The Case for Split 16mm Film

By D. J. WHITE
and A. N. BROWN

In an era of constant progression toward ultimate miniaturization of equipment, the splitting of standard films for sound recording is normal and consistent. Improved head gap to magnetic film contact and greater compliancy in the medium made possible more compact film transport components. These and other advantages of split 16mm are discussed.

SHORTLY AFTER World War II major motion-picture recording facilities began to look to magnetic film as a means of recording original dialogue, music and effects. This new medium offered many advantages over the optical method of recording, because dubbing and sound transfer work could be done with a minimum loss of quality. In the beginning, 35mm magnetic film was used, mainly because existing optical recording and reproducing equipment could be converted to accommodate magnetic tracks with a minimum of redesign, and a magnetic recording program could be put in operation with a minimum of time and expense.

Because in most recording only a small portion of the 35mm film is used, it is obviously feasible to split into 17½mm and save 50% on medium costs. Manufacturers designed and built film transports to accommodate split 35mm film for studio use. The smaller weight and reel size for 17½ permit designing smaller, lighter and more compact portable equipment for location recording.

Along with the growth of the television industry, there has been a great growth in 16mm film with a wide acceptance of 16mm equipment operated at 36 ft/min.

Basic sprocket-type, portable recording equipment was introduced in 1952 by Magnasync Corp. as its 602 Type 1 machine (Fig. 1). This recorder weighed 39 lb and required 75w of 60-cps a-c power. The flutter content was below 0.18% overall. This model was offered in a 16mm version operating at 36 ft/min, and a 17½mm version operating at 45 and 90 ft/min.

Another version of the same basic design, the Type 5 (Fig. 2), utilized high resistance rotor torque motors for take-up and rewind. This 85-lb channel was and is favored in 35mm transport where the heavier reels of film require strong torque control.

As the 16mm field continued to grow, Magnasync Corp. foresaw the need of a small portable recorder designed specifically for 16mm production. In 1956 the X-400 model recorder was introduced for this purpose (Fig. 3). The complete unit was packaged in a split-apart carrying case and the total weight was 27 lb with an a-c power requirement of only 60 w, including the synchronous drive motor and amplifiers. Frequency response was from 50 to 8,000 cps with a flutter content of less than 0.2%.

The X-400 transport for 16mm film was used in the single-case Type 15 unit (Fig. 4). This design was an outgrowth of the 16mm producers' demand for the convenience of all-in-one portability.

During this period of constant progression toward ultimate miniaturization of synchronous recording equipment, the splitting of 16mm film and the use of Mylar as a film base provided the design engineer with material to produce easily portable equipment without sacrificing film motion or frequency response. Magnasync Corp. engineers ran extensive tests with Mylar split 16mm film of different thicknesses, to determine the thinnest film base that could be used with sprocket-driven synchronous recording equipment using the Magnasync Synkinetic tight-loop filter system. It was concluded that 3-mil Mylar stock was the optimum medium in split 16mm film. With Mylar film less than 3 mils in thickness the flutter content at 24 cps begins to rise due to the deformation of the sprocket holes caused by pressure on the sprocket teeth. Frequency response comparison tests between 6-mil acetate film and 3-mil Mylar film revealed that the Mylar base required less head pressure; and, therefore, a smaller mechanical filter system could be used to attain equal results. This enabled the engineers to use lighter flywheels, smaller bearings and a much smaller overall configuration.

In 1960 Magnasync introduced the Nomad Mark I Recorder (Fig. 5) using split 16mm Mylar film with a 3-mil base and with a unique system of mechanically interlocking the camera to the recorder and recorder to projector. This unit records two 40-mil soundtracks on split 16mm film. This enables the small industrial or professional producer to record his dialogue or commentary on track number one and, after editing, to record background music or effects on track number two. In reproduction, the play head scans both tracks simultaneously and automatically mixes the two tracks. The user has a miniature dubbing laboratory and can make his own sound transfers to magnetic-striped release prints using a magnetic recording 16mm projector. The Nomad Mark I recorder is completely transistorized with a built-

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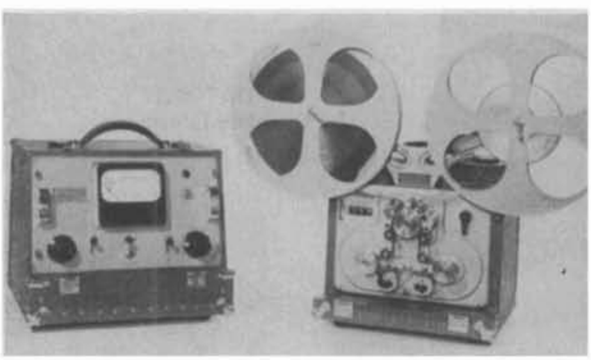

Fig. 1. Basic sprocket-type portable recorder, 602 Type 1, introduced in 1952.

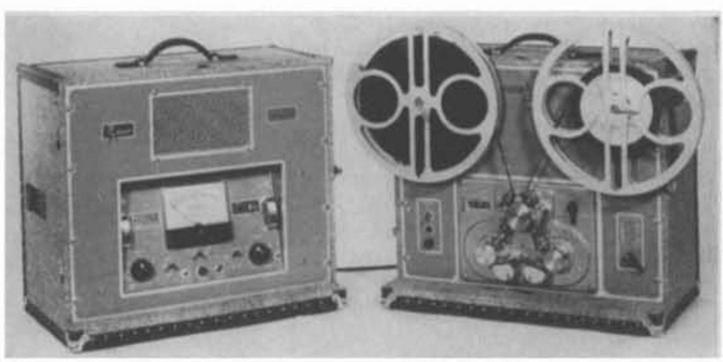

Fig. 2. Basic sprocket-type portable recorder, 602 Type 5.

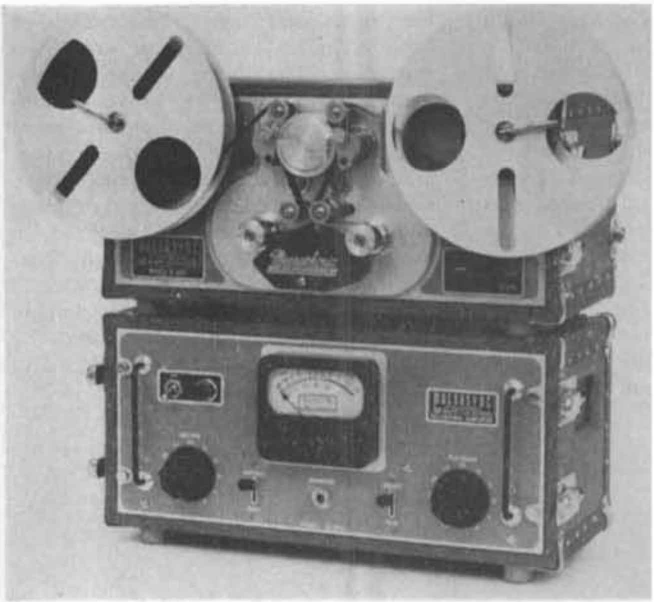

Fig. 3. The X-400 Type 1 portable recorder for 16mm production in a split-apart carrying case.

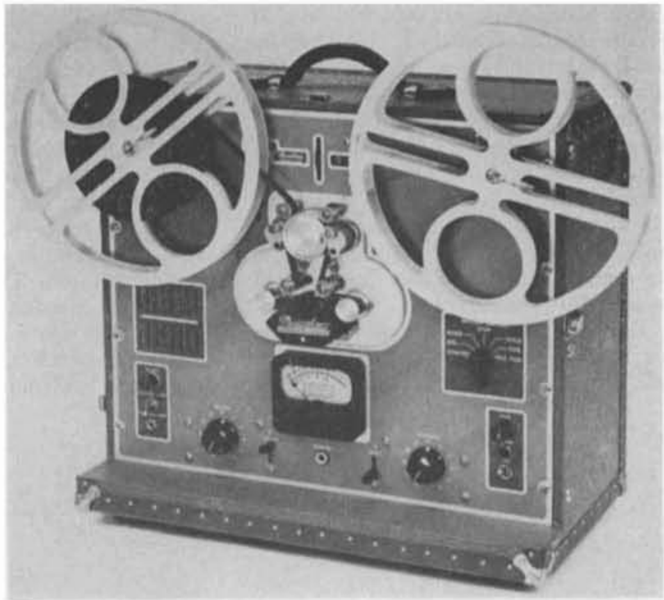

Fig. 4. The X-400 Type 15 portable recorder in a single case.

in rechargeable nickel cadmium battery and with a basic capacity of 100 ft. The total weight is 7 lb. Extension arms are available for 400-ft. capacity.

A need was anticipated for a separate double-system recorder of the easily portable type providing studio quality. In 1961 the Nomad Mark II recorder (Fig. 6) was introduced. The Mark II unit records and reproduces a single 200-mil track on split 16mm film. It weighs 12 lb. and is also completely transistorized. A 12-v rechargeable nickel cadmium battery is incorporated to power the amplifiers. A battery charger is built in and the VU meter doubles as a battery test meter. A four-pole synchronous motor, drawing 20 w, powers the film transport; therefore only 20 w a-c power is required in the field, and easily portable supplies may be used to drive the 16mm cameras with the recorder.

Two microphone inputs are provided with mixing and a standard VU meter determines the level. Dialogue equalization is provided on both microphone inputs. Locking type "XL" connectors are used on the microphone inputs and any high-quality 250-Ω microphone may be used. The flutter content in any one band is under 0.2% and is less than 0.25% over all.

As a companion piece of equipment the Mark II Dubber is designed to accommodate the two-track film recorded on the Nomad Mark I as well as the 200-mil single track film recorded on the Nomad Mark II. Two separate head assemblies are included for that purpose. A compact, interlock triple version of the Dubber incorporates two dubbers and one recorder in a common enclosure offering a complete laboratory in a package weighing less than 50 lb.

A two-track stereo unit with provisions for two microphones with dialogue equalization on each stereo channel is also available for the single Mark II Recorder.

A complete line of split 16mm easily portable equipment has been made available in single- or dual-track models, and a complete recording and dubbing facility can now be installed using split 16mm film.

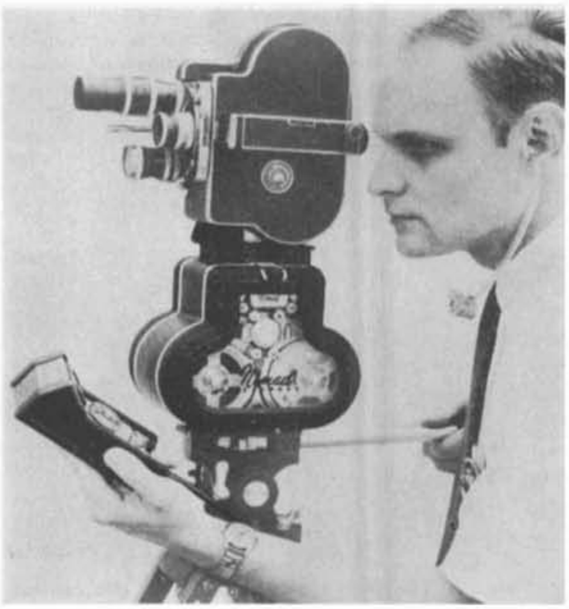

Fig. 5. Nomad Mark I recorder interlocking the camera to the recorder and recorder to projector.

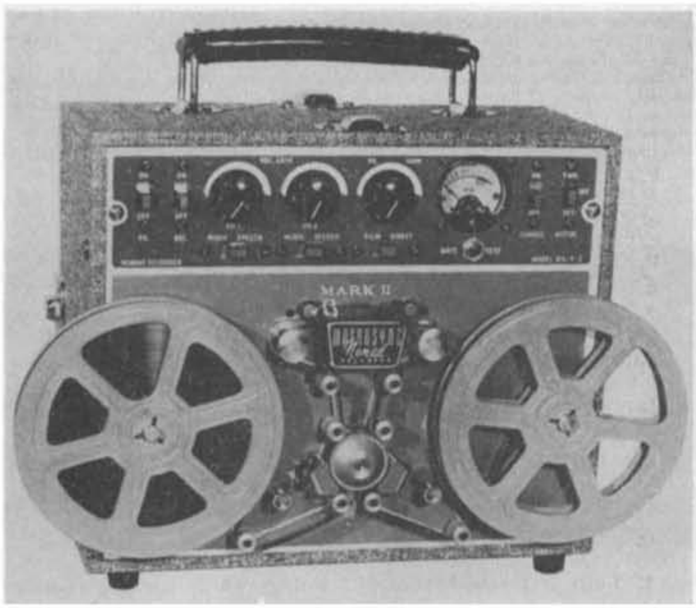

Fig. 6. Nomad Mark 2 recorder/reproducer.

When two tracks are recorded on split 16mm film, each track is 0.040-in. wide with a 0.062-in. separation. The track along the nonperforated edge of the film is 0.005 in. from the edge. The single 200-mill track on split 16mm film is recorded 0.005 in. from the nonperforated edge of the film. These track positions will be submitted to the SMPTE Standards Committee with a recommendation that they be adopted as an industry standard.

Dubber attachments are now available for rack installation under Magnasync 602 Type 16mm dubbers to accommodate split 16mm film. The split 16mm film reels are spaced out to place the film in the correct plane and the split 16mm film runs in the 16mm transport without any modification. The heads in the 16mm recorder are bypassed and the film is threaded through the split 16mm adapter, with the head output fed into the existing preamplifiers. Since the split 16mm film is recorded to the standard 16mm SMPTE characteristic, no further equalization is necessary.

We have now followed the miniaturization trend from 35mm to 17½mm to 16mm to split 16mm. Solid state electronics and printed circuits have been a major contribution to miniaturization. The "state of the art" is further advanced with modular construction, low power requirements, more efficient recording mediums, and smaller and smaller space requirements. Since speed is the essence of the Jet Age, more and more speed will be required in motion-picture production. The expression "30 days from script to screen" is now as passé as the horse and buggy. Tommorrow, 30 min could well be considered more realistic. The trend to miniaturization is just beginning.

The Use of Motion Pictures in an Analysis of the Masticating Cycle

By JUDSON C. HICKEY, JULIAN B. WOELFEL and JOHN L. FRIEND

A frame-by-frame projection of motion-picture film is used in an analysis of the human masticatory cycle. The position of the jaw on each frame is digitized on IBM cards and the information from the cards is plotted electronically to form a graphic tracing of the jaw movement. A knowledge of jaw movement during mastication is important in determining the tooth form for fixed and removable dental restorations.

THE HUMAN MASTICATING cycle has been studied by many means. Bennett[1] photographed the pathway of a beam of light that was attached to the mandible. Atkinson and Shepherd[2] attached beads to the incisor teeth and studied jaw movement on motion-picture film. Berry[3] reports cineradiographic studies of condyle movements that were analyzed electronically. Beck[4] transfers information from human subjects to a chewing instrument that accurately follows jaw movements. Schweitzer[5] attaches dentures to natural teeth and observes the movement of the dentures outside the mouth.

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The authors use a modified combination of two methods to study jaw movements, muscle activity during jaw movements, and denture movements during mastication. Motion-picture film of individuals performing different jaw functions is projected frame by frame for visual study, and information from the film is plotted electronically.

Both dentulous and edentulous subjects have been tested. The subjects are dental students with natural teeth or edentulous dental clinic patients who volunteer their services in exchange for free dental restorations.

Studying Jaw Movement

An indication of the relative activity of different jaw muscles during function is obtained by the use of electromyography.[6] The electrical activity from the muscles is recorded by ink-writers on moving paper. Such records are called electromyograms. Motion pictures that show jaw position of the subject alongside a mirror image of the electromyograms are studied frame by frame to correlate jaw position with muscle activity (Fig. 1).

Small white beads are attached to an upper and lower incisor tooth by means of a supporting wire and an orthodontic band that is cemented to the tooth (Fig. 1). Motion pictures are made as the subject performs simple jaw movements or mastication. The pathway of the beads indicates the direction of the jaw movement.

The beads are also attached to complete dentures that are constructed with inter-

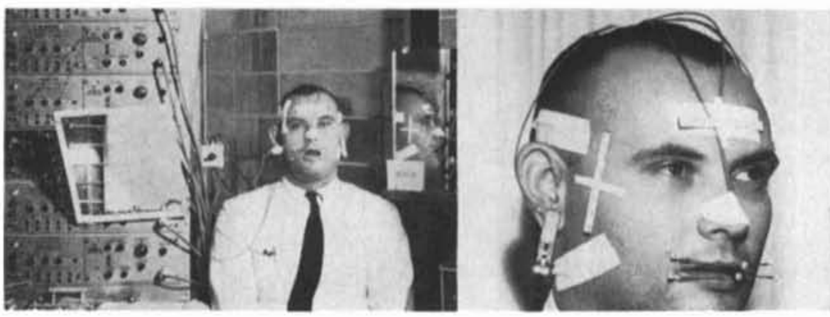

Fig. 1. Left: a Grass Model 5P3 Polygraph is used to record the activity of the muscles during jaw movements. Right: the movement of small white beads attached to the teeth with orthodontic bands is recorded on motion-picture film.

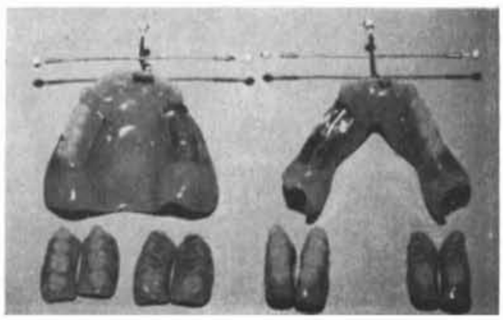

Fig. 2. The beads are attached to the central incisors of the complete dentures. The posterior teeth are interchangeable on the same denture base.