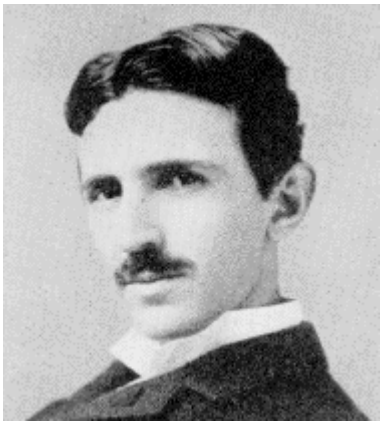
Nikola Tesla



The invention of the following two common known items have been attributed to the wrong men. These men were certainly responsible for the development of each of the inventions. However both items were first invented by Nikola Tesla who rarely gets acknowledgement for any of his many inventions.

- The transmission of radio waves is most often is attributed to Marconi.
- The vacuum tube used in radio and audio circuits is most often attributed to de Forrest.

Tesla was also the first to discover X-Rays, while he was busy with another invention, but Roentgen most often gets the credit for this discovery because he also did more follow-up work to make X-Rays a practical reality.

In fact, Tesla was one of the most prolific and brilliant inventors of electrical devices in the late 1800's and early 1900's, but he was regarded as an eccentric dreamer by many of his contemporaries. Tesla was famous at the turn of the century for developing the alternating current system still in use today. But his later inventions, documented in some 30 U.S. patents between 1890 and 1921, have never been utilized as Tesla intended despite their obvious potential for advancing in fundamental ways the technology of modern civilization. Despite Tesla's reputation, sharp businessmen were quick to grab on to some of Tesla's inventions when they thought that they could become rich men. Tesla certainly did have some ideas that were considered by many people at that time to be very far-fetched. Tesla talked of death rays that could destroy 10,000 airplanes at a distance of 250 miles, and he claimed that it was possible to split the Earth in two. He told how both voice and images could be transmitted through the air and he was dismissive of Edison's DC electrical system, believing that AC electrical distribution was far better.

Nikola Tesla was born in the town of Smijlan in Croatia, of Serbian parents, on July 10, 1856. Schooled at the Polytechnic Institute in Graz, Austria and then at the University of Prague, he never graduated, being forced to drop out after two years due to a shortage of funds after his father died. Tesla developed an extraordinary memory and learnt to speak six languages.

He began working at the Budapest Telegraph Company in 1880, and then for Continental Edison in Paris, France in 1882. During this time Tesla conceived a new type of electric motor that had no commutator, as direct current motors have, but operated on a principle of a rotating magnetic field that was produced by a poly phase alternating current. This started his interest in AC technology.

In 1883, Tesla constructed the first working model of a brushless, polyphase AC induction motor while on an assignment at Strasbourg, France. The AC electric motor was demonstrated to the former Mayor of the city and to wealthy potential investors. Unfortunately, Tesla found that nobody was interested in developing AC electric motors in Europe and he was unable to secure finance to develop his ideas.

So, in 1884, Tesla decided to emigrate to the United States. He arrived in the USA penniless, but had a written recommendation from Charles Batchelor, Manager of Continental Edison in France. This enabled him to obtain employment with Thomas Edison. Edison had just patented the light bulb, and he was expanding his DC electrical supply and distribution system. Edison had based all of his work on the DC

system of electricity, but was finding that DC had all sorts of problems. Apparently, Edison promised to pay Tesla a $50,000 bonus if he could make Edison's DC generators run more efficiently, thinking that it would be an impossible task. Tesla worked day and night on the problem and finally achieved success. For some reason, Edison refused to pay Tesla the bonus that he had earned, saying that he was only joking when he had made the offer. Disappointed that Edison had deceived him, Tesla resigned from Edison's company and started his own company, the Tesla Electric Light & Manufacturing Co., to develop his AC electric motor. However his financial backers, Robert Lane and B. A. Vail, refused to fund Tesla's AC motor development and Tesla was forced to close down his company. Tesla was then forced to accept whatever jobs he could find to finance his projects.

Eventually in 1887, Tesla built a more refined version of his AC induction motor and he filed worldwide patents on the invention.

In 1888, Tesla demonstrated his AC motors to the American Institute of Electrical Engineers (AIEE). Tesla's inventions caught the eye of entrepreneur, businessman and engineer, George Westinghouse and he immediately sees the potential of AC electricity. Westinghouse already owned the patent for the AC transformer and Tesla agreed to sell his AC Polyphase patents to him. Westinghouse also hired Tesla as a consultant to assist with the development of AC electricity systems. Tesla was responsible for setting 60 cycles per second (now Hertz) as the North American standard for AC power transmission and distribution. The "War of the Currents" then began between Westinghouse (AC) and Edison (DC).

In 1891, Tesla became a US citizen and he built his own experimental laboratory at 46 East Houston Street, in New York City. Experimenting independently in his Manhattan laboratory, Tesla developed and patented many different electric devices: Tesla coil, wireless radio, high-frequency lighting, x-rays and electrotherapy, to name only a few items.

In 1892, Tesla discovered X-Ray radiation while experimenting with high voltages and vacuum tubes. This was three years before they were rediscovered by Willhelm Roentgen. Tesla termed the effect "radiant energy" of an invisible kind. Tesla warned of the potential hazards of these rays during a lecture before the New York Academy of Sciences in 1897.

In 1893, Tesla demonstrated wireless transmission and reception in St. Louis. This was two years before Marconi's first demonstration.

In 1893, Tesla and Westinghouse designed and built an AC lighting system for the Chicago World's Fair.

Tesla began to research higher frequency AC, first in his lab in New York City, and then at a lab on the outskirts of Colorado Springs, Colorado. He first used high speed mechanical alternators (AC generators), and later he used spark gap oscillators to produce even higher frequencies. His early experiments uncovered the fundamental methods to enable practical wireless radio communication.

Tesla demonstrated the power of high voltage RF by generating 16 foot discharges in his New York City laboratory in 1894.

In 1895, the Niagara Falls hydro-electric power plant was commissioned, designed by Tesla and built by Westinghouse, and which was the first commercial 2-phase AC power generating plant.

In 1897, Tesla filed his basic wireless radio patents. Tesla was convinced that wireless transmission of electric power was possible while conducting high power RF research in Colorado Springs

When Tesla sold his patents to Westinghouse, he also concluded a royalty agreement under which he would receive $2.50 for each kilowatt of AC electricity sold. However in 1897, when the royalties due to Tesla started to exceed $1 million, Westinghouse ran into financial trouble. Tesla realized that if his royalty agreement remained in effect, Westinghouse would go out of business and that the future of AC power would be in jeopardy. Since Tesla's dream was to have cheap AC electric available to all people, he cancelled the royalty agreement in return for a once off cash payment.

In 1900, with $150,000 provided by financier J.P. Morgan, Tesla began construction of his so called "Wireless Broadcasting System" tower at Wardenclyffe on Long Island, New York. Initially, Morgan believed that the tower would be used for trans-Atlantic radio communications.

In 1903, when Morgan found out from Tesla that Tesla intended to transmit free electricity from the tower, Morgan withheld all further funding and project ended, uncompleted. Unfortunately, Tesla had also placed all of his funds in the project as well and then found himself in financial difficulties.

In 1904, the US Patent Office reversed its earlier decision to award the radio patent to Tesla and awarded the patent for wireless radio to Guglielmo Marconi.

Tesla ran out of funds in 1905, and was forced to close his Wardenclyffe lab. (The original Wardenclyffe main building is still standing today, located near the Shoreham Post Office and Shoreham Fire House on Route 25A, on the property owned by Agfa (GAF).)

In 1915, Tesla filed a lawsuit against Marconi for infringement of patent rights. This was the beginning of a legal battle that would last for 29 years.

After 1915, Tesla slowly faded into obscurity and in 1916 he was forced to declare bankruptcy. Tesla owed back taxes, but was penniless, living in poverty, on credit, at the Waldorf-Astoria hotel in New York. Throughout his life Tesla was relatively unconcerned about getting rich, seeking funds only to continue his research for the benefit of humanity.

In 1917, Tesla was awarded the Edison Medal by the AIEE. During the presentation, Tesla's impressive inventions were recognized.

In 1935, 15 out of 16 of Marconi's patent claims were invalidated by the Court of Claims. Tesla was acknowledged to have been the prior inventor on these portions of Marconi's patent. The outcome of the case, in Tesla's favour, is eventually ratified by the US Supreme Court in 1944.

On 7th January 1943, Tesla died penniless in his Waldorf Astoria hotel room. The FBI ordered the Office of Alien Property to seize Tesla's papers and possessions although Tesla was a US citizen. Tesla's personal papers and lab files were eventually inherited by Tesla's nephew, Sava Kosanovich, and are now kept at the Nikola Tesla museum in Belgrade, Serbia.

In 1956, the "Tesla", a new unit of magnetic flux density in the metric system, is named in Nikola Tesla's honour.

Some of Tesla's Inventions that concern Electro-therapy

1. Tesla Coil

Tesla's best-known invention takes Tesla's spark-gap oscillator and uses it to vigorously vibrate a coil consisting of few turns of heavy conductor. Inside of this primary coil sits another secondary coil with hundreds of turns of slender wire. In the Tesla coil there is no iron core as in the conventional step-up transformer, and this air-core transformer differs radically in other ways. Recounting the birth of this invention, Tesla wrote the following: "Each time the condenser was discharged the current would quiver in the primary wire and induce corresponding oscillations in the secondary. Thus, a transformer or induction coil on new principles was evolved. Electrical effects of any desired character and of intensities undreamed of before are now easily producible by perfected apparatus of this kind." Tesla also commented: "There is practically no limit to the power of an oscillator."

The conventional step-up transformer (short primary winding, long secondary winding on an iron core) boosts voltage at the expense of amperage. This is not true of Tesla's transformer. There is a real gain in power. Writing of the powerful coils he experimented with at his Colorado Springs lab, coils with outputs in excess of 12 million volts, Tesla wrote: "It was a revelation to myself to find out that ... a single powerful streamer breaking out from a well insulated terminal may easily convey a current of several hundred amperes! The general impression used to be that the current in such a streamer is small."

A Tesla coil secondary has its own particular electrical character determined in part by the length of that slender coiled wire. Like a guitar string of a particular length, it wants to vibrate at a particular frequency. The secondary is inductively plucked by the primary coil. The primary circuit consists of a pulsating high-voltage source (a generator or conventional step-up transformer), a capacitor, a spark gap, and the primary coil itself. This circuit must be designed so that it vibrates at a frequency compatible with the frequency at which the secondary wants to vibrate.

The primary circuit's frequency is determined by the frequency and voltage of the source, the capacity of the capacitor, the setting of the spark gap, and the character of the primary coil, determined in part by the length of its winding. Now when all these primary-circuit components are tuned to work in harmony with each other, and the circuit's resulting frequency is right for plucking the secondary in a compatible rhythmic manner, the secondary becomes at its terminal end maximally excited and develops huge electrical potentials, which if not put to work, boil off as a corona of bluish light or as sparks and streamers that jump to nearby conductors with crackling reports.

Unlike the conventional iron-core step-up transformer, whose core has the effect of damping vibrations, the secondary of the Tesla transformer is relatively free to swing unchecked. The pulsing from the primary coil has the effect of pushing a child in a swing. If it's done in a rhythmic manner at just the right moment at the end of a cycle, the swing will oscillate up to great heights. Similarly, with the right timing, the electrical vibration of the secondary can be made to swing up to tremendous amplitudes, voltages in the millions. This is the power of resonance.

In his experimenting over an eight-year period, Tesla made no fewer than 50 types of oscillating coils. He experimented with lighting and other vacuum effects, including x-rays. He also experimented with novel shapes for the normally cylindrical coils, getting satisfying results from cone shapes and flat spirals. At Colorado Springs, Tesla achieved phenomenally increased outputs by using a third coil resonantly tuned to the secondary. Observing the tremendous magnification this achieved, he gave much of his attention to integrating this extra coil, as he called it, into an evolved outsize Tesla coil that he called the Magnifying Transmitter.

2. Electrotherapy

Now that you know it's harmless, would you believe these currents are even good for you? The fact is that a whole branch of medicine was founded on the healing effects of certain Tesla coil frequencies. Tesla understood the therapeutic value of high-frequency vibrations. He never filed any patents in this area but did announce his findings to the medical community, and a number of devices were patented and marketed by others.

Patients were reported to have experienced relief from rheumatism and other painful conditions by focusing certain frequencies on afflicted areas, or, in some cases, just sitting in the vicinity of the vibrations from a device like the Lakhovsky Multi Wave Oscillator, which produced a wide range of frequencies, It was even considered a cure for certain types of paralysis. One theory was that that the effect of the electromagnetic radiation caused an increase in the supply of blood to the affected area and created a warming effect (diathermy). In addition, the oxygenation and nutritive value of the blood was improved and the elimination of waste products in the blood was also accelerated. All of these effects promote healing.

Electrotherapy devices were sold directly to the public via ads in popular magazines and in the Sears catalogues. Self-treatment was widespread. This easy access to treatment of all sorts of conditions led to the eventual suppression of the technology by the medical establishment.

<u>Tesla - the Father of Wireless Radio</u>

As we have seen, Tesla's earliest oscillators were dynamos, but, having determined that he could not reach the higher frequencies by this means, he went on to develop the spark gap oscillator, the Tesla coil, and the magnifying transmitter. But did any of these devices become the first to be used for overseas radio transmission? No, ironically, the first commercial overseas transmitter was a 21.8 kilocycle GE Alexanderson alternator operated by RCA, a design evolved straight out of Tesla's early dynamos. Such was Tesla's luck in radio.

<u>Simple Wireless Radio</u>

Early radio devices are fascinating and worthy of study if only because they remind us that powerful radio technologies can be so simple and accessible to anyone, the present-day micro complexity notwithstanding. As we have seen, the earliest transmitters in wide use by amateurs were not alternators but spark-gap oscillators. To get on the air all you needed was a battery, a telegraph key, an induction coil, a spark gap, a length of wire as an antenna, and a ground. Of course, the addition of a capacitor juiced it up considerably.

Tuned radio

The spark gap transmitter was indiscriminate as to the frequency of the disturbance. It put out a dirty complex of frequencies consisting of a rough fundamental determined by the width of the spark gap, together with a multitude of harmonics. The first Marconi units employed nothing more evolved than this rough method of signaling.

So why did Marconi become so famous? It is because, like Edison and Westinghouse, he built up an industry around the invention and made himself famous in the course of promoting his enterprise. Marconi's company was ultimately incorporated into RCA (now incorporated into General Electric). It owed much of its technological development to ideas lifted from the likes of Tesla. Tesla's contribution was the development of selective tuning. He set forth the principle of resonantly tuned circuits in his Tesla coil patent of 1896, and the principles of transmitter-receiver tuned circuits a year later in his wireless power patent.

The Tesla coil is a powerful and simple radio transmitter. If the primary circuit is smoothly vibrating well above the audio range, its signal can even be modulated for voice transmission by varying some circuit element.

Tesla's few published notes on modulation describe crude ways of varying spark gaps, but, conceivably, an inductance core mechanically linked to a loudspeaker transducer might modulate the signal with some fidelity.