Nikola Tesla, the Lightning Magician

It was a stormy summer weather, the midnight flashes had already begun to announce the birth of the lightning magician. Nikola Tesla was born at midnight, the first moment of 10 July 1856, in Smiljan, Lika, which was then an Austro-Hungarian part and nowadays situated in Croatia region. His father Milutin Tesla was a Serbian orthodox priest and his mother Djuka Mandic was a household appliances inventor, these skills seam to came from her family, which had an entire line of inventors and was considered one of the oldest families in the country.

The early death of his brother made a strong impression on young Nikola, it seems that a wolf frightened horse caused the injuries from which his brother died.

Since he was young Tesla was recognized as being different from other boys, one day when the boys were outside playing an older venerable man came by an gave to each boy a precious silver coin, when coming to Tesla the old man stopped, look at him and said: “No, not much; you can get nothing from me. You are too smart.”

Even from childhood Tesla experienced strange distresses, they weren’t hallucinations but strange actions from the brain to the retina in such way that a simple spoken word appeared like a real image in the front of his eyes, often these images were accompanied by strong flashes of light, later in his life he managed to control his visions and build exact images of his inventions.

In those times there weren’t many solutions on how to choose a career, he could became a priest like his father or enroll in the army, but his father noticed that none of these choices were good for him.

Tesla began studying mathematics and physics at the Polytechnic Institute in Graz but soon became fascinated with electricity. He became an electrical engineer and his first job of this kind was at a telephone company in Budapest 1881, since then he saw the magnetic rotating lines like the wheel of the sun and its rays and explained to a friend the basic principle of the induction motor. His first invention was a telephone repeater that could act like an audio speaker.

In 1882 he moved to Paris to work as an engineer for the Continental Edison Company designing improvements to the electric equipment.

While in Strassbourg in 1883 he managed to build privately his prototype of the induction motor and ran it successfully (Ferraris discovered the rotary magnetic field in 1885), but was unable to find someone in Europe to promote this new device so Tesla decided to take a ship to New York. Before he got to the steam ship he had been robbed of all his luggage, ticket and money. The captain let him sail anyway and he arrived in America with four cents in his pocket, a book of his own poems, a scientific article and a package of calculations for his plans for a flying machine.

He was accepted to work for Thomas Edison, and was helped by the introduction letter that Charles Batchelor his manager from his previous job wrote: “I know two great men, one is you and the other is this young man.”

He quickly progressed from a simple engineer starting to solve the major problems of the company, one of the major tasks was the complete redesign of direct current generators, Edison said that he would give him the sum of 50000$ (nowadays 1 mil. $) if he would manage to complete this major task. Tesla gave to the Edison company several improvements and new dynamo and lamp patents, but when Tesla asked about the promised money Edison replied: “Tesla, you don’t understand our American humor”.

Tesla also showed Edison his schemes about the induction motor and his opinions about the alternating current but Edison remained convinced that his direct current was the best and ignored Tesla’s new designs.

In the final confrontation Tesla not saying anything, just turn his back on to Edison and simply walked off, this was the beginning of the “War of Currents”.

For some years Tesla worked as a common laborer raising money for his projects,and even managed to form his own company “Tesla Electric Light and Manufacturing” in 1886, but the investors rejected the plan with the alternating current motor and once again deceived him and kicked him out of the company.

In 1887, he constructed the initial brushless alternating current induction motor, which he demonstrated to the American Institute of Electrical Engineers (now IEEE) in 1888. In the same year, he developed the principles of his Tesla coil and began working with George Westinghouse at Westinghouse Electric & Manufacturing Company's Pittsburgh labs. Westinghouse accepted his ideas for polyphase systems which would allow transmission of alternating current electricity over large distances and also bought the Tesla patents.

a)

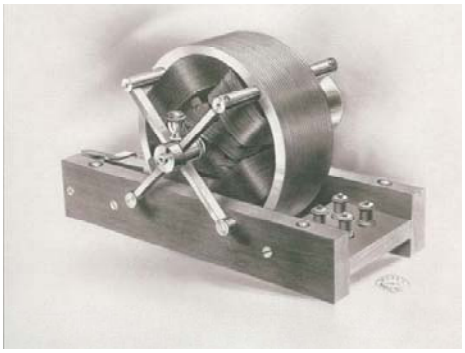

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Fig.1. a) Early Tesla induction motor fabricated by Westinghouse Electric Company; b) Two-phased ″ horsepower induction motor demonstrated before the American Institute of Electrical Engineers at Columbia University in 1888.

In April 1887 Tesla started to investigate what would later be called X-rays using his patented vacuum tubes, Tesla observed burns to the skin, ozone and even made photographs with his hand bones and sent it later to Röntgen, by 1892 Tesla knew what Röntgen discovered years later, he generalized this type of radiation as radiant energy.

In 1891 Tesla gave other demonstrations to the American Institute of Electrical Engineers, among the machines was the first Tesla coil design like in patent called “System of Electric Lightning” (1891 June 23), using Tesla coil design he managed to light up all the lamps from the laboratory situated in East Houston street wirelessly.

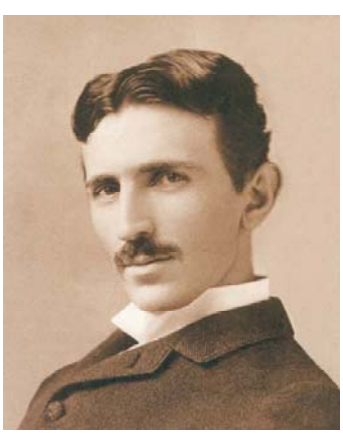
Tesla served as Vice-President of the IEEE in the period 1892-1894, also in 1893-1895 period has designed the conical Tesla coil capable of generating 1 million volts of high frequency alternating currents, he developed the skin effect in circuitry, he invented a machine for inducing sleep, cordless gas discharge lamps and designed tuned circuits building the first radio transmitter. The Tesla coil was gradually improved reaching 100 MV, the flash of lightning. At one moment he decided to use flat spiral coils gaining more voltage and reducing the risks.

Tesla made the first public demonstration of radio communication in 1893. Addressing the Franklin Institute in Philadelphia and National Electric Light Association, he described in detail the principles of radio communication, his apparatus contained all the elements necessary for radio systems, these elements are even present today in stereos, TV-sets and other equipments.

Marconi succeeded to be the first person to send a wireless telegraph across the Atlantic, which made Tesla remark: “Let him continue. He is using seventeen of my patents”,

only in 1943 U.S. Supreme Court granted full rights to Tesla for the invention of radio nullifying the claims of Marconi who had patented the-two-tuned circuit after Tesla's.

At the age of 35 Tesla was already an American citizen.



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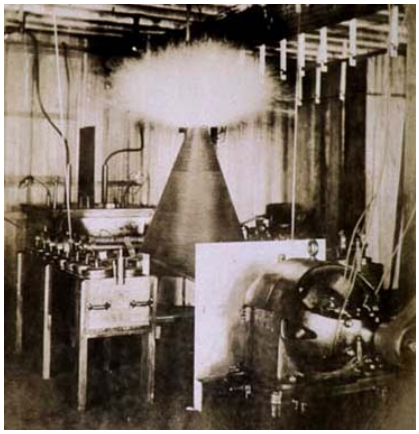

b)

Fig. 2. a) Nikola Tesla at the age of 38; b) The 1 million volt conical coil demonstrated in his lab in 1895.

Edison tried everything to stop the installation of AC current delivery system, even reached to the point of electrocuting animals in the front of the audience to prove that AC current was dangerous. Tesla reputation continued to grow when Westinghouse won the contract to supply the Chicago World's Fair in 1893, this was the first AC delivery system, also Tesla astonished the world at the World Columbian Exposition there in Chicago with his demonstrations, the lightning magician powered an entire display of light bulbs and lamps letting the high frequency current flow thru his body, also powered them without wires, demonstrating the wireless transmission of energy without wires at a small scale, he displayed the first practical phosphorescent lamps, a precursor of fluorescent lamps. Among the other demonstrations was the "Egg of Columbus", a device with a polyphase field coil underneath and a plate with a copper egg on the top, when the device was activated he created a rotating magnetic field that made the egg rotate and stand up on end looking like it is trying to resist gravity.

Since he was young Tesla dreamed to harness the power of Niagara Falls, his dream became reality when in 1896 were finished the hydroelectric generators generating 75 MW power and sending this power thru the three-phase implemented system of alternating current over the distance of 32 km up to Buffalo. The hydroelectric generators were built by Westinghouse Electric Corporation using Tesla's AC system patent, the project was also financed by J. P. Morgan, John Jacob Astor IV and the Vanderbilts. This was the first hydroelectric power plant and made Tesla the winner of the "War of Currents", demonstrating the major advantages of AC systems, thinner cables, easy transformation of voltage with transformation stations and suitable for long distances, of course from the beginning Tesla patented various types of transformers for his AC system.

In 1897 Tesla showed a radio controlled boat to the U.S. military and developed the so called "Art of Telautomatics", in 1898 the radio controlled boat was demonstrated once again to the public during an electrical exhibition at Madison Square Garden, these devices had an innovative coherer and a series of logic gates (also patented), these logic gates are the basics for the actual computer technology. The radio remote control remained a novelty until the 1960s.

Another familiar invention is the "electrical ignitor for gas engines" that was patented

in 1898, known commonly as the ignition coil of the automobile electric system this remained practically unchanged since it's introduction in use at the turn of the century.

Unfortunately in 1895 his lab from East Houston street was devastated by fire and he lost almost all his work, he decided later in 1899 to take all from the beginning and established his new lab at Colorado Springs where he had a lot of room for his high voltage and high frequency experiments, in this period Tesla kept a diary of all his experiments, the Colorado Springs notes have an great scientific value. In 1899-1900 period Tesla studied lightning and artificially built lightning with his magnifying transmitter(Tesla coil), he was convinced that he could transmit wireless power directly to the Earth producing standing waves, he discovered that Earth was resonating at low frequencies producing standing waves between Earth and ionosphere(he didn't know about ionosphere), this scientific fact is well known today as Schumann resonances, the lowest basic Earth resonance was estimated by Schumann at 7.8 Hz and by Tesla at 6 Hz, this is also the alpha wave of the brain, to remember that Schumann discovered this in 1952 so Tesla was on the right path.

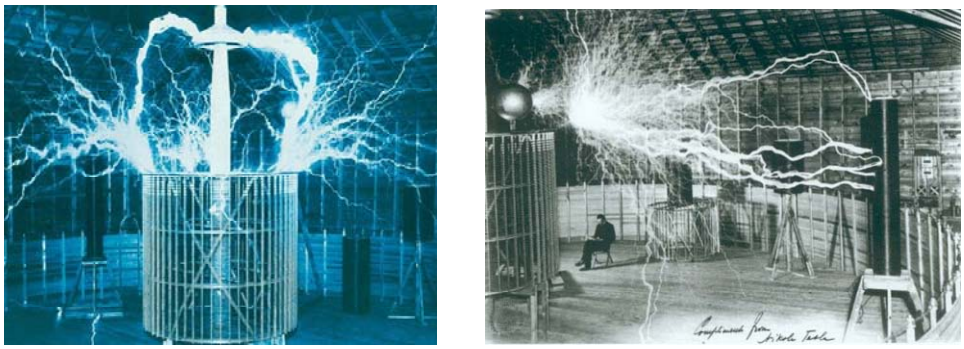

Fig. 3. Burning nitrogen from the atmosphere produced by the discharge of an electrical oscillator giving twelve million volts, discharge measures sixty-five feet across, in the second picture Tesla is sitting on a chair.

Strange electrical things happened near that lab. People would walk near the lab, and sparks would jump up from the ground to their feet, through the soles of their shoes. One boy took a screwdriver, held it near a fire hydrant, and drew a four inch electrical spark from the hydrant. Sometimes the grass around his lab would glow with an eerie blue corona, St. Elmo's Fire. What they didn't know was this was small stuff. Tesla in the lab was merely tuning up his apparatus. He was getting ready to run it wide open in an experiment that ranks as among the greatest, and most spectacular, of all time. One side effect of his experiment was the setting of the record for man-made lightning; some 42 meters in length (130 feet), thunder was heard booming around 22 miles away, in the town of Cripple Creek. Suddenly everything halted and all the lights in Colorado Springs had gone out, Tesla had just overloaded the generator from which was drawing free power for his experiment, the windings were on fire due to high frequency kick and the static charge of the earth. Leonard Curtis from the power company first offered him free energy for his experiments but this incident changed the situation and the power company refused to give more free electricity. Tesla ran his large coil at 33 kHz, he was trying to modify the ground's electrical potential, changing it from an electrical sinkhole to an electrical source, at that time there weren't any home computers and other delicate electronics hooked up to grounds then, this could be a terrific electromagnetic weapon nowadays.

In 1900 Tesla wrote in Century Magazine:"...that communication without wires to any point of the globe is practicable. My experiments showed that the air at the ordinary pressure became distinctly conducting, and this opened up the wonderful prospect of transmitting large

amounts of electrical energy for industrial purposes to great distances without wires...its practical consummation would mean that energy would be available for the uses of man at any point of the globe. I can conceive of no technical advance which would tend to unite the various elements of humanity more effectively than this one, or of one which would more add to and more economize human energy...".

Between 1901 and 1905 Tesla was building the Wardenclyffe laboratory in Long Island, Shoreham, financially supported by J.P. Morgan. This construction was huge, 187 feet high and capped by a 68 foot copper dome which housed the magnifying transmitter. The first purpose of this tower was a broadcast system, transmitting signals to any point of the globe, the second hidden and more important purpose was the transmission of power without wires.

Later when Tesla told his second purpose to J.P. Morgan he withdrew his funds saying "If anyone can draw on the power, where do we put the meter?". The incomplete tower was demolished in 1917 for wartime security reasons.

On his 50th birthday in 1906 Nikola Tesla demonstrated his 150 kW 16000 rpm bladeless turbine. During 1910-1911 several bladeless turbines were tested at the Waterside Power Station in New York, the power was between 100 and 5000 hp.

In 1915 Tesla and Edison were mentioned as possible laureates to share the Nobel Prize but the rumors never came to reality for Tesla.

In America Tesla was living at the hotels, at this time he lived in Waldorf-Astoria Hotel, the debt at the hotel were 20000 $, in 1917 the Wardenclyffe Tower was demolished also for his assets, Tesla received AIEE's highest honor, ironically the Edison Medal.

In August 1917 Tesla was establishing the first principles regarding frequency and power for RADAR units, in 1920 he was negotiating with the United Kingdom government about a "death ray" system. From 1917 until his death Tesla was working on far more advanced ideas, some of his papers are still classified by the American army.

The "death ray" was a particle beam weapon and was related to plasma and ball lightning phenomena, records of his indicates that it was based on narrow stream of atomic clusters of liquid mercury or tungsten accelerated by a high voltage using the magnifying transformer and exiting from a vacuum tube with a gas jet. This weapon could be used for antiaircraft purposes bringing down enemy planes from 200 miles away. None of the governments were interested to buy and build the device, it seams although that were some attempts to steal his construction plans.

Tesla said some methods and components were accomplished for this "teleforce" weapon in 1934: an apparatus for producing manifestations of energy in free air instead of in a high vacuum as in the past, a mechanism for generating tremendous electrical force, a means of intensifying and amplifying the force developed by the second mechanism, a new method for producing a tremendous electrical repelling force, this would be the projector, or gun, of the invention.

In 1928 he received the patent for an apparatus of aerial transportation which was the first instance of VTOL aircraft. His life goal was to create a flying machine without wings, propellers or an onboard fuel source, Tesla suggested that this machine will fly using a special electric motor powered by wireless ground stations, the idea was to move the ship in any direction only by electrical means using the "ropes of air".

Tesla found that a supercharging effect could be reach by short DC pulses and he abandoned his research on AC currents, even more interesting effects was observed like pressure shockwaves in the air, distant charging of metals and impossible shielding.

In his middle life, Nikola Tesla became a very close friend with Mark Twain. They spent a lot of time together in his lab and elsewhere, also was corresponding with Einstein and other important figures, he considered his relativity theory full with errors and metaphysical, his unsustained affirmations contributed to his decline.

Tesla died of heart failure alone in the New Yorker Hotel, on January 7th 1943, at the

age of 86. Despite selling his AC electricity patents, Tesla was essentially destitute and died with significant debts.

The year 2006 was proclaimed by UNESCO, as well by Croatia and Serbia, to be the year of Nikola Tesla being the 150th anniversary of Tesla's birth.

Fig.4. Twenty Serbian Dinars commemorative coins.

Tesla said: “Let the future tell the truth, and evaluate each one according to his work and accomplishments. The present is theirs; the future, for which I have really worked, is mine.”