Electronic Marking and Control for Rapid Location of Vertical Blanking Area for Editing Video-Tape Recordings

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A relatively simple and inexpensive method for splicing video tape has been developed. Three problems were investigated: (1) visual "development" of the video track; (2) accurate positioning of the splice; (3) joining tapes to achieve maximum mechanical strength. Electronics have been included in production machines to provide accurately spaced "edit" pulses to position the splice. Simplified tray spray "development" methods have been attained.

A PRELIMINARY STEP toward developing a method for accurately editing and splicing video tape was that of interviewing network engineers on their day-to-day problems. Data gathered in this manner provided a basis for experimental and testing work. Three basic problems were dealt with in early research and experiments: (1) the visual "development" of the magnetic image on the tape; (2) the accurate positioning of the splice in relation to the small mechanical tolerances within which the transition must be placed; (3) the method of joining tape ends to achieve maximum mechanical strength and minimum effect on the head drum assembly. Following extensive study and testing, a basic method of utilizing magnetically influenced particles in a high vapor pressure liquid suspension was adopted.

Tests were conducted to determine optimum particle size (ranging from 1 to 20 μ) which would give sharply defined read-outs on short duration, fast-rise time pulses. Particles in the 3- to 5-μ range proved ideal for this application. All magnetic metals obtainable in fine powders including iron, nickel, cobalt and stainless steel were checked for availability, ease of handling and reflectivity. Both carbonyl iron and stainless steel proved to be usable, each having specific advantages depending on the application.

The selection of a liquid carrier for the particles was limited to materials meeting these specifications: (1) low toxicity; (2) high vapor pressure for rapid read-out; (3) safety for use with the Mylar backing; (4) ease of cleaning so as to leave no residue on the tape and; (5) low viscosity to permit good mobility of the particles as they settle.

Several liquids proved to be acceptable. The two most common and easily available are lacquer diluent which is an industrial cleaning fluid; and Freon TF, a film cleaner. A commercially available package, called Ampex Edivue, consists of a suspension of carbonyl iron and diluent in a wide-mouth jar that can be used to "visualize" the video tape without needing a separate tray. As the diluent evaporates with the resulting increase in suspension density, a replenishing supply of liquid should be provided to maintain the original concentration.

The problem of positioning the splices required careful examination. The logical location for a splice is during vertical blanking time and after vertical synchronization has occurred. Under these conditions the home viewer will not see the splice going by because both video and sync continuity will be maintained and the transition will occur at a time when the vertical oscillator has just been fired and cannot be triggered again. The video at this point is blanked or out of sight at the top of the picture. Figure 1 shows a visualized tape using a stainless-steel developer. A regular monoscope pattern is recorded on the tape. The pulses along the bottom edge of the tape are spaced under the vertical blanking area on a monoscope recording. A video signal that may contain low brightness levels with all the information near blanking level would make it impossible to differentiate the blanking area from the rest of the video scans. Experimental data also showed that to maintain stability during a splice, it was of the utmost importance that the 240-cycle control track phase shift at the splice be kept under 15°. These two conditions made explicit the need of electronically marking the tape in such a way that the exact splice point would invariably be readily visible.

The circuitry to generate a high-amplitude, short-duration pulse, which is referenced to the vertical sync of the incoming video signal and the 240-cycle control-track signal was then developed (Fig. 2). This pulse is superimposed during record mode on the control-track signal and appears as a sharp blip on the bottom edge of the video tape when it is "visualized." The servo control unit includes a coincidence gate which is open for approximately 300 μsec by vertical sync and allows the differentiated rise-time pulse (approximately 100 μsec) of the 240-cycle signal from the photocell on the head assembly to be superimposed on the control-track recording. This assures that edit pulses will only be laid down when the recorder is in stable operation and that, when recorded, they will be at some fixed phase of the control-track signal. The edit pulses can then be positioned accurately in the proper relationship to the video signal by manual adjustment of the control-track record head. Figure 3 shows the waveforms of this circuitry.

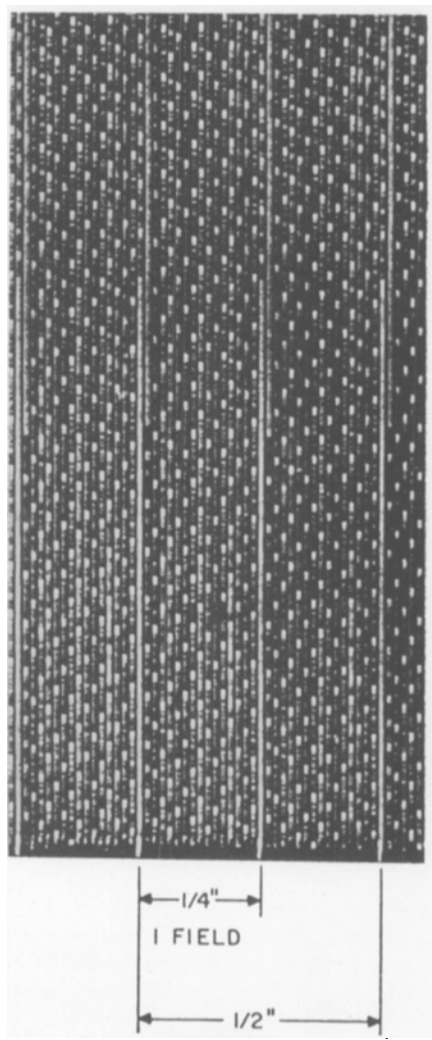

Fig. 1. Monoscope pattern recorded on tape. The vertical blanking intervals appear as long lines and horizontal sync pulses show as the pattern of dots between them.

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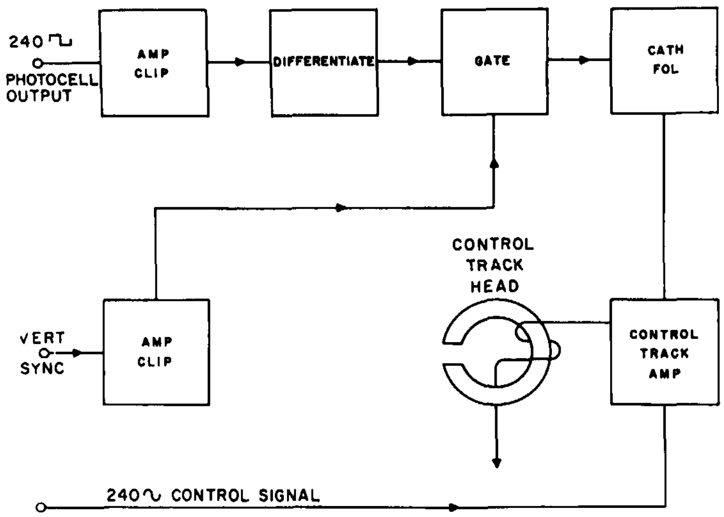

Fig. 2. Block diagram of system for edit pulses applied to the control track record head through the control track amplifier.

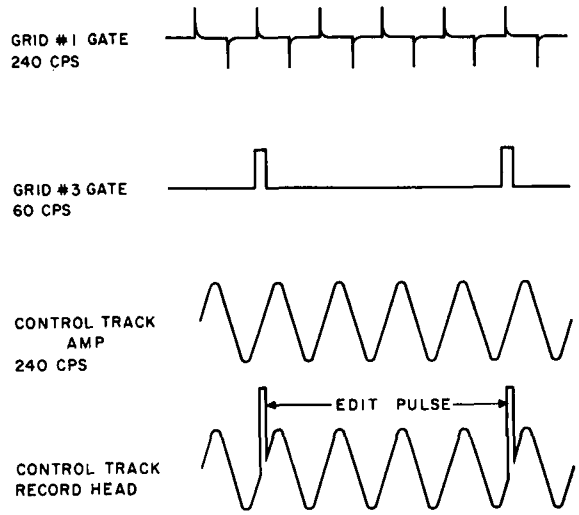

Fig. 3. The action of coincidence gate which allows the vertical sync at Grid 3 to gate through edit pulses phased to control track.

Joining the Tapes

The problem of how to join the tapes required careful consideration. There are four methods by which Mylar tapes can be spliced: (1) welding by controlled heat and pressure; (2) welding by dielectric heating; (3) overlapping an adhesive joint; (4) butt-jointing with pressure-sensitive backing tape.

The overlap adhesive joint and the heat and pressure methods were discarded, the first because of the limitation of a 5-mil overlap, and the second because the area around the splice becomes brittle and breaks at 10 to 15 lb.

A butt joint made with extra thin (under 1-mil) splicing tape, $\frac{1}{4}$-in. wide, was adopted as the best available method, and the project of developing a precision splicer was launched.

Before the precision splicer was complete a small manual splicing jig was made available. With this device, two tapes are held in good longitudinal alignment and a milled-out slot, angled correctly, against which a 6-in. straightedge is laid is the cutting guide for an Exacto knife or razor blade. The edit pulse is lined up against the straight edge and two similarly cut tapes can be butted together and spliced with thin backing tape.

The precision splicer (Fig. 4), developed later, simultaneously cuts two tapes that have been properly positioned in it with the edit pulses lined up under hair lines of the glass cutting guide. A three-position knob allows excess ends of video tape to be cleared away and the splicing tape to be pulled forward. The video tape then drops down on the adhesive side of the pressure-sensitive backing and a squeegee-type pressure pad is applied to seal on the backing. The excess backing tape is trimmed off and the splice is finished. Since edit pulses appear at every field, a defective splice can be corrected by cutting out two fields, which results in a loss of only $\frac{1}{30}$ sec of picture information.

Fig. 4. Splicing device in use.

Editing of the video-tape recording must be done on a video-tape recorder. As the tape is played back, either sound or picture can be used for selecting stop and start points. The precise braking characteristics of the video-tape recorder allow a predictable amount of tape to go by the head drum after the stop button is pressed. The mark on the back of the tape and a paper marker insert serve to locate the spot again. Cutting out or splicing in a section of tape can then be accomplished. Since the edit pulses appear at every field, 60 splicing points at $\frac{1}{4}$-in. intervals in every second of picture information are provided.

Since it is possible to erase and record audio without affecting the picture, sound dubbing is no more difficult than with standard audio recorders using present-day studio techniques.

The method of splicing video tapes, described above, seems entirely practical as a means of meeting immediate needs. Continuing research will undoubtedly lead to improvements and to new developments for recording and duplication of video tapes.