EXPERIMENTS WITH SOUND LIGHT & COLOUR

PART 4 By F.C. JUDD, A. Inst. E

THE cathode ray tube colour pattern display described in the second and third parts of this series lends itself most admirably for sound programming, i.e. for producing preconceived or random patterns and sequences of patterns in synchronisation with music. The system also offers exciting possibilities for filming, using all the various film techniques such as superimposing, zooming and panning. The writer has in fact produced a 15 minute colour film from the display, complete with electronic music sound tracks, but more of this later.

FORMATION OF PATTERNS

It may be realised that patterns can be preconceived by knowing precisely the frequencies and waveform of signals applied to the deflector coils and the frequencies of the grid pulses.

The photograph shown in Fig. 4.1 was taken from the c.r.t. display and although reproduced here in black and white it does show the basic formation of the pattern as circular. On the actual display the pattern appeared in multi-colour and moving, i.e. slowly spinning.

The pattern was formed from an amplitude modulated sine wave fed via the phase shift network to both deflector coils as described in Part 3. This produced the expanding rings effect shown in Fig. 4.2 and which is divided into four segments by grid blanking pulses. The one in the photograph (Fig. 4.1) is divided into five segments, but this division can be any number from two up to seven or eight or more.

Without the amplitude modulation and grid pulses the display would simply be a circle. With modulation at around 10Hz the circle will be displayed successively as in Fig. 4.4. With pulses applied to the c.r.t. grid parts of the expanding circle will be blanked out. The relationship between the fundamental frequency of the signal forming the circle and the grid pulses will decide exactly the number of blanked out segments.

The waveforms in Fig. 4.3 may serve to illustrate the pattern frequency to pulse frequency relationship more clearly, and (as Fig. 4.4 shows) would produce a pattern divided by two since each grid pulse occurs twice during one cycle of the pattern frequency. Therefore if the pattern frequency were 250Hz then the grid pulse frequency would be 500Hz.

The determination of given patterns is therefore a matter of relating the frequencies of deflector coil signals to those of the grid pulses. The frequency of the grid pulses can of course remain constant and the fundamental patterns or deflection signal frequencies varied accordingly.

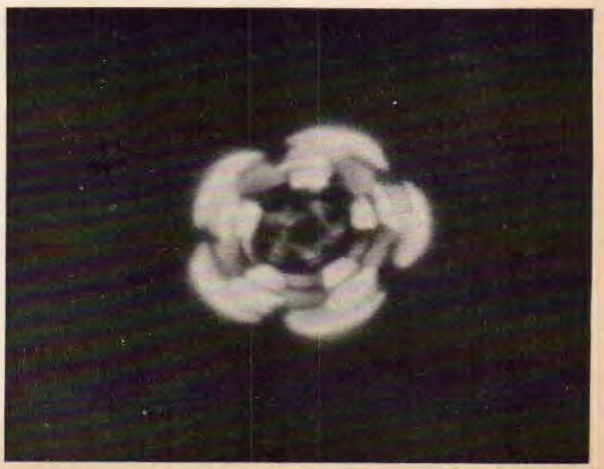

Fig. 4.1. A circular segmented pattern derived from the c.r.t. display

SIGNAL SOURCES

In order to produce complex patterns of this nature, at least two audio frequency sine square wave generators and a signal mixer are necessary—although interesting patterns can be produced from music only. The combinations of signal sources and ways in which these can be fed to the deflector coil amplifiers are as follows:

1. Audio generator to input 1 and audio generator to input 2.
2. Audio generator to input 1 and music signals to input 2 or vice versa.
3. Audio generator to both inputs with phase shift network in circuit.
4. Music to both inputs with phase shift network in circuit.
5. Audio generator and music signals mixed to both inputs via phase shift network.
6. Two or more audio generators with signals mixed to input 1 and music to input 2.

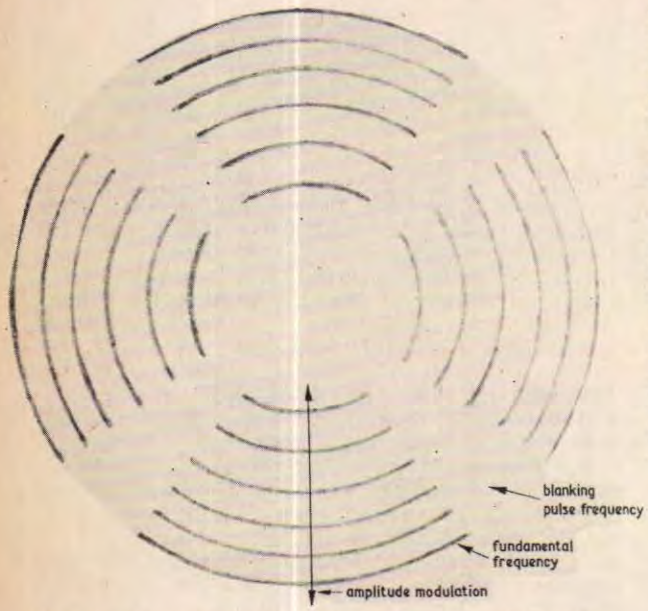

Fig. 4.2. How a circular "expanding rings" pattern similar to that shown in Fig. 4.1 is formed

CO-ORDINATING SOUND WITH PATTERNS

Since patterns can be partly or wholly formed from music signals, they can be made to appear to form and move in synchronisation, i.e. rhythmically with music. Moreover the signals for the patterns, whether derived from music or audio signal generators, can be recorded on magnetic tape with a conventional domestic tape recorder. A programme of patterns and music can therefore be tape recorded and replayed at any time.

ELECTRONIC MUSIC

The choice of music to which the patterns can be made to form and change and move must be left to aesthetic and musical tastes of the experimenter. Electronic music is of course a natural for a display of this kind and it was this type of music that originally prompted the writer to investigate the possibilities of sound, light and colour co-ordination as described in these articles.

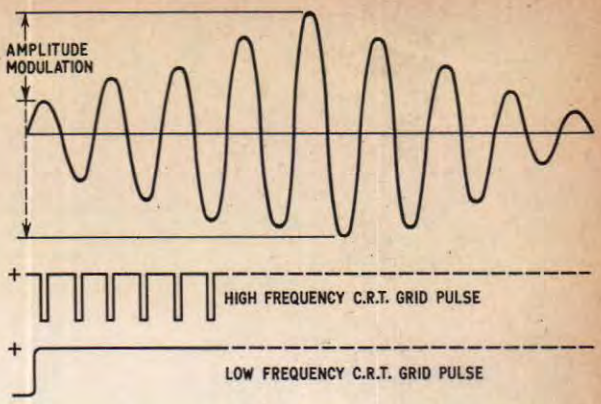

Fig. 4.3. Relationship of pattern signal frequency to grid pulse frequencies

There are a number of records of electronic music available and the fact that pure tone is frequently used in this kind of music makes it very suitable for producing patterns. Those who have the necessary audio signal generators and a tape recorder might well be able to produce both music sound tracks and patterns specifically composed one for the other.

CIRCULAR PATTERNS

Programming in its simplest form would be to feed music signals directly to both inputs of the display with the phase shift network in circuit. With this arrangement predominantly circular patterns would be formed and in exact time with the music.

As a variation a small 50Hz signal could be injected into one amplifier, just sufficient to produce a horizontal line to the maximum width of the screen. This forms a simple time base for music signals injected into the other deflector amplifier. The display will be rather like that of music on a conventional oscilloscope with a slow time base in a multiplicity of colours.

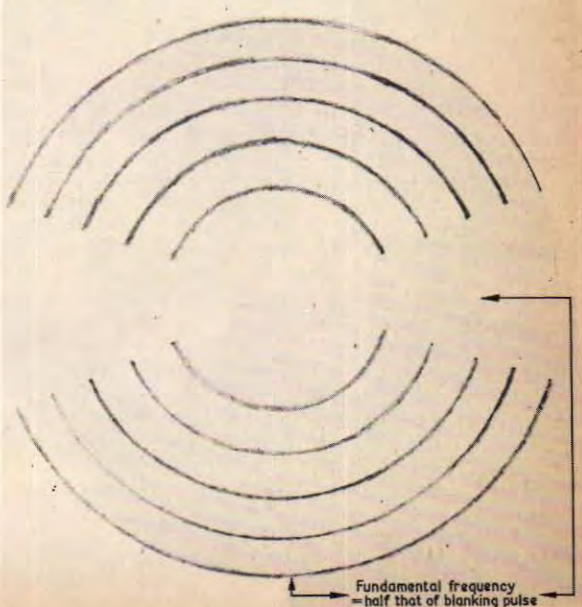

Fig. 4.4. How a pattern would be formed with the signals shown in Fig. 4.3

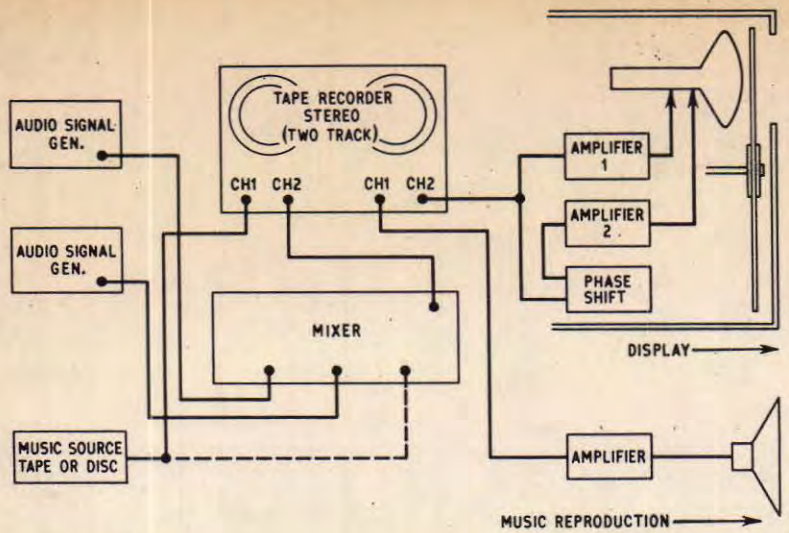

Fig. 4.5. System and equipment used by the author for programming pattern signals and music on magnetic tape

USING TWO DIFFERENT INPUTS

With the aid of one or more audio generators given patterns can be produced and made to come and go as well as move in time with music, but this requires very rapid manipulation of the generator controls.

A similar arrangement but one not so difficult to manipulate is to feed music to one amplifier and an audio generator to the other. The music signals will provide the rhythmic movement whilst formation or shape is produced with the generator controls, i.e. frequency variation, amplitude variation and switching from sine to square-waves.

TAPE RECORDER

Programming with a tape recorder and an audio generator, as well as music signals, provides the ultimate and most dynamic effects. With this equipment the signals for a programme can be recorded and the tape edited if necessary by the usual technique of cutting and splicing.

For example the pattern signals can be recorded first in chosen sequences by stopping and starting the tape. This allows ample time in which to carry out this part of the programming, i.e. the generator frequencies can be pre-set before actually recording. The ideal tape recorder for this is a half- or quarter-track stereo record/playback machine preferably with "off tape" outputs or at least through signal outputs. Such a recorder allows for feeding the pattern signals through to the display before and/or during actual recording.

The block diagram in Fig. 4.5 shows the arrangement employed by the writer for recording patterns and music tracks for the c.r.t. display described in the two previous articles.

LISSAJOUS PATTERNS AND MUSIC

Although comparatively simple in shape, the most striking patterns are 2 to 1 and 3 to 1 Lissajous patterns from sine or square waves. Over-complex patterns produced from music have no definite shape and after a while become uninteresting.

Superimposing music signals upon slowly moving Lissajous patterns is quite effective and gives the illusion of movement in time with the music. Low frequency signals produce the most contrasting colour effects, i.e. frequencies which are equal to, or multiples of the scanner speed and low frequency grid pulses (10, 15, 25 and 30Hz).

FILMING FROM THE DISPLAY

The brilliance intensity of the c.r.t. patterns is high enough for filming with ordinary 8mm artificial light colour film such as Kodachrome 25 ASA film, providing the patterns are reproduced within an area of approximately 2in × 2in. This means operating with a close-up lens, but most dynamic sequences can be filmed this way. The writer has made a 15 minute film with electronic music sound tracks. (Readers who are not equipped for filming might well find a local cinefilm enthusiast or cineclub interested in filming such unusual but nevertheless creative material from their own version of this c.r. colour display.)

The photograph, Fig. 4.6, shows the arrangement used by the writer with an 8mm reflex camera equipped for zooming and with a close-up lens so that patterns could be made to fill the cine screen. Here is a description of the way in which the film was produced.

First it was decided that a coloured background would enhance the overlays of colour patterns filmed directly from the display. The whole film was exposed at 12 frames per second with the aperture at f2.8 to a white surface illuminated in colour by means of a 60 watt lamp behind coloured cinemoid. Deep blues, green and dark red provided the best colour background.

SUPERIMPOSED PATTERNS

Then the film was run through no less than three more times in order to superimpose patterns one upon the other and employing all the filming techniques the camera would allow: zooming, panning, fading and de-focussing, etc. This, together with electronic

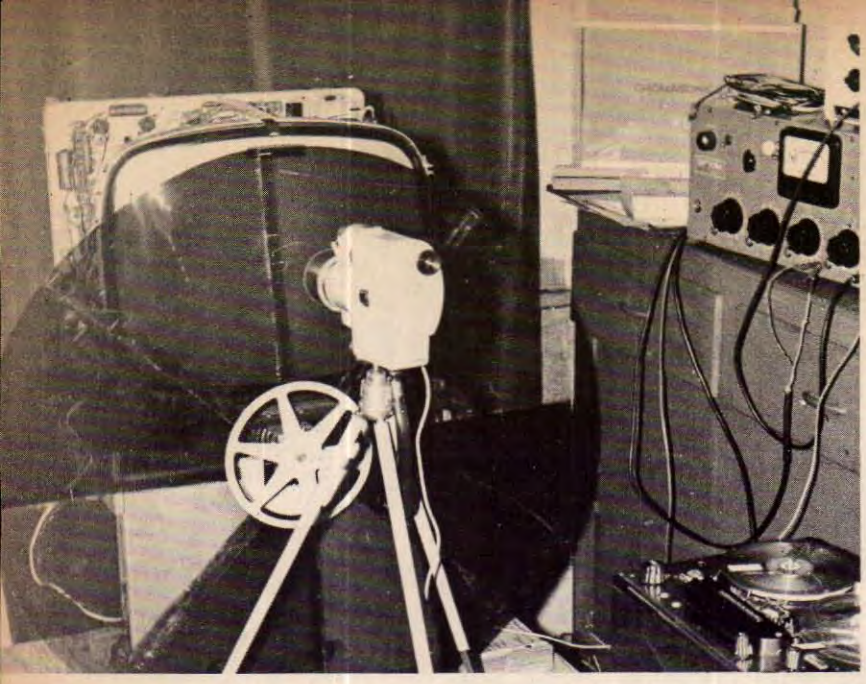

Fig. 4.6. Set-up for filming the c.r.t. colour pattern display. Note close-up lens on cine camera

control over the pattern signals, produced some excellent shots which were then edited for showing with sound tracks of electronic music.

A short sequence of film is shown in Fig. 4.7. Unfortunately this is not reproduced here in colour but in the original the background is deep red with the patterns appearing in yellow and mauve. The film speed was 12 to 16 frames per second at F2.8.

PROGRAMMING THE SIMPLE COLOUR LIGHT DISPLAY

The method of feeding music signals directly to the input of the simple colour light block display was dealt with in Part 1, which also gave constructional details of the display itself.

Audio sine tones from a signal generator and a tape recorder could also be employed to obtain repeating sequences of colour change and movement with this light display. The method of programming is similar to that described in the previous paragraphs, i.e. music is recorded on one track and control signals on the other. By using audio sine wave signals much more defined changes can be obtained since tones can be selected with frequencies midway between those covered by the filter circuits.

In conclusion the writer would like to mention that one PRACTICAL ELECTRONICS reader suggested the use of thyristor control for larger lamps in a display similar to the one described in our opening article. The method proposed could of course be used. In fact there is virtually no limit to the possible arrangements for controlling light from filtered music, or by means of impulse or tones recorded on magnetic tape themselves in synchronisation with music. The writer has attempted only to outline the subject and provide sufficient basic circuit information and other details to encourage others to experiment with two possible methods. A great field is open for those prepared to explore. ★

Fig. 4.7. An 8mm film strip showing patterns from the c.r.t. display. The original film was in brilliant colour (see text)