The Technology of the Light Console

by Brian Legge

At the ABTT Trade Fair, 1995, Frederick Bentham, Paul Weston and the writer found themselves continuously explaining the functions of the Drury Lane Light Console. The concept was, and remains, unique and is important for its influence on subsequent developments. The immediate successor was the Console-Preset perhaps better known as System CD. This was made in considerably greater quantity than the Light Console, the first theatre model being for the Palace Theatre, Shaftesbury Avenue.
For the benefit of those who have not seen a Light console perhaps it is useful to explain that it looks like a console for a pipe organ for a single screen super-cinema (it was rather too colourful for a church). However an organist would be somewhat confused by the octaves of 17 notes instead of the long-established, 12.

Quite a few of the original Light Consoles still exist in the Theatre Museum store, on display in their original theatres, or in the hands of individual enthusiasts, such as James Law. However none of the key part of the technology of the whole, the cross-bar relay, are known to survive. These were contained in unpolished wooden boxes essentially located near to the magnetic clutch operated resistance dimmer banks, and as such were not perceived as desirable relics. Some of the similar-looking memory boxes which, if fitted, were essentially located within or near the Light Console itself, have been preserved - these are more common because they were also used in System CD (also Systems B,C and C/AE). That they have been kept is probably out of respect for the concept, and the execution. Those Light Consoles without memory boxes, including that for Drury Lane, had manually set 2-position switches in the rear (1728 of them to be precise).:

Without a crossbar relay there is no clue to Light Console technology. This was the essential multiplex link between the "front end" and the dimmer bank. There are no complete wiring diagrams, because none were ever drawn - they were neither necessary, nor even useful, for manufacture. If there had have been, they would not really reveal how it worked, because essentially the Light Console technology was electro-mechanical. Add to this is the fact that all the considerable amount of control wiring was in the same colour (or non-colour which is the best description of double cotton covered insulation). This was also in tied cable looms where the only specific identification of a conductor was the precise location of both ends of the same wire. The remote control cable was also a tied cable, so the length was critical, and had but one wire for each channel, plus relatively few others associated with submasters,
known collectively and colloquially as "odds”.

All control wiring of console, cross-bar relay and dimmer bank(s) terminated at a test board with a wire of every cable loom threaded through a hole and soldered to a column of wide staples. A cable loom usually had two or more branches to different columns of staples. Every staple had at the minimum an "in" and an "out" wire. Nowhere did any component have more than one wire to a terminal; any joint was made at the testboard. The only exceptions to this rule were common power supplies of + and - 17V DC.

The explanation of the lack of specific record was not commercial secrecy, or deliberate mystique, but that a complete Light Console (and CD) was in fact manufactured by two different companies – The Strand Electric and Engineering Co. Ltd for the heavy hardware, and The John Compton organ company for what could be described as the hardwood. The two very different contributions did not always meet until they were joined on site. Without wishing to detract from the contributions of past colleagues in Strand's Power Road, Gunnersbury factory, the term "manufactured" in respect of the Compton share should be "crafted" because, following pipe organ tradition, this was all executed by just one man. His signature is to be found somewhere inside. "All" includes everything from choosing the grain

of the timber in the woodyard, constructing each keyboard all from the same piece of seasoned wood, to total manufacture of the intricate cross bar relay and memory boxes (if any), making his own cable looms and soldering all connections.(For a pipe organ he would form the pipes as well!) All of this under the benign eye of one Jim Pollard, who today would have the title of production manager. Jim's total record of a console, plpe or Light, was a narrow strip of wood about 75cm long which had every detail recorded upon its two faces. More than one church organ destroyed in the then not-so-distant war were totally rebuilt just from that strip of wood.

In circumstances described, the only people with an overview of the complete product were what would now be called the project engineer but then, if any title bestowed, the Inventor (Mr Bentham) or his assistant Paul Weston, and/or the writer for the last two Light Consoles.

What are the key elements of a Light Console? For each control channel there was a stopkey, or selector switch, the extended actuator of which was coloured white, red, blue, or green, and engraved with its channel name and number. These, which were only about 25mm wide were arranged in horizontal rows, curved in plan when a large number of channels, so that all remained within easy reach of a seated operator. Essentially within any one horizontal row there was a small gap somewhere near the middle, subdividing that row into Left and Right. Selecting a stopkey required very little ringer effort, and was also noiseless. Hidden from view behind the visible actuator were two electromagnets, if the front one was energised it would physically move the actuator downwards to select the channel exactly in the same manner as if it were operated manually; energise instead the rear coil and the channel would be deselected. The memory boxes, or the 2-way switches in the rear of the console, determined whether the front "on" magnet, or the rear “off" magnet was energised when a memory push was pressed (these were below the keyboard). Whether operated by hand, or by memory push, selecting a channel did that and nothing more - only when a submaster key was pressed would anything change. Pressing a submaster key would equally do nothing either if none of its associated channel stopkeys were selected.

The submasters were the keyboard, these keys were also self coloured white, red, blue and green in sequence, and excluding the "black notes” which were interleaved, there were 36 coloured keys, none of which have any other identification whatsoever! The specific identification was, as on a piano or organ keyboard, provided by the "black notes". The distribution of these were different from a music keyboard being 5:1:5:1:5. The single black keys divide the keyboard into Left, centre and Right subdivisions; the Left subdivision being the submasters for the channel stopkeys to the left of the gap, the Right block for those stopkeys on the right, and the centre subdivision for the Left and Right simultaneously.
Within any one subdivision there are five black keys centrally, these divide the subdivision into: 3 blocks of 4 coloured keys, 3 keys of each colour. As submasters could only effect channel stopkey selection of the same colour this was the final subdivision.
However these 3 keys had 4 functions, two of which are duplicated!
The explanation is that all keys have two operating pressures, the first against a light spring, and the second function against a heavy spring. The keys between the 5 black keys raise up selected channels at the first operating pressure, but do the opposite, fade down at the second operating pressure. The four keys between the single black and five black would blackout the selected channels at first pressure, but if then released the channels will restore to their previous dimmer setting. However if pressed through to the second pressure the channels will first blackout and then the dimmers fade down to zero - so when the key is released the output will not be restored. The other four keys would switch full on at first operating pressure, but when released would restore to previous dimmer setting, but if pressed through to the second operating pressure would raise the dimmer to match. Thus there were four basic functions up, down, blackout and full-on, but up and down were duplicated for operational convenience.

What of the "black keys"? These were not just visual markers but had useful functions. The single black key would cancel the existing channel selection on the Left or Right, by energising the off magnet of any stopkeys that were on. The group of five black keys preselected open white or any one, or combination, of four colours where colour change units were fitted to the luminaire. The channel stopkeys were used to determine which channels were selected to which colour(s) and normally had a filled black dot on the engraved tab to denote those fitted with colour change facilities.

Many of the Light Consoles had more than one keyboard - for a large number of channels, such as the 216 for both Drury Lane and the Coliseum, there was a keyboard for each horizontal row of channel stopkeys. Other “odd” stopkeys were provided to couple one keyboard to duplicate pressing keys on another - it was normal to couple to the bottom keyboard and in practice operate with three fingers spanning the four central keys, but opt out to smaller subdivisions when necessary for the “tricky bits”. There was not always a keyboard for each horizontal row of stopkeys - for example that for the Royal Festival Hall had only one to reduce the back to front dimensions for a space found as an afterthought. In technology terms the sub-divisions existed because of the construction of the crossbar relay where there was a vertical limit to the number of channels that could be accomodated in one box.

At the base of every Light Console there were foot operated pushes and at least one balanced speed pedal. Most of these foot pushes also had two operating pressures with the first pressure for selected channels and the second for all channels.

Hopefully it has been established above that the building block of the smallest subdivision by submasters is, say, the white stopkeys of the left hand side of the top row. The number of channels in this subdivision is not likely to exceed 14 and there are 4 submaster functions, disregarding colour change. At the crossbar relay each channel stopkey was represented by pivoting horizontal bar. When a channel was selected it energised an electromagnet which lifted this bar about 5mm. At right angles to the bar, but raised above it, there were a number of silver wire contacts. In the vertical plane a column of these contacts could be pulled down about 5mm by a electromagnet at the bottom pulling down an insulated strip through which all the wire contacts in that column passed. Essentially a lifted horizontal bar (channel) did not make contact with a wire contact except: when the bar was lifted and also a vertical column was pulled downwards. Each vertical column represented a submaster function. The horizontal bar was fed 17VDC positive, and the rear end of the wire contact in a vertical column was connected, via a testboard, to the corresponding function component. Thus there was a vertical column for the up magnetic clutch, the down magnetic clutch, the coil of the blackout contactor and the coil of the full-on contactor. The horizontal bar was full width because the vertical columns: included the white, red, blue, and green submasters, and O,A,B,C,D colour change presetting routes where applicable. Wire contacts were fitted for every matrix point, because collectively they formed the spring return of the vertical columns - however at the rear, external connections only occured at the intersection of a same-coloured channels and submasters.

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