systematic sound

an examination of the Mellotron Sound-Effects Console

BY DAVID KIRK

THOUGH often pleasurable, tape editing is a time-consuming and repetitive method of programme compilation. Yet how can one mechanise an operation that requires such close co-ordination between tape and handler? Automation has its limits, but, even in this unlikely field, instruments are slowly taking over the more arduous tasks, allowing the editor to pay more attention to the intricate business of timing.

The invention which gave rise to the *Mellotron Sound-Effects Console* was conceived as a musical instrument. The *Mellotron*—for such is its name—vaguely resembles a piano or electronic organ but is substantially more versatile than these, having facilities to reproduce the tone-colours of many conventional instruments. Versatility apart, the feature which makes the Mellotron unique is its employment of magnetic tape as the tone source. Musical instrument and sound-effects console are similar in appearance and design, differing mainly in respect of the recorded material. Both are complex tape playback mechanisms—their complexity resulting from the ability to replay any or all of seventy tapes at one moment.

We shall concern ourselves in this article, however, with the effects console, since an examination of this was the purpose of a recent visit to the London offices of *Mellotronics Ltd.*

Essentially, the effects console is a memory device capable of reproducing 1,260 separate sound-effects—each lasting up to eight seconds when played at the recorded speed of $7\frac{1}{2}$ i/s. A variable speed control allows 20% deviation above and below that tape velocity and can be employed to alter the character of the effects or to simplify the timing problem.

To find an individual effect, or set of effects, the operator examines a list supplied with the machine, against which is given the appropriate switch coding. This shows which of the seventy tapes (each referred to a key on the piano-style panel shown in **fig. 1**) contains the required effect. Each of these tapes is $\frac{3}{8}$in. wide and is scanned by a single head capable of aligning against any of three recorded tracks. Having detailed *Aircraft Wheel Skid* against, say, Key *39*, the list continues to state the track number.

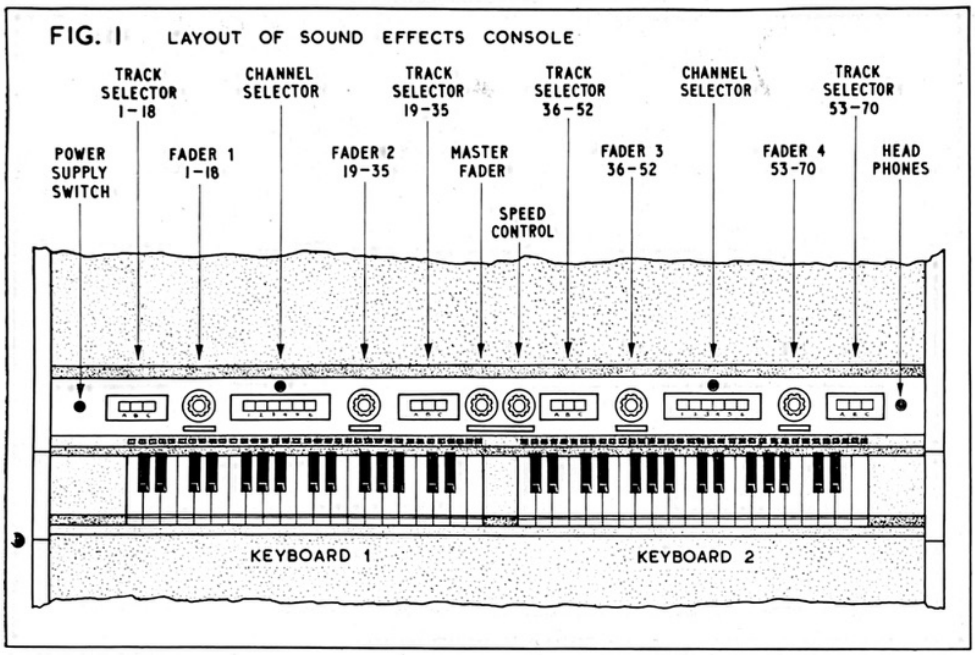
The seventy keys are divided into four groups, Keys 1-18 being controlled by one track selector, Keys *19-35* by another, and so on. These sets are paired into two separate keyboards, there being no special significance in the fact that each 'manual' covers nearly three octaves: two rows of toggle-switches might have served, though they would have been less easy to operate. As it happens, piano-style keys also simplify the tape transport mechanism, but this we shall leave until later.

Noting the desired effect to be on *Key 39*, *Track 2*, the operator then presses the Channel Selector (independent selectors are fitted to each of the two keyboards) to run the appropriate tape reel backwards or forwards to the start of the required eight-second sequence. The Channel Selector is a fast-wind device, operated through six push-button switches, each referring to one of six sequences on every reel. To culminate the selection of *Aircraft Wheel Skid*, therefore, the operator simply presses the listed channel button, whereupon, on pressing *Key 39* he can monitor the effect. It is no coincidence that several other aircraft effects are immediately to hand, since careful planning when the machine was originally programmed ensures that groups of effects are aligned across the seventy tapes. Thus, by accurate combination of individual sequences, the operator can 'play' the entire cycle of an aircraft taking off and landing, pressing one key to obtain *taxi*, another for *take-off*, continuing to *constant flight* and culminating with the three *landing*, *wheel skid* and *reverse thrust* effects.

Fig. 2 shows the schematic layout of the sound-effects console. Here are seen the four blocks of some 18 heads into which the 70 are divided, each block feeding a preamplifying network, on to a mixing network and then to the line amplifier, where the four blocks meet. Two outputs are provided from the amplifier, one feeding a master fader and jack socket to external equipment, and the other supplying a monitor circuit through a pre-fade listen control mounted on the far right end of the console keyboard. The effects can be monitored on headphones or through an external amplifier and loudspeaker.

The secret of the Mellotron music and sound-effects machines lies in the very original tape transport mechanism which uses a single capstan to drive all seventy tapes. The main problem the designers had to overcome was how to return the tapes to the start of each sequence rapidly without risk of snapping or stretching the tape, and without undue complexity. The description that now follows refers to just one of the 70 tapes, each having an identical transport and sharing only the capstan and spool spindles. Each of the tapes is wound on two spools (see **fig. 3**), actual position of the tape on each spool being governed by the Channel Selector. Pressing *Switch 1* thus positions the last five sequences on the feed spool, the beginning of the first sequence being located just before the playback head.

The tape is threaded from the supply spool down some 2ft. to a plastic pulley. **Fig. 4** shows these pulleys and the seventy tapes passing round them. From the pulley the tape returns up to another horizontal guide, down to another pulley, and up to a further guide. It then feeds over the playback head, across the capstan and straight on to the take-up spool. A pinch-wheel mounted half-way along a wooden slat



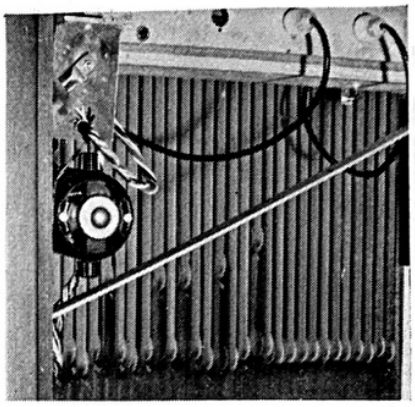
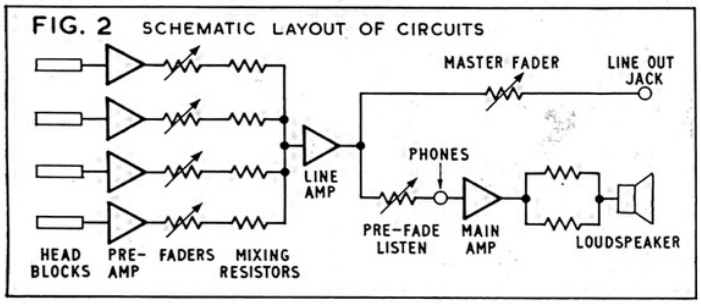
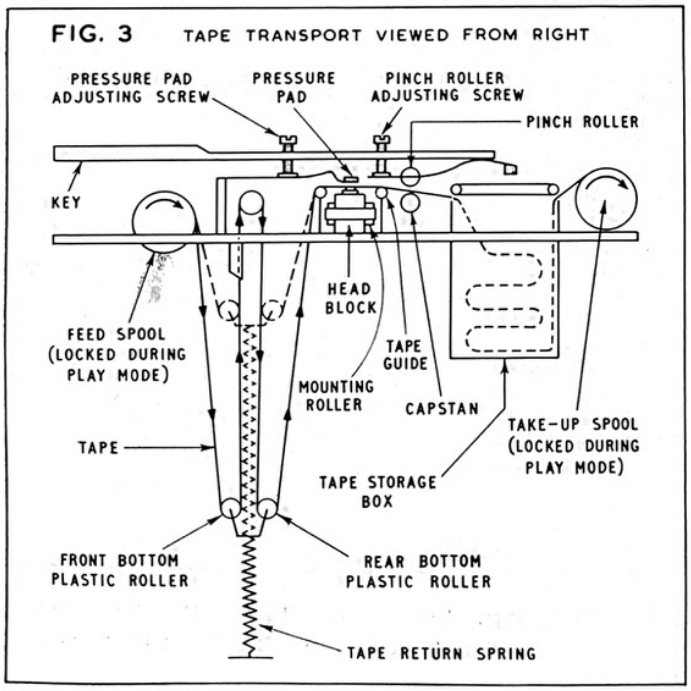
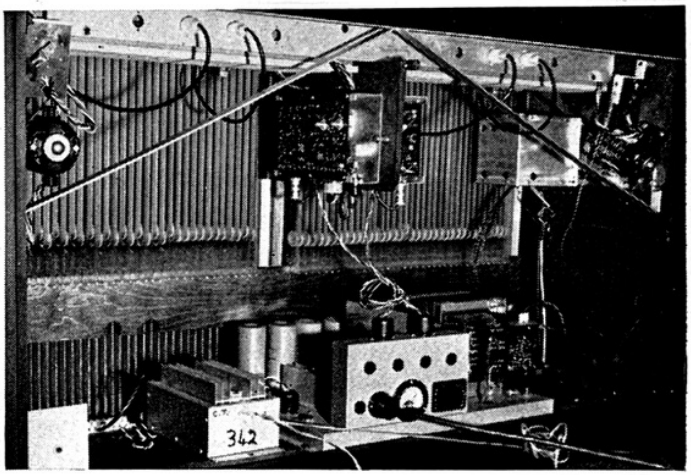


Fig. 5 (above) provides a close-up view of the tensioning pulleys an instant after keys have been pressed.

Fig. 4 (below) is a rear view of the Console, with the back cover removed. Note pulleys in rest position.







connected to the relevant keyboard tab moves down, when this tab is depressed, to force the tape against the capstan. Releasing the key causes the pinch-wheel to retract and halts further forward movement of the tape.

Except when the 'fast wind' Channel Selector is in operation, all feed and take-up spools are locked. The required tape sequence is temporarily stored in the loops formed by the plastic pulleys. The axis of each pulley is attached to the cabinet base by a spring of some 10in. length (when contracted). These springs are partly visible in **fig. 4,** to the left of the power supply components in the base. Pressing a key applies the tape to the capstan (a servo unit and a large flywheel keeping the speed steady), reducing the length of the loop and moving the plastic pulleys upwards. The spring provides a degree of back tension to this movement and is also responsible for the fast tape return when the pinch-wheel is released. Excess tape is fed into a temporary storage box as it passes between pinch-wheel and capstan. This amounts simply to an organised 'spilling' and ensures that the pulley spring will have no tension to fight against when the tape makes its return journey. The photograph labelled **fig. 5** shows a close-up of the pulley movement, several keys having been pressed together.

In the broader view of **fig. 4,** the capstan motor (far right of photo) and the tape wind motor (far left) are visible, while most of the circuitry is incorporated on the single chassis suspended beneath the centre of the frame. Power unit and variable motor supply are located on the base of the cabinet.

The $\pm 20\%$ variation of tape speed from $7\frac{1}{2}$ i/s is obtained by using a DC motor, rotation speed of which is directly governed by the supplied power. There is, of course, no parallel between this type of DC motor drive and that which gives the 'variable speed' (intentional or otherwise) found on many toy battery tape recorders. To overcome the inherent instability and inconsistency of DC drive, the mechanism of the sound-effects console is servo-controlled and as stable as any conventional professional recorder. Mellotronics quote the wow and flutter to be 0.3% RMS maximum. While on the subject of performance specifications, the signal-to-noise ratio with all outputs set to

(*continued on page 22*)

characteristics, one need only draw attention to the fact that many of our advanced microphones have variable characteristics from omni-directional through cardioid to figure-of-eight.

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produce 0dBm from a fully modulated (2% distortion) tape, is 46dB, improving—when only one output is employed—to 55dB.

The music machine employs a slightly more common form of variable speed mechanism, having a synchronous motor through which tape speed is locked to the frequency of the motor supply. Many medium-quality domestic tape recorders feature this type of drive, tape speed being locked to the 50 c/s mains supply. The Mellotron, however, incorporates a signal generator and very high power amplifier, Rotation of the speed control alters the generator frequency within fixed limits and thus provides an accurate means of controlling speed. Though a less expensive arrangement than the DC servo-drive, this system has not been employed on domestic equipment as the motor amplifier is itself very costly.

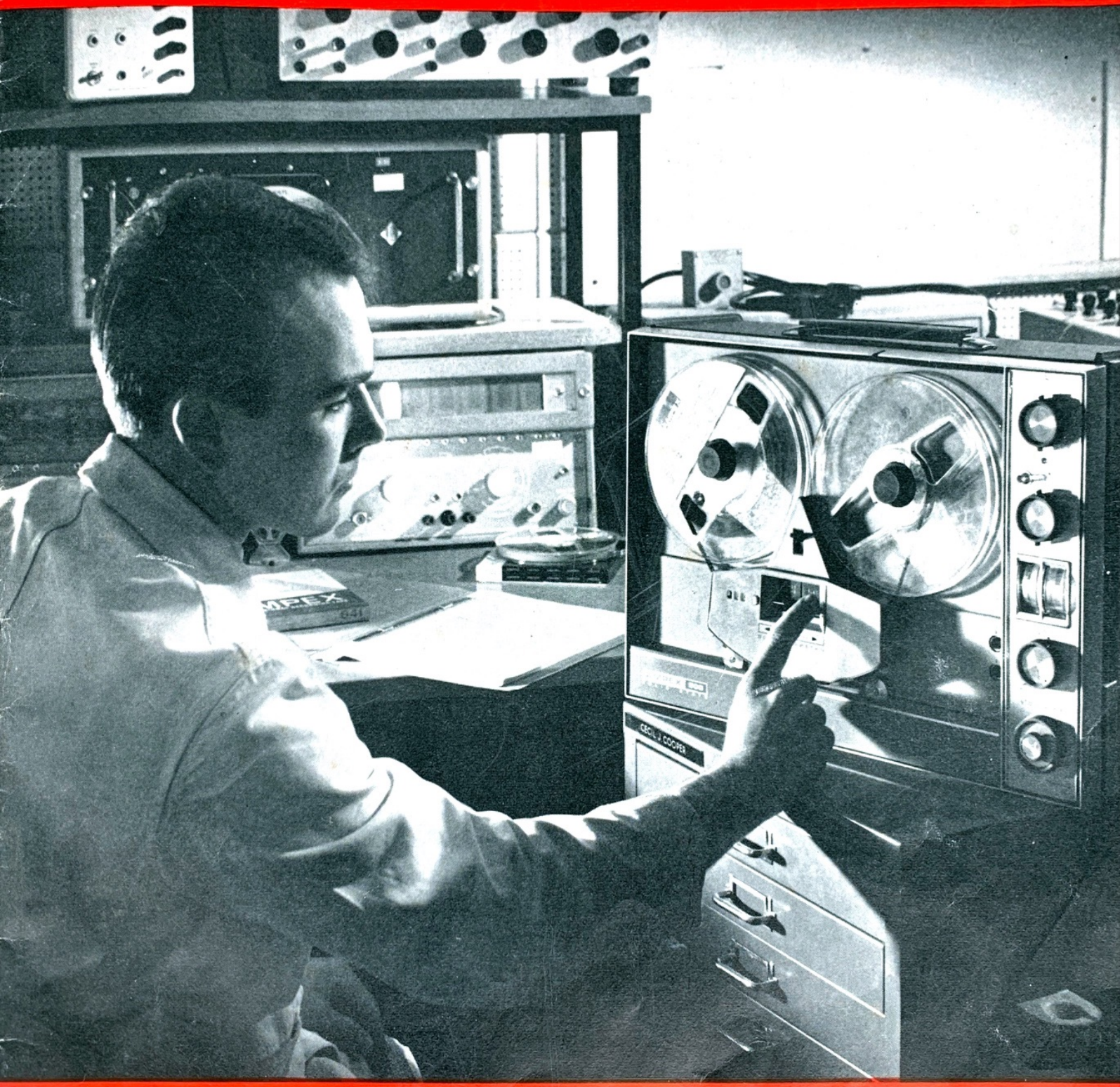
The BBC Sound-Effects Library is the source of all material used on the effects console. The machine can, however, be programmed with the user's own recordings, these being submitted to Mellotronics Ltd. on $\frac{1}{4}$in. tape at $7\frac{1}{2}$ i/s, where they are dubbed on to $\frac{3}{8}$in. tape for insertion into the console.

The sound-effects console is available on hire or can be purchased for £2,625. The BBC was one of the first customers and has shown great interest in its development and use. However, when one remembers that the device is not so much a piece of audio equipment as a very versatile information store, it is reasonable to expect a spate of widely differing applications to appear in the course of time. Medical authorities, for example, have expressed interest in a version of the sound-effects console, programmed with cardiac murmurs, faulty heart-beats, stomach rumbles and all ancillary noises worth memorising by the trainee surgeon.

Postscript: *A Mellotron Sound-Effects System will be demonstrated at the Central Office of Information Theatre, Hercules Road, London, S.E.1., on Wednesday 9th February. Organised by the BKSTS, a lecture demonstration will commence at 7.30 p.m. and will be given by Eric Robinson (Mellotronics Ltd.) and F. C. Brooker (BBC). Interested readers who are not members of the Society should contact:*
The Secretary, British Kinematograph, Sound and Television Society, 164 Shaftesbury Avenue, London W.C.2.

FEBRUARY 1966 TWO SHILLINGS

tape recorder



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