DISCHARGE LIGHTING COMES OF AGE

We sometimes consider the dawn of electric lighting to have been the introduction of the incandescent lamp in 1879. But by that year there was already in existence a business based on arc lamps. This included (as the British House of Commons Select Committee on Electric Lighting was to learn in 1879), a well known installation at the Albert Hall in London, which had succeeded in reducing the cost of lighting by one third. The electric arc had been known since 1802 and in 1808 Sir Humphrey Davy demonstrated an electric arc light, but it was not really suitable for small spaces.

So it was the search for the so called 'sub division of electric light' which was being pursued. And where the carbon arc seemed unlikely to provide a suitable solution for smaller lighting packages, incandescent lamps could.

As with many significant innovations, there was a dependence on other critical discoveries and developments occurring, in order for electric lighting to proceed as a practical venture at all. It was not until 1867 that the self excited generator was developed. Until then dynamos consumed more energy than they produced and so a reliable, economic supply of electricity did not exist.

Secondly the advent of the Sprengel Vacuum pump provided the means to produce the incandescent lamps. These were first demonstrated in 1879.

It is interesting that the two fundamental mechanisms of producing light – the electrical discharge and the incandescent filament – remain the basis for all popularly used light sources to this day.

Whilst the incandescent or tungsten filament lamp as it became known, provided an inexpensive and convenient means of lighting, discharge light sources enjoyed their greatest use initially in streetlighting from the early 1930's and increasingly in a variety of exterior and industrial situations as improvements were introduced.

A major discovery of suitable fluorescent coatings during the 1930's enabled another aspect of discharge lighting – the neon tube – to be developed into a practical fluorescent light source.

However it is the discharge lamp which has always enjoyed a high potential efficacy, but this has previously been at the expense of colour and has limited practical applications. For Strand another serious constraint has been the general unsuitability of HID (high intensity discharge) lamps for dimming in theatre applications.

The introduction of a new generation of compact HID lamps such as CSI/CID and HMI formats in the late 1960's and early 1970's brought improvements in colour rendering and appearance.

First shown at the Photokina exhibition in 1972 extensive HMI product ranges rapidly made progress in the motion picture industry. They were a compact replacement for the carbon or 'brute arcs' and . provided the higher illuminance levels required for the colour broadcast of OB sporting events.

These lamps work on the arc discharge principle but owe their improved colour rendering to a mixture of metals introduced in small but carefully controlled proportions as halide salts into the arc tube to give additional spectral emission lines . This provides a balance of colour lines in the spectrum, which merge into a white light.

Unlike incandescent lamps they do not produce a continuous spectrum and colour temperature cannot truly be ascribed. But they are generally regarded as having a high or cool colour temperature referred to as 'daylight', measured at 5600°K which is equivalent to the colour temperature at midday under an overcast sky. Incandescent lamps have a low or warm temperature of around 3000°K.

A wide range of HMI lamps has been available in a tubular double ended format and Strand's Quartzcolor Sirio range uses lamps from 575W through to 18000W.

Recent developments in HMI lamps have resulted in a more compact single ended format from 200W up to 4000W for which Strand is developing a number of new products including the recently announced Super Quasar 2500 SE and developments of the Sirio range (Sirio Bambinos and Sirio Twins).

New Developments in Single-Ended Metal Halide lamps – the MSR

A new range of metal halide lamps has been developed in single- ended format, known by the designation MSR (Medium Source Rare earth lamps). Their spectrum is comparable to the HMI and MSI lamps already well established for 'daylight' applications. The spectral energy distribution is a quasi-continuous spectrum due to the multiple line spectrum of rare earth elements and a continuum of molecular radiation. These lamps also enjoy very good colour characteristics with an equivalent colour temperature of 5600K and a colour rendition index (CRI)>90 giving a good match to daylight. These short arc length HID lamps enjoy high luminous efficiency in the range of 80 to 100 lumens per Watt (depending on rating) with very high illuminance and offer new opportunities in the design of studio and location lighting luminaires.

There are two families of MSR lamps now available. One, started from a relatively low ignition pulse (2kV to 5kV), in 200W, 400W, 700W and 1200W ratings, being single ended lamps with a prefocus lamp base. The other a family of hot restart lamps requiring ignition pulses between 25kV and 60kV and designed in such a way to ensure arcing from such high voltage pulses does not occur within the lamp base or internal structure available in 200W, 575W, 1200W, 2500W and most recently 4000W. It is this second family which is being introduced into the Quartzcolor range.

Electrically these lamps are compatible with the existing Strand Quartzcolor ranges of HMI ballasts in both compact and electronic formats.

A useful feature for balancing lighting levels on location work is an ability to dim to around 40% of nominal power, whilst maintaining a stable colour temperature, when used with Strand Quartzcolor electronic ballasts.

Electronic Ballasts

One major requirement of HID light sources is their need to operate from an AC supply in conjunction with a series ballast. The ballast stores energy and acts as a current regulator to maintain the arc as the mains voltage alternates through the cross-over point 50 or 60 times a second.

Although the eye sees a constant output from the lamp, the arc is actually changing following the mains supply, and the light output increases and decreases with the mains waveform. When discharge lighting is used with TV or film cameras, this effect is dramatic. A reel of exposed film shows the scene rapidly fading away to darkness and then fading up again as the mains supply alternates.

Using DC to supply the arc does not help, as the continuous uni-directional current gradually destroys one of the electrodes of the lamp. The solution is to provide the lamp with an AC supply which switches direction very quickly: a squarewave.

The electronic ballast therefore has two functions: it provides the constant current capabilities of a copper and iron ballast unit to maintain the arc, and it supplies power as a square wave which can be synchronised to the camera's shutter speed to eliminate the flickering as a dark frame is projected. The electronic ballast is frequently called 'flicker-free' for this reason.

Devices which can reliably withstand harsh operating conditions are now commercially available at an economic level, and this has led to new generations of electronic, flicker-free ballasts for the ratings of HMI and MSR lamps used in the Quartzcolor range from 575W through to 18kW.

The reduction in weight, flicker free operation, dimming capability and greater compactness all combined to provide smaller, powerful lighting systems for motion picture and location needs.