H. MIRZWINSKI, B.Sc (Eng), A.M.I.E.E

UNISELECTOR SWITCHING PANEL

One usually associates uniselectors with the hustle and bustle of automatic telephone exchanges, and their appearance in television may be viewed by some engineers with a trace of suspicion. The potentialities of the uniselector as a large capacity vision switch have been realized for some years, and as far back as 1956 Marconi engineers designed a simple uniselector switcher for industrial television. But in television broadcasting only the past few years have created an ever-increasing demand for larger and more sophisticated switching equipment. Gone are the days when a master control consisted of a couple of rotary switches and a patch panel! The facilities, which seemed ample even yesterday, today are being proved completely inadequate. A studio centre of even a modest size may require switching of up to twenty-five inputs to two or three transmission lines and several internal monitoring circuits. Simultaneous switching of vision, sound, control and cues is usually required. The equipment should be compact, inexpensive, very reliable and easily adaptable to automatic operation. Control panels should be simple and contain only passive elements.

Modern vision mixers for studio use usually employ relay or semiconductor matrices, but extending the same technique to larger switchers having more than a dozen inputs would be uneconomical on the grounds of cost and space. Also the high standard of performance required today becomes more difficult to achieve as the size of the matrix increases. Long input and output buses create problems of equalization of high-frequency response and delays. The vision crosstalk also becomes marginal, because in a matrix it increases with the number of inputs and with the number of outputs taking the wanted input.

ADVANTAGES OF UNISELECTORS

In view of these problems an effort was made to find a new technique and an alternative switching element which, by virtue of its construction, will lend itself better to larger switchers. The choice fell on the standard type of Post Office uniselector (see Fig. 1) which proved to be very satisfactory from all standpoints. The experience gained during long years of development and service in automatic telephone exchanges has made the uniselector an extremely reliable unit. Its price is also very attractive due to a very large demand and highly developed manufacturing techniques. Compared with relay or semiconductor matrices giving the same facilities, the price per crosspoint of the uniselector is considerably lower.

The small volume of the uniselector makes it ideal for compact packaging. The semicircular contact layout makes the signal path from all inputs to output short and constant, which is, of course, of a particular importance in colour switching. The capacitance between the contacts on a uniselector level is very small, less than 0·5 pF, which makes possible a high crosstalk isolation between the inputs. Moreover, in the uniselector, which is basically a rotary switch,

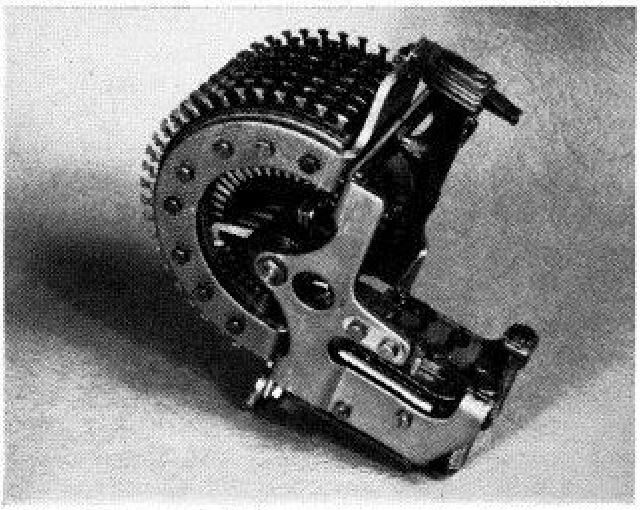

Fig. 1. B.P.O No. 2 Uniselector.

crosstalk is of importance only between the adjacent contacts.

The list of advantages is really impressive but the uniselector, as everything else in this world, is not perfect. One of its shortcomings is the acoustic noise, and the second is its finite switching time in the region of half a second, if it has to move right round. The acoustic noise is not really a very big disadvantage since it can be appreciably reduced by a suitable housing, but its switching time makes it unsuitable for studio mixer use. In many applications a time delay of half a second is of little consequence, but when an on-air switch is required a pair of uniselectors is used on a preview/transmission basis, so that an instantaneous cut can be made between the two uniselectors.

Of the many types available, B.P.O No. 2 uniselector was chosen because of its ruggedness and long life expectancy, about 100 million steps. Assuming that the switch is operated every two minutes for eight hours a day and that each operation is on average equivalent to twelve steps, then during the year the switch will make just over one million steps. At this rate the uniselector will last about 100 years, a round figure which should satisfy even the most far-sighted user.

UNISELECTOR SWITCHING PANEL

The advantages of the uniselectors were put into practical use in the Uniselector Switching Panel BD932. It is probably the world's first commercially available television switching equipment based on uniselectors. This fully transistorized unit is designed to give four independent outputs of sound and vision from twenty-five inputs. An alternative edition caters for sound switching only. Both editions of the Uniselector Switching Panel are used in applications where a separate sound and vision switching is required.

The heart of the unit is formed by four B.P.O No. 2 uniselectors. Each uniselector is an eight-level twenty-five-position rotary switch. Two of its levels are used for vision, two for sound, two for control and cues and two levels are unused.

VISION AND SOUND CIRCUITS

The simplified circuit diagram of the vision paths is shown in Fig. 2. Each of the twenty-five inputs is split four ways in a minimum-loss resistive pad and is fed to the four uniselectors via miniature coaxial cables terminated at the far end by 75 ohms. All cables from the splitter pads to the uniselectors are of the same length to make the delay constant. The resistive pads isolate the capacitance of the uniselector wipers and of the output circuitry from the input lines. By this means a good resistive input impedance of 75 ohms $\pm$ 2% to 6 Mc/s is maintained irrespective of the number of outputs taking the same input. The 12 dB loss of gain introduced by the splitter pads is restored in transistor output amplifiers. The overall frequency response of $\pm 0{\cdot}25$ dB to 7 Mc/s and not more than -3 dB at 10 Mc/s is obtained. The output impedance is 75 ohms ± 5 ohms to 5 Mc/s.

The uniselector wipers are connected to the output amplifiers via muting relays which replace the outgoing signal with sync whilst the uniselector is in motion. This prevents a quick succession of pictures appearing at the output as the wiper passes over the level contacts.

In the Uniselector Switching Panel vision crosstalk

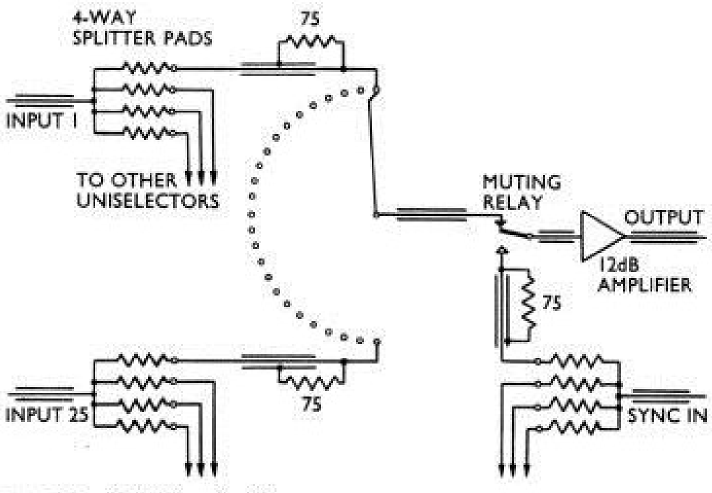

Fig. 2. Simplified vision circuit.

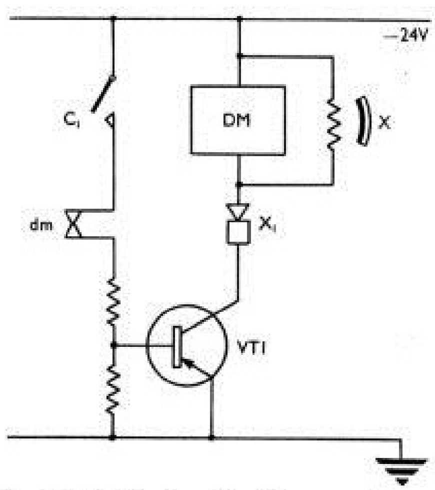

Fig. 3. Uniselector transistor driver.

is independent of the number of inputs and of the number of outputs taking the same input. An excellent crosstalk isolation ratio of 50 dB at 5 Mc/s is obtained. This is partially due to the mechanical construction of the uniselectors and partially to splitter pads which provide 24 dB isolation between the outputs. Thus crosstalks in separate uniselectors do not add up.

Another source of crosstalk—common earth impedance—is eliminated by joining together all outers of the input coaxial cables on the uniselector banks and earthing them solidly at one point only.

Sound circuits are completely passive. The twisted pairs of balanced sound inputs are looped over the levels of the four uniselectors. A sound muting relay operates in parallel with the vision muting relay. On larger installations sound inputs may be looped over several panels.

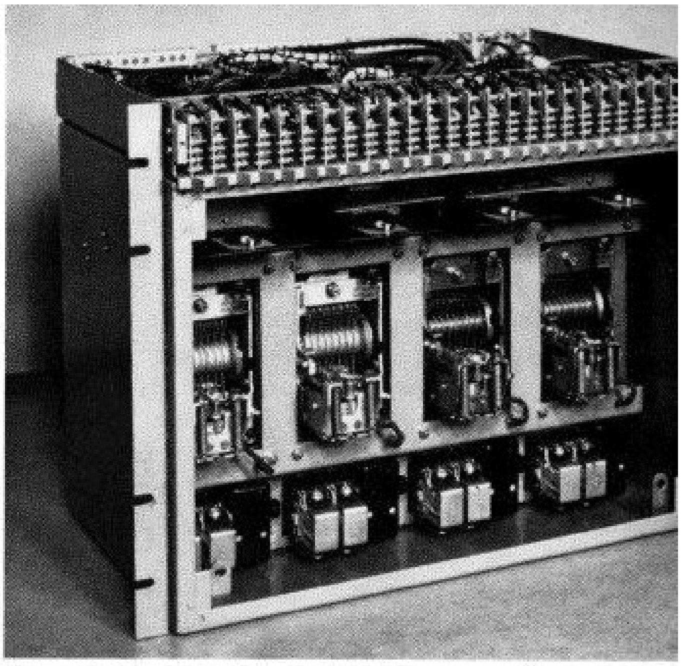

Fig. 4. Uniselector switching panel front view.

CONTROL AND CUE CIRCUITS

In the Uniselector Switching Panel great attention has been paid to suppression of internally generated interference due to breaking of current. This interference is liable to produce "flashes" on the vision and "crackles" on the sound. This problem of suppression, common to all switchers, is more acute in the Uniselector Panel due to a low level of switched vision and very high operating current of the uniselector coil. Luckily the uniselector has only one actuating mechanism which can be suppressed by more sophisticated means than, for example, a row of relays which have to be treated individually. Moreover, during the movement of the uniselector, outputs are muted, so that the movement cannot be seen or heard. Hence the interference is of importance only in so far as it affects the neighbouring uniselectors which may be feeding a transmission line. The problem of interference was solved by providing transistor drivers for control relays and uniselector coils. Currents interrupted by contacts are reduced by the gain of the transistor and by this means the suppression of contacts is more efficient and the interference completely eliminated.

The circuit of the uniselector transistor driver is shown in Fig. 3. DM is the uniselector coil, dm uniselector interrupter contact and C1 control relay contact. Normally C1 is open, transistor VT1 cut-off and the uniselector coil unenergized. When it is desired to move the uniselector to a new position the control relay is energized, C1 closes, VT1 saturates and the uniselector steps under the control of its interrupter contactor dm. When the uniselector wiper finds a marked position on the control level, control relay is released, C1 opens cutting off VT1 and stopping the uniselector. Contacts C1 and dm break only the base current of VT1 and not the full current of the uniselector coil, therefore their suppression with the usual RC networks is very effective.

To protect the uniselector in case of a fault in the external control circuit or failure of the driving transistor a thermal cut-out X is connected across the uniselector coil. If the uniselector hunts round for more than about forty-five seconds, the thermal cut-out operates and X1 breaks the supply to the coil. When the fault is rectified the supply can be restored by pressing a reset button.

The control relay is driven by a transistor connected in a circuit configuration similar to VT1. The sound and vision muting relays are operated by a control relay contact so that, during the movement of the uniselector, sound and vision outputs are muted. Several contacts of the muting relays are brought out to the output enabling any of the external cue circuits or displays to be muted.

Right from the beginning it was envisaged that the Uniselector Switching Panel will be used for a variety of switching applications where the control and cue requirements may be different in each case. Past experience has shown that the needs of master controls, presentation mixers, etc, cannot be met satisfactorily by a "standard equipment". The best the designer can do is to produce a range of "flexible bricks" from which any system can be built up. The Uniselector Switching Panel is intended to be one of such "flexible bricks", therefore only the minimum of control circuitry is included in the unit, the rest being provided on a control panel or other external units designed specifically to customer requirements.

The basic control circuit is designed in such a way as to give complete freedom as to the type of the external control used: manual or automatic, locking or non-locking buttons, "single-button" or "two-button" type of selection. Very often in television switchers much of the complexity and cost lies in the control and cue wiring. In the Uniselector Switching Panel a new approach to the problem has yielded a simple solution: the same wire is used for control, cues, additional displays and other auxiliary circuits. This saves on the interwiring between the panel and external units. Cues are fully revertive, that is, they show where the selector really is. The operator must feel more confident when cues reflect the real state of the switcher and not merely his wishes, as would be the case with cue information derived directly from the push buttons.

Two control levels from each uniselector are brought out separately to the output. This permits alternative control button arrangements. In "single-button" selection a separate button is provided for each input and only one control level is used. Interlocked or momentary contact buttons can be used. In this latter case the button has to be held down until the uniselector has reached the selected position. In some applications, where the control panel space is limited, it might be more convenient to use "two-button" selection. Inputs are coded according to their origin, e.g. Studios 1 to 4—S1 to S4, Videotape machines 1 to 3—V1 to V3, etc. The control buttons are arranged in two groups corresponding to letter and number codes. The contacts of one control level are linked in groups corresponding to letter codes and connected to letter buttons. Similarly, contacts of the second control level are linked in groups corresponding to numbers, i.e. S1, V1, etc. For greater flexibility the group wiring of the control levels is carried out on the output terminal blocks of the unit, in this way any grouping which will satisfy the needs of a specific installation can be accommodated.

The Uniselector Switching Panel requires two separately fused feeds of unregulated 24 V DC. The supplies on the panel are split in such a way that a fault on any part of the unit will not render all outputs inoperative. Two simple zener diode regulators provide 16 V to vision amplifiers.

MECHANICAL CONSTRUCTION

The four uniselectors with associated relays and output amplifiers are enclosed in a dust-proof box. This unit giving four independently selected outputs of vision, sound and cues from twenty-five inputs, which is equivalent to 100 crosspoints, occupies only 14 in. in a standard 19-in. rack. In spite of this compact packaging the accessibility is excellent and the layout allows ample room for servicing. All relays are of wire contact comb-operated plug-in type. The vision output amplifiers and the transistor relay drivers are printed circuit plug-in boards. Removable front and back covers are provided for ease of maintenance. All input coaxial cables are soldered directly to the splitter pad assemblies and all other wires are brought out via taper pin solderless connectors.

Great care has been paid to dust-proofing because, in the interest of contact reliability, uniselectors and relays must have a dust and lint-free environment. The dust-proof housing is of special value where the equipment is installed in newly erected buildings, when the installation engineer very often works in company with plasterers, carpenters and painters. The contact reliability of uniselectors is further improved by gold plating. The dust-proof box performs one more important function: it provides a very effective damping of acoustic noise generated by moving uniselectors.

Fig. 4 shows the front view of the Uniselector Switching Panel with the covers removed. In the front view at the top of the unit a cover plate is removed to show the construction of the splitter pad assembly. Each pad is mounted on an individual plate which can be withdrawn to facilitate soldering of the input coaxial cables. The use of taper pins besides providing a very compact output terminal layout cuts down the installation time. All the inter-connecting cables can be made in the factory with taper pins machine-crimped onto the wires. On installation the pins are simply pushed into appropriate taper pin blocks by means of a special insertion tool.

CONCLUSIONS

The Uniselector Switching Panel offers the maximum performance at the lowest cost. Its economic advantages are more apparent in larger switching systems having more than a dozen inputs. An article in a future issue of *Sound and Vision* will describe various applications of this unit. Here it is sufficient to say that relay or semiconductor matrices can be replaced with advantage by the Uniselector Switching Panel everywhere, except in cases where a preselection time of up to half a second cannot be tolerated.