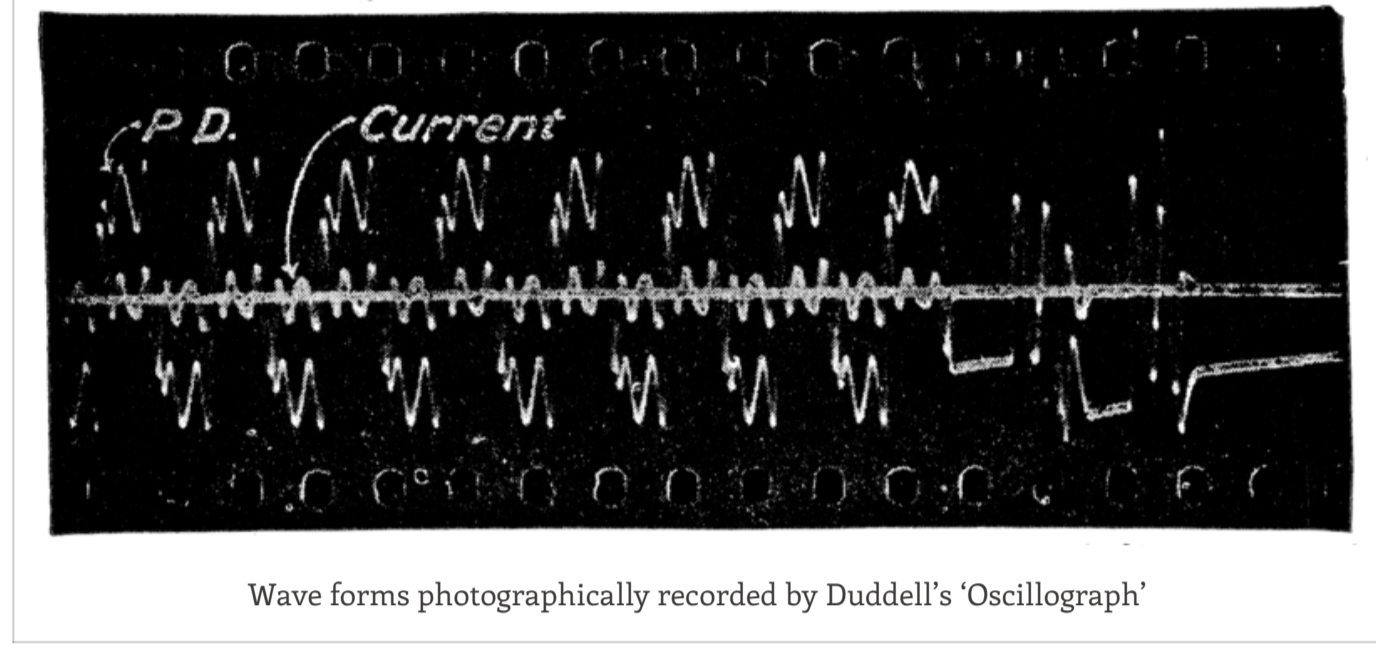


The 'Singing Arc' William Duddell, UK, 1899



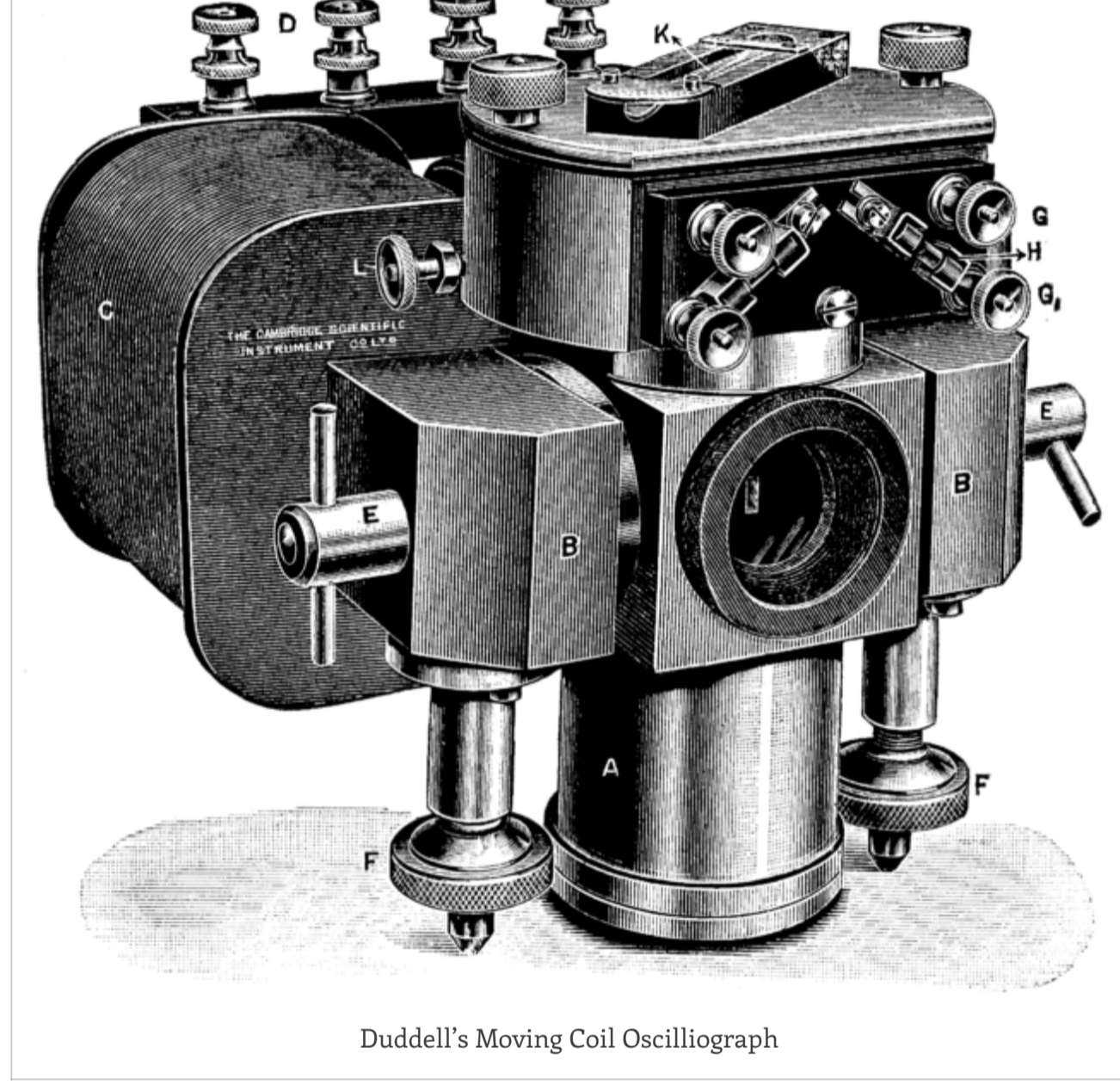
The singing arc

Before Thomas Alva Edison invented the electric light bulb in the United States, electric street lighting was in widespread use throughout Europe. The predecessor of the filament light bulb was the Carbon Arc Lamp which generated light by creating a spark between two carbon nodes. The problem with this method of lighting, apart from the dullness of the light and inefficient use of electricity was a constant humming noise from the electric arc. The British physicist and electrical engineer William Duddell was appointed to solve the problem in London in 1899. During his experiments Duddell found that by varying the voltage supplied to the lamps he could create controllable audible frequencies from a resonant circuit caused by the rate of pulsation of exposed electrical arcs.



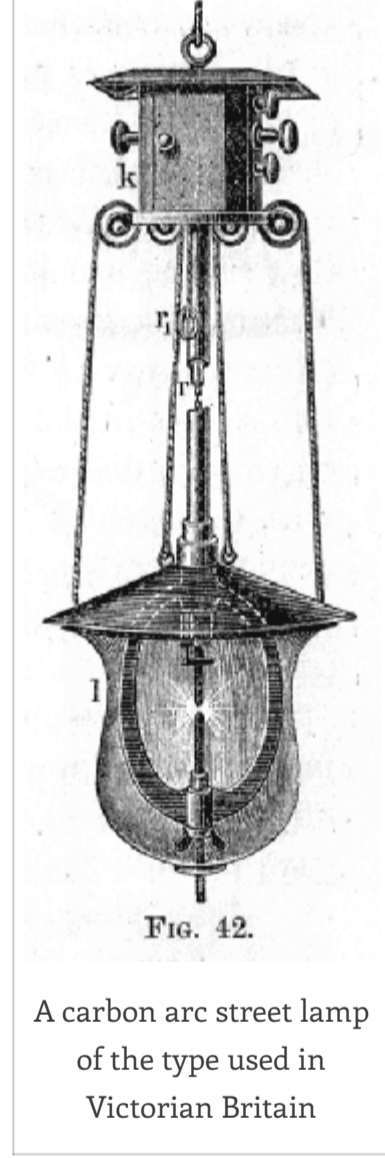
Wave forms photographically recorded by Duddell's 'Oscillograph'

(Technically note: a current arc between two electrodes, shunted by a circuit containing a capacitance and inductance would establish an oscillating circuit. The value of the capacitance and inductance determines the frequency of oscillation. An arc follows a characteristic, which is the inverse of Ohm's law in that when the current of the arc is increased, the voltage across the electrodes decreases. This characteristic is often called negative resistance. Placing a series LC circuit across the terminals of an arc will initially cause the capacitor to charge, diverting some of the current away from the arc. Given the aforementioned arc characteristics, the potential difference between the arc electrodes will increase, putting the capacitor at an even higher voltage. Once the capacitor reaches full charge the arc current will reverse to discharge the capacitor back into the arc. As the current into the arc increases, the potential difference will fall and the voltage across the capacitor will also fall to a point, which it will begin to charge again. If the circuit resistance is small enough, this process will continue as an oscillation. Duddell found that it was necessary to use a minimum of 1 microfarad of capacitance to obtain oscillations of considerable energy. With this large capacitance, it was not possible to reach high enough frequencies for transmission of Radio-telegraphy.).



Duddell's Moving Coil Oscillograph

This phenomena had already previously been recorded in 1898 by a Dr. Simon (Frankfurt, Germany). Dr. Simon had noticed that the electric arc could be made to "sing" by means of modulating the voltage to an electric arc supply. Dr. Simon showed that the electric arc made an effective loudspeaker which he demonstrated in public, Duddell may have been aware of these experiments. Dr. Simon's experiments also showed that the modulated arc produced not only sound but a modulated light beam by means of which the German Navy managed to make telephone calls between ships using a modulated arc searchlight and a photosensitive selenium cell.



A carbon arc street lamp of the type used in Victorian Britain

By attaching a keyboard to the arc lamps he created one of the first electronic instruments and the first electronic instrument that was audible without using the yet to be invented amplifier, loudspeaker or telephone system as an amplifier and speaker. When Duddell exhibited his circuit in the London institution of Electrical Engineers it was noticed that arc lamps on the same circuit in other buildings also played music from Duddell's machine this generated speculation that music delivered over the lighting network could be created. Duddell didn't capitalise on his discovery and didn't even file a patent for his instrument. Duddell toured Britain with his invention which unfortunately never became more than a novelty. It was later recognised that if an antenna was attached to the singing arc and made to 'sing' at radio frequencies rather than audio it could be used as a continuous radio wave transmitter. The carbon arc lamp's audio capabilities was also used by Thaddeus Cahill during his public demonstrations of his Telharmonium ten years later



William Du Bois Duddell

Biographical Information: William du Bois Duddell. UK b 1872

William Duddell an electrical engineer in Victorian England was famous for developing a number of electronic instruments notably the "moving coil oscillograph" an early oscillator type device for the photographic monitoring of audio frequency waveforms. Other inventions of Duddell's included the thermo-ammeter, thermo-galvanometer (an instrument for measuring minute currents and potential differences later used for measuring antenna currents and still used in modified form today) and a magnetic standard, which was used for the calibration of ballistic galvanometers.

Sources: