TECH NEWS

CAMERA TYPE TELECINES no. 2 in a series of 10

by rodger j. ross

The following is the second in a series of articles written by Rodger J. Ross for Cinema Canada about film post-production on videotape. It was first printed – and badly so – in issue no. 54 of the magazine under the title "Vidicon Cameras for Telecine Service." Not only was the title misleading, several of the paragraphs were out of order, rendering the article incoherent. Cinema Canada reprints the article in this issue with our apologies to Mr. Ross for the errors in issue no. 54.

The third article in the series, "Flying Spot Scanners: Film Post-Production on Videotape," was printed in issue no. 55; the fourth of the series, "Making Recordings on Videotape" also appears in this issue of Cinema Canada.

FILM POST-PRODUCTION ON VIDEOTAPE – Second in a Series

Camera-Type Telecines.

By far the most popular method for reproducing films and slides in North American television is the multiplexed camera-type telecine chain. Usually, telecine chains consist of two 16mm. projectors and a slide projector optically multiplexed into a television camera. As a rule, the film projectors are mounted at right angles to the right and left of the multiplexer, while the slide projector "looks" directly through the optical system into the camera. Moveable mirrors in the multiplexer can be shifted by remote control from a production coordinating studio, directing the light beam from any one of the projectors into the camera. These telecine facilities are designed to give continuous uninterrupted output over long periods of time.

In one quite common multiplexer model two mirrors 90 deg. apart are mounted on a vertical shaft and driven by air pistons. With film running in both projectors and the mirrors set to direct the light beam from one of the projectors into the camera, depressing the remote control button for the other projector shifts the mirror assembly in a fraction of a second to its new position. This cuts off the light from the first projector and directs the light beam from the other projector into the camera, producing an effect similar to a straight cut (splice) between two scenes. When a third button is pressed the mirror assembly shifts into a position where both film projector light beams are cut off, and only the light beam from the slide projector can enter the camera.

Remote control buttons are provided also to start and stop the film projectors. In some telecine installations projectors can be stopped automatically at the end of a program sequence by a patch of magnetic foil attached to the edge of the film. Slide projectors for telecine service are usually fitted with two drums or carousels to enable slides to be shown in a continuous sequence without dark periods between successive slides. This is accomplished by projecting the first slide in a sequence from one drum, and then, when the "slide change" button is depressed, the next slide in the sequence is projected from the other drum. The change-over from one slide to the next usually appears as a rapid dissolve rather than a straight cut.

Vidicon Cameras for Telecine Service.

Most telecine chains in broadcasting stations utilize vidicon cameras for generating color video signals from films and slides. A color telecine camera consists in reality of three separate camera units, each fitted with a vidicon tube, to produce separate red, green and blue signal outputs. These units are located on adjustable mountings in a common enclosure containing also the filter and mirror or prism assemblies for color separation. Surrounding each tube are sets of alignment, focus and deflection coils to control the scanning action of the electron beam.

The optical system in a telecine chain is quite complex. Two factors complicating the design are the long optical path between the projector gates and the face plates of the vidicon tubes – 30 to 40 ins. or more in some layouts – and the small size of the useful photo-area in the vidicon tubes. To achieve a magnification ratio of approximately 1:1 for 16mm. film images, a common practise is to utilize a large field lens at the entrance port of the camera. The film and slide

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projectors produce aerial images at the plane of the field lens, and these images are then focused sharply at the face plates of the vidicon tubes. The light beam entering the camera from a projector is split into red, green and blue components by dichroic filters, and these three colored beams are then reflected off front-surfaced mirrors to the corresponding vidicon tubes.

Color Registration.

The scanning patterns produced in the vidicon tubes must be exactly the same size and shape, and must be exactly registered at the camera output to give television pictures free from colored fringes. This is an additive system in which red, green and blue images are superimposed to produce all the other colors of which the system is capable. The Society of Motion Picture and Television Engineers makes available several test patterns in 35 and 16mm. film and 2x2 slide formats for the alignment of telecine equipment. Among these is a deflection linearity pattern. This pattern is utilized together with an electronically generated grating to obtain exactly matching images from the three vidicon tubes.

An alignment and resolution test pattern is also available from SMPTE, consisting of a target defining the portion of the projected image frame to be reproduced in the television system, and useful also for accurate alignment of the telecine projectors with the camera, as well as for adjusting optical and electronic focus. The "barber pole" border around this pattern enables adjustments to be made in the scanned area, and groups of vertical and horizontal lines in converging patterns provide a critical test for focus.

Picture Gray Scale and Color Reproduction.

The color television system as we know it today in North America was developed in the USA in 1953 by the National Television Systems Committee, from which the designation "NTSC" derives. A basic consideration in this system is what might be termed "neutral balance." This means that a properly aligned telecine chain should give a neutral (colorless) picture from a gray scale, as well as from black-and-white films or slides.

Eastman Kodak Co. produces a gray scale telecine test slide 3 1/4 ins. in size designed to be inserted at the field lens position. During alignment of the camera, the slide is illuminated by running one of the projectors with open gate. At the camera control console, it should be possible to display the outputs of the three camera tubes side-by-side on a waveform monitor. Depending on the color of the projector light source, the settings of the camera controls at the time and various other factors, the three waveform displays may not have the same amplitudes at peak white. This would indicate that the combined outputs will not produce a neutral television picture. After the camera controls have been adjusted to make the three waveforms match, the two remaining projectors can be checked by turning on their light sources and making the necessary adjustments to produce matched waveforms in each case. This might be done by altering projector lamp voltages or lens apertures, or by inserting filters (neutral density or color) in the projector light beams.

A Canadian company, D. & S. Corley Ltd. of Toronto, also produces gray scales and a number of other test patterns for telecine camera alignment. Among these patterns is a set of six vertical colour bars for checking the performance of color reproducing systems.

Picture Monitor Alignment.

To obtain a television picture in color the combined output signals from the telecine camera are carried by a cable to a television picture monitor. A picture monitor is a high quality and much more costly television receiver that is utilized by television stations and program production companies to evaluate television picture quality.

The inner surface of the face of the color picture tube in monitors and receivers is coated with large numbers of tiny phosphor dots. Three different kinds of phosphor are used for these dots, to give red, green and blue light. At the base of the picture tube are three electron guns producing sharply defined electron beams made to sweep across the inner surface of the tube face by deflection coils. As the electron beams strike the phosphor dots, colored light is emitted. Close to the layer of phosphor dots, which are laid down on the glass surface in triads, there is a perforated metal screen that allows only one of the electron beams to strike the corresponding dots. Thus, the "red" electron beam, representing the red portions of the film images, strikes only the red phosphor dots, and the green and blue dots are excited in a similar manner. As the signals applied to the electron guns vary, the brightness of the colored dots increases and decreases, producing the color television pictures.

An essential part of the basic telecine alignment procedure is the adjustment of the controls of the picture monitor so as to reproduce the gray scale test slide as a neutral (colorless) pattern. Controls are available also in the monitor to vary picture brightness and contrast.

It is a common practise for television technicians to adjust monitor controls to give what is considered to be a visually acceptable picture. This set up method is adequate so long as the picture monitor is being utilized only for continuity and program switching purposes. But when a telecine is being used to transfer films and

slides to videotape, the picture monitor should provide meaningful indications of the characteristics of the images being reproduced. For example, a film with a reddish color cast should produce television pictures that have a reddish appearance, and an excessively contrasty film should be reproduced with all detail in shadow areas clipped off. It is only in this way that the operator responsible for reproducing the films and slides can make the proper decisions as to what corrections are needed, so as to give a uniform, high quality picture output.

In a properly adjusted picture monitor the white screen at 100 units video level should be measured at approximately 30 foot lamberts, and its color temperature should be matched with a reference at D6500. Black level should be set with the brightness control at the point where the scanning lines disappear.

Operating a Camera-Type Telecine.

A well-maintained and properly adjusted camera-type telecine should give high quality color television pictures, sharp, clear, well balanced and with an excellent range of color and gray scale values. The greatest care is needed, however, in the alignment of the equipment to make sure that pictures with the best possible quality are being obtained. SMPTE supplies subjective color reference films or slides that can be projected in a review room, and then reproduced in the telecine for comparison.

Most camera-type telecines available at the present time have been designed for automatic operation in what is sometimes termed the "hands-off" mode. The first step that must be taken in setting up a telecine for film post-production is to disable these controls, so that the chain will operate as a passive reproducer, producing television pictures that correspond as closely as possible with the color images in the films or slides.

Because designers have been so much preoccupied with giving broadcasters automated equipment requiring minimum attention, available telecines seldom have adequate flexibility for post production. At the very least, the telecine should have color trim controls in addition to adjustable gain and black level. Most telecine cameras have some provision for electronic image enhancement to sharpen up the edges of picture details. Some telecines are supplied also with color masking and gamma correction circuits.

When a film is being reproduced, the operator cannot see what is on the film. The picture monitor shows only what is being taken off the film by the telecine. If these images are not acceptable or if it is considered that some improvement can be made in their appearance, the operator then adjusts the camera controls in whatever direction seems to be needed.

This method of picture reproduction has the advantage that the effects of any change in a camera control can be seen at once in the picture monitor display, and if the desired effect or picture change is not obtained, the control can be restored to its pre-set position as established during initial alignment. □

Making Recordings on Videotape

no. 4 in a series of 10

by rodger j. ross

4. MAKING RECORDINGS ON VIDEOTAPE.

In the early days of television, film was used extensively to make kinescope recordings of programs produced with live television cameras. But the picture quality obtainable when these recordings were played back in a telecine left a great deal to be desired. Extensive research was undertaken to find some way to record video signals on magnetic tape. At that time sound was being recorded successfully on 1/4-in. tape, but the frequency range in video signals – over 4 MHz as compared with 15 to 20 kHz – appeared to be an insurmountable problem.

Then in 1956 engineers at the Ampex Corp. in California announced that they had developed a workable system for recording television signals on magnetic tape 2 ins. in width by means of a high speed rotating head wheel. With this method narrow, closely spaced video tracks were recorded across the width of the tape as it was drawn over the head wheel at the rate of 15 inches per second. Sound was recorded in a continuous track along one edge of the tape while a control track on the opposite edge was used for synchronization. Demonstrations of production models of the Ampex recorder showed that the pictures recovered from the tape in playback on the same machine were very nearly indistinguishable in side-by-side comparison with the original pictures from a live television camera.

To ensure interchangeability of recorded programs, the 2-in. videotape system with transverse tracing of video tracks by a rotating head wheel fitted with four recording heads was quickly adopted by the television industry as the professional recording standard. The designation, 2-in quadruplex recording, was also adopted at an early stage. In short order almost every television station had at least one – and often several – of these recorders; according to a recent report over 4,000 were in use in North America alone.

Helical Scan Video Recording.

A new and quite different method of video recording developed by Japanese engineers was announced only a few years later. In this system the magnetic tape was wrapped around a large revolving drum containing a single recording head, the tape following a helical path from the feed to the takeup reel. As the tape was carried around the drum, long slanting continuous tracks were laid down on the tape.

This method of recording had several obvious advantages, the most important being greatly simplified machine construction and operation, and much lower cost. Soon, a great variety of helical scan or slant track recorders appeared on the market. Thousands of these machines have been acquired by business, industry and educational institutions for use in what might be