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THE MARCONI Mk. IV CAMERA

ONLY A FEW YEARS AGO no one was surprised to see poor picture quality from an image orthicon camera. Black halo, background graininess, white edges, and "ghosting" were all accepted in varying degrees as necessary evils.

A major improvement was possible with the Marconi Mk. III camera using the 4½ in. image orthicon and control of exposure with variable neutral density filter. Characteristic of the 4½ in. image orthicon tube as compared with the 3 in. tube is an improvement in all the parameters considered marginal in the 3 in. tube. There is a significant improvement in signal to noise ratio, resolution and contrast range. White edges and other effects associated with electron redistribution are also considerably reduced. These improvements all add up to a picture which has been described as "more photographic in quality".

Other advantages of the 4½ in. tube include its very low microphony and its potentially longer life compared with a 3 in. image orthicon of the same target to mesh spacing. In general, the 4½ in. tube is easier to operate for optimum results, this being in no small way due to the field mesh which practically eliminates black shading and visibility of the dynode surface.

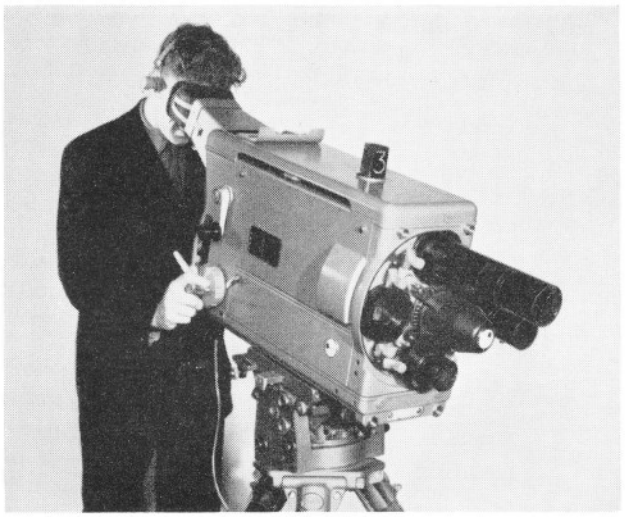
In designing the Marconi Mk. IV camera every effort was made to achieve the ideal. A mass of informed opinion was considered to find what users really wanted, putting aside all technical considerations such as size of camera tube or previous practice.

THE CAMERA

Of the many improved features embodied in the Mk. IV camera, two are of such importance that they merit special consideration. They are:

(a) a notable reduction in both size and weight of the camera unit;

(b) a hitherto unachieved standard of circuit stability and reliability which eliminates the necessity for continuous supervision and adjustment of the many controls.



The Mk. IV Camera, clearly showing its compactness and the ease with which it can be operated.

WEIGHT AND SIZE

It was considered essential that the weight of the camera unit should be less than 50 kg (110 lb) and that an appreciable reduction in overall size compared with the Mk. III camera should be achieved. In fact, the new camera weighs only 42·6 kg (94 lb) and only 45 kg (99 lb) including the remote iris control facility which is an optional extra, and is believed to be the smallest and lightest in the world using the 4½ in. image orthicon tube. Its dimensions compare favourably with the smallest camera designed to use 3 in. tubes only. Although the use of a 4½ in. tube is recommended, a simple conversion kit for 3 in. tubes is available, the yoke being of a new ventilated type with improved performance in respect of geometry and temperature rise. The use of the 3 in. tube results in a further reduction of 5 kg (11 lb) in weight.

STABILITY

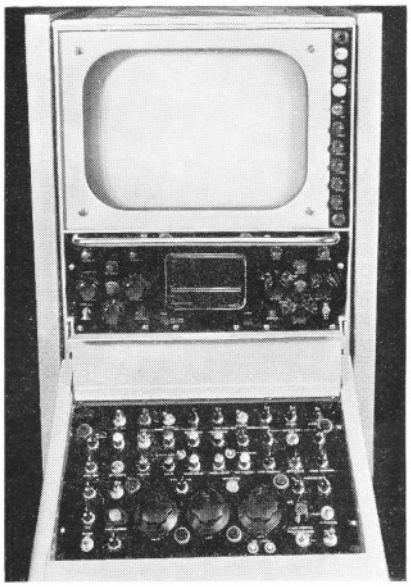
Once set up by a competent engineer, it was required that the channel be sufficiently stable to maintain its adjustment over long periods, thus reducing operation simply to control of exposure. This could be done either by the use of a variable neutral filter or by remote control of iris. The latter was preferred since there is always some loss of operational sensitivity when using a filter wedge. This is because it is necessary to operate with some neutral filter for normal scenes, leaving something in hand for darker scenes.

The required stability has been obtained in a number of ways; by the use of additional regulated supplies of 1·3 kV for the image orthicon dynode and −600 V for the photocathode; by applying negative feedback to the clamp circuit to improve black-level stability, particularly with reference to mains voltage variations, and by the use of conservatively rated components manufactured to Service specifications, with particular reference to temperature characteristics. Also, new type long life close tolerance valves are used extensively. Further, the principle of cathode DC stabilisation has been applied throughout the equipment. This is illustrated in Fig. 1. The use of special circuitry designed to minimise the effect of changes in amplitude and width of the pulses produced by the synchronising generator also contributes to overall stability as do numerous other circuit refinements based on past experience.

CONTROL FACILITIES

The high order of stability thus achieved permits a different approach to the layout of controls on the control panel. The majority of the controls can now be considered as pre-set, requiring only infrequent adjustment. These are normally covered by a hinged lid and only the more important controls such as gain, lift, iris and black stretch (contrast correction) are left exposed. These main operational controls can be extended to a remote position and can be grouped, if required, with those of other camera channels. Such an arrangement would enable one operator to control several camera channels, since he would be responsible only for exposure and production effects.

The iris control, which can be scaled in 'f' numbers, is coupled to the camera lenses through a servo system and a further refinement is that provision can be made for selecting, from the control panel, any one of three pre-determined black stretch laws.



The Mark IV Camera Control Panel.

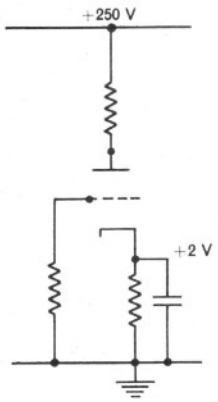


Fig. 1A.
Conventional
Cathode Bias.

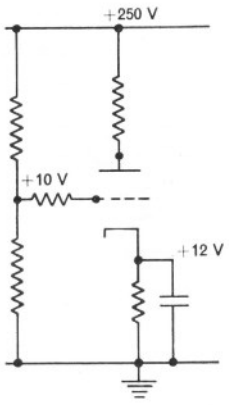
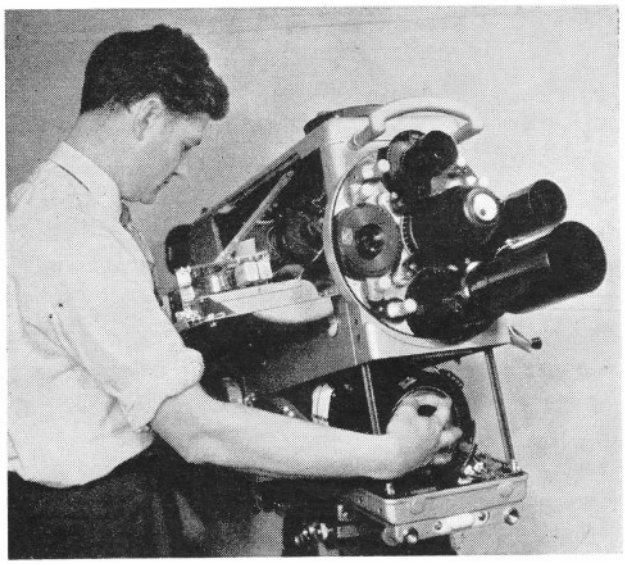


Fig. 1B.
Cathode DC
Stabilisation.

SUB-ASSEMBLIES

Of the various sub-assemblies which are embodied in the camera, the following are worthy of special note.

The ventilated yoke has several new features. It is smaller than that in the Mk. III camera and the weight has been reduced. An important improvement is the precision temperature control in which a contact thermometer is used to operate relays controlling the heater and fan. When first switched on, the fan blows heated air over the image section of the tube. After fifteen minutes from normal studio temperature the



The casing of the Mk. IV Camera raised to give access to the 4½ inch image orthicon yoke. The engineer has just inserted the tube and fitted the base connector.

camera is ready for use on rehearsals. At 40°C the heater and fan are switched off automatically, coming on again for short periods to maintain the temperature about this figure. In high ambient temperature conditions, the yoke will reach 47°C and the fan alone operates to prevent overheating.

The head amplifier is an assembly which plugs into a ten-way connector and is held in position by two knurled screws. It incorporates a number of improvements, including low ionisation condensers to eliminate black or white flashing, a low noise input stage incorporating negative feedback high peaking which gives a stable response and is free from LF streaking. The overall response is flat, aperture correction being incorporated in the camera control unit. There is a reverse picture polarity switch and separate controls for dynode and video gain. The dynode gain control permits operation at a substantially constant signal current, preventing "dynode overload".

The scanning chassis is also a plug-in unit and provides line scan for the camera and viewfinder, target blanking for the image orthicon and also the 12 kV, 1·3 kV and negative 600 V needed for the viewfinder and camera tube. Operation on 405, 525 or 625 lines may be selected as required. The amplitude of the camera line scan and scan reversal are operated from the camera control panel.

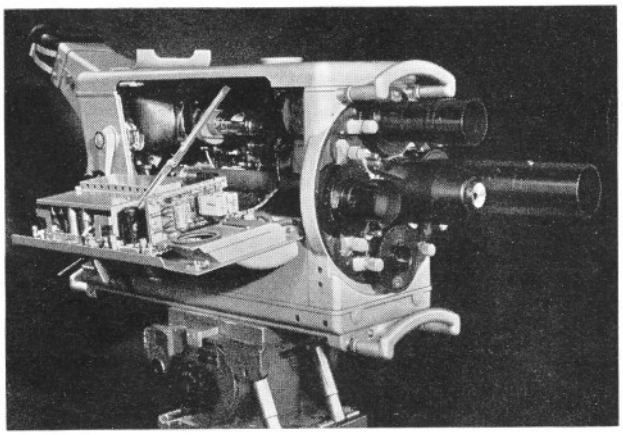
The orbiting generator, a device available as an optional extra, prevents "sticking" of the I.O tube and thus prolongs its life. Four shift coils are arranged around the image section of the tube in order to give the electron picture a slow rotary movement before it reaches the target. A small motor drives a sine-cosine potentiometer from which is derived the correct amplitude and phase of shift currents.

CONTROLS

Recessed into the rear casing are the few essential controls for talkback and viewfinder contrast and brightness. There are also switches for orbiting and for the I.O tube heater. Inside the camera are adjustments for the height and width of the viewfinder picture, the HF boost for the viewfinder, the head amplifier gain, the dynode gain, the image accelerator and line focus modulation. These controls can be pre-set and left alone after fitting a new I.O tube. All other controls are at the control room end of the camera channel, mostly on the control panel.

MECHANICAL FEATURES

A 4-lens turret of 8¼ in. P.C.D is designed to carry a new range of lenses suitable for remote iris control. The mountings are similar to, and compatible with, those used on the Mk. III camera. With a turret of this diameter, lenses from 1·35 in. to 40 in. (35 mm to 104 cm) focal length can be accommodated with very little restriction of complement, since the larger lenses are of the folded type. A "zoom" lens, such as the Taylor Hobson "Varotal", can be mounted as part of the normal lens set, with remote control of iris.



Side casing lowered on the right of the camera, showing the accessibility of units. Note the small sized lens turret with automatic iris control motor in the centre.

Control of "zoom" and focus can be extended to the rear of the camera via shafts through the base casting.

The iris control motor, which is silent in operation, is protected by a cast "nose cone". The reduction gear, an ingenious concentric arrangement of coarse and fine screw threads, is located inside the hollow shaft which connects the turret to the lens change mechanism at the rear of the camera.

When a Diascope is used, a supply for the lamp is obtained from contacts on the turret. Lamp brightness can be varied by the remote iris control.

A fixed filter turret can be mounted behind the lens turret plate and has spaces for four filters in addition to the usual clear aperture and "capped up" positions.

The lens change handle is conveniently placed on the right-hand side above the focusing handle. Both can be seen in the photograph showing a general view of the camera.

The mechanism of the lens change is both simple and positive, being a variant of the well-known Geneva movement which operates through a right-angle between the lens change handle and the turret shaft; this gives the required non-linear rotation. One turn of the handle rotates the turret to the next lens position.

The turret and associated mechanism is extremely robust, maintaining accurate lens alignment with the heaviest lenses in use.

The three-spoked capstan focus handle drives the focus carriage through a train of split gears and connecting links giving negligible backlash. Finger-tip control of friction is provided and the gearing allows two turns of the focusing handle for a complete yoke traverse. The main connecting link can be fixed to provide an alternative racking distance more suitable for outside broadcast work.

A number of other special facilities are provided and the more important of these may be seen in the photographs and are explained in the captions.

CONCLUSION

Only the special features of the Mk. IV camera are described in the present article, but the complete camera chain is composed as follows:

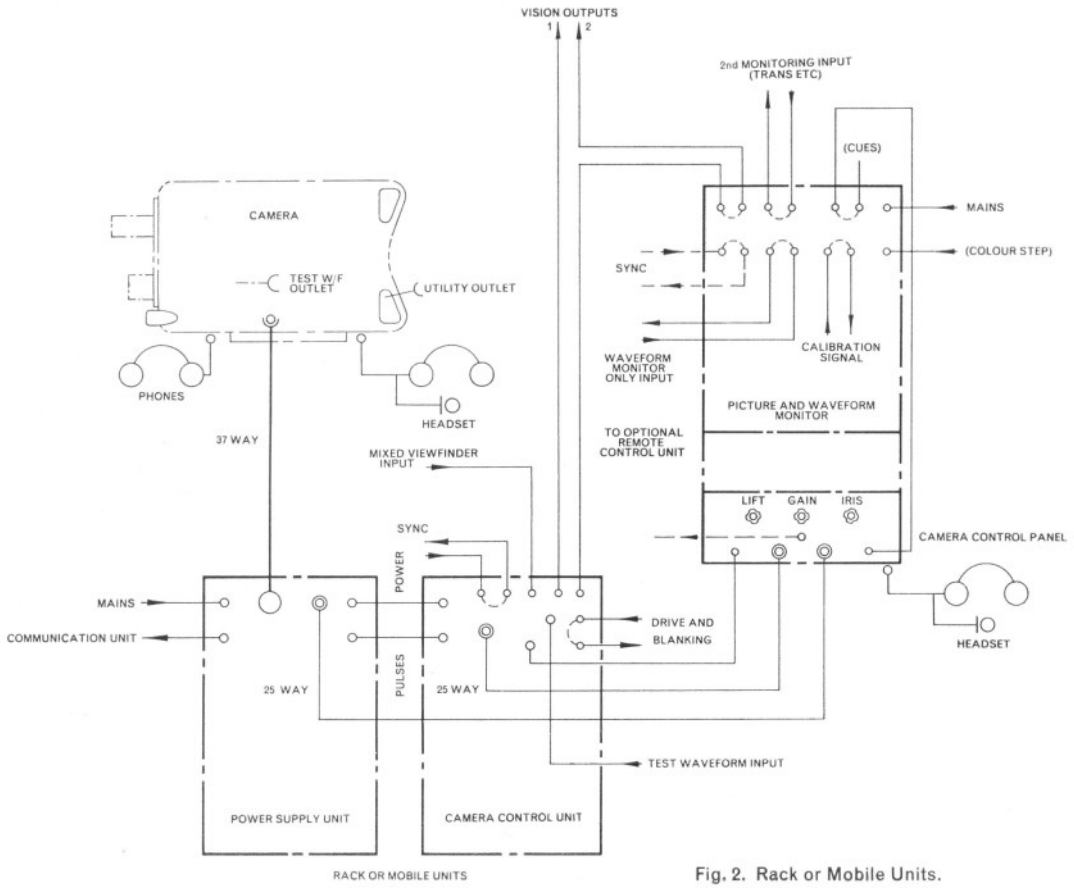


Fig. 2. Rack or Mobile Units.

1 The camera.

2 The power supply and remote servo amplifier which is contained in a new type of mobile case giving easy access for maintenance and is suitable for rack mounting or mobile use.

3 The camera control unit of construction similar to that of the power supply unit, containing the video processing chassis, a shading waveform generator and a pair of field scan units for the viewfinder and camera.

4 The camera control panel, which contains no valves, can normally be located up to 50 ft from the control unit. This panel contains all the operational controls required for the setting up of a camera channel for optimum picture quality.

5 The picture and waveform monitor with 14 in. and 5 in. display tubes, respectively.

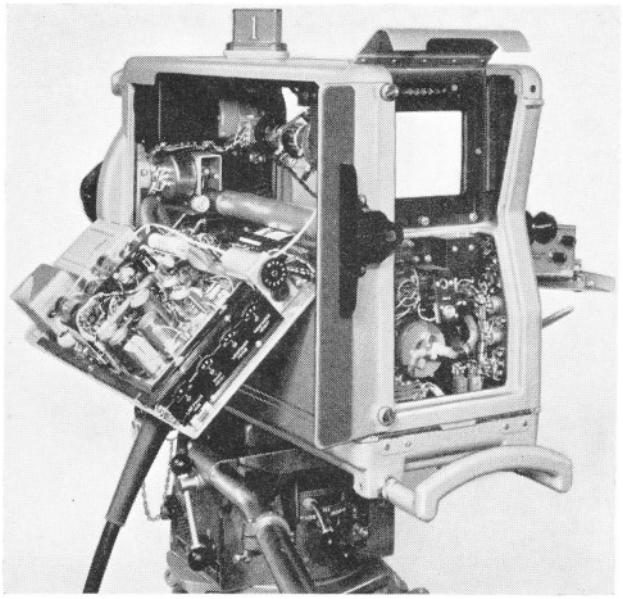
Although these units of the camera channel are outside the scope of the present article, it is proposed to describe them in a later issue of this Journal. The block schematic, Fig. 2, shows the camera chain arrangement.

Restating briefly the main features of the Mk. IV camera:

It is of manageable size and weight and yet extremely robust.

The technical specification is rigid and comprehensive.

A superior performance is achieved in respect of picture quality through the use of the $4\frac{1}{2}$ in. image orthicon.



Side casing lowered on the left of the camera showing units and controls exposed.

Many features and facilities are included for ease of handling in studios and on outside broadcasts.

The camera and all its associated units are accessible for service, with interchangeable plug-in units which are designed for a high standard of reliability.

Finally the camera is electrically stable, requiring the absolute minimum of re-adjustment during operation.

THE MARK IV CAMERA CHAIN

EXPERIENCE COUNTS

Marconi's pioneered the use of the 4½ inch Image Orthicon Camera using the tube developed by their associates, the English Electric Valve Company. Marconi's have amassed more 'know-how' on the use of the 4½ inch Image Orthicon than any other manufacturer.

OVER 500 MARCONI IMAGE ORTHICON CAMERA CHAINS HAVE BEEN SOLD THROUGHOUT THE WORLD

BD 863 MARK IV IMAGE ORTHICON CAMERA

EXTREME STABILITY
Novel circuit design and careful choice of components gives such a high degree of stability that operational controls have been removed from the camera.

FIRST CLASS PICTURE QUALITY
The 4½ inch Image Orthicon tube gives a picture quality substantially better than any other type or size.

LIGHT AND COMPACT
By reducing and simplifying the camera electronics its weight has been held below 100 lb. and its size made correspondingly small.

MARCONI

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