoom lenses to be fitted. The camera uses one inch lead oxide camera tubes and these are operated in a shortened version of the yokes used in the Mark VIII camera which employ etched scanning coils on a glass substrate. To reduce the weight of the yokes the focus coils are wound with aluminium wire.

In order that up to 50 metres of camera cable can be used between the camera head and the auxiliary pack slightly more electronic circuitry has to be packaged in the camera than would be the case if the distance was limited to say 2 metres. The camera head, therefore, contains the head amplifier front end, the line scan output stages, the beam focus stabilizers, communications amplifiers, target blanking generator and scan protection. In order that a single, standard camera cable can be used, several wires used for dc control functions such as beam control and beam focus also carry communications.

It would have been possible in principle to have mounted the field scan output stages in the camera head and thus make available some wires in the camera cable for other purposes. This presents problems in a unit which is very remote from the power supply, since adequate decoupling to avoid low frequency earth currents becomes virtually impossible due to the size and weight of the components. Due to the resistance of the conductors in the cable, low frequency earth currents result in unwanted signals being added to the video signals from the camera head amplifier. It was, therefore, decided to mount the complete field scan in the auxiliary pack.

Auxiliary Pack

The auxiliary pack is built into a form which can be conveniently mounted on a small two-wheeled trolley, which resembles a golf trolley, or fitted to a shoulder harness which can be carried by the cameraman or his assistant. The unit contains the camera power supply which is

a high frequency dc to dc converter and is identical to that fitted in the standard Mark VIII camera head. Also contained in the auxiliary pack is the field scan board, viewfinder video decoder, multiplex decoder, line scan generator and part of the camera head amplifiers providing gain switching highlight clipping and a 75 ohm output stage.

Viewfinder

Of particular importance in any camera channel is the provision of a high grade viewfinder to enable the cameraman to frame the picture and achieve accurate optical focus. For portable use a viewfinder has been designed which uses a 1" C.R.T. primarily developed for a high resolution electronic gun sight. The tube, which is supplied complete with integral scanning coils and mu-metal shield is mounted with a prism and magnifying eyepiece in a small detachable unit together with the scanning generators, video amplifier and E.H.T. generator.

Since only three coaxial cables exist in the standard Mark VIII camera cable, some form of carrier system has to be used for the viewfinder signal, if, as in this case, the red, green and blue camera output signals occupy the three coaxial cables as normal analogue video signals. In the standard Mark VIII camera channel the viewfinder signal is frequency modulated on a 15 MHz carrier and transmitted up the coaxial cable allocated to the blue head amplifier output signal to the camera head where it is demodulated.

The same signal could have been used for feeding the portable camera viewfinder, but space was not available in the camera head or the viewfinder for the fairly complex filters, which are necessary due to the relatively close spacing of the video signal and the lowest frequency sidebands of the FM signal, and the electronic circuitry associated with the limiters and discriminator. It was decided, therefore, to demodulate the FM signal in the auxiliary pack, which makes available a video signal at this point for monitoring purposes, and to use this to amplitude modulate a 35 MHz carrier. This is transmitted on the coaxial cable used by the blue video signal to the camera head where the two signals are separated by simple filters. The 35 MHz signal is demodulated in the viewfinder using an integrated circuit low level synchronous demodulator primarily designed for the receiver industry.

To obtain the maximum utilisation from the camera head, various mounting arrangements have been designed to allow the camera to be used in different situations. In the shoulder mounted application the camera body may be mounted forward of the shoulder with the front supported by a 'chest pod'. This is probably the best position when using the lighter 6:1 zoom lens. When a larger lens such as a 10:1 zoom is used the camera can be mounted to the rear of the shoulder such that it is near balanced on the shoulder. This provides a very comfortable carrying position when using the heavier lens. Adjustment of the shoulder mount and the viewfinder position has been arranged so that the camera can be readily adapted to suit cameramen of different builds.

The shoulder mount can be readily removed and an adaptor fitted to enable the camera to be fitted to a lightweight pan and tilt head and tripod. Additionally, the camera may be used with a seven inch viewfinder and fitted with a standard wedge to a studio pan and tilt head.

The optical block housing, the camera base and most parts of the shoulder mount are made from magnesium castings, magnesium having nearly half the density of aluminium. This, in conjunction with an overall low

www.tvcameramuseum.org

weight design, has resulted in a camera providing excellent portability and ease of handling consistent with robust construction and offering all the facilities and performance of a standard broadcast camera.

It is of interest to consider the performance which is to be expected from a small camera of the type described, compared to the normal studio or O.B. camera in use today.

The significant difference lies in the use of the smaller 25 mm lead oxide tube. This tube allows the use of smaller yokes, splitting block,lens, thus contributing considerably to the saving in size and weight and any differences in performance are related almost exclusively to the differences in performance of the two types of tube.

It is usual to operate the green tube in a camera using 30 mm tubes at a signal current of 300 nA. In a camera using 25 mm tubes the equivalent figure is about 200 nA. This results in a worse signal to noise ratio by approximately 3dB. On the other hand less light is required to produce 200 nA of signal current than 300 nA for the same lens aperture. The camera using 25 mm tubes, therefore, appears more sensitive than its larger counterpart.

It is usual in cameras employing equal image sizes for the three colours to have a neutral density filter in the green optical path to make the signal currents more nearly equal in the three tubes. This reduces differential lag, but again reduces sensitivity by approximately 6dB or one lens stop. Such a neutral density filter is used in the Marconi Portable Camera and this makes the sensitivity no worse than most colour cameras. The Marconi Mk VIII camera, however, uses minified images in red and blue and thus is able to show a similar reduction in lag without the associated loss in sensitivity. This is, however, a unique solution to the lag problem and not suitable to a camera using 25 mm tubes.