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A NEW PRESENTATION SWITCHING SYSTEM

INTRODUCTION

The focal point of a television studio complex is the presentation area where the operation of tape, film, studio and other sources is co-ordinated to produce a complete day's broadcasting schedule. The presentation task is fundamentally one of switching programme sources to transmission in sequence to a rigid time schedule. Operational activity is peaky; there will be times during lengthy programmes with little activity followed by 'breaks' with great activity. During these 'breaks' several sources will be cued, started if machines, and switched to transmission in rapid sequence. A complex operational pattern will result particularly where machine control does not necessarily bear an event by event relationship with programme switching. A film projector required, for example, after a short slide sequence may be started before the slides are put 'on air'.

It is the timing aspect of presentation switching which creates most operational problems. Controls for source selection, audio/video transitions and machines have to be operated in proper and time interrelated sequence. Changes to the programme schedule, which can arise for several reasons, represent an additional hazard. Such changes will almost always require a last minute change of schedule timing. It may be necessary to drop or cut short, or possibly add an event.

SIMPLIFICATION OF OPERATION

Advantage can be taken of the peaky nature of presentation switching. Flattening of the activity curve will spread some operations from busy to less active periods. This may be achieved by presetting some switching operations during programme transmission, so that at the end of each programme simple operations only are necessary. The 'next channel' mixer configuration is a good example; next sources are preset and at the required time a 'take operation' is made, the 'take operation' being simply the movement of a fader or the depression of a cut button. This type of operation can be applied to both audio and video switchers and often a combined or married operation is possible. Interconnection of the mixer next channel circuits with machine control assignment can be utilized to provide a single start control which will start the next machine.

This type of simplification is well known and has for many years greatly assisted the presentation operator in his task. It has enabled more time to be devoted to the more important aspects of presentation, such as the co-ordination of programme timings and the introduction of a variety of video transitions appropriate to the linking of programme segments.

However, the growth of commercial operations, more complex 'breaks', and the ever increasing use of tape and film material, reduced the value of the 'next channel' system. It was evident that the presetting of a single 'next source' was not sufficient. More sources must be preset, and preferably sufficient to span a break. Simple stores have been designed to meet this requirement, the Marconi Eight-Event store[1] being a good example.

At an early stage in the development of this type of presentation operation it was realized that the capacity of the store could be extended. If transition and timing information were also stored the whole presentation operation could proceed automatically against time coincidences with the station clock. The system could be updated automatically from information prepared in advance and stored on paper tape. Furthermore, the tape could be punched simultaneously as a result of typing the daily routine sheet. Errors of interpretation of the routine sheet would be eliminated and the operator freed from routine tasks. This time could then be fully devoted to implementing last minute schedule changes and performing necessary manual functions, such as cueing and taking live announcements.

AN AUTOMATIC SYSTEM

At the time when stores of the above type were designed extension of capacity was not really viable, for two reasons. Firstly, storage equipment reliability was not obtainable at an economic price and secondly, the display of large quantities of stored information was not practical. The display problem is particularly relevant to presentation

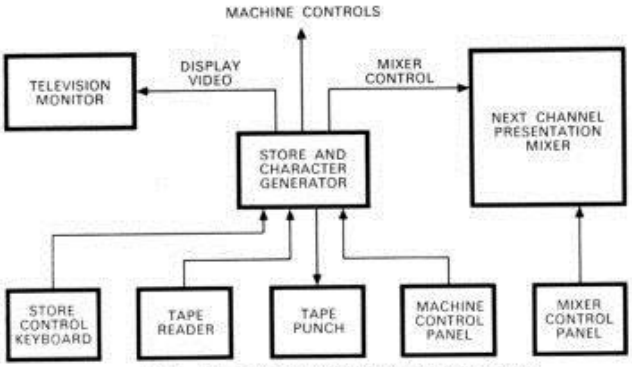

Fig.1 Automatic Presentation Switching System.

operations. It is essential that all source, timing and transition information for the next few events is on display, since this will be needed for adjustment by the operator when schedule changes or corrections are to be made.

The computer revolution of the sixties brought with it cheap storage systems and new display techniques. The integrated circuit was conceived and developed to bring about a new level of reliability to large computer systems. These devices, little more costly to make than transistors, opened up new horizons for the equipment designer. Integrated circuits became available in a wide variety of logical functions, each equivalent to complex circuits of discrete components. They were also fast and made possible the design of electronic character generators which could be used to display large quantities of information on standard television monitors.

In designing a new storage and display system to take full advantage of modern technologies first consideration had to be given to operational requirements. An essential operational feature of such a system must be simple man-machine communications. This has influence in two design areas. Firstly, the machine must accept simple instructions from the man. A control keyboard must execute functions with a minimum of key pushing. Access to the store for loading purposes must, for simplicity, be sequential, with overriding random access facilities for making schedule changes.

Secondly, best advantage must be taken of the available display capability.

Store contents must be displayed in simple tabular form, redundant information eliminated, and special symbols avoided.

The storage and display system should also form a separate equipment package. It should connect on to the mixer control circuits in such a way that full manual control is readily available for emergencies. The block diagram, figure 1, illustrates the basic system concept, while figure 2 shows the store and character generator equipment.

The mixer is a conventional next channel type with solid-state matrices used for both audio and video switching. The store and character generator controls the mixer in parallel with the mixer control panel, which is retained to provide full emergency override facilities. A special panel, the store control keyboard, is used to load the store and also, if desired, to make changes to stored information displayed on the television monitor. The machine control panel provides access to 'on air', 'next' and 'second event' machines; it is an emergency panel and may be used to override the automatic control system. The tape reader is used to update the store as events are taken on air. Tapes for future usage may be prepared via the system using the tape punch. Alternatively, if access to a computer is available, they may be made when the routine sheet is typed, the computer being used to translate to an acceptable form the necessary switching information from the typewritten schedule, a simple data processing function.

STORE CONTENTS

The contents of the store are displayed on a standard television monitor; figure 3e is a photograph of a typical display. The fifteen events on display represent from the top, 'on air', 'next', 'second', 'third' and so on to the 'fourteenth event'. As events are taken on air the display is rolled up in readiness for the next 'take' and a blank space will result at the bottom of the screen. This space

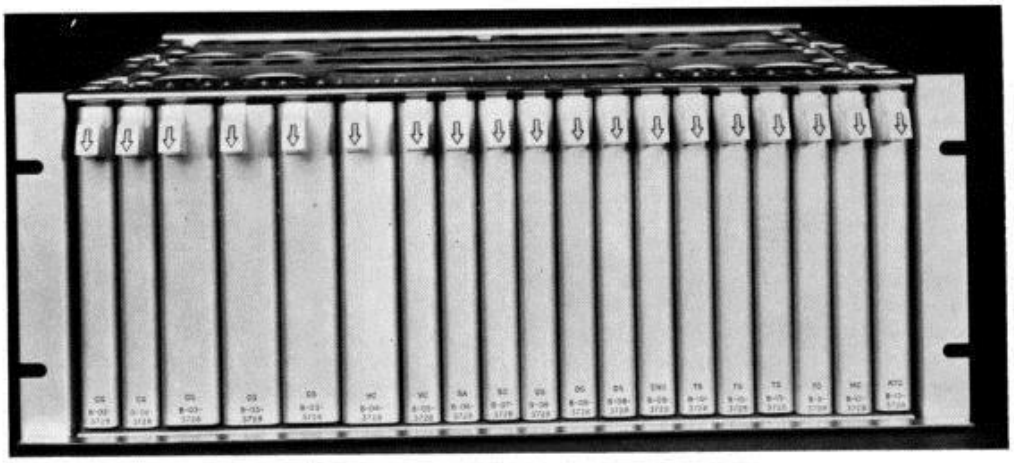

Fig.2 Store and Character Generator Equipment.

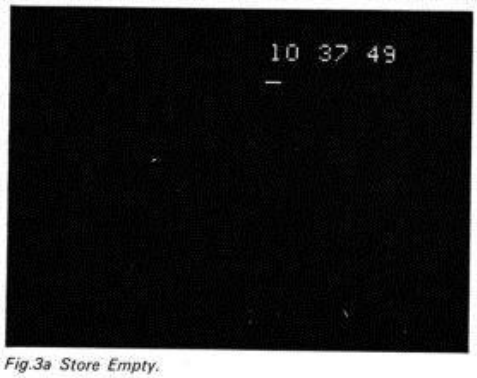

Fig.3a Store Empty.

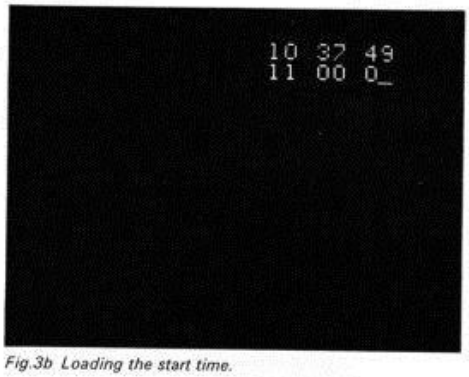

Fig.3b Loading the start time.

Fig.3c Ready to take first event.

Fig.3d First event taken.

Fig.3e Store full.

Fig.3f Open-ended event 012 ready to go on air automatically.

Fig.3g Event 013 ready to be taken manually.

Fig.3h Event 013 taken, time corrected to take time.

Fig.3 The Store Display.

will be automatically filled if tape control is used, or await the operator for manual reloading if not. In the case of manual reloading, a number of 'takes' may be made, then, at a quiet period, the resulting several blank spaces reloaded in readiness for the next break.

Each column of information display is backed up by corresponding store and logic circuit modules. It is therefore possible economically to regulate system complexity to suit particular requirements. Timing system modules may, for example, be omitted if automatic time control is not required.

The first column of displayed data consists of a three digit event number. This is used to reference the display to the original typewritten schedule. The event number reference has been chosen in preference to programme titles for simplicity, less information need be stored and is more easily loaded. Further, to store titles, twelve or so character spaces would be required which would clutter the display and leave less space for the more important switching information. The event numbers are also of use in control of the systems; they may be used to home a control tape to any particular location. This feature is particularly useful when the equipment is used in the tape checking mode. A desired tape location may be sought, checked and, afterwards, a simple automatic return made to the last 'on air' situation.

The second and third columns of the display represent video and audio sources for unmarried operation. For example, the 'next EVENT' 002, (3e), is Telecine 'A' Slide with audio from the announcer. Telecine sources are followed by a designation 1, 2 or S. This is to indicate film 1, 2 or Slide of multiplexed machines for control purposes.

Secondary video and audio sources may be written into the store for caption and audio over purposes when such events are made to occupy two display lines. The first line indicates the primary sources, the second line indicating the caption or audio over source required.

The next three columns of the display are used for time; hours, minutes and seconds. The upper line is true clock time. The following lines represent the time to go on air for each successive event. These times are derived from a summation of stored duration times referenced to the time at which the last programme was put on air.

The last column of stored data controls the video transition. A large selection of transitions are possible and, with the exception of CUT, a choice of three rates, fast, medium or slow is available to each. Transitions indicated include Cut, Mix, Fade and Wipe. The choice of wipe patterns is indicated by the second letter whilst the third indicates the transition rate.

TIME CONTROL

Time control of both mixer and machines is on a real time basis. The store and character generator includes a twenty-four hour clock which is operated normally from the television timing waveform. If, however, it is desired to slave that clock to the station clock, a feed of one second timing pulses to the equipment will take priority. Should the external pulse source fail, the clock will automatically revert to television timing to maintain operation.

As previously noted, timing information for each event is stored as duration time. On first loading the store for a day's programming, the start time of the first event is entered into a special memory location (Figs. 3a and 3b). The start time, partially entered will be 11 00 00. On entering the last 0, units seconds, the entry will be loaded into the special start time memory location of the store and removed from the display. The first event entry will next be made, the time inserted as duration time. Duration time, in this case thirty seconds, will be shown until the event entry is completed by the video transition entry. The display then switches to time to go on air, in this case the start time 11 00 00. To the start time the first and all subsequent event duration times are added to yield a display of the times to go on air for each event (Fig. 3c). The next picture, figure 3d, shows the display at 11 00 15, when the first event of the schedule has been taken on air. A space at the bottom of the screen is ready to take the next entry, figure 3e. The start time is updated following the commencement of the broadcast with the clock time at which each event in turn goes on air. Should it be desired to override the timing system the facility is provided to take the next event early, or 'hold' and take it late. When this is done the start time is corrected to take time and the display of times to go on air will be adjusted to show the new time scale automatically. Similarly, random access facilities may be used to change the duration time of any particular event. In this case the times to go on air for each event subsequent to the event modified will be corrected to the new time scale.

These inbuilt arithmetic features are particularly useful when schedule changes are made. An event required to have a fixed 'in time' can be made to occupy two display lines, the second line containing the fixed 'in time'. The fixed time will be observed for control purposes and all successive events will be related to this. Changes to preceeding event timings will be reflected as a difference between the calculated time to go on air, the first line of the fixed event and the 'in time' stated in the second line. The operator is thus warned of over or under run to the fixed 'in time' and can make further timing adjustments to obtain good continuity.

Coincidence between the clock and the time to go on air of the next event, the second line, causes automatic mixer operation. Machine control is obtained similarly, show and slide change signals resulting from time to go on air coincidence. Stop signals from the time to go on air of the following event and start signals from time to go on air are compared with clock plus pre-roll time. All events on display are surveyed for start signals, seven different pre-roll times may be intermixed. Start signals are initiated by the system as required by time rather than event order, an advantage gained

from the use of real time control. The pre-roll times can be programmed in one second intervals through the range zero to fifty-nine seconds.

In operation no regard need be paid to pre-roll requirements, pre-roll information is pre-programmed in the system on installation and will be called upon as source data requires it. It is possible to send to any source more than one pre-roll signal. This facility may be utilized to provide, by means of a second signal, an advance warning cue at say thirty seconds to go. The store and character generator design treats all sources as machines. Cues can therefore be fed to all sources irrespective of type.

An interesting feature of the time control system is the ability to handle open-ended events, figure 3c, event 012 and 020. When loading an open-ended event a cue time key is used for time entry. This key instructs the store that the duration time of this event is unknown. A star will be shown in the tens hours location until the event entry is completed. The time entry of the first open-ended event will then switch to time to go on air (event 012), while further open-ended events will be marked by stars (event 020). Following events will be displayed with duration time since time to go on air cannot be derived from the open-ended events. These entries are punctuated by stars to warn the operator that the first event of the series must be manually taken (Fig. 3g).

When taken, the clock time will be noted and the time display corrected to show times to go on air relative to this time (Fig. 3h). The take time in this case was 12 36 25 which will put event 014 on air at 12 36 40 following the 15 seconds of the event 013. The second open-end event (020) is now shown to have a time to go on air. Following events will remain in duration times until event 021 is manually taken.

STORE CONTROL

A typical keyboard is shown in figure 4. This has been designed for the control of a sixteen input presentation mixer. The manual control panel for the same mixer is shown in figure 5. The keyboard is labelled in mixer terms. A complete entry of source information, for example VTRB, is entered from a single key. Each entry is stored as a binary number corresponding to the mixer input connection carrying that source. The stored data is therefore compatible with mixer control requirements, all that is needed is to translate the stored numbers to source abbreviations for display. This function is provided by character selector modules which allow four character identities to be allocated to each source. A full system requires three character selector modules, one each for audio and video sources, the third for video transition. A matrix of plugs on the modules represent four character locations for each identity and also each character available in the character generator. Programming of the display is done by patching character locations to desired characters to form the abbreviations. Later changes to identities are simply made by repatching the character selectors.

Numerical information, time entries and event numbers are entered sequentially from keys labelled 0–9. This data is stored and passed directly to the character generator for display. Other keys select video transitions and the rate of transitions. Provision for a selection of audio transitions is not provided; audio is always faded at a fixed rate to silence and back to the next source. If it is desired to hold the same audio over from one event to the next the word HOLD is inserted in the audio column when audio fading action will then be inhibited.

The remainder of the keys control the tape punch and reader and also provide for positioning the cursor when changes are required. In normal operation the cursor seeks and identifies the next empty location of the store to be filled and appears as a dash in the display. On entering timing information the entered duration time is shown until the event entry is completed by the video transition information. A switch is then made to the calculated time to go on air. The duration time of an event may be reshown by shifting the cursor to any part of the chosen event. Cursor positioning keys, labelled with arrows to indicate the direction of movement, are used for this purpose. Movement of the cursor to any particular location of an event enables the stored data in that location to be changed. Two special keys, Cancel and Clear, will delete an event

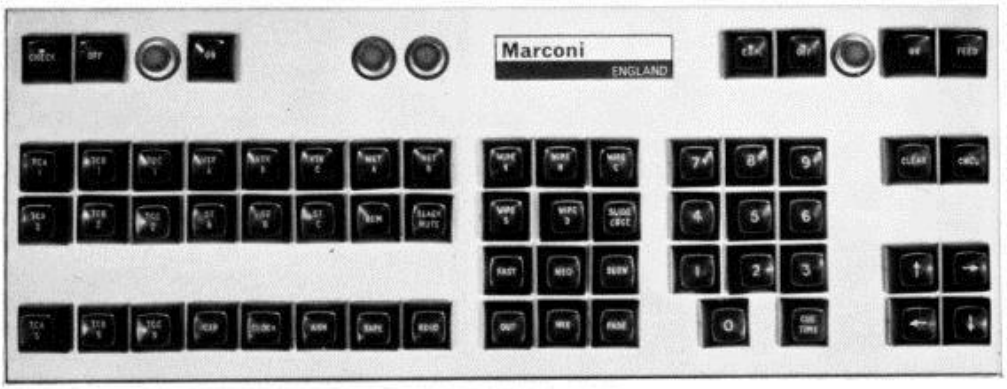

Fig.4 Store Control Keyboard.

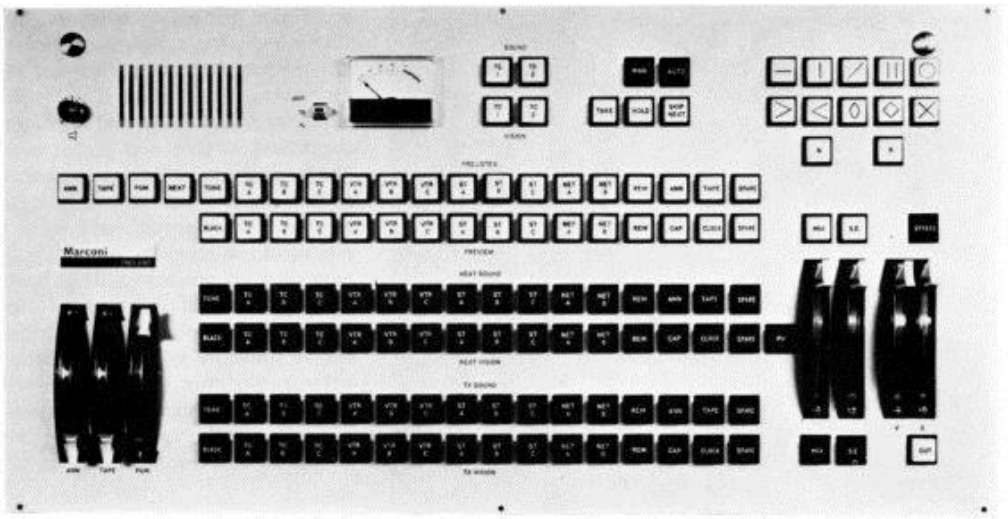

Fig.5 Presentation Mixer Control Panel.

or clear a space for a new event to be inserted. In the first case, Cancel, the event space is emptied and the duration time of that event changed to zero. This event will then be skipped out on reaching the next event location. In the second case, Clear, the accessed event and all following events are moved down one space to allow the entry of an additional event. The fourteenth event is moved to a back space which is not displayed but will reappear following the next take. The back space has priority over both manual and tape entries to the fourteenth event and information will not be accepted from these sources until the back space is cleared.

TAPE PREPARATION

The store and character generator is capable of both tape preparation and checking in addition to presentation control. It is desirable to allocate a second equipment to this function since little spare time will be available on the presentation control equipment for tape preparation. The second equipment may be situated, with its own keyboard, monitor and tape equipment, in an office area for schedule preparation. Switching information for a future period is entered by the keyboard. The information may be checked and modified if necessary using the monitor display. When correct a punch key is depressed causing the data on the monitor to roll up and be punched onto tape. The last event punched will remain on display as a leader to the next entries. Information entry is then continued until again the screen is full. A second operation of the punch key will then punch this data onto the tape and this procedure is continued until the complete schedule is transferred to tape. The last event entry will be followed by an 'end' code which prevents the tape reader running on when the tape is read to the end of the schedule.

The check mode of operation is most useful in the presentation area as it enables a quick check to be made of events ahead. Operation of the check key causes the display to roll up one event every five seconds irrespective of the stored timing information. Whilst in the check mode control of both mixer and machines is disabled. On return to normal operation the tape will be automatically homed to the last 'on air' situation. Mixer and machine control conditions will then be restored in readiness for the next take.

Although, so far, the use of paper tape for bulk schedule storage has been discussed other media may be used. Paper tape is normally used since it is fast enough for normal operation. A whole event is made up of fourteen characters and occupies 1·4 inches of tape. This will be read into the store from a simple reader in about half a second.

This speed is more than sufficient to maintain a 'store full' condition since the shortest duration time which may be specified is one second. Alternatives to paper tape could be punched cards, magnetic tape, or similar systems. The equipment may also be fed on line from a computer.

A computer may be used for preparing the control information for the store and character generator. A programme may be written to enable the computer to extract and translate schedule information for presentation switching from a routine sheet prepared on a teletypewriter. Similarly the same facility may be obtained via a computer terminal. The switching information, this time, is received at the terminal in the form of a paper tape suitable for the control of the presentation equipment.

PROGRAMME SWITCHING

Both video and audio switching are done with solid-state matrices, each employing microcircuit crosspoints of the same type. The crosspoint is essentially a two-pole electronic switch controlled by an 'AND' gate which decodes binary control information. In the video case the two poles of the crosspoint are used for video and on air cue switching. For audio they are used for the balanced signal. The video matrix has been previously described in

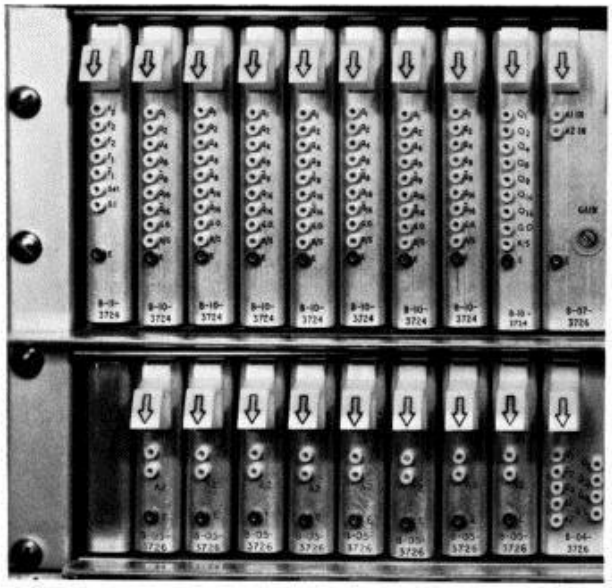

Fig.6 Audio Matrix (8 input x 8 output)

this journal.[2] The audio matrix, figure 6, is in all respects very similar. Matrices may be built up in quantities of 8 inputs by one output to a maximum size of 32 inputs by 8 outputs. Facilities also exist for the slaving of audio and video matrices. This may be achieved with some economy since the latching circuits of one matrix are then shared with the other.

The audio matrix will handle balanced sources peaking to +20dBM. The input impedance is high, 40kilohms bridging. An input transformer is not used – instead electronic common mode rejection is provided. A transformer coupled output circuit is employed. The output impedance is 50 ohms balanced and floating, and is suitable for driving long cables terminated in 600 ohms. An alternative output amplifier for the audio matrix offers a remote fading facility. An exponential fade is obtained from a linear 5V ramp signal applied to the control input. Both amplifiers feature preset gain adjustment control with ±3dB range for output balancing purposes. The fading amplifier may be used in the matrix or separately for automatic programme fading.

A wide variety of programme switching and mixing facilities are available for presentation purposes. Compatible modules may be assembled together to provide a multitude of video transition and signal processing functions. Individual specifications are met by special purposes logic modules designed to integrate the control of transition and processing equipments. Two logic modules are generally required. The first is a digital logic module controlling cueing and preset control functions. The second, an analogue logic module, allocates control signals from either fader paddles or electrically derived ramps to control transition and processing equipments. An additional logic module may also be employed. This feeds back to the automation equipment manual changes made at the mixer control panel. The store display then shows the state existent due either to manual or automatic control of the on air and next events. The use of this module will enable a simple printer, connected to the automation equipment, to record all transmitted events.

CONCLUSION

The design of an automatic presentation switching system has been discussed. The special purpose store and character generator described has much to offer over systems designed purely round computers. The hardware necessary for automatic control, being purpose designed has no redundancy factor and integrates completely with presentation mixers of various types. The requirement of special purpose interface equipment is eliminated. Thus a complete system will typically be assembled in only one equipment bay.

The equipment may be used not only for presentation control but also for the assembly and verification of schedule information for future use. Comprehensive facilities for manual override of the automatic control are provided, as are also facilities to change the schedule.

ACKNOWLEDGEMENTS

The author would like to express his thanks to all colleagues who have contributed to this project. In particular he would like to thank John Wood whose ability to translate complex logic requirements to simple hardware is well demonstrated by the small size of the store and character generator.

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