SOUNDS INCREDIBLE - 2

By R. C. MILLS..... B.B.C. RADIOPHONIC WORKSHOP

THIS, the second and last part, will describe special editing techniques and effects used in the BBC Radiophone Workshop.

EDITING TECHNIQUES

Tape, being such a flexible medium, contributes the major facility to the manipulation and treatment of sound. Even the most simple and most basic operation, editing, can be applied in other ways than just sticking pieces of recorded tape together.

Let us take an example: Suppose a note from an electronic organ has been recorded; it can be represented as in Fig. 3a. It can be joined up to the leader tape as in Fig. 3b but, due to the usual oblique splicing, there will be a momentary tape hiss before the note sounds. This is due to the unrecorded piece of tape marked x. If the splice cuts into the sound to prevent this a false "attack" is put on to the note, and it sounds as if it has been rapidly faded in Fig. 3c.

To make sure of obtaining the true sound the tape must be spliced to approximate to the original note attack, i.e. by making *almost* a right-angle cut. Perfect right-angle cuts in the tape are liable to produce a click on replay with a perfectly aligned replay head azimuth, so it is practicable to use a near vertical cut to achieve the effect required without too much risk of this occurring (Fig. 3d).

Many different musical instruments sound almost identical when their characteristic starting transients, which in fact identify the instrument to us, are removed intentionally or otherwise.

With the use of an exaggerated angle of cut, spread over two editing blocks (Fig. 3e), the cut in the tape is much nearer to being parallel to the tape edge, so that a very long cross fade of sounds can be achieved without mixing. It takes plenty of patience and care to make these cuts well, but is shows how editing can be creative as well as remedial.

TAPE LOOPS

Remaining with tape for a moment, a valuable asset used to study sounds, and to aid investigation of their properties, is the tape loop.

Many signature tunes made in the Radiophonic Workshop are constructed from a single sound source. For example, suppose an empty wine bottle is struck with the palm of the hand over the mouth of the bottle, and the sound recorded. Then suppose a tape loop is made from this recording. This basic sound tone can be replayed at different speeds to make up a musical scale of "notes", without constantly rewinding the tape for each note selection.

Similarly, having a constant running loop enables filtering to be selected at leisure. This useful dodge makes it easier to construct or compose background music from two or three running loops. Each loop can be brought in at any time and made synchronous, or otherwise, by adjusting loop lengths or starting times.

MUSIC CONSTRUCTION

Signature tunes are usually constructed in a standard manner. A melody line, a bass line and harmony, and decorations are patiently built up separately. Then all three tracks are played in synchronism, using the three standard tape machines while the mixture is recorded on a fourth.
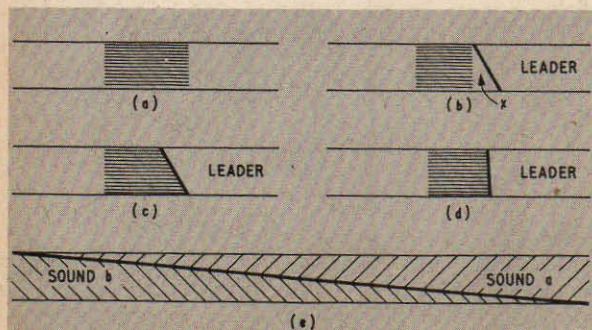
Fig. 3. Special editing to avoid hiss and artificial "attack"

Each music line is built up note by note, and the tempo, in terms of crotchets to a bar, is transposed to read 1 crotchet = x inches of tape. Each note must be recorded at precisely the right level and carefully given the right attack by editing, as described earlier; any timed leaders are also inserted.

Before playing with the other two similarly constructed sound tracks, each track may be treated with filters or echo, to give it the desired sound quality and aural perspective. Sometimes it is preferable to add echo when all tracks are heard together; the degree of treatment on one of the tracks may have been misjudged and perhaps quite inaudible against the other two.

It may be thought that this is a long-winded way of doing things, when perhaps multi-track tapes could be used? However, the Radiophonic Workshop have found that it is easier to keep sound tracks separate, both physically and electronically. In this way, each component sound can be fully controlled. If the result is not satisfactory after a final mix, it is easier to correct individual faults on a separate tape, than on one track out of four, or even eight, on a single wide tape.

PROBLEMS WITH PURE TONES

Throughout the Workshop's history of sound manipulation, of all the sounds handled the most difficult to process were those from the signal generators, particularly the sine waveforms. These are practically unmixable, using the conventional stud faders, as each step is immediately noticeable on the pure tones. With more complex waveforms, the effect is not so apparent.

This problem was overcome by the development of a noiseless fader, which worked by means of a photo-electric cell arrangement. Figs. 4a and 4b show how these operate.

Opening or closing the fader alters the brilliance of a lamp, which in turn alters the resistance of a photo-cell in the programme circuit. Any "steps" due to the stud fader are absorbed by the filament of the lamp, and not noticed in the sound output. To achieve some sort of standard, the lamp voltage is adjusted so that, with the fader closed, the lamp filament just glows.

This principle has been extended, and provides a means by which one sound can amplitude modulate another; the modulating sound is used to vary the lamp brilliance.

Another problem, also encountered when using tones, is that it is very difficult to edit or switch the tones without getting a click. Therefore, to get a uniform start to oscillator notes, a small keying unit is employed; depressing a note on the keyboard, results in a rapid fade up of the oscillator output, in about 10ms.

A further development provided networks to vary this "attack" time, and also the decay time, so that "shape" could be given to the output of the signal generator. This hides the fact that the signal generators do not all start from the same part of the frequency cycle when initially switched on. Synchronised waveforms are achieved by using a single oscillator with multiplying or dividing networks.

Let us now continue into the treatment of sound by means of more sophisticated equipment.

NON-STANDARD EQUIPMENT

At first sight the jackfields associated with the control desk seem quite unmanageable, but it must be remembered that each programme chain is similar, i.e. sound source→amplifier (if necessary)→filter→fader,
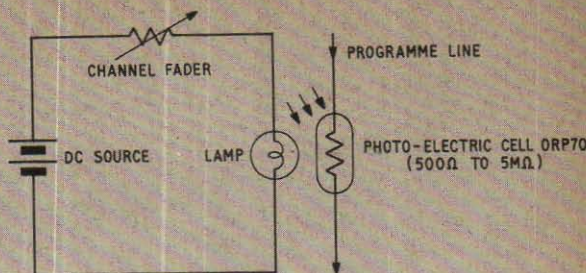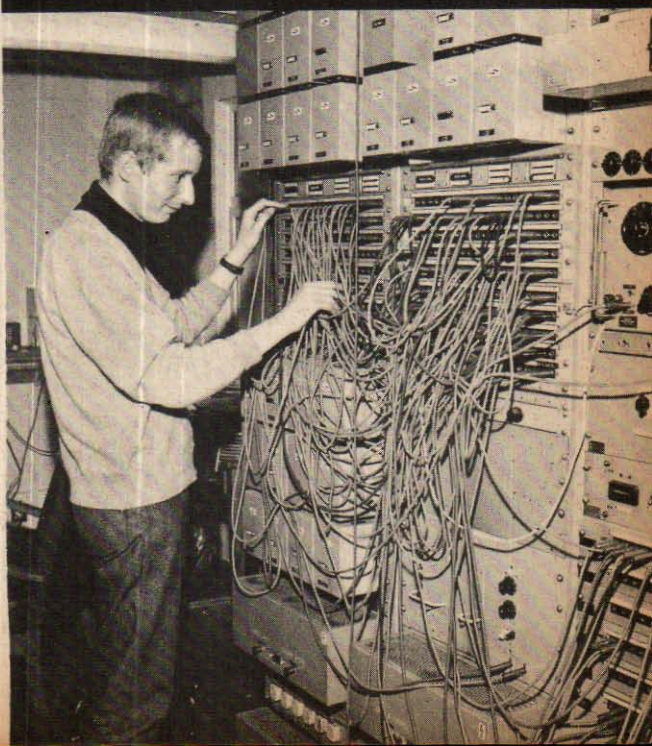
(a) *Simple theoretical circuit using a photocell*
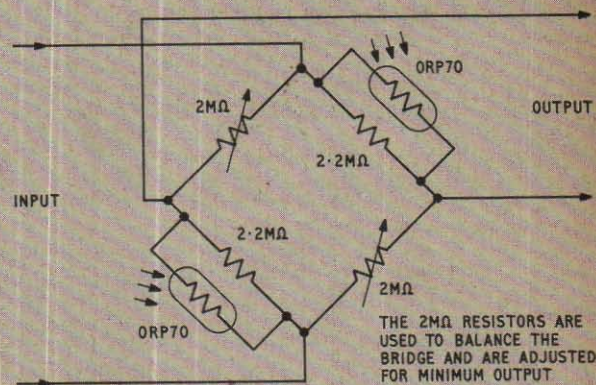
(b) *Bridge circuit used in the Radiophonic Workshop. The lamp and photocell are housed in a light proof fader body*

Fig. 4. *Noiseless fader circuits*

The jackfield rack where equipment is linked up

and most of the connecting cord arrangements are merely repetitions for different channels.

The reason for not tidying up on these arrangements is that access to every point in each programme chain is very desirable, from the creative point of view, as well as the maintenance one. For instance, a tape delay system can be inserted into an echo circuit, and various filters, especially the non-standard types which are used as and when the occasion demands, are plugged into various positions in the chain.

A point worth making here: whilst not upsetting the programme and effects set-up, any part of it can be checked, and usually is. However, the creator's ear is the final judge of performance—not the programme meter.

The special filters are used in isolated cases and, because they are limited in number, are used in conjunction with "group switching". Every sound source on arrival at the control desk, has a choice of routes: independent, group 2 or group 3. In the independent mode, only filters normally associated with particular sound source are operable. Groups 2 and 3 may well have a different filter associated with each, although when switched to a group, the sound source retains its original filter.

For instance, the filter normally associated with one particular source, may not be capable of giving the desired effect. By selecting another group, another filter may be tried. Furthermore, a large number of sources all requiring similar filter settings can all be switched to one group, and one filter will suffice.

Most of the foregoing has been normal studio practice, but a number of special devices have evolved, to assist the sound manipulator.

TAPE LOOP STAND

Starting with the simplest, the tape loop stand enables loops of any length to be played, and has a spring tensioned guide to maintain tape tension. It is usually placed in front of the associated tape machine, whilst there is a miniature version that is used on the tape deck itself when playing very small loops.

For very long loops, it can be advantageous to use another tape machine to help pull the loop round. In some cases, it can divert the tape path to avoid obstructions such as room pillars and equipment.

It often occurs that an interrupted signal is required. One way of achieving this effect is to make up a tape loop made up of alternate tape and leader sections; the sound is recorded on to, and simultaneously played back from this loop. The length and frequency of interruption depends upon the size of the segments of tape and leader, and on tape speed.

Another method of interrupting a sound is by means of a relay unit, to switch sound on and off. Refinements on this principle include a control to vary the operating speed of the relay, and the length of the pause. An additional input is provided to enable other sounds to be injected into the pause.

RING MODULATOR

Still on the subject of interruptions, a device much heard of these days in electronic music concerts, is the ring modulator. This consists of a network of rectifiers and two centre tapped transformers (Fig. 5).

Any sound fed into input 1 can be modulated by another sound applied at input 2. A certain amount of breakthrough of the modulating frequency can be experienced but, by using a field effect transistor, this problem has been overcome.
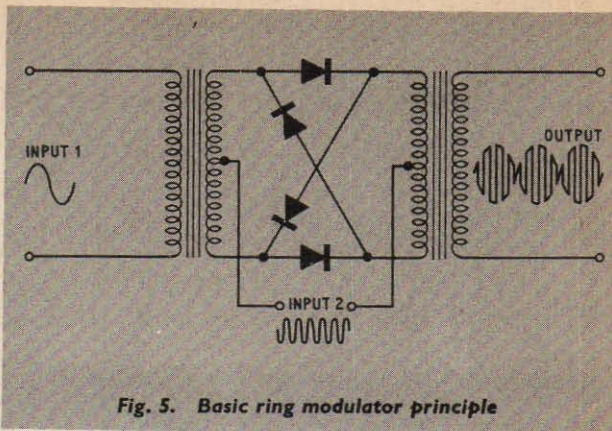

Fig. 5. Basic ring modulator principle

An ingenious, but rather clumsy, form of vibrato, has been achieved by means of a separate replay head moving to and fro against the tape. It is moved by a system of cranks linked to an old gramophone motor. A more sophisticated method used today is a rotary scanner with an associated delay line. It is also possible, using this device, to feed the stators of the scanner with a number of different sounds; the rotating pick-up samples each in turn, producing a pattern of sounds.

HOWL ROUND STABILISER

A piece of equipment used to stabilise public address systems and prevent "howl round" between microphone and speakers, has proved to be very useful to the sound creator. The stabiliser raises or lowers the frequency of sounds fed to it by a few hertz. When the output is mixed with the original sound a low beat frequency is heard, being the difference in frequency between the two sounds.

This stabiliser can be inserted into a feedback circuit, so that any sound subjected to the treatment will get higher and higher, or lower and lower, in pitch, depending on the setting of the system.

Phasing or "skying", another technique in fashion in pop music, can be achieved using two tape machines recording, and simultaneously replaying, the same sound. (The machines must *not* be connected to their own inputs.) If one of the machines is made to run slightly slower than the other, by simply keeping a thumb on the left hand spool, the slight speed difference causes a slight difference in time between the outputs, and frequency cancellation occurs. This effect can also be achieved with two pre-recordings of the same sound.

There is nothing especially created in the line of apparatus to give the Radiophonic Workshop any extra special techniques. It is fair to say that most of the equipment is standard to normal professional sound studios, the only difference is in the imaginative way, unorthodox if you like, that the equipment is used.

FILM EQUIPMENT

A large part of the Workshop's output is for television, and of this a good proportion is for films. The latest additions to the equipment list are, a film viewing desk, a 16mm magnetic recorder and a synchronising machine. This means that a sound sequence can be tailor made to fit the film sequences, as all the sounds can be transferred to sprocketed tape and laid against the film to ensure accurate synchronisation.

SOUNDS INCREDIBLE

The Radiophonic Workshop, being a service department within the BBC, very rarely has time or opportunity to create electronic music as an original, and complete art form. However, collaboration with "outside" composers have resulted in public performances, and recently the Workshop has released an LP of a selection of its work. (BBC Radiophonic Music—Radio Enterprises REC 25M.)

A facet recently added, is the dimension of stereo. Various productions have used Radiophonic sounds in stereo, from the total radio production "Rus" to the cockan'bull tale "The Shagbut, the Minikin and the Flemish Clacket". Another offering from the same stable was "The Shadow of Napoleon".

Various innovations such as synthesisers are likely to be used in future. Such apparatus would provide more original sounds but, as has been found with electronic organs, constant use breeds not only contempt, but instant recognition. It may be that the treatments achieved by means of a synthesiser, will be more important than the sounds produced by it.

IMPROVEMENTS

As more and more new equipment becomes available, technical quality continues to improve. Recording tape has increased coercivity, this is important in sound manipulation, as the number of times a tape can be copied and recopied is limited, without the sound quality seriously deteriorating. With modern tape, higher levels can be recorded without distortion, and a higher signal/noise ratio is maintained.

The only thing that seems incapable of improvement, is the humble razor blade (well, not in the way it is used in the Workshop), unless anyone can produce a plastic, non-magnetic one that cuts tape just as well as the steel ones.

This then, is the continuing story of the BBC Radiophonic Workshop, for whilst the fertile minds of the programme authors continue to demand special sound, and music, the Workshop must continue to supply them. ★