# INVENTOR FRANK SPRAGUE

## From: *Seldom Told Tales of Sharon (Book Three)*

## by Ed Kirby

Perhaps the name Frank Julian Sprague qualifies as the least well-known of the most extraordinary characters in Sharon's rich history. Yet in his field the inventions and works of Mr. Sprague rivaled and often surpassed those of his better-known contemporaries Thomas Alva Edison, William Stanley, Jr., Elihu Thomson, Alexander Graham Bell, Nikola Tesla and George Westinghouse. Known as *The Father of Electric Traction,* engineer genius Frank Julian Sprague and his family owned a home in Sharon for nearly twenty years in the early twentieth century. As a mathematical genius and inventor Sprague developed a new breed of electric motors that provided horizontal traction for cutting edge vehicles such as the trolley car and subway train. In the field of vertical traction Sprague developed electric elevators that far surpassed the effectiveness of the water, steam and hydraulic systems. Among his numerous accomplishments were the development of the electric streetcar, the electric multi-unit control for light transit trains, and electric elevators for extremely high-level city buildings. The inventions of Frank Sprague not only made transportation more available and practical, they had a profound affect on the economic growth of cities.

### *EARLY URBAN TRANSPORTATION*

In the early urban centers of the fledgling United States walking was the primary mode of transportation. While the privileged few traveled about the cities in their carriages drawn by fine teams of horses, those of the working class in and near the city centers walked daily from home to job and back. The fact that transportation on foot severely limited travel distances also limited the growth of cities.

In the late 1820s the working class began reaping the benefits of the horse drawn vehicle as larger commercial or government-financed wagons were pulled to and from the outlying areas of the cities. Travel routes expanded, but wagons with wooden wheels operating on rough gravel and frequently muddy roads, had severe time and distance limitations. To combat these limitations, by the 1850s some cities had laid steel tracks and used iron wheels on horse or mule drawn cars to further increase the transportation spread. More efficient transportation led to more business that in turn resulted in prosperity and jobs.

Although horse and mule drawn trolleys improved in-city travel significantly this method of transportation had inherent problems. The animals had to be housed, groomed, fed and cared for day after day. In addition the equines produced prodigious amounts of manure the disposal of which cost the trolley companies a significant amount of money. Since a typical two-horse team pulled a streetcar for perhaps a dozen miles a day and worked for four or five hours, many systems needed ten or more horses in stable for each trolley. The demand for cleaner and faster and cheaper transportation grew.

Some cities introduced elevated trains pulled by small steam engines. Though the system was fairly efficient and faster above the streets it was costly to build and operate and suitable only for the largest cities. Next came the cable car suitable to cities with the steepest climbs such as San Francisco but very expensive to build, operate and maintain.

The most likely solution to the increased demand for"horizontal" city transportation in the latter nineteenth century was what became known as the trolley car. It was generally agreed by top inventors that electricity would be the most effective way to supply the power for trolleys. But in the early 1880s two unrelenting problems faced the inventors. The first was the transmission of electricity to the cars; the second (depending on a solution to problem one) was the method of transmission of the electric motor power to the car's wheels.[1]

"Enter inventor Frank Julian Sprague, with solutions to both problems."[2] His first invention brought continued electric power on demand via a spring-loaded pole with a wheel mounted on the roof of each car to contact an electric wire suspended directly above the center of the track.Then he devised a simple but clever method of mounting his motors so they were protected from vibration, and delivered their power smoothly to the wheels.[3]

Frank Julian Sprague's contribution was not to invent the trolley car, but perfect it and make it practical. In the same period Alexander Graham Bell did not invent the telephone but he perfected it and Thomas Alva Edison did not invent the light bulb but he perfected it.

[1] TROLLEY: The Cars That Built Our Cities, http://www.transitgloriamundi.com/trolley_videos/trolley/narration.html
[2] Ibid.
[3] Ibid.

*THE EARLY YEARS*

Engineering genius Frank Julian Sprague was born in Milford, Connecticut on July 25th, 1857, the son of David Cummings Sprague (1833-1896) and Frances Julia King Sprague (? -1866). Frank was the second child born to the couple, the first son, Seaver, having died in infancy. A younger brother, Charles May Sprague, was born on April 30th, 1860, also in Milford.[4]

Frank Sprague attended elementary school in Milford until the death of his mother on January 31, 1866. Following her death, David Sprague went west first sending Frank and Charles to North Adams, Massachusetts to live with and be raised by their aunt Elvira Betsy Ann Sprague (Aunt Ann). The 1870 United States Census for North Adams shows Frank Sprague, age 12, living in the household of Martin Whitney. In North Adams Frank attended Drury High School where he excelled as a student particularly in mathematics.[5]Built as an independent school in 1843 through a $3,000 grant from the will of Nathan Drury, the institution became a free, public high school in 1851. In 1867, seven years prior to Frank's graduation the original building was torn down and replaced with a new building. Undoubtedly the strong history and updated facilities provided an excellent learning environment for young Sprague.[6]

Because of his exceptional mathematical and scientific skills Sprague was advised by his principal to take the qualifying test for West Point held in Springfield, Massachusetts. Upon arrival at the testing center Sprague learned the scheduled test was for an entrance appointment at the Naval Academy in Annapolis, Maryland. Deciding to take the exam in spite of his West Point preference, Sprague's high score earned him an appointment to the Naval Academy at age seventeen in 1874.

At the United States Academy at Annapolis, Maryland, Sprague excelled in physics, chemistry and mathematics, graduated seventh in the Class of 1878 and passed his examination as midshipman in 1880. Following graduation from Annapolis Sprague was commissioned in at the rank of ensign in the United States Navy. At Stevens Institute and Brooklyn Navy Yard his first duties were in experimental electrical work. [7]

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[4]TheSpragueProject<http://www.spraguedatabase.org/genealogy/getperson.php?personID=I125347&tree=Sprague Project.

[5] Ibid.

[6] Drury High School 1898, North Adams, MA <http://www.rootsweb.ancestry.com/~maberksh/towns/nadams/1898drury.htm.

[7] Sprague, Harriet Chapman Jones, *Frank J. Sprague and the Edison myth*, (New York: William-Frederick

Sprague's first sea-going assignment was on the *USS Richmond,* a steam-powered ship commissioned in 1860 with a displacement of 2,604 tons. Very active earlier in the Civil War the *Richmond*had a length of 225 feet and a complement of 259 officers and enlisted men. In 1881, while his ship was in Newport, Rhode Island, Sprague'sfirst invention was an inverted type of dynamo. It soon became obvious that Frank Sprague was an electrical genius. [8]

Soon after Sprague transferred to the *USS Lancaster*, flagship of the European Squadron. The *Lancaster*, a screw driven sloop-of-war displacing 2,362 tons, was 236 feet in length and powered by steam. On the *Lancaster* Sprague designed and installed the first electric call-bell system to be used on a U.S. Navy ship. Because of his expertise in the field of electricity he was granted leave to attend the 1881 Paris Electrical exhibition.[9]

During the latter portion of the nineteenth century there was significant growth in the knowledge and use of electricity in the United States and Europe. As a result the first International Electrical Exhibition was held in Paris from August to November 1881. Although advances in electric lighting were the primary focus of the exhibition, by this point Sprague had decided to concentrate on the use of electricity for power.

Attendance at the Paris International Electrical Exhibition had a significant effect on Sprague's future experiments in electricity. Sprague again obtained a leave to attend the Crystal Palace Exhibition in Sydenham, England. In Sydenham Sprague was selected for the jury of awards givenfor gas engines, dynamos and lamps. Of the three topics, dynamos captured his creative interest. At the same exhibition, Sprague became further interested in the concept of the electric street railway. While the first electric street rail system had been introduced in Berlin during their 1879 exhibition, it would be improved upon and developed in the United States by none other than Frank Julian Sprague.[10]

*SPRAGUE AND EDISON*

Frank Julian Sprague was a first a mathematician and then an inventor. When a tool or machine or concept was needed to improve or develop a process Sprague began the development of the process mentally.

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Press1947)
[8] Ibid.
[9] http://en.wikipedia.org/wiki/USS_Lancaster_(1858).
[10] http://www.theiet.org/about/libarc/archives/featured/paris-exhibition.cfm]

He next attacked the problem mathematically on a blank sheet of paper improving the concept in each stage. Once past the mathematical stage he drew a plan, improved the plan and only then moved to the stage of a working prototype for testing and demonstration.

The Industrial Revolution (1820-1870) radically altered the economic development of the United States. The War of 1812 had made it obvious that America needed a better transportation system and greater economic independence. Industrial entrepreneurs responded to the crisis by expanding American manufacturing. Industrial growth was dependent on three critical developments. First, transportation methods must improve, second electricity must be harnessed and controlled and third industrial procedures must be streamlined and production accelerated.

Despite early efforts toharness electricity during the Industrial Revolution, widespread use of lighting and power grew slowly and provided little improvement in American lifestyles. Yet, by the early 1880s, numerous advances were on the horizon.

The developing use of electricity would make the 1880s exciting times in the field of horizontal transportation.Having learned of Sprague's methods and outstandingresults in the navy, and particularly the Paris Exhibition, in 1883Edward H. Johnson, a business associate of Thomas Edison, persuaded Sprague to resign his naval commission and come to Menlo Park, New Jersey to work for Thomas Alva Edison.

Although the partnership of Edison and Sprague in the commercial use of electric energy was for the most part compatible, their individualmethods of arriving at practical successes differed markedly.

One of Sprague's significant contributions to the Edison Laboratory at Menlo Park, New Jersey was the introduction of mathematical methods. Sprague's mathematical and scientific method saved much needless tinkering. As Edison's "assistant" he did important work including calculating corrections on several of Edison's systems.[11]

Though Thomas Edison was committed to the transmission of electricity by direct current (DC), Frank Sprague, Nikola Tesla, George Westinghouse and William Stanley, Jr.were convinced that alternating current

[11] Ibid.

(AC) was the only way to successfully transmit electric power over extended distances. The work of Stanley in particular would prove to be of immense value to the future inventions of Frank Sprague.

American physicist William Stanley, Jr. (1858-1916) was born in Brooklyn, New York. Following private secondary school education in New York he was accepted at Yale University where his father hoped he would major in law. However, young Stanley had other ideas and before his first semester was completed at age twenty-one he had left Yale to become an electrician.

During Stanley's lifetime he was granted 129 patents covering a wide range of electric devices. The most notable of these is the induction coil, a transformer that would create alternating current electricity. In the 1880s every electricity distribution system used direct current (DC). The problem was that DC transmission over long distances was impractical, dangerous and required heavy gage wires. On the other hand, alternating current systems did not have these drawbacks. AC voltage systems could be varied by use of induction coils, but no practical coil system had been invented. Stanley's U. S Patent #349,611 of September 21, 1886 changed all this and became the prototype for all future transformers.[12] As a result Sprague's systems could convert the DC current from its source to AC for long distance transmission and then convert it back to DC for effective electric power.Romulus Riggs Colgate's electric production and transmission projects in Nevada County, California and Sprague's electric transmission for rails and trolleys made use of the principals discovered and implemented by Stanley. For additional information regarding the relationship through the years of developing electric traction by Sprague and the transmission of electricity to the San Francisco Bay area by Colgate, both men were in contact with Stanley.

After inventor and industrialist George Westinghouse learned of William Stanley's accomplishments, he hired Stanley as his chief engineer at the Westinghouse Pittsburgh factory. It was during this time that Stanley began work to develop a transformer. After Stanley left Pittsburgh, in 1886 he built the first AC transmission system, providing lighting for offices and stores on the Main Street of Great Barrington, Massachusetts. He also produced transformers, auxiliary electrical equipment, and electrical appliances. Following years of success the Stanley Electric Manufacturing Company was sold to General Electric in 1903.

*SPRAGUE MARRIES*

[12]http://inventors.about.com/library/inventors/blstanley.htm

At Menlo Park, New Jersey, Sprague spent significant time correcting Edison's system of main lines and feeders for central electric station distribution. In 1884, he decided his interests lay elsewhere, and he left Edison and founded the Sprague Electric Railway & Motor Company, based in New York City.

In 1885 Frank Sprague married Mary A. Keating in New Orleans, Louisiana. A son, Frank Desmonde Sprague, was born to the couple in New York City on March 29, 1888. A few years later, perhaps as the result of Sprague's many contractual responsibilities and the resulting constant travel, the union with Mary ended in divorce.Father and son remained close and young Frank often accompanied his father on his many trips, later working with him. During these times he was known as Desmond Sprague without the eof his original middle name.

*THE RICHMOND UNION PASSENGER RAILWAY*

Transportation by electric trolley cars grew slowly during the 1880s. By late mid-decade, nine short lines were operating in Europe and ten in the United States. Those in the United States had an aggregate track length of only 60 miles and the lines were basically inefficient. Radical improvements were necessary to guaranteecommercial success on a large scale, and finally realize the potential of electrical traction.

In the spring of 1887 two important contracts were signed by the Sprague Electric Railway and Motor Company. The first, financed by a group of New York investors, was with the Union Passenger railway of Richmond, Virginia; the second with the City of St. Joseph, Missouri. The Richmond contract called for the completion of a trolley line with 12 miles of track (unlaid at the time), a route undetermined, equipment of a complete steam and electric central-station plant and 80 motors on 40 formerly horse-drawn cars in 90 days. Thirty cars were to be operated at anyone time,with many steep grades (some 10%) and dangerous curves. The payment upon completion, made only if the line was deemed satisfactory, was $120,000.

The Richmond Union Passenger Railway project would prove Frank Sprague to be one of America's major risk takers and innovative engineers. Receiving no front moneyfrom Richmond, and working with very limited company funds, Sprague was forced to borrow heavily. In the beginning he had no operating prototype for the 80 motors to be used on each of the two trucks of the 40 trolleys. As biographer Fred Dalzell stated in 2010, Sprague's circumstances in Richmond were that of a *Catch 22.* Sprague could not sell his concept of the electric motor without a prototype for testing and he could not develop a prototype without additional

funding.[13]He would be paid if the project was a success. Most industrial engineers of the period (and today) would never agree to such an arrangement but Frank Sprague believed he could do it and was determined to succeed.

From the start both the technical and financial aspects of the project encountered problems. Even upon completion early runs were not without difficultyincluding frequent mechanical and electrical problems, the indignity of mules reigned to the trolleys for the additional pulling power needed to climb the tracks' steepest incline, and the further embarrassment of seeing broken-down trolleys towed away by a mule. However, with additional tinkering and adjustments, Sprague's perseverance paid offand the system was soon made reliable and eventually accepted as far superior to horse-drawn trolleys.[14]

When the Sprague Electric Railway & Motor Company completed work the Richmond Union Passenger Railway became the world's first large-scale electric trolley system. Prior to this project, there had been dozens of attempts to build systems in the United States, Canada and in Europe. With this success Frank J. Sprague confounded his critics by completing an electric railway that was safe, convenient and reliable.The difficulties met were numerous but success was finally achieved.The Richmond system was recognized as the first of modern trolley lines and the pioneer of electric traction.[15]Although the line became a financial success for the ownersand demonstrated electric trolleys as a more profitable system than animal-powered street railways, Sprague himself lost a considerable amount of money on the installation.

The electric streetcar era officially began in St. Joseph, Missouri on July 4, 1888, when the Union Railway Company formally began regular service of its electriccars between Market Square and New Ulm Park. The company began operation with 5 electric cars from the Sprague Electric Railway Company. Fourdays later a sixth electric car was added. Horse-drawn cars were used to helpsupplement the electric cars for the first two weeks, until they were finallybanished from the northern section of the Union line on July 16th.[16]

Within two years Sprague could boast that 110 electric railways with his equipment had been built or were under contract. His closest competitor, the Thomson-Houston Company, soon modified its design to

[13] Dalzell, Fred; *Romance of an Engineer*, presentation at Ventfort Hall, Lenox, MA, September 10, 2010.
[14] http://inventors.about.com/library/inventors/blstanley.htm
[15] Encyclopaedia Britannica, Volume 8, Page 296, Encyclopaedia Britannica, Chicago, IL, 1943.
[16] St. Joseph *Daily. Gazette*

incorporate Sprague's methods of electric traction. General Electric and Westinghouse also built products that were based on Frank J. Sprague's designs. [PHOTOS – RICHMOND TROLLEY; TROLLEY POLE]

Key to the successful operation of Sprague's trolley lines was the incorporation of the overhead electric line above the center of the track with a contact wheel mounted on a pole above the car center.This novel but basically simple invention allowed freedom of both vertical and horizontal movement. From the pole electric current was carried to the individual motors mounted on each of the trolley's four wheeled trucks. Even the electric motors developed by Sprague to power the trolleys for this project were much more efficient than those used previously.

*ELECTRIC ELEVATORS*

Even as he worked on the development and implementation of the complex Richmond, Virginia trolley line, Frank Sprague's mind was busy on other projects. While the horizontal growth of a city depended on effective transportation to bring workers to the city center, i.e. the trolleys of the Sprague Electric Railway & Motor Company, cities could only rise so high without access to vertical space. As a result of increasing the passenger capacity and speed at the Richmond Union Passenger Railway, Sprague hypothesized that similar results could be achieved in vertical transportation. He theorized that increasing the capacity of elevator shaftways would not only save passenger time, but would also generate even greater revenues from tall buildings. At the time building height was limited not only by the total floor space taken up in the elevator shaftsbut also by the slowersteam or hydraulic-powered elevators.In 1892, Sprague founded the Sprague Electric Elevator Company, and with Charles R. Pratt developed the Sprague-Pratt Electric Elevator. The company developed floor control, automatic elevators, acceleration control of car safeties and a number of freight elevator designs. The Sprague-Pratt elevator ran faster and with larger loads than hydraulic or steam elevators and 584 elevators were installed worldwide in a short period. Sprague then sold his company to the Otis Elevator Company in 1895.[17]

*THE SOUTH SIDE ELEVATED OF CHICAGO*

Sprague's experience with elevator control led him to devise a multiple unit system of electric railway operation, one that accelerated the development of electric traction by adding a power source to each railroad car. In the multiple unit control system each car of the train carried electric traction motors on the

[17] http://en.wikipedia.org/wiki/Frank_J._Sprague#Multiple_unit_train_controls

wheel trucks on either end of the car. By means of relays energized by train-line wires the motorman commanded all of the traction motors in the train to act together. For lighter trains there was no need for locomotives so every car in the train generated revenue. Where locomotives were used, one motorman still controlled the entire train.

Sprague's first multiple unit (MU) order was from the South Side Elevated Railroad (the first of several elevated railways locally known as the "L") in Chicago, Illinois. This success was quickly followed by substantial multiple-unit contracts in Brooklyn, New York and Boston, Massachusetts.[18]

As history shows to this date, Sprague's MU system was his most significant contribution to the field of horizontal electric traction because it increased both acceleration and total number of cars per train and could be operated from either end.

*THE NORTHWESTERN PACIFIC RAILROAD*

By the 1890s the inventions and improvements designed by Frank Sprague had vastly accelerated the development of horizontal traction. It was his work in the area of horizontal tractionwith the Northwestern Pacific Railroad in California that would establish him as a pioneer in the replacement of locomotive steam power with electric power.

In 1871 the San Rafael and San Quentin Railroad was a narrow gauge line powered by steam locomotives. The line ran from San Francisco across the Bay by ferry to the landing near the San Quentin State Prison and then north on the rails to San Rafael. The railroad gave residents of San Rafael access to San Francisco but failed to take advantage of the opportunities in western Marin County to transport the plentiful timber and dairy products to the City by the Bay.[19]

The line that did take advantage of the freight potentials was the North Pacific Coast Railroad, a system that eventually combined with the San Rafael and San Quentin lines. Ultimately the line was extended from the

[18] Ibid. [This writer's Uncle Jim, James Finnegan of West Roxbury, MA,, was a motorman on Boston's MTA in the 1930s, resulting in a few free rides.]

[19] Demoro, Harre W., *Electric Railway Pioneer*.

ferry landings in the Marin County towns of Tiburon and Sausalito to the northern section of Humboldt County with side routes along the way.[20]

Shortly after the turn of the century two electric power entrepreneurs, Eugene de Sabla, Jr. (1865-1956), and John Martin (1858-1928), reviewed the potential of the North Pacific Coast Railroad. Along with their partner, Sharon's Romulus ("Rome") Riggs Colgate, they had formed the California Gas & Electric Company later, in 1903, to become the present Pacific Gas & Electric Co. In the 1900 formation of the organization, Romulus Colgate, grandson of William Colgate founder of the toothpaste and soap empire, was elected president with both Martin and de Sabla serving as vice-presidents.

Although Romulus Riggs Colgate was spending a great deal of time in the West he and his wife Susan Lyman Prince Colgate were residents of New York City. Colgate's office was in Brooklyn where he was a Vice-President of Robert Colgate & Company whose prime product was *Dutch Boy Paint*. However, the Colgates already had a strong connection with Sharon spending a few weeks each year between 1896-1902 at the *Governor John Cotton House* (now *Weatherstone*) on South Main Street. Beginning in 1902 Colgate's agent Judge Willard Baker was busy securing the properties that would become *Filston,* the country estate of Romulus and Susan.[21]

Through the entrepreneurial expertise of de Sabla and Martin and the efficiency and finances of Rome Colgate, a major electric power system had been implemented on the western slopes of the Sierra Mountains in Nevada County and in the surrounding California region. The formation of the California Gas & Electric Company was due to a merger of the Bay Counties Power Co., Nevada County Power Co., Valley Counties Power Co., California Gas & Electric Co., South Yuba Water Co. and Standard Electric Co. of California. Extremely efficient Pelton water wheels powering turbines in the Sierras produced electricity forGrass Valley, Nevada City and the Sacramento regionand onto the Bay Area. Not surprisingly the general increase in the availability of electric current shortly began to change the lifestyles of Bay Area residents.

The family of Eugene de Sabla, Jr. was one of nobility in France. After the fall of the Bastille in 1789 his great-grandfather was forced to flee with family and fortune to Martinique in the West Indies. Later

[20] Ibid.
[21] Kirby, Ed; *Seldom Told Tales of Sharon – Book II,* Sharon Historical Society, Sharon, CT, 2008. Read for a complete story on Colgate and *Filston*.

generations resided in Guadalupe, the Isthmus of Panama in New Grenada, Columbia and Guatemala. Eugene, Jr. was born in Panama and brought by his father Eugene de Sabla, Sr. to San Francisco in 1870 where his father opened an export and import business. Eugene trained as an assayer and went to work for a copper mine in Arizona prior to his arrival in Grass Valley, Nevada County, California.[22]

Following the financial recession of 1893, John Martin (1858-1928) arrived in Grass Valley. Born in Indianapolis, Martin spent his boyhood in Brooklyn, New York. After employment in Alabama and Chicago, he established the John Martin Company as a dealer in pig iron and an agent for the U.S. Cast Iron Pipe Company. Martin was also authorized to sell products for the Stanley Electrical Manufacturing Company of Pittsfield, Massachusetts.[23]

Later, fascinated by the potential of electric power development, John Martin traveled east to Pittsfield, Massachusetts and met with William Stanley to contract for the use of reliable electric equipment. Martin and Eugene de Sabla then entered into a contract with the Nevada County Power Company to provide and install electrical equipment and set up a local transmission line to Nevada City and Grass Valley.[24]

Extremely enthusiastic over their success in the production and long distance transmission of electricity, Martin and de Sabla purchased the North Pacific Coast Railroad in 1902 and reorganized the line as the North Shore Railroad. At that time steam locomotives powered longer rail lines. The attempt by de Sabla and Martin to use electricity for locomotion would be the first in North America. Though the electricity for locomotive power on their railroad was produced a considerable distance away Martin and de Sabla overcame that problem by the installation of a one hundred fifty mile alternating current transmission line from the Colgate Powerhouse in the Sierra Mountains to Alto.[25] In reality the connection to Alto did not require a totally new electric line from the Colgate Powerhouse in the Sierras since California Gas & Electric Company was already transmitting power to the Bay Area. Shown on the 1899 Rand McNally Atlas in Marin County (not shown on most present day atlases), Alto was about ten miles north of Sausalito near present day Marin City.

[22] Ibid.
[23] Ibid.
[24] Ibid.
[25] Demoro, Harre W., *Electric Railway Pioneer*, Interurban Press, Glendale, CA, 1983.

With the electric power available the next problem for Martin and de Sabla would be to design and produce electric locomotives to pull the trains. Although documentation has not been found it is likely that Sharon's Romulus R. Colgate recommended hiring Frank Julian Sprague for the job.

At that time Sprague was living at 241 West End Avenue in New York City with an office at 165 Broadway. Well established in his field with the success of the trolley line in Richmond and the MU control on the South Side Elevated in Chicago, Sprague was an ideal choice for the electrification of the North Shore Railroad.

Prior to the electrification of Martin and de Sabla's newly acquired line, electric railways were primarily city trolley lines or lightweight trains mostly incapable of higher speeds. While electric power had been applied to trains in some areas to avoid smoke in tunnels and terminals, the level of technology and equipment had not yet been reached to adequately power the trains for greater speeds and longer distances. The challenge would be great but once again Frank Julian Sprague would meet the challenge.

Designing an electric locomotive to pull passenger or freight cars was only effective to a point. Each car added to the locomotive reduced the overall efficiency of the train. In addition through a somewhat cumbersome process at the end of the line, the locomotive had to be uncoupled and moved to the other end of the train for the return trip.[26]

Sprague attacked the electrification problem with his usual vigor and expertise. Usingprinciples demonstrated earlier in Chicago he arranged MU control units in each car. Placing the electrical control equipment in a box under the car Sprague ran a series of connecting wires through the control box of each car. From the power plant at Alto the high-voltage alternating current was converted to lower voltage direct current to power the trains. Since each car had its own motors the length of the train did not affect the efficiency because each car was self- propelled. The engineer controlled the train from the front car. When the train reached its terminus the engineer simply moved to the other end and controlled it in the opposite direction.[27]

[26] Ibid.
[27] Ibid.

Using Sprague's MU controls the opening day of the North Shore electrified operation was on August 20, 1903 with the line operating until 1941.[28] Today portions of the abandoned roadbed can be viewed off California State Highway 1in western Marin County.

*UNDERGROUND IN NEW YORK CITY*

*GRAND CENTRAL TERMINAL*

In October 1871 Grand Central Depot was opened to the public giving access to The New York Central and Hudson River Railroad, the New York and Harlem Railroad and the New York and New Haven Railroad. The head house, originally housing a hotel, restaurants, passenger waiting rooms, railroad ticketing offices and railroad offices was an "L" shaped structure with a short section running east-west on 42nd Street and a long leg running north-south on Vanderbilt Avenue.

Development of the transportation system in and out of central Manhattan was a long-term process. Park Avenue was still Fourth Avenue in 1831 when a group of investors chartered the New York and Harlem Railroad affecting the then open land to the north. New York City was very different at that time as illustrated when on the double-track area; a locomotive hit a cow at East 58th Street in 1839. In the 1860s Railroad Tycoon Cornelius Vanderbilt gained control of the railroad and in 1871 built the first Grand Central Depot.[29]

During the 1860s when Vanderbilt was in control of the New York and Harlem Railroad he proposed leaving the track open at a level well below the city streets with "elegant bridges" across the rail line. Despite his opposition the Fourth Avenue was covered creating considerable revenue producing acreage on what would become Park Avenue.[30]

Between 1899 and 1900, the original Grand Central Depot head house was essentially demolished. It was expanded from three to six stories with an entirely new facade, from plans drawn by railroad architect Bradford Gilbert. The train shed was kept though tracks that previously continued south of 42nd Street were removed and the train yard reconfigured in an effort to reduce congestion and turn-around time for trains. The rebuiltstructure was renamed Grand Central Station.[31]

[28] Ibid.
[29] The New York Times, Sunday, September 13, 2009
[30] Ibid.
[31] http://en.wikipedia.org/wiki/Grand_Central_Terminal#History.

From 1896 to 1900 Frank Sprague served on the Commission for Terminal Electrification of the New York Central Railroad, including the Grand Central Terminal in New York City, where he designed a system of automatic train control to ensure compliance with trackside signals. He founded the Sprague Safety Control & Signal Corporation to develop and build this system. Along with William J. Wilgus, he alsodesigned the Wilgus-Sprague bottom contact third rail system used by the railroads leading into Grand Central Terminal.

During the construction of the new terminal electric magnate George Westinghouse wrote to the New York Times criticizing the planned electric system proposed and under development by Frank Sprague. Westinghouse was particularly critical of the use of electricity underground and Sprague's multi-unit control system.His letter was published in the Times on January16, 1902. On January 17, Sprague's cryptic response was printed by the Times. The response read as follows:

To the Editor of The New York Times: Your editorial in yesterday's issue, deservedly rebuking Mr. Westinghouse for his pessimistic and ill-advised letter, is in error in stating that it will be read with consternation, or even with surprise, by electrical engineers, notwithstanding Mr. Prout's indorsement (sic).

Mr. Westinghouse's choice is incorrect in using the opportunity to first assume what the railway company itself is not yet ready to announce, and then condemn, its possible adoption by criticisms based on false premises, and supported by misleading statements. That the multiple unit system, already indorsed by 300,000 horse power **of** equipment within four years is an essential in any general solution of many railroad problems of to-day, goes without saying, but it is equally certain that modified or alternative plans must be applied to other problems.

Mr. Westinghouse declares that already there have been many serious collisions on electric cars, with great loss of life. It would have been more to the point if he had explained that almost invariably these have been with single cars on single-track roads, where no adequate signals were in operation, or where they were ignored. Where there have been collisions on electrically operated elevated roads, the cause has been for and absence or disregard of signals, and the loss of life has been a minimum. In no case has such a collision caused a conflagration: this last, when it occurred, have been on account of defective work. There is less reason why fires should occur on well-equipped multiple unit operated trains than on the single cars in the streets, for it is undeniably true that much greater care has, at least in some cases, been exercised to create fire and fool proof apparatus.

The statement is also gravely advanced that the amount of current necessary to operate a train would melt a large bar of iron. So, to, would the amount of current to light an ordinary building, but an essential of the multiple system is the localization on any motor car of controlling apparatus individual to its motors, and limited in current to their capacity. No controlling devise in this system carries the entire current to its motors, and limited in current to their capacity. No controlling devise in

this system carries the entire current of the train; heavy currents are prohibited being carried from one car to another, and the controlling currents are less than those in an ordinary lamp circuit.

Ignorance and carelessness of motormen is largely discounted, in that the current in-put in each motor equipment is, where the system is properly installed, automatically limited to safe amounts. Where derangement of a circuit occurs, causing an abnormal increase of current, safety devices of reliable character provide against its continuance.

Mr. Westinghouse makes reference to an accident, the first of its kind on that road, although in operation for eleven years, which recently occurred in the tunnel section of the Liverpool Overhead Railway. This equipment had the very objection which the multiple system was designed to avoid, in that main currents were carried from the regulating apparatus at the head of the train to motors at the rear end. Whatever the actual cause of trouble, the presence of creosoted wood largely contributed to the serious character of the disaster.

Evidently Mr. Westinghouse is apprehensive that the multiple unit system may be found advantageous in some proposed equipment on the New York Central, but it is safe to assume that any well-matured plans will not be stopped because of objection from a manifestly interested source, and if it be satisfactorily demonstrate to the railway company that electrical operation will prove advantageous, it will be adopted, whatever the system or cost.
FRANK J. SPRAGUE

New York, Jan. 17, 1902.

During the period 1903 to 1913, the entire Grand Central Station was torn down in phases and replaced by the current Grand Central Terminal. This work was accompanied by the electrification of the three railroads.It was then that the Park Avenue line was buried to 96th Street. The result of this was the creation of numerous blocks of prime real estate in Manhattan, which were then sold for a large sums of money. The new terminal opened on February 2, 1913. Frank Julian Sprague had outpaced his detractors once again.[32]

*THE MAPLES IN SHARON*

Following the 1895 divorce of Frank Sprague and Mary, the couple remained in amenable contact for the rest of his life. In the spring of 1899 Sprague was introduced to Harriet Chapman Jones (1876-1969) the daughter of retired U. S. Army officer Captain Henry R. Jones. Miss Jones grew up in New Hartford, Connecticut, a few miles east of Winsted. Educated in local public schools she went to colleges and studied languages and music in Switzerland and Germany as well as in the United States.

On October 11, 1899 Frank Sprague married Harriet Chapman Jones in her hometown of New Hartford. Nineteen years his junior, Harriet would soon provide the social contacts and support needed for her husband's ongoing business success.

The couple settled in northern Manhattan on Riverside Drive while Frank was working on the last stages of the development of his multiple-unit control system. As pointed out by Frederick Dalzell in his book *Engineering Invention,* the marriage to Harriet was a success perhaps because she was simply a better match for him than Mary, or perhaps because Sprague was ready to be a better husband. Whatever the case, his life appears to have changed following the marriage. Two sons resulted from the union. On August 3, 1900, Robert Chapman Sprague was born, followed by Julian King Sprague on June 14, 1903, both in New York City.

Under Harriet's influence, the couple took time to travel, sometimes as far away as Europe, sometimes from New York City to northwestern Connecticut and western Massachusetts. Most sources state that Harriet persuaded Frank to buy a house in Sharon. However, this writer is convinced that the

[32] Ibid.

Sprague's move to Sharon was a direct result of hisrelationship with Romulus R. and Susan L. P. Colgate.

During the summers of 1896 through 1902 the Colgates vacationed at the *Governor John Cotton Smith House* (today*Weatherstone*) along the Green adjacent to the property that would eventually be purchased by the Spragues. Colgate and Sprague must have known each other well by 1902. Though one was an inventor and the other primarily an investor, both were keypioneers in the field of electricity. It seems likely that the Colgates shared their love of Sharon with the Spragues, and perhaps even that a small house and land were for sale adjacent to where they vacationed. By 1902 the Colgate mansion *Filston* was under construction in Sharon and Colgatein the process of purchasing several additional substantial tracts of land.

On August 3, 1906, as the Colgate mansion *Filston* was nearing completion, Harriet Chapman Sprague became the owner of record of the twelve acre property south of the intersection of Town Street (now South Main) and Herrick Road.[33] Mary L. Smith who had been granted the property from the estate of her husband Aaron R. Smith was the previous owner. The property was part of a larger segment shown as Lot Number 16 on the *Original Home Lots of Sharon*. Samuel Butler of Hartford was the initial owner but like a majority of first purchasers he never built on the property. In fact is unlikely that Butler ever came to Sharon to view his holdings.[34]

As in this case it was not unusual for city owners of Sharon properties to record the owner in the name of the wife. This practice was obviously for tax, mortgage and potential litigation purposes and is currently still used for many Sharon properties. As it turned out this was a particularly good move for the Spragues since periodically Frank would go into debt when contracting for new projects. According to Sharon land records Harriet negotiated mortgage adjustments or changes on more than one occasion.

After Butler, the next owners of the location, Stephen & Naomi and Joseph & Elizabeth Read sold the property of thirteen acres and ten rods to Daniel Griswold.[35] Griswold, sometime between 1776 and 1779 built the original small housealong Town Street. Through the remainder of the seventeenth

[33] Sharon Land Records, V43 – 149.
[34] Original Sharon Home Lots map, Sharon Historical Society.
[35] Sharon Land Records, V7 – 239.

century a barn and blacksmith shop were addednear the intersection of South Main Street and the street(now Herrick Road) to the Sharon / Litchfield Turnpike.

By 1780 the property was owned by the Smiths and their descendants. When in 1786 Dan Smith transferred the property to Paul Smith, Jr. the property became known asthe *Paul Smith, Jr. House*, the title listed today in town histories.

When the Spragues purchased the property the small house remained near Town Street. The house was then moved east well away from the highway. Under architect Mann & Mac Neilles' plan, instructions by one Edwin Aday and certainly supervision by Frank and Harriet, the old building was modified and a large Colonial Revival expansion was extended toward the west. Aday carefully laid out the locations of the tennis and croquet courts and established magnificent vegetable and flower gardens.[36]

Soon after the Spragues became owners of the Sharon property, daughter Frances was born in what was the unfinished house in 1906. Then with the house, gardens, tennis court and croquet court completed, the Sprague estate was titled *The Maples,* a name seldom used by town folk to describe the location. The handsome building did add to the grace of South Main Street, bordered to the north by the *Governor John Cotton Smith House* and to the southeast by *Perkins Castle*.

Life at *The Maples* provided some of the happiest years for the Spragues. While Frank continued his work the train service on the New York Central between Sharon Station and Grand Central Depot made it possible to travel from his New York home and office to Sharon on a regular schedule. In Sharon Harriet organized the social schedule and developedit not only in breadth but also in depth. In addition to the entertainment of local guests many notables spent time with the Spragues.

At one point Mary Dimmick Harrison, second wife and widow of former PresidentBenjamin Harrison,and her daughter spent a week at *The Maples.*[37]Mrs. Harrison (1858-1948) was born in Honesdale, Pennsylvania. Interestingly, Arthur Duane who was born in Honesdale in 1859 had

[36] Middleton, William D. and Middleton, William D. III; *Frank Julian Sprague – Electrical Inventor & Engineer*, Indiana University Press, Bloomington & Indianapolis, IN, 2009.
[37] Ibid.

completed his house, *Cool Gales,* just around the bend from *The Maples* on south Main Street in 1893. It is quite likely that Mrs. Harrison and Duaneknew each other well, growing up in Honesdale, a town of only 4.12 square mileswith a small population. Arthur Duane was also a close associate of the Sharon Colgates and iron maker Charles W. Barnum of the Barnum Richardson Company who continued toadministrate the Sharon Valley Iron Company until 1898.

Harriet Sprague was a close friend of Clara Clemens, daughter of Samuel Langhorne Clemens, known to most of the world as Mark Twain. On June 16, 1908, Mark Twain moved into his new home, an eighteen-room villa titled *Stormfield.* Located in Redding, Connecticut, *Stormfield* would be the last home of the great writer/humorist. As friends of the Spragues the Clemens came to dinners at *The Maples* in Sharon and the Spragues dined at *Stormfield.* How long they stayed is not known but it is known that"weekend visits" at the Spragues often lasted for several days.

At *Stormfield* Mark Twain kept a rather handsome brown guest book to be signed by those who came to the house. Twain's story was that any male visitor needed to pay one dollar upon signing with the money to go to the new library to be named for him in Redding. The guest book, now in the collection of the University of California at Berkeley, contains numerous scribbled entries on its thirty-four pages. The signatures, often accompanied by whimsical asides, reveal not only the large number of visitors but also the variety of backgrounds from which they came. Twain appeared most impressed with those of Helen Keller who wrote of him as a king and actress Billie Burke whom he described as young, gifted, beautiful and charming. The book also included the September 18, 1908 visit by a pair of burglars who snatched the family silver and obviously did not sign, but Twain later signed for them and listed their address as "state penitentiary."[38]

Page thirty of the Twain guest book contains the signatures of Frank J. and Harriet Sprague for September 5, 1909. Harriet signed first showing *Sharon, Connecticut* under address followed by *Sept. 5,1909*in the date column. Perhaps attempting to emulate the humor of his friend the next line shows *Frank L. Sprague* with a scratchy underline*The Land in the Summer* as his address and *No later* beneath the Sept. 5, date inscribed by Harriet. Despite his normal intensity Sprague was a bit of a humorist as well.

[38] Cowan, Alison Leigh, *The New York Times*, Sunday April 25, 2010.

Another fall visit by the Spragues to *Stormfield* was for the purpose of attending the wedding of Twain's middle daughter Clara Clemens to Russian concert pianist Ossip Gabrilowitsch. On October 7, 1909 *The New York Times* carried the following story (here abridged):

## MISS CLEMENS WEDS MR. GABRILOWITSCH

**Mark Twain, in Scarlet Cap and Gown,**

**Sees His Daughter Married to Russian Pianist.**

**AVOIDS "CEREMONY DELAYS"**

**Humorist in Prepared Interview Says a Happy Marriage is**

**One of the Tragically Solemn Things of Life.**

WEST REDDING, Conn., Oct. 6. - Miss Clara L. Clemens, daughter of Samuel L. Clemens, (Mark Twain,) was married at noon today to Ossip Gabrilowitsch, the Russian pianist. The wedding took place in the drawing room at Stormfield, Mr. Clemens's country home, with the Rev. Dr. Joseph H. Twitchell of Hartford, a close friend of Mr. Clemens, as officiating clergyman. The bride was attended only by her sister, Miss Jean Clemens, but her cousins, Jervis Langdon of Elmira, N. Y., and Mrs. Julia Loomis, wife of Edward Loomis, Vice President of the Delaware Lackawanna & Western Railroad, were present.

Miss Ethel Newcomb of New York City played a wedding march as the bridal party entered the drawing room. This room was prettily decorated with evergreens. Autumn leaves, and roses, and the bride and bridegroom stood beneath a bower of white roses and smilax.

While the ceremony was being performed Mr. Clemens was attired in he scarlet cap and gown which he wore when the Degree of Doctor of Literature was conferred upon him by Oxford University. After the wedding he wore a white flannel suit.

Forty guests from New York City were present and attended a wedding breakfast which followed the marriage.

Mr. and Mrs. Gabrilowitsch left for New York this afternoon. After remaining that city about a week they will go to Berlin, where Mr. Gabrilowitsch has taken a house. Later Mr. Gabrilowitsch will make a tour of Germany in concerts.

Among the guests at the wedding were Richard Watson Gilder, Mrs. Gilder and three daughters, Mr. and Mrs. A. M. Wright of Boston, Mrs. E. F. Bauer and the Misses Flora and Marion Bauer of New York, Miss Lillian Burbank, Miss Marie Nichols, Mrs. John B. Stanchfield, **Mr. and Mrs. Frank J. Sprague**, Miss Foot, Miss Comstock, Miss Mary Lawton, Mr. and Mrs. Theodore Gaillard, Mr. and Mrs. Charles Hapgood, Mr. and Mrs. Albert Bigelow Paine, and Miss Ethel Newcomb, all of New York.[39]

At the ceremony there was only one photo of the wedding party, that taken by Frank Sprague. Harriet Sprague is in the photo.

Among other important friends of Frank and Harriet Sprague was William Dean Howells (1837-1920) author, editor and critic who in his earlier years had written a campaign biography for Abraham Lincoln. This extensive work provided the wherewithal for Howells to move from Ohio to the northeast where he became acquainted with some of the late nineteenth century literary giants including Ralph Waldow Emerson, Nathaniel Hawthorne, James Russell Lowell, Henry David Thoreau and others. As editor of the *Atlantic Monthly* Howells published works by Henry James and Mark Twain while becoming personal friends of both. The mutual friendship with Twain soon led to a strong friendship between the Howells and the Spragues.After dinner discussions between the threesome often went well into the night with the others fascinated by both the romance and new uses of electric energy as told by Sprague.[40] Another close friend of Sprague in the period was James Brander Matthews (1852-1929), one of the most influential American scholars and literary critics of the late nineteenth and early twentieth centuries.

[39] Bold face of the Spragues by this writer.
[40] Middleton, William D. and Middleton, William D. III; *Frank Julian Sprague – Electrical Inventor & Engineer*, Indiana University Press, Bloomington & Indianapolis, IN, 2009.

The local social life for the Spragues in Sharon was Harriet's domain.In 1910 the Sharon Woman's Club (SWC) was formed and for a few years Harriet was a member. At one point the SWC minutes show Frank Sprague as asustaining member, a classification obviously established to place additional funds into the treasury. Sprague's neighbor down the road, Arthur Duane, was listed under the same category.

During the eighteen plus years that the Spragues had a home in Sharon a number of changes took place on the local scene.In 1898 the Sharon Valley Iron Company blast furnace was taken out of blast and soon the associated iron works were closed. Industry in Sharon was on the decline. As a result the population was on the decline as workers sought employment in other industries and other locations, some rather distant.*Perkins Castle*was torn down and the marble blocks used to build a dam for Harold Hatch across the north branch of Mill Brook that would form the water body known today as Hatch's Pond.

In town paved sidewalks were in place even before Main Street was paved in 1924(?). At that point a new paved road was being constructed across the new cement Cornwall Bridge, and west toward Ellsworth and Sharon Village.The Cornwall Bridge Covered Bridge remained for foot traffic until its demise in the great ice break upof 1936.

*THE LATER YEARS*

In 1910 Frank Sprague was awarded the prestigious IEEE Edison Medalnamed after the inventor and entrepreneur Thomas Edison. Four years later the American Institute of Electrical Engineers (AIEE) entered into an agreement with the group to present the medal as its highest award. The first medal was presented in 1909 to Elihu Thomson, the next in 1910 toFrank Sprague. One cannot help being impressed by the fact that the first seven recipients of this prestigious award included not only Sprague but also the major figures of the period he worked with, competed against or both.The special seven winners were Elihu Thomson (1909), Frank J. Sprague (1910), George Westinghouse (1911), William Stanley, Jr. (1912), Charles F. Brush (1913), Alexander Graham Bell (1914), (no medal awarded 1915) and Nikola Tesla (1916).[41]The Edison Award continues to this day.

[41] Jutte, Evelyn; *Arlington National Cemetery Website,* http://www.arlingtoncemetery.net/fjsprague.htm

Yet, this writer and probably most readers will have difficulty in identifying award winners other than the original seven and Edison himself!

Although Sprague never received the public adulation of Edison, Westinghouse or Bell he was recognized professionally with a series of prestigious awards over a period of forty-six years. In addition to the 1910 AIEE Edison Medal he earned the gold medal at the Paris Electrical Exhibition in 1889 and the grand prize at the St. Louis Exhibition in 1904. The Franklin Institute awarded him the Elliott-Cresson Medal in 1904, the Franklin Medal in 1921 and the Frank Julian Sprague Bronze Portrait Bust presented at the January 1934 annual meeting of the American Institute of Electrical Engineers. Three days before he died Sprague was notified that representatives of four national engineering societies had selected him to receive the John Fritz Gold Medal for 1935.[42]

In recognition of his outstanding accomplishments in horizontal and vertical traction Sprague was also the recipient of prestigious honorary degrees including Doctor of Engineering from the Stevens Institute of Technology in 1921, Doctor of Science from Columbia University in 1922 and Doctor of Laws from the University of Pennsylvania.

Frank Julian Sprague died at his New York home at 40 West Fifty-Fifth Street on Thursday October 25, 1934. His funeral was held two days laterat the West End Collegiate Church on Seventy-Seventh Street and West End Avenue. Burial took place with a Naval guard of honor at Arlington National Cemetery on Monday, October 29.[43]

*PRESERVING THE SPRAGUE LEGACY*

Harriet Chapman Jones Sprague outlived her husband by thirty-four years. With growing concernover the credit given Edison for inventions and work actually accomplished by Frank, in 1947she published her short booklet titled *Frank J. Sprague and the Edison Myth.* In her treatise Harriet credited Edison for his significant work, patents and inventions. Beyond that point she made a strong and documented case for the inventions and ideas of Frank Sprague, many of which had been credited to

[42] Middleton, William D. and Middleton, William D. III; *Frank Julian Sprague – Electrical Inventor & Engineer*, Indiana University Press, Bloomington & Indianapolis, IN, 2009.
[43] Patterson, Michael R., Webmaster; *Arlington National Cemetery Website*, http://www.arlingtoncemetery.net/fjsprague.htm

Edison. Included in her credits were the flourishing development of systems of electric railway cars, the multi-unit controller for more efficient navigation of tracks, and a multiplicity of advances in elevator technology. In each of these cases the true inventor was Sprague and yet in somehow Thomas Alva Edison wound up receivingthe credit.

Harriet Sprague'smission in writing the booklet was obviously to clarify the historical record giving credit to her husband where credit was due, without denying Edison credit for his outstanding contributions. To document her findings Harriet quoted a detailed number of newspaper and journal articles, company records and letters from a tribute held in Sprague's honor on his 75th birthday in 1932, some of which were quoted in their entirety.[44]

In fairness to all it should be realized that upon the completion of a major project, and when preparing for another, Frank Sprague often sold the former to competitors such as Edison, General Electric, Otis Elevator or others. Following the sale the brass identification plate no longer indicated the name of the Spraguecompany, but that of the sale recipient.Over time, this made it difficult to identify the true inventor. However, a quick review of the list of Sprague's ninety-five registered patents makes it clear what he actually accomplished.

Harriet Chapman Jones Sprague died at age ninety-three on October 1, 1969. Her internment took place six days later next to her husband in Arlington National Cemetery.

On May 15, 1999, *The Shore Line Trolley Museum* in East Haven, Connecticut welcomeda large gathering of Sprague descendants for the opening of a new permanent exhibit: *"Frank J. Sprague: Inventor, Scientist, Engineer."*

The centerpiece of this exhibit is what is believed to be the oldest surviving Sprague electric motor constructed in 1884.Three generations of Spragues were present at the opening. For some, it was their first visit to the museum, while others remembered the dedication of the Sprague Building in 1959,

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[44] Sprague, Harriet Chapman Jones. "Frank J. Sprague and the Edison Myth." New York: The William-Frederick Press, 1947.

made possible by a gift from Harriet Sprague. Today the museum displays additional tributes to Sprague as well as providing a delightful trolley ride through earlier times.[45]

For those who live in Sharon and the surrounding region the legacy of Frank Sprague should be quite obvious. Taking the train from Wassaic to Grand Central Terminal provides several immediate opportunities to recognize and benefit from some of the remarkable inventions of this man. When your train arrives in Wassaic the engineer is in the diesel-electric engine on the front of the train. Now the engineer goes to the opposite end and, thanks to Sprague's Multi-Unit (MU) control system, controls the train from the opposite end. As you travel south note the system of automatic train controls that enforced compliance with trackside signalsinitiated by Sprague. South of Southeast station you can see the Wilgus-Sprague bottom contact third rail system extending along the tracks. As your train enters the tunnel toward Grand Central Terminal note the intricate track system designed in consultation with Sprague.Even the concept of running underground, electrically powered trains into New York, despite the strong objections of George Westinghouse, was the one successfully promoted by Sprague.

Once in the terminal you may wish to take a quick trip to Fifty-ninth Street on the Lexington Avenue Express, an IRT Line with a daily ridership of 1.3 million, greater than the combined ridership of San Francisco and Boston's entire transit systems. Thanks to the design by Frank Sprague this line has both local and express service. With a combined four-track system the express follows a direct north-south line with two tracks while the local twin tracks veer from the direct line to reach additional locations. Yes, the Lexington Avenue Express trains can be extremely crowded but they are also very efficient.

Back in the Grand Central Terminal area you might have an appointment in one of New York City's numerous skyscrapers. If it is on the sixty-sixth floor no problem. Thanks to the electric elevator system invented by Sprague you will be at your appointment site in a matter of moments. At another building you may be raised to an even higher elevation meeting by two elevators in the same shaft designed to preserve valuablefloor space at each level. In those systems you may take the first elevator to the fifteenth floor then the next in the same shaft to your higher elevation. This system is also the result of another remarkable invention of Frank J. Sprague.

[45] The Shore Line Trolley Museum, <http://www.bera.org/articles/sprague2.html>

Should you travel further to Boston or San Francisco or other locations you will have the opportunity to ride on trolley car lines that have incorporated Frank Sprague's spring-loaded contact poles and individual electric powered truck systems.

On your way back to Wassaic en route to Sharon, review once more the contributions of this remarkable man who maintained a very active and welcoming home in our town for almost twenty years.

Frank Julian Sprague, onetime resident of Sharon, was a remarkable man. As ascientist, inventor and engineer he held a total of ninety-five U. S. Patents. There were many inventors that had more patents but few had the socioeconomic impact of the successful trolley system, the multiple control unit or the electric elevator. Sprague's inventions and engineering changed the horizontal and vertical dimensions of most of the cities of the period. His work also affected the lives of individuals who both used his inventions his inventions and who filled the thousands of jobs building the factories and machines, assembling the electric motors and installing the equipment. He was also a colleague of the foremost minds and most famous inventors of our time.

Frank Julian Sprague made things move: up and down and back and forth. He was truly *The Father of Electric Traction.*

**Book Three Contains the Following Stories:**

Sharon and the Ice Age

Industries Along Ellsworth's Guinea Brook

A Connecticut Yankee in Oregon's Court

Frank Sprague- Father of Electric Traction

Preserving the Sharon Valley Lime Kiln

John Wike and the Smith Brother's Murder