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HANDS OFF THE CAMERA

INTRODUCTION

TELEVISION IS A FORM of mass entertainment and communication based on very complex engineering techniques, involving practically all facets of technology. Electronics, optics, acoustics, power engineering, illumination, mechanical engineering and ergonomics are involved — not to mention economics. Yet despite all this, however much engineers may regret it, the technicalities are merely a means to an end—that of producing programmes. In an ideal situation the technical equipment would continue to operate indefinitely, producing perfect pictures under all conditions without any attention. This happy state has not been reached because certain immutable laws of physics stand in the way. However, great advances have been made in the last decade, particularly with camera equipment. The additional complication of colour has added further stimulus to the search for equipment which is simple to operate and does not intrude into programme production methods. This article is confined in detail to monochrome camera operation but the same principles of operation, although not so highly developed, apply to colour. It is hoped to cover this in a later issue.

A BRIEF HISTORY OF CAMERA CONTROL

Early cameras had marginal performance and were extremely susceptible to environmental changes. Continual readjustments had to be made to ensure optimum camera performance at all times. Hence, vision

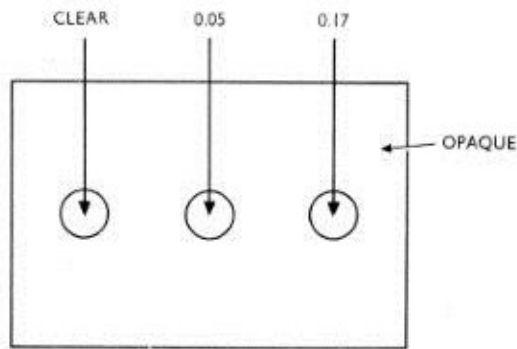
control operators were responsible for the continual 'jockeying' of the many camera controls. A programme's success could depend on the operator's ability to correct the right parameter at the right time. Their task required much skill and experience, and they commanded such respect that some producers would only work with an individual team of vision controllers. As audiences grew larger, television services became more complex and increased in number. There was a corresponding scarcity of skilled vision control operators which, combined with a general scarcity of engineering manpower, made it essential to remove as much as possible of the required vision control skill.

Several British organizations attempted to simplify the task. Marconi, in conjunction with the BBC, removed the unstable elements from the Mark III camera to produce a channel which could be operated in a 'hands-off' manner. The first specifically designed 'hands-off' camera was the Mark IV.

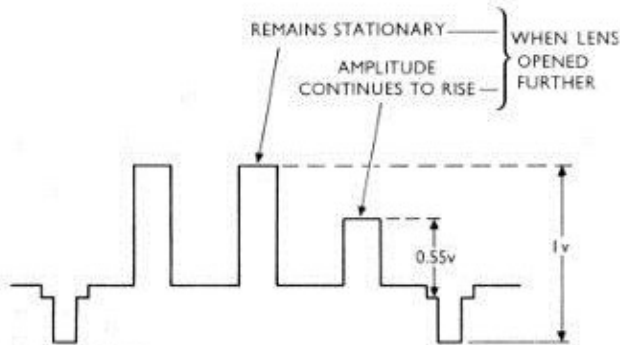
WHAT IS 'HANDS OFF'?

The aim, can, therefore, be stated as designing an inherently stable camera and devising setting-up and operating techniques to allow full use to be made of this stability without any need to adjust the camera except for the artistic requirements of the producer.

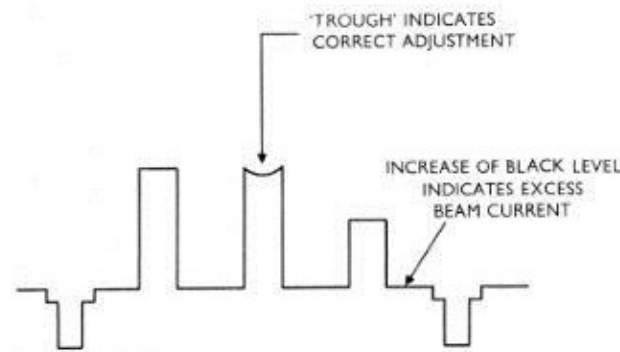
The setting-up procedures must be based on the assumption that standardized levels and uniformity of lighting are achieved and used in the studio. On this



Test slide.



Setting the knee.



Setting the beam.

basis the camera channel is set up in a technically correct fashion for these conditions. The only adjustments then left to the operator are limited range controls of lens iris and black level to correct for unavoidable variations from correct lighting and to allow artistic effects called for by the producer. The camera electronics should not be used to correct the basic shortcomings of the lighting.

Thus the vision control operator has only two controls, directly relating to picture quality, on a purely passive control panel in the studio. All others are relegated to a distant apparatus room.

Typically, one operator with artistic rather than technical skill can now control four colour camera

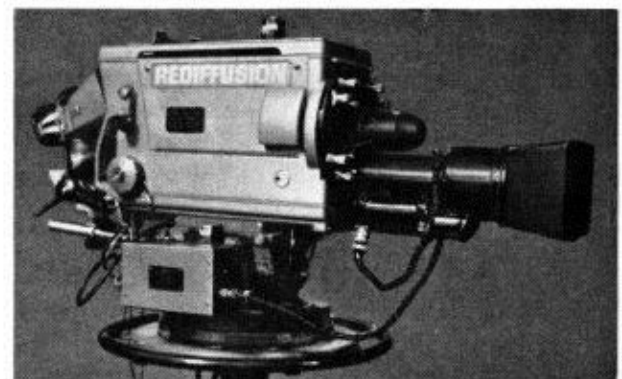
channels with consistently high picture quality, whereas before, three or more skilled technicians were required to control four monochrome camera channels.

However good the lighting is, it is seldom technically possible to give the correct light level and contrast ratio throughout a scene. This is essential for correct exposure of the tube, and must, moreover, be the same for various positions of the artists and different angles of view. It is therefore best, in rehearsals, to operate all cameras 'hands off' and adjust the lighting for the best possible results. Then during the final rehearsal and transmission, only minor adjustments of iris and lift are required to take up small unavoidable errors of lighting. One could now consider, as a final rationalization, the function of lighting supervisor and vision controller combined in one picture controller.

LINE-UP PROCEDURES

One of the main requirements in adopting 'hands-off' operation is stability of all parameters, a quality now inherent in most broadcast standard camera equipment. The operating technique is applicable to all stable broadcast equipment. A simplified line-up procedure enabling consistent results to be obtained in camera setting up is also necessary. Ideally, such setting-up techniques should not involve any subjective 'picture quality' assessment, but should have an objective, repetitive procedure which gives consistent quality results independent of the operator who carries them out.

The more difficult operating points to find consistently are the correct exposure of the image orthicon and the correct target setting. Several methods are used to obtain this, differing only in detail, and one



The Mark IV television camera.



Marconi Mark IV camera in action with Rediffusion Television, London.

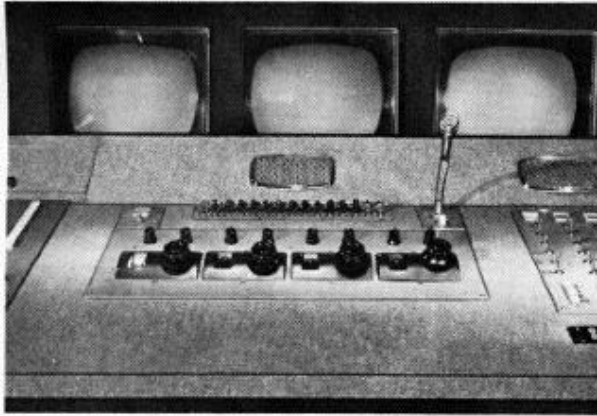
of the best, used by Rediffusion Television, will now be described.

A special 'three-hole' slide is used as the test object, comprising a 2×2 in. slide which is opaque with the exception of three $\frac{1}{4}$ -in. diameter holes. One of these (the left-hand one) is clear, the centre has a piece of neutral density material of 0.05 density, and the right hand, 0.17. The slide is mounted in a hood which fits over a 3-in. lens, and holds the slide $\frac{1}{4}$ in. from the front glass of the lens. A photographic safe-light, fitted behind the slide, has a 25-W lamp and suitable neutral density filters to give a brightness of 50 ft/lamberts (or whatever reflected brightness the station standard lighting technique gives) checked by a light meter. For zoom cameras a larger slide would be required, at a greater distance, with stray light eliminated, but the same principle holds. The camera head amplifier gain is adjusted to standard (1 V out) with a test waveform at the 'test waveform' input, lift and gain controls having been set to their mid-position. The channel is then switched to normal operation, to view the slide. A wide-band strobing waveform monitor (Marconi Picture and Waveform Monitor) is set to display the three holes. Coarse lift is adjusted to give 1% of lift, and iris adjusted until the 'knee' is reached. (If the lens is opened beyond this point the centre hole amplitude will remain stationary and the next highest will increase.) The dynode gain is then adjusted so that the centre hole is at 1 V and the iris is reset for the knee. The lens aperture should not be greater than $f/5.6$ for normal camera sensitivity (or as appropriate to lighting

levels in use). Switch to 'Set Target' and adjust 'Target' control so that the edge of the centre white circle is just visible. Return to normal and set 'Beam' control so that a depression just appears on the top of the centre hole waveform. An increase of beam beyond this point causes lifting of the black level. This procedure may have to be repeated two or three times to obtain optimum adjustment of all parameters. The setting up does not, of course, have to be carried out every day—it forms part of the weekly (or less frequent) maintenance check together with that of resolution, noise, linearity, etc. The daily check need only consist of a look at a resolution chart (such as Marconi No. 1) with the standard lighting level used in the studio operation.

The channel gamma correction is set by feeding the gamma-corrected sawtooth output of the camera and a linear sawtooth of equal amplitude into a differential oscilloscope with extra gain and comparing the trace with a special graticule.

The BBC use a similar line-up method but a different test slide which includes a resolution test wedge. Exposure is checked by adjusting iris and dynode gain to position the lower two of three density steps to coincide with two special marker lines on an oscilloscope graticule. Target setting is found by operating the 'Set Target' switch and adjusting the target potentiometer until the amplitude of the main body of the picture is reduced to the order of the dark current variations. The target volt potentiometer is preset to 3 ± 0.1 V. Gamma correction is set up in a similar fashion to Rediffusion Television



Operational control position at Tyne-Tees Television.

Other operators such as Tyne-Tees Television find the correct exposure by observing the point at which peak white in a test chart begins to compress, and open the lens a further half stop. The intensity of the lighting of the test chart is, of course, carefully adjusted to equal the light level reflected off a correctly lit set.

Another important point of adjustment for 'hands-off' operation is the picture monitors in the technical control room. All must be set at the same high-light brightness and black level, if the pictures from the cameras are to be correctly matched. This is most easily done by using the Picture Line-Up Generating Equipment (PLUGE) developed by the BBC. This provides an accurate test signal which can be displayed on all monitors. The high-light brightness should be set by a light meter, and the black level by the special signal level incorporated in PLUGE. Needless to say this should all be done under normal operational lighting conditions in the control room.

This is not, of course, an exhaustive treatment of the subject of 'hands off'. Only one method of line up is described in detail and each station will doubtless in time develop its own techniques. The important point is that the method be consistent, objective and independent of the technician carrying it out. The 'green-finger' approach must give way to the scientific if the full benefits of improved picture quality and artistic flexibility are to be realized.