THE elmer a. sperry award for 1966

the elmer a. sperry award medal

In the words of Edmondo Quattrocchi, the sculptor of the medal . . .

"This Sperry medal symbolizes the struggle of man's mind against the forces of nature. The horse represents the primitive state of uncontrolled power. This, as suggested by the clouds and celestial fragments, is essentially the same in all the elements. The Gyroscope, superimposed on these, represents the bringing of this power under control of man's purposes"

PRESENTATION OF THE

1966 elmer a. sperry award

TO

HIDEO SHIMA

MATSUTARO FUJII

SHIGENARI OISHI

With Citation to the President
and all the dedicated engineers of the
Japanese National Railways

BY

The Board of Award under the sponsorship of
The American Society of Mechanical Engineers
Institute of Electrical and Electronics Engineers
Society of Automotive Engineers
The Society of Naval Architects and Marine Engineers
American Institute of Aeronautics and Astronautics

AT THE IEEE INTERNATIONAL MEETING BANQUET

MARCH 22, 1967 · NEW YORK HILTON · NEW YORK, N. Y.

PURPOSE OF THE AWARD

The Elmer A. Sperry Award shall be given in recognition of—

"A distinguished engineering contribution which, through application, proved in actual service, has advanced the art of transportation whether by land, sea or air."

1966 BOARD OF AWARD

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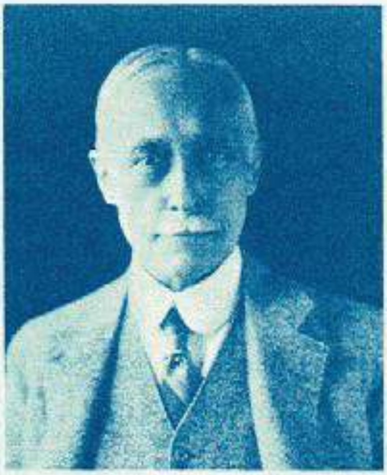


ELMER AMBROSE SPERRY
1860-1930

FOUNDING OF THE AWARD

The Sperry Award commemorates the life and achievements of Dr. Elmer A. Sperry (1860-1930) by seeking to encourage progress in the engineering of transportation. Much of the great scope of the inventiveness of Dr. Sperry contributed either directly or indirectly to advancement of the art of transportation. His contributions have been factors in improvement of movement of men and goods by land, by sea and by air.

The award was established in 1955 by Dr. Sperry's daughter, Mrs. Robert Brooke Lea, and his son, Elmer A. Jr., and is presented annually.

AWARD CITATIONS

HIDEO SHIMA

. . . for directing the study, design and development teams of the Japanese National Railways which engineered, with many innovations, the New Tokaido Line.

MATSUTARO FUJII

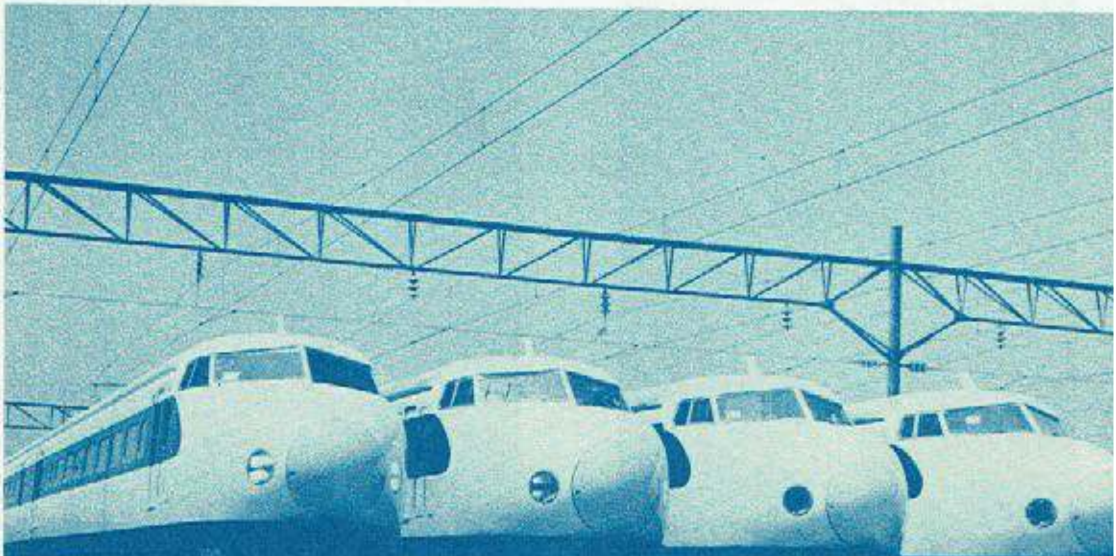
. . . who continued the engineering leadership of the Japanese National Railways teams as they constructed and put into operation the New Tokaido Line with its great comfort and safety at high speed.

SHIGENARI OISHI

. . . who played a leading role in coordinating the design and construction of the New Tokaido Line and brought it to completion.

CERTIFICATE OF CITATION

To the President and all the dedicated engineers of the Japanese National Railways for their loyal efforts and highly skilled contributions to the design, development and construction of the New Tokaido Line with its many important advances in railroad transportation.



Bullet-nosed streamliners of the Japanese National Railways' New Tokaido Line between Tokyo and Osaka. Offering the world's fastest regularly scheduled train service, NTL super-expresses cover the 320-mile route in 3 hours, 10 minutes, and pass through the industrial and tourist heartland of Japan.

THE NEW TOKAIDO LINE

The New Tokaido Line, a completely new standard-gauge, double-track railway, was opened to traffic in October 1964 to provide a high-speed link over the 320-mile distance between Japan's two largest cities, Tokyo and Osaka. Today, it offers the world's fastest passenger train service and has attracted international attention because of its comfort, smoothness and efficient operation.

In constructing this railway, the latest technology and the top engineering skills were mobilized in all phases—tracks, structures, rolling stock and electrical facilities—to make it one of today's most modern, reliable and safe means of transport.

On the Tokyo-Osaka route, the "Tokaido" (Eastern Sea Road) as it is called, where 40 per cent of Japan's population and 70 per cent of her industrial output are concentrated, 60 passenger trains—super expresses and limited expresses—are operated daily each way. The running time between these points is 3 hours and 10 minutes by the "Hikari" (Light) super expresses, which stop only at Nagoya and Kyoto, and 4 hours by the "Kodama" (Echo) limited expresses which make 10 intermediate stops. The present top commercial speed of these trains is 125 miles (200 km) per hour, and the super expresses average 101 miles (162 km) per hour.

Ingenious developments were achieved and coordinated in the fields of electrical, civil and mechanical engineering to permit multiple-unit rolling stock to operate at these high speeds with maximum safety. These included newly designed bogies to prevent swaying, a special braking system, air suspension instead of conventional springs, advanced means of electronic control including automatic train control (ATC) and centralized Traffic Control (CTC), and a standard design for the several thousand bridges of varying lengths required by the new system. The end result has been referred to by passengers as the smoothest and quietest ride they have ever experienced.

Engineering studies for the New Tokaido Line were begun in 1957 and the system was designed and built in record time on the most economical route and with no grade crossings.

Actual construction started in 1959 and was completed five years later exactly on schedule at a cost of over one billion dollars (380 billion yen).

When opened to traffic on October 1, 1964, just prior to the Tokyo Olympic Games, a total of 30 trains a day were operated in each direction on the New Tokaido Line. Today this number has been doubled. The average number of passengers carried daily on the Line during its first three months of operation was 56,000. By the second fiscal quarter of 1966 (July through September), this figure had more than doubled to 114,000, and the trend is still upward. On January 4, 1967, a new record was established when 227,928 passengers were carried in a single day.

SIGNIFICANCE OF THE NEW TOKAIDO LINE

Since 1872, the Japanese National Railways (JNR) has been a prime force in Japan's economic and industrial growth, continuously developing route mileage as well as service to the nation. The accelerated pace of the country's economic and industrial progress necessitated new transportation facilities, especially in the Tokyo-Osaka region. The Tokaido area, with its heavy concentration of population and industry, is a belt-shaped zone stretching for over 300 miles (500 km) along the Pacific Coast of Central Japan between Tokyo and Osaka. It is regarded as the economic and cultural center of the nation.

The Japanese National Railways route serving this area constitutes the country's most important traffic artery, connecting such economic centers as Tokyo-Yokohama, Nagoya and Osaka-Kobe.

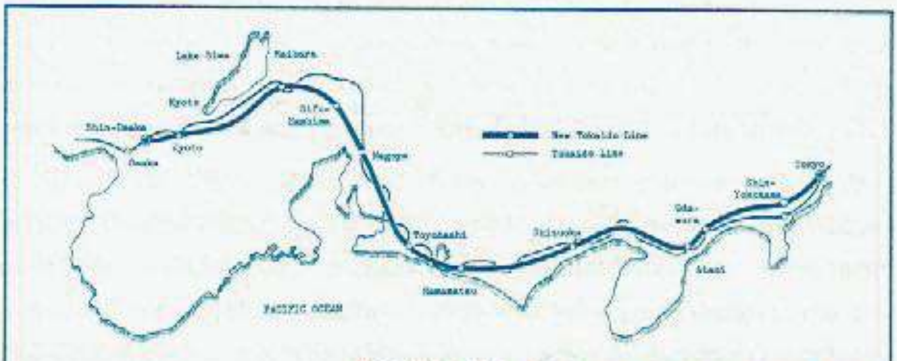
Before the opening of the New Tokaido Line, the old narrow-gauge line of 348 miles (560 km)—less than 3% of the JNR total route miles—had been handling an enormous volume of passenger and freight traffic, totaling 26% and 24% respectively, of the entire system. This high volume required a large number of trains, as many as 180 to 200 daily in each direction.

Due to the rapid expansion of the nation's economy, especially in the Tokaido area, the old line alone was incapable of meeting the ever-increasing requirements in passenger and freight traffic which was expected to double during the following 15 years. All possible steps had been taken to increase its traffic capacity, including more and longer trains, electrification of the entire line, and additional tracks.

Construction of the New Tokaido Line, a massive undertaking, was proposed when it became evident that the old line had reached the physical limit of its traffic capacity.

CONSTRUCTION OF THE NEW TOKAIDO LINE

Thorough study led to the conclusion that the new line should be standard gauge of 4′ 8½″ (1,435 mm) rather than the narrow gauge of 3′ 6″



ROUTE MAP OF THE NEW TOKAIDO LINE

(1,067 mm) used for the rest of the JNR system. The standard gauge would enable larger cars to run at higher speeds, providing a traffic capacity almost twice that of a narrow-gauge line.

Prior to completion of the new line, a test-run section of 20 miles (32 km) was built near Odawara to carry out various tests on rolling stock and ground facilities. A temporary depot was erected at Kamonomiya for the maintenance of railcars, testing of equipment, and for the training of crews. Three test units were assigned to this depot: a two-car unit for catenary inspection, a four-car unit for testing rolling stock, and a single car for track inspection (the latter, interestingly enough, uses the Sperry gyroscope to detect unevenness in the tracks). The temporary depot at Kamonomiya provided maintenance of tracks and ground equipment in the test-run section.

The first test was held on June 23, 1962. The speed of test trains was raised gradually as the roadbed settled, and on March 30, 1963, the highest speed of 160 miles (256 km) per hour was achieved. This success, coupled with results obtained from other exhaustive tests performed on the section, demonstrated the feasibility of operating trains safely at the maximum commercial speed of 125 miles (200 km) per hour upon completion of the line.

Track construction work, started in April, 1959, was scheduled for completion in five years, a short period in view of the anticipated difficulties. One-and-a-half years were spent in negotiation with landowners for acquisition of the right-of-way and for consultations with authorities of cities, towns and villages through which the new line was expected to pass.

A great many structures were needed to make the route as straight as possible. Of the total length of line, 13% is through 66 tunnels, 4% on bridges and 18% on elevated track. Design and construction work were expedited by adopting every new device available, including application of mechanical methods of construction, standardization of designs and special construction techniques.

Of all technical problems, the completion of the new Tanna Tunnel on schedule was considered most essential, because of its critical effect on the deadline for the whole project. This 5-mile (8 km) tunnel, longest on the new line, passed through a hot-spring area noted for its extremely complicated geological structure. By making full utilization of JNR's experience with the old Tanna Tunnel, which took 16 years to complete, and by maximum application of the latest in mechanical equipment, the new tunnel was finished in 4 years and 10 months.

Since 3,000 bridges of many different lengths were required, a standard unit was used throughout to reduce design time and simplify construction.

In the Tokyo area where houses are close together, and traffic is very heavy, construction was extremely difficult. However, even here work progressed smoothly through application of specially developed methods.

Power equipment was used to the fullest extent in track construction and installation of electrical facilities. Laying of rails over the entire route was completed on July 1, 1964.

Among the many new technical features of the New Tokaido Line are:

ELECTRICAL INSTALLATION

(1) The new line is electrified by 25 kv, single phase, 60 Hz (cps) alternating current. In Japan, two industrial frequencies, 50 Hz and 60 Hz are used. As the line runs through areas served by both of these systems, frequency converters were installed at two substations near Tokyo.

(2) Conventional wayside signals were eliminated and an automatic train control system (ATC) was developed to insure safety at high-speed operation. It has six speed stages, 130, 99, 68, 43, 18 and 0 miles per hour (210, 160, 110, 70, 30 and 0 km per hour). The ATC equipment installed on the trains is used to check the difference between the speed specified by the coded signal current transmitted through the track circuit and the

CENTRAL CONTROL CENTER. In the central dispatchers' room in Tokyo are control desks, equipped with signal levers for train control and with dispatching telephones. The panel on the wall shows the movements of all trains throughout the line.

THE CAB. Interior of the motorman's cab of a New Tokaido Line Express.

GRADE CROSSINGS. As a safety measure, there are no grade crossings on the New Tokaido Line. Much of the right-of-way is elevated above the surrounding terrain.

actual train speed. In the event the latter exceeds the former, brakes are applied automatically.

(3) All train movements are controlled by a centralized traffic control (CTC) system. In addition, unmanned substations, installed every 12 miles (20 km) as well as sectioning posts are remote-controlled by a centralized substation control (CSC) system. Both CTC and CSC systems are regulated from the Control Center in Tokyo.

(4) A unique catenary system, composed of a spring and damper, was designed for the pantographs to enable them to collect current efficiently during extreme high-speed operation.

(5) Small pantographs, light in weight but excellent in current collecting capacity, were developed. These have shown good performance up to a maximum trial speed of 160 miles (256 km) per hour.

(6) Silicon rectifiers are provided on the cars to correct the 60 Hz (cps) power from the trolley catenary to direct current for individual car traction motors.

(7) By means of a UHF radio-telephone system, trains on the entire line can be contacted individually or simultaneously by the Control Center in Tokyo. Passengers may also receive or make telephone calls while the trains are in motion. Inside tunnels, a transmitting/receiving cable permits continuous communication to and from trains.

SAFETY MEASURES

(1) Electrical equipment for automatic train control (ATC) is installed on the rolling stock as well as on the ground. A "fail-safe system" is adopted for this equipment.

(2) In an emergency, a motorman can short circuit the power supply

by using a switch in the cab, and all trains in the same block section can be stopped automatically.

(3) Telephones are installed alongside the track at intervals of 1,640 feet (500 m) for direct communication with dispatchers in the Tokyo Control Center.

(4) All grade crossings have been eliminated. Sturdy metal fences have been built where necessary to prevent trespassers from entering the right-of-way.

(5) Substations along the railway line are equipped with seismometers that automatically cut off the power in event of earthquakes which are beyond a certain degree of intensity.

ROLLING STOCK

(1) Each train consists of multiple-unit cars having motors of 185 kw output on each axle giving 8,880 kw for an entire train of twelve cars. As compared with locomotive-powered trains, those on the new line are lighter, have faster acceleration and deceleration, and are more convenient for shuttle service.

(2) Each pair of cars in the train forms one electrical unit.

(3) Railcars are equipped with air suspension.

(4) Cars are airtight to minimize fluctuations of air pressure, and to protect passengers from ear discomfort as the trains pass through tunnels. For this purpose, a special flap is installed on each ventilation opening on the roof and these are automatically closed before entering a tunnel. Entry doors are sealed by air pressure when closed in order to ensure that the passenger compartments remain airtight.

(5) High-speed operation calls for a superior braking system. Dynamic

electric brakes are applied at speeds over 30 miles (50 km) per hour, while pneumatic disc brakes are used at lower speeds.

These are just a few of the many new engineering components which have contributed to the outstanding record of safety, comfort and speed established by the Japanese National Railways' New Tokaido Line.

Since service began, public acceptance has been so great that the Line will be more than tripled in length during the coming years, eventually linking Morioka in northern Honshu with the city of Hakata on the southern island of Kyushu. Meanwhile, JNR's engineering staff is continuing to develop new refinements which will lead to even higher operating speeds and greater efficiency while maintaining top standards of safety at all times.

PREVIOUS ELMER A. SPERRY AWARDS

1955 to WILLIAM FRANCIS GIBBS and his Associates for development of the S. S. United States.

1956 to DONALD W. DOUGLAS and his Associates for the DC series of air transport planes.

1957 to HAROLD L. HAMILTON, RICHARD M. DILWORTH and EUGENE W. KETTERING and Citation to their Associates for the diesel-electric locomotive.

1958 to FERDINAND PORSCHE (in memoriam) and HEINZ NORDHOFF and Citation to their Associates for development of the Volkswagen automobile.

1959 to SIR GEOFFREY DE HAVILLAND, MAJ. FRANK B. HALFORD (in memoriam) and CHARLES C. WALKER and Citation to their Associates for the first jet-powered aircraft and engines.

1960 to FREDERICK DARCY BRADDON and Citation to the Engineering Department of the Marine Division, SPERRY GYROSCOPE COMPANY, for the three axis gyroscopic navigational reference.

1961 to ROBERT GILMORE LETOURNEAU and Citation to the Research and Development Division, FIRESTONE TIRE AND RUBBER COMPANY, for high speed, large capacity, earth moving equipment and giant size tires.

1962 to LLOYD J. HIBBARD for application of the ignition rectifier to railroad motive power.

1963 to EARL A. THOMPSON and Citation to his Associates for design and development of the first notably successful automatic automobile transmission.

1964 to IGOR I. SIKORSKY and MICHAEL E. GLUHAREFF and Citation to the SIKORSKY ENGINEERING DEPARTMENT for the invention and development of the high-lift helicopter leading to the Sky Crane.

1965 to MAYNARD L. PENNELL, RICHARD L. ROUZIE, JOHN E. STEINER, WILLIAM H. COOK and RICHARDS L. LOESCH, JR. and Citation to the Commercial Airplane Division, THE BOEING COMPANY, for the concept, design, development, production and practical application of the family of jet transports exemplified by the 707, 720 and 727.

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