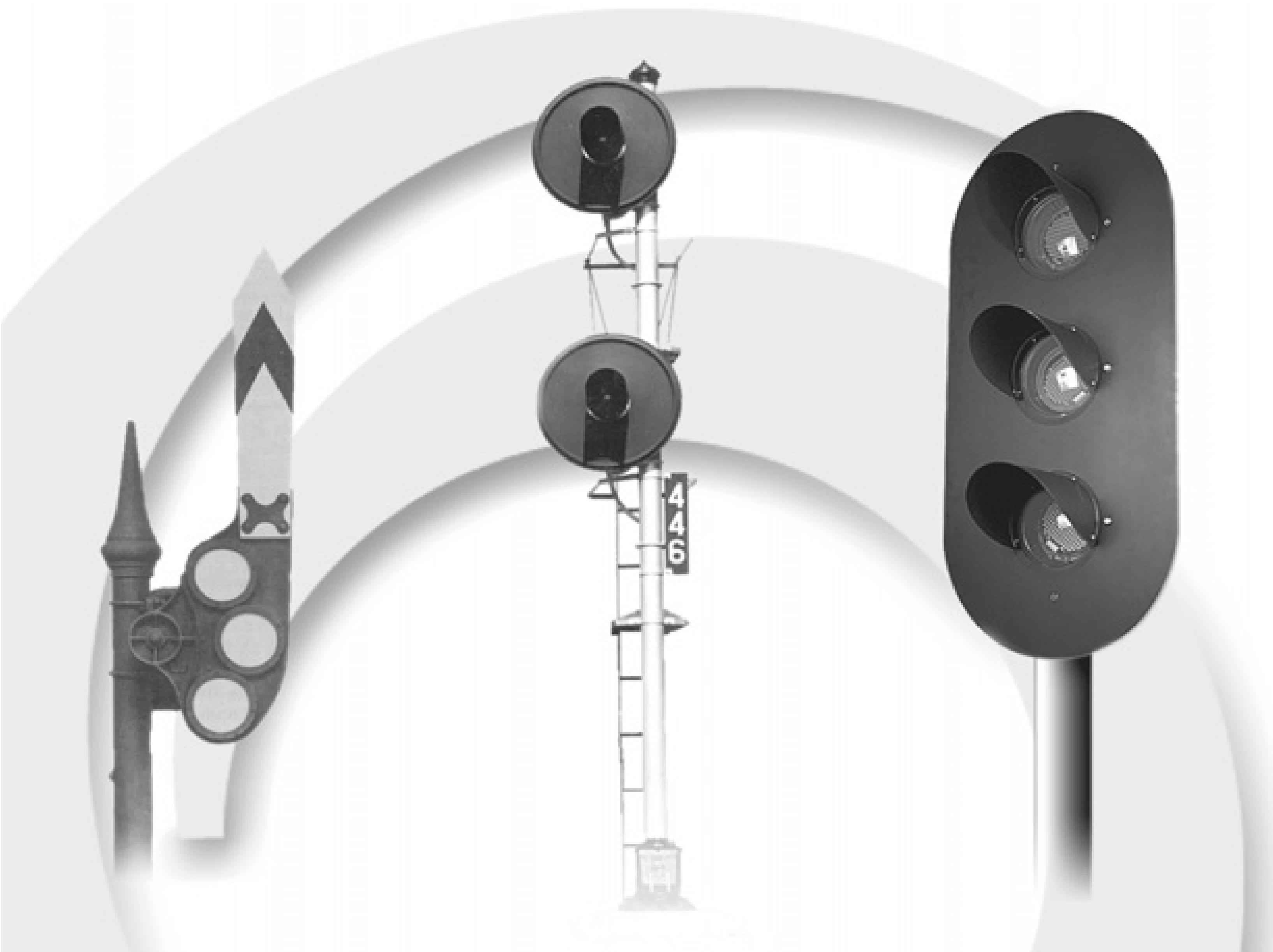
A Centennial

History of ALSTOM Signaling Inc.

(Formerly General Railway Signal Company)



1904 – 2004

Main Office and Manufacturing Facilities of the General Railway Signal Company, Rochester, NY (1902-1992).

Administration and Engineering Office, Brighton, NY (1993-2003).

Manufacturing and Office Facility, West Henrietta, NY (1993-Present).

PREFACE

This book was originally compiled in 1954 as part of General Railway Signal's 50th Year Commemoration. Although not published until later, has often been read by new employees to enhance their understanding of the Company and its valuable contributions to the art of railway signaling. In 1979, the book was updated in recognition of the Company's 75th Anniversary. In 2004, the book was again updated in recognition of the Company's 100th Anniversary.

The past presidents of the General Railway Signal Company and its successor companies, SASIB/GRS and ALSTOM Signaling Inc., are as follows:

1904-1934	Wilmer W. Salmon
1934-1951	Paul Renshaw
1951-1955	Herbert W. Chamberlain
1955-1958	Arthur E. Heimbach
1958-1965	Percy W. Smith
1965-1968	Jack K. Records
1968-1989	Gerald E. Collins
1989-1995	Stuart A. Brown
1995-1995	James B. Stokes
1996-1997	Mario Mastroni
1997-1998	William Darling
1998-1999	John Penny
1999-2000	Bruce E. Alspach
2000-2001	Frederic Dyevre
2001-2004	Stephane Navarra
2004-Present	Ulisses Camilo

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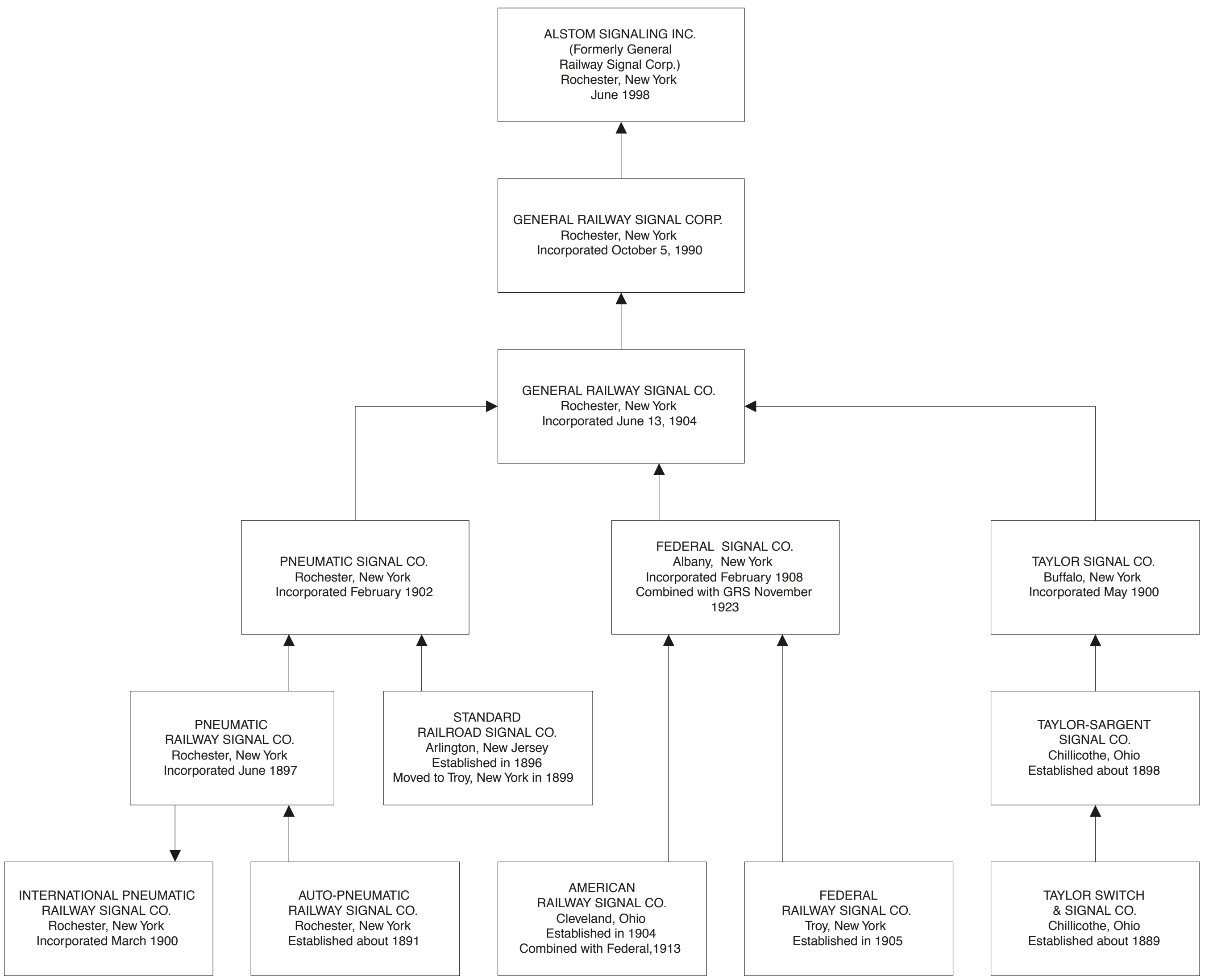
CORPORATE HISTORY SUMMARY (1889-2004)

ALSTOM SIGNALING INC.

(Formerly GENERAL RAILWAY SIGNAL CORPORATION)



INTRODUCTION

This history of ALSTOM Signaling Inc. (formerly General Railway Signal Company (GRS)) records the events and accomplishments of a successful organization throughout the years of ever-changing conditions in industrial America, throughout wars and panics, good times and bad.

Like every progressive business organization, ALSTOM Signaling Inc. is concerned more with what lies ahead than with the past achievements. But those, whose job it is to build for the future must also fully appraise past performances, must profit by the successes and analyze the failures of those who have brought the signaling art to its present high stage of development.

In 1830, the Baltimore and Ohio Railroad, in the United States, and the Liverpool and Manchester Railway, in England, began business as common carriers. From these beginnings there has developed one of the greatest industries in the world - rail transportation.

A survey of railway development in the United States shows that although railroad construction received strong impetus from the start, the most rapid extension of track mileage was during the 65-year period from 1865 to 1930. In 1930, the mileage of track owned reached a peak of 410,634 miles. At the end of 1969, it was reduced to 339,000 miles although operating efficiency, as expressed in net ton-miles per freight train-hour, quadrupled during this 39-year period.

Railroading in the 1970's saw rapid changes resulting from a wave of bankruptcies and mergers, particularly in the East and Midwest. Out of the insolvency of the giant Penn Central and several smaller eastern lines, emerged the Consolidated Rail Corporation (Conrail) for freight traffic and the National Railway Passenger Corporation (Amtrak) for passenger service. These changes spurred the abandonment of poor revenue trackage and increased operating efficiency until, by 1976, there were 324,000 miles of track and net ton-miles had increased 12 percent over 1969.

The Staggers Act of 1980 deregulated the railroad industry to a significant extent, replacing the regulatory structure that existed since the 1887 Interstate Commerce Act. Railroads were permitted to determine where they ran trains and how much to charge. This act provided the basis for the railroads to once again become competitive and market driven. While track miles have continued to decrease to 152,000 in 2003, ton-miles have increased by 180% from 1980 to 2003.

Two salient facts have brought about this increase in efficiency in spite of a decrease in track mileage:

Fact 1: To move a 100 percent increase in traffic with a decrease in track mileage has meant moving heavier trains faster. This has been accomplished by better equipment, by heavier motive power (especially the diesel-electric locomotive), by improved roadbed, by grade reduction, and by the aid of modern signaling systems such as centralized traffic control (cTc).

Fact 2: Although signaling was introduced to American railroads as early as 1857, no extensive installations were made until after the year 1900. Railroad management recognized the value of signaling in expediting traffic.

In 1825, train protection was provided by a mounted flagman.

Pneumatic Railway Signal Comany, 1902, a predecessor of General Railway Signal Company.

RAILWAY SIGNALING SYSTEMS – The early years

The main purpose of any railroad is to transport passengers and goods swiftly, safely, and economically. The aim of railway signaling systems is to provide safety and efficiency for rail transportation. Safety to persons, goods, and equipment - efficiency to keep trains moving with a minimum of delays and with the most effective use of personnel and equipment.

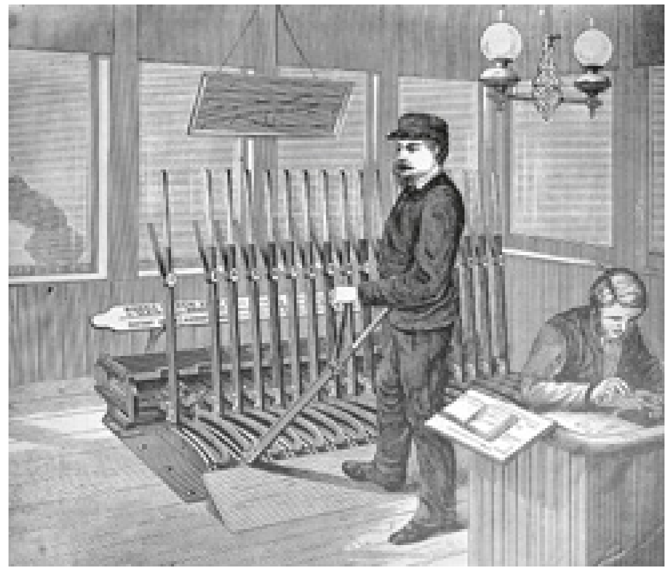
The railway signaling systems and apparatus manufactured by GRS provide for safe and efficient rail transportation. Following is a brief history of the company as it parallels signaling development.

MECHANICAL INTERLOCKING

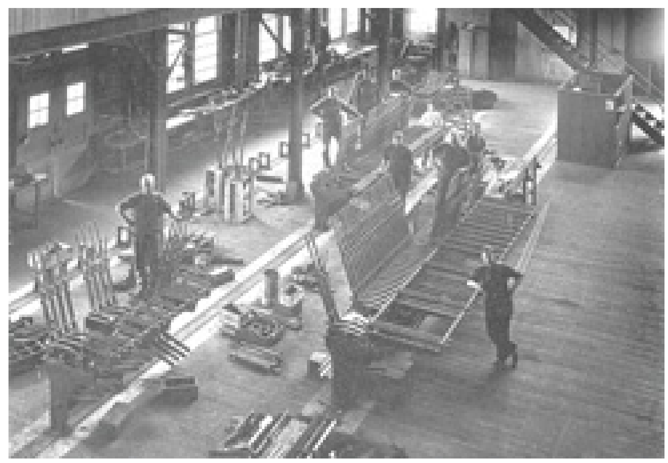
Mechanical interlocking uses manpower to move the large levers in the interlocking machine which, in turn, operate switches and signals through pipe connections or, in early days, wire pulls.

Mechanical interlocking was first installed in England, in 1843, at Bricklayer's Arms Junction. The first mechanical interlocking was installed in America in 1870 at Trenton, New Jersey. The first one made in America was manufactured by Messrs, Toucey and Buchanan. It was installed at Spuyten Duyvil, New York, in 1874.

The Standard Railroad Signal Company of Arlington, New Jersey, was organized in 1896 by participants in a former company, the Johnson Railroad Signal Company of Rahway, New Jersey. The Standard Railroad Signal Company offered railroads the Johnson type of mechanical interlocking. When the Company was purchased by A.H. Renshaw (Trojan Car Coupler Co. of Troy) and J.T. Cade, a plant was established at Troy (Green Island), New York, in 1899. It manufactured mechanical interlocking machines of the Saxby and Farmer type. Sales offices were maintained in New York and Chicago. In 1900, Standard, a predecessor of GRS, marketed the Style A interlocker, an improved mechanical machine.



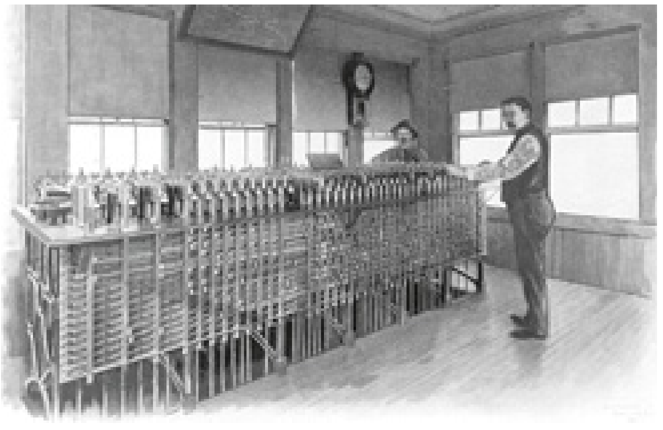
Mechanical interlocking required strong arms and a stout back to operate the signal appliances.



GRS mechanical interlocking assembly department in 1910.

A Stock Certificate from Standard Signal Company.

A low-pressure pneumatic interlocker as shown in an 1894 catalog of the Auto-Pneumatic Railway Signal Co.



Pneumatic Railway Signal low pressure pneumatic interlocker installed in 1900 at Jamaica, NY on the Long Island Railroad.

The pneumatic interlocking installed in 1900 at Wayne Jct., PA required thousands of feet of underground pipe.

LOW-PRESSURE PNEUMATIC INTERLOCKING

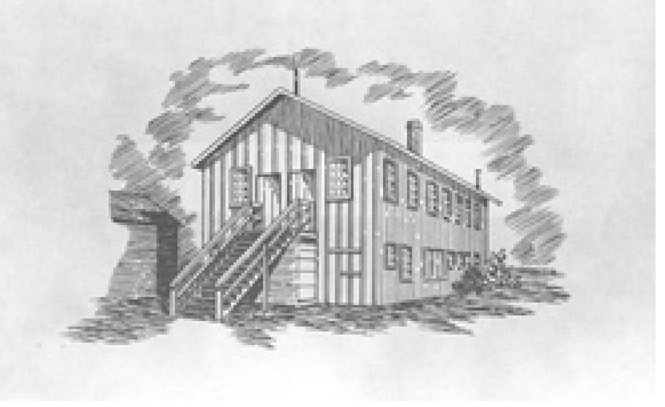
In an effort to overcome the limitations of mechanical interlocking, Dr. J.H. McCartney of Rochester, New York, substituted pneumatic pressure for muscle power in his system of low-pressure pneumatic switches and signals, patented in 1890. Dr. McCartney and associates formed the Auto-Pneumatic Railway Signal Company in Rochester, New York. The Company pointed out in their "Interlocking Switch and Signal Plant" reference catalog of 1894, that their system "embodied certainty of action, simplicity of operation and construction and, finally, low cost operation and maintenance" — requirements still fundamental in modern railway signaling.

In June of 1897, the Auto-Pneumatic Railway Signal Company sold its patent rights and property to the Pneumatic Railway Signal Company of Rochester, New York (formed by J.N. Beckley). The first contract made by the new Company was with the New York Central and Hudson River Railroad for a low-pressure pneumatic interlocking plant at the Exchange Street Station in Buffalo, New York. This was put in service in January of 1898. In 1900, the company provided a low-pressure pneumatic interlocking at Grand Central Terminal in New York City.

In July of 1898, Pneumatic contracted to have the Standard Railway Signal Company of Troy, New York, manufacture signal equipment for them and make installations of pneumatic systems in North and South America and Cuba.

In 1900, the Pneumatic Railway Signal Company expanded its sales territory to include outlets in England by forming the International Pneumatic Railway Signal Company with headquarters in Rochester.

To increase their efficiency, the Pneumatic Railway Signal Company, the International Pneumatic Railway Signal Company, and the Standard Signal Company of Troy were reorganized on February 27, 1902 to form the Pneumatic Signal Company. The Troy plant was maintained for the manufacture of mechanical interlocking apparatus. A new plant was constructed in 1902 on West Avenue in Rochester.



The first dynamic indication electric interlocking machine was made in 1889 by John D. Taylor in this carpenter shop in Chilicothe, Ohio.

First Taylor Signal Co. electric interlocker was installed at Eau Claire, Wisconsin in 1901 with Model 2 Electric Semaphore signals.

Model 2 Electric Switch Machine at Eau Claire, Wisconsin.

ELECTRIC INTERLOCKING

The all-electric interlocking employing dynamic indication was invented by John D. Taylor of Chillicothe, Ohio. In the Baltimore and Ohio Southwestern Railroad shops, Mr. Taylor constructed the first interlocking machine and apparatus installed by the Taylor Switch & Signal Company, in 1889, at East Norwood Ohio, at the crossing of the B&O Southwestern and the Cincinnati Northern Railroads. This was the first installation where track switches were moved by electric power. The original interlocking plant was removed in 1904 and replaced by a new model electric interlocking machine manufactured by GRS.

After making only one other installation, at Edgewood, Illinois, on the Illinois Central Railroad, in 1896, the company reorganized as the Taylor-Sargent Signal Company in 1898 at Chillicothe, Ohio. The new company made three installations: New Albany, Indiana, in 1898, on the Baltimore & Ohio; Brussels, Belgium, for the Continental Hall Signal Company, in 1898; and Nortonville, Kentucky, on the Illinois Central, in 1899.

In May 1900, the Taylor Signal Company was organized by Alvah W. Hall, formerly of the Hall Signal Company, by acquiring the properties of the Taylor-Sargent Signal Company. The Taylor Signal Company started in a two-story factory in Buffalo, New York, with offices in that city and in Chicago. The first Taylor electric interlocking was installed in 1901 at Eau Claire, Wisconsin, on the Chicago, St. Paul, Minneapolis and Omaha Railway. After making a number of electric interlocking installations of the new and improved design, the Taylor Company built a new plant at Elmwood Avenue, Buffalo on the New York Central Belt Line. As the Taylor interlocking was the only all-electric system in existence, and as it offered unusual safety and facility in train operation, installations both in this country and Europe followed rapidly. Notable US installations include those at LaSalle Street Terminal and at 16th and Clark Streets, Chicago; at South Englewood, Chicago; and at Omaha, Nebraska.

Quoting from an article entitled "Big Merger of Signal Plants," appearing in the Buffalo Express of May 4, 1904: *"Authoritative announcement was made yesterday that Buffalo is to be made the headquarters of the big $5,000,000 General Railway Signal Company which is to be organized with the merging of the Taylor Signal Company of Buffalo and the Pneumatic Signal Company of Rochester.... Yesterday afternoon a party of Rochester capitalists, including some of the officials of the Pneumatic Signal Company of that city, came to Buffalo to inspect the plant of the Taylor Signal Company. They made the trip to this city in the private car of John N. Beckley, President of the Toronto, Hamilton and Buffalo Railway Company. Mr. Beckley is also president of the Pneumatic Signal Company...... Upon reaching this city, President Beckley's car was switched to the Belt Line tracks and taken out to the plant of the Taylor Signal Company. There the Rochester men were met by a large number of Buffalonians......... Both the Buffalo and Rochester men were delighted with the Taylor Signal Company's plant. It was built a little over two years ago, is absolutely fireproof in construction, is operated entirely by electricity and its equipment is perfect in every respect..... Both companies manufacture interlocking switch and signal devices for railroads, and it is understood that after the merger has been perfected, the Buffalo plant will manufacture the electric system exclusively while all mechanical and low-pressure forms of signals will be turned out at the Rochester plant.*

'The merging of the two companies, of course, is expected to result in material economy in the engineering, experimental, advertising and sales departments as well as in manufacture.'

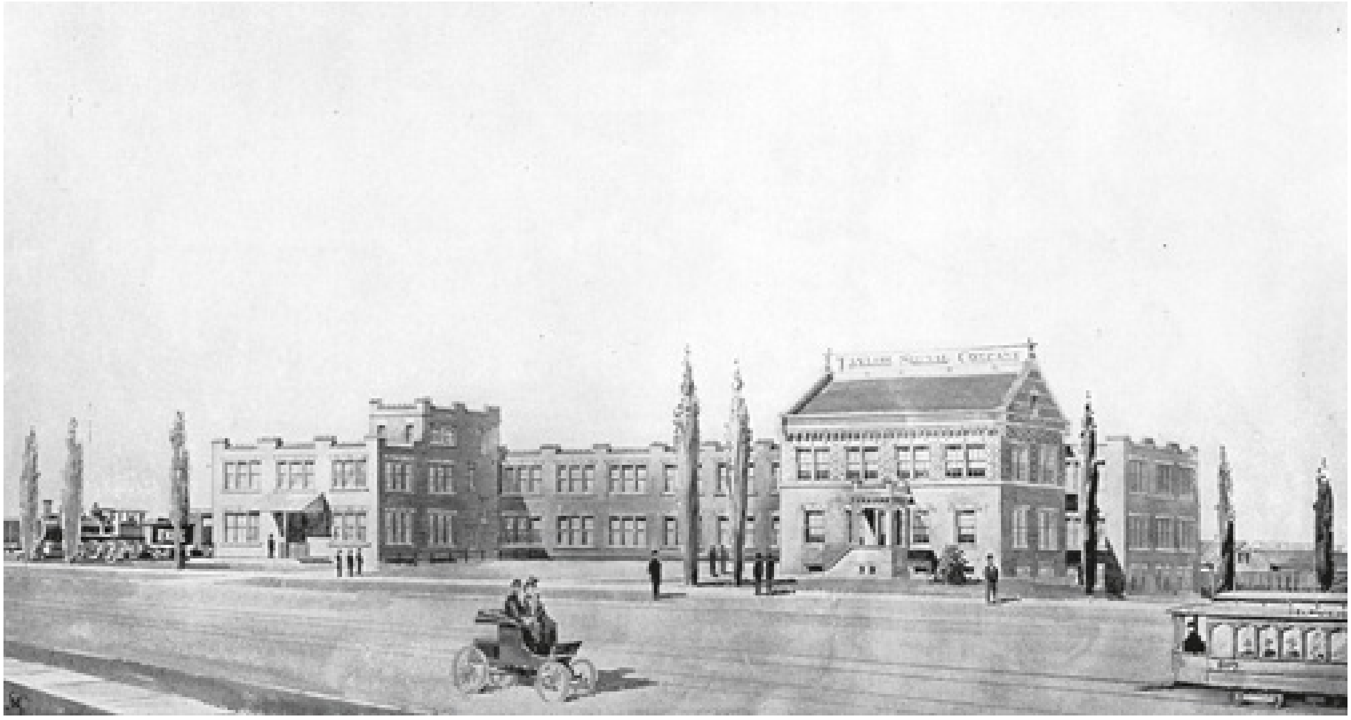
The General Railway Signal Company was officially incorporated under the laws of the State of New York on June 13, 1904. The Taylor plant in Buffalo was named the General Railway Signal Company, while the plant in Rochester retained the name of the Pneumatic Signal Company, although a part of the corporation.

The chief business of the new company was in the manufacture of electric interlocking systems. The system proved so far superior to existing forms of power interlocking that the company soon decided to abandon manufacture of the outmoded pneumatic system.

In May of 1907, after enlarging the Rochester plant, all manufacturing operations were moved to Rochester. Work no longer needed to be transferred from one plant to another, thus greatly reducing confusion, which arose from the shipment of orders in two parts from two different factories.

In 1904, this GRS electric interlocker was installed at East Norwood, Ohio, on the B&O Southwestern R.R. to replace the original 1889 Taylor machine.

A stock certificate from Taylor Signal Company.



The first Taylor Signal Company plant in 1900 at Wells and Carrol Streets, Buffalo, NY.

General Railway Signal Company plant on Elmwood Avenue in Buffalo, NY in 1906.

THE MEN WHO STARTED IT ALL

In 1904, as a result of the various mergers that led to the formation of General Railway Signal, the company was able to offer complete product lines for three basic interlocking technologies – mechanical, pneumatic and electric. It was, however, their innovation, design and development in the electric interlocking technology that propelled the company into the forefront of signaling companies.

John D. Taylor - the Inventor

The Signal Engineer for January 1, 1914 carried an obituary for John D. Taylor (1861-1913) entitled 'A Tribute to the Man Whose Monument Is the Electric Interlocking System'. Mr. Taylor *"began his inventing career in 1888 when he was a telegraph operator on the Scioto Valley Railroad at a small town in Ohio. Having obtained a number of patents on electrical devices to be used in train despatching, he set out ….. that the principles of his scheme might be used in signaling…… John graduated from Piketon high school when he was about 17, and he never had the advantages of a college education……. He was a natural mathematician and inventor and his love of books occupied a large part of his life. His studies in higher mathematics, thermodynamics, chemistry, and electricity brought him recognition as an authority in those branches of science…..*
His education was self secured."

John D. Taylor, inventor of the all-electric interlocking.

Wilmer W. Salmon – the Leader

Wilmer W. Salmon (1866-1936) became President and General Manager of Taylor Signal Company in Buffalo, NY in 1901, a position he maintained with the formation of General Railway Signal Co. in 1904 until his death in 1936. A graduate of Dickinson College with both Bachelor's (1886) and Master's (1890) Degrees, Mr. Salmon began his career in 1886 in the engineering corps of the Pennsylvania Railroad, with additional career moves to the Philadelphia and Reading Railroad in 1887, and to the Chicago & Northwestern Railway in 1890. In 1893 he joined the Hall Signal company as an engineer and successively moved into sales manager and European representative and vice-president.

His February 1, 1936 obituary in Railway Age stated *"he was sent to Europe to interest foreign railways in signaling systems and during his stay abroad he designed and was responsible for the first subway signal system ever put in service, which system is today in operation on the Metropolitan (Underground) Railway of Paris. He also installed the first automatic block signal system in Europe on the Paris, Lyons, & Mediterranean railway of France, and made several similar installations on the Belgian railways."*

The same article also stated *"Mr. Salmon combined in a remarkable degree the qualities of an engineer with those of a successful business executive. He was not only responsible for the creation and growth of General Railway Signal Company but he was the guiding spirit in the development of electric interlocking so widely used throughout the country……. Many of the detail devices and other products which the General Railway Signal Company now markets are due to his knowledge of railway problems - the fruit of life experience – which enabled him to visualize in advance the operating benefits which would accrue to the railroads from these inventions. Mr Salmon's skill as a business executive was manifest by the manner in which he guided his company through the difficult years of the depression."*

Winthrop K. Howe - the Engineer
Winthrop K. Howe (1868-1954) was an 1889 graduate of Purdue University with a degree in mechanical engineering and stayed on to pursue a year's worth of graduate work in electrical engineering. Mr. Howe entered the signaling business in 1900 when he took a position at Taylor Signal Company in Buffalo, NY as a principal assistant engineer in charge of the electrical department under John D. Taylor.

The Signal Engineer for December 15, 1913 included an article entitled 'A Personal Tribute to the Steinmetz of Railway Signaling – A Real Gentleman.' This article described Howe as *"Between the theorists who figure things out that ought to be done and the individuals who derive pleasure or profit from them after they are done, stand the men who do them - the men who reduce theories to practice. Winthrop Keith Howe is such a man….. He has done some notable things in the thirteen years he has been connected with signaling. For example, he designed the Model "2-A" signal mechanism – the "A.1" proposition that put the "A's" in adaptability – and the Model "4" switch machine, one of the foremost devices of its kind. He was the first to suggest and produce a highpower light signal for use on interurban railways; and he is responsible for many of the developments in alternating current signaling for electric lines, and for a good many improvements in electric interlocking. He designed the well known "polyphase" relay, the lock-and-block apparatus and a number of other devices which his company manufactures. He is the originator of the one-power alternating-current system of supply and distribution for signal systems now so largely used, and in which not only the track circuits but all of the signals, relays, lamps, indicators, etc., as well, are operated by alternating current taken from the same transmission line."*

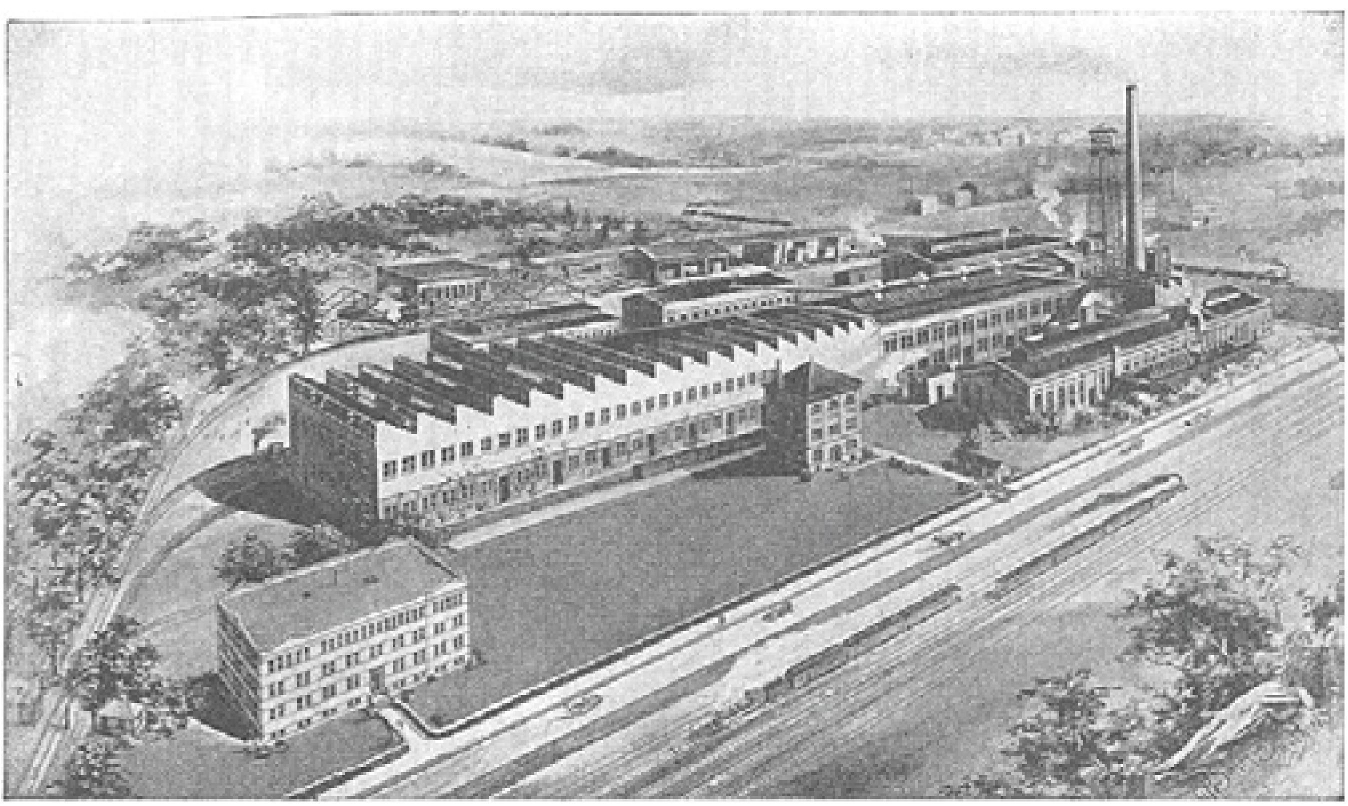
Mr. Howe quickly rose to the position of Chief Engineer of Taylor Signal in Buffalo and remained in that position with the formation of General Railway Signal in 1904. He maintained the position of Chief Engineer until his appointment to Vice President in charge of engineering in 1943. Mr. Howe retired from GRS in 1945 having been awarded 191 patents during his long and distinguished career.

A December 15, 1913 article in The Signal Engineer highlighted the successful teamwork of Messr's Salmon and Howe when it stated *"And it is safe to say that Salmon, whose genius formed the company, and the rest of that earnest, loyal and hardworking bunch who made it successful, are all mighty glad they know Howe and that Howe knows how. If Salmon put the "general" in General Railway Signal, Howe put the "signal" in it….."*

Winthrop K. Howe, Chief Engineer of Taylor Signal (1900-1904) and General Railway Signal Company (1904-1945).

A stock certificate from General Railway Signal Company.

Pneumatic Signal Company plant on West Avenue in Rochester, NY shortly after the formation of the General Railway Signal Company.



With the expansion of the Rochester plant in 1907, all operations were consolidated on West Avenue.

RAILWAY SIGNALING SYSTEMS – The advancement years

BLOCK SIGNALING

Concurrent with the development of the interlocking are the crude beginnings of block signaling systems. The first block signal system was installed in America between New Castle, Delaware, and Frenchtown, Maryland, on the New Castle and Frenchtown Railroad, in 1832. Indications were provided by ball signals spaced 3 miles apart and read by means of a telescope at each block office.

Perhaps the most important page in the history of railway signaling was the invention of the closed track circuit by Dr. William Robinson in 1872. This track circuit made automatic block signaling possible and is the foundation of modern signal systems.

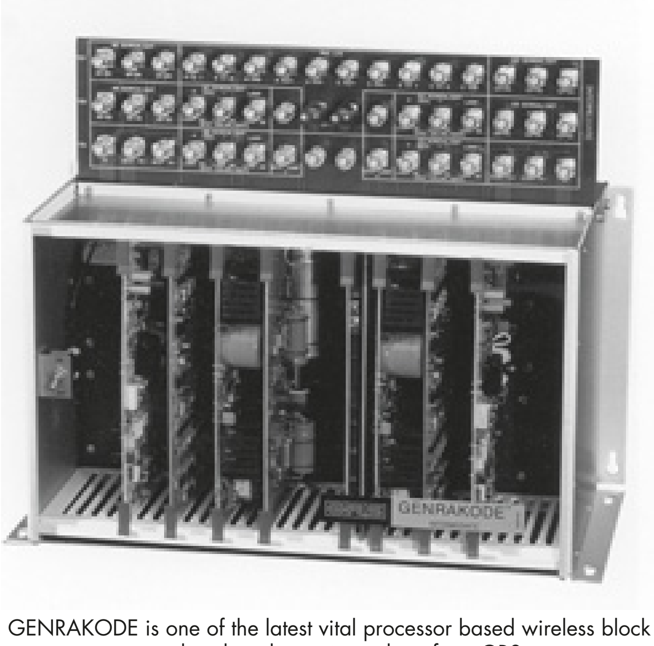
The advent of electric railways presented a signal engineering problem because the rails had to be used both for track circuits and for return of the propulsion current. The Young System patents, purchased by the Pneumatic Signal Company in 1903, covered a system providing continuous a-c track circuits for electrified lines.

During the early part of the century, GRS developed several types of block signals: the Model 3 two position, lower-quadrant motor semaphore, installed on the Union Pacific in 1906; the Model 6 a-c lower-quadrant semaphore and Model 7 d-c semaphore in 1906; and the Model 2A upper-quadrant semaphore in 1908 which became an industry standard. This signal was first installed on the Baltimore & Ohio and over the next 10 years 24,500 Model 2A semaphore signals were installed making it one of the most successful signal designs of the century.

In 1910, considerable interest developed in signaling for high-speed, single-track electric lines of the trolley type. Many state governments, as well as railroad officials, instigated studies into the possibilities of adequate signaling for these rapidly expanding services. Up to this time, such railways had in general either not regarded signaling as a necessity, or believed that some form of contact device actuated by the trolley would suffice for signal control. GRS automatic block systems proved very effective and were applied to many miles of trolley lines soon after this time.

GRS invented Absolute Permissive Block (APB) signaling, making the first installation on the Toronto, Hamilton and Buffalo Railway in 1911. This was the first system to provide complete siding-to-siding protection for opposing movements and signal-to-signal protection for following movements, the same as on double track. All the basic principles of the original GRS APB system are in use today. In fact, absolute permissive block signaling is a basic part of centralized traffic control.

In 1832, ball signals like this one were observed through telescopes from distant block offices.



GENRAKODE is one of the latest vital processor based wireless block signal and track circuit products from GRS.

An "ironless bond", part of the Young system of a-c block signaling.

A "meet" on the world's first APB installation in 1911 on the Toronto, Hamilton & Buffalo Railway.

CENTRALIZED TRAFFIC CONTROL

On July 25, 1927, the first centralized traffic control system in the world went in service between Stanley and Berwick, Ohio, on the Ohio Division of the New York Central Railroad. This system, invented by Sedgwick N. Wight of GRS, was a tremendous stride forward in improving facility and economy of train operation.

Here is a first-hand account of operation with the new system as given in an address by Mr. J.J. Brinkworth of the New York Central Railroad before the Signal Section of the Association of American Railroads in 1947. *"… I was particularly involved in centralized traffic control in 1927…. I went to Rochester, to the General Railway Signal Company plant, and saw the actual machine there. I, of course, became aquainted with Mr. S.N. Wight of that Company, who studied out the details of the cTc machine. I went to his house and in the back room we talked it over in detail for hours."*

"Then we came to 1927, when the final date was set to install centralized traffic control on the Toledo & Ohio Central and put it into service. Needless to say, we were all over at Fostoria, Ohio, and we watched the progress of the various signals being put in along the approximately 40 miles of railroad between Toledo and Berwick. Then, after a comparatively short time, trains started to move over that piece of single track for the first time without train orders".

"I recall very distinctly, as we had supper in the hotel at Fostoria and got through, I said to the gang, I do not know what you fellows are going to do tonight, but I'm going over to the tower at Fostoria and stay there until I see a non-stop meet.' Well, they all decided that if the boss was going over, the rest of the gang had better go, too. So we went over to the tower at Fostoria in the evening. The dispatcher was there and he was just filled up with enthusiasm on this new gadget called centralized traffic control. Along about 10:00 o'clock, he just yelled right out loud, 'Here comes a non-stop meet.' Well, we all gathered around the machine and watched the lights that you know all about, watched the lights come towards each other and pass each other without stopping."

"That, to me, and to you, too, was history on American railroads, the first non-stop meet on single track without train orders, of course, that we knew of. We waited at Fostoria until the southbound train arrived there and you never saw such enthusiasm in your life as was in the minds and hearts of that crew, the first non-stop meet of which they had ever heard."

Thus occurred the first non-stop meet, today commonplace on thousands of miles of cTc.

Today, instead of manually operated lever-type control machines, GRS provides minicomputer-and microprocessor-based control consoles which enable one man to efficiently control an entire railroad.

This machine, at Fostoria, Ohio, on the New York Central, controlled the world's first cTc – Stanley to Berwick. The machine is now in the Smithsonian Institute's collection.

With the invention of cTc, the non-stop meet became a reality.

Today's computerized cTc system has a control console with color-video displays of track and traffic conditions and a keyboard to enter commands to the computer.

ALL-RELAY INTERLOCKING

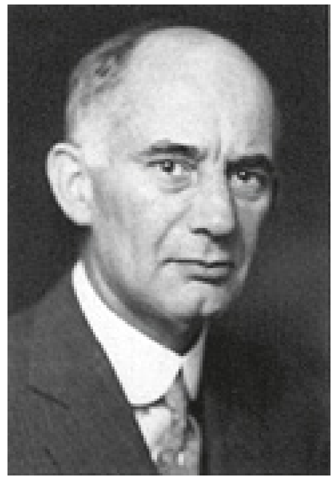
The invention of an all-relay interlocking was an outgrowth of the principles applied successfully in centralized traffic control. Now the cumbersome lever locking beds of the electric interlocking machine were abandoned in favor of relay interlocking between the switches and signals in the field. Control distance ceased to be an important factor.

GRS furnished equipment for the first remotely controlled, unit-wire all-relay interlocking system, put in service February 1929, on the Chicago, Burlington and Quincy at Lincoln, Nebraska.

The first installation of an all-relay interlocking with pushbutton automatic selection of routes and positioning of switches and signals, the GRS Type NX (eNtrance-eXit), was made at Brunswick, England, on the Cheshire Lines in February of 1937. The first NX route-type interlocking in the United States was installed at Girard Junction, Ohio, on the New York Central in 1937.

Heralding the approach of the pushbutton age, this GRS NX interlocking machine (the world's first) was placed in service in 1937 at Brunswick, England.

The first NX machine in the US was placed in service later in 1937 on the New York Central at Girad Junction, Ohio.



THE MAN WHO EXTENDED AND AUTOMATED SIGNAL CONTROL

Sedgwick N. Wight (1879-1968) joined General Railway Signal Company in 1910 as an assistant commercial engineer. He received a BS Degree from Hiram College in Ohio in 1903 and started as a draftsman for the signaling department of the Lake Shore & Michican Southern (New York Central) in Cleveland Ohio, and later became a signal inspector.

The May, 1910 issue of Signal Engineer announced Wight's move from the railroad to GRS and prophesized the future when it stated as to his being *'in close and intimate touch with the executive and technical phases of signal construction work; and he made excellent use of his opportunities. His associates and all who knew him cannot but feel that General Railway Signal Company is pursuing the right policy in securing men of Mr. Wight's character and ability.'* Wight's GRS inventions included Automatic Permissive Block Signaling (1911), Centralized Traffic Control (1927) and eNtrance-eXit (NX) push button interlocking control (1937). Mr. Wight received patents for these and other inventions, ultimately receiving 92 patents in his long career at GRS.

In 1971, the Elmer A. Sperry Award was posthumously awarded to Mr. Wight (in memoriam) for recognition of *"a distinguished engineering contribution which, through application in actual service, has advanced the art of transportation whether by land, sea, or air." The award cited Mr. Wight "for his foresight and ingenuity in the planning and execution of the first practical installation of Centralized Traffic Control on a railway. This first installation gained worldwide acclaim." The award committee said, "Mr. Wight's concept of decentralizing the safety features while centralizing the control facilities ushered in a new era of safe and efficient train operation."*

PROCESSOR BASED INTERLOCKING

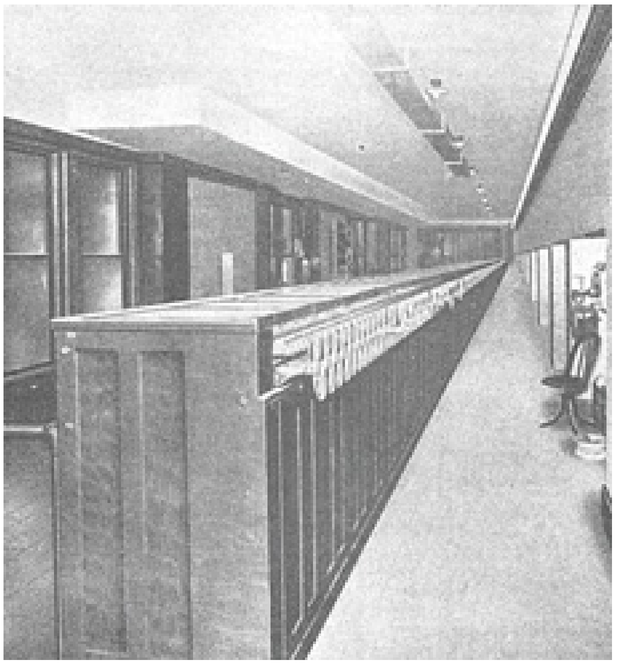
Shortly after the invention of microprocessors in the early 1970's, GRS Research Engineers began investigating methods and techniques to harness this new technology for the vital fail-safe control of interlocking equipment. In 1975, they began developing a series of hardware and software techniques that permitted a single microprocessor to operate in a vital fail-safe system. This series of techniques was trademarked as GRS Safety Assurance Logic (SAL™). The first commercial product released using SAL techniques on a microprocessor merged with a vital relay was the MICROCHRON ® Timer in 1981. This vital timer was a direct replacement for a family of vital motor timers and was switch settable in one second increments from one second to one hour. This product has been enormously successful with more than 10,000 units shipped since its introduction.

GRS Research Engineers continued to build upon the concepts of SAL. In 1978, they brainstormed an approach to expanding these techniques into a general purpose application programmable interlocking control product. Utilizing mathematical principles from communication security and from cryptographic technologies, the engineers extended the SAL techniques to an enhanced set of techniques referred to as Numerically Integrated Safety Assurance Logic (NISAL ™). These techniques became the backbone of a major new product line known as the Vital Processor Interlocking (VPI ®) Control System. After extensive prototype testing at several North American and European test sites, the first in-revenue service installation of this product occurred in January, 1986 at the Clinton Interlocking plant in Chicago, Illinois on a Chicago & Northwestern Railway's freight and commuter rail line into the Northwestern Terminal.

In 1913, a brand new Grand Central Terminal in New York City opened for service utilizing the latest in state-of-the-art electric interlocking equipment from GRS. This largest of North American passenger terminals utilized this equipment until 1993 when the latest state-of-the-art processor based central control systems teamed with a geographically distributed system of 17 VPI Interlocking Control systems were placed in service as part of a major terminal refurbishment project. This terminal consists of 211 switches, 189 signals, and 295 track circuits and sees in excess of 700 electrified commuter trains per day, primarily during four hours of rush hour service.

VPI Systems have evolved in ability and sophistication. VPI systems may be configured and application programmed from a simple vital fail-safe interlocking control to a highly sophisticated, fully automatic driver-less transit application with VPI in control of both the interlocking and the block-line functions. A single VPI system can be configured to control a simple remote holding signal or a single turn-out control point or up to a large interlocking of some 25-30 switch machines and related signals. Larger interlocking plants can be configured with a distributed arrangement of VPI systems.

As the company reaches the century mark, ALSTOM Signaling, Inc. (formerly General Railway Signal Company) has manufactured and deployed more than 1000 VPI systems for 54 different customers in 15 countries. These systems have accumulated more than 55,000,000 operating hours ***without a single reported safety incident.***



400 lever GRS electric interlocking machine was placed in service in 1913 at Tower "A" in Grand Central terminal, NYC, NY.

400 lever interlocking machine for Grand Central terminal on GRS factory floor in 1912.

The G.R.S. Dynamic Indication Electric Interlocking was adopted as the system ***best suited*** to meet the ***exacting traffic requirements*** of the new Grand Central Terminal, New York City.

This is one of the great terminals of the world. The tracks are on two levels, 42 tracks on the upper (express) level and 25 tracks on the lower (local) level. Capacity, 4000 cars—550 trains per day, all operated by electricity.

The G. R. S. electric interlocking, because of its ***reliability under all conditions***, its ***safety*** and ***simplicity***, was found to be the system to use.

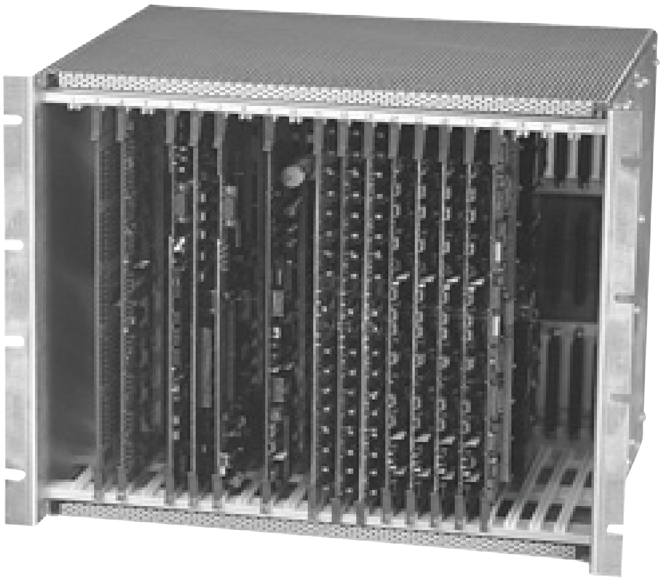
"Safety First"

GENERAL RAILWAY SIGNAL COMPANY

ROCHESTER, N.Y.

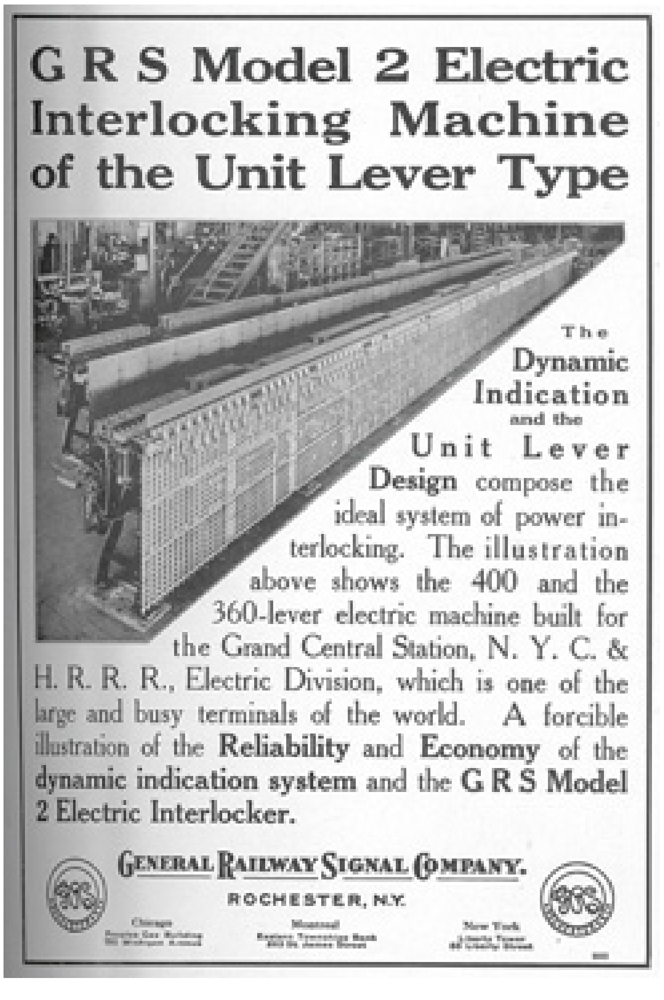
San Francisco Chicago Montreal New York

1912 GRS advertisment for the Grand Central terminal interlocking.



In 1993, 17 distributed VPI systems replaced the original 1913 GRS interlocking control machines in Grand Central Terminal.

1993 GRS central control console for Grand Central Terminal.



G R S Model 2 Electric Interlocking Machine of the Unit Lever Type

The **Dynamic Indication** and the **Unit Lever Design** compose the ideal system of power interlocking. The illustration above shows the 400 and the 360-lever electric machine built for the Grand Central Station, N. Y. C. & H. R. R. R., Electric Division, which is one of the large and busy terminals of the world. A forcible illustration of the **Reliability** and **Economy** of the **dynamic indication system** and the **G R S Model 2 Electric Interlocker.**

GENERAL RAILWAY SIGNAL COMPANY.

ROCHESTER, N.Y.

Chicago Montreal New York

1912 GRS advertisment for 400 lever and 360 lever interlocking machines for Grand Central Terminal on GRS factory floor.

AUTOMATIC TRAIN CONTROL

It is doubtful if any technology ever received as much attention as automatic train control. Thousands of patents were issued, millions of dollars spent in experimentation, and yet only a few systems have survived the tests of practical use.

A trial installation of GRS intermittent inductive train stop was made on the Buffalo, Rochester and Pittsburgh Railway in 1919. By 1923, the first commercial installation was made on the Chicago and North Western Railway. Many installations were made in the ensuing years.

In 1953, GRS made the first commercial use of transistors in the railroading industry with the installation of a cab signal system on the New York, New Haven and Hartford Railroad.

In 1973, GRS supplied automatic train control equipment using cab signals for Amtrak locomotives operating on several mid western railroads.

Building upon the techniques and principles of Safety Assurance Logic, in 1988, GRS installed the first Micro CABMATIC™ Automatic Train Control system, a vital microprocessor based system. This product is configurable from a basic Automatic Train Protection system up to a completely automatic driver-less system. The system has been deployed in both railroad and transit applications.

GRS intermittent inductive train control was tested on the Buffalo, Rochester & Pittsburgh Railway in 1919.

AMTRAK locomotives operating on certain mid-western railroads have automatic train control systems supplied by GRS.

GRS installed the first Micro CABMATIC™ Automatic Train Control system in 1988.

CAR CLASSIFICATION

GRS led the field with the first commercial installation of all-electric car retarders, in 1926, at East St. Louis on the Illinois Central Railroad.

The next significant development in car classification was the GRS invention of the automatic switching system in 1950. The initial installations of this system were made at Markham Yard, Illinois, on the Illinois Central Railroad, and at St. Luc Yard, Montreal, on the Canadian Pacific, both in 1950.

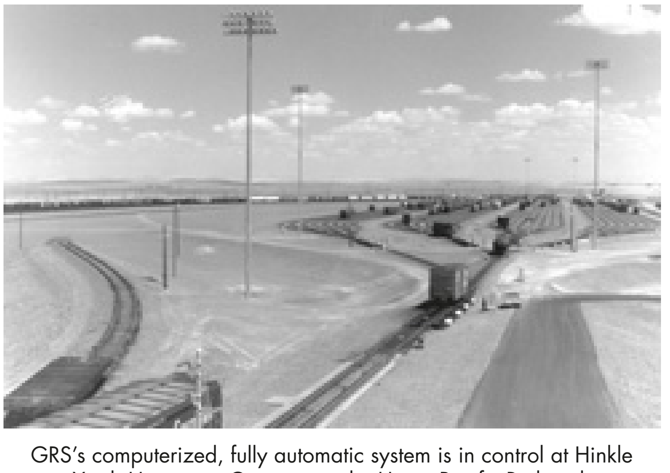
In 1953, another GRS invention, automatic retarder control using a GRS analog computer, was installed at Kirk Yard, Gary, Indiana, on the Elgin, Joliet & Eastern. This system utilized the latest techniques of ultrahigh frequency radiation (radar) for speed measurements.

In 1968, GRS made the first commercial installation of a digital computer in a car classification yard - the Alfred E. Perlman Yard at Selkirk, New York, on the New York Central Railroad.

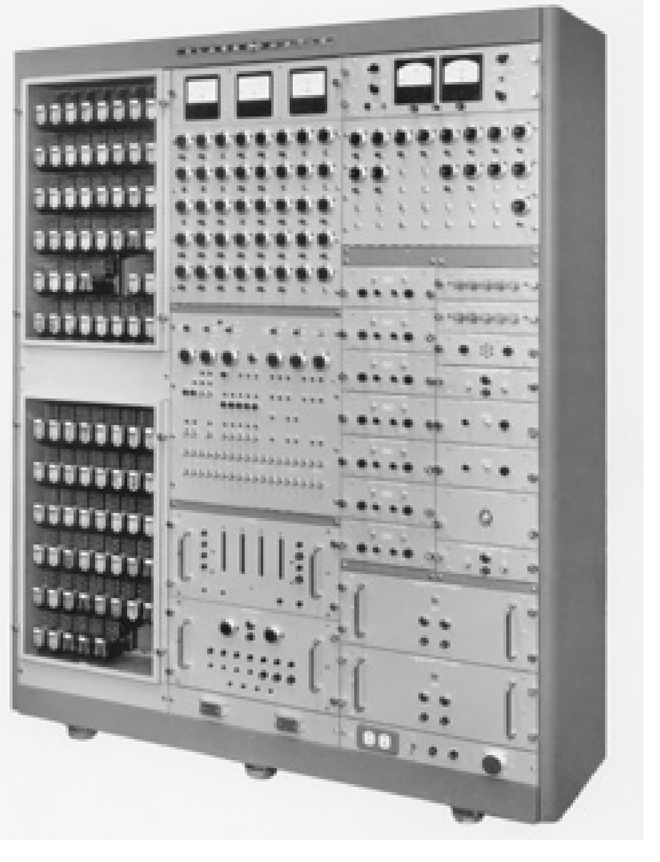
In 1980 GRS introduced a distributed mini-computer and micro-computer system (YARDS 2000 ™) for the control of car classification yards which continually fine-tune yard operations by compensating for such conditions as track curvatures, wear, and settling.

The 1980's and 1990's witnessed a dramatic change in the style of North American railroading from loose car traffic to unit trains and inter-modal trains, all of which dramatically reduced the need for car classification yards. GRS exited from this market in the early 1990's.

GRS made the world's first installation of electric car retarders of East St. Louis in the Illinois Central in 1926.



GRS's computerized, fully automatic system is in control at Hinkle Yard, Hermison, Oregon, on the Union Pacific Railroad.



A GRS CLASSMATIC™ Analog Computer used in 1950's and early 1960's Yard Automation Projects.

RAPID TRANSIT SIGNALING

Since its incorporation, GRS has furnished equipment for rapid transit (subway) lines both in the United States and overseas. This equipment has included: automatic block signals, wayside trip stops, wayside signals, all-relay and NX interlockings, coded remote control, high-frequency track circuits, cab signals, automatic train dispatching and train identity, and fully automatic train operation.

In New York City, the first subway installation was made on the Interborough Rapid Transit Lines in 1904. Many installations have been made in the intervening years on these and other lines in the metropolitan area. On the express tracks of the subways, signal systems make it possible to maintain headways as close as 90 seconds.

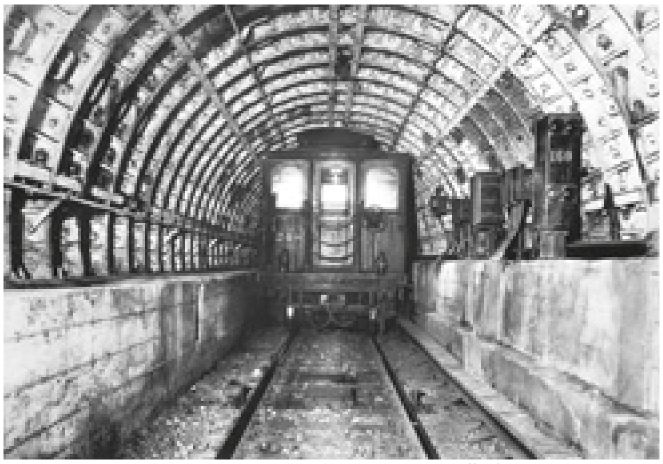
Starting in 1924, the company signaled subway systems in three cities in Spain. In 1927, subway signaling was placed in service on a new subway in Rochester, New York.

In 1965, GRS installed the world's first high-frequency, electronic track circuits on the Chicago Transit Authority's Lake Street Line. This was the first major improvement in track circuit technology since the original closed track circuit was invented by Dr. Robinson in 1872.

In recent years, extensive installations of GRS equipment have been installed on the rapid transit lines world-wide. Installations include Boston, Buffalo, Chicago, Cleveland, Philadelphia, New York City, Toronto, Washington, Atlanta, Los Angeles, San Francisco, Taipei, Taegu, Seoul, and Shanghai.

The rapid increase in the use of automobiles in the US during the 1920's began the demise of most trolley car systems in the country. The 1980's and 1990's saw a re-birth of this style of transit system under the guise of Light Rail Transit (LRT) systems in a number of cities. Using a mixture of traditional signaling products integrated with a number of new products, ALSTOM Signaling Inc. has participated in a number of these new projects.

A modern day Light Rail Project, Hiawatha Metro Transit (2004).



GRS automatic trip stops were installed in 1904 on a New York City subway.

The Rochester, New York subway was equipped with GRS automatic block signal system in 1927.

In 1976, the first section of the Washington Metro was equipped with a GRS fully automatic train control system which permits trains to operate up to 70 mph with 90-second headways.

RAIL-HIGHWAY GRADE CROSSINGS

GRS introduced its first highway crossing gate in 1905 utilizing a semaphore signal motor as the drive mechanism. Over the years, the company continued to improve its gate operating mechanism, right up to the Type D gate mechanism.

GRS began the serious development of rail-highway grade crossing warning systems in the early 1920's. This coincided with the rapid increase in automobile production and the beginning of a national highway system. Prior to that time, there was a variety of warning signals, typified by the wigwag and banner types.

In 1977, GRS introduced the vandal and impact resistant LEX-C™ flashing light signal made of polycarbonate resin, which was provided in both 8" and 12" sizes.

With the advances in opto-electronics in the 1990's, GRS introduced the AURORA™ product line of Light Emitting Diode assemblies for both crossing signal and gate arm lights in 1997.

GRS automatic rail-highway crossing with Type D Gate Mechanism.

Early Highway Crossing Signal using a Model 2A Semaphore mechanism (1910).

AURORA LED Crossing Signal and Gate Arm Lights (1997).

PERSONAL RAPID TRANSIT

Starting in 1970, GRS began the development of a personal rapid transit system (people mover). This system was designed to transport people to points in a limited area, such as central business districts, airports, and college campuses.

In one outstanding project, GRS provided the automatic control system for the Airtrans vehicles operating at the Dallas/ Fort Worth Regional Airport. The fully automatic system includes vehicle protection, automatic operation over predetermined routes, scheduled operation, and automatic vehicle merging.

One of the AIRTRANS vehicles at the Dallas/Ft.Worth Airport which transports passengers between terminals in 1973.

Personal Rapid Transit demonstration at TRANSPO '72 at Washington's Dulles Airport; utilized a GRS vital minicomputer control with a moving block system.

INDUSTRIAL RAILWAY SYSTEMS

For many years, GRS supplied systems and equipment to mining and industrial railways. In 1962, GRS developed and installed a control system for the world's first fully automated, driver-less trains on the Carol Mine Railway in Labrador.

In 1963, GRS introduced a radio remote control system, which enabled a locomotive engineer to control his train from the ground and at distances up to one-half mile. More than 257 units were installed on 13 industrial railroads, 33 units in eight car classification yards, and 1 unit on a mainline railroad. When the market for this style equipment became stagnant in the mid-1980's GRS exited this market.

GRS radio remote control enables the operator to control his train from the ground.

GRS automation system has provided crewless train operation in Labrador since 1962.

THE CORE TRAIN CONTROL PRODUCTS FOR A CENTURY

During the one hundred and fifteen years since John D. Taylor created and installed the first all-electric interlocking at East Norwood, Ohio in 1889 on the Baltimore and Ohio Southwestern Railroad, GRS and its predecessor and successor companies have produced families of switch machines, signals and relays to meet the needs of the railroad and transit properties served and to maximize the advantages of technological innovations as they became available. These devices have been an important element of all the train control systems developed during this first century and have all progressed through many improvements and renditions.

SWITCH MACHINES

The 1889 East Norwood, Ohio installation is the first known use of an electric motor performing the movement of track switch points.

The Model 2 Switch Machine was introduced in 1900 by Taylor Signal Co. and featured integrated throw and locking functions. W.K. Howe who joined Taylor in late 1900 designed a higher power motor (Model 3 motor) for this mechanism in 1902.

The Model 4, 4A & 4B Switch machines designed by Howe were a lower profile machine integrating the switch circuit controller (point detection) , throw and locking functions and was initially released by GRS in 1910. This machine has been the basis for most of the switch machine designs for the next ninety years.

The Model 9B Switch Lock introduced before 1916 evolved from the earlier Model 9A Switch Lock released in 1911 and its predecessor, Model 1 Switch Lock initially released in 1905 by GRS.

The Model 10 Handthrow Lock initially released for production in 1943 remains the standard on RR properties to this day.

The Model 7J and 7K Switch circuit controllers were first released for production in 1927 and still remain the standard for railroad and transit customers today. Earlier notable products are Model 3 Form D and Model 5 Form A switch circuit controller released in 1911.

The Model 5 Switch machine designed specifically for the NYC subway system was released in 1914 and remains the NYCT standard to this day.

The Model 9 Hand Throw machine with Lock and Detection functions was initially released in 1945, and also adapted as a Spring Switch Lock when used with the 'Mechanical Switchman'.

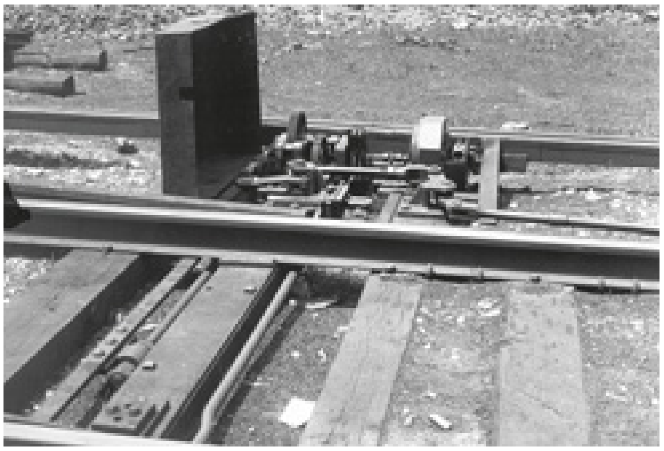
The Models 5E (initially released in 1958), 5F ,5G and 5H evolved from earlier models 5A (initially released in 1919), 5B, 5C, 5D to provide the interlocking functionally required by North American railroads and have maintained themselves as industry standards for decades.

The Model 6 Switch Machine, specifically designed as a fast acting trailable machine for use in classification yards, was initially released in 1926 and is still an industry standard today.

The SpeedFrater is a compact trailable machine designed for use in place of hand throw switch stands and for use in classification yards and was initially released in 1968. The SpeedFrater superceded the 'Electric Switchman' trailable and non-trailable machines released in the early1960's.

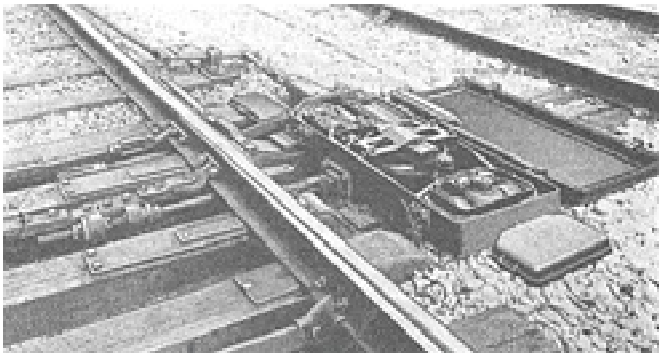
The Models 55 E and G, initially released in 1964, were designed specifically for rapid transit service featuring a low profile and weighing approximately 500 pounds making installation easier than that of the railroad standard machines. GEC/GS, a forerunner of ALSTOM in the United Kingdom, was licensed to manufacture this design in the early 1970's in the UK and Australia. This machine known as the model HW became an industry railway standard in these countries.

The most recent development in switch machine technology has been the Grandmaster line of machines initially released in 1997, featuring a universal power-brushless motor, a restorable or non-restorable latch-out mechanism, split link cam bar, and a footprint supporting easy change out in existing layouts of both the GRS and Union Switch & Signal (US&S) switch machine types. These features were included to satisfy the current requirements of rail and transit customers. Most recently the Grandmaster has been further updated for improved performance, robustness and reliability and will serve ALSTOM Signaling Inc. as the flagship of its switch machine line, promising a continuation of its reputation as a leading Railway Signaling technology innovator.

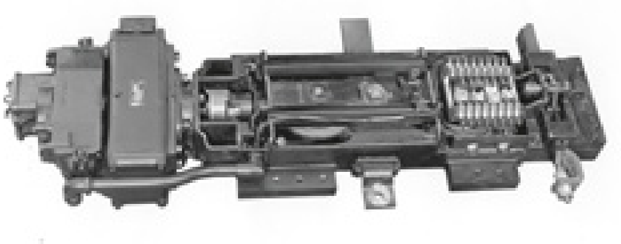


Model 2 Switch Machine (ca.1900).

Model 6 Yard Switch Machine (1926).



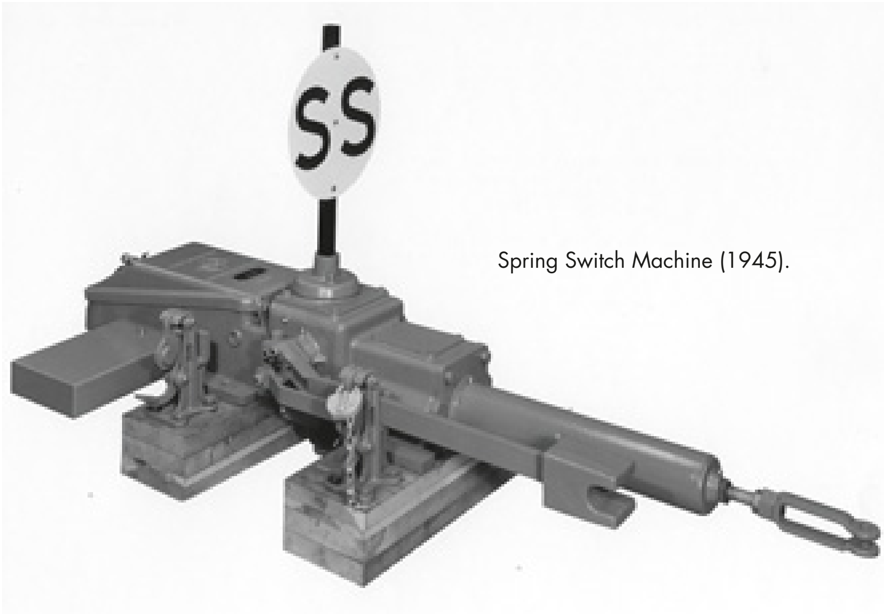
Model 4 Switch Machine (1907).



Model 5 Switch Machine (1914).

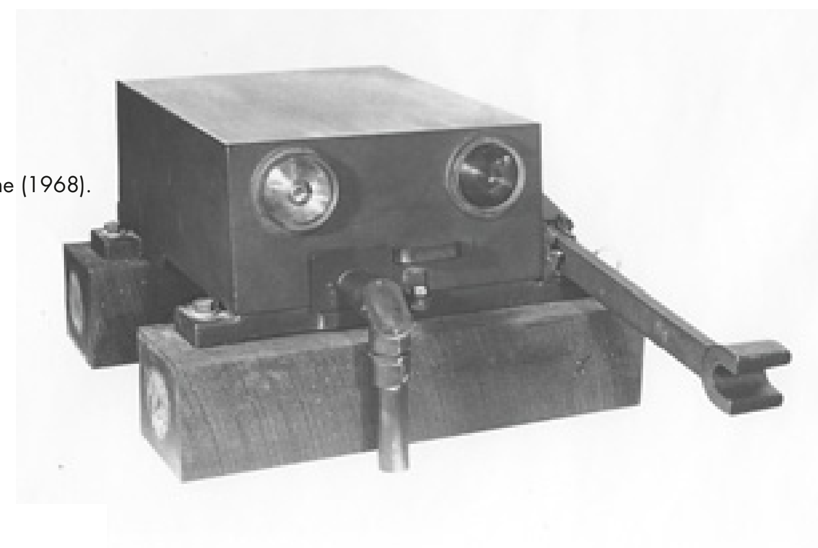
Model 55 Switch Machine (1964).

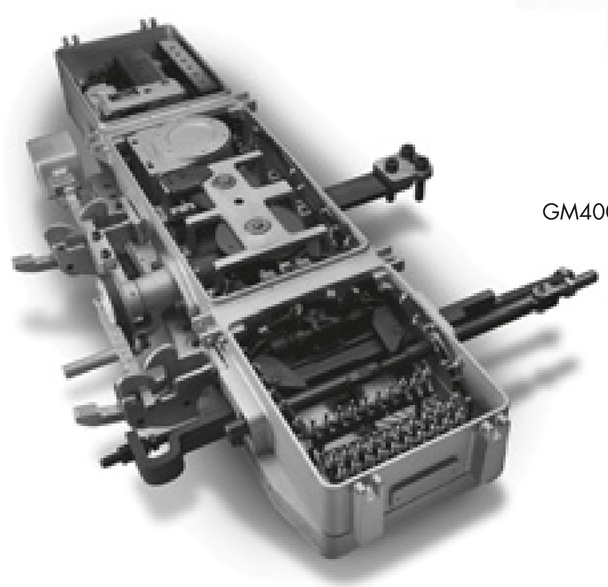
Model 5F Switch Machine (1958).



Spring Switch Machine (1945).

Speed-Frater™ Yard Switch Machine (1968).





GM4000™ Switch Machine (1997).

SIGNALS

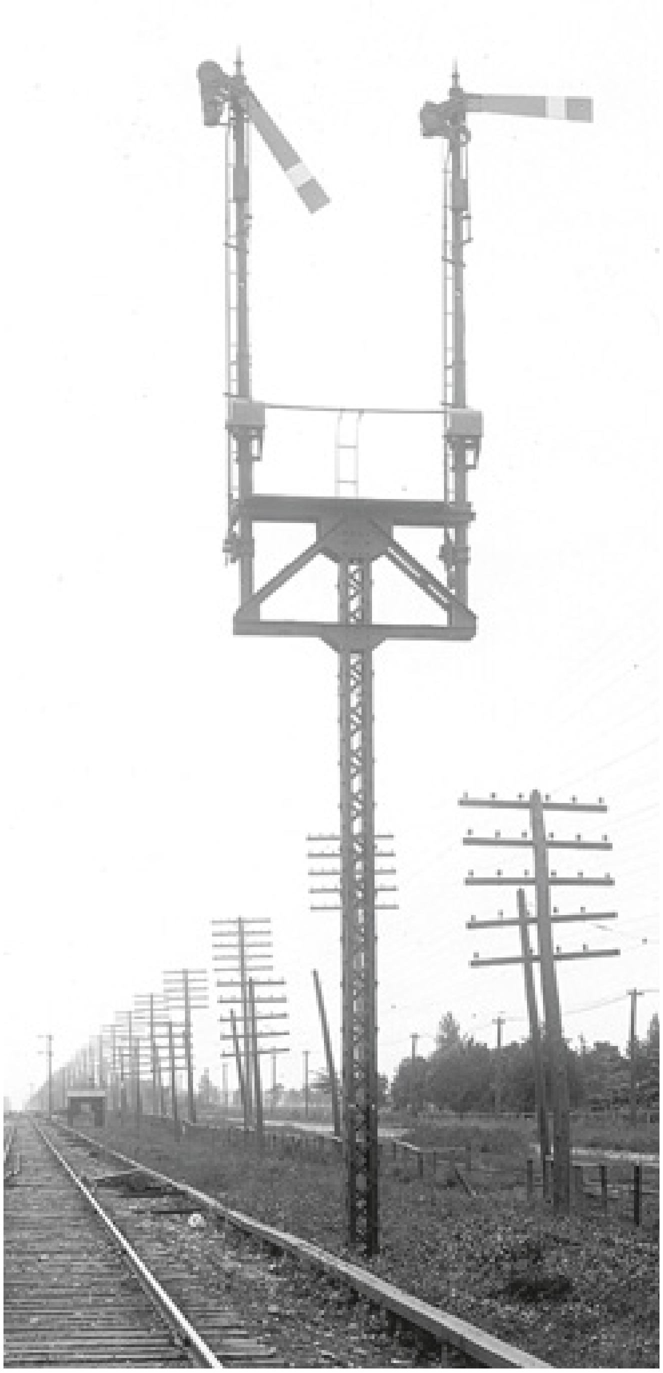
The 1889 East Norwood interlocking plant also used electric motor driven semaphore signals designed by Taylor. The Model 2 Semaphore was a much improved design by Taylor and appeared in the late 1890's. W.K.Howe redesigned the semaphore signal which was known as the Model 2A and that was released in 1908 and became an industry standard. Over 24,500 Model 2A Semaphore units were produced in the first ten years of production.

Listed below is a summary of many popular models of signals released since the founding of the company in 1904.

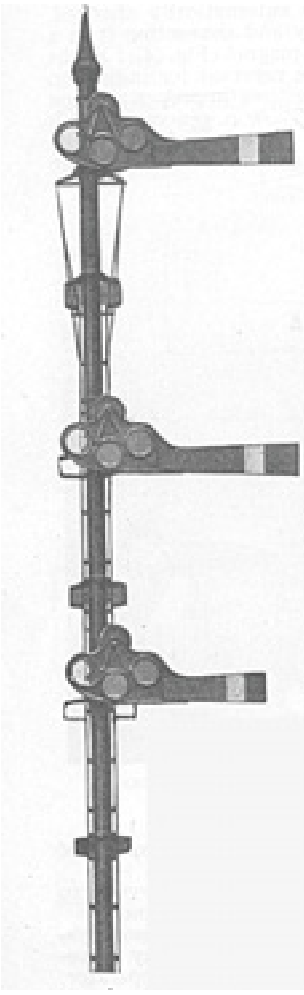
- Type D- Color Light Signals (Vertical) released for production in 1912.
- Type E- Color Light Signals (Horizontal) released for production in 1923.
- Type G – Color Light Signal (Triangular) released for production before 1925.
- Type FA – Color Light Dwarf signals released for production before 1925.
- Type SA Searchlight Signals released for production in 1927 remain a popular signal to this day. Over 70,000 searchlight signal units have been produced to date and shipped world-wide.
- Type P – Color Light Signal, a front to back two position unit was introduced in1925.
- Highway Crossing Signals XA, XB, XC, and XD were introduced in the 1930's and 40's.
- Type W – Color Light Signals were introduced before 1941.
- Type AT – Color Light Signals introduced in 1931 remain the standard for tunnel signals to this day.
- Type AW – Color Light Signals introduced in 1934 remain the standard for wayside transit signal to this day.
- Types MD & ME Color Light Dwarf Signals were introduced in 1930.
- Types U Color Light High Signals introduced before 1937.
- Types V and VA Dwarf Color Light Signals were introduced before 1937.

With the advances in opto-electronics, GRS released the Aurora Highway Crossing Signals in 1997. LED technology is quickly becoming the standard in Color Light Signaling featuring improved visibility and system reliability.

With ALSTOM Signaling Inc. beginning a new century, a newer Line of Color Light Signals utilizing state of art LED Technology is now a key component in the latest signal product offerings.



Model 2 Electric Semaphore Signal (ca. 1900).

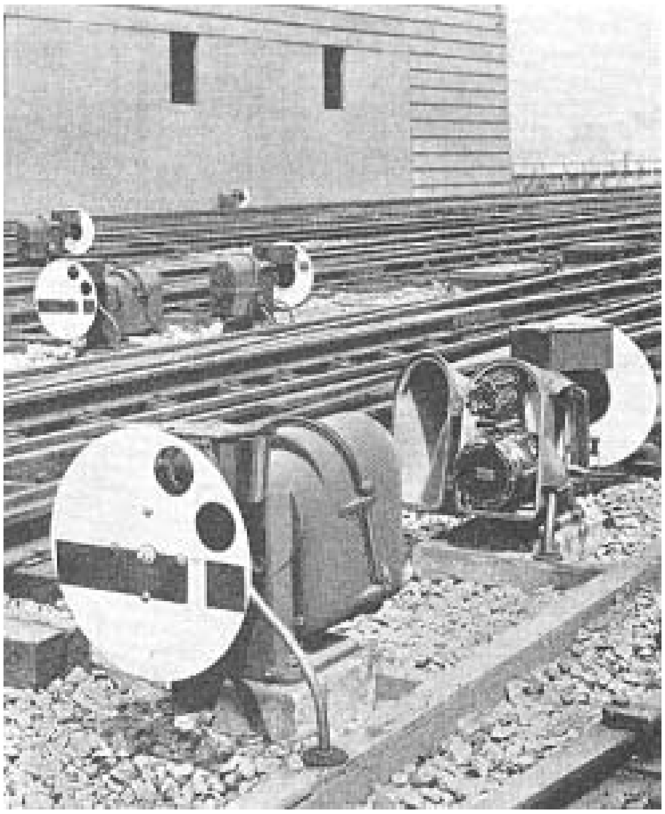


Model 2A Electric Semaphore Signal (1908).

Type V Color Position Light Signal (1937).

Type D Color Light Signal (1912).

Type SA Searchlight Signal (1927).



Model 2A Dwarf Signal with Rotating Disc for C&NW (1910).

Type ME Dwarf Signal (1930).

Model 2 Dwarf Signal with Semaphore Arm (1901).

Type MD Dwarf Signal (1930).

Type G Color Light Signal (1925).

Type D LED Signal (1997).

RELAYS

Early relays were essentially extensions of telegrapher relays adapted for the rail industry. The 1889 East Norwood plant used a relay to drive a Switch Machine and a motor driven semaphore signal designed by Taylor. It is assumed that this relay was a forerunner of the Taylor Signal Model 1 relay. The ensuing century saw a vast multitude of relay designs to meet the many special requirements of the rail and transit industry. A summary of some of the early popular relays and some of the current products are listed below along with key product release dates.

- Model 1 DC Track Relay available in coil resistances from 4 to 1000 ohms was introduced before the formation of GRS in 1904. One of the earliest drawings in the GRS records is of the Relay Complete, dated November of 1900.

- The Model 2A relay was a popular polyphase rotor type AC track relay used on electrified rail and introduced before 1905.

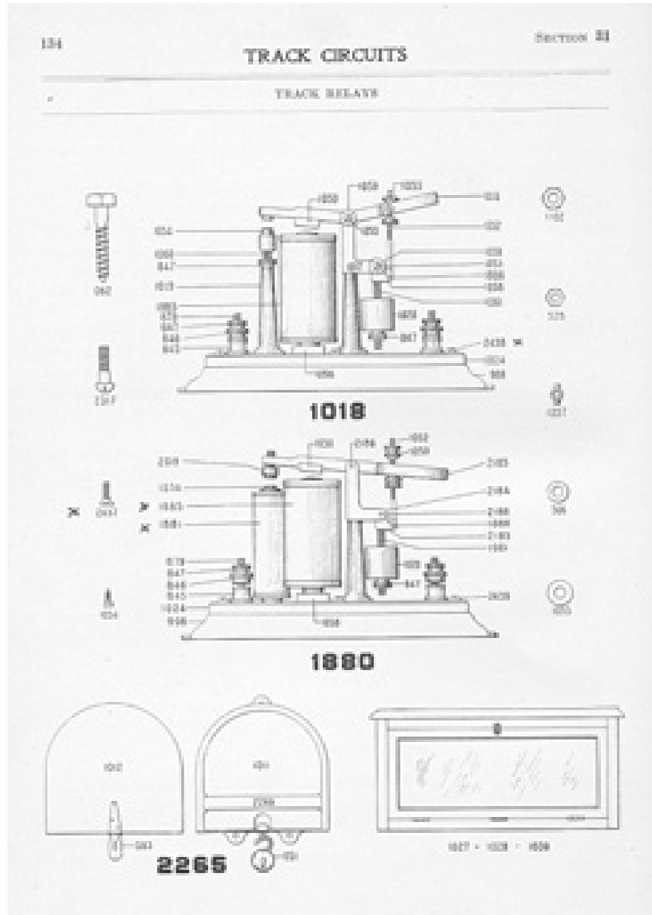
- Model 3, a popular single phase rotor type AC track relay used on electrified rail and the Model Z rotor type AC or DC Line Relay were introduced after 1910.

- AC Vane Relays Type C single element were introduced after 1920. Double Element AC Vane Relays Type N and Type L were introduced after 1930. Today's Type B2 AC Vane Relay was first introduced in early 1937 and has remained an industry standard for electrified track.

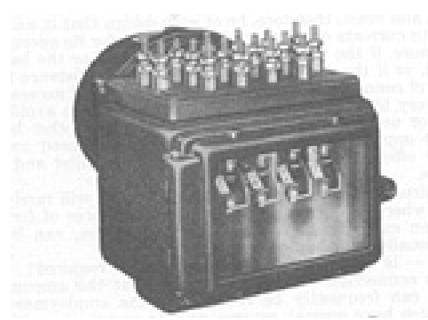
- The Type K shelf mount DC Relay was first introduced in 1926 and remained popular until the late 1970's. The Type W shelf mount AC Relay was first introduced in 1926. The Model 9 was the forerunner of the Type K design and was introduced about 1908.

- The Type B1 and B2 relays are plugboard mountable relays designed to satisfying the full spectrum of rail and transit signaling requirements, were initially introduced in 1935. These relays have remained the industry standard for relay signaling to this day, with over 2 million sold.

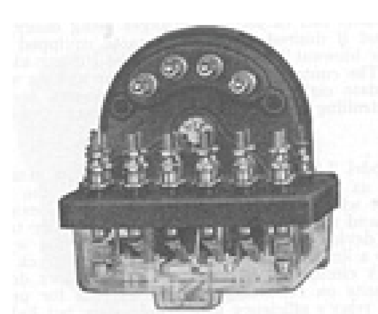
- The Type J Relay Non-vital relay was introduced in1961 and the JT Non-Vital relay was introduced in 1964.



Taylor Track Relay (ca.1900).



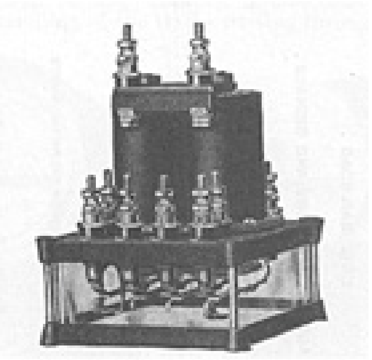
Model 2 Polyphase Relay (ca. 1905).



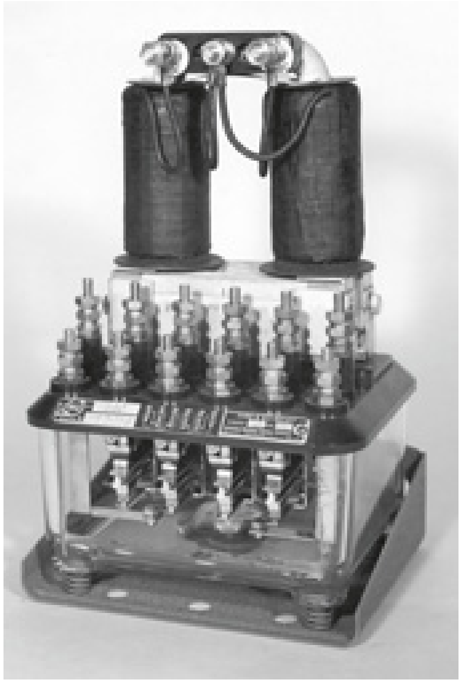
Model 2 A.C. Relay (ca. 1906).

• The MICROCHRON Vital Timer Relay, introduced in 1981, is a blend of a traditional B1 vital relay design with a vital microprocessor timer function to produce a single design in a B2 package that replaces many earlier versions of electromechanical vital timer relays.

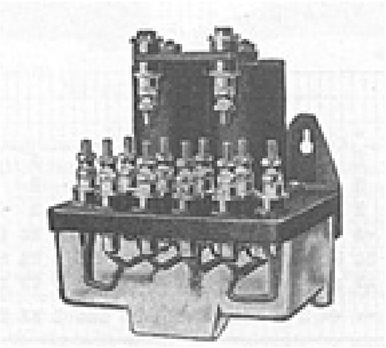
ALSTOM continues to perfect its electro-mechanical relay product line satisfying the industry needs for vital and highly reliable electrical switch gear.



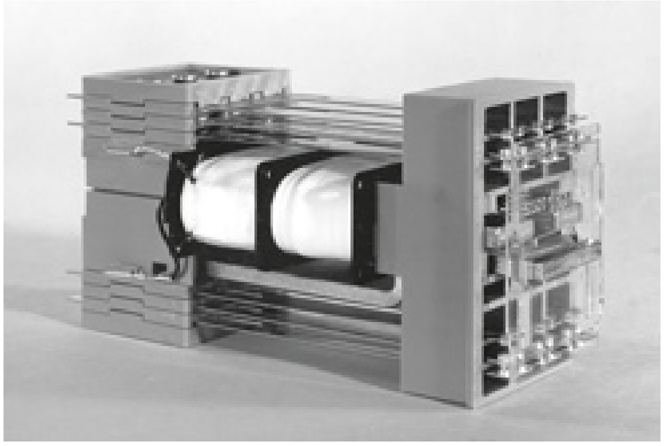
Model 9 Shelf Relay (1908).



Type K Size 4 Biased Neutral Relay (1926).



Model 9 Wall Relay (1908).



Type J Non-Vital Relay (1961).

Type B Size 1 Neutral Relay (1936).

MICROCHRON® Vital Timer Relay (1981).

FEDERAL SIGNAL COMPANY

In 1905, the Federal Railway Signal Company was organized in Troy, New York, by former employees of the Standard Signal Company (A.H. Renshaw and J.T. Cade). Standard had been consolidated with the Pneumatic Signal Company, Rochester, in 1902.

Three years later, on February 1, 1908, the Federal Railway Signal Company was reorganized under the name of the Federal Signal Company. This company was located in Albany, New York. In 1913, Federal took over the American Signal Company, which had been started in 1904 in Cleveland, Ohio.

On November 1, 1923, the business and properties of the Federal Signal Company were purchased by GRS. At the time of the merger, GRS was doing approximately 30% of the total signaling business in the United States, and the Federal Company about 14%. The consolidation permitted increased production with greater economy, both companies having heretofore maintained practically duplicate engineering, manufacturing and sales organizations, having sales offices in New York City, Chicago and other points.

Federal Signal Company electric interlocking machine installed at Utica, New York, on the New York Central Railroad in the early 1920's.

DIVERSIFIED ACTIVITIES

During several periods since 1904, GRS has turned to the development and manufacture of products other than signaling equipment for railroad and rapid transit customers. The following paragraphs briefly describe these ventures.

During 1915 and 1916, GRS manufactured small gasoline engines for Cyclemotor Corporation of Rochester, New York. The single cylinder air-cooled engines got up to 100 miles to a gallon and, together with their rear wheel belt transmission drive system, weighed only 21 pounds. They provided a top speed of 25 mph on a level road.

WORLD WAR I

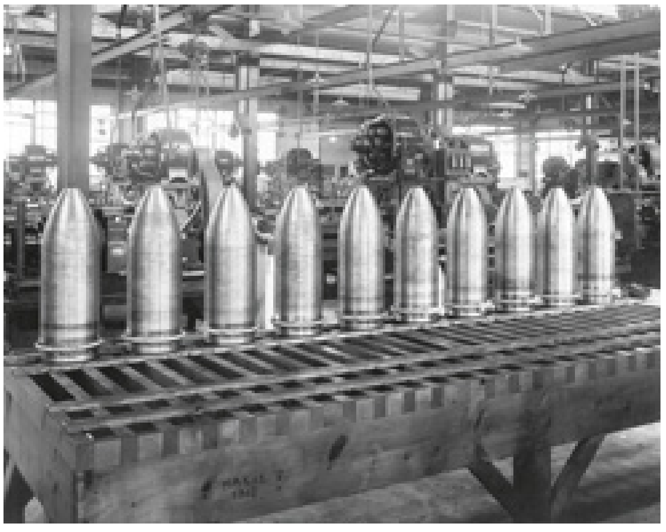
Before the declaration of war by the United States on April 6, 1917, the J.P. Morgan & Company of New York City, acting as agents for the British Government, placed an order with GRS for artillery shells amounting to about $7,000,000. This was, at the time, the largest single order ever secured by a Rochester corporation. This event was directly responsible for increasing GRS stock by 33 points in a two-week period.

To manufacture the 9.2 inch shells GRS had to construct new manufacturing facilities. A contract was made with the John W. Cowper Company of Buffalo to construct a new building in 60 days, with a substantial bonus promised for each dayunder this limit. The building was completed in 43 days, creating a new record for the construction of such structures in Rochester.

Rough forgings of the artillery shells, weighing about 300 pounds, were furnished by the Bethlehem Steel Company. These went through 15 operations in the GRS plant, with final inspection by representatives of the British Government.

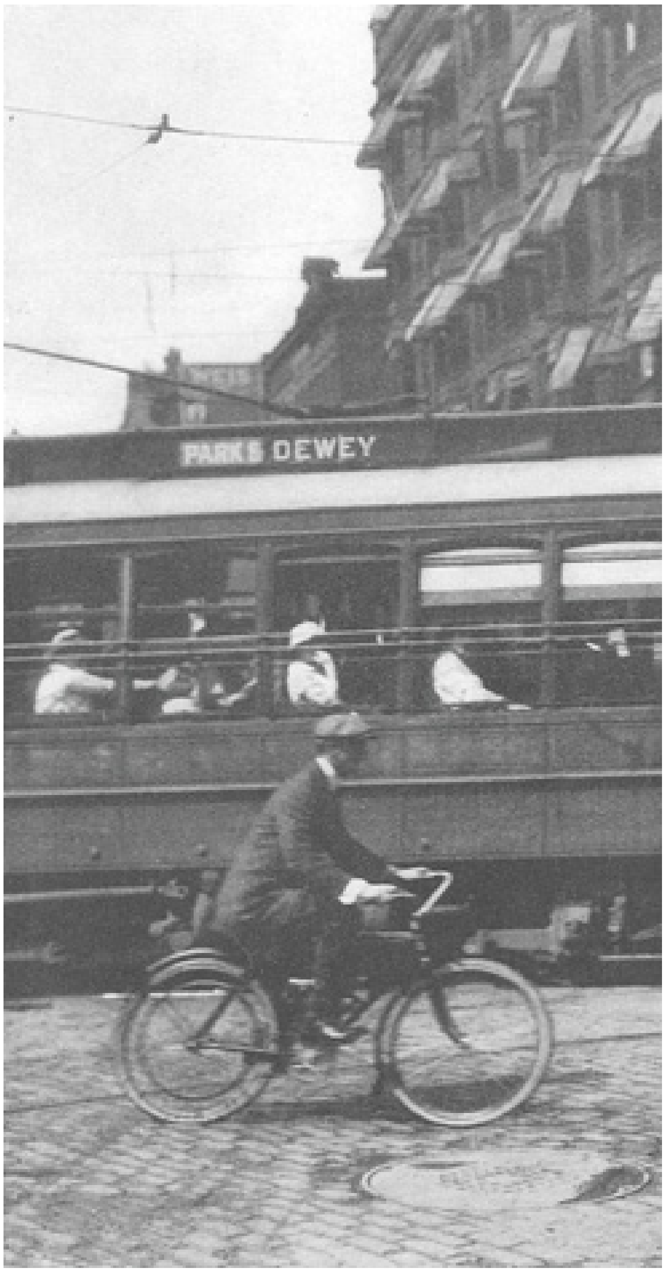
A total of 80,000 shells were completed on schedule by March 31, 1917. A souvenir shell was presented to the Rochester Historical Society in 1919.

Construction of this building at the West Avenue facility, for the manufacture of shells, started in November and completed on December 24, 1915.



GRS manufactured 80,000 9.2-inch artillery shells for Great Britain in World War I.

The Cyclemotor as applied to an ordinary diamond-frame bicycle.



A cyclist with a Cyclemotor passing a Park & Trolley in Rochester, New York.

COMMERCIAL CASTINGS

Left crippled by government intervention during World War I, the railroads were financially unable to resume their signaling improvement programs for some time. To keep its skilled forces available, GRS turned to the production of castings for commercial purposes and the manufacture of major household appliances.

Quoting from an article in the Rochester Democrat and Chronicle, dated June 13, 1920: "The magnitude of the business of the Signal Company impresses the visitor at the Lincoln Park Works. He finds that a large number of the leading industries of this city and country are its customers and that it is an important cog in their manufacturing wheels. It is plating parts of one of the country's most luxurious automobiles (the Cunningham). Castings of aluminium, brass, iron, and other metals are made by it in raw and finished form for industries requiring the finest of work...."

"..... The industries dependent upon the Signal Company for manufacture of parts are clamoring for increased output and the company finds itself unable to take all the orders which come to it."

The foundry was expanded at this time to handle the increased tonnage of commercial castings. Among other improvements, a large electric steel furnace was installed. The foundry was completely renovated in 1959.

GRS PRODUCTS, INC.

In 1920, G-R-S Products, Incorporated, was formed as a subsidiary of GRS to manufacture and sell electrical clothes washing machines. After only three months of production, the output on washers reached what was at that time a remarkable output of 30 per day. Reports from dealers indicated that the washers were highly regarded by their owners.

In 1922, the subsidiary company placed an electric dishwasher on the market. "Banished is the dish cloth, vanished are the reddened and roughened hands," was the sales slogan.

GRS felt at the time that by thus diversifying its products, the volume of business would in the future show less violent fluctuation, thus enabling the company to maintain an organization and employ facilities on a more economical basis than in the past.

Following the acquisition of the Federal Signal Company by GRS in 1923, the manufacture of non-signaling devices, the clothes and dishwasher, was transferred to the former Federal plant at Albany, New York.

By 1925, with a general upswing in business and GRS stock taking a jump from $100 per share to $400 per share, the production of household appliances went into full swing, and national distribution was being considered.

By 1926, the tide had turned, and it was felt necessary to direct the company's efforts toward its rapidly growing signal business. As a result, G-R-S Products, Inc., was liquidated. Concentrating on the signal business, the year 1926 showed the highest net income in the company's history, reaching almost four million dollars.

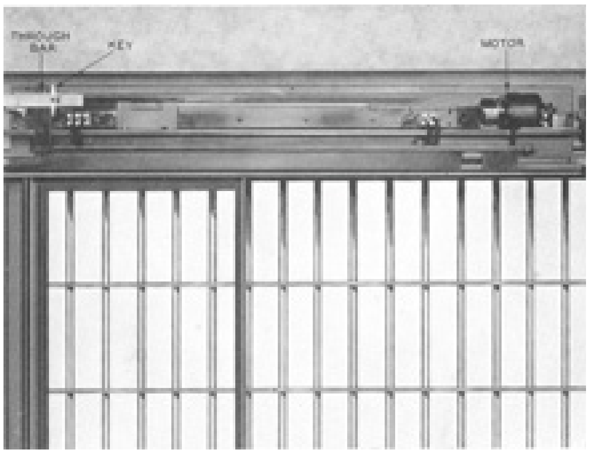
The GRS Clothes Washer – Good Reliable Servant.

GRS Dishwasher.

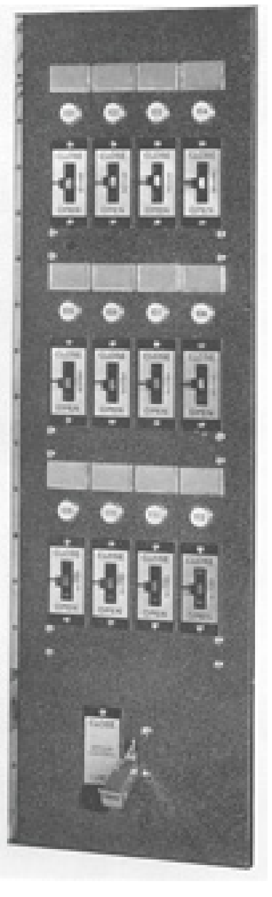
PRISON CELL DOOR LOCKS

In 1940, GRS developed, in cooperation with the Federal Bureau of Prisons, a control system for prison cell door locks. This system provided for the locking, unlocking, opening, and closing of cell doors as well as for indicating the positions of the doors.

During 1941, three installations were made: Federal Prison, Alcatraz, California, and penitentiaries at Lewisburg, Pennsylvania, and Petersburg, Virginia.



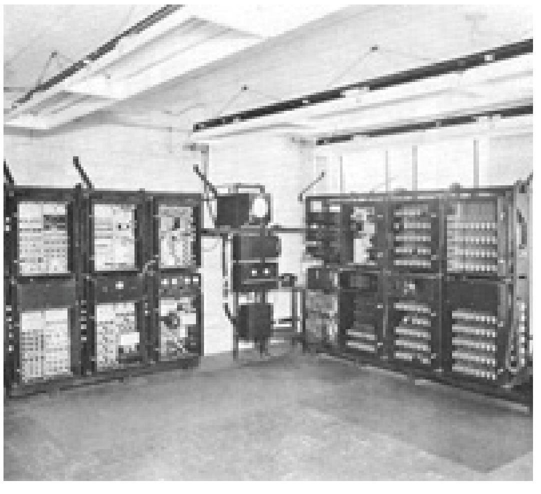
Control Panel (below) and prison cell door lock (above) installed at Alcatraz in 1941.

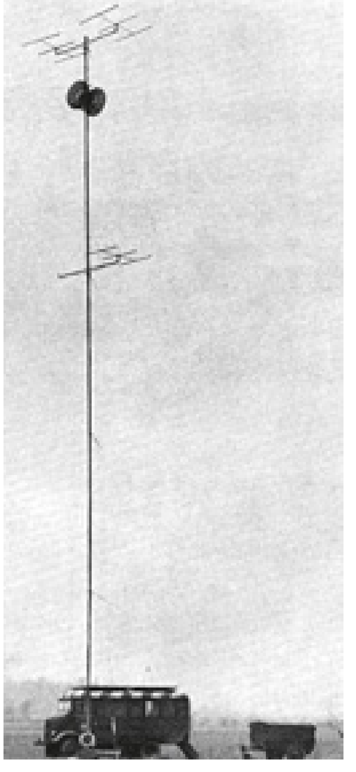


AIR TRAFFIC CONTROL

In 1941, GRS engineers directed their attention to applying the basic principles of safety engineering to air traffic control. As a result, a GRS approach control system was installed in 1945 at LaGuardia Airport in New York. In the early 1950's the company furnished several airports with a system which provides joint altitude control of airway traffic control over a "fix," or intersection, in the air.

Air Traffic Control Master Control Station in Rochester (below), typical ATC Block Station in Albion NY (right), ATC aircraft antenna installations (above) in 1948.





WORLD WAR II

For more than 5 years prior to the Pearl Harbor attack, GRS had been designated by the Ordnance Department to manufacture 105 mm, M1 shells for the military in the event of an emergency. In February of 1940, the first contract was awarded for the machining of 1,250,000 shells.

By purchasing additional plant facilities, the company was able to increase output by 200% after production had started in 1941. This new plant was the first in the country to be completely power- conveyorized from raw forgings to the painted shell. The top production reached 500,000 shells per month in June 1942. The Ordnance Department stated in 1945 that the company's shell plant was generally considered to be one of the most efficient in the country. This was in large part due to the new manufacturing processes developed by GRS engineers.

The company received a contract from the Air Corps, in 1942, for the production of remotely controlled turret systems for B-29 long-range bombers. By August of 1945, when the contract was terminated, the total production was 2100 completed sets of this ingenious and complex equipment.

Country's first completely power-conveyorized system speeds assembly of 105-mm shells in World War II.

Remote control turrets for B29 bombers were made by GRS during World War II.

VEHICLE TRAFFIC CONTROL

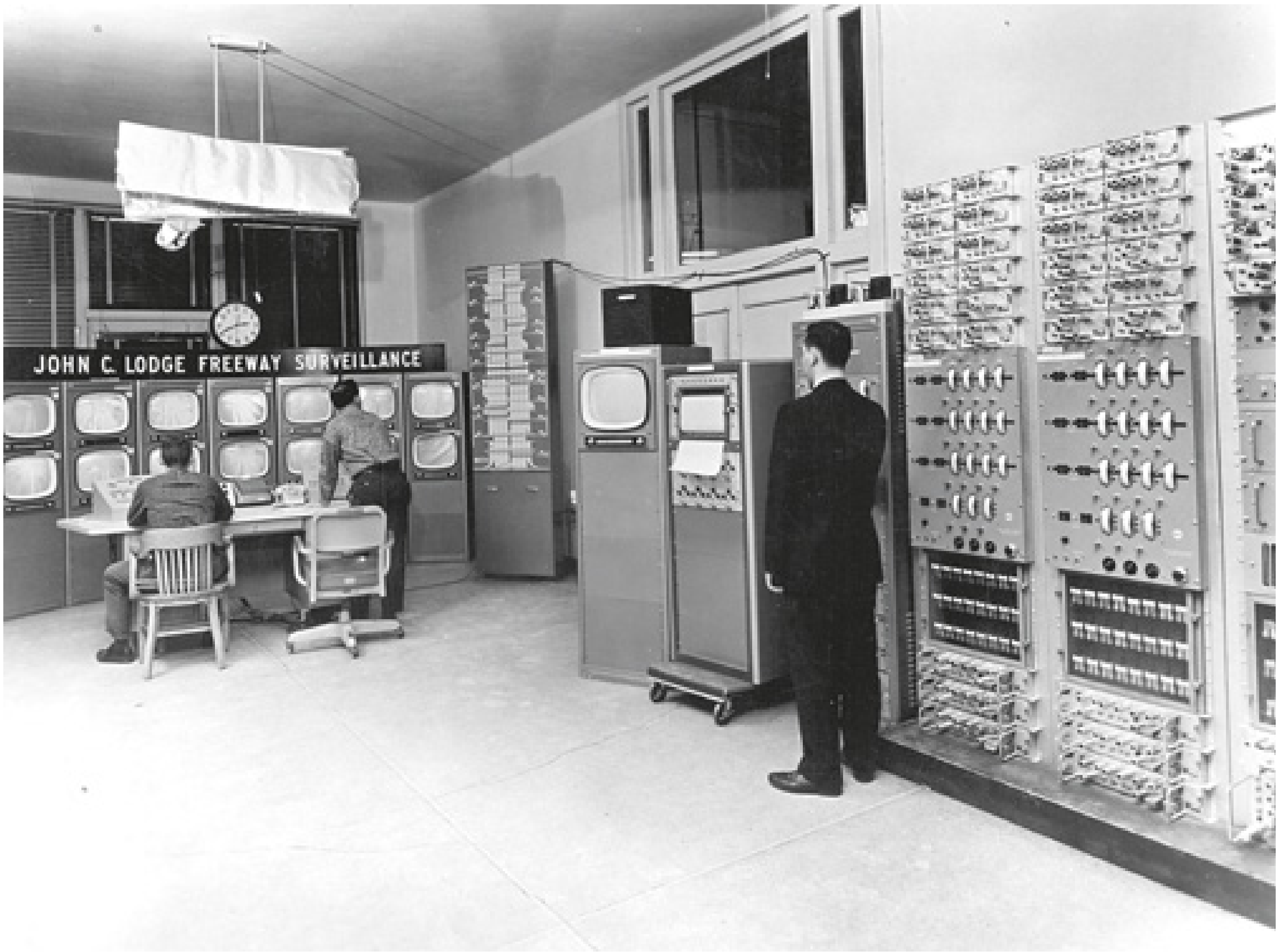
In the late 1950's, GRS started the development of systems for the detection and surveillance of vehicular traffic. In 1959, the company introduced the first ultrasonic detector for highway traffic signal control. The detection element, commonly referred to as "green turtle," was suspended over the roadway in advance of a traffic signal; the electronic portion of the system was housed in an aluminium case mounted on the detector mast near the ground.

Subsequent developments by 1964 led to the installation of ultrasonic detectors used for traffic surveillance on the Eisenhower Expressway in Chicago, the John Lodge Expressway in Detroit, and the New Jersey Turnpike. GRS also supplied systems for parking garages, which used ultrasonic detectors for check-in, check-out purposes.

In 1966, GRS supplied a computer-controlled traffic signal system to the City of Buffalo to improve traffic flow on Main Street.

With strong competition from long-established suppliers of vehicle traffic control devices, GRS withdrew from the field in the middle 1970's.

Typical ultrasonic detector installation on an urban street.

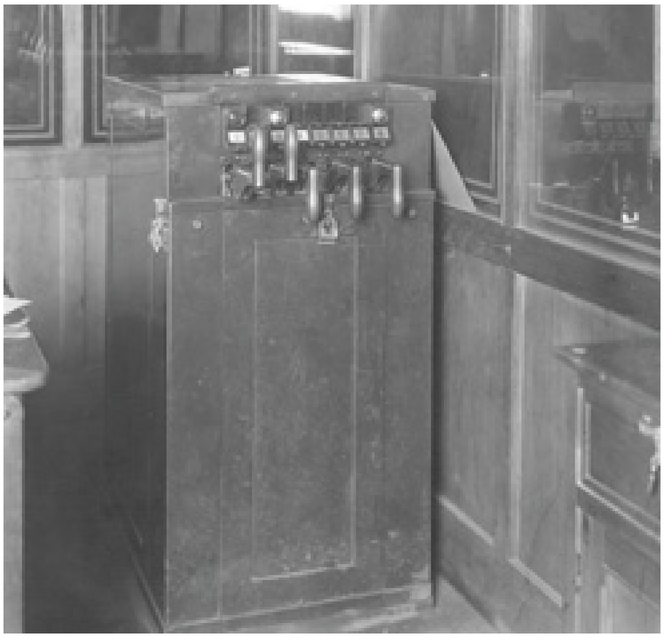


Surveillance control center, John Lodge Expressway, Detroit.

OTHER DIVERSIFICATIONS

In the early 1980's, GRS embarked on a program of diversification and expansion primarily into the allied transit bus industry under the direction of its newly formed Business Development Division. Through acquisitions of Chicago-area companies, GRS supplied bus control systems, public address and related radio and electronic products (Midwest Electronic Industries), and a complete line of fare collection systems (General Farebox Incorporated). This division became an independent division of General Signal in the late 1980's.

In addition, the company purchased Electric Panelboard Company of Rochester, a speciality designer and manufacturer of custom-fabricated process control panels and consoles, sheet-metal cabinets, power-distribution equipment, and other sheet-metal and wiring fabrications. The wholly owned subsidiary was a major supplier of GRS control system consoles and wayside electronic equipment housings. Electric Panelboard Company was absorbed into GRS in the early 1990's.



This GRS electric interlocking machine was supplied to the Barcelona Metro in 1924.

FOREIGN BUSINESS

GRS systems and equipment are in service in almost every country in the world in which railroads exist.

United Kingdom

The International Pneumatic Railway Signal Company of Rochester, formed in 1900 by the Pneumatic Railway Signal Company, furnished signal equipment through manufacturing connections in the United Kingdom. In 1901, through the Continental Hall Signal Company, an electric interlocking machine was supplied in Luxembourg at Petange on the Chemins de Fer and Minieres Prince Henri.

In 1916, GRS supplied the first electric interlocking in England, which was installed at Victoria Station, London, on the South Eastern and Chatham Railway. The original control machine for this installation went down with the sinking of the RMS LUSITANIA in1915. In 1926, Metropolitan Vickers-GRS (MV-GRS), Limited, was formed in the United Kingdom, closely followed by Rail Brakes, Limited, for the manufacture of signaling equipment to GRS specifications and designs. The world's first NX (eNtrance-eXit) pushbutton interlocking, a GRS development, was installed at Brunswick, England, in 1937. The first NX interlocking in South Africa was installed in Johannesburg on the South African Railways and Harbors in 1939. In 1942, MV-GRS and Rail Brakes became subsidiaries of Metropolitan Vickers Electrical Company, Limited, London. MV-GRS supplied signaling equipment throughout the British Commonwealth, including large quantities in Australia, India, Pakistan, South Africa, and Rhodesia. In 1960, Metropolitan Vickers Electrical Company became a subsidiary of Associated Electrical Industries, Ltd., and accordingly MV-GRS, Ltd. became AEI-GRS, Ltd.

Australia

From 1912 through 1917, GRS was represented in Australia by R.W. Cameron & Company of New York City. In 1914, the first electric interlocking plant in Australia was installed at Adelaide on the South Australian Government Railways. In the same year, automatic block signals were furnished for the New South Wales Government Railways and the Melbourne suburban lines of the Victorian Railways.

In 1918, GRS Company Proprietary, Limited, was formed in Australia for the supply of signaling equipment in that country and New Zealand. The first absolute permissive block signaling outside North America was supplied to the New Zealand Government Railways in 1921.

Spain

Automatic block signaling was introduced in Spain in 1922, installed on the MZA Railway between Barcelona and Mataro. The Barcelona subway was signaled in 1924, followed by other subway installations in Madrid. GRS Iberica, Limited, formed in 1930, continued to furnish GRS equipment until the Spanish Civil War in 1936. In 1951, a license was granted by GRS to Marconi Espanola, S.A., for the manufacture of GRS equipment in Spain. The first cTc in the Iberian Peninsula was supplied through Marconi to the Spanish National Railways in 1952. GRS Iberica, S.A., an associated company, was incorporated in 1961.

Italy

GRS interests in Italy had been in the hands of S.A. Scipioni Innocenti Bologna (SASIB) for many years prior to and after World War II. In 1960, American Machine and Foundry (AMF) acquired control of SASIB, so that the GRS Italian licensee was called AMF-SASIB.

Netherlands

In the early 1920's, electric interlocking systems were introduced to other European countries. In 1947, Spoorweg Sein Industrie was formed in the Netherlands for supplying signal equipment to certain European countries. After this arrangement was terminated, an associated company, Algemene Sein Industrie, was incorporated in 1961 to serve this function.

Central and South American Countries

Since 1913, GRS has supplied signaling equipment to various South American countries. The GRS relationship with a Brazilian company, Cia. Brasileira de Material Ferroviaria (COBRASMA) , commenced early in 1945. In 1947, the first GRS retarders were introduced into Chile by the Chilean Exploration Company. In 1960, GRS de Argentina, S.A., was formed to take care of GRS interests in Argentina. GRS equipment was introduced into Mexico as early as 1906. Since 1951, GRS cTc, NX, and car classification equipment have been supplied to the Mexican National Railways through Henry S. Dabdoub, S.A.

The 534-mile Sishen-Saldahna ore railroad in South Africa is controlled from this color-video display console.

INNOVATIVE AND CREATIVE

General Railway Signal Company has been blessed for 100 years with a team of extremely innovative and creative personnel. This team has harnessed many technological changes during the century into products and systems to serve not only the rail and transit markets, but also several other industrial and commercial markets.

Countless man years have been spent brainstorming, observing, listening, problem solving, experimenting, prototyping, and testing to bring a myriad of ideas into solutions to serve the customers needs.

Some 307 GRS personnel have amassed a total of 2434 patents during the century. Eight individuals have received more than fifty patents each: J.H.Auer, Jr. (93), C.S.Bushnell (98), O.S.Field (104), W.K.Howe (191), T.J.Judge (54), N.D.Preston (88), H.C.Sibley, Jr. (66), and S.N.Wight (92).

Electrical Laboratory at Taylor Signal Co. in Buffalo, NY (1900).

HISTORY OF PATENTS

ALSTOM Signaling Inc.
(formerly General Railway Signal)
Inventors and Number of Patents Issued

Abendroth K W	10
Albrighton R F	13
Alexander W C	1
Allen W P	1
Anderson R F	8
Andreasen C E	2
Appleman L	3
Archibald R E	1
Auer J H Jr.	93
Balcaen R G	1
Ballet H S	1
Ballet J B	2
Banner F H	3
Barker W M	15
Bechtold R H	2
Belanger E A	2
Benedict F	11
Bennett J	3
Birnbaum D	2
Blaisdell D	4
Blodgett E O	5
Bloechi L T	1
Bodde T	4
Bolton N A	24
Brady T W	2
Brammer D W	4
Branson E H	7
Brixner F W	20
Brockman L	8
Brown D	1
Brown N C L	29
Bryant S C	2
Buchanan J P	1
Buck R C	2
Burke J	2
Burnett J H	3
Bushnell C S	98
Butler W	2
Cade J T	1
Carroll E J	1
Carswell L G	1
Carter A T	8
Casper F T	2
Chappell C V	1
Christofferson C A	1
Churchill	1
Clarke G E	1
Clarke J A	1
Cloud W D	1
Coleman C W	3
Coley N B	39
Colwell C E	1
Conklin T A	1
Connell R	1
Conrad R	2
Cook R G	1
Craig F S	9
Craig R W	2
Craig C R	1
Cross R K	1
Curran J W	1
Daly F A	5
Dansbach D J	1
Dasburg A V	4
Davison G W	7
Day S M	20
Degen D S	1
DeKramer A T	5
DeLong C I	1
DeLong D F	7
DePalma J A	1
Dicke O H	29
Dinger R W	3
DiPaola J J	4
Dodge L E	4
Dodgson F L	37
Dorschel C H	1
Drake C	1
Dryden G H	1
Dudley S W	1
Duffy G E Sr.	5
Durand P H	1
Eblovi R	2
Eggebrecht C	3
Estwick C F	9
Fairbanks E B	2
Ferm G O	9
Field O S	104
Fodge A J	1
Ford H C	2
Freehafer J E	4
Freeman S W	6
Frelinghaus K H	28
Garber A R	1
Geer M F	9
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George F	1
Griffith L	2
Groce G H	1
Hagen R A	5
Hagenbach G O	1
Hager M	4
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Hall F N	3
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Hartung R M	2
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Henry W S	22
Hentz R	1
Hewes R W	19
Heydweiller J	1
Heywood T	1
Hitchcock F B	31
Hochman R	1
Hoelscher J R	5
Hoff M E Jr	2
Holt J	1
Hoppe W H	10
Hormats M	2
Hoven M H	1
Howard J Y	7
Howe W K	191
Huffman J P	16
Hughson J D	25
Ilenberg C J	2
Jachino C	1
Jackson A J Jr.	1
Jackson C T	3
Jacobus J J	3
Johanek G J	5
Johnson S G	1
Judge T J	54
Karet J G	1
Kempster E B Jr.	4
Kendall H C	27
Knapp J W	3
Kovaldik V P	6
Kubala R	1
Kunde D A	1
Kure L J	1
LaForest J P	3
Lager E P	1
Langdon A	
Langdon J Lawrence	1
Langdon J LeDoit	1
LaPola A	1
Larry E	
Lavoie S D	1
Layton C E	1
Leaf W B	1
Leake R C	
Linde J C	
Lisuzzo F C	1
Little R J	8
Livingston W L	9
Lizzard	1
Locke W C	1
Luhrs A G	1
Lundy B A	1
Lucarelli A V Sr.	1
Macano S J	4
Mackey S J	6
Macomber W	7
Maderer G G	1
Maenpaa W K	7
Mannell L G	1
Marpe T P	1
Marsh D B	3
Marsh G E	6
Matthews W J	6
Maynard W D	15
McCauley D R	5
Merkel J F	
Mersereau D W	4
Moore E W	
Morcom T H	2
Morgan W V	2
Morse C W	4
Murphy D J	1
Murray J R	1
Nilson F C	2
O'Brien J C	13
O'Neil J	1
Ober H P	5
Ohriau H	1
Orpin L H	3
Osborne J L	3
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Paul J N	3
Pearce H J	3
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Plank R	4
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Polsky L M	1
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Porteous C F	1
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Post E K	1
Post H B	1
Powell W T	25
Prescott C W	12
Preston N D	88
Pulverenti J	1
Rees F X	21
Refick R J	1
Reich S	5
Reichard W H	42
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Rekers G	5
Renshaw A H	2
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Rice W B	1
Richmond C A	3
Rossell J	1
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Ross O A	6
Rudd	1
Rusik J H	2
Rutherford D B	5
Saint S P	3
Salmon W W	12
Sarvey J L	1
Scheg M A	18
Schumann L W	1
Schwab C E	1
Schwarz P D	4
Sexton E F Jr.	1
Shahbaz Z	1
Shook C G	2
Sibley H C Jr.	66
Simmen P J	4
Simmen P S	1
Sluis M H	1
Smith B L	6
Smith E K	1
Smith J H	2
Smith P W	8
Smith R R	1
Smith W R	35
Snell A J	6
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Soule R M Jr.	2
Springett I R	1
Stafford C F	4
Stephenson J E	17
Stevens O E	3
Stevenson C E	1
Stillman N A	1
Stright B M	1
Sutton P	1
Swane P H	2
Swanton C L	8
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Taft B	1
Taylor H B	20
Taylor J D	6
Thomson A G	1
Towey M	1
Townsend F	10
Townsend J J	1
Turner D E	2
Twitchell C M	3
Vande Sande G	10
VanWormer R P	2
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Vineall E G	1
Waldron L F	2
Walley E D	1
Webster O B	1
Wells R F	7
Wenholz W W	12
West J F	1
Wetmore A W	6
Whitehorn A R	5
Wiskon H	1
Wiegand F B	1
Wight I W	1
Wight S N	92
Wilcox C S	15
Williams R E	1
Williamson E B	2
Willging E	26
Wilson G H	4
Wolfe R J	2
Workman W H	1
Wormsbecher R P	1
Wrege W R	4
Wuerpel M	4
Wynn H S	8
Young S M	12
Zaffarano F P	5

Development Department at GRS (1910).

Electronics Laboratory at GRS (1962).

Electronics Laboratory at GRS (1952).

Electronics Laboratory at ALSTOM Signaling Inc. (2004).

Electronics Laboratory at GRS (1962).

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100 YEARS

ALSTOM

ALSTOM Signaling Inc. - 1025 John Street - West Henrietta, NY 14586 (USA)
Tel.: (585) 783-2000 - Fax: (585) 274-8777 - www.alstomsignalingsolutions.com

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