STUDIO

LIGHTING

WORKBOOK

by
Melanie Heinrich

STAGE DIMMER

A comprehensive unit designed to handle up to 20A per channel with **emphasis upon ease of construction and versatility** in operation

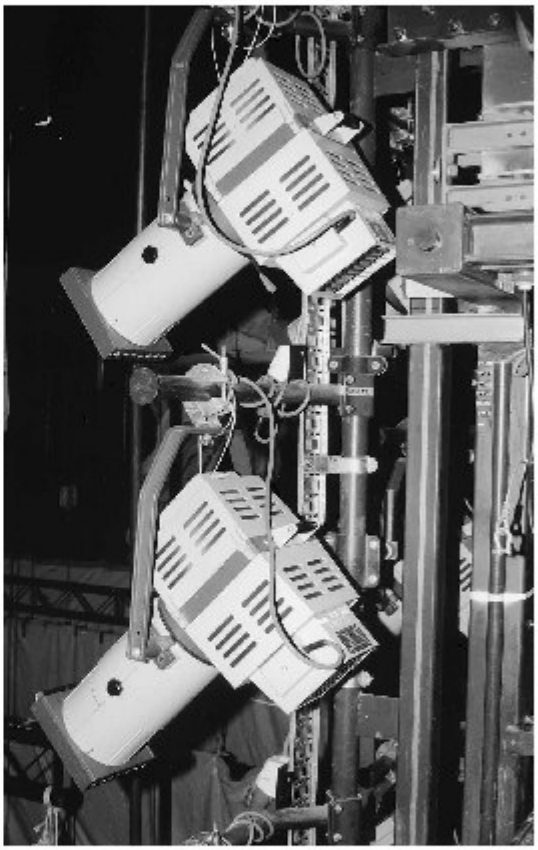
SINCE THE EARLY DAYS of the theatre the need for lighting has been all-important Just as important has been the need for control of that lighting. This ranges from very crude initially to very sophisticated today often with a computer doing the controlling in the creation of special moods and effects.

The first types of dimmer used of which there are still some examples in older theatres, was a variable resistance type which used either a variable or switched power resistor in series with the load With small loads a wire wound resistor or a carbon pile was used while larger loads used a tank of saline solution with a central electrode which was raised or lowered in the liquid, effectively changing the resistance This type of dimming, while reasonably effective, dissipated a lot of power which made life uncomfortably hot for the operator, since to minimise mechanical linkages the dimmers themselves were often in the control room.

stage-lighting control

with DMX512 protocol

Before the computer age, it required quite a number of assistants to control the stage lighting in a theatre. Today, however, even here the computer has proved its usefulness as a tool. With the DMX512 (***D***igital ***M***ultiple***X*** for 512 units) standard, a computer can control the entire lighting system, including ancillary functions such as the colour filters and dimmers. In this setup, a simple interface cable enables the computer to control up to 512 separate lighting units.



By our Editorial Staff

Some of us theatregoers may remember the large theatre lights that were manually operated. Each light required at least a pair of hands – a labour-intensive and therefore costly affair. When electronic control units, and later the computer, became available, many theatres adopted analogue lighting control systems that were much simpler to operate, and therefore more cost-effective.

However, over the past ten years or so, digital control systems controlled by computer have become the norm. In most smaller theatres, the set of instructions developed for the United States Institute for Theatre Technology (USITT), code-named DMX-512, has been adopted. This is an efficient, yet simple, digital protocol, accepted in many parts of the world, which enables all aspects of the stage lighting to be controlled by a computer.

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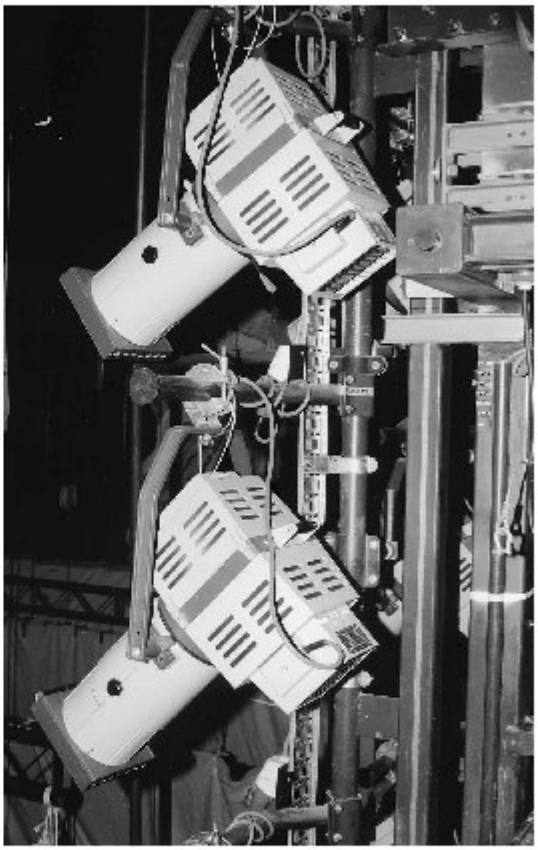

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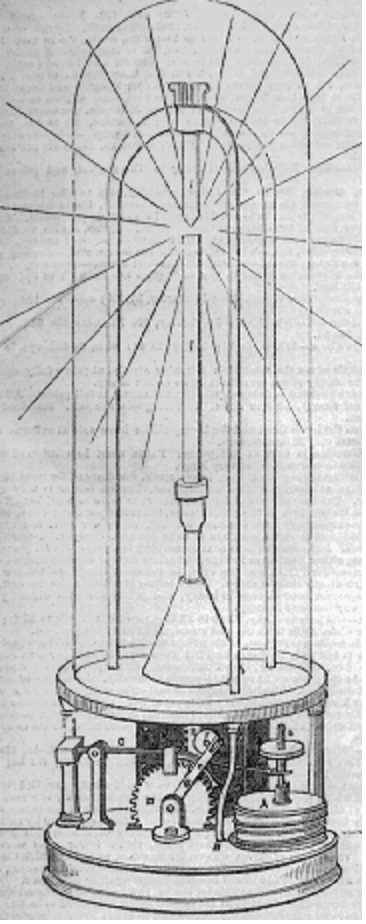


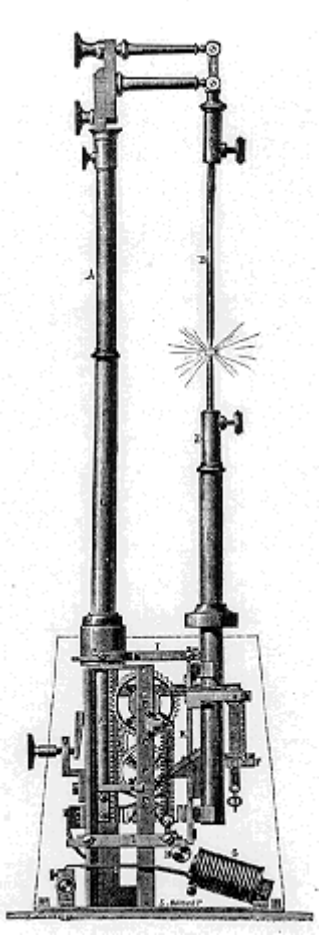
William Edwards Staite

William Staite made a major contribution to the development of the arc lamp in Britain. He began experimenting with arc lamps in 1834. Over the next few years he took out several patents both for lamp mechanisms and for the production of carbons, and in 1836 he showed that the movement of the carbons could be regulated by clockwork. With the help of William Petrie he continued to improve his lamp, taking out futher patents between 1846 and 1853. They gave many demonstrations around the country - in his memoirs on the development of the light Staite lists 40 different displays. In 1848 they floodlit the portico of the National Gallery in London, and by now the public were getting used to demonstrations of electric light. *The Illustrated London News* pointed this out, but it also pointed out that arc lamp systems were too costly for use on a regular basis.

The problem was that there was as yet no cheap electricity supply and very few practical generators. Primary batteries such as the Daniell cell and other chemical batteries had to be used to power individual lamps, and batteries cost too much to be used for a permanent system. Staite found this out the hard way - his Patent Electric Light Co. failed in 1850 after only a few years in business. He received little credit at the time for his work. Arc lamps were featured in the Great Exhibition of 1851, but no mention was made of Staite's pioneering efforts, despite the fact that the lamps on show used many features that he had helped to develop. *The Times* declined to publish a letter from Staite setting out his claims,

which partly prompted him to write a memoir of his work with arc lamps. This manuscript is now in the IEE's archives.

Back to the arc lamp story.



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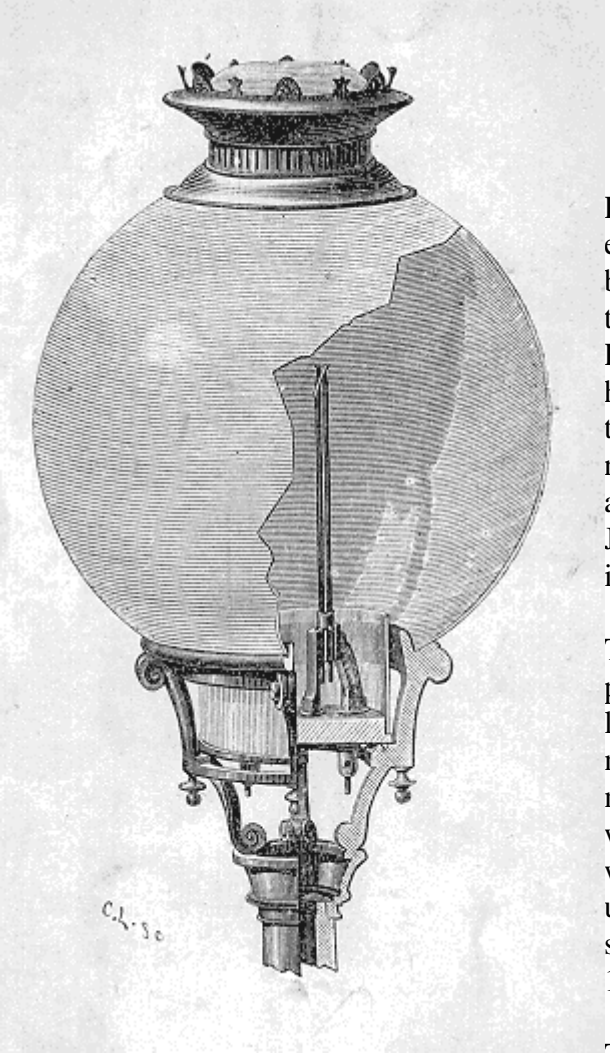
Arc Lamps up to the 1870s

Sir Humphry Davy's experiment to demonstrate the electric arc was easily reproduced by other scientists, but it was not immediately embraced as a source of electric light. As yet no practical means existed of generating a current sufficient to sustain a light over a long period of time. With the development of chemical batteries in the 1830s and 1840s, arc lighting entered a period of practical experiment. Several engineers designed and patented lamps, many of which used clockwork to control the mechanism. These included the lamps of the Frenchman Leon Foucault, famous for his pendulum experiments. Foucault began work with arc lamps in the early 1840s, devising a means of maintaining the arc by hand regulation of the mechanism. He patented his clockwork mechanism in 1849. William Staite took out patents for clockwork mechanisms in Britain.
However, chemical batteries were a very expensive source of electricity, and most of the engineers experimenting with arc lamps during this period concluded that as yet, arc lighting did not have a wide field of application. With a few exceptions, there was a lull between 1859 and the development of cheaper batteries and practical generators in the 1870s. Some lamps survived in limited use however. These included the lamps of Duboscq (1858) and Serrin (1857). Serrin's lamp in particular was a success, and when Col. R.E.B. Crompton started out in the electric lighting industry, his first lamps were based on Serrin's design. Such lamps were important in keeping electric lighting in the public eye, but it was not until the large scale installations of the Jablochkoff Candle in the late 1870s that arc lighting came into true practical use.
Serrin's arc lamp

Back to the arc lamp story.

The Jablochkoff Candle



Paul Jablochkoff (1847-1894) was a Russian telegraph engineer who had risen to the post of director of telegraphs between Moscow and Kursk. In 1875 he resigned, planning to travel to America to see the international exhibition in Philadelphia. However he only got as far as France. In Paris he met Louis Bréguet (1804-1883) who had developed telegraphs and electric clocks for the French navy and railways. Bréguet gave Jablochkoff the use of his laboratory and in 1876 Jablochkoff developed his electric 'candle'. The Jablochkoff Candle was one of the first arc lamps to be used in large quantities.

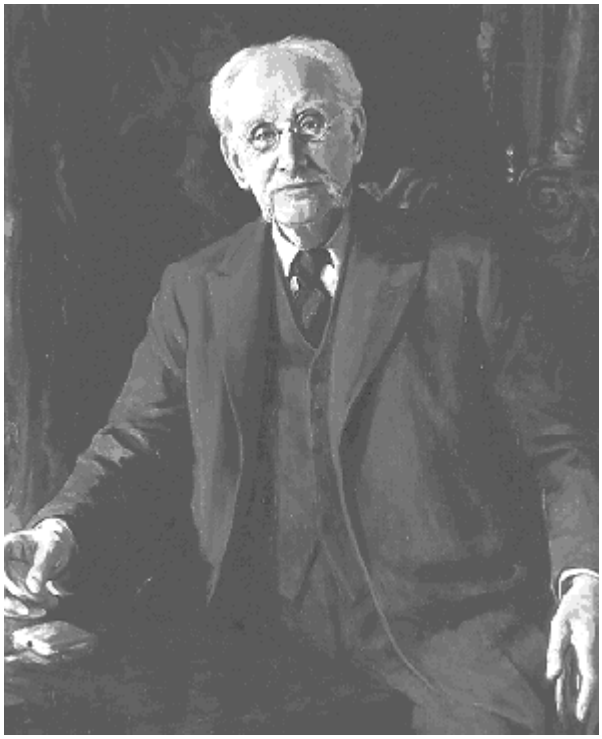
The Jablochkoff Candle was cheap and simple compared to previous arc lamp designs, and it was far brighter than gas lamps. The carbons stood upright, parallel to each other - this meant that the candle did not require complex regulating mechanisms. The main importance of the Jablochkoff Candle was that it brought electric light to public attention. The lamp was marketed by the Société Générale d'Électricité and was used to light streets, public buildings and docks. It was also shown at all the electrical and industrial exhibitions in the late 1870s and early 1880s.

The candle was influential in Britain too. In 1878 the Metropolitan Board of Works installed candles on the Victoria Embankment, while the City of London used them to light Billingsgate fish market, the Mansion House and Holborn Viaduct. In March 1880 there was an abortive attempt to demonstrate the candle to the Society of Telegraph Engineers (the nascent IEE). However the major problem with the candle was that the carbon arrangement had to be completely replaced every time the lamp was switched off, and it was soon superseded by lamps with reliable mechanisms for moving the carbons.

Back to the arc lamp story.

Col. R.E.B. Crompton (1845-1940)

Col. Rookes Evelyn Bell Crompton was a major pioneer of the electrical industry in the late 19th/early 20th century. His interest in engineering began at school, and after a period in the army he joined T.H.P. Dennis & Co. in 1875. He soon formed his own company, Crompton & Co., and produced instruments, domestic appliances, lamps and almost every other electrical device.



He was the first major British manufacturer of generators, and his power station at Kensington Court, which began supply in 1887, represented one of the first practical supply schemes. He was also a champion of international electrical standardisation, and was instrumental in the formation of the International Electrotechnical Commission in 1906. He was twice President of the IEE.

Crompton's work with arc lamps began with Dennis & Co. He was dissatisfied with the French lamps he was importing, so he designed a lamp of his own based on the successful Serrin lamp. He placed the mechanism above the carbons so that it cast no downward shadow, and improved the regulating mechanism to reduce the amount of flickering. Crompton continued to improve arc lamp mechanisms, and his design based upon the Pochin lamp produced one of the best arc lamps available.

To publicise the electric light, Crompton used portable generating sets to mount spectacular displays, including demonstrations at the Henley Regatta and Alexandra Palace in 1879. In 1880 he published one of the first lighting manuals, *The Electric Light for Industrial Uses*. In the same year he met Joseph Swan, and was impressed by Swan's incandescent lamp. Crompton and Swan worked together, their joint company installing both arc and filament lamps. Crompton's installations included the Law Courts, King's Cross station and the Opera House and several public buildings and theatres in Vienna. Crompton also pioneered the military searchlight, again using arc lamps.

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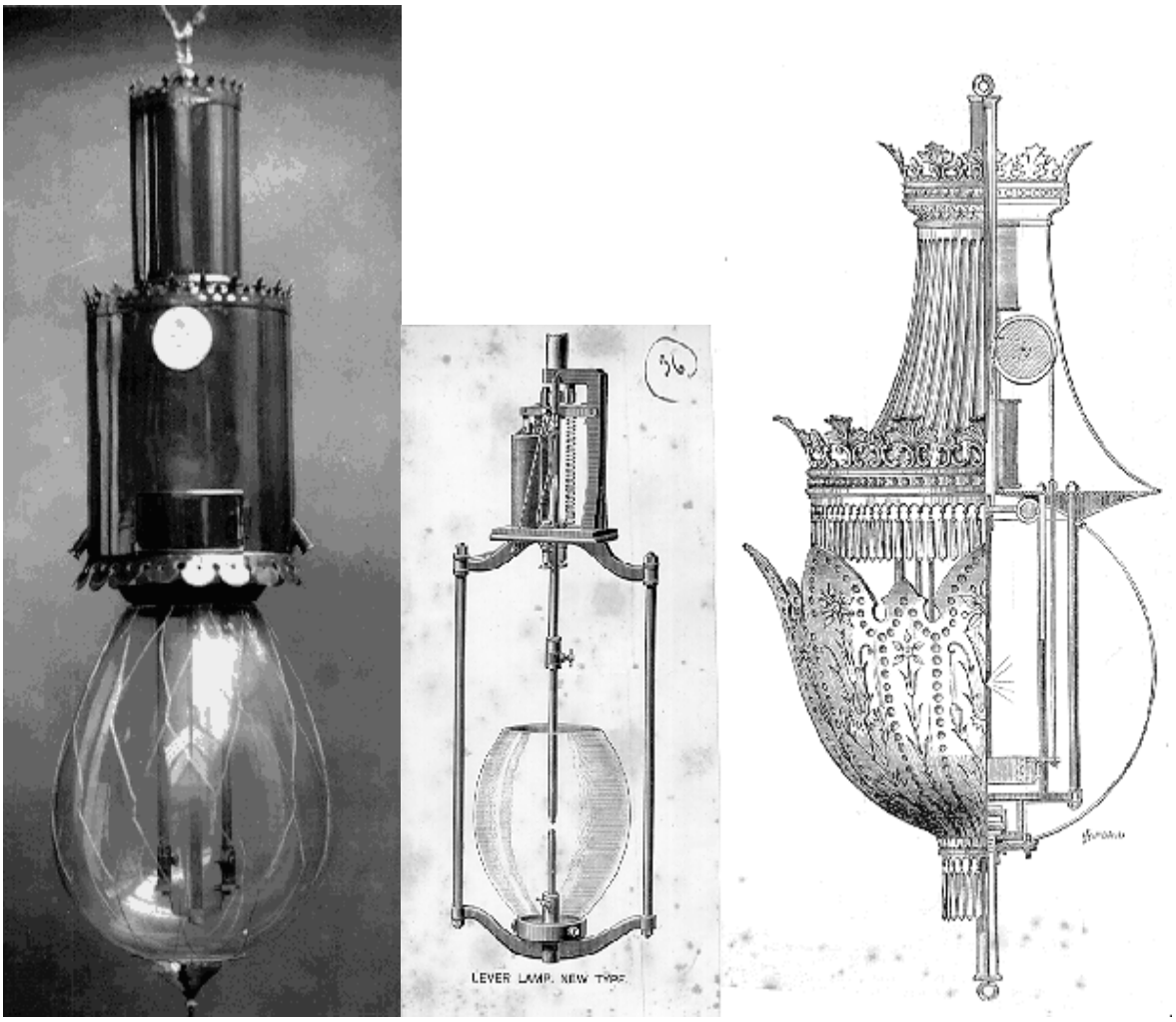
Some arc lamps from the 1880s and 1890s

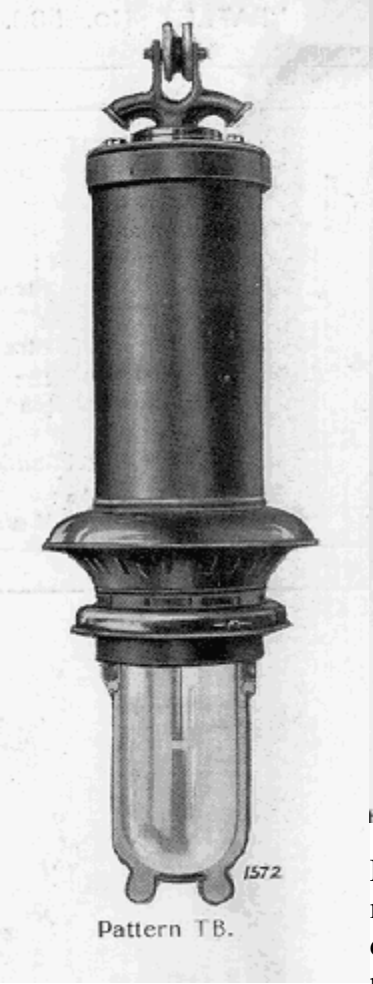


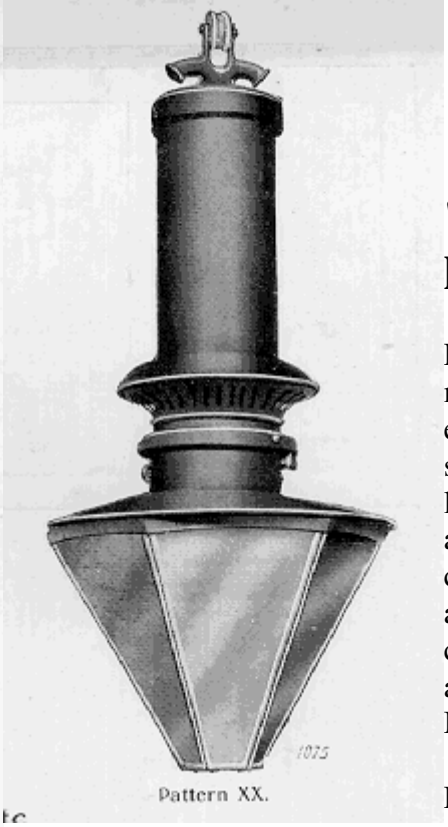
Left to right; Jolin-Parsons, Lever and Pilsen arc lamps.

Three examples of typical arc lamps from the 1880s. Engineers were constantly trying to find ways of improving the arc lamp's mechanism for regulating the movement of the upper carbon - it descended as the two carbons burnt away. Lever used a spring mechanism, while Jolin and Parson's lamp, which won the approval of Silvanus P. Thompson, used an electromagnet.

The Pilsen lamp was developed by two Austrian engineers, Ludwig Piette and Franz Krizik, and was marketed in Britain by Henry F. Joel. It had a complex regulating mechanism which used an iron core between two solenoids. The lamp was quite extensively used, and won a Gold Medal at the Paris Electrical Exhibition of 1881. The illustration shows a lamp with an ornamental covering for use in theatres.

Back to the arc lamp story.





'Enclosed' and 'flame' arc lamps.

Enclosed and flame arc lamps were the final major developments in arc lamp design. In an enclosed lamp, the arc was contained in a small glass tube within the main globe of the lamp. This restricted the flow of air round the arc and reduced the consumption of the carbons by a factor of about five. Enclosed arc lamps therefore had reduced maintenance costs, but required more power. The enclosed arc was introduced by an engineer called Marks in 1893.

Flame arc lamps had cores of flame-producing salts added to the carbons. Mixtures of flourides of magnesium, strontium, barium and calcium were mainly used to make the cores. Adding a salt core increased the light output, and different types of salt core gave different colours of light. Salt cores were patented in 1889, but came into use slightly later than enclosed arc lamps.

Several companies manufactured enclosed and flame arc lamps - the enclosed arcs pictured were made by R.E. Crompton & Co. in 1914.

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