Chapter 4

THE CONTROL CONSOLE

Developing the cues for operating the lighting is one of the most important steps in lighting design. Clearly, the very nature of the cues, the designers' approach to them and the manner in which they are recorded and operated depend on the design of the console. The more flexible the console design is and the greater the capacity of the computer which assists it in its operations, the more freedom the designer will have to develop sophisticated and artistically effective lighting. Moreover, a modern console will also save a great deal of time and money by speeding up the cue recording process.

The Evolution of Presetting

Lighting control began with the gas valve before electricity was introduced into the theatre. Gas lights were controlled by a backstage array of valves which controlled the flow of gas to the rows of gas burners that made up the dangerous borderlights and striplights of the 19th century theatre. The valves had one advantage, they could be turned up or down to adjust the amount of light the burners put out—the earliest "dimmer." However, if the gas was turned completely off, it had to be relit producing a very obvious flare of light.

The switchboard

Soon after ways were developed to produce enough electrical current, electric lamps were installed in theatres to eliminate the fire hazard of gas lights. Electric lamps were simply substituted for the gas burners in the long rows ("borderlights") hanging over the stage and in the footlights. The electrical circuits were controlled by "on-off" switches installed on a "switchboard." This was a slab of slate or marble upon which were mounted open knife switches—electrocution waiting to happen.

The beginning of presetting

The possibility of gradual adjustment of the light output vanished with the introduction of the "on-off" switches, but "presetting" came into being. The switches were grouped according to the color and location of the lamps they operated. (e.g., “Red footlights” “Blue first border,” etc.) Each group was controlled by a color master switch and the whole switchboard was controlled by a “main switch.” Thus there was a “red master,” a “blue master,” and a “white master.” The electrician could preset the colors on stage while the curtain was down and an act was taking place on the apron illuminated by the limelight follow spotlight. When the next full-stage act opened, the electrician threw the proper master switch or even the main to bring up the color arrangement he (female electricians were unknown at this time) had preset. Thinking of lighting as series of internally static presets was on its way.

Resistance dimmers

Although resistance dimmers were installed in a theatre in London almost as soon as electricity was introduced, most theatres were equipped with the switchboard first and dimmers considerably later.

These were not part of the switchboard but existed as a separate rack to be operated by another electrician.

Later the resistance dimmers and switches were incorporated into a single but very large unit. A safety factor was added: The entire front of the device was enclosed in metal preventing any possible contact with live parts (see Figure 4.1). The back and sides were covered with metal mesh to allow the heat from the dimmers to dissipate. This arrangement was touted as “dead front.” The unit was now called a “controlboard.”

Mechanical interlocking

Dimmers made it possible to adjust the light output of the borderlights and footlights providing gradual color changes and also to begin and end scenes with a fade-in or fade-out. The dimmers were all installed on a common shaft to which they could be locked, making it possible to move an entire row at the same time. Unfortunately all of them had to be

The Now-Obsolete Resistance Dimmer

Resistance dimmers work by adding resistance in series with the lamps thereby cutting down current flow. When about 3 to 4 times the resistance of the lamps has been added, the current will be reduced to the point where the lamps produce no more visible light. A considerable amount of the current that was being used by the lamps is converted into heat making the dimmers run very hot, particularly at half-dim settings.

Since the amount or resistance needed to black out the lamps varies with the resistance of the lamps, a given dimmer can dim out only a relatively narrow range of lamp loads. Too much load will cause the dimmer to take the lamps out prematurely and too little will make it impossible to dim them out to black. Thus the dimmers must be matched to the loads or, loads must be adjusted to fit the dimmers by adding extra lamps known as ghost loads. In addition to having the proper amount of resistance, the dimmer must be designed to carry the current up to, and usually well above its rated load.

Load sensitivity, heat and size made the now totally obsolete resistance dimmer an undesirable stage lighting control device. Its only advantage was that it was nearly indestructible—a questionable advantage when it came time to persuade theatre owners to replace them.

at the same reading to be interlocked. The entire set of several rows of dimmers could also be interlocked on many of these early dimmer racks, although this made an exceedingly heavy mass of interlocked machinery. It could only be operated by means of an extra long lever or, for long slow fades, by operating a special worm gear drive device controlled by a wheel. Much later, resistance dimmers were replaced by autotransformer dimmers eliminating the many electrical and mechanical problems of the resistance dimmers (see Figure 4.2). However, at least in large installations, the mechanical arrangement and backstage location of the dimmers and switches remained basically the same.

Autotransformer dimmers

Direct Control

Throughout all of this period of lighting history the control was direct, i.e., there was a mechanical connection between the handle of the dimmer and the current-carrying parts of the dimmer. This meant that the dimmers and switches and all other direct control apparatus had to be large enough and heavy enough to handle the current, well enough insulated to protect the user, and designed to dissipate the very considerable heat when resistance dimmers were in use. This resulted in very bulky controlboards which were always placed backstage to shorten the

Backstage controlboards

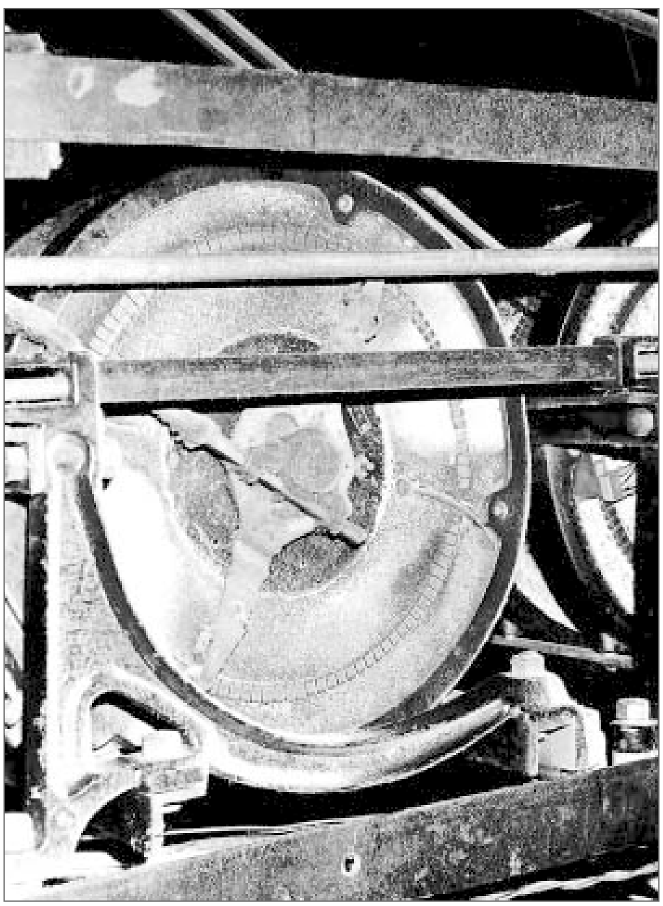


Figure 4.1. This photo shows the face of a typical resistance dimmer. The Nichrome resistance wire is imbedded in a ceramic layer installed on the inside of the dish-like steel enclosure. The wire is arranged in a zigzag pattern making it possible for the brass contacts, which extended up through the ceramic, to have several inches of wire between each adjacent pair As the contact arm was rotated, resistance wire was added or subtracted from the circuit.

The scraping of the moving contacts over the fixed ones often made these dimmers noisy to operate. They also produced heat in significant quantities, particularly at partial settings. Note that the face of the dimmer presented live contacts accessible to anyone foolish or careless enough to touch them. For this reason the dimmer racks were enclosed in metal mesh or steel covering to achieve a “dead front.” Although now a forbidden practice, resistance dimmers were often circuited into the grounded neutral of the lamp loads making it possible for a single large dimmer to dim a number of load circuits even if they were fed from different phases.

expensive runs of wiring needed and to place the operators where they could take cues from the stage manager. This used up valuable backstage space and located the operators where they could see little of the results of their work—so little that cueing was sometimes done by telephone from a back-of-house location and relayed to the people running the board.

Remote Control

In engineering terms, remote control means that the device handled by the operator does not actually control the current supplying whatever device is being controlled. Instead, the control mechanism sends an electrical signal, usually a tiny current compared to what is being controlled, to the remote device which reacts to the signal and effects the control. Some of the advantages of this arrangement are:

- Lighting control devices for remote control applications can be designed and sized to fit the needs of the operator, not to satisfy the engineering needs of heat dissipation, insulation and the like. This has turned out to be the most significant advantage of remote control for stage lighting purposes.
- Multiple control locations and complicated interlocking controls become possible at reasonable cost and with good reliability.

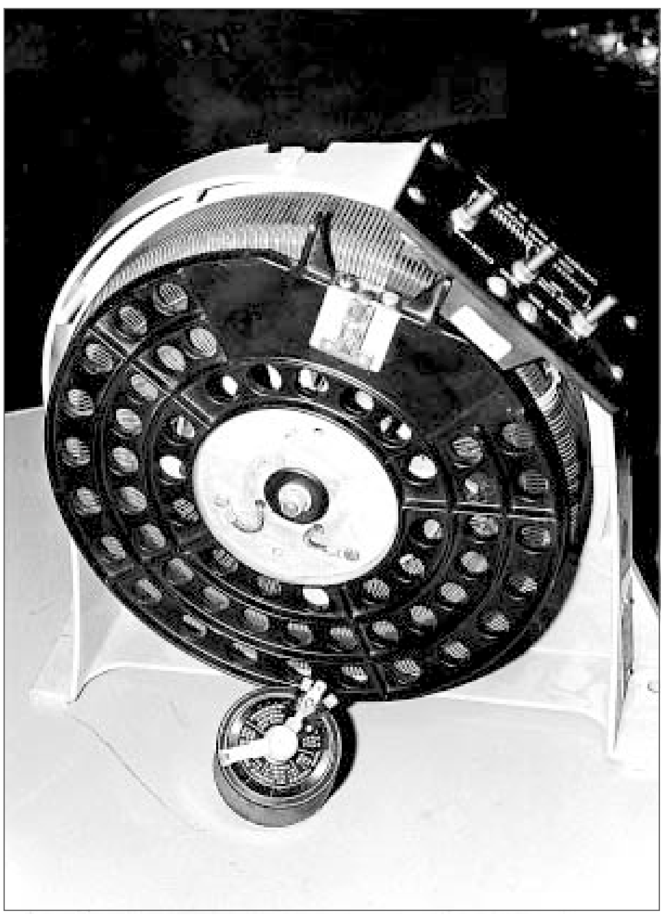


Figure 4.2. This photo shows the working parts of two autotransformer dimmers, 6 kW and 100 Watts. The 6 kW unit was commonly installed as a replacement for resistance dimmers and was made to fit into the same space. The 100 watt unit served as a master controller for ranks of resistance-based individual circuit controllers in early preset consoles.

Note the coils of copper wire in both units They are wrapped around an inner core of laminated soft iron plates that serves to concentrate the magnetic field making the back EMF more effective. Voltage adjustments are made by rotating the sliding graphite contact (most visible on the 100 W unit) over an exposed part of the copper coil. Without load, either of these dimmers will draw only a minuscule amount of current.

As made for setting voltage in an electronics laboratory, ATDs were equipped with a knob which required about 340° turn to go from full-on to full-off. This motion is awkward and not very useful for making long, smooth theatrical dims. Therefore the dimmers were equipped with rack-and-pinion devices by which a handle could move the dimmer over its entire range as the handle moved perhaps 45° to 60°. For the large dimmers, this arrangement could be further mechanically interconnected by inserting it into the same shaft-and-dog system then used for resistance dimmers. Although now obsolete, autotransformer dimmers are still in use.

The Autotransformer Dimmer (ATD)

The autotransformer dimmer (Figure 4.2), a non-load-sensitive voltage-setting device, replaced the resistance dimmer in the 1940s and early 1950s. Early ATDs were simply laboratory instruments imported to the theatre. They were operated by rotating a dial over about 340 degrees—a movement nearly impossible to perform with one motion of the hand. Although there was no way to mechanically master them, electrical mastering was possible.

ATDs were designed to output voltage linearly from 0 to 120 volts which left them with a less than ideal operating characteristic for theatrical use. Incandescent lamps respond to increasing voltage non-linearly. Therefore movement of the dial at the low voltage end produced little change but movement near the full voltage end caused rapid change. Later, some ATDs made specially for theatrical use were constructed to avoid this problem. These later ATDs were also designed to be mechanically mastered and to fit into the same controlboard framework that was already in use for resistance dimmers. This resulted in the installation of many controlboards with the same bulky size as controlboards containing resistance dimmers despite the fact that heat dissipation was no longer a problem. Some of these remain in use.

Some autotransformer-equipped "portable" package units (they were actually very heavy) were manufactured containing six 1000 watt dimmers plus a 6000 watt master. A switching arrangement allowed the six 1000 watt units to be operated from the output of the large dimmer or independently, as needed. When in the master-dimmer mode the unit provided completely proportional dimming—the six individual dimmers could each be placed at any setting and dimmed by the master maintaining the proportional settings until the attached lamps were either full-up or full off—a function impossible with mechanical mastering. Also directions were circulated by manufacturers of autotransformer dimmers for building homemade units for small theatres. Either of these options made it possible to locate the controls at the back of the theatre if wiring were available. However, back-of-house control was considered radical and dangerous by some authorities because of the possible breaks in communication with the stage manager.

During their heyday, ATDs were considered very desirable because of their lack of load sensitivity, the fact that they produced almost no heat and could be adapted to electrical mastering. Unfortunately ATDs were also very heavy, somewhat noisy and not as durable as their predecessors. They were soon replaced by electronic dimmers.

- Noisy and/or heat producing equipment can be located where noise and/or heat will not bother. For example, stage main switches are large and best operated by an electromagnetic device (called a “relay”) which will open or close them accurately but noisily. These relays are best located in the basement far from the stage. Dimming equipment can also be noisy. Locating it away from the stage can be advantageous.
- Until recently, lighting control equipment was bulky and precious backstage space could be saved by locating it elsewhere.
- Expensive runs of heavy wire to feed the stage supply can be shortened substantially by locating the dimmer bank and associated switching mechanisms near the building power service entry.

Remote control dimming

Although remote on-off control had been common in electrical engineering applications for many years, it was only after World War II that electronic equipment became available from which remote control dimmers could be economically and reliably made. The next decade saw a rapid evolution through electronic tube (“thyristor” or “thyratron”) dimmers to silicon controlled rectifier dimmers (SCRs) to today’s modern refinements of SCRs (see Chapter 12). The result was smaller, lighter, less noisy and much more reliable remote control dimmers which are presently almost “invisible” to the console operator.

The “remote” end of a remote control system consists of whatever arrangement of signaling devices is appropriate to the system being controlled. Because it carries only a small amount of current, mostly at low voltages, it can be compact, light in weight and therefore portable, and designed to fit the needs of the operator. For example, a tiny push-button can signal a huge, noisy stage- main relay to turn on or off thousands of amperes of current.

“Consoles” or “desks”

The introduction of the remote control dimmer changed even the terminology of lighting control. The operator(s) no longer struggle backstage at a “switchboard” or “controlboard,” instead they work at a “console” (often called a “desk”) located at the back of the house where they can see exactly what changes they are making in the lighting. Remote control also effectively separated the problem of selecting a console from that of selecting dimmers. Standardized digital signaling systems (protocols) such as DMX512 have made it possible for most consoles to signal most dimmers.

Console design

The development of the remote control dimmer also brought into existence the art and craft of console design—the creation of consoles adapted to the needs of the operator(s) instead of meeting the engineering requirements of a power handling device. For a considerable period of time this art moved ahead without the benefit of the computer, which was still in its infancy. During this pre-computer era both the designer and the operator(s) were frustrated by the console’s limited ability to handle cue information. At first there was no way to store cue information except by writing it down, just as had been done for direct control systems. Operators looked at the cue sheet when warned of an oncoming cue, organized their hands on the controls, and moved them on “take.”

Per-computer console designs

Very soon consoles were devised whereby an extremely limited amount of cue information could be stored in rows of controllers, each row representing one complete set of dimmer readings for the entire console. These controllers had to be set individually by hand while the row was inactive. A single row represented the data for one cue which could be brought to the stage by activating the entire row and deactivating the row that previously controlled the stage. At first two rows ("two-scene preset") were provided. It was soon apparent that there were many cue situations where there wasn't time between cues to reset the inactive row before the next cue was called. The immediate solution was to add more rows creating multiple scene presetting, eventually up to ten scenes! The result was monstrous consoles with bewildering arrays of controllers and a special crew member who did nothing but readjust the preset knobs to stay ahead of the operator. Errors abounded and were nearly impossible to correct because it was so difficult to find which controller was off its setting. This was presetting at its worst (see Figure 3.2).

Early attempts to simplify this data entry task resulted in such things as stacks of punch cards (easily dropped and scrambled) each containing the information for a single cue, and even a system in which a number of portable racks of controllers, each representing one cue, rode on an endless chain arrangement that moved them into position and inserted them into the system so the cue could be run.

Computer-Assisted Consoles

The earliest attempts at handling cue information by computer were limited because computer memory was limited and expensive. Not enough cues could be stored to get through an entire show unless it was very simple. Therefore the memory had to be reloaded between acts. Thankfully this era is long gone.

Huge memories make modern consoles possible.

The modern computer has proven to be a near-ideal solution to the problem of handling cue data. It can accurately store huge amounts of data and bring it back for change or operation almost instantly. Modern computer memory has become economical and available in huge quantities, eliminating any need for reloading. In fact, some systems allow cues for several shows to be stored in memory at the same time. Additionally, removable storage devices with huge capacity make it possible to store any amount of cue data outside the computer and/or to take it from console to console with ease.

Total automation of lighting is not applicable to legitimate theatre.

It is important to note what "computer-assisted" means: The computer does the same job that was so poorly done by pre-computer devices handling cue data. It keeps the cues in order and makes the data available to the operator as needed—*it does not run the show*, although it could. Total automation is not desirable in live theatre where actor-audience interaction is of the essence and where subtle but very important changes may be made by the operators during each performance to synchronize the lighting with the show. Nevertheless, equipment to operate completely computer-run shows is standard in suppliers catalogues. Such shows are found in amusement parks where the entire shows are automated and the actors, if there are any, must follow a prescribed pattern of movements on an exact time line. While spontaneity has little to do with this arrangement, consistency and economics do.

The Ideal Console

The ideal console should resemble a musical instrument as far as its relationship with the operator is concerned. A fine violin is so designed that it allows a master violinist to completely command it, making it seem to vanish from the listener's and musicians's attention leaving the artist and the music as a seamless experience. Similarly, the ideal control console should be so well adapted to the operation of the lighting that the operator can concentrate on the lighting he or she is "playing" while the console remains in the background. Clearly, modern consoles still do not reach this ideal state, although they come much closer than any from the past.

Console compared to a musical instrument

Some General Concepts of Lighting Control

As lighting control has developed from the crude beginnings with resistance dimmers controlling border lighting, the following control concepts have evolved. They are common to most modern consoles:

Proportional dimming

Historically, this concept was a much longed-for improvement over the mechanical mastering provided by the practice of mounting resistance dimmers on a common shaft to which they could be attached by means of a metal rod (a "dog") that fitted into a notch running the length of the shaft. This rod was spring loaded but could be locked in its up position keeping it clear of the shaft or could be released allowing the dog to engage the shaft when the notch lined up with the dimmer rod. Thus all interlocked dimmers had to be at the same reading. With this arrangement it was common practice to perform a fade-up by locking in the dimmer which was at the lowest reading and setting the remaining dimmers to latch as the shaft rotated and picked them up. The result was that as the fade-up progressed all of the dimmers were brought to the same setting, destroying the ratios previously set between the individual dimmers.

Mechanical dimming—all dimmers at same setting

The introduction of the ATD brought the first real prospect of true proportional dimming where the ratio between the individual circuits could be maintained until the circuits reached either full up or full out depending on the direction of the fade. This was first done by providing a large ATD capable of handling the total load of the smaller dimmers to be mastered by it. A switching arrangement was usually provided that allowed the master dimmer to control individual dimmers up to its capacity or, if mastering was not needed, to use the large dimmer to control a large load such as house lighting. Note that this circuitry could be applied using resistance dimmers but the result would be that any change in one of the individual dimmers would also cause the rest to change (unless the master dimmer was at full on) because of the load sensitivity of the master resistance dimmer. Nevertheless such systems were occasionally constructed and used although they were frustrating for operators.

Large ADT as master

Proportional dimming is now the assumed standard for all consoles. However, it is no longer accomplished by huge dimmers capable of carrying the load of many individual circuits. Remote control electronics has solved that problem by doing the mastering at the control level where, Remote control eliminates the need for large master dimmers.

in fact, the same circuitry may be found, but in tiny controllers which master each other by setting voltages, not carrying loads. Digital circuitry can also accomplish mastering using even less current and providing still greater flexibility.

Pile-on

Highest reading takes precedence

The term pile-on describes the situation where an individual circuit controller is controlled by two or more masters at the same time—a common occurrence when the same channel is part of two or more presets operating simultaneously. The usual practice is to engineer this situation so that whichever master controller is at the highest setting takes control of the individual circuit. There is no adding together of the control signals. This is often described as "highest reading takes precedence."

Moving a master up can cause a downward effect in the piled-on circuit.

However there is also on many consoles another possibility: "last takes precedence." Whichever master is last moved establishes the setting for the piled-on circuits. Last action may be selectable over the entire console or may apply only to certain designated channels Obviously this makes for a different kind of cueing. For example, a cue might begin with one master at 8, the other at 4, and the piled-on circuit at 10. The master reading 8 is the last one moved and the piled-on circuit is at 8. Consider the effect of moving the other master *up* from 4 to 6: The piled-on circuit will be to dimmed *down* to 6 because this is the last movement. This type of control provides the chance for an *up* motion of a fader to cause *down* movements of some circuits while effecting up movements in others The reverse is, of course, also possible.

This type of control can effect changes that otherwise cannot be done with a single control handle without executing a cross fade between presets that removes one set of readings while adding another. Obviously, both operators and designers must be very sure which mode they are using when establishing cues.

Intensity vs. rate control

"Normal" controllers, submasters and masters set the brightness of the luminaires they control. The rate of change depends on the speed and rhythm of the movement of the controller. However it is also possible, and sometimes desirable, to have controllers which adjust the *rate* of change instead of the intensity.

Rate changes alter the rhythm of the cue.

Rate control offers the operator a degree of subtlety different from simple intensity control. The end effect of the cue remains the same as it would if controlled only by an intensity controller. However, varying the rate will change the duration of the cue, thus affecting its rhythm. Rate control may be applied to a wheel control and thereby control the rate of all channels assigned to that wheel. This kind of control is particularly effective for making adjustments to account for variations in the pace and rhythm of a production from performance to performance.

Preset vs. tracking

In a typical example of the evolution of console terminology, an addition has been made to the definition of the word preset. This has come about with the development and promotion of "tracking" as a desirable feature in modern consoles. Tracking simply means that once a channel is set at a reading, it will continue through subsequent cues at that reading until changed by another cue. For example, if the warm sidelights are set at 80% in cue 3, they will continue to appear at that setting in all future cues until changed by another cue setting them, for instance, to zero. Actually, this concept is no different than what now obsolete manual boards provided; a dimmer, once set, remained at that setting until moved. However modern tracking is a computer-assisted function that offers not only basic tracking, but also the possibility of isolating a single channel or package of channels from the cues memory and examining its settings throughout the show. Changes can be made globally on tracked cues or by segments. Some consoles may allow tracking to be selected or deselected, depending on the designer or operator's needs.

With computer-assisted tracking came the need for a term describing its opposite. "Preset" is the favored term. This is logical because on old-fashioned manual set preset banks no settings carried over from one row of controllers unless they were reset.

Tracking can be a convenience to the operator or a nuisance, depending on how the cues are interrelated in the show. If it remains in effect, the operator who is setting cues must take extra precautions to black out channels not wanted when moving from cue to cue. Indeed, some operators routinely include a "blocker" cue as the first cue in each scene which sets all channels back to zero. Then the new cue may be built up knowing that no tracked channels lurk in the background.

Modern Consoles as "Platforms"

In the jargon of the computer specialist, "platform" refers to the device itself (e.g., Macintosh, IBM, etc.) combined with the basic operating system ("OS") that determines how the machine will operate. However a platform can do nothing until it has been loaded with a program of software such as "Microsoft Word," or "Pagemaker" which determines what it can do. This arrangement makes the computer an exceedingly flexible machine capable of a wide variety of functions, depending on which programs are loaded into it.

Hard wired vs. software

Unlike computers, most lighting consoles, with the exception of some of the most modern, are hard wired. This means that the program is built into its electronics and cannot be easily changed. Thus the early console, "Lightboard," operated only within one set of instructions. Changing its program would have required extensive electronic reworking. On the other hand, some modern consoles are structured more like their computer relatives. Rather than having their various functions built in, their functions depend on the software installed in them and that software can be easily changed.

Depending on the brand, consoles may be considered as being pure "platforms," almost totally subject to reconfiguration by the software or they may be partially "hard wired" which means that some control configurations are permanent parts of the console and others subject to alteration by changing the software.

Consoles As Related to Dimmers

Electronic and mechanical dimmers respond to the same commands

In terms of engineering, the entire console is a "remote control device." It only handles very small amounts of electrical current using it mainly to send electrical signals to electronic or mechanical dimmers and operate pilot lights. Electronic dimmers (Chapter 12) are usually located in some space close to but not on stage where the heat and noise (both mechanical and electronic) can be controlled and the dimmers protected from mishandling and overheating. Mechanical dimmers (really motor-driven shutter-like devices) are found built into automated luminaires. The console devices which control either type of dimmer can be identical and interchangeable.

Fortunately dimmers are normally "transparent," i.e., they impose no special concerns on the operator or designer except to see that they are properly circuited when the lighting equipment is installed and, if loads are changed during the show, that they are not overloaded.

The Effect of Automated Equipment on Console Design

Originally one kind of control: intensity

Color changers (one type is known as "scrollers") were introduced into the theatre many years ago but have only recently become common. Automated luminaires, sometimes known as "wiggle lights" or "robot luminaires," are a still more recent addition. They were first used in the concert lighting world which contributed much to their development and are now moving into the legitimate theatre. (See Chapter 8 for details on these luminaires.) These devices have multiplied the number of variables handled by a console many times over. In the past, all changes commanded by the console varied the light output of luminaires and only indirectly changed the color and distribution of the light on stage, automated luminaires can directly vary a number of attributes (sometimes called parameters, variables, functions, etc.) of the light produced. Although the number, nature, and names of these attributes vary from manufacturer to manufacturer, the following list is typical:

- Mechanical dimming
- Movement of beam (pan and tilt)
- Color varied by dichroic or standard filters on a color wheel or by subtractive color mixing with dichroic filters
- Beam shaping
- Selectable beam angle
- Beam rotation
- Adjust for hard/soft beam edge
- Strobe effects
- Gobo (or slide) selection
- Movement of gobo (or slide)
- Variable focus of gobo (sharp or soft)

Designers of lighting for opera and musical theatre, in particular, will find the artistic potential of these luminaires overwhelming. However devising adequate control for these complex applications proves to be a challenge. Early solutions to this control problem, devised by the pop concert industry, consisted of multiple presets which could be rapidly sequenced to create a light spectacle to go with the music. Note the description of the "touch plate" below. Elaborate electronically generated "chases" were also often added to bring still more movement and glitter into the concerts.

Overwhelming new potentialities for lighting control

Rapidly changing presets for pop music

However this kind of control offers little to the designer of legitimate theatre lighting. The great artistic potential that these luminaires promise can be achieved only if the console can provide *individual control over each variable for each luminaire*. Although the beginnings of this kind of console development are now evident, the ultimate console for handling this awesome array of control variables remains a dream of the future. See Figure 3.3 for some current partial solutions to this problem.

Individual control over functions is necessary.

Devices Commonly Found on Consoles

In the "generation" of consoles just prior to the present each of the devices listed below appeared as a separate physical device. In consoles of the "platform" variety these devices may exist as software functions assignable to one or more controller-like mechanisms. Thus the function "submaster," for example, may, for different productions using different software, appear on different parts of the console. It is even possible that these functions may shift position during a single show.

Not all of the items on this list will be available on every console or with every software package. Unfortunately the names given to these devices vary from manufacturer to manufacturer. It is up to the potential user to determine exactly what they do. Figure 4.3 illustrates a top-of-the-line console.

Controller: This is the most basic unit of control. It affects only one electrical channel, making it possible to dim that circuit up or down or, if the circuit under control handles an attribute of a moving light, controls that one variable for the luminaires on that channel. Note that however many luminaires are attached, they will all operate as one. Controllers found on most consoles are slider devices usually calibrated 1–10. These may be physically identical to and interchangeable with other sliders used for the functions below.

In consoles where functions are determined by software, rows of sliders are often provided which take on the function of "controller" whenever the software commands, but can also serve other functions if so designated. Such rows of multiple-function controllers may be referred to as "submasters" in manufacturers' literature.

Submaster: A device or assignable function that controls a group of individual circuits each of which also has individual control. In turn, a group of submasters may be assigned to a master.

Note that controllers, submasters and masters may all have the same mechanical appearance and that, in many cases, the same device can serve any of these functions depending on software commands. On consoles where the functions are hard wired, each of these will be represented by a mechanical device specially designed to serve its function, although the internal parts may actually be about the same.

Page(s): Refers to programmable consoles only. A typical statement in the specifications for a console might read: "Twenty pages of submasters are supplied."

A "page" of submasters is a configuration of submasters and circuits assigned to them that exists as a unit of memory in the computer. It can be brought into play making a highly specialized package of control available to the operator. While the page is in control, the operator has the advantage of the particular pattern

Figure 4.3. Control Console Components. This highly sophisticated console, the Strand 550i, illustrates the appearance and organization of controls on modern consoles. Note that no individual channel controllers are present, although, they would look about like the submasters. Instead, individual channels may be digitally called up, given an intensity setting and assigned to any of a wide variety of controls. Submasters however abound, supplemented in this console by bump buttons that allow instant on-off action of the channels controlled by the submaster, and by LEDs that indicate active or inactive status. Note the six supermasters with their liquid crystal displays that allow labeling to indicate what channels are being controlled. A grand master controller and a blackout or stop button are also present.

The Playback section consists of two split cross faders capable of a variety of actions including automation, depending on software. Adjacent to them is a wheel which can vary the rate of progress of any cue(s) assigned to it. This playback section can be split into two control packages, one for moving lights and one for fixed lighting equipment.

The Moving Lights section features a trackball to which one or more moving lights may be assigned and their pan and tilt controlled, or any other attribute appropriate to control by trackball. Note also the four fingerhole knobs. These are also for motion control.

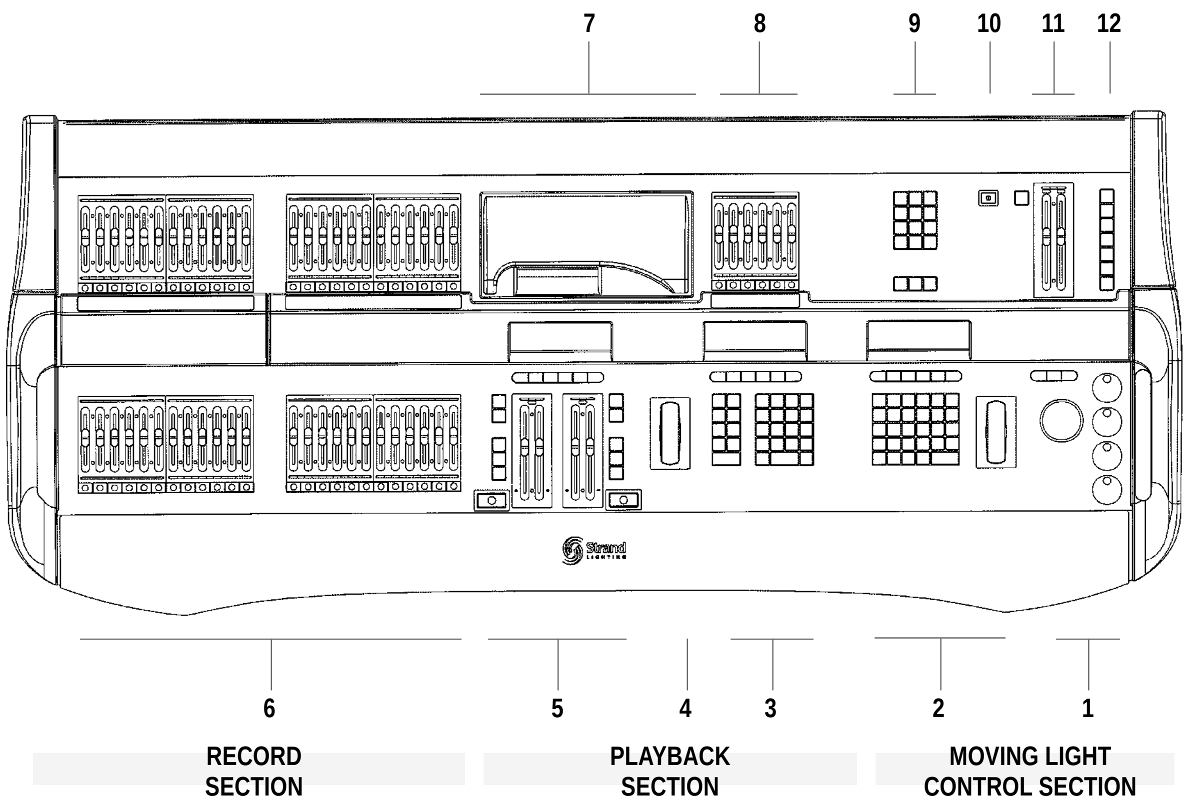
This console is software configured and can, by itself, control as many as 6000 intensity channels and 2000 scroller or moving lights channels. In addition, a number of these consoles can be interconnected to afford control over very large facilities and/or large numbers of moving lights plus regular lighting. Photo courtesy Strand Lighting.

of control he or she predetermined. When that configuration is no longer needed, another page can be activated making a new organization of the submasters available for use. Thus pages are a major way of reorganizing the console as the operator(s) run the lighting cues. It is advantageous to have a number of pages available on a console. Note that shifting from page to page is a common way of altering the function of many of the devices on the console, for example, changing the function of an erstwhile controller into that of a submaster.

Pages configure control for specific lighting situations.

Master: This is a device (or function) which effects control over a number of individual controllers and thereby controls a number of channels.

Grand Master: A master-like device that controls all or almost all of the circuitry on the console. This can be a very powerful control—if it is so circuited, the entire stage may be blacked out by operating it.



1. Tracker ball, rotary controls (fingerhole knobs) and option keys for moving light control
2. Command keypad, multifunction wheel, context sensitive soft keys and graphics LCD
3. Function keypad, effects keypad, effects soft keys and graphics LCD
4. Rate wheel
5. Playbacks, 'GO' buttons, context sensitive soft keys and graphics LCD
6. Submasters, bump buttons, 'active' and 'loaded' LED indicators
7. Floppy disk drive
8. Supermasters or extra submasters
9. Display and command routing key pad
10. Power On/Off
11. Grandmasters and 'stop' button
12. User programmable keys

Fader (Crossfader): This is a slider-operated device that shifts control from one package of control to another. Unlike the controller and master controller, crossfaders have no “off” position (unless one end is purposely left unloaded). Moving the slider from one end of its travel to the other gradually shifts the control from one group of settings to another. In its intermediate positions, both sets of controllers and master(s) have control, the degree depending on the location of the slider.

A wide variety of controllers, submasters and even masters may be assigned to either end of a crossfader. This makes the crossfader one of the most-used devices found on the playback part of the console.

Split Fader: This device could be thought of as two masters installed so that the “off” position of one is mechanically adjacent to the “on” position of the other. One may assign all of the “up” movements in a cue to one half of the split fader and the “down” movements to the other. This makes it possible to control the outgoing part of the cue at a different pace and over a different time period than the oncoming part of the cue, something highly desirable in most lighting situations.

Autofader: This may be either a single fader or a split fader. The distinction is that this device will automatically time a fade once it is signaled to start the movement. The most sophisticated autofaders allow the rate of change to be programmed to follow a predetermined time pattern. A variety of these “fade curves” is usually available and custom curves may be possible. Faders can be used to control intensity, the usual arrangement, or they may control rate of fade.

Wheel: This device is literally a knurled wheel part of whose perimeter extends through the surface of the console. Any one or more of the various control devices or functions on the console may be assigned to the wheel. While assigned, their setting may be altered either up- or downward from wherever it was when the device was assigned. Once changed, the new setting may be recorded into the current cue, made into a new cue, or abandoned in favor of the original setting. This flexibility makes the wheel a desirable device for quickly changing settings “live.” Note that the wheel has no stopping point. Its movement simply raises or lowers the setting from its present amount.

Touch Plate: This device is rare on consoles designed for the legitimate theatre but common on those designed for the concert field. It consists of a rectangular metal plate that only needs to be touched to cause it to function. Its purpose is to make it possible for the operator to “play” a series of presets rapidly and in random sequence. Changes are usually as near to instantaneous as the luminaires will allow. Also touching a plate could serve as a “go” signal for an automated cue sequence.

Trackballs and *Fingerhole Knobs*: These are special controllers normally used to control the movement of automated luminaires. The trackball may be simply the same device often found in place of a mouse on computers. The fingerhole knob is a conveniently large knob with a finger hole in its face to allow the operator to rotate it smoothly over a complete circle. Either of these devices make it possible for the operator to angle one or more luminaires over a wide range, the limitation being the capability of the luminaire itself.

Organization of Consoles

The pervasive influence of the preset concept is reflected in the organization and labeling of many consoles. One section is often entitled "recording" and another "playback." (Figure 4.3) The recording portion is arranged to facilitate the creation and storing of preset cues. It will usually contain a bank of controllers, sometimes one per channel, sometimes a lesser number to which any load circuit or circuits may be assigned by computer. Many consoles contain what amounts to a manual two-scene preset controlboard which is intended to enable the operator to create and record cues and also to run simple shows directly from the console without previously creating presets. The two-scene setup provides two controllers for each circuit under control making it possible not only to create preset cues but also to design and record the transitions between cues. On many consoles, this two-scene preset arrangement will handle only a fraction of the total number of channels in the system unless several are loaded onto each controller. When not being used to build up cues, these same controllers can be digitally reassigned, frequently as submasters.

Record and playback sections of a console

The "record" portion of the console will also contain or be adjacent to the apparatus needed to assign cue numbers and sometimes names, and then to record them into memory. Transitions between cues may also be recorded on the more elaborate consoles. Note that almost every console available provides facilities for the insertion of additional cues between those previously recorded.

Inserting additional cues into the sequence

"Playback" Section of Consoles

The playback part of the console (Figure 4.3) will contain facilities for calling up cues, assigning them to a control device and then taking the cue at the proper moment in the production. Cross faders are the commonest device for this operation. Cues are sequentially assigned to the inactive end of the cross fader and brought up when the fader handle is moved to that end. If the console is set in its "sequential mode," as soon as the fader has reached the limit of its traverse, the next cue in memory will be called up and assigned to the inactive end. This makes it possible to move from cue to cue as fast as the fader handle can be moved back and forth. Obviously, this arrangement is ideal for operating preset cues. The ultimate in this sort of automation is for the transitions to be recorded into the cues taking even the timing of the transitions out of the hands of the operator who has only to press a "go" button (or move the autofader lever slightly) to initiate the cue.

Sequence mode

Using Modern Consoles for Counterpoint Lighting

Although the labeling and outward arrangement of most modern consoles reflects their history as preset devices, all but the most primitive offer a wide variety of ways to operate counterpoint lighting or, even better, to combine preset and counterpoint lighting. The designer and operator(s) must simply ignore the labels such as "record" and "playback" and use the functions provided.

Ignore "record" and "playback."

One of the most useful functions of a modern console is the previously mentioned "page" arrangement for re-configuring the channels operated by "submasters." Despite the name, an adequate number of these devices provides an ideal way to set up pattern control, provided that the submasters actually exist or can be made to exist on the console and are not merely software. The usual procedure is to assign a number of individual channel controllers to a submaster to make up a pattern. If these controllers are actually present on the console, they may also be used to tweak settings within the pattern. Most modern systems allow the same load circuit to be assigned to more than one control path at once making it possible for an individual circuit to serve more than one pattern at a time.

Pages of submasters offer ideal flexibility.

Patterns for an individual segment of the show can be built up on a single page and, when the time comes to add or drop one or more patterns, this can be accomplished by setting up the new arrangement on another page and switching between the two. "Live" page changing should be possible on any console intended for use with counterpoint cueing. Although the usual number of patterns being changed at any given moment during a production will usually not exceed three or four, as many as ten patterns may need to be available on pages to allow for rapid shifting instantly from one working group of patterns to another.

While counterpoint is being operated via the pages of submasters, one or more presets can be operating to care for the static or near-static portions of the lighting. These will, of course, carry through without being affected by the pattern changes.

Presets can run along with patterns.

Note that this scheme almost reverses the apparent intent of the console designer's labels. The "playback" section becomes the control for whatever presets are in effect and may require relatively little of the operators' attention. Meanwhile the counterpoint lighting will be effected on the "record" section, often with intense activity. Those considering the purchase of a new console may wish to keep this in mind giving those consoles which provide adequate space for this activity an advantage over those which crowd the "record" section into the smallest possible space.

Other Parts of Consoles

A wide variety of features is offered by most manufacturers, particularly for their more elaborate (and expensive) consoles. Here are some of them:

Tracking: In addition to offering the designer and console operator a way of making a channel setting or settings continue automatically from cue to cue until changed, tracking affords the technician a way of searching through the cues to discover why something mysteriously goes wrong with a channel at some as-yet-unknown point in the show.

Global Change or *Cancel*: This function, associated with tracking enables the operator to change the reading of the identified circuit over the entire show or to cancel that circuit out completely. “Cancel” is particularly useful during the run when a luminaire gets knocked out of focus and light is striking where it is not intended. The offender can be canceled out until repairs can be effected.

Using tracking to solve problems

Flash or *Bump*: This is an electronic means of identifying a luminaire or luminaires on a single circuit so that changes can be made. Flash causes the circuit to flash on and off enabling the crew to identify the luminaires associated with it. Bump temporarily brings the luminaire(s) to full thus making it stand out from the many others presently on. Both of these features are helpful during focusing sessions and when making changes between rehearsals.

Utility Controls

Although not a direct part of lighting design and operation, such items as house lighting, work lights, orchestra pit lighting and, of course the lighting for the console itself, must be controlled. Many consoles can be ordered with controls for these items installed ready to be hooked up. In other cases, the controls for these utilities will be mounted adjacent to the console but not as part of it.

Emergency Controls

The theatre building emergency lighting system will automatically come on in case of power failure without any action on the part of the lighting personnel. Indeed, the emergency system is intentionally kept entirely separate from the theatrical lighting system and even utilizes a separate set of lamps mounted in the house and throughout the building. Its automatic controls are installed well away from the stage lighting system. However, many municipalities also require a “panic” system controllable from a number of legally specified locations including the lighting control area, backstage right and left and the house manager’s office. Panic buttons are engineered to transfer the house lighting from its normal dimmer-operated source to a constant and separate power supply, thereby providing house lighting in the event of a complete failure of the stage system, but not of the entire building supply. The panic button in the lighting control area should be installed near the console, although legally it cannot, in most instances, be a part of the console. Operators should be well informed about its purpose and also about the emergency system.