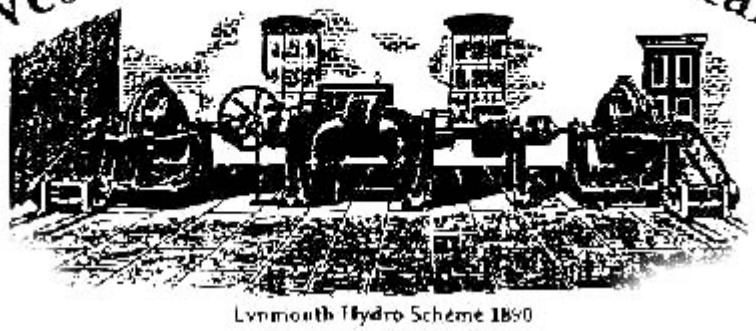
South Western Electricity Historical Society



Lynmouth Hydro Scheme 1890

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This site contains all the necessary contact information you may require.

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Supplement to HISTELEC NEWS No.6
August 1997

Electric Arc Lamps in Bristol

by Peter Lamb

In looking at old photographs of late Victorian or early Edwardian scenes, many of you may have noticed very, decorative street lights gracing the foregrounds. These lamp standards had long cylindrical shapes above the lamp, which distinguished them as being electric arc lamps. You may have wondered, like me, what was inside these housings. These cylinders, known colloquially at the turn of the century as "chimneys" were not chimneys at all, but housed the complex mechanisms regulating the carbon electrodes. Only two lamp standards of this distinctive design remain as street furniture on the Bristol streets and these are situated at The Mall, Clifton Village.

Public lighting in Bristol prior to 1893 was by gas using a simple gas jet, which only provided a light of 15 candle-power. The gas mantle, at eight times brighter, had not been invented prior to this time, and a commercially viable design did not become available until 1895.

A public electricity supply commenced in Bristol in August 1893 when the first generating station was commissioned at Temple Back. At that time, generation was solely for domestic and public lighting and there were two systems installed alternating current (AC) and direct current(DC). The AC supplies were used primarily for the domestic supplies, distributing at high voltage (2,000volts, single phase) and transforming down to 105/210volts at small substations. For lighting in domestic dwellings, incandescent filament lamps, with carbon coils as filaments, were used. Arc lamps were not used in the home, since they were too fierce and too smelly. The incandescent lamp, which had first appeared in the mid 1880's, had a luminosity of 15-100 candle-power being brighter than the gas jet. The great advantage of the arc lamp at 1500-2000c.p was its extreme brightness at 100 times greater than the gas jet and also greater than the incandescent filament lamp. Therefore it may be appreciated why it was more suitable for street lighting.

The DC supply generated at Temple Back was at 600volts for public lighting using 96 arc lamps, initially connecting 12 per circuit in series, thus giving a voltage per lamp of 50volts. Over a decade later the voltage was changed to 500volts with 10 lamps per circuit. Before describing the Bristol arc lamps, I would like to take you through a brief history of the development of the arc lamp prior to 1893.

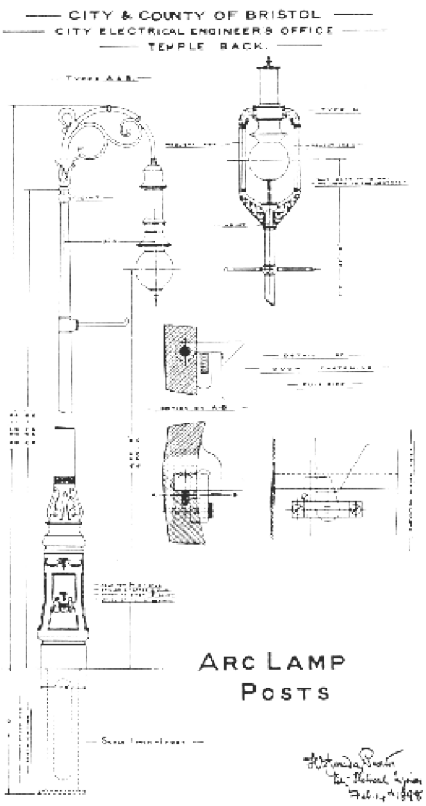
Sir Humphrey Davey is credited with inventing the first arc lamp, when he demonstrated his invention at the Royal Institution in 1810. It was powered by batteries and used charcoal elements enclosed in a vacuum. The vacuum allowed a longer arc with a much higher voltage. It was some years later (1844) that the principle was further developed by a Frenchman by the name of Foucault. He used carbons from the retorts of a gasworks, which were more durable. Thomas Wright devised the first arc lamp, which involved adjustment of the carbons automatically as they burnt away, and W.C.Staite used an electric current for the regulation of the carbons. Foucault responded in 1858 by producing his regulating lamp.

In 1876 Paul Jablochkoff, a Russian living in Paris, produced what was considered at the time to be a big breakthrough, selling 4000 within a few years. His device was known as the "electric candle", since it involved two parallel carbon rods in an upright position separated from each other by a layer of Piaster of Paris. As the carbons were consumed, the positive rod was eaten away at twice the speed of the negative rock so alternating current was preferred to equalise the erosion. In other later arc lamps the positive carbon

rod was made twice the size as the negative rod.

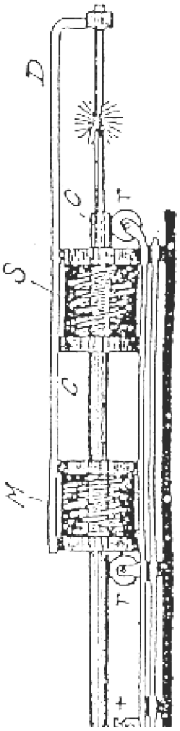
Jablochkoff's invention was soon overtaken by lamps with more sophisticated regulating devices and there were many to choose from by 1893. Arc lamps were devised to work on both DC and AC, but a brighter light was achieved on a DC system. Also some lamps were open and some were enclosed. There were advantages and disadvantages with enclosing the arc in a vacuum or inert gas. The carbon rods did not bum away so quickly when enclosed, but soiled the glass enclosure, thus requiring regular albeit different maintenance. This was partially overcome by using carbons with a purer content i.e. less metal oxides included. Not only was there a wide choice of manufacturers, but also a wide choice of regulating devices, which can be condensed into five varieties as follows :-

1) Clockwork mechanism
2) Basic electrical, involving two solenoids
3) Two solenoids with a clutch
4) Two solenoids with a brake wheel
5) Electric motor operated

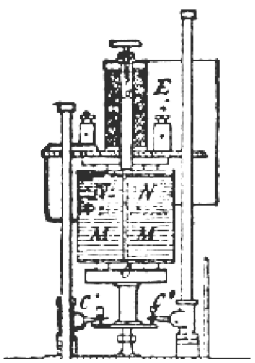


Bristol Corporation Electricity Department chose the Brockie Pell open type lamp with two pairs of carbons from advice given to them by their Consultant, William Preece, (later Sir William), Chief Electrical Engineer to the Post Office, and their newly appointed (in 1892) Electrical Engineer, Harold Faraday Proctor, a relative through his mother's side, of Michael Faraday. See early drawing dated 1898 illustration no. 1 of street light column personally signed by Harold Faraday Proctor, highlighting the importance of lighting at that time.

The Brockie-Pell lamps are described in some technical literature as being of the type with two solenoids and a brake wheel. Professor Silvanus P.Thompson describes the Brockie Pell Lamp as having a see-saw leverage system First of all, it is necessary to explain the basic principle of most arc lamp regulating devices, which involved two solenoids, since the majority of regulating lamps consisted of these basic parts.



The diagram illustration no.2 shows the Pilsen Lamp with two solenoids. The basic principle of this lamp was for the main coil M acting on a bi-conical core C to pull one carbon apart from the fixed one, thus striking the arc. When a current is drawn through the shunt coil S, it pulls the carbon rod in the opposite direction, until a balance is achieved. As the carbons burn away they are automatically moved closer together maintaining a specific gap.



Although I am unsure, which specific type of Brockie-Pell arc lamp was used in Bristol. A patent design was filed in October 1881 by J.Brockie using two pairs of carbons and this is shown in the diagram illustration no.3, which shows the complex mechanisms involved. It is not intended to describe in extreme detail the workings of this arc lamp, suffice it to say that they were designed to achieve two objects :- (a) To feed the

carbons very gradually as they arc eaten away, maintaining a constant gap and voltage across the arc. (b) To change over the one pair of carbons, when one pair had been eaten away.

By 1911 there were 695 arc lamps connected to the Temple Back DC system involving 5 different types of arc lamp and three different manufacturers. All the arc lamps had two pairs of carbons with added mechanisms as above, which changed over the carbons to a second pair of carbons. One pair of carbons only lasted 6-8 hours and one pair would barely last one night before requiring the replacement of the carbon rods or "pencils" as they were known locally. Also the men who changed the carbons were known as "trimmers", a relic from the days of trimming oil lamp wicks passed on to the gas men trimming gas mantles and thence to electricity workers!

The lamps on the system in 1911 were :-

185 Brockie-Pell 10 ampere open type with 2 pairs of carbons

364 Oliver 5 ampere open type with 2 pairs of carbons
116 Oliver Oriflamme 10 ampere enclosed
16 Oliver Oriflamme 7 ampere enclosed
14 Excello Flame bv Union Co. open type

The flame arc lamps achieved a greater brightness by the introduction of other chemicals such as salts of calcium, barium and strontium into the carbon rods. Also some of the flame type arc lamps, involved even more complex mechanisms, such that they had a magazine containing six pairs of carbons and thus extended their lighting time from 12 hours to 36 hours, although these latter types often went wrong.

Although exploring these lamps in books can be a fascinating activity, it would be even more fascinating to explore one in "the flesh". If anyone knows of one other than those in the Science Museum, please let me know.

(David Gledhill, member, is thanked for some of the information contained in this article)

Supplement to HISTELEC NEWS No.6
August 1997

Bristol's Arc Lighting System

by the late Cedric Blackett

The original street lighting system in Bristol in 1893 used carbon arc lights connected to a D.C. system in series.

The D.C. system of supply was 250-0-250 volts, centre point earthed. The carbon arc lamps ran at 50 volts and therefore the lamps had to be run in circuits of ten or five lamps in series 500 or 250 volts per circuit, that is after they had been changed over from the 600volt system. The lamps, which were of Brockie Pell manufacture, were connected by single core cables starling and finishing at Temple Back Electricity Works (the generating station of its time in 1893). Experience showed that the cables used (some of which were gutta-percha insulated) were not very reliable, and faults were common. For this reason, two motorgenerators were available which provided 250 or 500 volts, without any earth connections. Thus with these, if any particular circuit went down with an earth fault, the circuit could be maintained until repairs could be carried out.

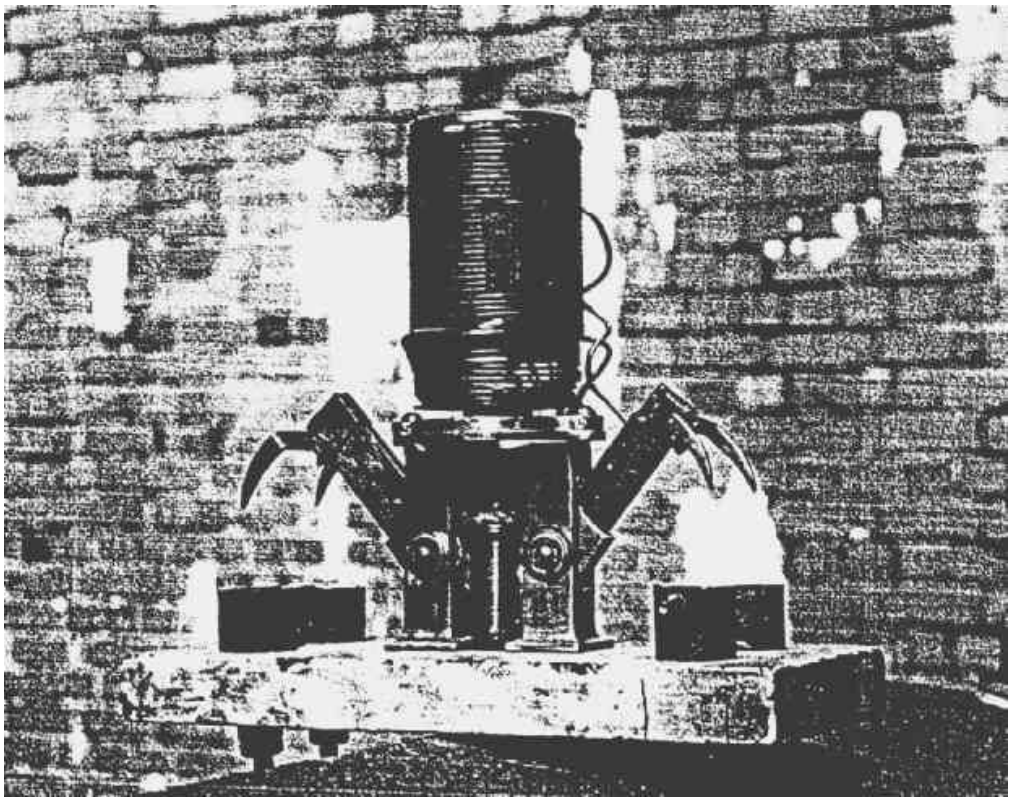
This method of lighting had a number of difficulties, but was the only method available at that time where a large wattage was needcd.. Arc lamps were much brighter(20 times) than the only carbon filament lamp then available and therefore were more suited for street lighting purposes.

First the area covered was fairly small using ten lamps. This was overcome by having a relay at the remote part of the circuit, which, in a further circuit, picked up its supply from the local network. The early relays were designed as mercury bath dip switches, one of which can be seen in the Society's museum collection and is illustrated here.

Second. with a series circuit, if one lamp failed. the whole circuit failed. This was overcome by having a wire wound resistor in the base of the lamp, which was switched in automatically if the lamp failed.

The arc lamp circuits were controlled from a special plug board of Ferranti design. Connection was made by inserting the appropriate plug, so that any circuit can be connected to any source and with any polarity. Any alteration to the circuit arrangement to these circuits had to be done with the supply dead - any attempt to operate with the system alive produced a spectacular display -- D.C. at this voltage is very nasty stuff.

Right from the start, the lamps had two pairs of carbon pencils, which automatically changed over when one pair had burnt out, thus lasting a longer time. This system of carbon arc lighting, whilst very effective, was very expensive in maintenance needing almost daily visits to replace or adjust the carbon "pencils" . Replacement etc. was carried out using a tower wagon, which was moved around manually. The system was altered in the 20% using 50 volt tungsten filament lamps, as soon as these became available on the market. These remained thus until the War, when the blitz damaged many circuits beyond repair and the system was never used again.



Photograph by Peter Bulley. member