The Mark IX portable colour camera

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Summary The portability of a portable camera permits it to be used in environments generally more hostile than those encountered by studio cameras. However in spite of this and of its small size, the portable camera is expected to produce picture quality comparable with that of a studio camera. It is also expected to be equally stable. This article describes the portable version of the Mk IX colour camera and shows how lightness and portability in the camera head have been combined with the use of the standard Mk IX camera control unit and power supplies. The use of 25mm tubes, and a conventional optical splitter block and the removal of the power supply from inside the camera head have made it possible to produce a camera weighing only 17lbs (7·7Kilos) excluding the lens.

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Introduction

A portable camera will be faced with operational requirements generally more demanding than those faced by the studio camera. Sensitivity is of great importance because of the camera's usefulness in conditions where no control of light or contrast is available. Some form of protection against the normally objectionable effects of light overload is almost equally important.

The portable camera must also be rugged and extremely reliable, as in operation it will be certain to be subjected to mechanical shocks not experienced by studio cameras. During the course of a few minutes the portable camera may have to operate outside in cold weather and inside under studio lighting conditions. Equally likely is the other possibility of having to operate in hot sunlight one minute and in a cool air-conditioned interior the next. Consequently the temperature stability of the electronics is extremely important and the mechanical parts must be designed so that optical registration does not vary with temperature. The need to be able to operate outdoors in rain or snow means that the camera must not overheat when enclosed in a waterproof cover.

Finally, the power consumption must be kept to a minimum to permit operation from batteries in a boat or helicopter for instance.

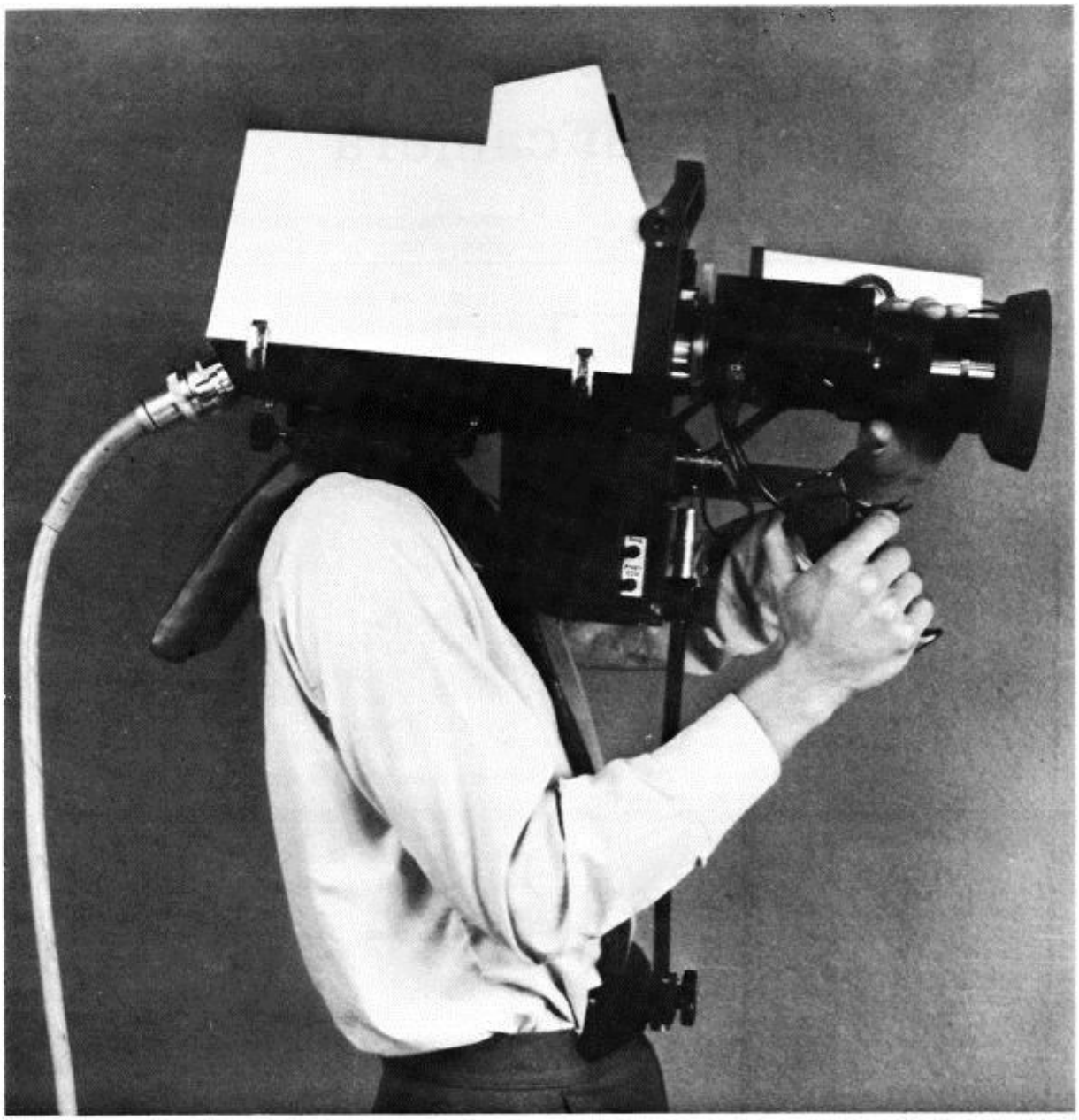
In spite of the difficulties under which the camera is expected to operate, it is also required to produce pictures of virtually imperceptible impairment compared with those of a larger studio camera and also to match the studio camera precisely in terms of colour reproduction. Obviously in the design of such a camera many compromises have to be made. High sensitivity and small lens size are incompatible; the lens stop number is only meaningful when considered in conjunction with the image format, and for any camera the sensitivity is established by the effective diameter of the front element of the lens because this determines how much light can be collected from the scene. If the lens diameter is halved the sensitivity will be down by two stops.

Similarly, ruggedness and mechanical stability are incompatible with lightness and small size so that another compromise has to be made. Yet again, high temperature stability demands generally more complicated circuitry, more components and a larger camera.

Having considered some of the difficulties and compromises to be made we can now look at the Marconi answer to the problem as incorporated in the portable version of the Mark IX colour camera.

Differences between the Mark IX studio and Mark IX portable head

The Mark IX portable uses exactly the same c.c.u. as the Studio Mark IX.[1,2] The small size of the c.c.u., 8·75 × 19 × 22ins (222 × 483 × 556mm), makes it very suitable for use in even very small OB vehicles. However in the case of the portable camera there is no power supply in the camera



The Mark IX Portable camera

head. Instead the required converter boards are housed in the c.c.u. This arrangement permits operation of the camera at up to 90 metres from the c.c.u. Operation up to a further 800 metres from the c.c.u. can be obtained by connecting an "in-line adaptor" in series with the camera cable at up to 90 metres from the camera. The "in-line adaptor" is roughly the size of a normal house brick and is of rugged cast construction. It houses the two small converter boards that were used in the c.c.u. when operating at less than 90 metres of cable. The in-line adaptor receives a 200v supply from the main c.c.u. switched mode power supply and feeds the required voltages to the camera head.

Apart from being smaller and lighter than the studio camera head, the portable head has a number of other differences. It employs 25mm lead oxide tubes as opposed to the larger 30mm tubes employed in the studio camera. The use of 25mm tubes permits a worthwhile reduction in size and weight whilst still retaining picture quality suitable for combination with Mark IX studio camera pictures without objectionable impairment. The 25mm tubes are used with a conventional splitter block and no internal diascope is provided. A plug-in diascope is available for line-up purposes however. The use of a conventional optical block allows the camera body to be much narrower than that of the studio camera.

Minifiers are not used in the red and blue channels of the portable camera. The images on all three tubes are consequently of equal size and this allows the geometry correctors of the studio version to be omitted. The portable camera is

designed to operate with highlight overload protection or A.C.T. tubes and with light bias. The highlight overload protection gives immunity from objectionable effects from light overloads of up to 5 stops.

The 25mm tubes in the portable camera normally run at a signal current in green of 200 nA compared with the 300 nA used in the green channel of the studio camera. A link is provided in the head amplifier of the portable camera, enabling the gain to be decreased by 3 dB. This may be used in conditions of good lighting to obtain a better signal to noise ratio by running at 50% higher signal current approximately.

The 25mm tubes have lower capacitance than the studio camera tubes, i.e. 2·5 pF to 3·5 pF compared with 4 pF to 6 pF in the larger tube. In order to take advantage of this small capacitance the input F.E.T. of the head amplifier is fitted inside the yoke close to the tube target connection. This permits a signal-to-noise ratio of 46 dB to the achieved in the green channel for a signal current of 200 nA.

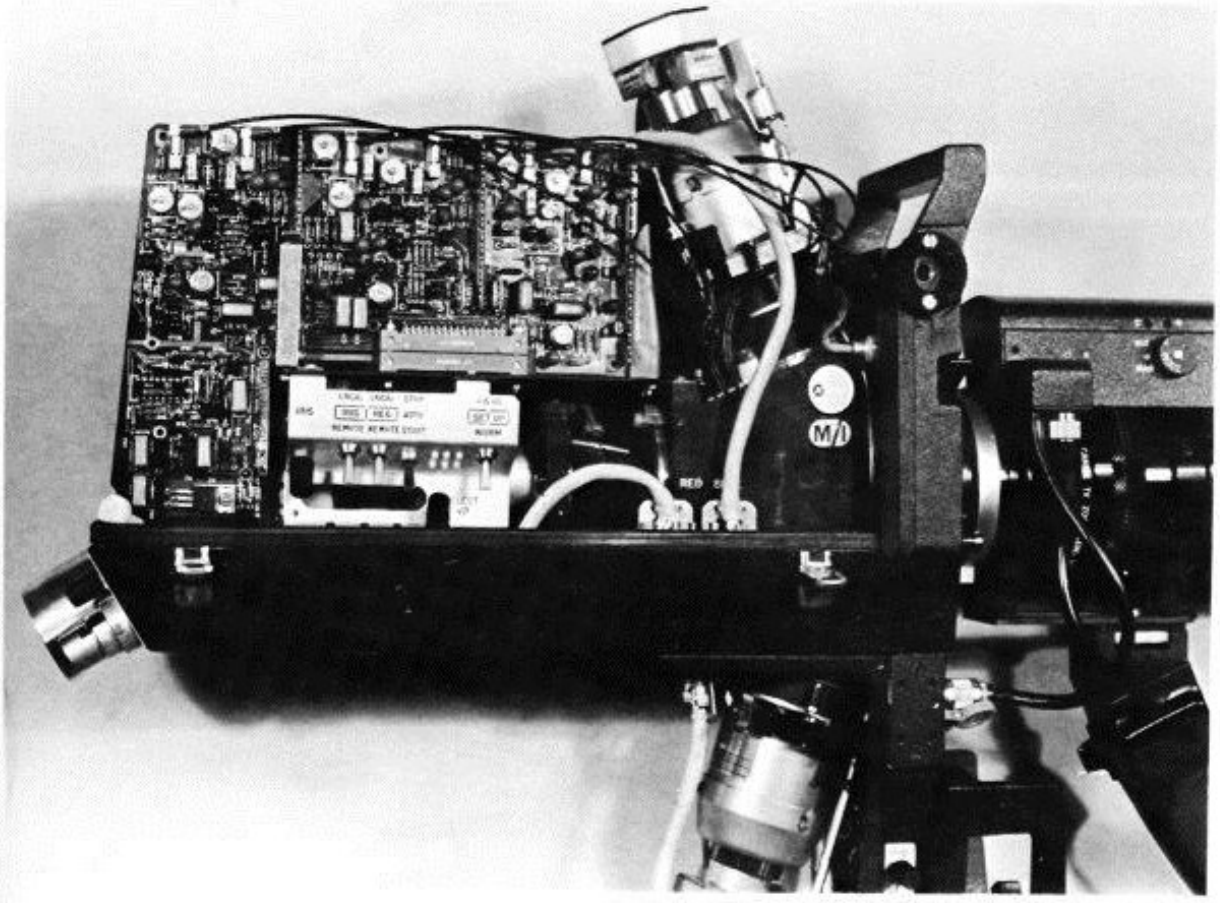
In order to obtain acceptable performance with respect to lag at low light levels without the use of minifiers it is necessary for the red and blue tubes to run at higher signal currents compared with green than would have been the case had minifiers been used. Typical current values for the three channels in the portable camera are green 200 nA, red 80 nA, blue 80 nA.

The overall effect of the tube and optical system is that for an illumination of 1100 lux on a 60% reflectance white screen, a signal current of 200 nA will be achieved in the green channel at a lens setting of f/2·8. A gain switch, increasing the gain by 12 dB allows just acceptable pictures to be obtained at 90 lux if the lens is opened to f/1·7.

In order to further lighten the camera head the double filter wheel in the studio camera is replaced by a single manually operated filter wheel. Also there is only one high-quality microphone channel in the portable head compared with two in the studio head.

Mechanical arrangement

The portable camera head is constructed around a rigid casting containing the optical splitter block supporting the yokes. To the front of this casting is attached another casting incorporating a carrying handle and lens mount. On the second casting a V shaped member is fitted for engagement in the camera mount on the lightweight camera dolly or in the 7in viewfinder mount. All other parts of the camera head which are attached to the main casting are fixed in such a way as not to exert bending forces in the area of the prism block and yoke mountings. This is extremely important as any small distortion caused, for example, by lifting the camera on to the shoulder, can produce pronounced registration errors.



View of the camera with covers removed

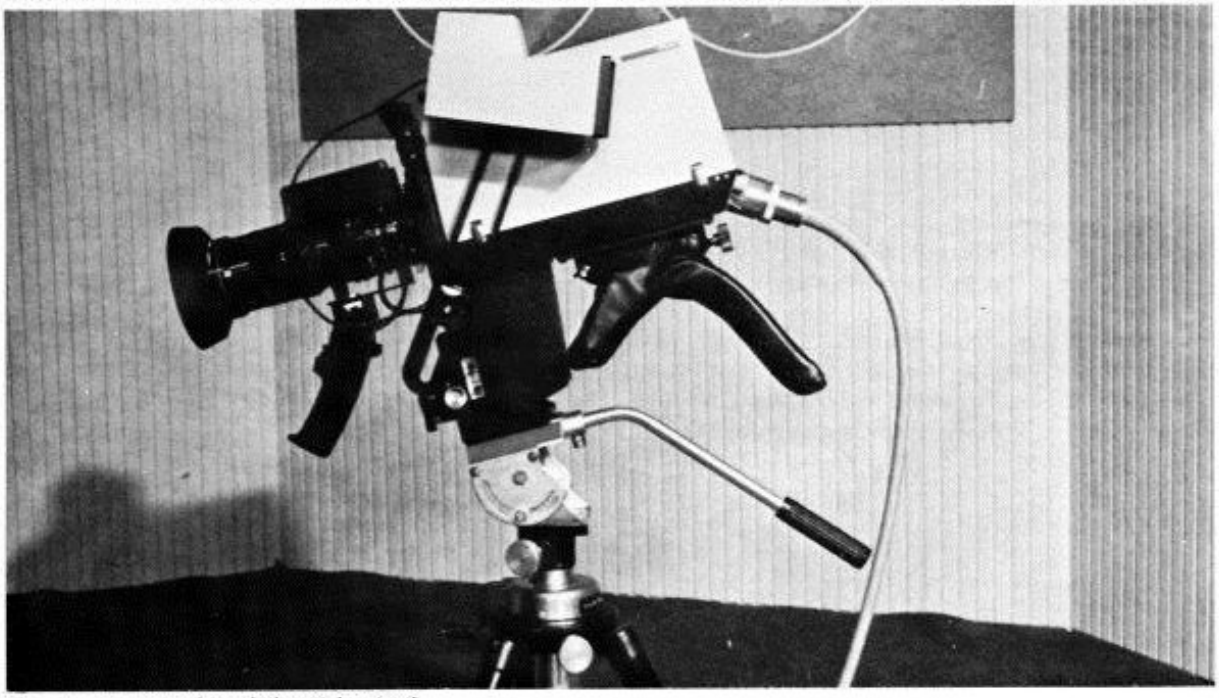
The electronic package consists of the following five boards: scans, tube supplies, beam focus and alignment, viewfinder demodulator and talk-back, and head amplifier. This package is supported in a strong trough-shaped member attached to the front casting and forming the base of the camera. The scans board occupies one whole side of the camera and the other shorter boards plug into a mother board and stand parallel to scans board. A small microphone modulator board fits inside the camera base.

The adjustable padded shoulder mount is attached to the underside of the camera base and together with the adjustable stomach brace, allows the camera to be firmly supported on the shoulder even with both hands temporarily removed from the camera. A simple cover incorporating a "pod" with a cue lamp lens, encloses the top, side and back of the camera.

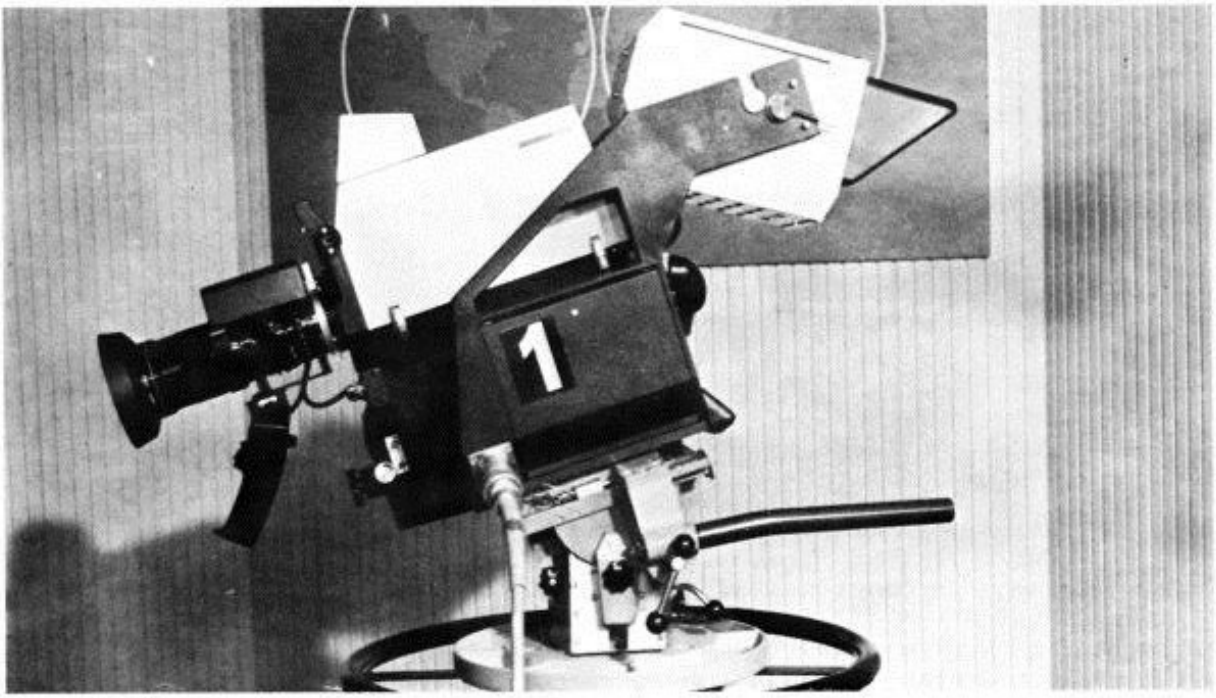
The result is a camera head which without the lens weighs only 17lbs (7·7 kg) including the viewfinder, and there is no additional "back pack" or trolley to be used.

Additional facilities

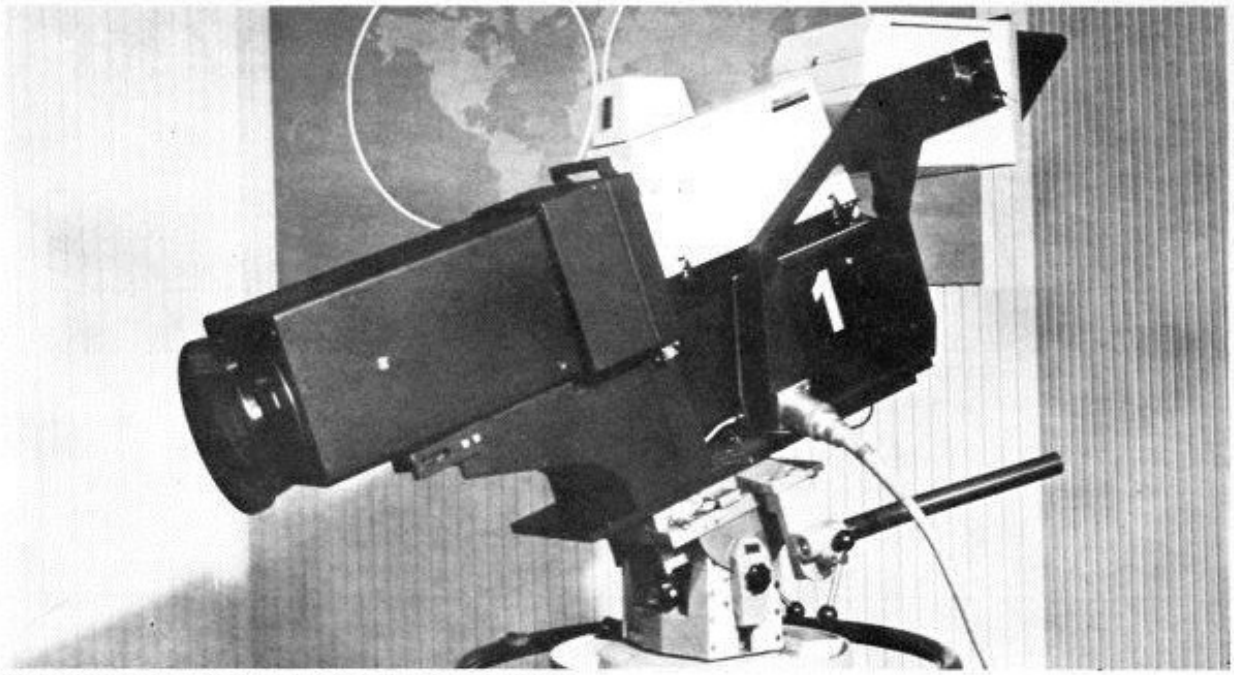
In order to make the portable camera as versatile and cost effective as possible two optional facilities are available to make the camera attractive for



The camera mounted on a lightweight tripod



The camera with 7in viewfinder



The camera fitted with a large studio lens and 7in viewfinder

additional use in a studio or other location not requiring a truly portable camera. One of these items is the 7in viewfinder mount which fits on to a conventional camera pedestal. This is basically a cradle which supports the camera and a 7in viewfinder. The viewfinder mount carries the drives and output boards previously mentioned in connection with the "in-line" adaptor, so that 900 metres of cable can be used between camera and c.c.u. It also carries a further pair of similar boards to provide power for the viewfinder and the zoom lens.

Another facility is the large lens adaptor, a "T-bone" shaped attachment to provide support for larger zoom lenses, and which carries a small interface printed wiring board. A large range of standard 30mm zoom lens can be used but of course the zoom angle will be rather less than that indicated on the lens because of the smaller tube size of the portable camera.

Facilities common with the studio camera

Apart from the facility of having a built-in diascope all the automatic facilities of the studio version are available for the portable. For automatic registration of the portable the lens has to be removed and a separate diascope attachment plugged in to replace it. This is because the simple optical splitter employed in the portable camera does not have a separate diascope input. The automatic facilities available are the following:

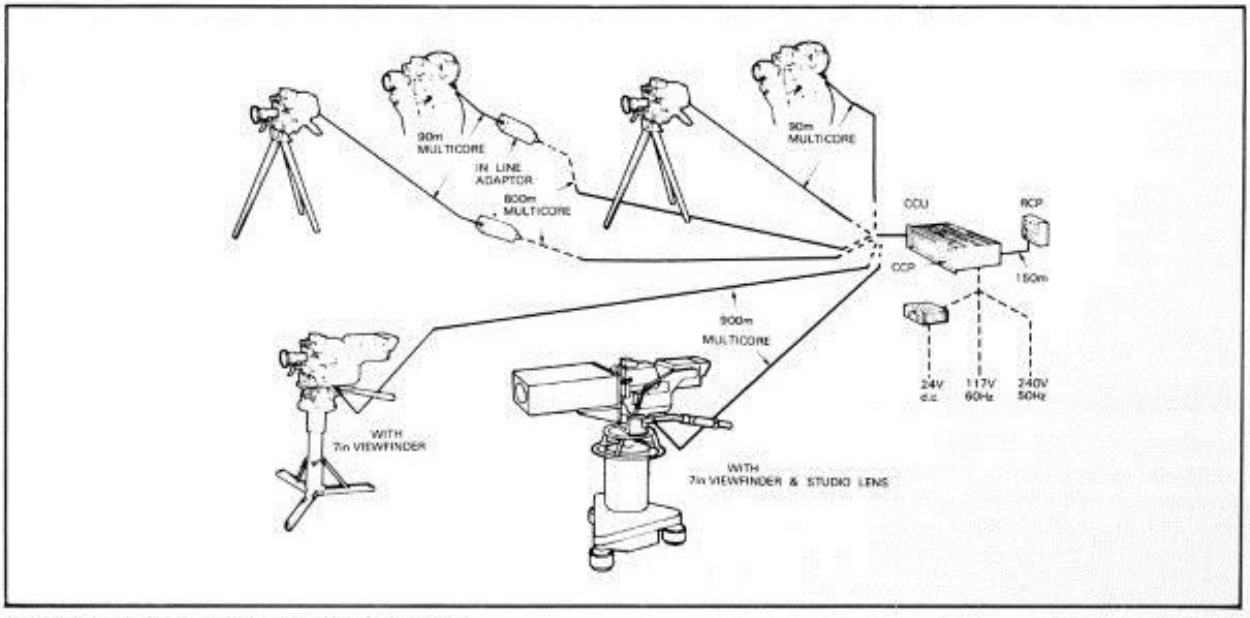


Fig. 1. Modes of operation using multicore cable

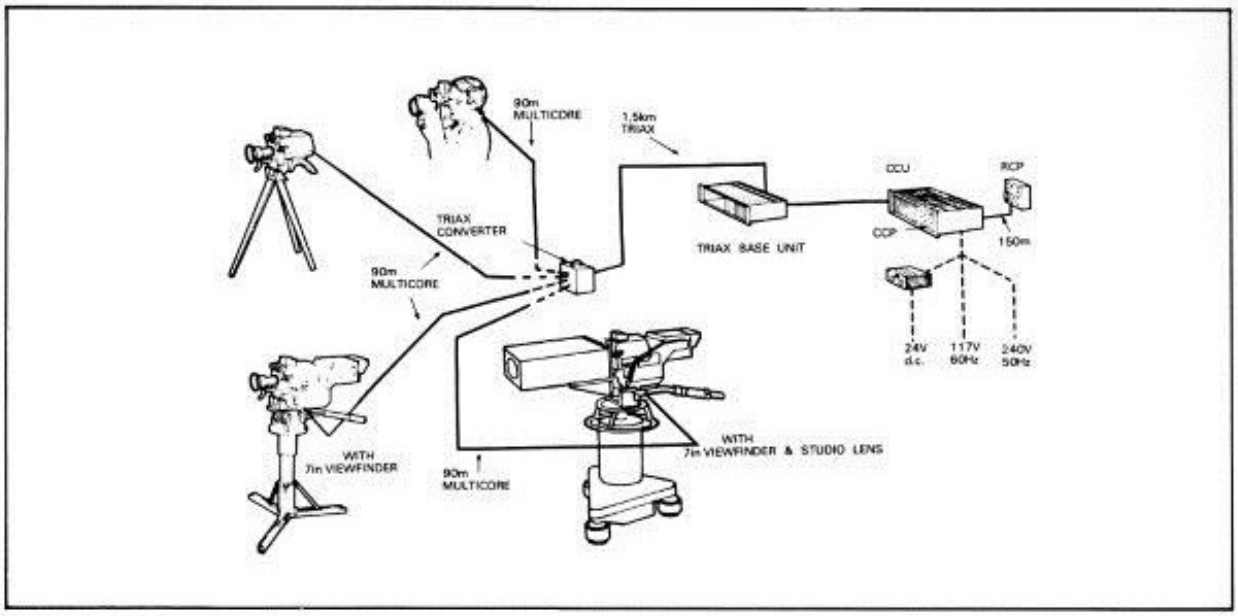


Fig. 6. Modes of operation with triax cable

Video

(a) Automatic white balance
(b) Automatic black balance
(c) Automatic iris
(d) Automatic master black
(e) Automatic dynamic gain

Registration

(a) Automatic registration
(b) Automatic centring

Triax Operation

The portable camera may be operated with triax cable at distances up to 1500m from the c.c.u. In this case a Triax Converter Unit stationed up to 90m from the camera is connected to the camera by multicore camera cable. This converter connects to the Triax Base Unit at the c.c.u. by up to 1500 metres of triax cable.

References

1. N.N. Parker Smith: "The Mark IX — a camera system for the 80s", Communication & Broadcasting, Vol.4, No.2, pp.4–9, (Spring, 1978).
2. J.R. Crook and I.E. Gibson: "A new studio/outside broadcast camera channel", Communication & Broadcasting, Vol.4, No.2, pp.10–15, (Spring, 1978).
3. G.R. Boustred: "The Mark IX triax camera system", Communication & Broadcasting, Vol.5, No.1, pp.49–56, (July, 1979).

RESUME

La mobilité d'une caméra portative permet son utilisation dans des milieux généralement plus défavorables que ceux rencontrés par les caméras de studio. Cependant malgré cet inconvénient et ses petites dimensions,la caméra mobile est escomptée produire une qualité d'image comparable à celle de la caméra de studio. On s'attend également à ce qu'elle soit tout aussi stable. L'article décrit la version portable de la caméra couleur MK IX et fait ressortir comment la légèreté et la portabilité de la tête de caméra se sont conjuguées grâce à l'utilisation de l'unité de contrôle de caméra standard MK IX et des alimentations, L'utilisation de tubes de 25mm, d'un bloc du viseur optique conventionnel et le retrait de l'alimentation à partir de l'intérieur de la tête de caméra ont permis de réaliser une caméra qui ne pèse que 7·7 Kilos sans l'objectif.

ZUSAMMENFASSUNG

Infolge ihrer Transportfähigkeit kann eine transportable Kamera allgemein unter ungünstigeren Umgebungsbedingungen eingesetzt werden, als die normale Studiokamera. Trotzdem und trotz der kleinen Größe wird erwartet, daß die Bildqualität der mit einer Studiokamera erzielten vergleichbar ist. Außerdem wird ein gleicher Stabilitätsgrad erwartet. In diesem Artikel wird die transportable Ausführung der Farbkamera MK IX beschrieben und aufgezeigt, wie Leichtgewicht und Transportierbarkeit des Kamerakopfes mit dem Einsatz der Kameraregeleinheit und Stromversorgung der serienmäßigen MK IX verbunden worden sind. Durch Benutzung von 25-mm-Röhren, eines herkömmlichen optischen Schnittbild blocks und Anordnung der Stromversorgung außerhalb des Kamerakopfes war es möglich, eine Kamera zu entwickeln die ohne Linse nur 17lb (7·7 Kilos) wiegt.

SUMARIO

La portabildad de una Cámara Portátil permite que se utilice en ambientes que en general son más hostiles que los que encuentran las Cámeras de Estudio. No obstante y a pesar de esto y de su pequeño tamaño, la cámera portátil se considerá producirá una calidad de imagen comparable a la de la cámara de estudio. Se espera además que será igualmente estable. El presente artículo describe la versión portátil de la Cámara de Color MK IX y explica cómo se han combinado el poco peso y portabilidad del cabezal de la cámara con el uso del Control de Cámara MK IX standard y el normal Suministro Eléctrico. El uso de tubos de 25mm, un bloque convencional de distribución óptica y la eliminación del suministro eléctrico del interior del cabezal de la cámara han hecho posible producir una cámara que sólo pesa 7·7 Kilos sin incluir la lente.