INTRODUCTION TO VISION MIXERS

General

The vision mixing unit enables a producer to select the required source or sources in order to compose his programme. A number of sources is available at the mixer input, typically 8 or 10. The output may be derived from any one of these inputs or from a combination of two or more of them.

These notes describe the ways in which the above functions are carried out and also the additional processing required to ensure that the video output has standard syncs and burst.

Basic Mixer

Fig. 1 shows a block diagram of a simple mixer with limited facilities. The video switches, shown for convenience as rotary switches, enable any one of the four sources to be routed to each of the group faders A and B. Using two groups in this way permits mixing between two sources.

To avoid disturbance to subsequent equipment the actual switching of the video signals takes place during the field blanking period.

The outputs of the two group faders are combined and fed to the Stab. Amp. (synchronising-pulse-stabilising amplifier).

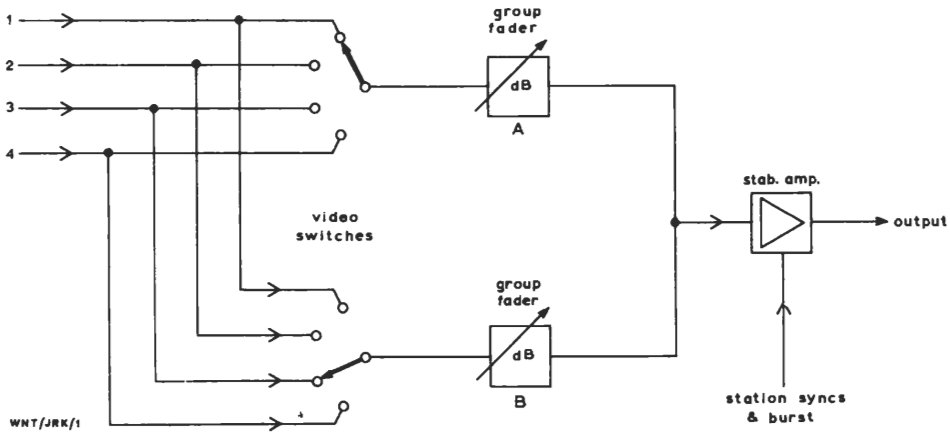

Fig. 1. Block diagram of a simple mixer suitable for synchronous sources

The Stab. Amp. is a signal processing unit which ensures that the output has 0.3-V syncs, that the signal is correctly limited at blanking and at white level and that the colour burst is of the correct amplitude. These functions are necessary because the action of fading or mixing affects the sync and burst amplitudes as well as the picture and sub-carrier amplitudes.

Synchronous Sources

The mixer in Fig. 1 can handle synchronous inputs only. Synchronous sources are those which obey the following conditions:

(i) the sync timing is ideally within 50 ns and certainly within 300 ns of station syncs.

(ii) the burst phase is within 5° of that of the station burst.

When these conditions are satisfied station syncs and burst are used for the stabilising process as indicated in Fig. 1.

Non-synchronous Sources

For non-synchronous inputs the syncs and burst used in the Stab. Amp. must be timed correctly for the source selected. Syncs and burst must therefore be obtained from the incoming signal before it reaches the faders. Fig. 2 shows the modifications necessary for the mixer to handle non-synchronous sources.

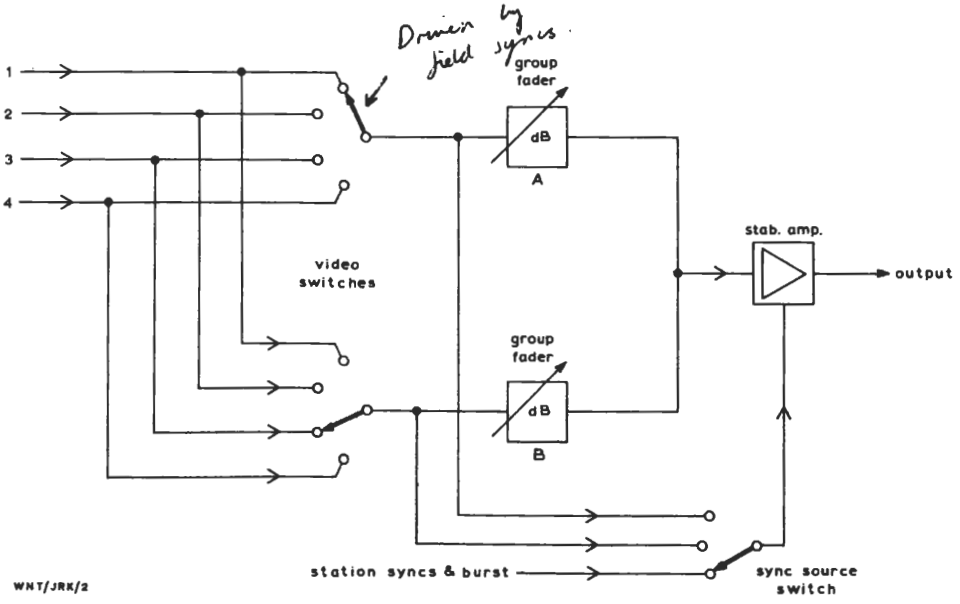

Fig. 2. Block diagram of a simple mixer suitable for non-synchronous sources

The sync source switch changes the supply of syncs and burst to the Stab. Amp. according to the type of signal being processed. (The sync separator and burst gate which are used to separate the syncs and burst from the unfaded video are not shown in this diagram.)

Mixer Facilities

The mixer in Fig. 2 has the following facilities:-

(i) Any single source may be selected (e.g. "Cut to Cam 1")

(ii) Any single source **may** be faded (e.g. "Fade out Cam 1")

(iii) Any two synchronous sources may be superimposed (e.g. "Superimpose Cam 2 on Cam 3")

(iv) One synchronous source may be faded out as another synchronous source is faded in (e.g. "Fade out Cam 3 and mix to Cam 2").

The mixer should include circuitry to prevent a non-synchronous source being superimposed upon, or mixed with, any other source. If either of these conditions were to occur it would be impossible to add the correct syncs in the Stab. Amp.

In practice a source is declared non-synchronous by throwing a switch associated with each channel on the mixer from "Sync" to "Non Sync". A third position may also be available labelled "Auto" or "Remote" in which the mixer employs coincidence sensing circuits and decides for itself whether a source is sync or non-sync.

Split Screen Unit

One additional facility which is usually available is a Split Screen Unit. This unit enables sources to be combined by switching from one to another during the active picture time rather than by superimposing them. Thus the group fader controls now alter the ***position*** of the wiping edge instead of the ***amplitude*** of the output signal. A number of possible wipes are illustrated in Fig. 3.

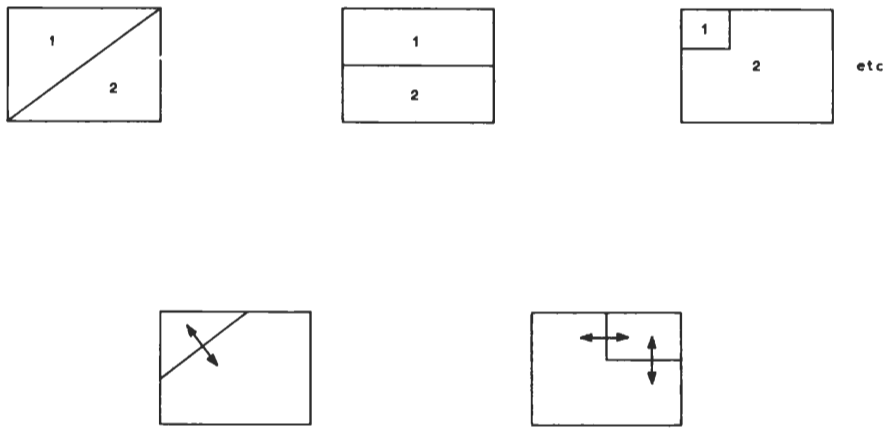

Fig. 3. Illustrating the wiping action possible using the split screen effects unit

Fig. 4 shows the block diagram of the mixer with the split screen effects unit added. This is the basic form of the mixer used in Outside Broadcast mobile control rooms.

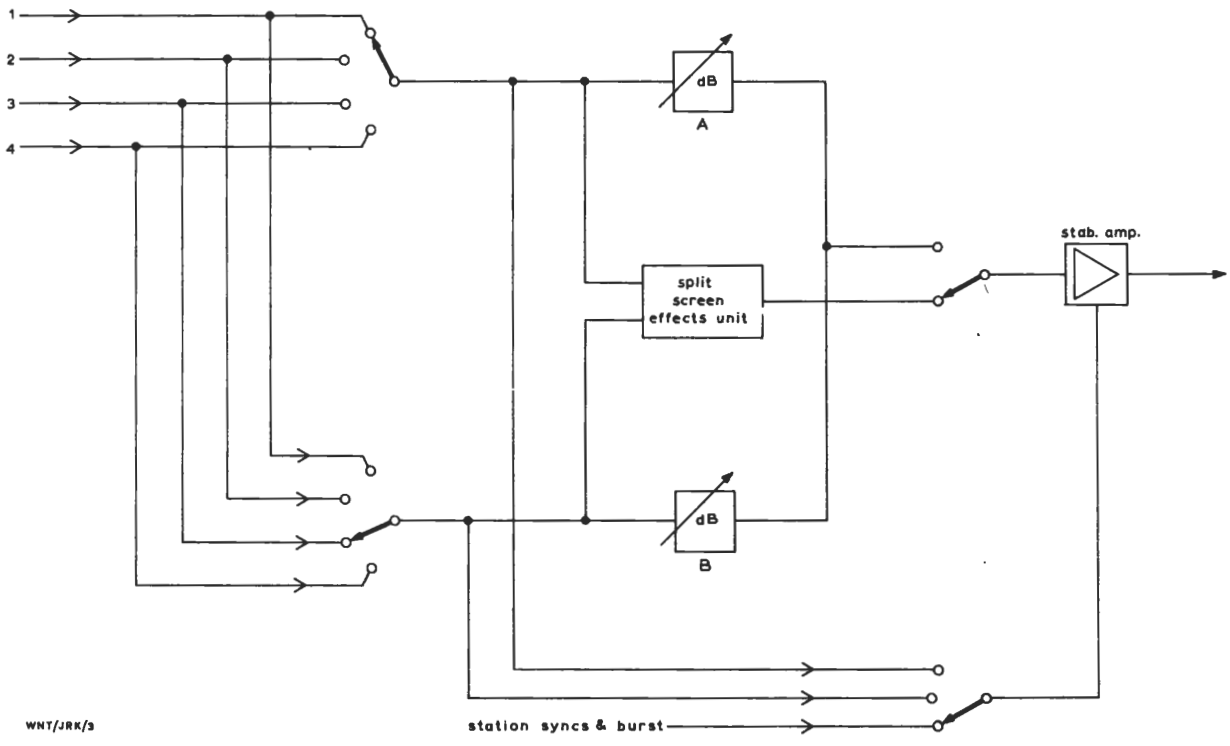

Fig. 4. Block diagram of simple mixer with split screen effects unit added

The O.B. type of mixer will now be discussed in more detail but only those units necessary for a basic understanding of the mixer video and sync and burst chains will be described. A more comprehensive description is given in the appropriate Technical Instructions listed at the end of these notes.

The studio type of mixer follows a similar plan but has extra facilities - principally a fader for each channel, in addition to the group faders - and a slightly different method of selecting syncs and burst. The studio mixer is described towards the end of these notes.

O.B. TYPE MIXER

A block diagram of the complete O.B. Mixer (MX1/501A) is given in Fig. 5. The mixer is similar to that shown in Fig. 4 but has two stabilising amplifiers fed in parallel. Their outputs are available at a change over switch, one amplifier being used for transmission and the second as a stand-by in case of failure.

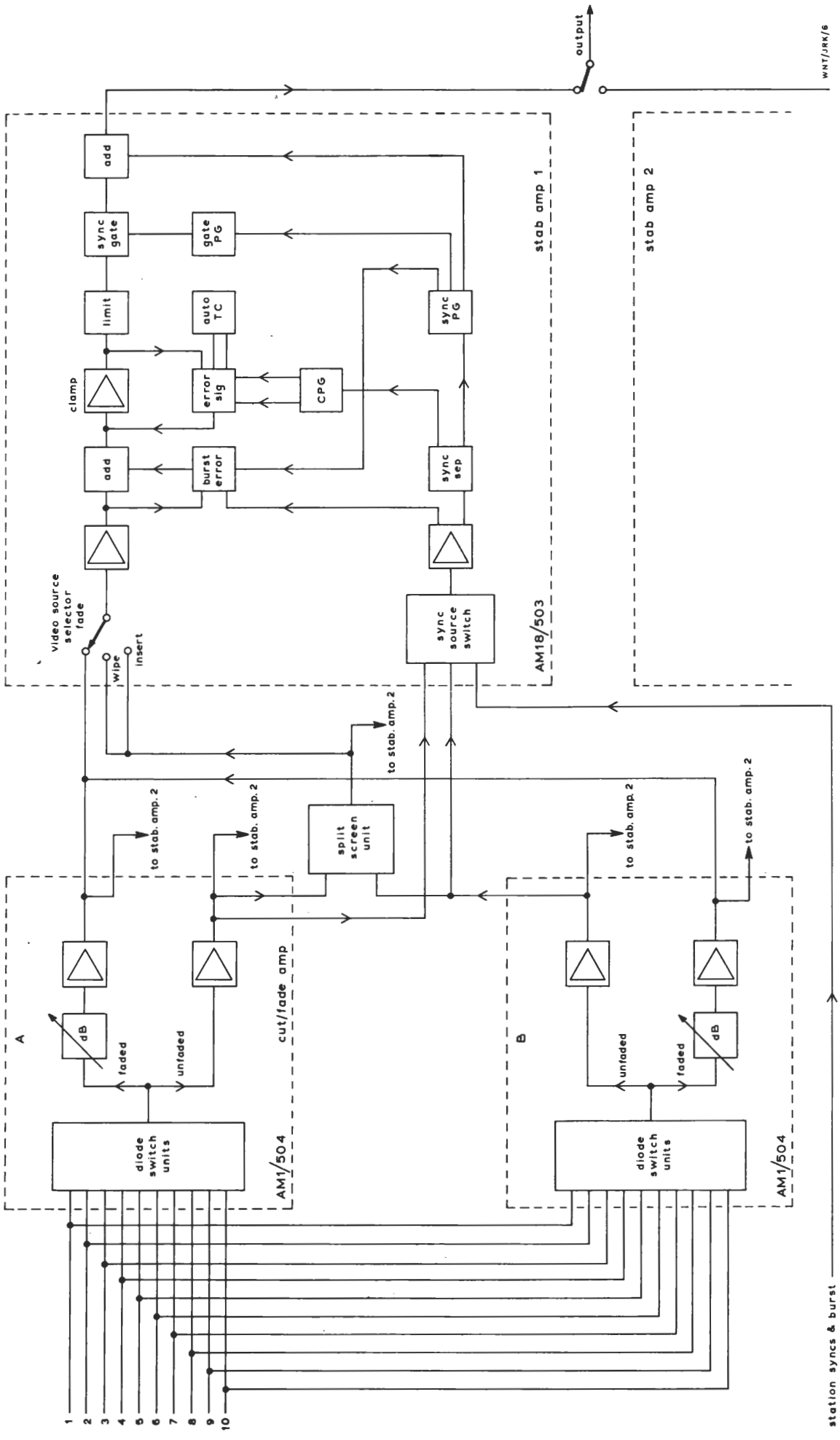

Fig. 5. Block diagram of O.B. - type mixer

Signal Path through the O.B. Mixer

The mixer accepts ten inputs, each of which is split and fed to the A and B diode switch units. (These replace the rotary switches of Figs. 1, 2 and 4.) The switches are so arranged that only one source may be cut-up on each group of switches at any one time. The output from the diode switch units is split to provide the 'faded' and 'unfaded' feeds. The term "faded" is a little misleading since it refers to the signal which is *about to be* fed to the fader.

Fader

The fader is basically a Wheatstone's bridge which produces no output when balanced. As the balance is upset by altering the fader an output becomes available.

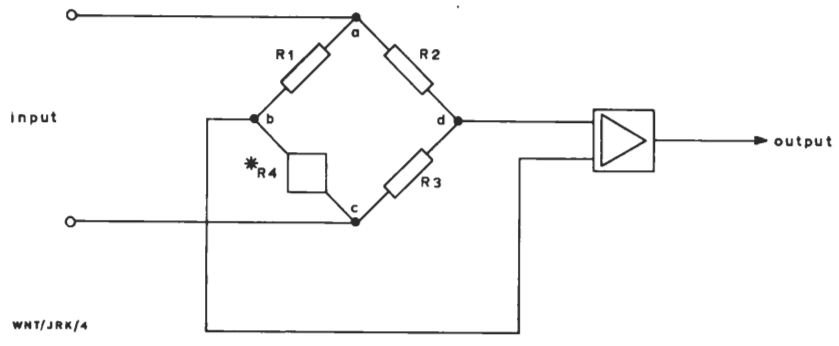

Fig. 6. Basic circuit of fader

R4 is the variable component of the bridge. When $R_1.R_3 = R_2.R_4$ the bridge is balanced and no signal exists between b and d. Thus there is no video output.

*R4 is in fact a diode bridge arrangement as shown in Fig. 7.

When y is made positive with respect to x the diodes are biased off and the resistance of the diode bridge between points b and c is approximately 220 ohms. This is the condition for ***no video out*** i.e. the video bridge is balanced.

As x is made ***more*** positive with respect to y the diodes begin to conduct and lower the effective value of R4. The video bridge thus becomes unbalanced and a video output is produced.

Unfaded Output

The unfaded output from the diode switch is amplified and fed to the split screen unit. Another feed is taken to the Stab. Amp. to provide syncs and burst for non-sync sources.

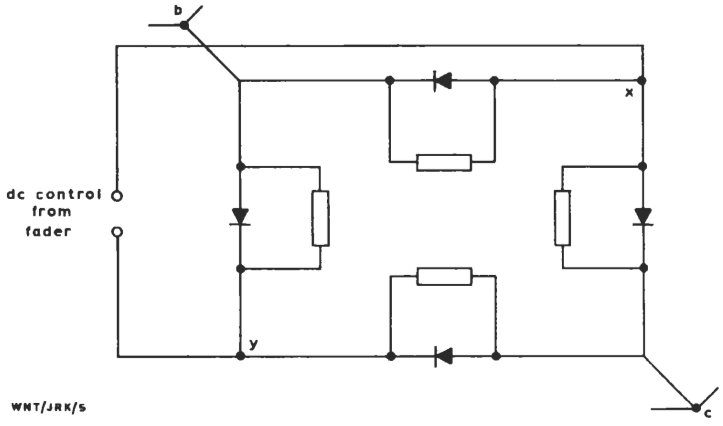

Fig. 7. Circuit of R4 in Fig. 6

Split Screen Unit

The inputs to the unit are the two unfaded outputs of the diode switches. The function of the split screen unit is to switch between these inputs to provide wipe facilities.

A simplified block diagram is given in Fig. 8 and applies to a corner wipe.

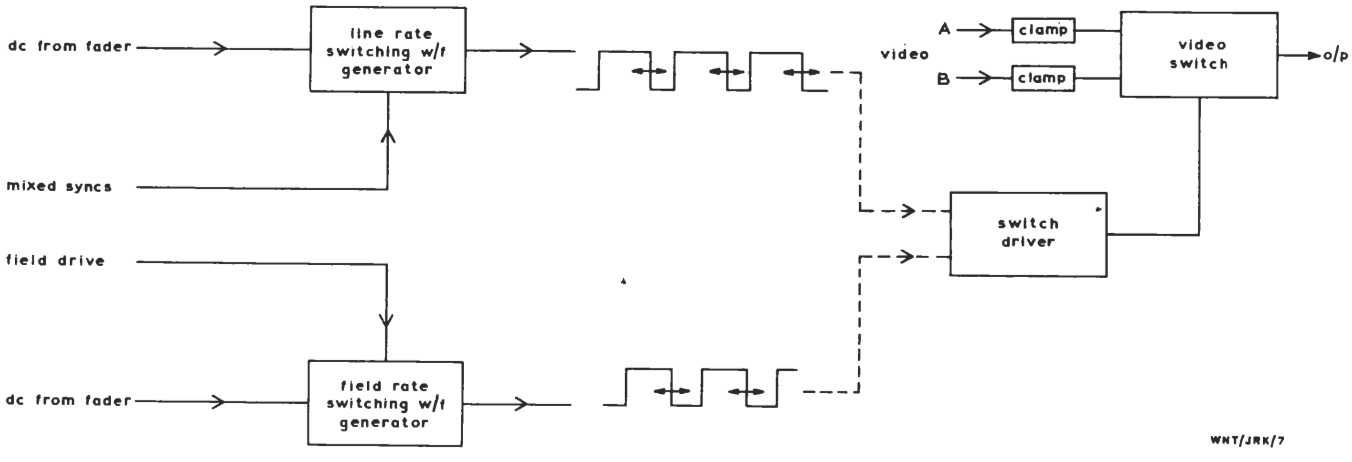

Fig. 8. Illustrating the action of the split screen unit in producing a corner wipe

The line rate switching waveform consists of line-frequency pulses of variable duration. The duration is controlled by the fader position. The waveform determines which video (A or B) should be fed to the output at any given instant during the line period.

The field rate switching waveform performs a similar function for the duration of the field period.

The two waveforms are combined to produce a corner wipe as shown in Fig. 9.

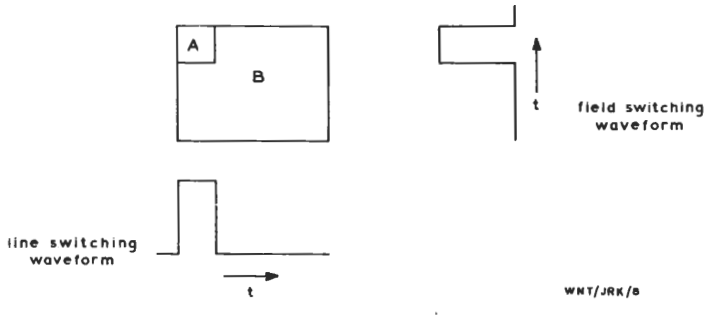

Fig. 9. Combining line-frequency and field-frequency pulses to give a corner wipe

Variation of the fader positions varies the d.c. feeds to the switching waveform generators. These vary the duration of the line and field pulses which together determine whether input A or input B should be passed to the output.

Line and Field "splits" are shown at (a) and (b) in Fig. 10: these are produced by suppressing the field or line switching waveforms respectively.

A diagonal wipe (Fig. 11) is produced by using a line rate switching waveform only, but altering the mark/space ratio as the field progresses.

Alternatively the split screen unit may be operated in the 'Insert' mode instead of the 'Wipe' mode.

In the 'Insert' mode the fader controls are locked and cannot be used for fading or wiping. A separate "joystick" is provided on the producer's panel which carries out all the wipe functions in place of the fader controls. The reason for this facility is that a 'wipe' can be pre-set on the joystick for a later part of the programme while the faders are being used normally. When the producer requires the preset wipe he throws the selection key from "fade" to "insert" and thus obtains the pattern required without having to adjust the shape whilst on transmission.

The output from the split screen unit and the output from the faders are fed to a switch operated relay at the input of the stabilising amplifier. This controlling switch on the producer's panel is the one which enables 'Wipe,' 'Fade' or 'Insert' mode to be selected.

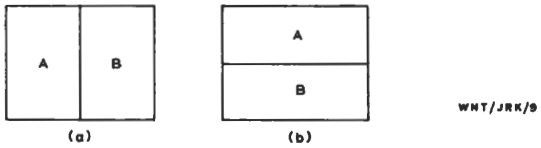

Fig. 10. Line and field splits

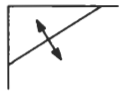

Fig. 11. A diagonal wipe

Burst Amplitude Stabilisation

To ensure that the burst amplitude is 0.3-V p-p regardless of the position of the faders, the burst on the incoming video is compared with the burst from the sync source switch. The video input to the video amplifier and the feed from the sync source switch are gated by pulses derived from mixed syncs. Two sets of burst are thus separated, one from the video (V) and the second from the sync source switch (S). Burst V is then subtracted from burst S and the resultant returned to the video chain. This produces a burst on the output video signal which is identical to that (S) from the sync source switch. It is essential that S and V are of the same phase in the comparator otherwise the correcting burst which is returned will be of the wrong phase and the resultant burst on the video will be incorrectly phased relative to its colour sub-carrier. The process is illustrated in Fig. 12.

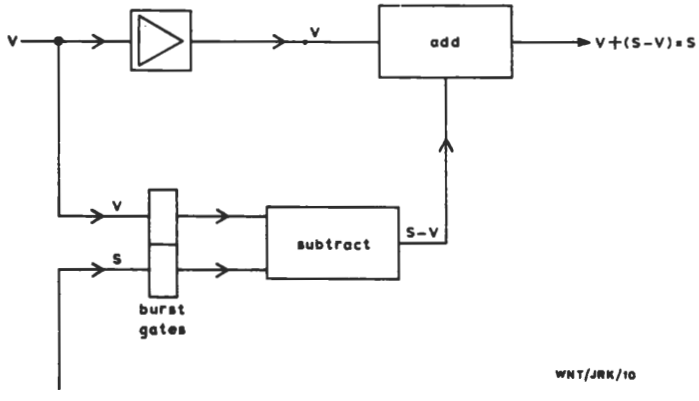

Fig. 12. Basic circuit of burst stabiliser

Clamp

The clamp is of the feedback or shunt type and a block diagram is given in Fig. 13.

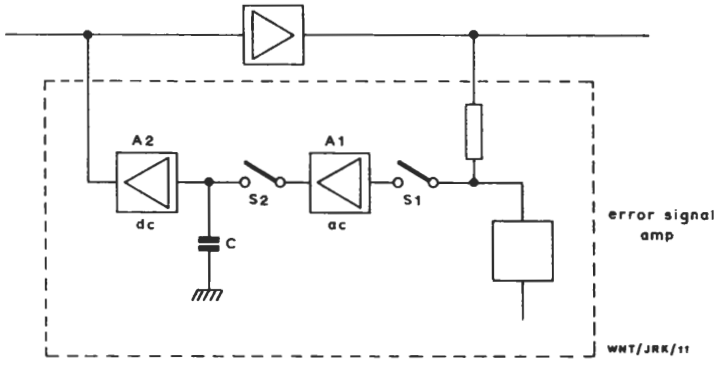

Fig. 13. Basic circuit of the burst error clamp

Diode switches S_1 and S_2 close during each back porch period, any voltage present being amplified by A1 and fed to the storage capacitor C. (A subcarrier filter is included to avoid disturbance by the burst.) The voltage across C is amplified by A2 and the correction is added to the video signal. Thus a feedback loop is established which continually corrects any error of back porch level.

The charge/discharge time constant for C is variable in order to make clamp 'softening' possible for noisy signals. The softening circuit may be controlled automatically if required by a unit (auto time constant controller) which measures the amount of noise in the back porch.

White Level Clipper

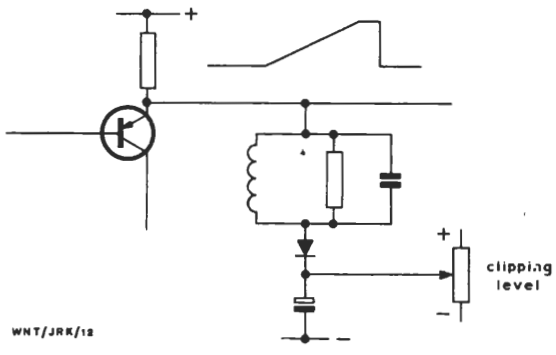

Fig. 14. Basic circuit of white level clipper

This circuit consists basically of a diode which prevents the video rising above a level predetermined by the clipper control. The tuned circuit prevents clipping of sub-carrier.

Sync Pulse Processing

After the signal has left the clipper the video and burst have been fully processed. The remaining function of the Stab. Amp. is to ensure that syncs are at the standard 0.3-V level.

The syncs already on the signal are not necessarily of a correct amplitude since the video may be faded or mixed before arriving at the Stab. Amp. The syncs are therefore removed completely and a new set added.

Sync Gate

The gate consists of two bridges of the type shown in Fig. 15.

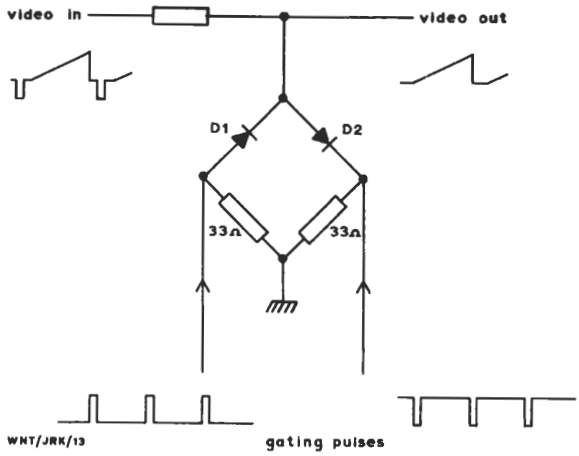

Fig. 15. Basic circuit of sync gate

The diodes are switched on for a period overlapping the sync period by pulses derived from the output of the sync switch (see Fig. 5). Thus the signal path is virtually short-circuited during the sync pulse period. (In fact a loss of about 26 dB is introduced by each of the two bridges).

Sync Adder

To produce the final composite output correct syncs must be added: these are supplied by the sync source switch and added as indicated in Fig. 16.

The resultant composite signal is fed to an emitter follower with an output impedance of 75Ω which provides a standard level video output.

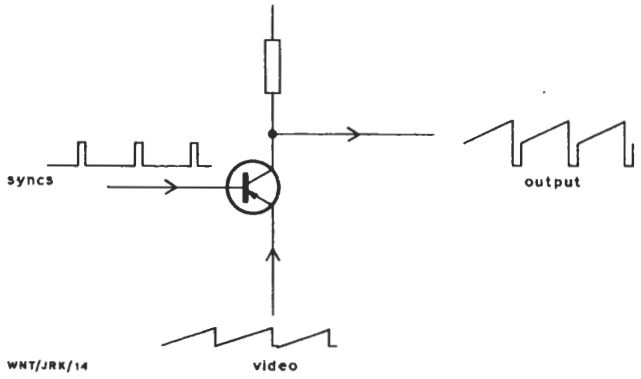

Fig. 16. Basic circuit of sync adder

Sync Source Switch

This unit ensures that the various pulse generators in the Stab. Amp. and the sync adder are fed with the correct syncs. (See Fig. 5.) A block diagram is given in Fig. 17.

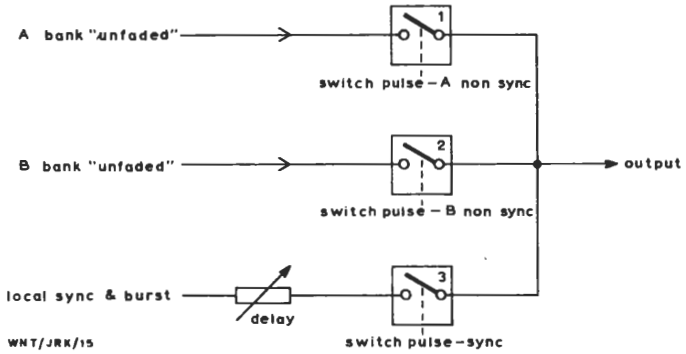

Fig. 17. Basic circuit of sync Source Switch

The delay ensures that local syncs and burst are correctly timed into the Stab. Amp.

One of the switches shown is always closed when a source is selected by the producer.

If the producer selects a synchronous source then the syncs and burst are routed via switch 3. If he selects a non-synchronous source on the A bank then the unfaded video is routed via switch 1. If he selects a non-synchronous source on the B bank then switch 2 is used.

As previously mentioned a non-synchronous source cannot be fed to the Stab. Amp. at the same time as any other source. If, however, the producer selects a synchronous source on bank A and then superimposes a synchronous source from bank B there will be no switch change over since both are synchronous and the syncs and burst will pass via switch 3.

STUDIO MIXER

The block diagram is given in Fig. 18. The video chain at the top of the diagram is similar to that of the O.B. mixer, the only major differences being:

(i) The provision of cut and fade for each channel.

(ii) The provision of two sets of group cut fade amps.

These differences in the video chain are responsible for the more complex syncs and burst chains.

Each channel can be faded individually. Thus unlike the O.B. mixer no 'unfaded' output is available. This means that syncs must be tapped off before the Cut/Fade amps and a bank of sync switches must be provided. The sync switches ensure that the syncs appropriate to the faded up video are passed on towards the Stab. Amp.

When the mixer was modified for colour working a feed of colour burst was required by the Stab. Amp. A further set of switches - the "Video" switches - was therefore provided. The switches ensure that the appropriate burst is passed on towards the Stab. Amp. (The switches also pass syncs and - for non-sync sources - video. Video and syncs are however gated out in the Stab. Amp. and only the burst is used.)

Thus the feeds of syncs and burst required by the Stab. Amp. are provided despite the lack of the 'unfaded' output.

The second major difference in the video chain is the provision of two sets of group cut/fade amps. The reason for this is that it enables the second Stab. Amp. to be used for providing pre-view monitoring facilities.

The two group mixers are each fed with:

(a) The output of the A channel mixer.

(b) The output of the B channel mixer.

(c) The output of the split screen switch.

In each group mixer a cut/fade amplifier is provided for each of these inputs.

The outputs of group mixers 1 and 2 are fed to Stab. Amps. 1 and 2 respectively.

Suppose that Stab. Amp. 1 is being used for transmission and Stab. Amp. 2 for preview.

Suppose also that the mixer is switched to "fade" rather than "wipe". The cut/fade amps associated with the split screen inputs to both group mixers are thus producing no output.

Although there are A and B cut/fade amplifiers in ***both*** the Group 1 and Group 2 mixers there is ***only one*** A fader control and cut button and ***only one*** B fader control and cut button.

The A fader and cut button operate the A cut/fade amplifiers in both the Group 1 and Group 2 mixers simultaneously. Similarly the B fader and cut button operates on both group mixers. However, when the A channel is cut up on Group 1 it is not cut up on Group 2. Similarly when the B channel is cut up on Group 1 it is not cut up on Group 2. Thus if the operator changes sources by cutting between A and B the transmission output will be the one fed via Group 1 and Stab. Amp. 1. Group 2 and Stab. Amp. 2 output will represent the source which the operator wishes to use next. He may thus select his next shot on the bank which is not on transmission (and is thus on preview) and then cut to it on the group mixer at the appropriate moment.

As stated earlier the description above applies when Stab. Amp. 1 and the group 1 mixer are in the transmission chain and Stab. Amp. 2 and the group 2 mixer are in the preview chain. Their function may be reversed - a useful facility in the event of failure in the Group 1 mixer or Stab. Amp. 1. Group 2 and Stab. Amp. 2 would then be used in the transmission chain and the faulty units used for preview.

The studio type of mixer thus provides more facilities than the O.B. type of mixer but at the expense of considerably increased complexity.

RELEVANT TECHNICAL INSTRUCTIONS

MX1/501A O.B. Mixer Handbook

EP5/502 Studio Mixing Equipment Handbook.

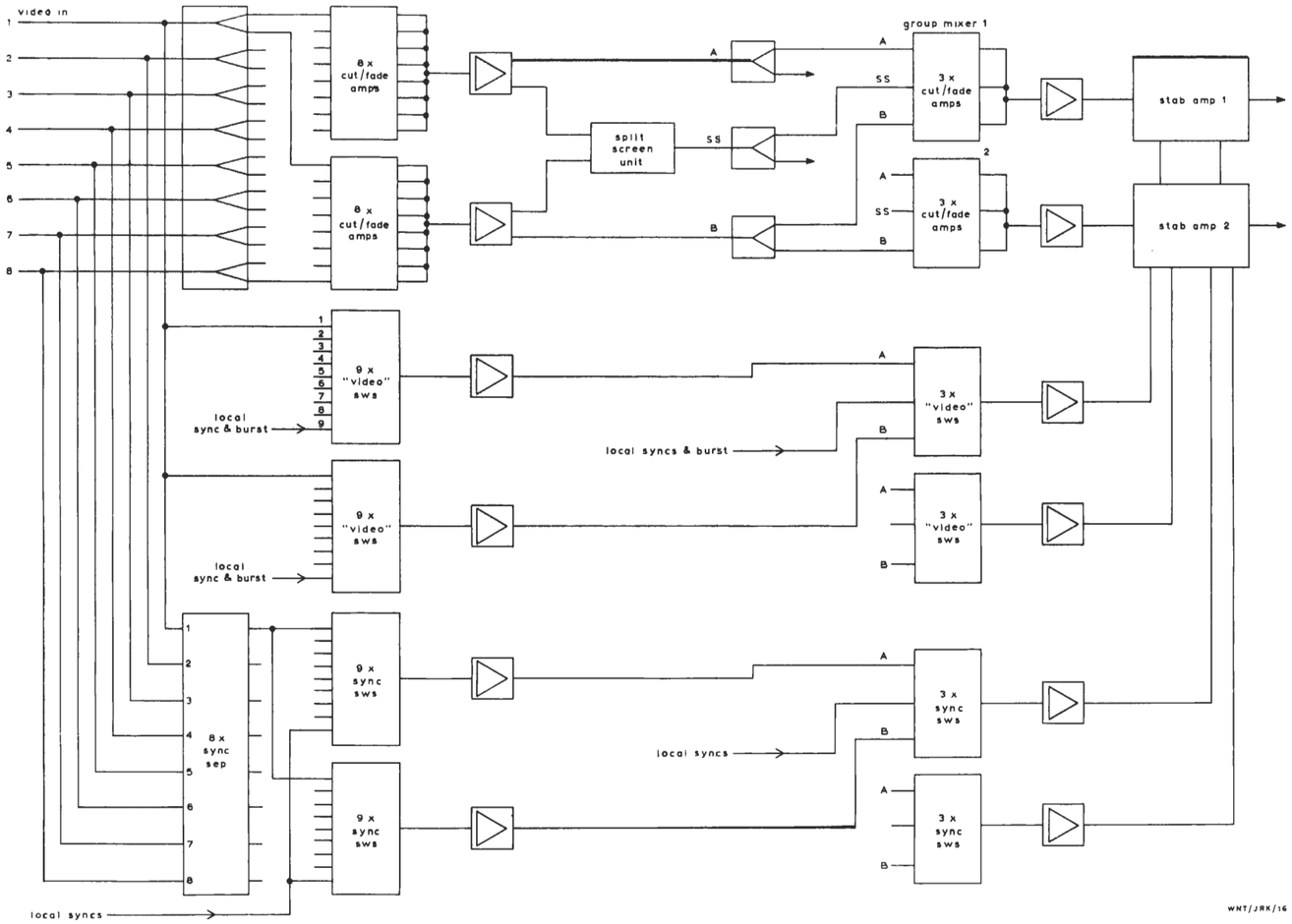

Fig. 18. Block diagram of studio mixer