A New Studio Vision Mixer

By G. FARNWORTH

THE BASIC UNITS OF custom-built vision mixing and switching equipment can be assembled into a straightforward vision mixer which will meet most requirements. Such a mixer, the BD920 Studio Vision Mixer, is available in two versions, without and with "special effects."

There is wide demand for vision mixers which lie somewhere between the simplest unit, such as used in outside broadcasting units or simple studios and the elaborate custom-built arrangements which are essential for larger stations. The BD920 is such a mixer, designed as a studio unit but can, in certain cases, be used in a presentation role.*

Facilities are provided for cutting and mixing on an A/B basis with the addition of two preview panels. In the case of the "special effects" system one of the preview channels can be used for selection of the

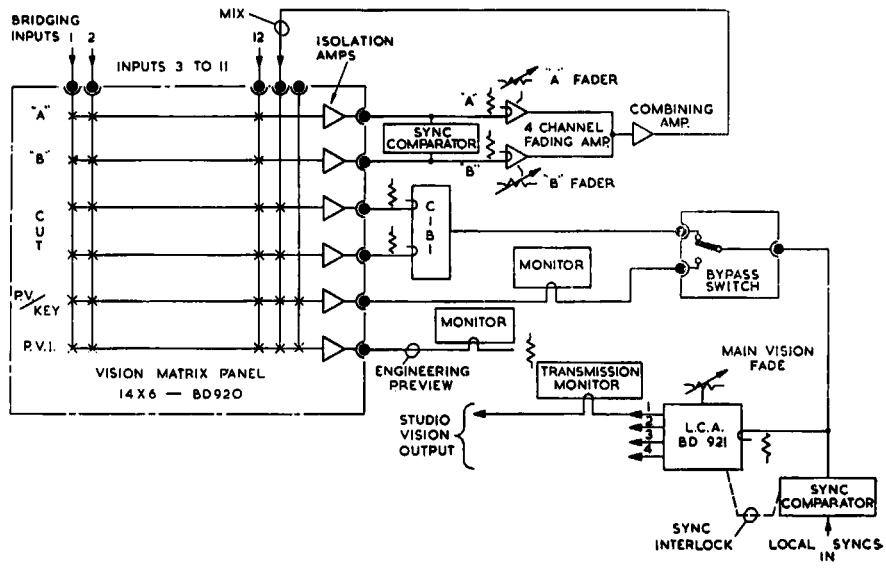

Fig. 1. A simple A/B/Cut studio vision mixer (with two preview rows).

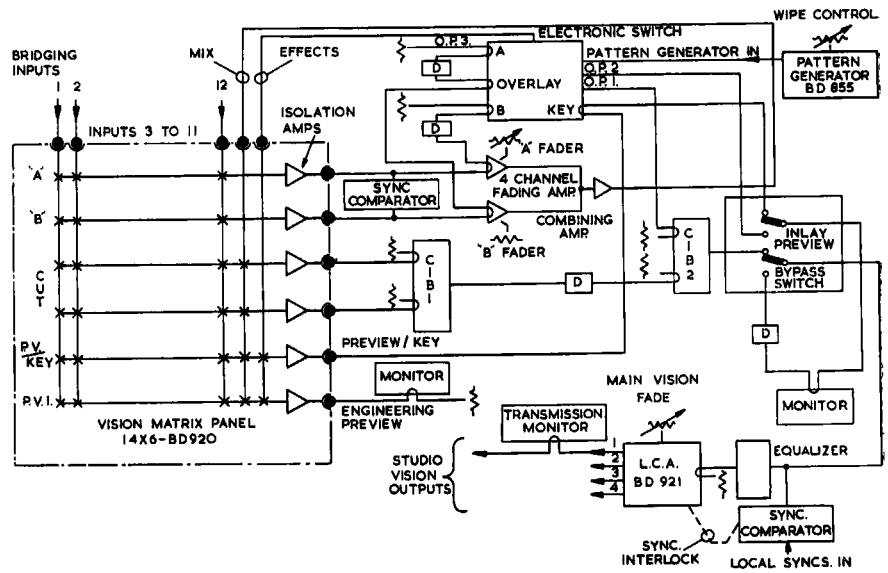

Fig. 2. An A/B/Cut studio mixer with special effects.

This article by G. Farnworth, formerly of Broadcasting Div., The Marconi Co. Ltd., Marconi House, Chelmsford, Essex, England, is reprinted in slightly abridged form from *Sound and Vision Broadcasting*, *V:* No. 2 (a Marconi Publication), 6–11.

* G. E. Partington, "A modern relay mixer," IEE Conference Report, No. 5, June 1963.

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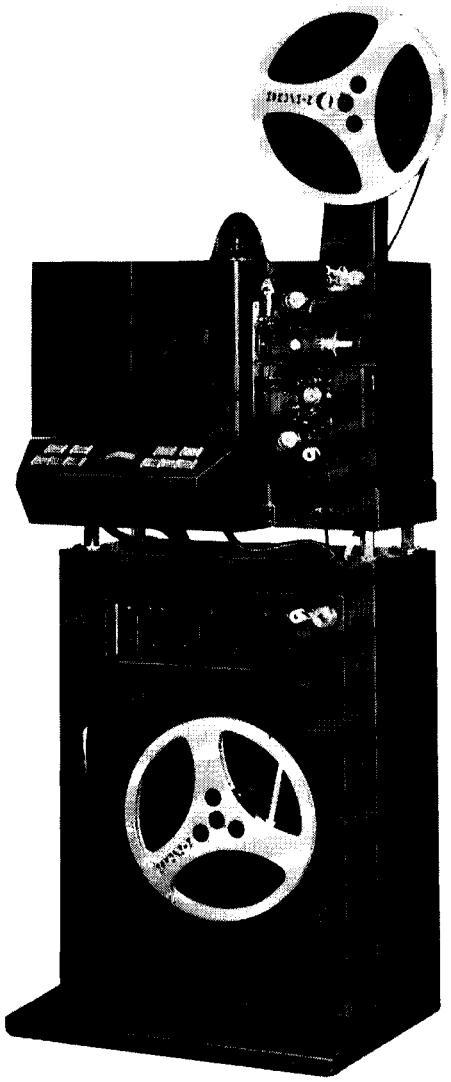

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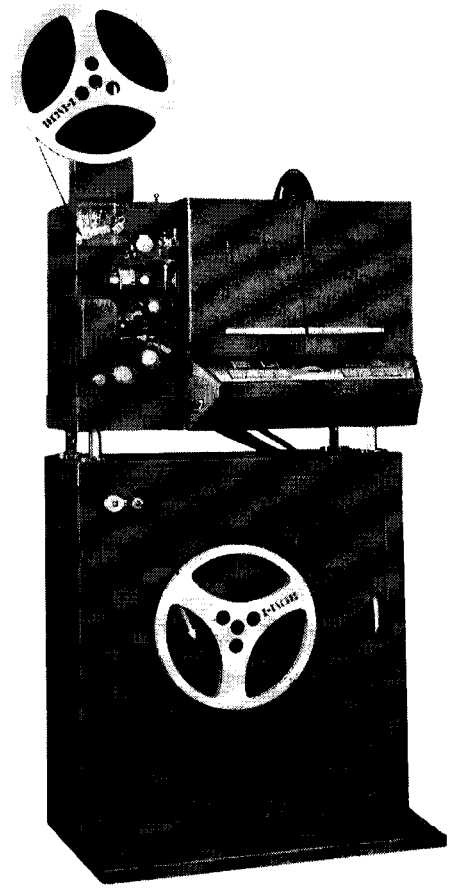

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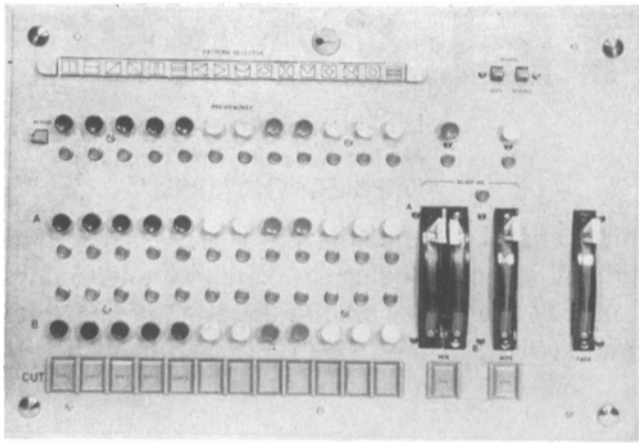


Fig. 3. The control panel.

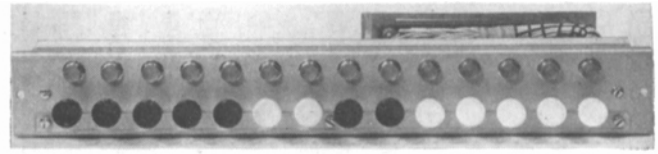


Fig. 4. Control panel for a separate preview channel.

keying signal. In the standard arrangement, one of these previews is controlled from the main control panel of the mixer while the second may be located wherever it is required. In addition to the A/B mixer, master fading to black and bypass facilities in the event of an electronic failure are also provided.

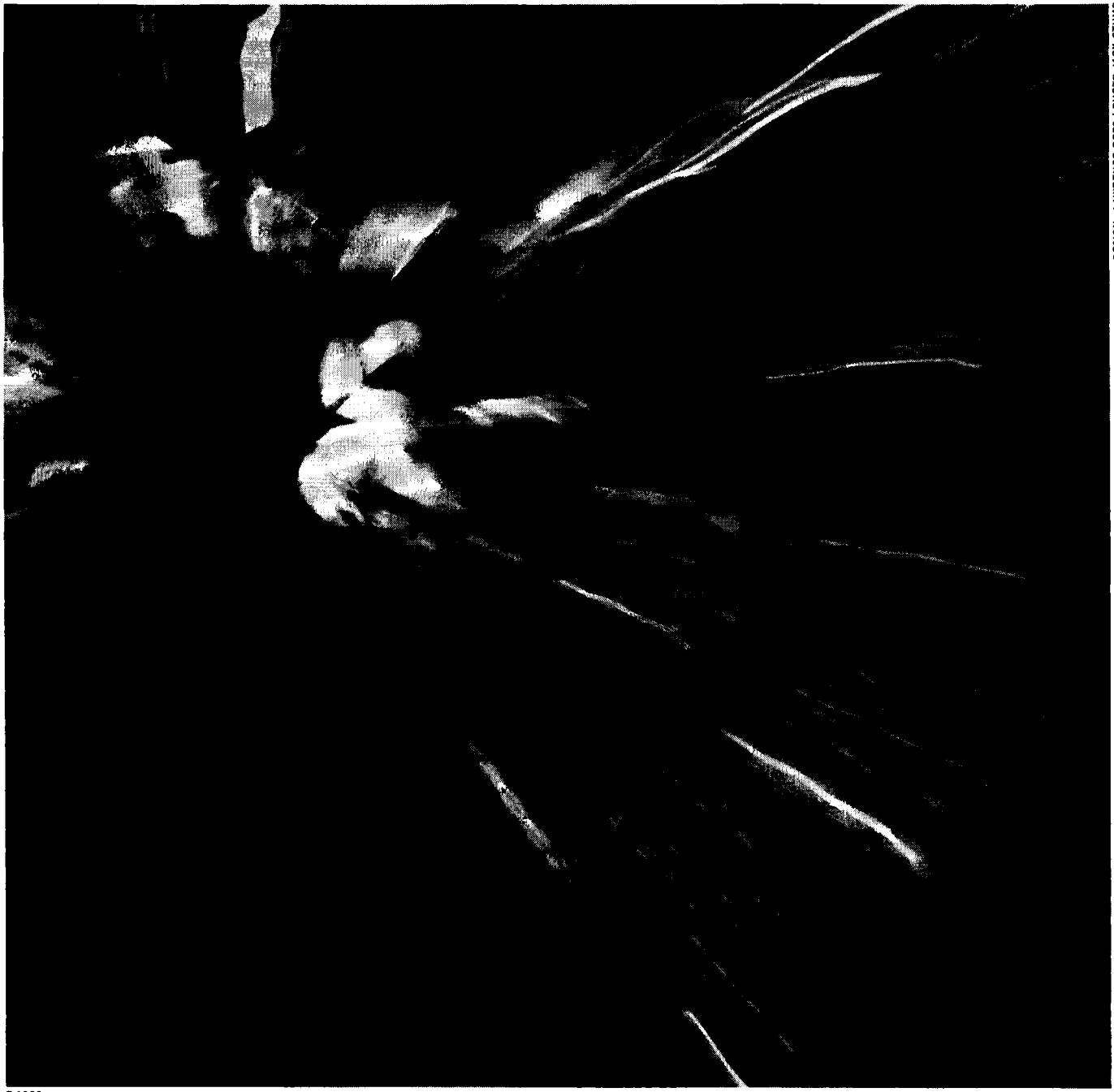
The mixer can take two forms: one a straightforward vision mixer (Fig. 1) and the other a similar mixer with "special effects" facilities (Fig. 2). In Fig. 1, the mixer has 14 inputs of which 2 are kept for the mix output of the A/B bus-bar and (Fig. 2) the special effects output. The 12 other inputs may be used for any sources, synchronous or asynchronous.

The equipment comprises a control panel, the 14 inputs 6 output relay matrix panel, the line clamp amplifier type BD921 and a group of processing units, with the addition of an electronic pattern generator and electronic switch in the case of the mixer with "special effects."

The Control Panel

Similar control panels are used for both mixers, the only difference being that the pattern selector switches and the wipe fader *are omitted* in the simpler one. The control panel (Fig. 3) is a flat panel finished in silver enamel paint with black lettering and is designed to be mounted into a wooden desk provided by the user.

The bottom row of push buttons allows for cutting between the 12 independent sources or for selection of mix or wipe. They are self-illuminated and are engraved with the source designations according to the requirement of the user. The following code has been adopted: green for cameras and mix inputs, yellow for telecine, white for caption and video tape recorders and blue for remote sources, effects and miscellaneous. These colors normally illuminate the engraving, but when a push button is pressed, the color changes automatically to red to show that it is on transmission. In the lower middle of the panel are the push buttons to select the sources to the A and B bus-bars. Selection here is by means of a non-locking push button key, one for each source, and the buttons are colored to the same code as has just been described



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Associated with each button is a small cue light which lights when the appropriate source has been selected. These cue lights are so designed that no color shows until the lamp is lit. To the right of these two rows of selector buttons are the A and B faders which are so arranged that they can be moved either together when a cross mix is required, or independently if a particular superimposition is required. Adjacent to these two faders and above the wipe selector button in the cut row, is the wipe fader fitted when special effects are incorporated. On the extreme right is the master fade control which fades the outgoing signal of the mixer down to black when required.

Above the A and B selectors is the preview selector row which has similar buttons and cue lights. There are two extra buttons here to allow preview of mix and special effects. At the top of the panel, when incorporated, are the selectors for the special effects patterns, employing a mechanical interlocked switch which is self-indicating as to the pattern selected. The buttons are white and engraved with the patterns which are available. Just above and between the mix and wipe faders is another cue light which shows red as a warning when asynchronous sources have been selected on the A and B bus-bars. This is a very valuable feature since the mixing of asynchronous sources produces unfortunate results.

To suit the individual installation, such as engineer's preview, there is a second preview channel controlled by a panel similar to that illustrated in Fig. 4 which may be mounted elsewhere in the control desk. It uses the same non-locking buttons and cue lights as the A/B and preview selectors of the main control panel.

The 14 × 6 Relay Matrix

The 14 × 6 relay matrix (Fig. 5) is the heart of the mixer. It is 29-¾ in. (75.5cm) high and designed for mounting in a standard 19-in. (48-cm) rack. There are six rows of 14 high speed plug-in relays forming the matrix itself and a seventh row of relays which provides the cue control services, mounted in a frame with covers back and front. The covers are held by quick-release fasteners which allow ready accessibility but ensure that the relays are kept completely free from dust. The input bridge tee networks are mounted to one side of the box containing the relays, in such a position as to ensure a minimum length of coaxial cable to the feed points on the center of the input bus-bars. The six output isolation amplifiers are plug-in units mounted into the bottom of the box where they connect straight on to the output bus-bars. Behind them are the taper pin blocks for connecting the control and cue wiring. Each of the relays has six changeover contacts, two of which are used for vision switching and a third for electrical latching which allows momentary touch switches to be used on the control panel. The remaining three are used for cue purposes; one for "on-air" cues, one to give the revertive cue light to the control panel and the last can be used for sync interlock purposes. In this particular case, however, the sync comparators described later eliminate this need.

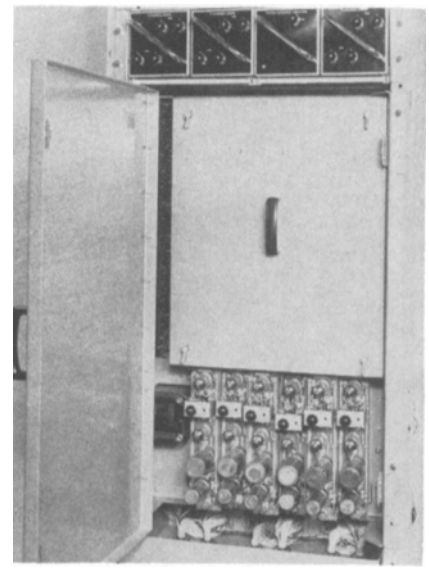

Fig. 5. The 14 × 6 relay mixer.

Processing Units

Mixer Processing Units consist of four plug-in units mounted in a frame similar to that used for the BD886 vision distribution amplifier. The frame with its units (Fig. 6) is made up of a 4-channel fading amplifier, a combining amplifier, a cut-in-blanking unit, and a dual sync comparator.

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2490 RAR (ESTAR Base)		Blue	For oscillography (mercury, xenon); modulated glow-tube (argon) recording; seismic recording (variable area or density); and CRT recording with blue-emitting phosphors (P5, P11, P16).	4-mil ESTAR	Dyed Gel	64
2492 RAR (ESTAR Base)		Ortho	For oscillography (tungsten); fluoroscopy; hydrogen-bubble chamber photography; high-speed photography; and CRT recording with green-emitting phosphors (P1, P2, P15, P24, P31).	4-mil ESTAR	Clear Gel	160
2494 RAR (ESTAR Base)		Ext. Red Pan	To be replaced by KODAK 2479 RAR Film (ESTAR Gray Base)	4-mil ESTAR	Clear Gel	800
2479 RAR (ESTAR Gray Base)		Ext. Red Pan	For outdoor and artificial-light (all sources) photorecording; oscillography (all sources); modulated glow-tube (neon) recording and CRT recording with all types of phosphors.	4-mil Gray ESTAR	Clear, fast-drying	650 (ASA 400)
2486 RAR (ESTAR Gray Base)	Reversal Processing	Ext. Red Pan	For artificial-light (all sources) and outdoor photorecording; cloud-chamber photography; modulated glow-tube (neon) recording; and CRT recording with all types of phosphors (especially white and orange—P4, P7, P12, P14, P20, P22). Reversal-processed films have excellent projection quality.	4-mil Gray ESTAR	Clear, fast-drying	160
	Negative Processing					125 (ASA 80)
2498 RAR (ESTAR Gray Base)	Reversal Processing	Pan	High speed for photorecording with all types of light sources (daylight, artificial light, electronic flash) especially when the illumination level is low. Reversal-processed films have very good projection quality. Antihalation coating under emulsion enhances sharpness and minimize halation.	4-mil Gray ESTAR	Clear, fast-drying	320
	Negative Processing					250 (ASA 250)
LINAGRAPH Recording (ESTAR Base and ESTAR Thin Base)		Blue	For oscillography (mercury, xenon); seismic and modulated glow-tube (argon) recording; well logging; and CRT recording (P5, P11, P16). Thin base for maximum footage per load.	2½ and 4-mil ESTAR	Dyed Gel	32
LINAGRAPH Drift Survey		Ortho	For drift-survey cameras and photoinclinometers. Will withstand 300 F temperature for up to 2 hours during the exposure run.	5¼-mil Triacetate	None	6
LINAGRAPH Ortho		Ortho	For oscillography (tungsten); fluoroscopy; hydrogen-bubble-chamber photography and CRT recording with green-emitting phosphors (P1, P2, P15, P24, P31). Also available on gray base.	5¼-mil Triacetate	None	400
LINAGRAPH Pan		Pan	To be replaced by KODAK 2479 RAR Film (ESTAR Gray Base).	5¼-mil Triacetate	None	400
LINAGRAPH Shellburst (ESTAR Gray Base)		Ext. Red Pan	For cinetheodolite photography of aerial objects against a blue- or white-sky background and for cloud-chamber and hydrogen-bubble-chamber photography.	4-mil Gray ESTAR	Clear, fast-drying	200
2475 Recording (ESTAR Gray Base)		Ext. Red Pan	For all types of photorecording and police science photography when weak illumination, extremely short exposure times, or high writing speeds require an extremely high-speed film.	4-mil Gray ESTAR	Clear, fast-drying	1250 (ASA 800)
High Speed Infrared		IR	For all types of recording between 700 and 900 mμ, such as thermography, infrared luminescence, and high-speed photography. Requires a WRATTEN Filter No. 25, 29, 70, 87, 87C, 88A, or 89B.	5¼-mil Triacetate	None	320

The 4-channel fading amplifier in fact allows mixing of 4 signals, in this particular case, however, only two are used. The circuit is a double triode connected as a long-tailed pair which provides very constant mix performance without complicated preset controls to match one channel against another, followed by a combining amplifier which combines the outputs of the two fade stages in the fading amplifier. Figures 1 and 2 show that these two units together provide the mixing facility required across the output of the A and B bus-bars.

The cut-in-blanking unit is a semiconductor device with two bridging vision inputs, with a semiconductor switch cutting between vision inputs during the first field blanking period after the selection is made. This is connected across two more bus-bars in the matrix to provide the cut facility of the mixer (Figs. 1 and 2). A feature of the cut-in-blanking unit is that the inputs are dc restored and dc connected through the switch so that there is no transient effect after the cut.

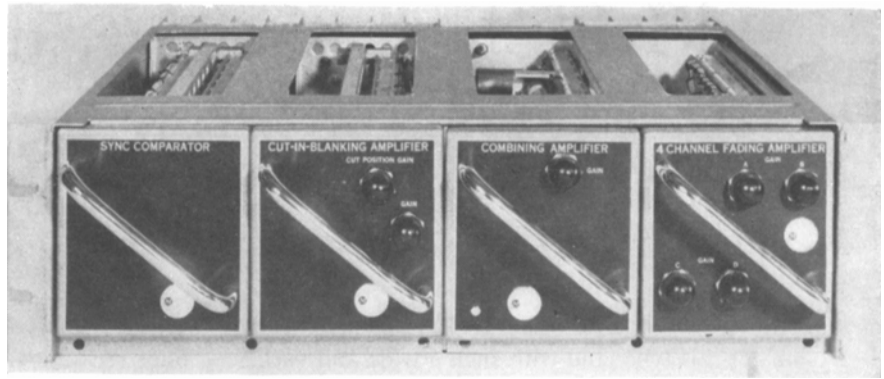

Fig. 6. The processing units.

The sync comparator has two high impedance inputs which are connected by teeing. These inputs are fed to sync separators, the outputs of which are subtracted with the result that the final output is only present when the signals are not synchronous. If the inputs are nonsynchronous or mistimed, an output is produced and the control voltage developed is used to operate relays elsewhere in the system. The first of the sync comparators is used to compare the signals selected on the A and B bus-bars (Figs. 1 and 2). If these are nonsynchronous, the "Do Not Use" lamp on the control panel lights. The second sync comparator is used at the output of the mixer on the input of the line clamp amplifier to monitor the output signal and compare it with the local synchronizing pulse generator. In the event of asynchronism, the sync interlock works and inhibits the injection of local sync to the outgoing signal. This sync comparator also ensures that the line clamp amplifier feeds sync pulses to line should there be no output signal from the mixer itself for any reason. The sync comparator is designed to ignore any momentary loss of signal occasionally due to gap switching on the A and B bus-bars.

Cutting

Cutting between any of the available sources is effected by momentarily pressing the appropriate button in the cut row. The button is normally illuminated to the appropriate color key and changes to red when selected to go on the air. The cut row controls two rows of the matrix across which a binary circuit operates so that the two rows of the matrix are used alternately. Across the outputs of these two bus-bars is a cut-in-blanking amplifier which, triggered from the matrix, causes the changeover from one source to another to occur during field blanking. The output of the cut-in-blanking amplifier is taken via a bypass switch to the line clamp amplifier. The bypass switch permits changeover of the line clamp amplifier input from the output of the cut-in-blanking amplifier to the output of the preview channel in the event of failure in the cut system. The input of the line clamp amplifier has a sync

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comparator connected to it and local sync is fed into the other side. The output of the sync comparator is then used to control the sync interlock relay in the line clamp amplifier automatically switching it to local or remote sync operation as appropriate. The main fader on the control panel operates the fading stage of the line clamp amplifier.

Mixing

The mixing circuit uses two more bus-bars on the matrix labelled A and B on Figs. 1 and 2. The outputs of these bus-bars are fed to two inputs of a 4-channel fading amplifier, and the sync comparator is connected across them controlling the "Do Not Use" light on the control panel, which warns when an attempt is made to mix two non-synchronous sources. The output of the 4-channel fading amplifier is taken to a combining amplifier, and the output of this unit is then fed back to input 13 of the matrix to allow it to be cut to or previewed. Two channels of the 4-channel fading amplifier are controlled by the "Mix" faders on the control panel, which are connected in opposition so that moving the two faders over from the one side to the other fades down one channel and fades up the other.

Preview

The last two bus-bars of the matrix are used for preview. The first is controlled from the main control panel and the second may be controlled from any alternative point by means of a suitable row of momentary touch keys.

The relays of the matrix are arranged to change over in the gapping mode except for the A and B rows which automatically lap switch when they are on the air. The bypass switch adjacent to the row of preview buttons on the control panel is a three-position switch. In the normal position the preview system operates. In the bypass condition the preview keys and the preview bus-bar are used to feed the line clamp amplifier, and under these conditions the timing of the relays is altered to give lap cutting. The third position of the bypass switch allows the preview row to be controlled from an alternative set of switches.

Special Effects

Figure 2 shows the basic mixer with special effects added. The A and B bus-bars of the matrix are used to select the signals fed to the electronic switch. This is achieved by looping the outputs of the matrix through the 4-channel fading amplifier and through a delay line into the electronic switch. The delay line is necessary in order to allow for the inherent delay of the electronic switch. The electronic switch is controlled either by a pattern generator giving the standard patterns indicated on the appropriate keys on the selector switch (Fig. 3) or alternatively, it may be controlled by a keying signal derived from one of the inputs of the matrix itself. In this case, the preview row of keys is used to select the keying signal, and preview of the effects signal is then achieved by an automatic changeover of the preview monitor to an output of the electronic switch. When standard patterns from the pattern generator are used, the special effects signal is previewed in the normal way as an output of the electronic switch is fed into Input 14 of the matrix.

The pattern generator provides 15 standard wipe signals and is controlled by the wipe fader on the control panel. Switches are provided on the control panel to allow normal and reverse wipes as well as wipes which are effective always in the same direction.

When a special effect is selected for transmission by pressing the appropriate key on the control panel, the changeover is effected in a second cut-in-blanking unit inserted in the circuit between the cut output of the matrix and the by-pass switch. Into this line also has be to be inserted an appropriate delay to match the delay through the system.

Conclusion

Although the two systems described herein will meet the need of most studio applications, the basic elements of this mixer, that is the 14 × 6 matrix, the processing components, etc., can and have been used in many custom-built systems.

Some 20 of the basic matrices have already been supplied to broadcasters such as Tyne-Tees Television Newcastle upon Tyne, Intertel, Ulster Television, the Danish Broadcasting Authority, Granada Television Manchester, Hungary, Belgium, Rumania, while systems are also being developed for Australia and Associated Rediffusion.