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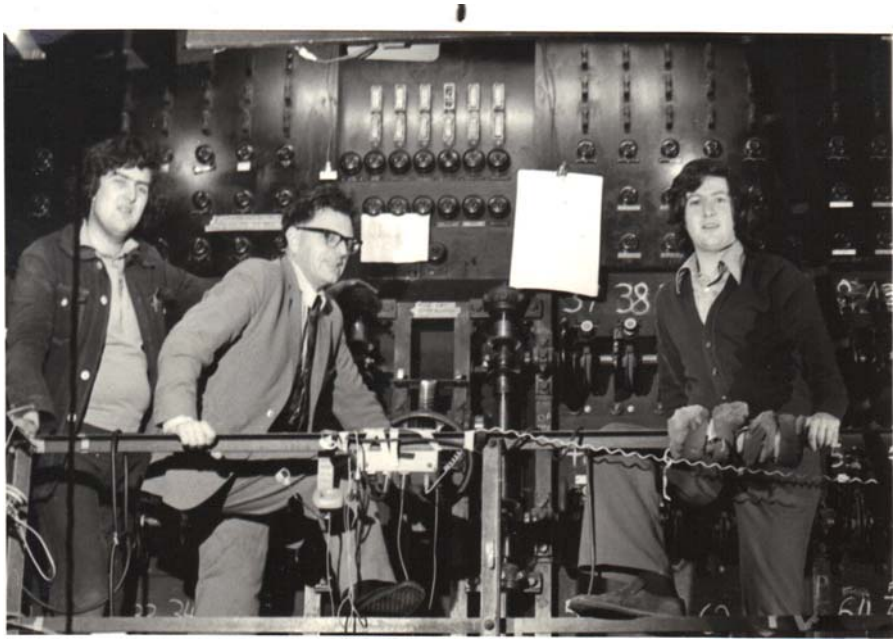
Farewell to the steam age of stage lighting

In the autumn of 1974 I became First Electrician at the New Theatre Oxford, the largest theatre in which I had worked during my short career. Within months I was promoted to Chief Electrican, responsible for all stage electrics serving the cream of British touring opera, ballet and theatre companies as well as commercial tours and many classical and rock concerts. My job was not only on the “artistic" side of the curtain, I was also the house engineer, responsible for the heating, air conditioning, elevators, street-side lighting, internal telephone system, and the entire electrical installation of this massive 1800 seater art-deco theatre. Together with my crew of three “electrical daymen" and a host of casual show-staff, our electrical crew during a performance often numbered over twelve or fourteen. I was 18 years old. Nothing in my previous work in summer-season or weekly rep could have prepared me for the intensity of my years at the Oxford New Theatre. Little did I realise, as I arrived at Oxford in 1974, that I would be participating in a major change that was about to arrive for theatre lighting.

Built in 1934 by the Oxford Dorrill family, the New Theatre was heralded as “Englands Finest Theatre" with the most modern stage equipment of its day. The massive stage with its huge proscenium, trapdoors and revolve, with some 60 counterweight lines and an orchestra pit that could accommodate over 100 musicians was only limited by its wing space - like so many theatres of its age, little space was given to areas outside that which the audience could see.

My new domain was high on a gantry on stage left, usually hidden behind black curtains stood the lighting board – actually two lighting switchboards – a 70 way Grand Master and a 32 way Sunset – both from Strand Electric of Floral Street vintage. Massive though these boards were, they represented the last generation of fully manual lighting boards, their capability only limited by the number of operators a given show could afford to employ.



Pic 1 - Backstage at the Oxford New Theatre sometime in 1974, the Grand Master lighting board with (l-r) myself, Ken Hodgson (first dayman) and John K. Leventall (casual showman)

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Until the early 1960's the Grand Master was the ultimate lighting control board in English theatres, though by the mid sixties with was becoming eclipsed by a new control systems, many of which were based on organ-consoles that could be located front of house giving the operator - for the first time - a view of the stage and of the result of his efforts. These new boards were initially "remote controlled" versions of the Grand Master, controlling banks of the same sunset resistance dimmer modules, which continued to perform their dimming function by inserting a variable resistance in series with the lighting load – resulting in high energy consumption and a lot of waste heat.

It is hard today in the age of computer contolled thyristor dimmers, with which almost anything is possible, to recall the often severe limitations that manually operated resistance boards placed on the lighting designer, and thus the director and the performance. The ingenuity of board design, the stage lighting installation, and not least, the operators, seems archaic to me today, and yet we worked with such limitations for many years, often without even considering them limitations.

Before I address the electrical and mechanical limitations, it is important to understand the fundamental difference between the operation of these manual boards and the lighting control systems of today. Today's lighting designers and operators think in terms of lighting states – the "picture" that we create on the stage in any given state of the production, with the cues themselves being the transitions between those states. Thus, modern boards store and recall the memory numbers of specific states following any given cue together with the dynamic data about how the transition must occur. The information required to achieve a given state is always avaliable to the operator.

With manual boards such as the Grand Master, we never dealt with the concepts of states, unless the lighting was completely static from the moment the audience arrived until they left – which was almost never.

Instead, everything we did was planned and plotted according to the actions necessary to transition from one state to another, our plot recording only the transitions for individual faders for each cue. These transitions would be recorded – circuit by circuit - on a plot sheet, that was usually the back of a poster card for a previous performance. A transition for a given circuit would be recorded as a fraction, with the circuit number above and the level below – for example 27/4+ would mean circuit 27 to level 4+ - halfway between level 4 and level 5. The reproduction of more discreet intervals of level was rarely attempted. An upwards or downwards pointing arrow beside this fraction would indicate whether the action was fading up or down.

This method worked because it gave the operators the only information that they required for any given transition, but it did pose limitations. During technical rehearsals, especially of complex longer shows such as opera and ballet where the director might wish to rehearse only specific scenes to save labouring the principal perfomers or, following mistakes, might wish to reset to an earlier state, the lighting operators would have to "rewind" to the last know state – typically a full blackout - and then work their way through the subsequent transitions until they arrived at the desired state. This process could be very time consuming.

This was not the only limitation imposed by the manual lighting control board. There were a host of other, more complex challenges defined by the mechanical and electrical configuration of the board itself. To illustrate this I will use the example of the Grand Master at Oxford.

The Grand Master was essentially a very heavy iron framed rack holding several rows or banks of mechanical resistance dimmers. In front of the rack were a series of "fader" levers, each operating a single dimmer module.

The fader levers were each pivoted on a transverse axle, to which they could be locked or "ganged", allowing a group of adjacent faders to be raised or lowered together, by manual operation of a wheel at the end of each axle. If for example several circuits had to fade up from blackout to the same level, the requisite levers would be locked to the axle, and the axle would be rotated until the levers reached the desired level. If the levers had to reach different levels, then one operator could turn the axle, and the other operator could "un-couple" one or more levers from the axle as they reached the desired level, allowing the other levers to proceed to a higher level. The same would be the case when fading down to different levels. Circuits, the level of which did not change with a given transition, would simply be left un-coupled.

This approach could work well with a small number of circuits, the faders of which were on the same axle, though this would rarely be the case.

The Oxford Grand Master had six banks of fader levers on six axles. (Some larger Grand Masters were equipped with eight banks). At Oxford, these banks were arranged in two sets of three – one above the other, with each bank of three to the left or right of the centre of the board.

Bank 1 – circuits 1 – 12		Bank 4 – circuits 37 - 46
Bank 2 – circuits 13 – 24		Bank 5 – circuits 47 - 58
Bank 3 – circuits 25 - 36		Bank 6 – circuits 58 - 70

The resitance dimmers and fader banks occupied the lower part of the board. Above these was a heavy bakelite panel onto which the switches and fuses for each circuit were mounted, and behind which the busbars and wiring was arranged.

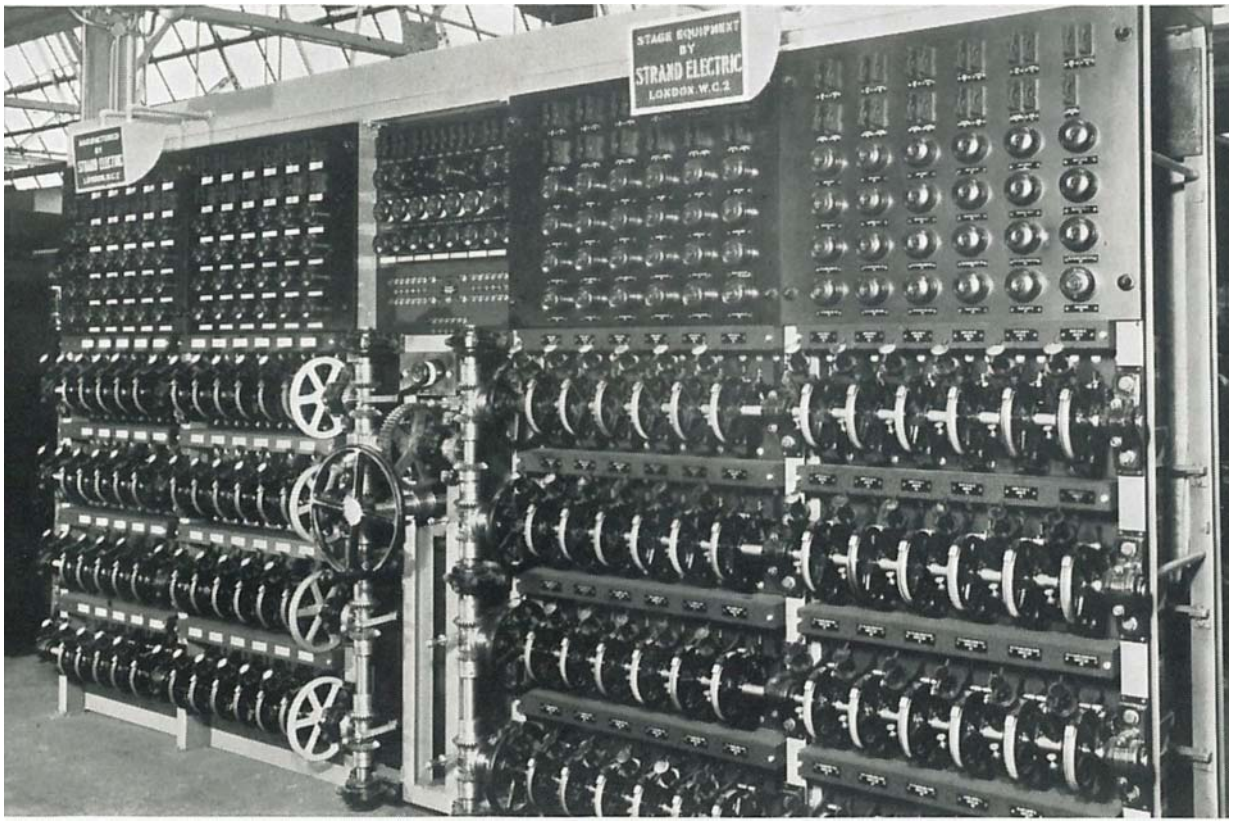
In the lower centre of the board was the Grand Master wheel and interlinking axles. There were two vertical interlinking drive shafts – on serving banks 1 – 3 and one serving banks 4 –6. Both of these vertical shafts were driven through gears by a single master wheel. Thus the master wheel could drive both vertical shafts and all six bank axles at once.

Each bank axle was equipped with a gear lever, which allowed the axle to be coupled to the vertical drive shaft. The gear lever was arranged so that in its middle position it was in neutral (un-coupled from the vertical drive

shaft) in the up position it would be coupled to the vertical drive shaft in one direction, in the down position it would be coupled to the vertical drive shaft in the opposite direction.

Thus to accomplish a simple cross fade between circuits on two banks, the requisite circuits would be coupled to their respective axles, and the gear levers for each axle would be engaged so that one would fade up and the other would fade down. This still required the operator to remember which direction to turn the grand master wheel.

In this way, quite complex transitions between lighting states could be configured, with each bank axle rotating in one or other (or neither) direction, and each required fader lever locked on or off to its axle.



Pic 2 - A four bank 96 way Grand Master

The operating examples I have described above are quite simple – controlling several fader levers on single bank or cross-facing between circuits on several banks. But in the real world of operation things were always much more complicated, not least because the operator had limited control of which lights could be connected to which fader circuits. Such were the limitations of the electrical configuration – not only of the Grand Master itself, but also of the entire installation.

In most theatres of the Grand Master period all lighting circuits were hard-wired from the dimmer to the outlet. This was the era before full patching of loads became possible.

This meant that the design of the electrical installation dictated to a large degree, which circuits would be available in different parts of the theatre. By the time that the Grand Master arrived, most theatres were operating on AC power, supplied from the utility company in three phases. Electrical safety regulations dictated that there should be six feet of physical separation between any two single phase portable appliances that were powered on different phases – thus reducing the risk of interphase electrical shock to those working with the equipment.

Whilst phase separation was rarely enforced at the operational level of theatre rigging, it was usually enforced in the actual installation – the hard wiring. A typical separation solution would be to feed front of house circuits on one phase, outlets above the stage (fly sockets on the second phase, and outlets at stage level (dips on the third phase.

Of course no hard wired installation could take account of the fact that different productions would require lighting units to be located differently. Thus many a theatre electrician, when faced with the demands of the lighting designer, would have to feed stage floor equipment from available circuits on the fly floor, or lighting bars from available circuits at stage level.

There was some attempt, not least on the part of Strand Electric and other equipment suppliers, to standardise theatre installations, particularly in the days of variety theatre, where lighting was often limited to a choice of colour mixes. In some theatres, including Oxford when I first arrived there, some lighting fittings, especially overhead battens and footliights, were hard wired in three or four “colour” circuit groups. Thus it was common to find that such equipment was wired to the lighting board in such a way that each color group would be configured to a dimmer on a single fader axle, so that all the “blue” circuits would be on one axle and all the “amber” circuits would be on another – thus making simple cross fades between banks simple. This approach was better suited to lighting variety shows but fell far short of the flexibility required for opera, ballet or straight drama.

But the concept of colour grouping extended also to the hard wiring of the board itself. Behind the to control panel, each dimmer circuit was fed from switched busbars, each controlled by a relay. In this it was possible to switch an entire colour group on or off. By an ingenious use of the colour master relays and the mechanical dimmer controls, it was possible to exact some complicated state changes – though not always in the way particular production would have wished for – but it gave some level of flexibility. The Oxford Grand Master had four colour groups – denoted as white, red, orange and green.

The aforementioned configuration was further complicated – behind the switch panel, by the requirement to create colour groups involving dimmers that were operating on different phases – therefore some colour groups had to be fed and relay-switched from separate group specific multiphase busbars.

And to cap it off, the entire installation was fed through a single three phase relay, allowing a single blackut switch to control everything. The mechanical noise of the color group and master blackout relays was often a problem in quiet perfomances.

From the Grand Master switchboard there was also switched (not dimmed control of several circuits – orchestra (music stand lights, working lights (often installed in the overhead battens and "stage locals" – general purpose outlets for dressing tables and other loads. There was also a single wired fuse for each circuit on the bakelite panel, these often had to be rewired during a performance.

Another aspect of the inflexibility of resistance dimmers what that dimmers where designed and build for specific loads – typically 500w, 1000w and 2000w – the performance curve of a dimmer was directly related to its load – a 500w spotlight on a 2000w dimmer would perform quite differently to the same light on a 500 dimmer curcuit. In fact, small loads on big dimmers required an additional "dummy load" – such as a old spotlight of the required rateing, hidden on the fly rail or in the cellar, to be added to the load to ensure that the dimmer gave a reasonable response curve – otherwise a low wattage load would appear fully lit with the dimmer at level 4.

Each circuit was also furnished with an independent feed – by switching the circuit switch to "independent" the circuit would be fed independently of the resistance dimmer, and thus be fully "on". All circuits switched to independent could be switched off via a master independent switch. Unlike some later Strand boards which allowed circuits switched to independent to have the dimmer reallocated to another load (to make it possible to light a show with more lights than dimmers, though never dimming all at once, the Grand Master could not do this. But the independent feature was useful if the circuit had to be sluightly overloaded – the dimmer could handle the fade up or down, but relieved of the overload that would otherwise have produced excess heat.

In the late fifties the seventy circuits of the Grand Master board proved inadequate for the New Theatre Oxford. But these boards were not "modular" in the modern sense of the word, the addition of extra circuits would require extensive electrical and mechanical modifications – something that was both time-consuming and expensive for a theatre that was in production almost every day. So a simple yet cumbersome workaround was chosen – the addition of a separate 32 circuit "Sunset" dimmer board alongside the Grand Master. Whilst giving the required additional circuits, this negated the ability to control everything from a single master wheel or single group or master blackout relays, and it implied, for many shows, the need for additional operators.

Operating the Grand Master was often hard and hot work. I remember productions at Oxford in the 70's when we had up to six operators on the board for complex shows, simply because one man could not physically reach all levers and switches at the same time as turning the Grand Master wheel. The wheel itself could be cumbersome to operate. When locked to its bank axle, each fader lever was fitted with a stop at each end of its travel, which released its grip on the axle when it reached these extremities, thus reducing the friction aginst which the operator would have to work with the Grand Master wheel. Despite this, busy shows with many repetitive fade-ups and downs were hard work, and at some time in its life, the board at Oxford was fitted with a heavy cast iron flywheel behind the board to ease the operaton of the Grand Master wheel. If I recall, a total fade up or down of all circuits could be accomplished – with practice and training – in under six seconds.

The Grand Master was hardly silent in operation – though oiled daily, the axles would sometimes creak and scream, and the relays would chatter. The operators could not see the stage, and had often to hide behind blackout curtains so that their overhead lights could be used to read their plots without light-spill onto the stage. Entry to the gallery was via an iron ladder, and the gantry itself did not make it easy for the operators to pass each other. Due to the proximity to the stage, communication between operators often relied on hand signals, and although intercom was introduced for some touring shows, most communication was by red and green cue lights from prompt corner.

Whilst as a theatre electrician I quickly became proud of my ability to harness the power of the Grand Master and to make it do what the show required, I was also a budding lighting designer myself, and in this role I soon realised that most of my proficiency as an operator was about working around the limitations of the technology rather than exploiting its possibilities and serving the production. Later, when touring Britain in as a lighting designer with musicals, I was often faced with limitations of the local lighting board which became increasingly irrelevant when viewed from the perspective of the script or the production.

One of my first major lighting design assignments was for the 1975 pantomime *Cinderella* at Oxford New Theatre, and I was determined to ensure that we got a new lighting board in time for this production. Our choice was the Strand Electric MMS, installed in a new control room at the rear of the dress circle. A new 120 channel dimmer room was added in the basement, with much more load-patching capability than before, particularly front-of-house, where adding extra circuits each week had become a time consuming challenge.

On a Saturday at the beginning of December 1974 – if I recall it was a performance by the D'Oyly Carte Opera Company, we ran our last show on the Grand Master that had served this theatre since 1934. The same night, electrical contractors moved in and installed the MMS system, with new wiring throughout, with intercom to the prompt corner, and with a view of the stage at last. Suddenly, and not a moment too soon in my opinion, it became an everyday possibility to control any spotlight or a whole rig, exclusively according to the demands of the show, rather than as dictated by the convoluted wiring and the colour concepts of yesteryear.

I don't mourn the passing of these great dimmer boards of the theatres "steam age", in fact I am glad that I came into the theatre at a time when they still existed and that I learnt my profession in that age. As I have subsequently discovered in my work as a television cameraman, editor and graphic artist, an understanding of the old ways makes the embracing of new techology only more enjoyable and rewarding, and now, as I reach the age of 64, I am often confronted by younger colleagues who think that today's technology can be complicated and challenging and I think to myself "you should have seen how we did this years ago".