THE BRITISH BROADCASTING CORPORATION ENGINEERING TRAINING DEPARTMENT

THE COLOUR CAMERA CHANNEL

The colour camera channel consists of an optical system giving three colour separated outputs, and in the case of four tube cameras a luminance output. These three (or four) images are incident upon the same number of camera tubes which have a similar number of camera channels associated with them. It would seem then that a colour camera is an optical system with three monochrome camera channels. While it is certainly true that all the elements of three (or four) monochrome channels are contained in the colour camera, it also contains certain unique features and certain of the "normal" components are more refined.

This information sheet is not concerned with the optical system and will deal only with the electronics. It is assumed that the general principles of monochrome cameras are familiar to the reader and this information sheet will only mention items which are (a) more critical or (b) unique to the colour camera channel.

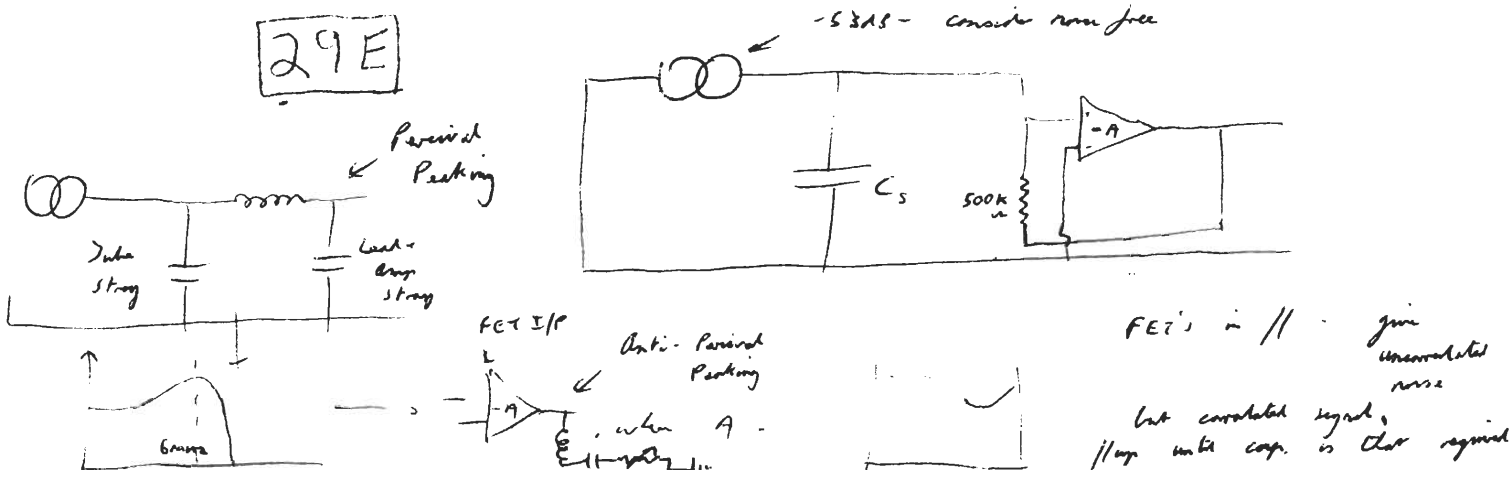
These are:-

(1) Head Amplifier

This fulfills the same function as its monochrome counterpart, that is to convert a constant current, high impedance signal to a constant voltage low impedance signal with little h.f. loss. As the camera tube is a photoconductive type, head amplifier noise is the main source of noise in the channel. It is therefore necessary to design the amplifier with this in mind, and because the number of correction circuits in the channel are greater (most of which deteriorate the signal/noise ratio) the head amplifier must have the minimum noise possible. As the tube transfer characteristic is linear the improved head amplifier performance can be used also to lower studio light levels.

(2) Aperture Correction

Both vertical and horizontal aperture correction will be used. The horizontal correction is often made level-dependent so that no correction occurs at low luminance levels where γ correction deteriorates S/N most and a technique known as "Contours Out of Green" will be used for three tube cameras. For four tube cameras only the luminance channel is aperture corrected.



(3) Gamma Correction

Monochrome channels usually use correctors which use straight line approximation to the curve. This type is thought to introduce colour fidelity errors near the 'Knee' points and a corrector giving a continuous correction curve is usually used.

(4) Clippers

Because the tube used has no 'Knee', specular highlights can cause large amplitude signals. These could disturb the clamps etc. and some form of limiting often occurs early in the signal chain. At some later point this may be repeated to clip at a level nearer the maximum required.

(5) Colour Matrixing

Cross-coupling of the tube outputs before γ correction is carried out so as to improve colour fidelity.

(6) Optical Flare Correction

The veiling glare which occurs in the optical system adds to the signal a 'pedestal' whose amplitude is proportional to the average light level. Because this will be coloured by the predominant scenic colour it must be compensated for.

(7) Pulse Correction

In addition to the wanted video, the head amplifier picks up spurious pulses in the blanking period from the scanning circuits. These may be of either polarity. In order that colour balance is not affected when electronic gain is varied, this pulse must be cancelled.

(8) Dichroic Tilt Correction

Practical colour separation systems suffer from a modulation of the light falling on the tubes due to the light through the dichroics varying in angle. This effect can be minimised by modulating the output of one tube to match the other two.

(9) Livingstone Correction

A colorimetric study of a television system having three tube cameras and γ correctors in the C.C.Us shows that the luminance of the coded signal is of smaller amplitude than the original scene whenever any colour is transmitted. This affects the monochrome viewer although the luminance and chrominance seen by a colour viewer is correct. When four tubes are used in the cameras exactly the opposite situation arises, the monochrome

viewer sees the correct luminance and the colour viewer has both luminance and chrominance incorrect. This is known as Livingstone Case No. 2 and several forms of correction have been proposed.

(10) Scanning

The line scanning waveforms maybe obtained from common generators and parallel fed to the three yokes. The green tube is made the master and operation of the master scan amplitude and linearity is usually the only method of controlling the scans of the green tube. Additional controls are provided for red, blue and luminance. These also have an additional control marked SKEW which corrects for any trapezoidal distortion of these tubes relative to the master tube. Horizontals are aligned by mechanical rotation of the yokes. It is desirable that all electronic scan controls be operated from the CCU where a high quality monitor is available.

T.E. Wakes/VM
22nd September 1967

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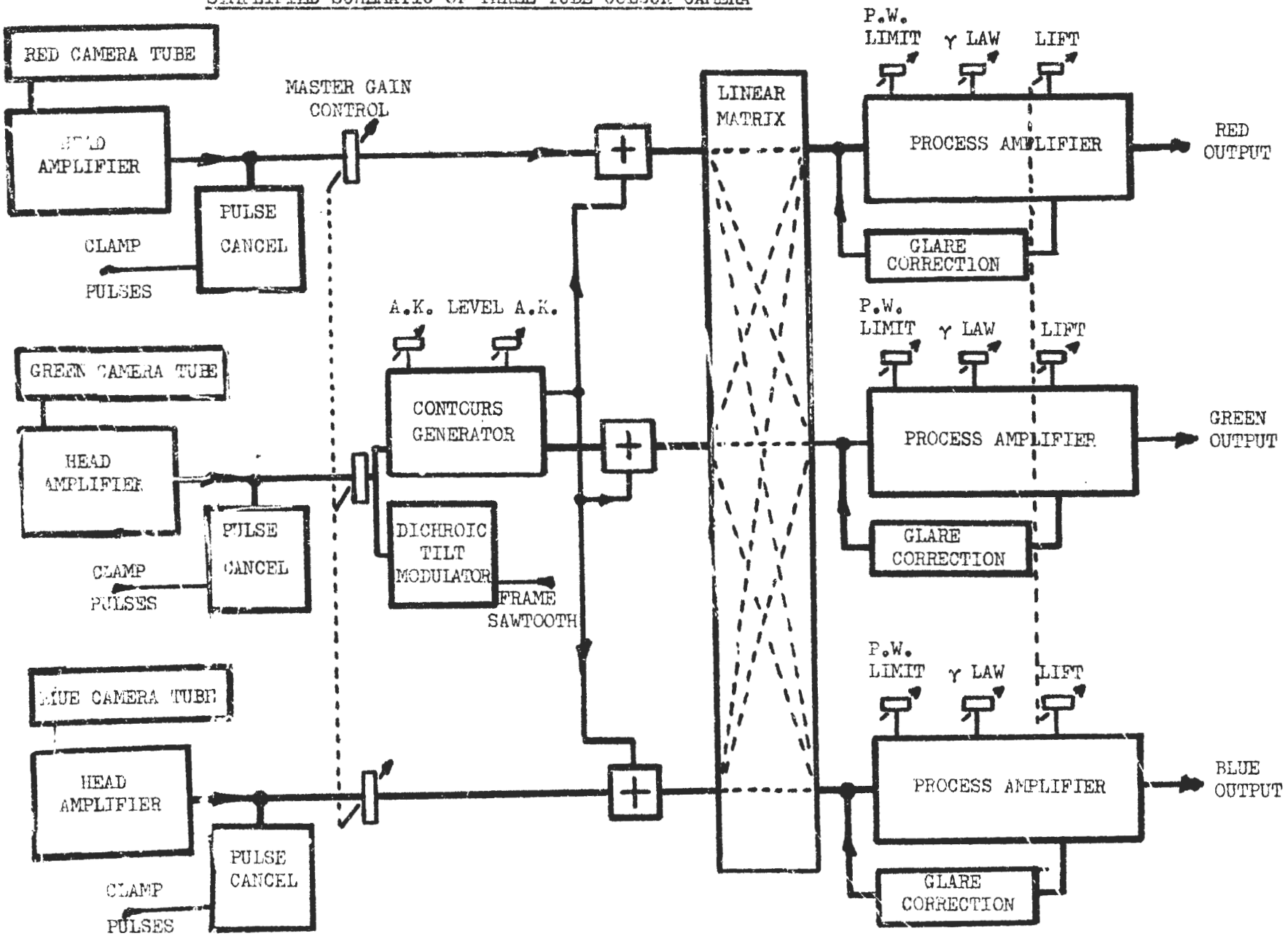
SIMPLIFIED SCHEMATIC OF THREE TUBE COLOUR CAMERA



Mr. T.E. Wake-VM
27th September 1967