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Frank J. Sprague

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JOHN FRITZ MEDAL

Biography of

FRANK JULIAN SPRAGUE

MEDALIST FOR 1935

SUPPLEMENT TO JOHN FRITZ MEDAL BOOK

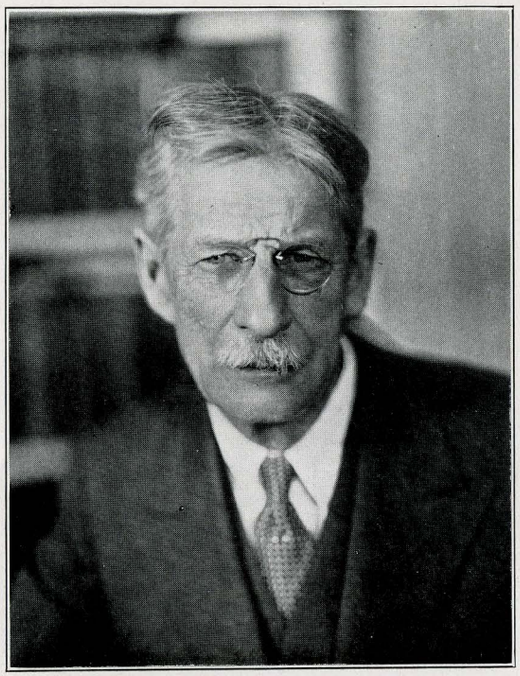
NEW YORK : OCTOBER : 1935

THE JOHN FRITZ MEDAL

THE JOHN FRITZ MEDAL *is the honor awarded by representatives of four national engineering societies, having more than sixty thousand members, namely:* — AMERICAN SOCIETY OF CIVIL ENGINEERS, AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, *and* AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. *In memory of John Fritz, of Bethlehem, Pennsylvania, one of America's great pioneers in the iron and steel industries, Hononary Member of several societies, friends and associates, most of whom were members of the four societies, in* 1902 *established the John Fritz Medal.*

The medal is of gold, awarded not oftener than once a year, for notable scientific or industrial achievement, without restriction on account of nationality or sex. It is accompanied with an engraved certificate. This certificate states the origin of the medal, the specific achievement for which the award is made, and bears the names of the Members of the Board by which the medal was awarded and the signatures of the President and the Secretary of the Board.

FRANK JULIAN SPRAGUE



FRANK JULIAN SPRAGUE

FRANK JULIAN SPRAGUE

FOR DISTINGUISHED SERVICE AS INVENTOR AND ENGINEER THROUGH THE APPLICATION AND CONTROL OF ELECTRIC POWER IN TRANSPORTATION SYSTEMS.

FRANK JULIAN SPRAGUE'S notable scientific and industrial achievements in both horizontal and vertical transport of passengers by means of electricity, in applications of electric power, and in controlling devices assuring safety and comfort, are major items in the permanent record of the early industrial development of electricity. They brought lasting benefits to the whole world. As "the father of electric traction" he will long be remembered, but this pseudonym is an inadequate characterization. To him the world is indebted for the early constant-speed motor, the electric railway, the electric elevator, the multiple-unit system of train operation. He invented also a system of regeneration used on electric railways and elevators, and a system of automatic signal and brake control to enforce obedience to signals on railways. He developed an alternating-current induction smelting furnace.

Frank Sprague was born 25 July 1857, at Milford, Connecticut, son of David Cummings Sprague and Frances Julia King Sprague, of old New England lineage. He attended high school in North Adams, Massachusetts. In 1874, he was appointed to the United States Naval Academy at Annapolis, and was graduated in 1878 with high honors. In 1882 he was a member of a jury at the Crystal Palace Exposition in London and reported to the Navy Department on dynamo-electric machines, gas engines and

Note: The 31st award of the medal was made 19 October 1934. Notification of the award was delivered to Mr. Sprague's office on the 20th. A few days before, he had become ill with pneumonia. The letter of notification was read to him on the night of the 22nd by Mrs. Sprague at their home, and gave him great pleasure. He died on 25 October, after a week's illness. The medal was presented to Robert C. Sprague, one of the medalist's sons, as the representative of the family, on the evening of 23 January 1935, at the "medal" session of the winter convention of the American Institute of Electrical Engineers, immediately following the presentation of the Edison medal to Willis R. Whitney, Vice-President of the General Electric Company in charge of research.

electric lights. Shortly after graduation he submitted to Thomas A. Edison a new system of telephony. This system was not developed, but its submission brought him to Edison's attention. In 1883 he resigned from the Navy.

Sprague's career from this date was narrated by Dr. Gano Dunn, a former member of the John Fritz Medal Board of Award and a past-president of the American Institute of Electrical Engineers, in his address preceding the presentation of the medal.

Following resignation from the Navy, Sprague was Edison's assistant for about a year. Impressed with the power possibilities of the constant potential system of distribution, which Edison had introduced into New York in the Pearl Street Station in 1882, Sprague set himself with brilliant success to developing a motor that would run at constant speed on constant potential systems. He not only produced the upright type of motor, but introduced the differential series winding. Sprague motors began to be used everywhere on Edison circuits and were finally officially endorsed by the Edison companies on account of their simplicity, effectiveness and the growing use of electric current which they began to bring about.

For the manufacture of these motors, and with an eye on the application of electric power to street cars, Sprague, in 1884, organized the Sprague Electric Railway and Motor Company. But it was not until 1887, that he astonished the technical world by taking a contract to build and equip in 90 days, an electric street railway in Richmond, Virginia. The problems that were successfully and brilliantly solved in the design and construction of the Richmond road and its equipment, and the methods by which Sprague met emergency so impressed the technical world as well as the public, that they founded the title: "The Father of Electric Traction."

So spectacular was this accomplishment, notwithstanding many imperfections that were later removed, that within two years, his company had closed contracts for 110 more roads, and in 1890, it was merged with the Edison General Electric Company, which later became the General Electric Company.

While he was Mr. Edison's technical assistant, Sprague originated and perfected the mathematical determination

of electrical distribution, which was of permanent value to the whole electric light development in greatly increased accuracy and saving of time. This Sprague patent was assigned to the Edison Company.

Sprague turned his attention from the field of horizontal to the field of vertical transportation. Hydraulic elevators had reached an unparalleled perfection for ordinary heights. Steam elevators were considerably used, and there was some use of electric elevators, but all of these failed to meet adequately the demands for higher speeds and longer runs called for by increasing skyscraper construction.

Sprague saw from his electric railway experience how increased speeds had markedly increased line capacity and earnings, and with this experience in horizontal transportation before him, he foresaw that similarly increasing the capacity of elevator shaftways would not only save the time of passengers, but would also favorably react on the earnings of tall buildings, of which the height was already beginning to be limited by the greater and greater proportions of total floor space necessarily subtracted by the shaftways of slow running elevators.

With Charles R. Pratt, he developed the Sprague-Pratt Electric Elevator, and in 1882, organized the Sprague Electric Elevator Company, which built nearly 600 elevators, when it was absorbed by its then greatest competitor, the Otis Elevator Company.

In 1926 Sprague made the remarkable proposal of operating two elevators in the same shaft, the lower one for local and the one above it for express service, rendered possible by the perfection of the controlling devices which he had invented.

Electrical devices in the hands of Sprague became ideally adapted to control to an extent that led to the development of high speeds with safety and comfort and to the working out of the unattended automatic or so-called push button elevator now so much in use in private houses, apartment houses, and other locations, where the traffic is not dense enough to require an operator.

While developing the high speed and the automatic electric elevators in which the control of the hoisting machinery was effected indirectly by small pilot motors and other con-

trol devices located near this machinery, these pilot motors in turn being operated by signaling circuits from the car, Sprague saw that through the principle of pilot operation and signal circuit control, he had discovered not only a means of effectuating more rapid, more precise, and more flexible control of a single car, but also a means of controlling cars in groups in all sorts of predetermined and un-predetermined combinations.

The demand for group control did not exist in the elevator field, but Sprague with the unerring insight of a great inventor, saw what could be accomplished with such group control if applied to the railroad field.

In 1895 Sprague conceived his multiple-unit system for the operation of trains of cars, and about 1897 applied it to the operation of the Southside Elevated Railroad in Chicago. His multiple-unit system abolished the customary locomotive and distributed its power elements along the train without reducing the tractive effort which the train as a whole could exert upon the rails in starting. The tractive effort was not only not reduced but greatly increased. By this means so great an increase in acceleration was made possible, that the limit was no longer the point at which the wheels of a locomotive would slip, but the point at which passengers would be made uncomfortable or, if standing, be thrown to the floor, by the rapidity with which the train got under way. Quoting Dr. Sprague's own words written in 1932: This system made possible the combination of any number of equipped units, regardless of sequence or end relation, all controlled from any desired point.

This increased acceleration brought about by the Sprague multiple-unit system so greatly increased average speed that under certain conditions it nearly doubled the capacity of a road without increasing at all the maximum speed at which its trains must run. These accelerations resulting in vastly increased line capacity, were not the only advantages deriving from Sprague's great invention. Trains could be made up at will of any number of units, large or small, and could be broken up at junction points without reference to presence or absence of locomotive equipment.

The constant speed motor favorably reacted upon the introduction of electric power into factories, with all that

that has meant; the electric street railway, now in eclipse, owing to the development of free wheeled rubber tired vehicles, was the progenitor of the present suburban and subway electric train; the high speed electric elevator with its competent indirect control, has reacted upon the building industry and the development of great cities. The creation of the multiple-unit system of train operation and control has brought about the daily transportation of millions, with speed and safety, which, without it, would be impossible.

Sprague had a dynamic personality, characterized by an insatiable passion for invention. He fired the enthusiasms and the ambitions of unnumbered others to great achievement in the electrical and related fields. His qualities were the admiration and delight of hosts of friends, who will see in the discernment of the John Fritz Medal Board of Award which selected Frank Julian Sprague for the medal, a complete vindication of the purpose of the founders of the medal and an additional tribute of honor to the name of John Fritz as well as to the name and fame of Frank Julian Sprague.

During the participation of the United States in the Great War, 1917-1918, Sprague was engaged in the development of fuses and of air and depth bombs. He was also chairman of committees on electricity and ship construction, of the United States Naval Consulting Board.

Sprague was president of the American Institute of Electrical Engineers for the term 1892-93 and was elected an honorary member in 1932. In his honor a bronze bust was placed in the Institute's headquarters in January, 1934. He was a member of numerous other engineering and scientific organizations in the United States and Great Britain.

He was a member of the Bankers', Century, Engineers, Railroad and University clubs, of New York.

He had been president also of the New York Electrical Society, the American Institute of Consulting Engineers, and of the Inventors Guild. He was an honorary member of the National Electric Light Association, of the Franklin Institute, and of The Engineers' Club of New York.

The following awards were made to Sprague before the John Fritz Medal:

Gold Medal, Paris Exposition, 1889, for electric railway development;
Elliott Cresson Medal of The Franklin Institute, 1904, for multiple-unit system of train control;
Grand Prize, Louisiana Purchase Exposition, St. Louis, 1904, for invention and development in electric railways;
Edison Medal of the American Institute of Electrical Engineers, 1910, for meritorious achievement in electrical science, engineering and art; (presented in the presence of Edison);
Franklin Medal of The Franklin Institute, 1921, for fundamental inventions and achievements in electrical engineering.

From educational institutions Sprague received the following honorary degrees:

Doctor of Engineering, Stevens Institute of Technology, 1921;
Doctor of Science, Columbia University, 1922;
Doctor of Laws, University of Pennsylvania, 1924.

An unusual tribute was paid to Dr. Sprague on his 75th birthday, 25 July 1932. A host of friends and admirers, including many leaders in engineering, science, industry and education, met in the Engineering Societies Auditorium in New York to receive him and extend appreciation of his life work.

The meeting was held under the auspices of the Anniversary Committee. Mr. Gano Dunn, presiding, called on Dr. John H. Finley, Associate Editor of the *New York Times,* who spoke of the importance of such engineers as Sprague to the welfare of the world.

Mr. Frank Hedley, President of the Interborough Rapid Transit Company, spoke with force and authority of the noteworthy contribution of Sprague to transportation, and finally Rear Admiral S. S. Robison talked of the career of Sprague as a naval graduate, ending his address with the presentation of six volumes of letters and photographs from 482 friends, many of them leaders in the field of electrical industry, education and art, or former co-workers in Dr. Sprague's enterprises.

Interspersed in these letters was an array of references vividly evoking the salient phases of Dr. Sprague's life in the role of a master engineer, a pioneer inventor and a friend.

Frank Julian Sprague was buried with naval honors in the National Cemetery at Arlington, Virginia, 29 October 1934.