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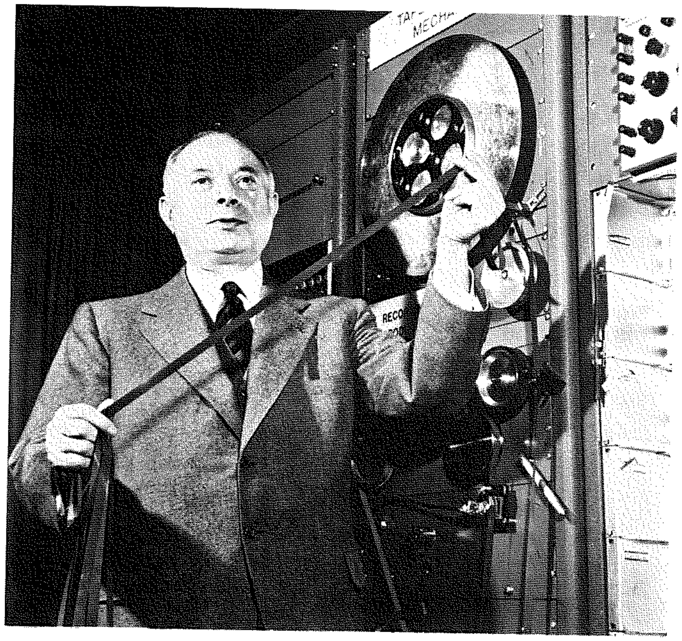
The art of videotape editing

Follow the 25-year history of videotape editing — a blend of technology and art — from the Jack Paar Show, *through the* The Flip Wilson Show, *to today.*



The late General David Sarnoff with an experimental half-inch videotape developed in 1955 by 3M. It was a forerunner of the tape in today's home videocassette — not even dreamed possible a quarter century ago. (Courtesy 3M)

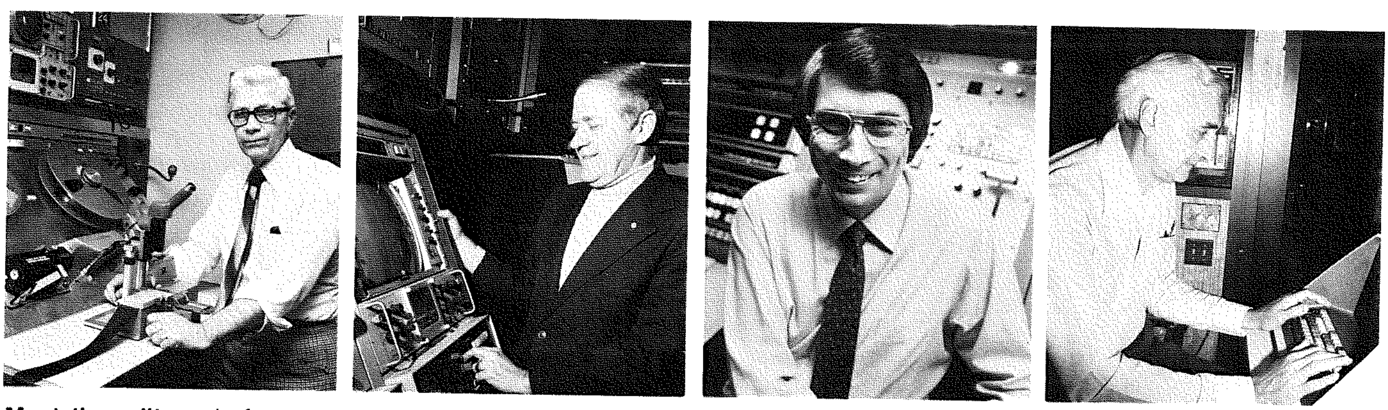
Abstract: *"What you see is what you get" as scenarios intersperse the exposition, and the authors follow the technology of videotape editing from manual splicing through computer-controlled editing. The future of videotape editing will encompass various new technologies that will continue to change the television landscape.*

Of razor blades and splicing tape

Charles "Buddy" Shadel peered into the microscope lens atop his Smith and Smith splicer as he completed the physical alignment. He reached for an Allen wrench to make a minor but necessary correction in order to slice precisely in the middle of the 5-mil guardband that separated the 10-mil-wide tracks of video information. A successful splice required Buddy to cut in the proper area and to be lucky enough to match an odd with an even field. "Someone must find a way to identify the proper place for me to cut," Buddy mused. "It would make being a videotape editor so much easier."

The first challenge

In March 1956, Ampex introduced videotape recording. Almost immediately, producers were anxious to rearrange the scenes they had recorded on this new "magical medium." Prior to this date, the only practical way to record an electronically generated television signal was to aim a film camera at a monitor, a crude process known as kinescope recording. Videotape eliminated the need for an optical transfer by recording the electronic signals directly on a two-inch-wide magnetic tape.



Meet the editors. Left to right, Charles "Buddy" Shadel, Walter Balderson (both now supervisórs at the NBC New York videotape desk), Rex Bagwell (Manager of Post-Production, Burbank) and John Olszewski (senior CMX editor in New York).

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The design engineer's first challenge was to record a wideband signal equivalent to 18 octaves of frequency, while maintaining a reasonable linear tape speed. After much experimentation, four heads were placed 90° apart on a drum that rotated perpendicularly to the surface of the tape. By modulating the video on an FM carrier, the required bandwidth was compressed to four octaves. The frequency response required to record this signal was obtained by moving the tape at 15 inches per second (ips) and rotating the video head drum at 240 revolutions per second, producing an equivalent head-to-tape velocity of 1,560 ips. These heads, plus stationary audio, cue, and control track heads, produced a magnetic footprint which is illustrated in Fig. 1.

Originally, the only way to accomplish the requested rearrangement of program segments was physically to cut the tape. The simple quarter-inch audio editing block was enlarged to a two-inch width to accommodate the wider videotape. This method was imprecise, it generally did not allow for a synchronous edit and caused a severe disturbance in the picture, and it sufficed for only a short while. The production team's demand for an undisturbed edit led designers to seek a system that would allow editors like Buddy Shadel to make a synchronous splice.

For years researchers had used a medium in which carbonyl iron filings were suspended to "develop" audio tape for the purpose of checking track alignment and spacing. When this solution, called Visimag (RCA) or Edivue (Ampex), was applied to the tape and allowed to dry, a pattern like that shown in Fig. 2 would emerge. Using the solution, the editor was able to develop the tape, peer through a hand-held jeweler's loupe, and find the edit point. See edit sequence, Fig. 3a-f.

During the late 1950s, several improvements were introduced that speeded up the physical editing process. These included a means of running the splicing foil under the tape, the addition of a guillotine device for more accurate cuts, and the addition of a microscope with a graticule to assist in finding the edit point (Fig. 4a-b).

Still the editor had only a 50/50 chance that his cut would make a proper edit. To work around this problem, many editors included a few additional frames of video in the first cut. If the splice matched two similar fields (even to even or odd to odd), the edit would bobble and break up. He would then recut the splice, take out the required number of fields to get back in sync, but be careful not to trim to the point that the program no longer made sense. All this made a difficult process even more tedious.

At the April 1958 Society of Motion Picture and Television Engineers (SMPTE) Conference in Los Angeles, Jerome Grever of RCA described an RCA

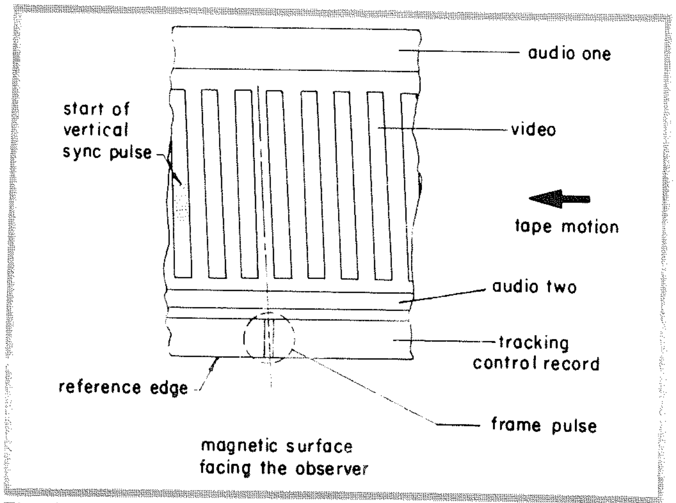

Fig. 1. Magnetic "footprint" of a 2-in. Quadruplex videotape recording. The audio, cue (audio two) and control signal are longitudinal tracks recorded by fixed heads. The video information is contained in the transverse tracks inscribed by the four rotating heads. (courtesy SMPTE)

design that used a 30-Hz edit pulse to replace the 60-Hz field pulse. He stated, "We have a slightly different system... Every half an inch there (is) one frame pulse, this being slightly different from the Ampex system which has pulses every quarter inch, every field." This new pulse would finally provide an accurate indication of the point at which an editor could be certain of making a synchronized splice. This "frame pulse" later underwent minor modifications, but formed the basis for an edit standard when it was incorporated in the Ampex machines and adopted by SMPTE (Figs. 2 and 5).

Five minutes a splice

Buddy was about two-thirds of the way through editing this week's Jack Paar Show. *It was 1:20 p.m.*

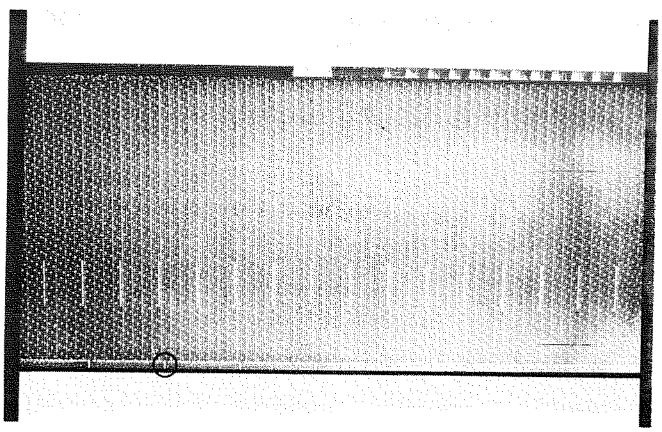

Fig. 2. "Developed" piece of videotape. The *frame* pulse contained in the control track is circled. This 30 Hz signal improved the odds of a correct edit by marking the frames, instead of each field.

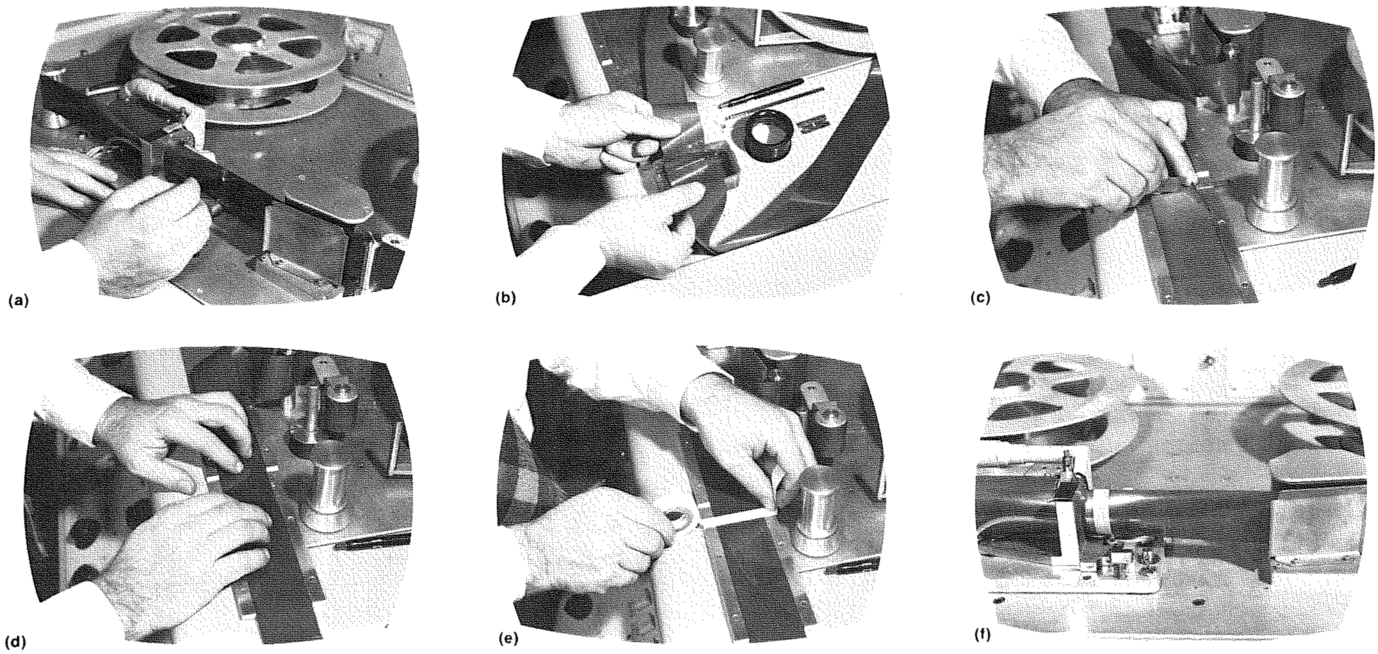

Fig. 3. Editing sequence with an early splicing block. (a) Editor marks the desired edit point, **(b)** the tape is dipped in a suspension containing carbonyl iron filings to "develop" the tracks; **(c)** after the proper place is located with the aid of a magnifying lens (bottom of photo), the cut is made using a straight edge as a guide; **(d)** tape must be flipped and repositioned in order to **(e)** apply the splicing tape to the backing; **(f)** the splice must be played back to determine if it is acceptable. (Courtesy Ampex Corp.)

Surrounding his work area were the tools of a videotape editor: splicer, marking pen, razor blade, roller, even white gloves. Except for the Smith and Smith splicer itself, these tools very much resembled those used for cutting film (Fig. 6).

Buddy marked the start of an off-color joke by Buddy Hackett, which the NBC "censor" said had to come out. He then played the tape to just beyond the audience laughter, stopped the VTR, and marked the out point. The "pregnant pause" left by Hackett provided enough space to make a good edit without any lip-flap. With both sides of the edit marked, Buddy used scissors to cut out the large segment that separated them. After shaking the glass jar to re-mix the carbonyl iron filings and Edivue diluent, he used a cotton swab to place this suspension on the control-track edge of the tape. Within seconds, a pattern of white "hash marks" appeared. He placed them under the microscope and closed the top left side of the jig.

Under the microscope, the developed pulses could be seen clearly. Turning the knob on the splicer, Buddy positioned the edit pulse under the center stripe of the graticule. He moved the tape three tracks to the right, centered the guardband, and made his cut with the built-in guillotine. He performed the identical routine on the right-hand segment.

Buddy then pulled out a clean section of ultra-thin

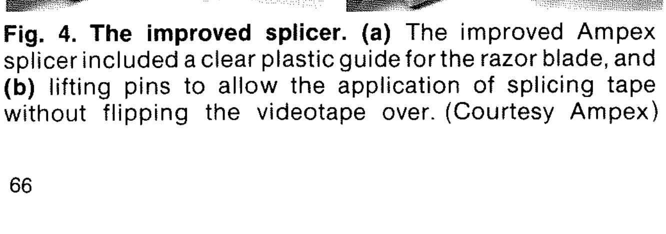

Fig. 4. The improved splicer. (a) The improved Ampex splicer included a clear plastic guide for the razor blade, and **(b)** lifting pins to allow the application of splicing tape without flipping the videotape over. (Courtesy Ampex)

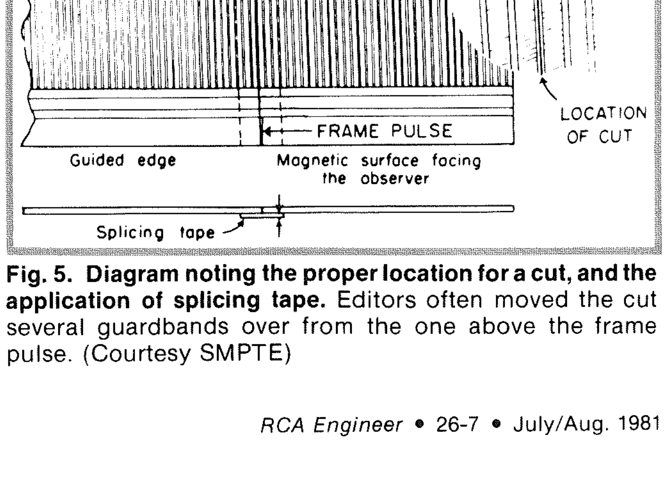

Fig. 5. Diagram noting the proper location for a cut, and the application of splicing tape. Editors often moved the cut several guardbands over from the one above the frame pulse. (Courtesy SMPTE)

foil tape. This splicing material had to be very strong to withstand the punishment of the headwheel, while adding very little to the thickness of the videotape itself. After positioning the foil under the cut, Buddy allowed first one end and then the other to contact the adhesive. To insure a good bond, he "ironed out" the tape with a rubber roller. As he finished trimming the excess splicing foil, Buddy noticed the time — 1:25. Five minutes a splice was a good pace!

But major obstacles still existed. Years before, film had perfected a double system for editing picture and sound individually. Videotape's format did not allow for separate cutting. The 9.25-inch distance (Fig. 7) between the audio and its corresponding video signal made physical splicing all the more difficult. As he lit his pipe for the twelfth time today, Buddy muttered, "There has to be a better way."

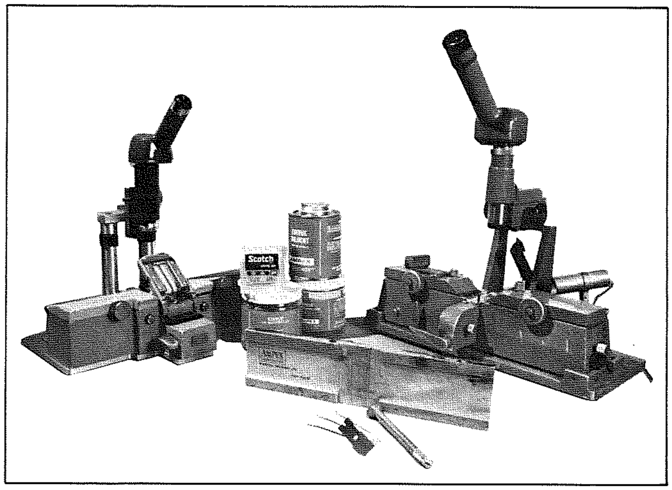

Fig. 6. The editor's tools. Background, left to right: Ampex splicer with "home brew" microscope added; splicing tape and Edivue diluent; the S&S splicer. Foreground: original edit block with rubber roller, swabs and, most important, the razor blade.

The better way

Walter Balderson struggled with the cart that contained all the Flesh and Blood *master reels as he made the turn into VTR 15 and 16.*

It was August, 1967, and he was about to be the first NBC-New York editor to splice a show electronically using the Editec™ system. The noted director Arthur Penn (Bonnie & Clyde, Alice's Restaurant, *and* Missouri Breaks) *had completed the teleplay called* Flesh and Blood *at NBC's Brooklyn Studios. Even though most of the special effects had been recorded in the studio, Baldy needed about three weeks to assemble the correct scenes, make internal edits, and put the finishing touches on this 90-minute production. "Editec™," said Baldy, "opens a whole new era of editing. Now I can preview a scene, make adjustments, move the cue point, and not bother the original tape." As he completed timing the editor and making a trial edit, Unit Manager, Bruce Bassett, entered the room. It was now time for Baldy to make his first electronic splice.*

The second challenge

Several years before, in the early 1960s, RCA and Ampex, the two major VTR manufacturers, were locked in a battle to market the first electronic splicer. To design such a system, engineers had to address problems at the edit point such as double recording, phase differentials, and servomechanical disturbances.

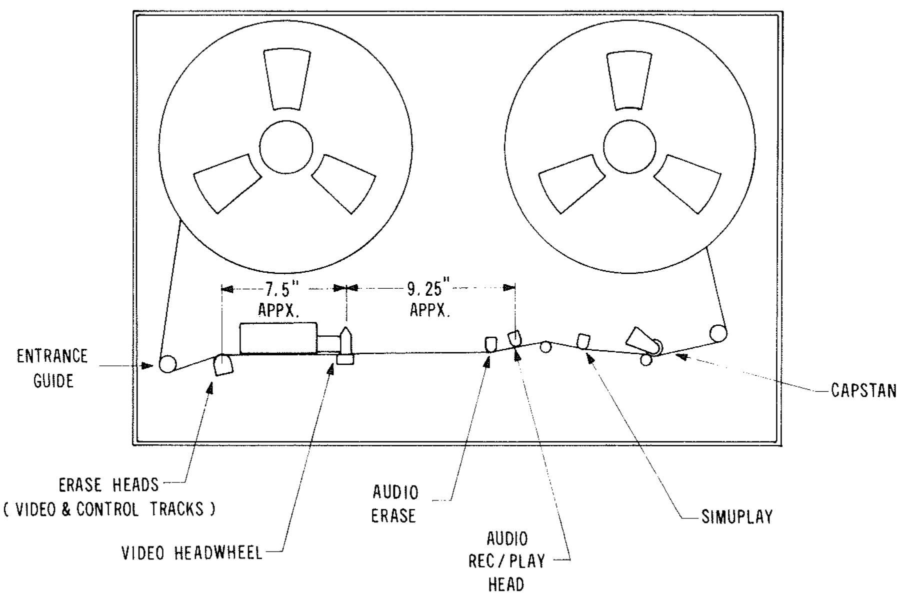

Fig. 7. Simplified tape path of a TR-70 indicating the offset of the erase, video, and audio heads. Ampex located the position of the VR-2000's erase stack closer to the entrance guide, adding approximately 1.5 inches to its separation from the video head.

OFF-LINE

A term used to describe a low-cost edit system that uses an inexpensive tape format (like ¾-inch cassette) to prepare a "workprint" and generate an Edit Decision List (EDL).

ON-LINE

Refers to a system that employs high quality equipment to produce a final edited master, and where edit decisions are made in real-time.

AUTO-ASSEMBLY

A process where the EDL produced in an off-line session is loaded into an on-line system, for computer controlled execution of the edits in either sequential (A mode) or checkerboard (B mode) patterns.

Double recording was a physical problem precipitated by the location of the erase head with respect to the video head (Fig. 7). The erase head had been placed just inside the entrance guide, a full nine inches in front of the video head. If the erase bias and video record current were applied simultaneously, approximately 18 frames of tape would contain both the old and new information, until the newly-erased section was reached. The design team changed the machine's control logic to use the video synchronizing pulses as counters which would turn on the video record head 18 frames after energizing the erase head. An identical approach was used to solve the out-splice problem.

A servo system locked to the same source during the transition from playback to record solved the servo-mechanical problems and made assemble edits possible. In the assemble mode, the editor adds program material to the previously recorded segment and builds his production piece by piece. This mode allowed the producer to build his show sequentially, but did not provide the means to place one segment within another as required for a video-only cut away. Out of this need came the "insert" edit system, that used the previously recorded control track as the locking source for the capstan.

With only minor changes, the editor was given the ability to select between the audio/video, or video-only modes. Finally, the producer had the flexibility to rearrange picture and sound in a fashion he had used in film.

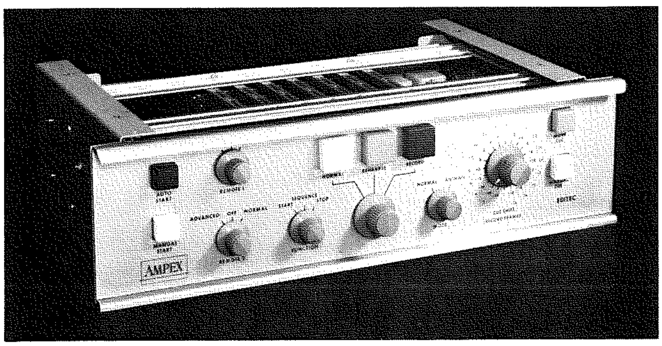

Fig. 8. Early model of the Editec programmer. Later versions included a video only mode, animation controls, and secondary cue provisions. (Courtesy Ampex Corp.)

"That's a buy... we'll fix it in editing"

Bruce Bassett was joined in the edit room by Joan King, the production assistant, and Hal Venho, the associate director on Flesh and Blood. *Today's edit sequence involved Edmund O'Brien slapping his daughter, played by Kim Darby. Besides the basic switched master, isolated wild shots of this scene had been recorded which Baldy would use to edit a montage that would increase the dramatic impact of the scene. The use of videotape editing for such a purpose was, in itself, novel.*

After transferring the basic shot onto the master tape, Baldy hit the CUE button at an appropriate point. A distinct "chirp" was heard as it was recorded on the cue track. A second cue was put on the tape to mark the out-splice or end of the edit. By using the one-frame cue shift function in conjunction with the preview capability, Baldy could place the insert exactly where he wanted it. The flip of a switch allowed him to change from an "audio/video" to a "video-only" edit (Fig. 8).

Once Hal was satisfied with the preview, Baldy re-racked the tape to the proper pre-roll point, rolled the VTRs, and "armed" the editor. From here on, Editec™ was the shining star. The controller read the in-cue, and started the countdown to the electronic splice. Moments later, the second cue began the count-down toward the out-splice. After a series of these preview and record operations, Baldy had created a sequence of time expansion which heightened the dramatic turn of events that the slapping had precipitated.

Electronic splicing helped videotape rise above mundane assembling of scenes to the creation of artistic, dramatic moments. Although complex servo and timing circuits were used to make it a reality, the editor's control panel was fairly straightforward. Once the cue points were determined and previewed, an edit could be made in little more than the actual record time. This system of electronic splicing was limited only by the inaccuracy of normal cueing and the inability to provide perfect parking and start up of the playback machines. Tape editors needed the electronic equivalent of the "edge numbers" used for years as an index in film.

"Down for the count"

Rex Bagwell was busy at VTR 18/20 preparing for a 10 a.m. session to edit this Thursday's Flip Wilson Show.

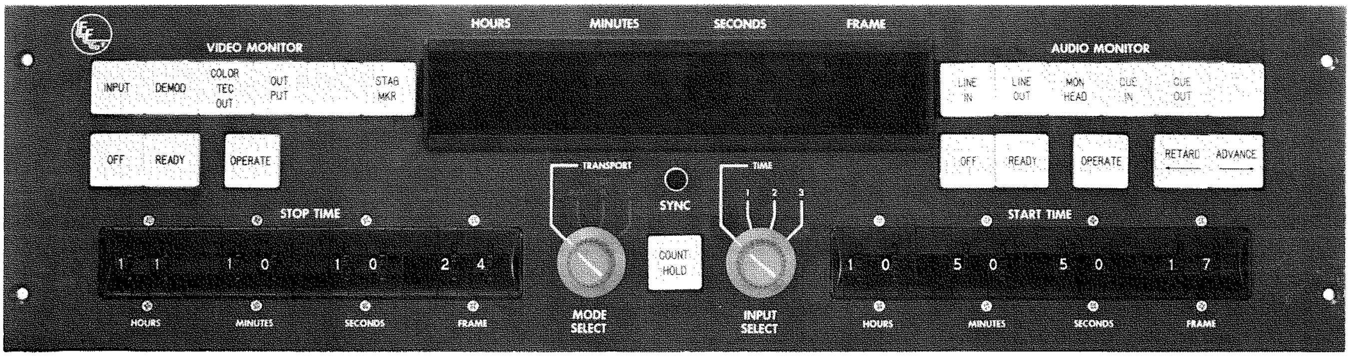

Fig. 9. "On Time". This first timecode editor was designed to work with the VR-2000. (Courtesy EECO)

Monday he had logged the time code from the master segment reels and now had a list of preferred takes. After loading the reel, Rex dialed in the eight digit number for the first location and put the VTR into FAST FORWARD. Within moments Bob Henry's production team would be ready to start work.

The third challenge

During videotape's infancy, while electronic editors were being created on the lab bench, the United States entered the Space Age. To index space flight telemetry on data tapes, NASA and other agencies developed a variety of coding systems.

In early 1964, Richard Hill of CBS-Hollywood proposed that one such code, the AMR (Atlantic Missile Range) C-1 code, be adopted for use in videotape editing. In a paper, Hill later enumerated the videotape applications of this time code: timing of tapes; footage measurement in time; rapid location of recorded material; remote indication of footage for cueing purposes; automatic cueing of tapes; automatic starting of playback machines; synchronizing machines during overlap playback; automatic exact synchronization of machines (for double system recording); and electronic editor control with automatic starting of playback machines during transfer editing. The introduction of time code ushered in videotape's second decade and became an integral part of it.

Hill worked closely with Electronic Engineering Company of California (EECO) on the design of the first television timecode editing system, called ON-TIME™, which was introduced in March 1967 (Fig. 9). Timecode was on its way toward slaying the monster called videotape editing. No longer did the editor have to mark "on the fly" and settle for an edit point that was "close enough." If he was unhappy with a preview, he could adjust the time code as required; he was also freed from the inaccuracies caused by imprecisely cued machines. However, in the early days of timecode editing, synchronization between two machines was possible only if the code on each tape matched exactly.

Just as government agencies developed different numbering systems, VTR manufacturers came up with incompatible codes. In early 1969, SMPTE attempted to reduce the chaos by establishing a committee to develop a standard code that would insure interchangeability (Fig. 10). This standard, known as SMPTE code, assigned an 80-bit data stream to each television frame, which defined it by hours, minutes, seconds and frame count (30 frames per second). Some experimentation was done on a system that would have modulated the control track with the timecode, but this was later dropped in favor of placing it on the cue track.

In mid 1970, RCA joined with EECO to develop and market an all new Electronic Editing System (EES)

"...time coding became a tremendous value because...that allowed you to take notes out in the field and when a person got to a point in a speech where he said something that you know you wanted—you jotted down that time, brought it back and could go right to that time again."

...*Joseph Angotti,* Producer, NBC News

NON-DROP FRAME

A format of continuous timecode (also called "Color Time") based upon the color rate of 29.97 frames per second. Timecode generated at this rate is 108 frames ahead of clock time at the end of each hour. A one-hour program timed, using Non-Drop Frame as a reference, would be 3.6 seconds (108 frames) too long.

DROP FRAME

A format (also called "Clock Time") that discards two frame counts at the beginning of each minute, with the exception of every tenth minute. No actual video frames are lost, only their numerical designations are shifted in order to keep the count in-sync with actual clock time.

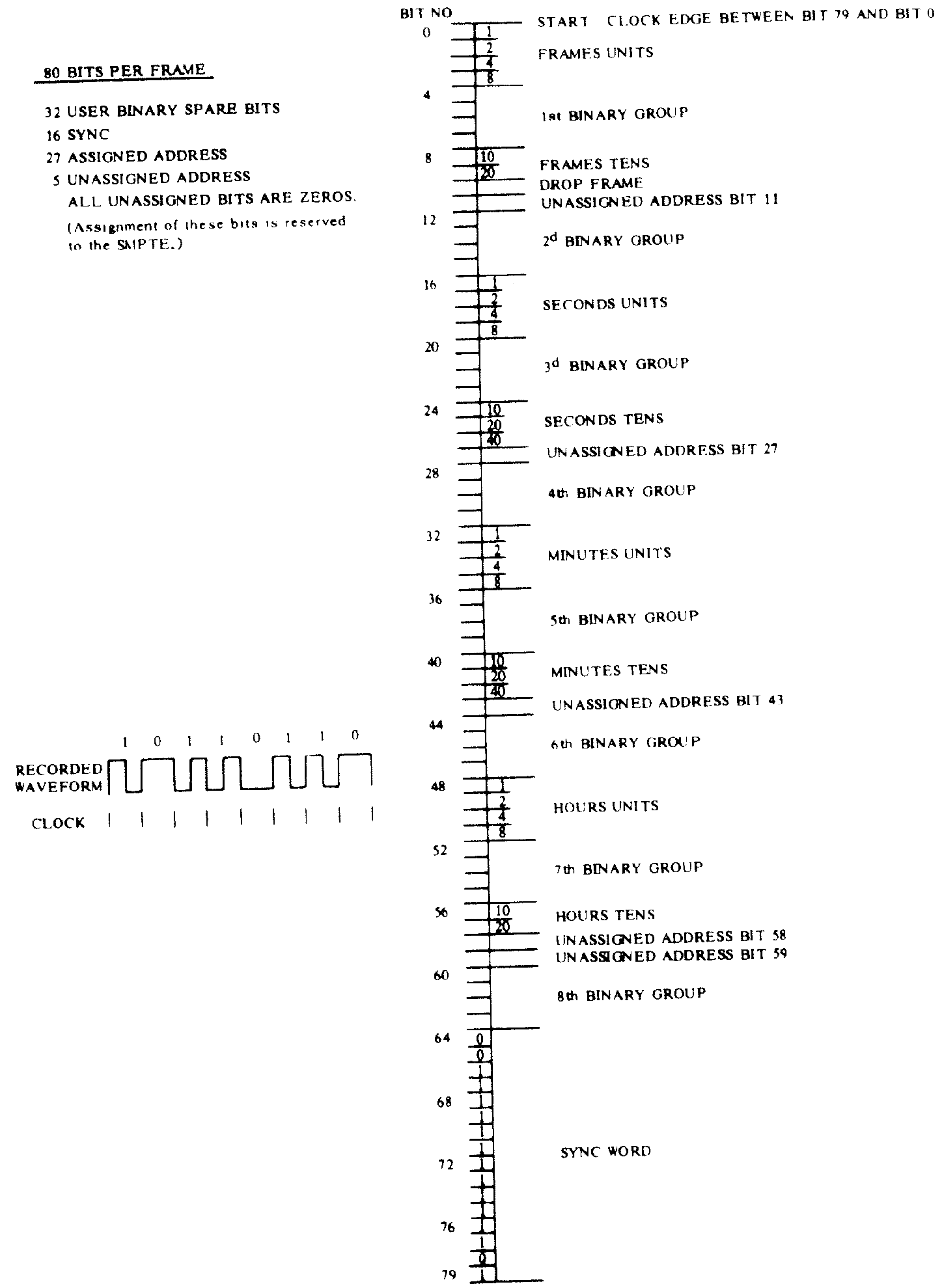

Fig. 10. Data stream of the 80-bit SMPTE videotape time code. Besides the eight digit address or "edge number," the code has provisions for user-defined information, drop frame indication, direction of tape movement, and five unassigned bits for future use. (Courtesy SMPTE)

based on timecode. This system had operator-oriented improvements such as the entry of edit points into memory, edit preview, higher speed search to an edit point, and single-glide cueing. Direct data entry from a keypad and the TCE-100's centralized transport controls formed an early edit cockpit (Figs. 11 & 12).

"What you see... is what you get!"

Rex Bagwell had completed the picture and sound edits for the first two segments of The Flip Wilson Show. *After re-recording a one-minute and two-second slug for commercial position two, he was ready to insert the segment featuring Flip's popular*

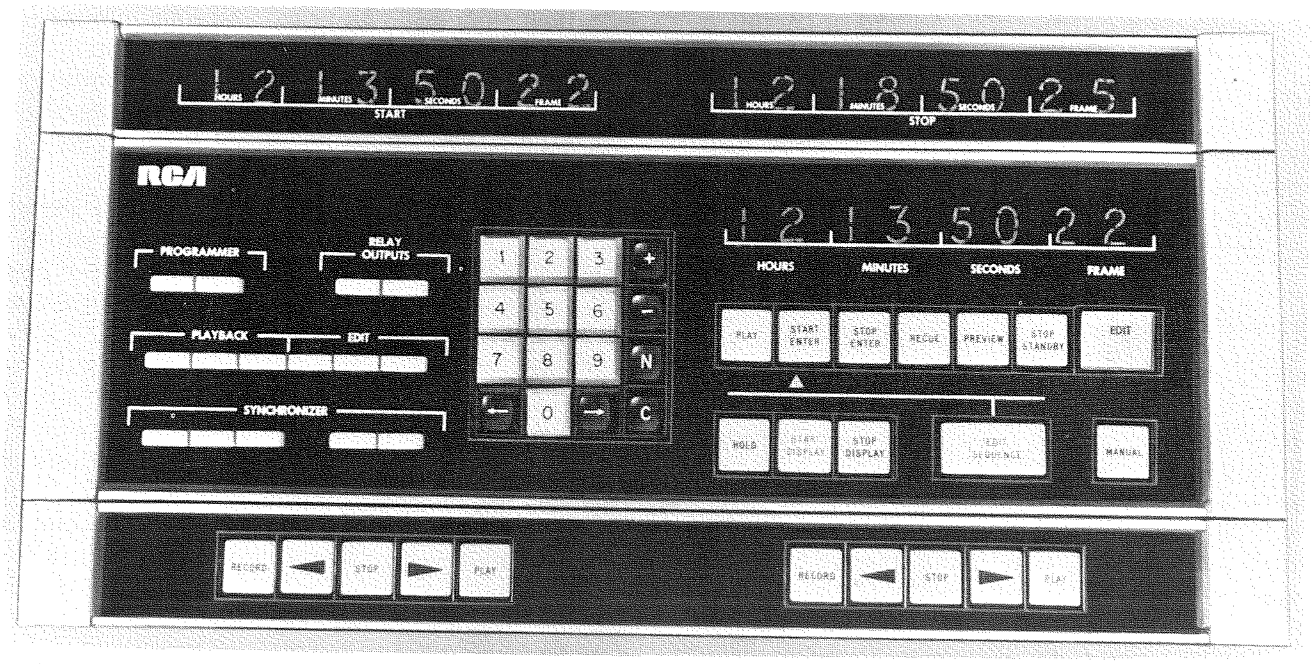

Fig. 11. TCE-100 edit controller. This system included three code read-outs; edit controls on the main input panel, including a keypad for timecode entry; and a transport control panel.

character, Geraldine. Rex loaded his next start and stop points into the record machine controller, and placed the VTR in the correct shuttle direction to locate the new point.

Consulting the time code log, he found the "buy take" for the Geraldine skit started at 21:07:52:00. He wound the tape to that area and viewed the scene for an exact "in-point," allowing a good amount of time for the wolf whistles, screams, and applause that greeted Geraldine's entrance. Geraldine's first line was a sassy, "What you see . . . is what you get!" *To add impact to that line, the director edited in a facial close-up which had been isolated to a separate reel of tape. By noting the IN and OUT points for the line and loading the isolated camera reel, Rex made a video-only edit that was in exact sync with the audio and the switched master.*

Since all the VTRs (Program and Isolated) were fed a common timecode while recording, it was easy to drop in a special shot from the iso-reel with precision. This new timecode system would allow Rex to transfer the edited sound, along with the code, onto an audio multi-track machine. Laughs and applause could then be added to ease-over edits that might otherwise sound jarring.

That first step in 1964 was a giant leap toward assuring the director that "what he wanted *was what he* got." *What remained now was for the design engineers to simplify the manipulation of time code points, develop frame accuracy to its ultimate degree, and make the system more responsive to the creative needs of Rex and other editors.*

Timecode *GO*es east

John Olszewski was about to start editing Drag Race, *an episode of the* GO! *show's second season.*

The first year had been difficult for the editors on GO! *because the complete CMX system had not yet been installed at NBC-New York. An off-line System 400, employing non-broadcast one-inch VTRs, was*

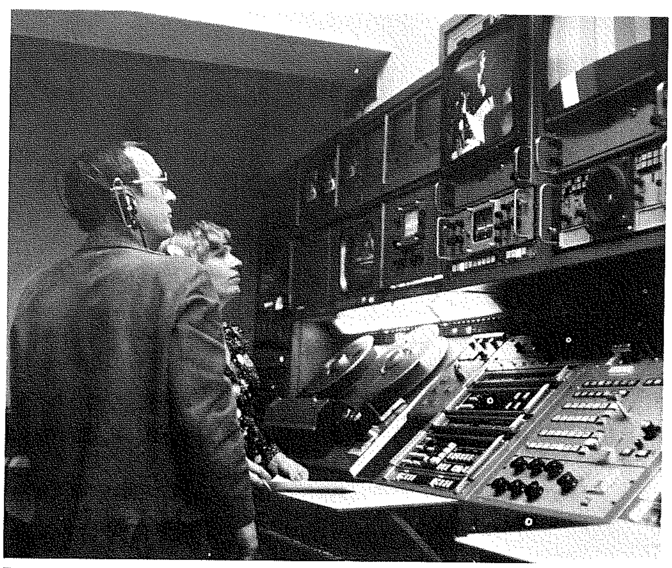

Fig. 12. An edit bay at NBC, Burbank, California. To the right of the edit system is a video switcher with dissolve-and-wipe capability, and a small audio mixer. These added devices expanded the signal manipulation capabilities in parallel with the increased sophistication of the editor. (Courtesy EECO)

used to pre-edit the shows. The editing or "conforming" of the two-inch broadcast master, however, had required the editor to re-type each record IN and OUT point, as well as the playback IN point on a Datatron 5000 system. "The first year I often went to sleep to the tune of 8-digit time code numbers," said Johnny O. "Our new system will be a big operational improvement."

The fourth challenge

If EECO and RCA had provided a "cockpit" for editing, then CMX introduced the equivalent of "Mission Control." In 1970 a joint experiment between CBS and Memorex (CMX) produced a super-sophisticated editor called the CMX 600 (Fig. 13).

There had been a great desire to get away from the concept of an individual programmer for each machine, and to interface all functions into one unit. With a Digital Equipment Corporation mini-computer as its "heart," the CMX system used an array of computer-oriented peripherals to put the editor in control.

The pictures and editing menus appeared on dual CRTs directly in front of the editor. A light pen, connected to the console, allowed him to make his selection, and to control the picture motion on both screens. In the 600, pictures and sound were stored with their time code as analog signals on magnetic disk packs. Only six systems were sold due to the high initial cost (about $300,000). The limited storage of source material in black and white made it practical only for pre-edit of short segments such as commercials.

Two years later the CMX System 300 became available for on-line editing and auto-assembly of pre-edited shows. By using a computer to manipulate standard VTRs, a system was developed that allowed the editor to control the record and playback machines, as well as the switcher, from a typewriter-like keyboard. This frame-accurate editor, with its off-line system 400 counterpart, became a success. The editor was freed from the drudgery of arithmetic calculations, manual entry, and record keeping. The producer was able to preview and execute edits that included dissolves, wipes, and other effects in a manner that was repeatable. The computerization allowed the editor to concentrate less on the hardware and more on the creative aspects of his task.

A punched paper tape record was generated with all the time code IN and OUT marks, as well as the edit types. It was then possible to re-load this edit decision list (EDL) into the computer memory for auto-assembly (Fig. 14). Soon other manufacturers picked up this edit systems concept, and videotape editing became a sophisticated art.

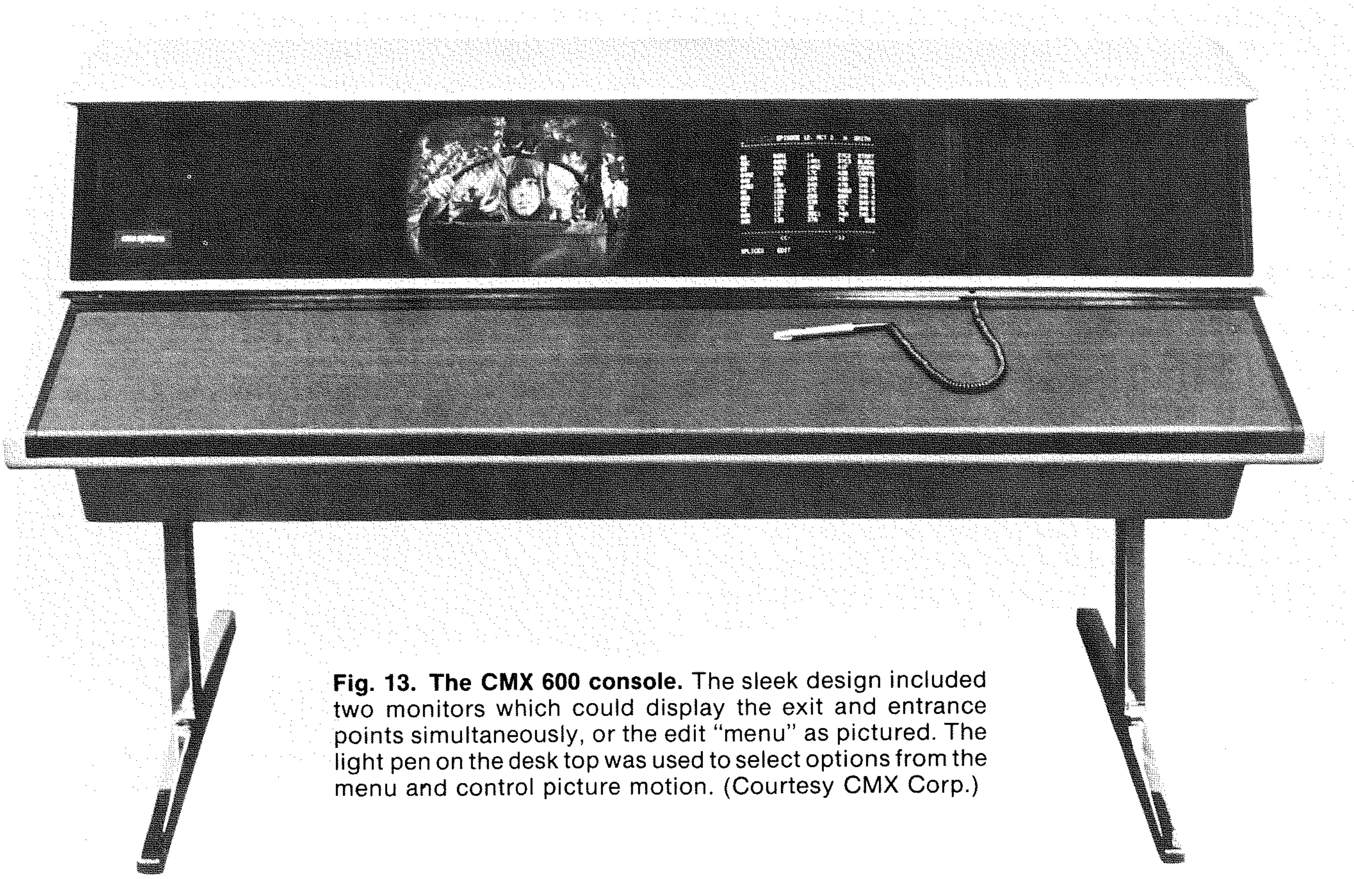

Fig. 13. The CMX 600 console. The sleek design included two monitors which could display the exit and entrance points simultaneously, or the edit "menu" as pictured. The light pen on the desk top was used to select options from the menu and control picture motion. (Courtesy CMX Corp.)

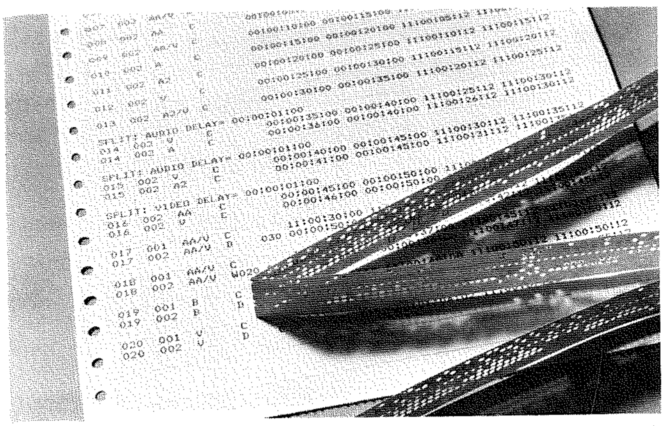

Fig. 14. Sample Edit Decision List print-out and punch paper tape. Among the information included is the edit number, reel number or source, audio/video mode, type of transition (and duration if applicable), Record IN and OUT times and Playback IN and OUT times.

Going with *GO!*

For the last several days in May 1974, John Olszewski and Rift Fournier, a GO! *director, had pre-edited a work copy of the show from the six hours of material shot last month at The Grand Nationals in Quebec, Canada. Besides showing plenty of dramatic races, Rift had written a story around Jack Hart, safety director for the National Hot Rod Association. As he loaded the edit list into the PDP 11/05 computer, Johnny O. explained that Jack Hart's inspection of each race vehicle served to emphasize the importance of safety to* GO!*'s young audience.*

Just then the computer reported "186 EVENTS LOADED" on the CRT screen. Johnny O. told Don Reilly, his playback man, to load the first 3 reels. The documentary style of GO! *required a "B" mode or checkerboard assembly. In this way the computer scanned down the list of edits and executed all the events for which the proper reels were loaded. To keep pace with the computer, Don checked off each edit as it was recorded, and Johnny O. adjusted the video levels during pre-roll. The computer stopped the VTRs and reported "EDIT 27 REQUIRES REELS 01 and 14." Johnny O. checked his notes and realized that edit 27 was a dissolve from the intro of* DRAG RACE *host Don Imus, to the* GO! *montage and opening theme. Once Reilly had loaded reel 14, the assembly was resumed.*

"This computer program is not very easy to manipulate." thought Johnny O. "But, thank goodness, it does save me from retyping the more than 6,100 numbers and spaces needed to define these edits."

The GO! *show schedule called for Johnny O. and the audio mixer to edit music, sound effects, and Imus' narration to fit the completed video master. They would then lay the audio segs onto a multi-track audio tape that had the VTR natural sound and corresponding timecode already on two of the 8 tracks. "After a day of mixing the audio elements," Johnny O. mentioned, "we then re-lay the mixed track onto the two-inch video master. Then it's time to start the cycle over with another director and a new episode."*

The cycle that John Olszewski followed was held together by the common element of time code, the digital "genie" that, in conjunction with the computer, produced accurate edits, lenghly automatic assemblies, and absolute synchronization heretofore possible only with the use of *sprocket holes!* It was indeed a turning point for videotape editing.

The cycle continues

Technology has improved vastly in the seven years since that *GO!* edit session. CMX introduced the 340 expandable system that, along with the Sony 7000, uses distributive processing to perform simultaneous functions and machine interface. With improved 340X programs, it became just a matter of a few key strokes to transfer edit times from one machine to another, or from one segment of the EDL to another. The enhancements include the storage of all edit decisions in memory, expanded list management, and auto-assembly within the main operating program.

The future challenge

Throughout the 25-year history of videotape editing, the most effective and useful improvements have been made when the technical design team, the tape editors, and the production team communicate effectively with each other. The future of videotape editing may encompass a variety of new technologies still on the drawing board (e.g., digital recording and solid state storage), but in any case, the direction it must take is clear:

1. Make the device more responsive to the editor. One way could be instant scene access via "bubble memory" storage of source material.
2. Create a "transparent" system that allows the editor flexibility without getting in his way. A new CRT that allows the user simply to point at information he wants to retrieve or modify may be a step in the right direction.
3. Increase the edit accuracy. Audio edits, especially music cuts, require greater resolution than 1/30 of a second.

From the production point-of-view, a *good edit* is one that you don't notice. A *good edit system* is one that does the job without overshadowing the tape editor's aesthetic and creative goals.

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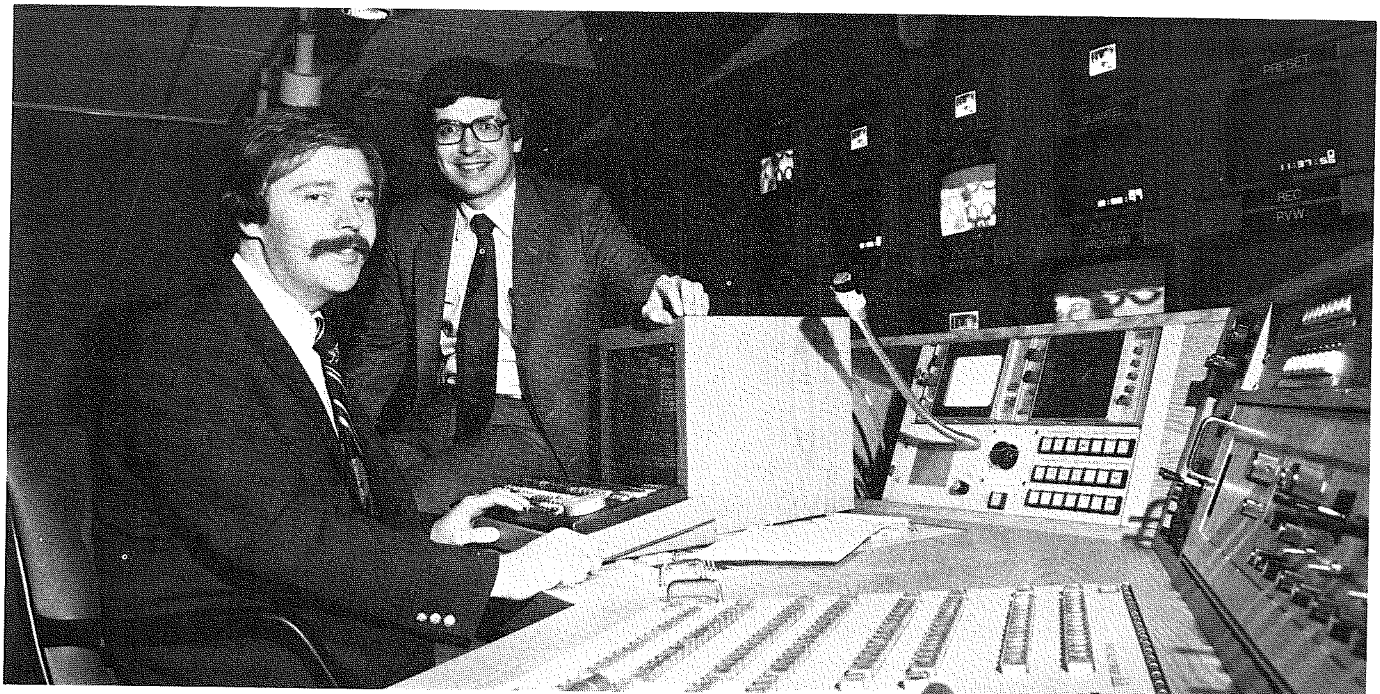
Bibliography

1. Annual Report of the EECO (Electronic Engineering Company of California) for 1967.
2. "Discussions on Videotape Recording," *Journal of the SMPTE* (Nov. 1958).
3. "Electronic Film/tape Post-Production Handbook," 1973 Edition.
4. "Operation Manual for Smith Television Magnetic Tape Splicer," S&S Manufacturing Company, Alto Loma, Calif.
5. "TV Tape Splicer," *RCA Broadcast News* (March 1960).
6. Bonney, R.B., Kloba, T.J., and Pargee, R., "A Proposed Standard Time and Control Code for Videotape Editing," *Journal of SMPTE*, (March 1970).
7. Ennes, H.E., *Television Broadcasting Tape Recording Systems*, Howard W. Sams & Company, Inc., Indianapolis, Ind. 1973 and 1979 editions.
8. Hill, R.E., "Digital Time Code Systems for Television Broadcast Operations," (Feb. 1966).
9. Macheim, K.R., "Techniques in Editing and Splicing Videotape recordings," *Journal of the SMPTE* (Nov. 1959).
10. Rozien, J., "Electronic Marking and Control for Rapid Location of Vertical Blanking Area for Videotape Recordings," *Journal of the SMPTE* (Nov. 1958).
11. Weller, C., "Splicing Videotape Without Edit Pulses," Internal NBC Instruction Manual, not published (1960).



Jerome Haggart, Senior Videotape Editor and **Robert Muller,** Director of Video Recording Operations, at the CMX 340X keyboard in Edit Room 5, NBC, New York's newest post-production facility.

Jerome Haggart, a Senior CMX Videotape Editor, began his career at NBC-New York in 1970 when he joined the videotape staff as vacation-relief operator. Since becoming a permanent editor in 1972, he has been recognized for his contributions to the Peabody Award-winning children's series *GO!,* and also received several Emmy nominations and Certificates of Achievement from the National Academy of TV Arts and Sciences. In 1977, Mr. Haggart was honored for his work on *NBC's Sportsworld* with an Emmy for "Outstanding Individual Achievement in Videotape Editing." He most recently won The Creative Excellence Award in the U.S. TV Commercial Competition for a 60-second NBC Football promo. He has taught videotape editing seminars, and is currently working on a variety of shows, network advertising and promotion, and sports projects.

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