TELEVISION

VIDEO TAPE SIGNAL ANALYSIS

1.01 This section is issued to make available to the Bell System, Report No. 2 of the Network Transmission Committee. The Report deals with signal impairments which are peculiar to the video tape recording-playback process. It also presents a glossary of terms and a brief description of impairments that may occur in signals from both monochrome and color video tape machines.

1.02 The Network Transmission Committee is the subcommittee of the Video Transmission Engineering Advisory Committee. Representation consists of the following:

American Broadcasting Company
Columbia Broadcasting System
National Broadcasting Company
The Bell System

ENGINEERING REPORT No. 2

VIDEO TAPE SIGNAL ANALYSIS

MARCH, 1959

NETWORK TRANSMISSION COMMITTEE

of the

VIDEO TRANSMISSION ENGINEERING ADVISORY COMMITTEE

(Joint Committee of the Television Network Broadcasters and the Bell Telephone System)

TELEVISION
NETWORK TRANSMISSION COMMITTEE
ENGINEERING REPORT No. 2

VIDEO TAPE SIGNAL ANALYSIS

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OUTLINE OF REPORT

VIDEO TAPE SIGNAL ANALYSIS

1. INTRODUCTION

The increasing use of video tape recording by the network broadcasters has made it important that both Broadcasting and Telephone Company operating people be able to recognize and compare certain signal impairments which are peculiar to the video tape recording-playback process. This report supplements the booklet "Television Signal Analysis" originally published by the American Telephone and Telegraph Company in 1955. It presents a glossary of terms and brief descriptive information covering impairments which can occur in signals from both monochrome and color video tape machines. Certain background information is included for completeness.

This report does not purport to set up standard terms for industry use. However, it is hoped that the terms defined will enable more efficient exchange of information in handling network operational problems.

2. THE VIDEO TAPE SYSTEM

All three major television networks are using Video Tape Recording (VTR) equipment. Figures 1 and 2 show the appearance of typical VTR equipment.

What appear to be transmission impairments of signals from this equipment may be caused by:—

(a) the tape
(b) the tape machine
(c) the interconnecting facilities

2.1 *The Tape*

Signal-to-Noise Ratio

The chief factors determining the signal-to-noise ratio in the tape are the smoothness of the tape surface and the ability to magnetize the tape to optimum flux density. In the final analysis, it is necessary to choose the best compromise between signal-to-noise ratio and available modulation bandwidth.

2.2 *The Tape Machine*

The most serious impairments caused by the tape mechanism are "head-hunting," "mistracking" and "banding."

Head-Hunting

Because the magnetic head assembly in current VTR equipment is a rotating device controlled by a servo system, it is subject to hunting.

Mistracking

The tape is moved longitudinally past the head by a servo controlled transport mechanism. Variations in playback speed with respect to recording speed cause mistracking of the head.

Banding

There are four video heads in each rotating head assembly. Each head records sequentially approximately 16 picture lines in each field. Because of interlace the band appears as 32 lines on a monitor. Many impairments, therefore, show as distinct horizontal bands in the reproduced picture.

2.3 *Interconnecting Facilities*

Problems generally associated with interconnecting facilities are discussed in the prior booklet "Television Signal Analysis." In this connection, a word of caution: Beware that legitimate network transmission troubles are not neglected or overlooked just because they may be similar to, and therefore, assumed to be video tape impairments. On the other hand, when a tape machine is running at high speed (as during rewind) or is stopped, the output signal may resemble a "microwave open circuit."

Fig. 1 - Monochrome Video Tape Recording Equipment

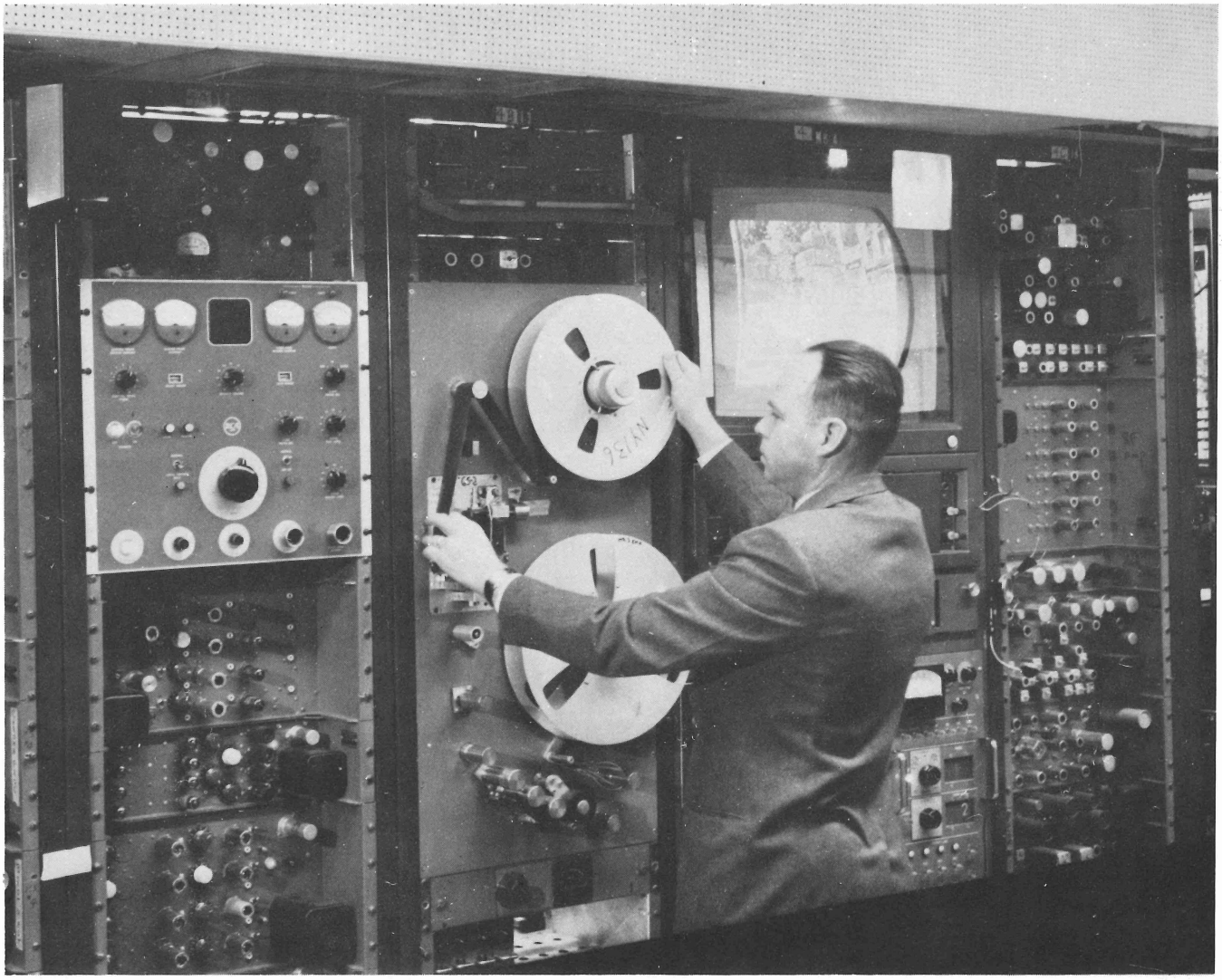
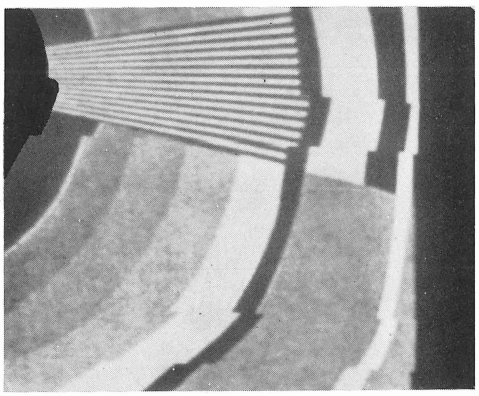


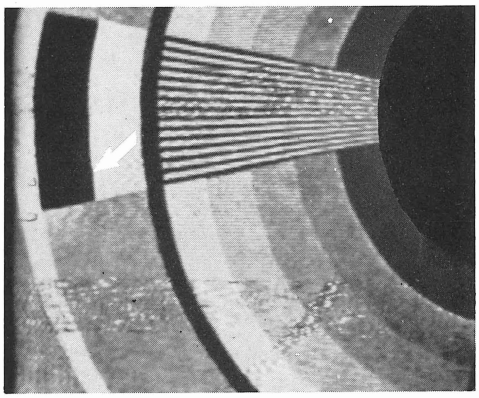
Fig. 2 - Color Video Tape Recording Equipment



BANDING

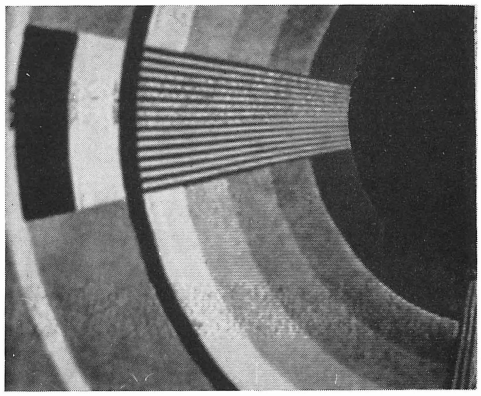
Delay Banding

Banding made visible by differences in head geometry (quadrature), and/or by differences in electrical delay between the head channels.



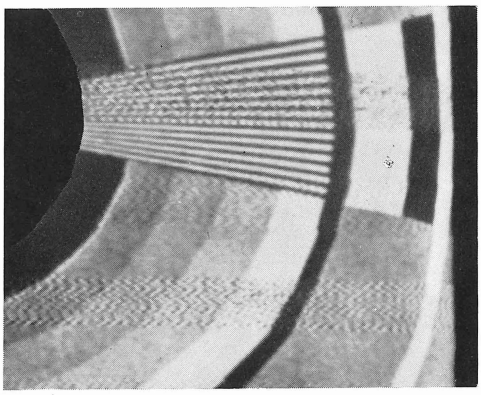
Head Displacement

A recurring displacement of every 16 lines in each reproduced field, caused by a slight horizontal displacement of a head or misadjustment of the switching system.



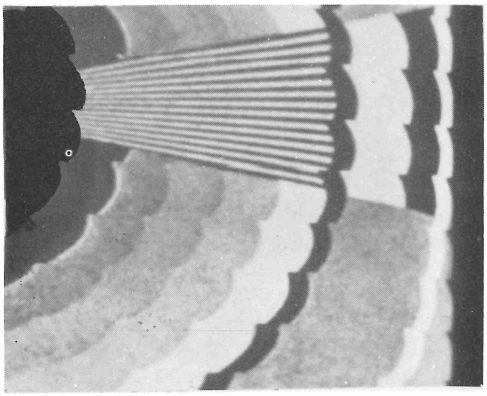
Noise Banding

Banding made visible by differences in signal-to-noise ratios between head channels.



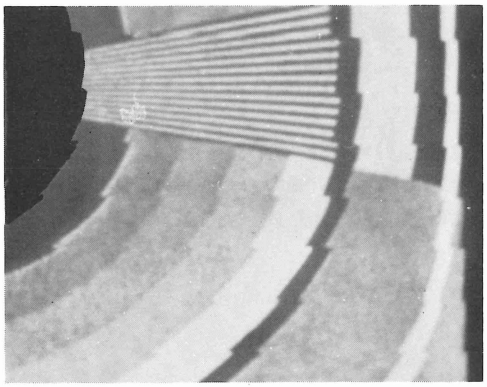
R.F. Banding

Banding made visible by undesirable radio frequency patterns.



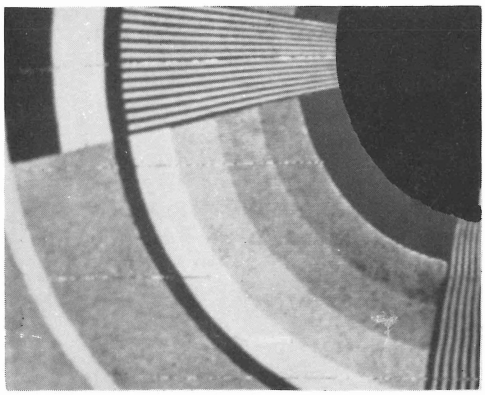
Scalloping

A rounding of the edge of each band of lines caused by incorrect vertical positioning of the tape.



***Venetian Blind* (*Not to be confused with co-channel interference*)**

A linear displacement of lines within each band, giving a sawtooth vertical picture edge. It is caused by incorrect pressure between head and tape.



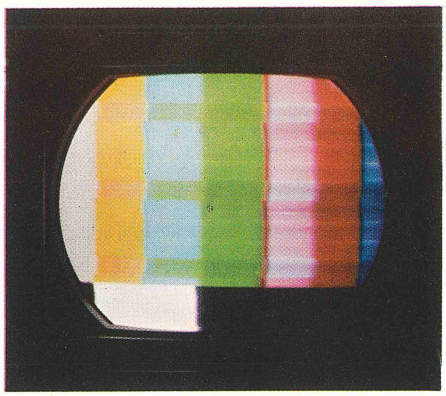
BRUSH NOISE

Repetitive noise which is similar in appearance to ignition noise, caused by faulty slip-ring contact.

CHROMA FLUTTER

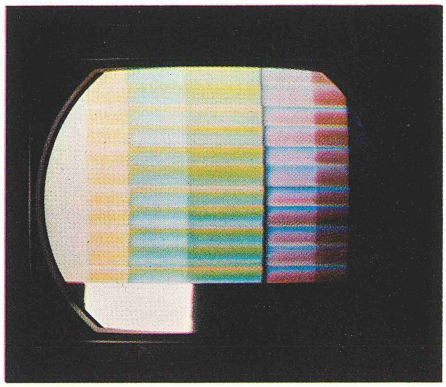
A random change in color saturation in portions of the picture.

COLOR BANDING



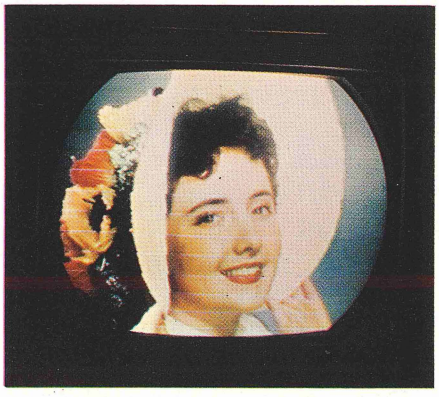
Color Phase Shift Banding

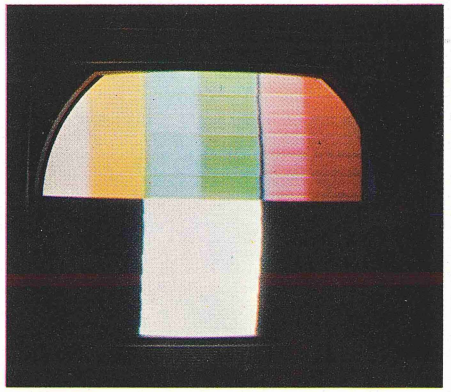
Banding made visible by differences in color phase between head channels.



Hue Shift Banding

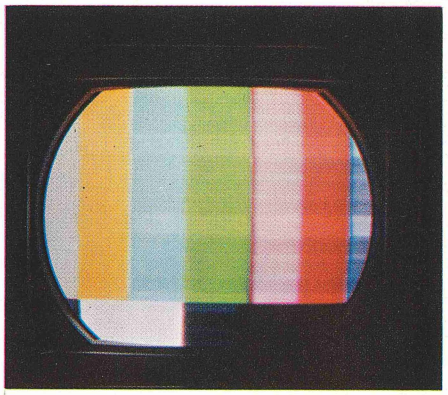
Banding made visible by hue shifts within a band.





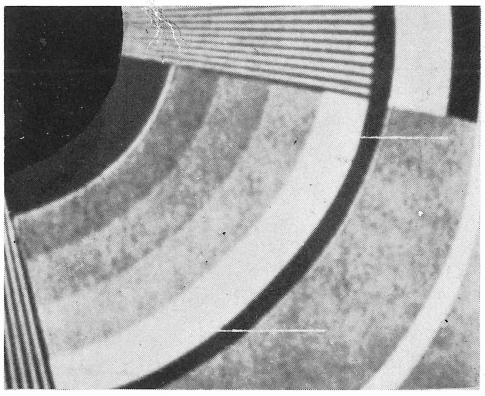
First Line Hue Shift

Banding made visible by a difference in hue of the first line of each band.



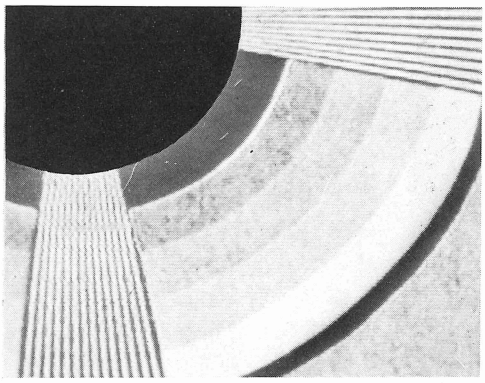
Saturation Banding

Banding made visible by differences in saturation between head channels.



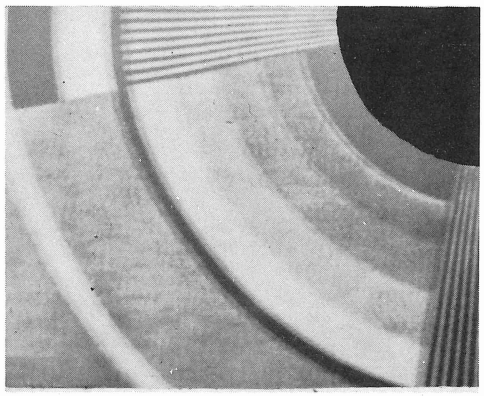
DROPOUTS

Random noise flashes directly associated with imperfections in the magnetic coating of the tape.



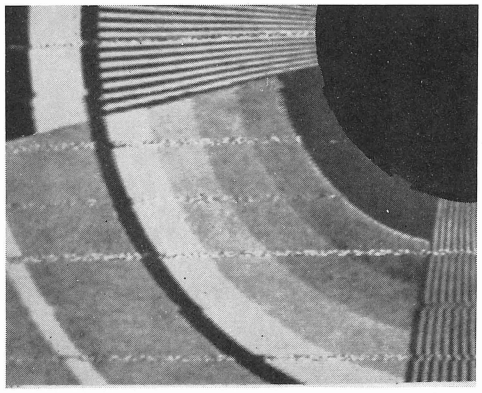
EDGE BEAT

An irregular beat at edges of sharp luminance transitions. This is caused by intermodulation between the various component signals.



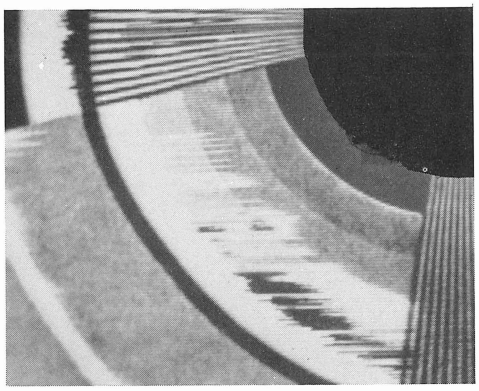
HEAD HUNTING

A horizontal shifting back and forth of the reproduced picture, caused by undesirable fluctuations in speed of the head.



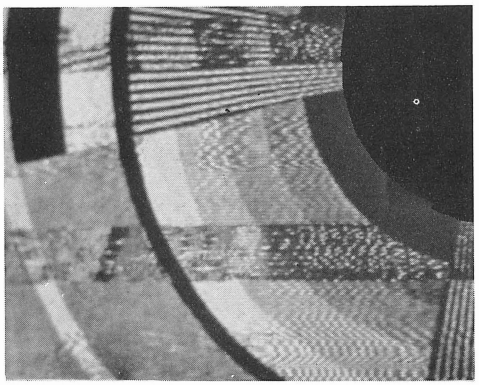
HEAD SWITCHING TRANSIENTS

White or black transients which occur regularly in bands, resulting from improper operation of the head switching system.



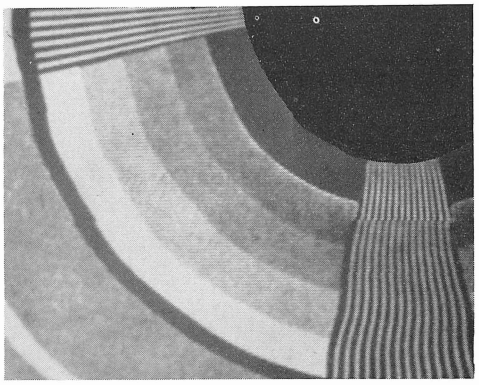
HIGH-LIGHT TEARING

Polarity changes of high-light picture areas, caused by overdeviation in the modulation process.



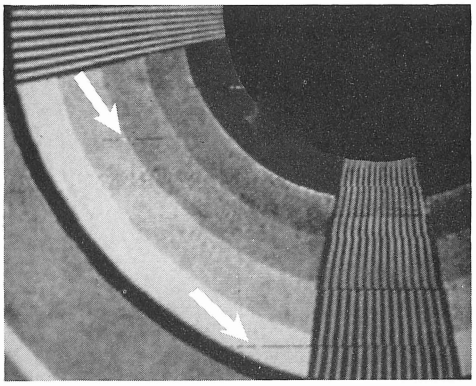
MISTRACKING

Deterioration in picture quality, caused by errors in positioning of the tape with respect to the head. The degree of impairment may vary from a reduced signal-to-noise ratio through heavy moiré to complete loss of picture.



ROTATIONAL "S" DISTORTION

A horizontal shift of picture lines in time with a rotation of the head, (repeating every 4 heads).



SCRATCHES

Noise flashes forming a geometrical pattern, usually diagonal, and caused by physical scratches in the magnetic material.

WATERFALL

A shimmering effect over the entire picture, which may be caused by defective or worn bearings.