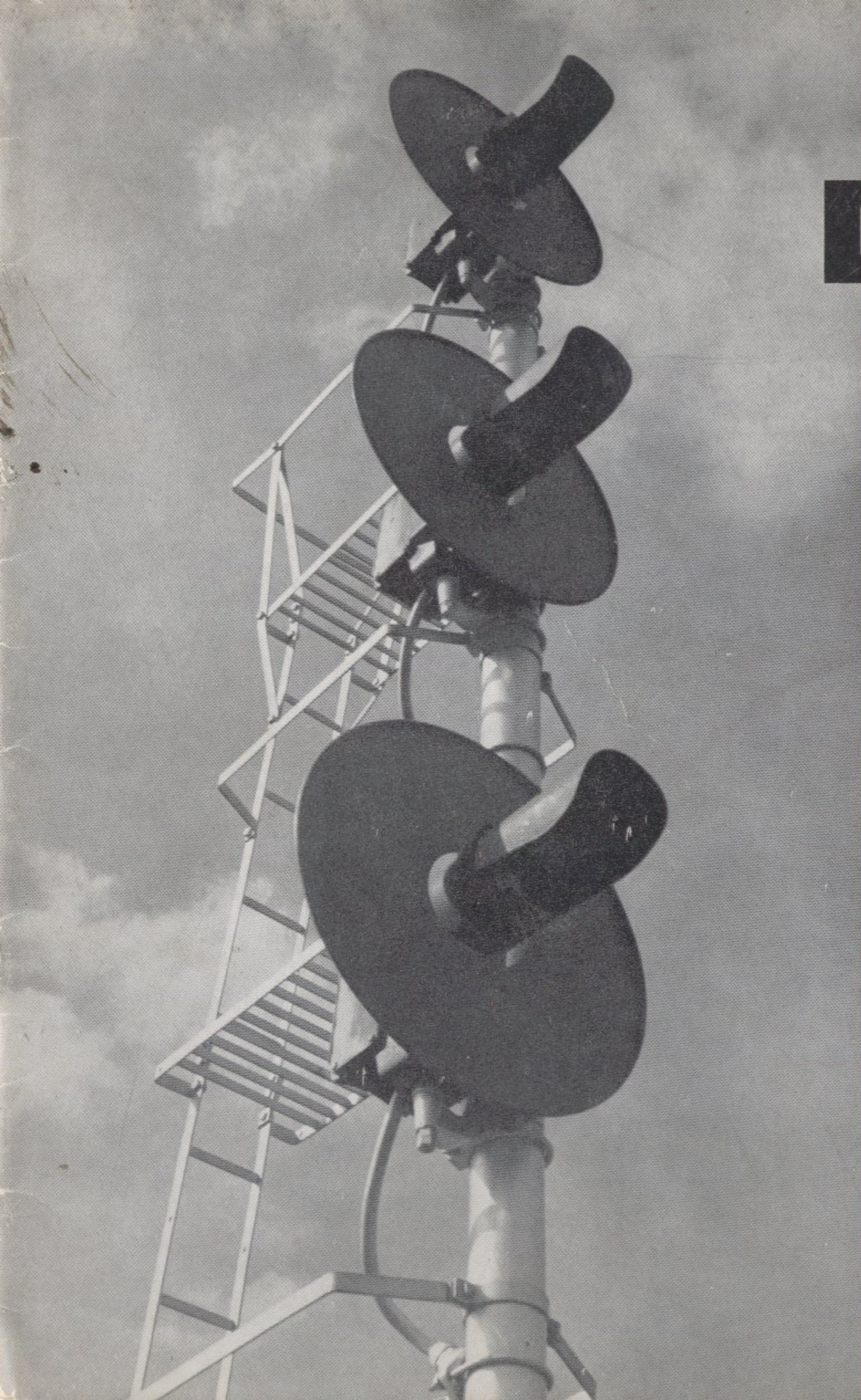
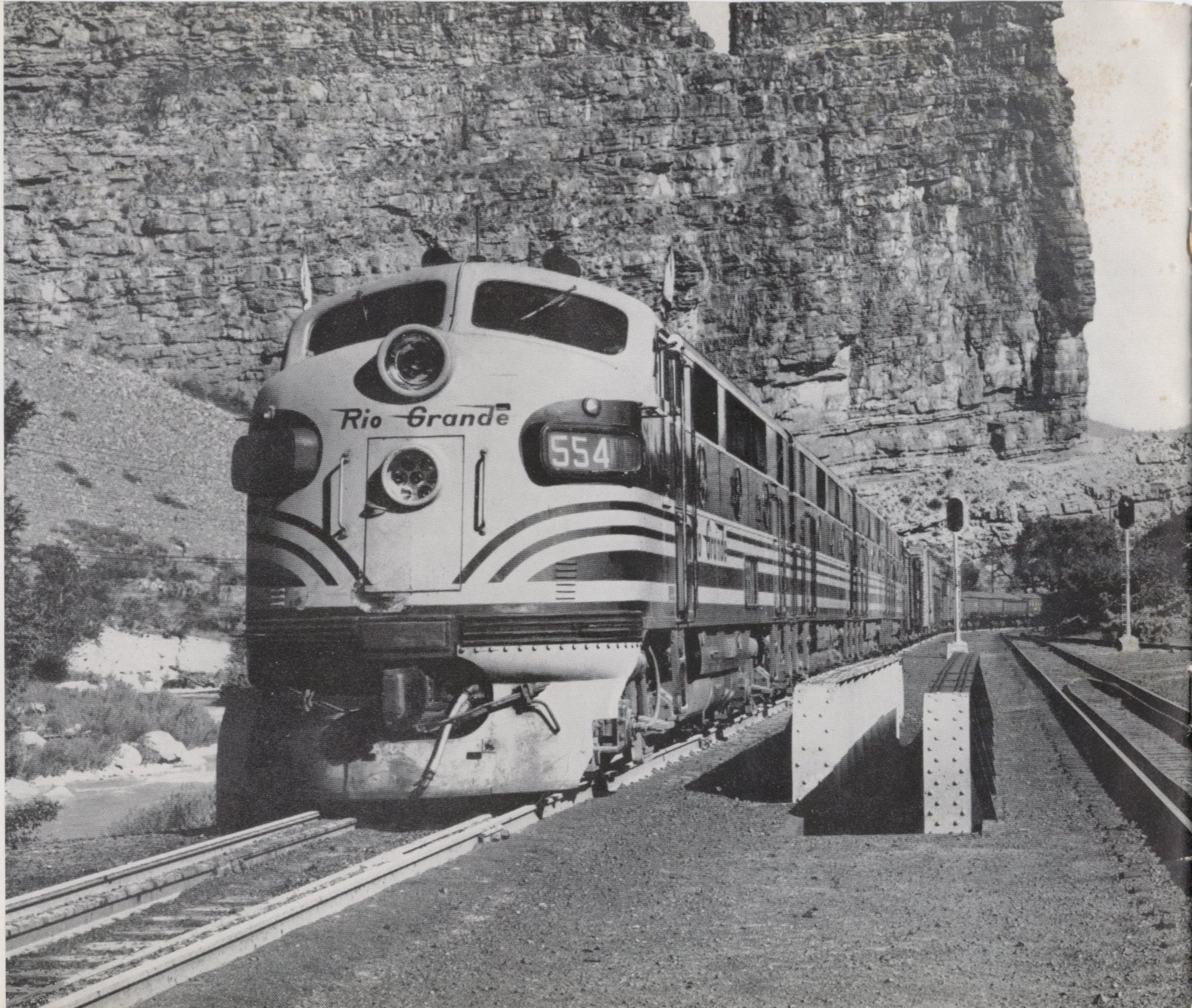


RAILWAY SIGNAL ENGINEERING

A challenging profession for electrical and mechanical engineers

GENERAL RAILWAY SIGNAL COMPANY


Rio Grande
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Our Place in the Railroad World

THE GENERAL RAILWAY SIGNAL COMPANY is located on the main line of the New York Central Railroad at 801 West Avenue in Rochester, New York.

The Company manufactures railway signaling and communication systems and appliances. It is one of the largest railway signal manufacturing companies in the United States. Normal employment ranges between 1500 and 2000.

This publication will show you, in brief outline, the history, the purpose, and the principal systems of railway signaling. But there is another aspect of this profession that words and pictures cannot properly describe—the infinite variety, the challenge, the sense of worthwhile achievement that this profession offers.

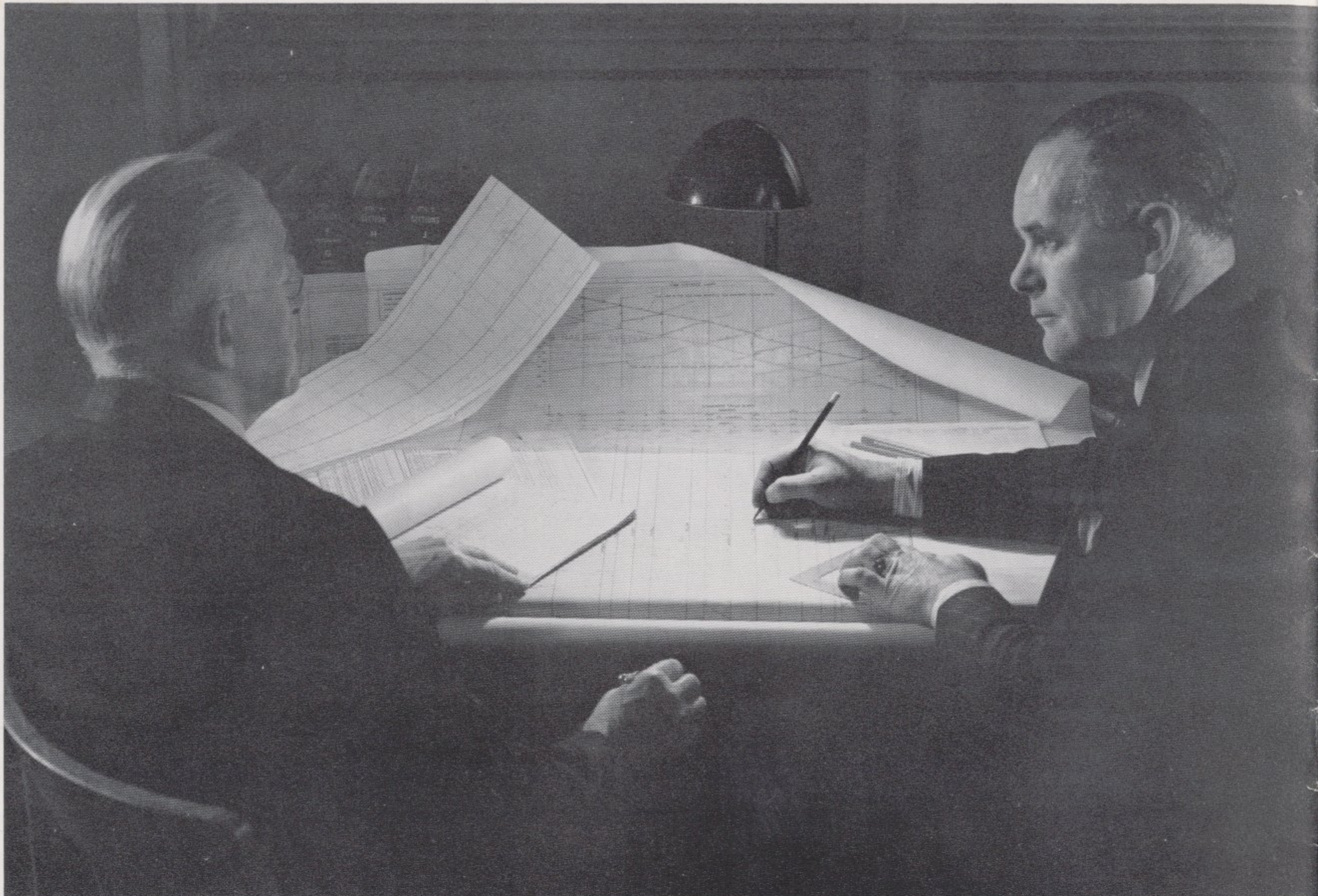
G-R-S automatic block signals protect this Rio Grande freight on its way through the towering grandeur of Castle Gate, Utah.

Railroads are essential elements in the life of progressive countries, molding themselves to the hills, the valleys, the plains, and the streams. They carry people and products of forests, farms, mines, and mills in a vital, never-ending stream that is the very lifeblood of a nation's economy.

Each railroad, each subdivision of a big railroad, assumes in part the character of the people and the land that it serves. Thus each part differs from the whole. Each signaling installation is a fresh challenge to the skill, the ingenuity, the creative imagination of the signal engineer. Working with principles and appliances proved in years of service, he adapts each system to individual installations so that the particular requirements of each installation on each railroad shall be met to the fullest degree. Such is the job of the signal engineer.

G-R-S signals help the Canadian National haul heavy tonnage safely, swiftly, on schedule.

G-R-S engineers, skilled in train operation, study actual traffic patterns when designing signaling fitted to the needs of a particular railroad.



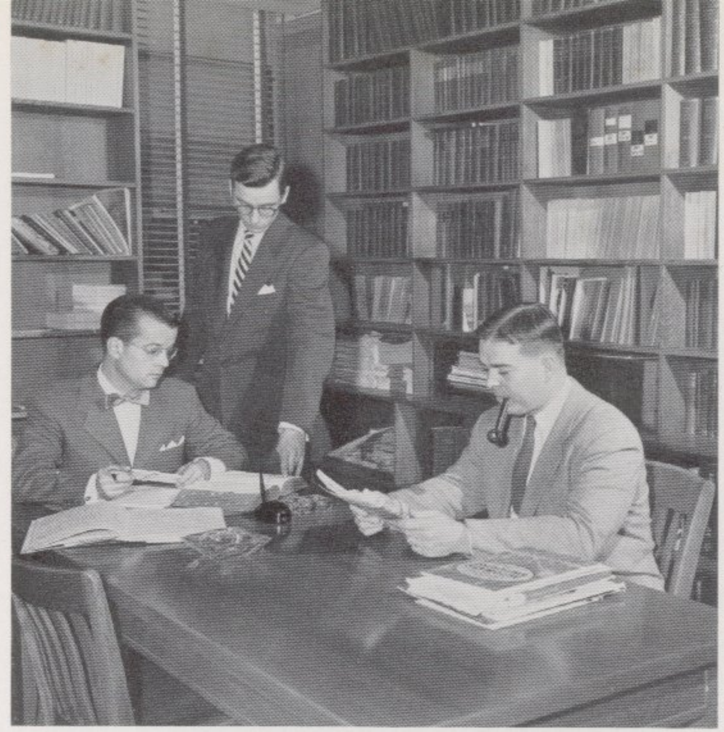
Railway Signal Engineers

EVERY industry, large or small, depends upon its engineers for progress through research and development. The General Railway Signal Company employs a large engineering staff as compared with its total working force.

The various parts or devices used in railway signaling systems are developed by the development engineer. He is constantly improving the design and operation of devices now in use, as well as developing new apparatus.

The planning of a railway signal system requires extensive electrical circuit design. The application of circuits varies with each new installation of a particular system. The circuit engineer applies the devices and apparatus developed by the mechanical and electrical engineers.

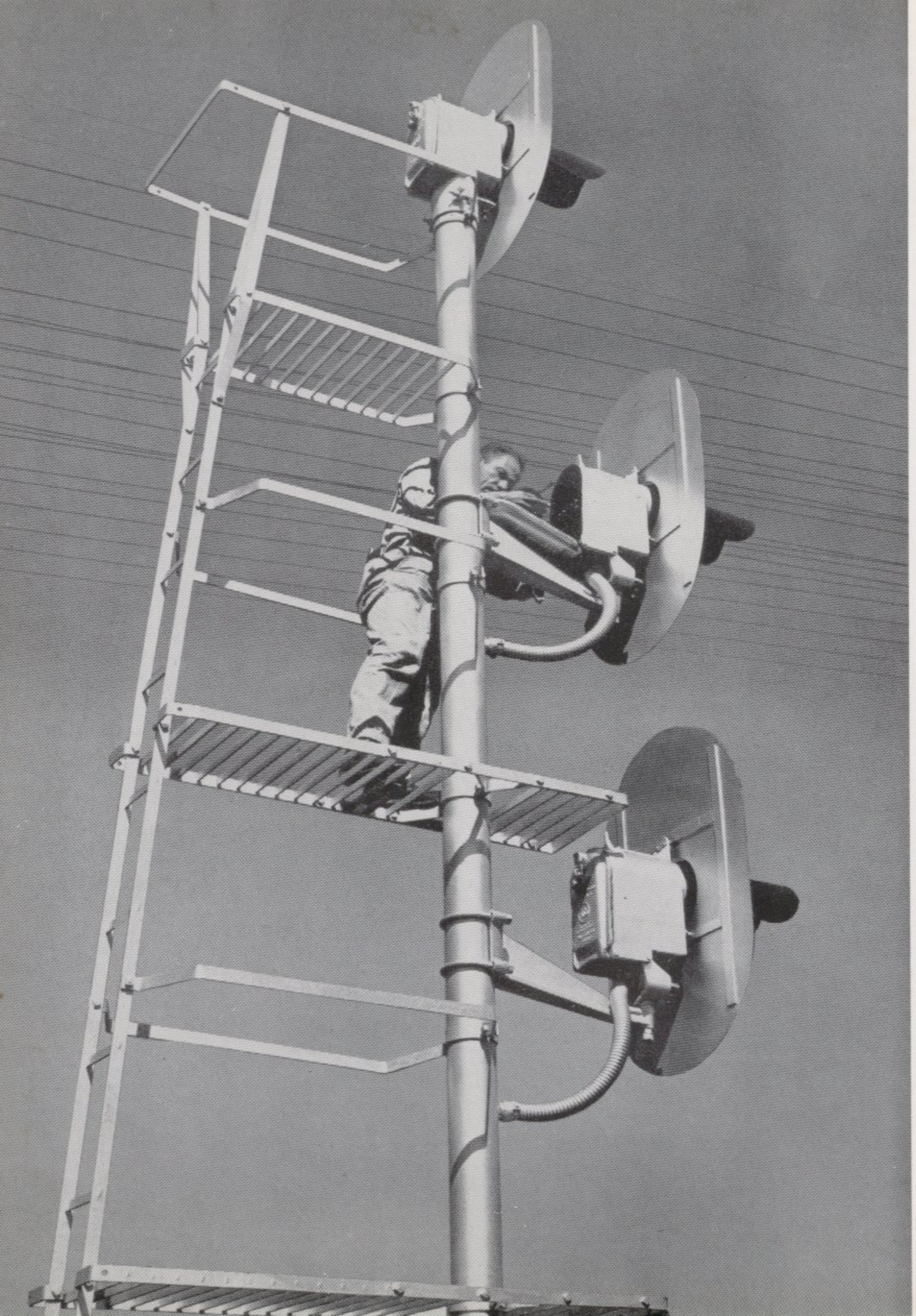
If a new engineer so desires, and the opportunity presents itself, he can gain valuable experience by assisting in the installation of a signaling system on a railroad.



A technical library is available to all G-R-S engineers.

On occasion, engineers trained in our Company are offered important positions, as in the signal departments of railroads. In this manner our Company is able to help the railroads by furnishing them with men who have practical knowledge and experience in railway signaling.

Circuit engineers, because of their training and experience, are sometimes selected as our sales engineers.



The Need for Railway Signaling

IN 1830, the Baltimore and Ohio, the first 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 since 1930 discloses two significant facts of special importance to the new engineer. Although railroad construction received a 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 1949, it was reduced to 376,108 miles, although operating efficiency, as expressed in gross ton-miles per freight train-hour, doubled during this 19-year period.

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

G-R-S color-light signals are used all over the world. Here a Chicago and Northwestern signalman is inspecting one of the units.

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;

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.

Railway signaling, therefore, is a relatively new field and is looking for young engineers to help further its research and development.

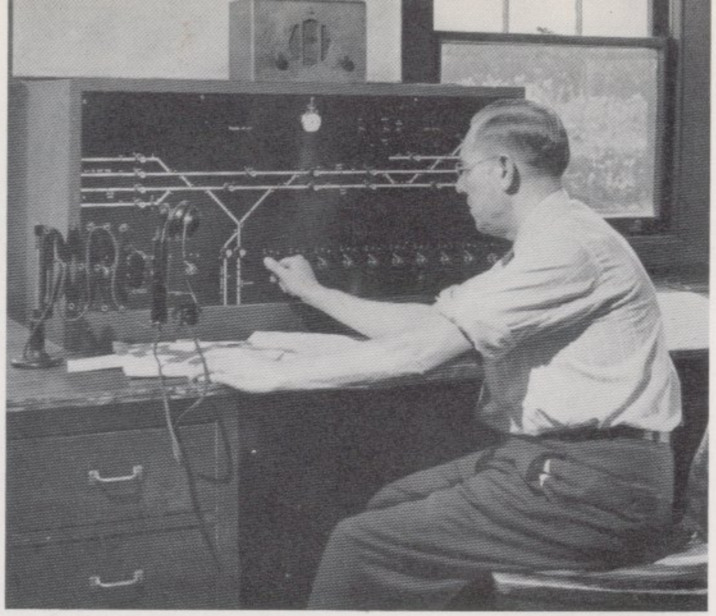
The Boston and Maine uses modern signaling to operate efficiently in difficult mountain country.

Railway Signaling Systems

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 principal railway signaling systems are described on the following pages.



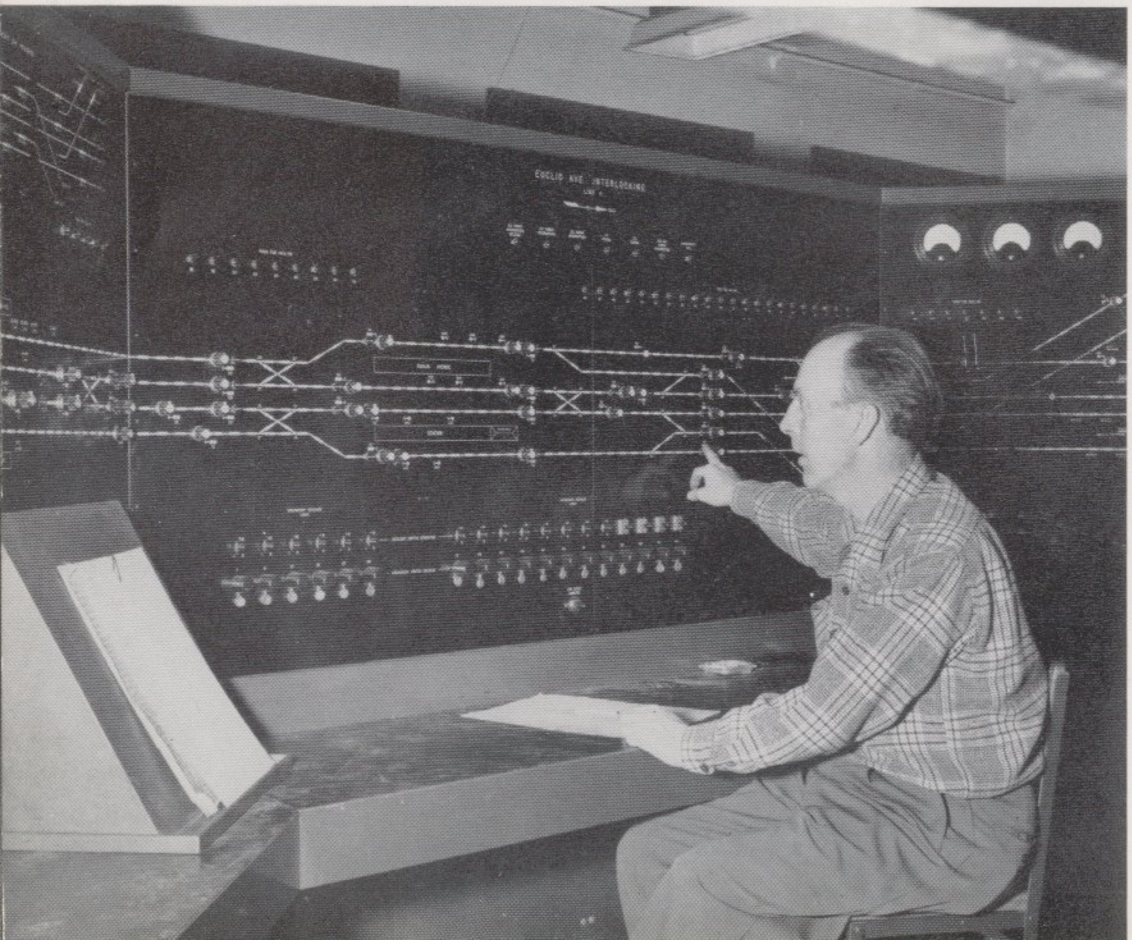
The operator positions a switch lever on a relay interlocking control machine at Niagara Junction, New York, on the Lehigh Valley Railroad.

Relay Interlocking

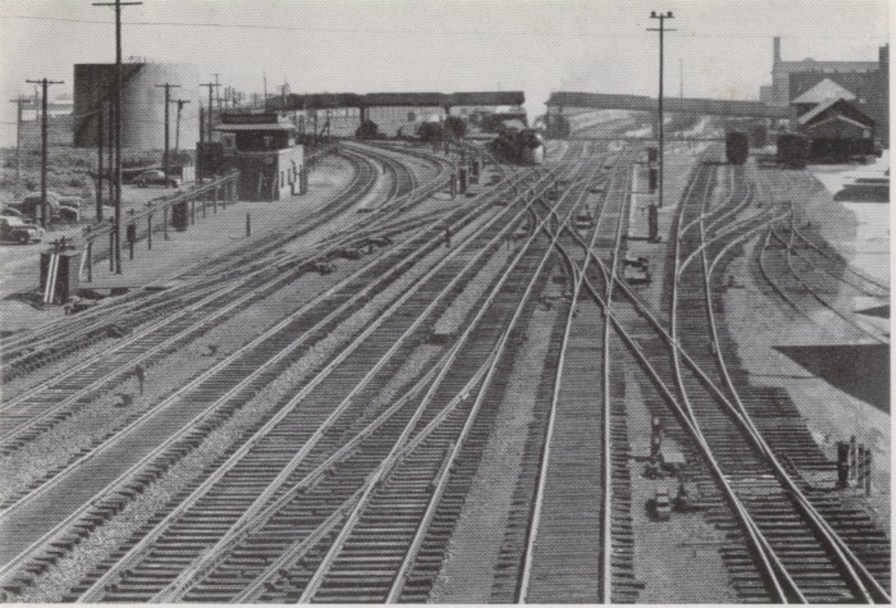
Relay interlocking is a system which controls a number of interrelated switches and signals to set up various routes for the movements of trains through terminals, junctions, grade crossings, and over drawbridges.

Miniature levers control, by means of relays, their respective track switches and wayside signals.

There are two types of relay interlocking, both developed by G-R-S. With entrance-exit (NX) interlocking, the control machine operator can set up a complete route through even the most complicated maze of switches and signals by two simple finger-tip manipulations of pushbuttons on his control panel. He pushes a button on his track model at the point where the train is to enter the plant. Then he presses a button on his track model at the point where the train is to leave the plant. Immediately, powerful electric switch machines line up the proper switches. When the



The operator presses the exit button on a large relay interlocking control machine used in the subways by the Board of Transportation, City of New York.

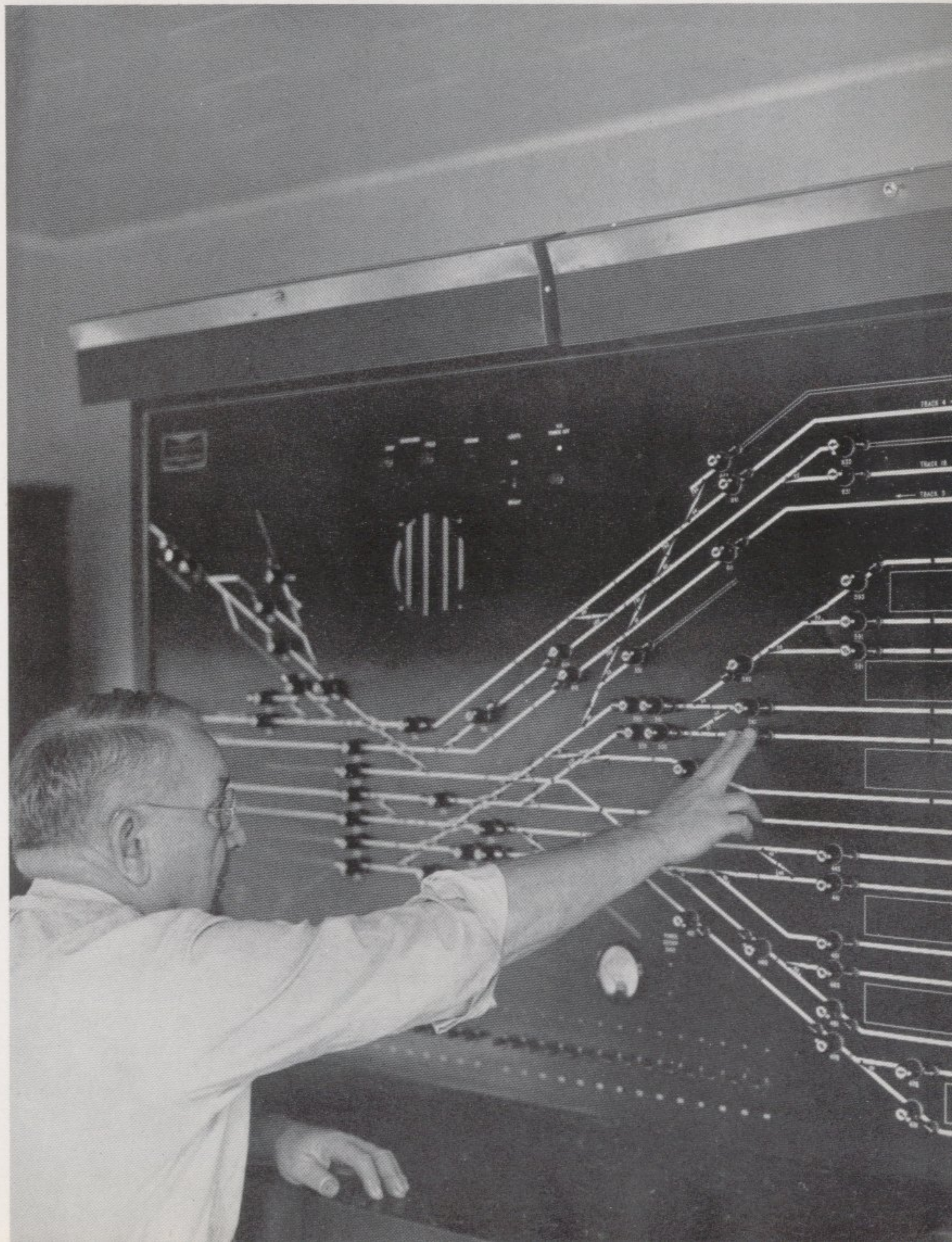


last switch is properly positioned, the signals show "Proceed," and the train can move through the interlocking, fully protected from any interference.

The individual-lever interlocking has individual levers for each switch and signal in an interlocking. To set up a route, the levers concerned are positioned individually.

NX interlocking is fast and best for handling large complicated plants, or plants where rapid route lineups are a necessity because of heavy traffic. Individual-lever interlocking is for small plants, or for large plants with light traffic.

By pushbutton manipulation, this operator lines a route through the NX interlocking at Utica (shown above), one of the busiest plants on the New York Central.



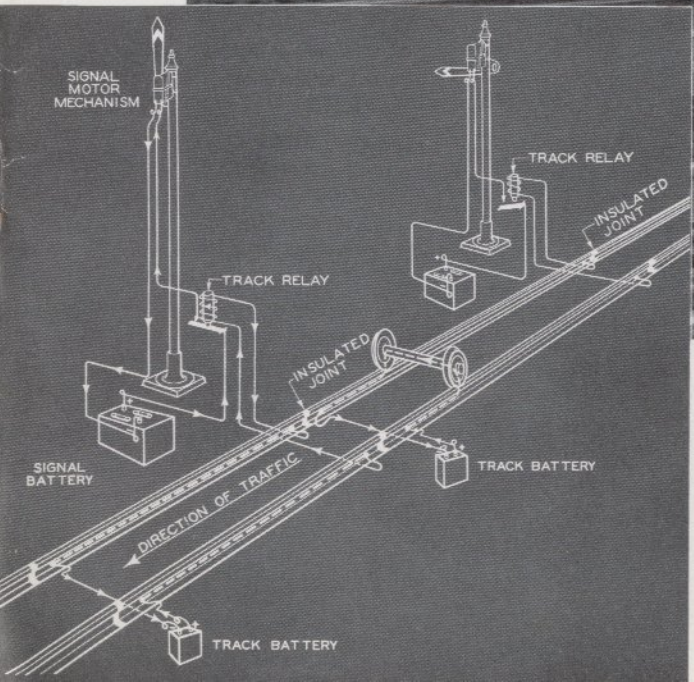
Block Signaling

A BLOCK, in railway terminology, is a length of track of defined limits over which the passage of trains is governed by block signals. A series of consecutive blocks constitutes a block signaling system. Signals placed along the right-of-way indicate to trainmen whether or not there is a train in the block ahead.

The primary purpose of block signaling is to reduce the collision hazard by providing a space interval between trains. The signals are controlled automatically by means of continuous electrical circuits carried by the track itself. Immediately after a train enters an unoccupied block, the electric current which has been controlling the circuits holding the signal in the "Proceed" position is shunted through the wheels and axles of the cars. The protecting signal then goes to the "Stop" position. Thus a following train will be warned that the block ahead is occupied.

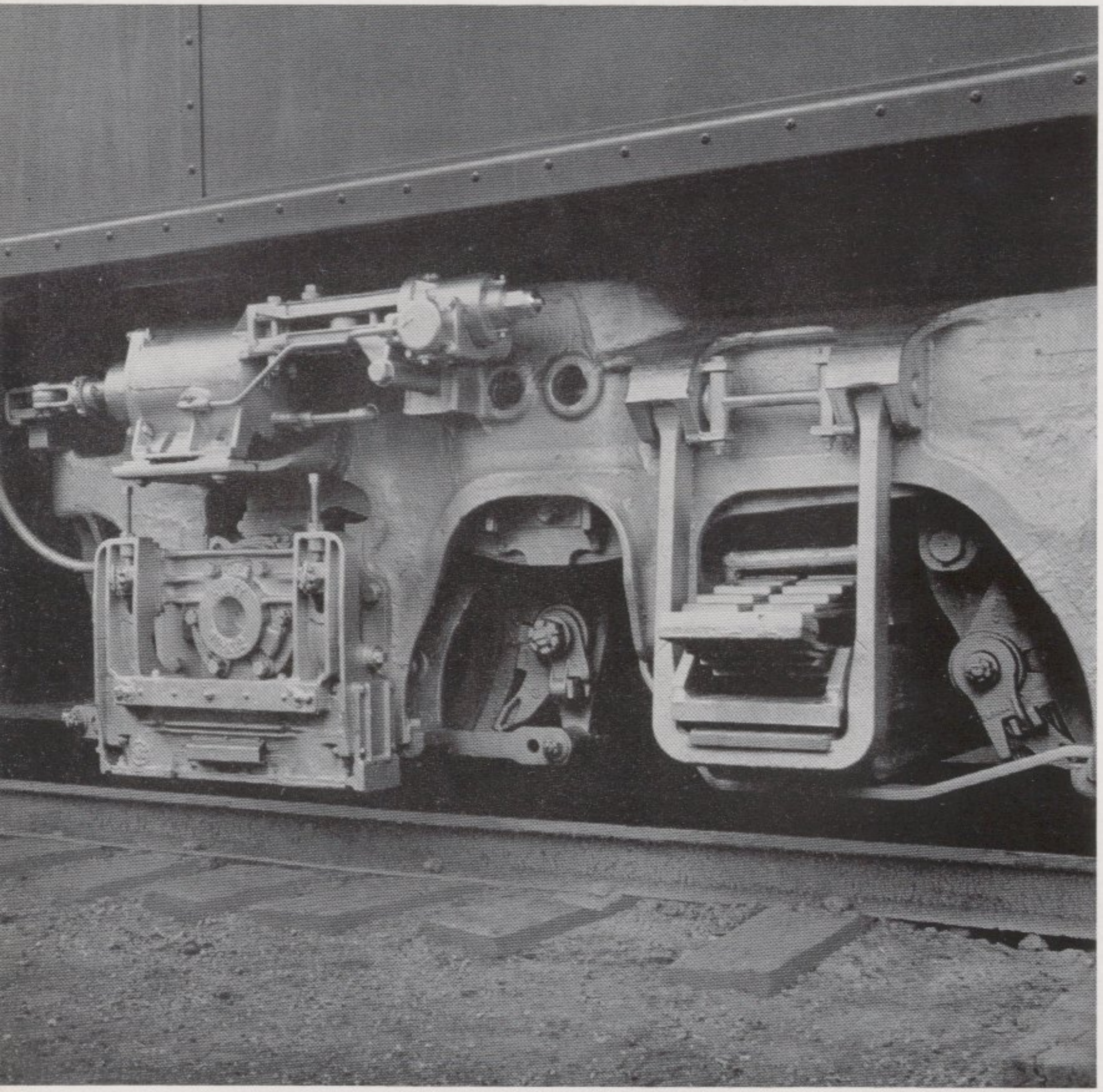
Advance warning is provided by having each stop signal preceded by a caution signal.

G-R-S color-light signals protect Canadian National trains on single track through the Canadian Rockies.



G-R-S automatic block signals and automatic train control permit safe, high-speed operation on this four-track New York Central mainline.

Diagrammatic illustration of the track circuit showing its use in automatic block signaling. The semaphore signal is being rapidly replaced by the modern color-light signal.



A receiver, shown here mounted on the truck of a Diesel-electric locomotive, establishes a link between the moving train and the wayside signaling circuits.

Automatic Train Control

AUTOMATIC train control systems are used to aid in the spacing and controlling of trains. They employ apparatus on the locomotive co-ordinated with apparatus along the wayside. Train control when effective only at certain definite points along the wayside is called "intermittent." When effective continually, it is termed "continuous." Usually the controlling points on the wayside are located just preceding the signals.

Train control in its simplest form acts to stop the train by an automatic application of the brakes when the wayside apparatus indicates that a stop is required. This stop control may be extended to include a speed control system, used to enforce maximum permissible speeds by applying the brakes when that speed is exceeded.

Audible or visual signals in the cab may also be a part of such a system to provide continuously in the cab the same information that would be supplied by wayside signals.

Above: There is no mechanical contact as the receiver passes over the inductor. Invisible magnetic linkages check whether all is clear ahead. Left: Each wayside inductor (shown here in foreground) stands ready to transmit a warning to passing trains if there is danger ahead.

Centralized Traffic Control

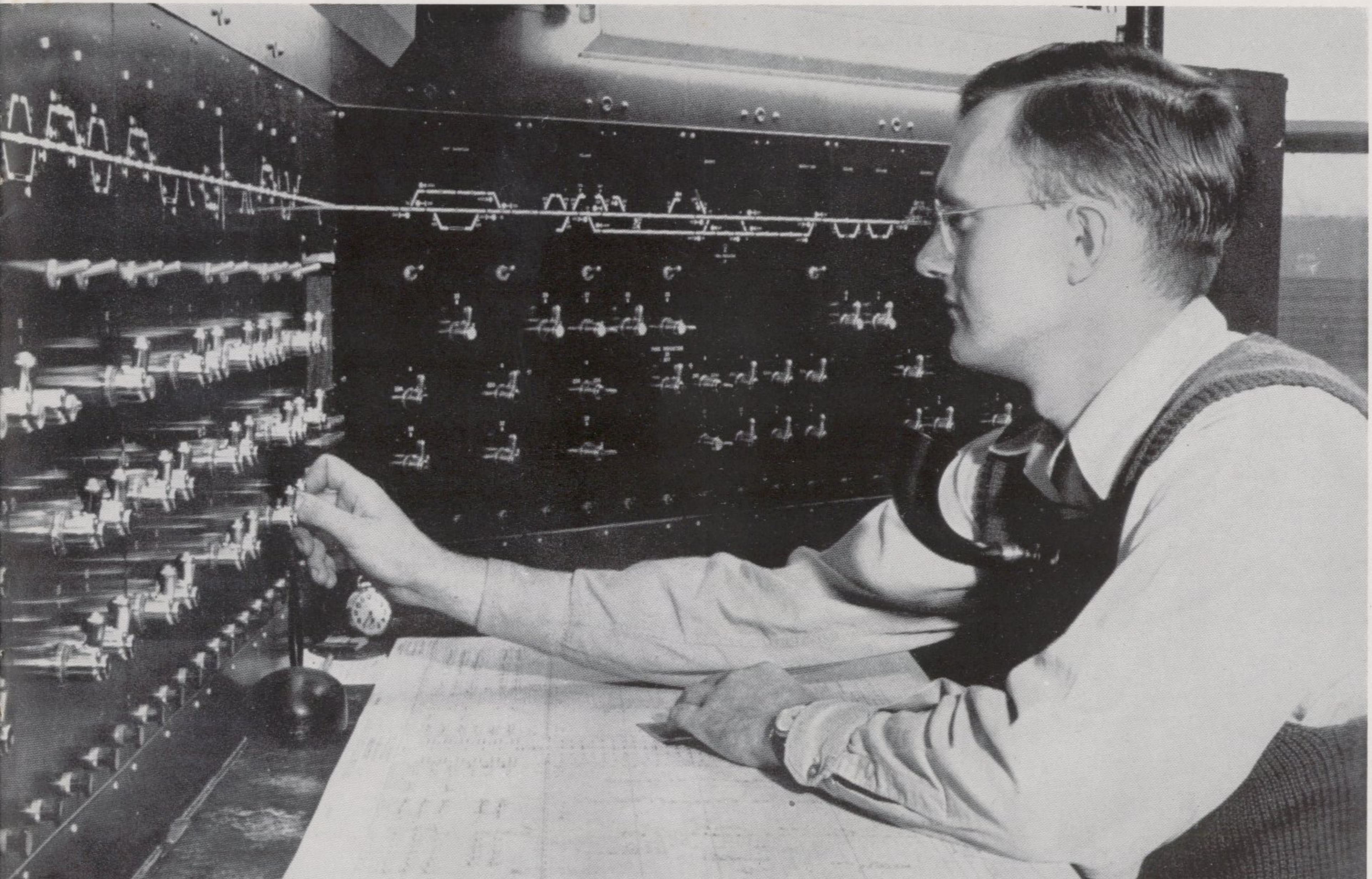
Centralized traffic control is a system which places the control of switches and signals on many miles of track directly in the hands of one operator. The system is so engineered that the operator cannot line up conflicting routes.

Centralized traffic control directs trains entirely by signal indications, thus abolishing written train orders, an older method of controlling traffic. Besides enabling the operator to position switches and control the aspect of signals electrically, the system informs the operator automatically, by visual and audible indications, of the whereabouts of all trains.

The purpose of centralized traffic control is to increase safety, reduce operating expenses, and improve train operation.

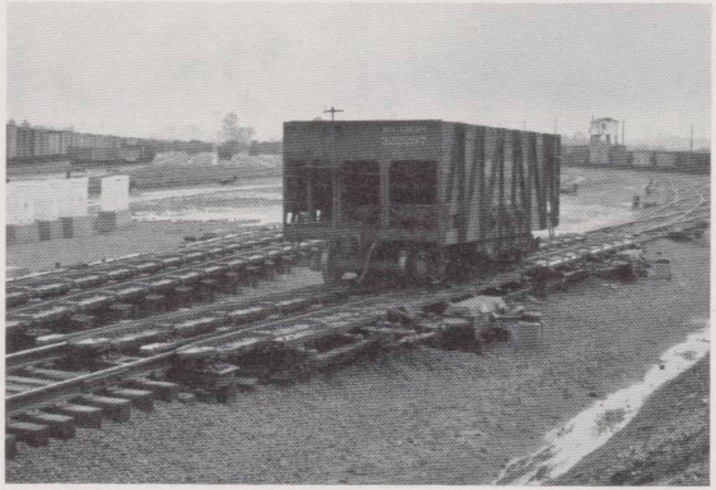
This system, developed by G-R-S, marked a distinct era in rail transportation. Since 1927, our Company has provided equipment for thousands of miles of cTc, as centralized traffic control is called.

Controlled from a distant tower, this signal is one of many that keep traffic flowing in a swift, orderly stream on the Boston and Maine.



This Chesapeake and Ohio operator can throw a switch or clear a signal many miles away. There's no stopping a train to throw switches in cTc territory.

Controlled by electric retarders, each car in Reading's Westbound Rutherford Yard rolls into its classification track at the proper speed.



Car Retarders and Automatic Switching

A CLASSIFICATION yard is used to receive trains, sort and classify the cars in these trains, and regroup them in other trains having different routes or destinations.

In modern classification yards, the string of cars to be classified is pushed up an artificial hill, or hump, as it is called. At the crest of the hump, the cars are uncoupled singly or in groups, as required by the classification. The cars then roll by gravity down the hump and into their proper classification tracks.

Some cars, of course, roll more easily than others and would accelerate to such speeds that they would collide with the cars already classified. Power-operated track brakes, called retarders, are located at intervals in the yard, and enable a towerman to control the car speeds.

John Sevier Yard at Knoxville, Tennessee, uses pushbutton routing to speed train makeup on the Southern.

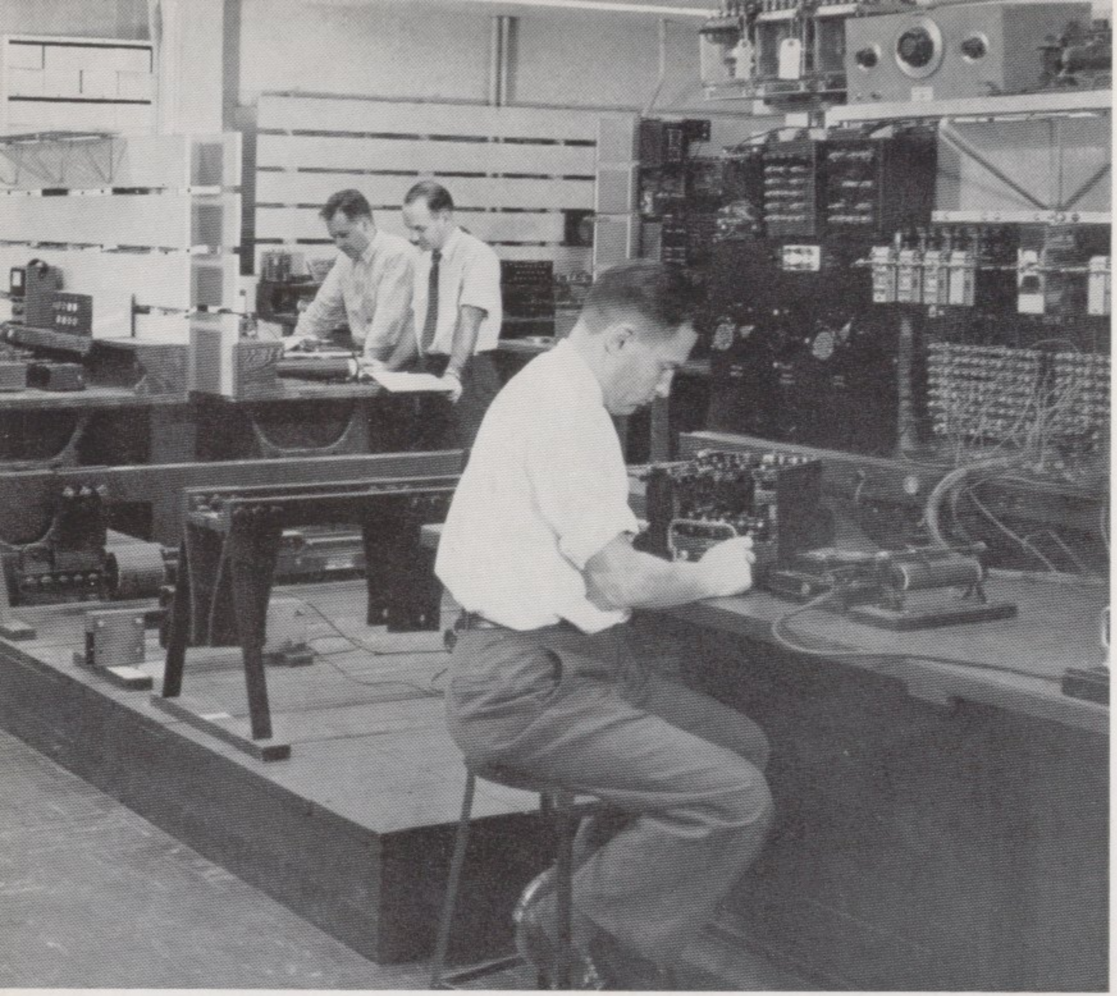
Retarder control machine, located in the tower; and the hump control machine, located in the hump office.

Electrically powered track switches are operated to route the cars to their proper classification tracks.

In large yards, automatic switching, a G-R-S development, positions the switches. This system automatically operates the switch machines by means of relayed coding circuits. The hump conductor merely pushes a numbered pushbutton at the hump, and a car is automatically routed to its proper classification track. Older systems necessitated individual alignment of each switch in a route, thus requiring additional towermen in large yards.

Car retarder systems decrease cost of car classification, increase the capacity of yards, reduce delays, reduce damage to cars and contents, and reduce injury to employees. Automatic switching makes it possible to operate even the largest yards with only one retarder operator—thus saving manpower and control towers.

In half a second, this electric switch machine can position the switch points to route the car to its classification track.



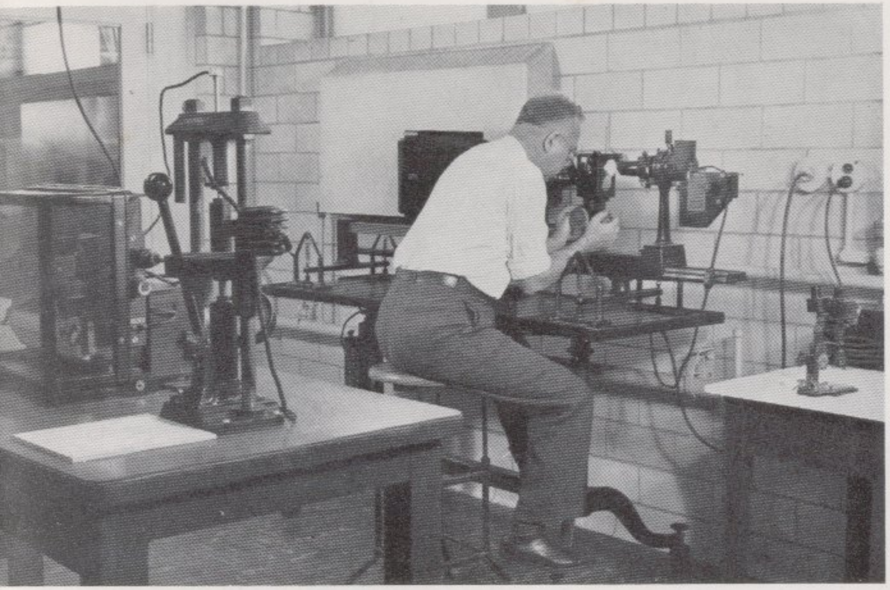
General Engineering Facilities

G-R-S has a modern engineering building in which research, development, and other engineering activities are contained under one roof. There are six principal laboratories in the building: chemical, metallurgical, physical, mechanical, electrical, and electronic. A substation in the basement supplies the laboratories with electrical energy of practically any voltage and frequency.

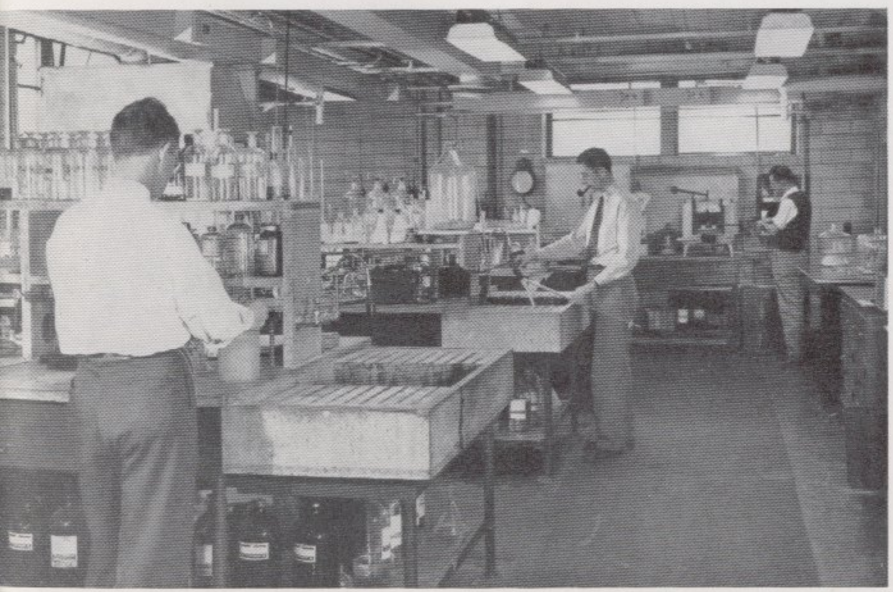
The building has 50,000 square feet of floor space and is completely air-conditioned.

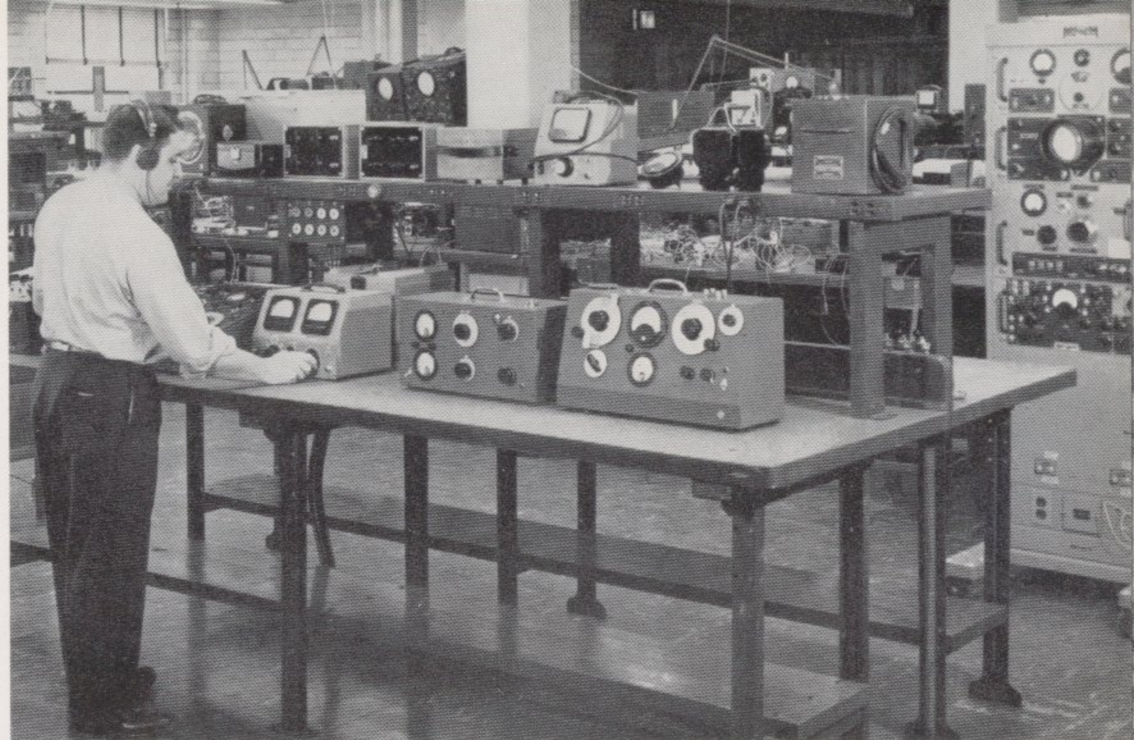
Electrical laboratory.

Engineering drafting.

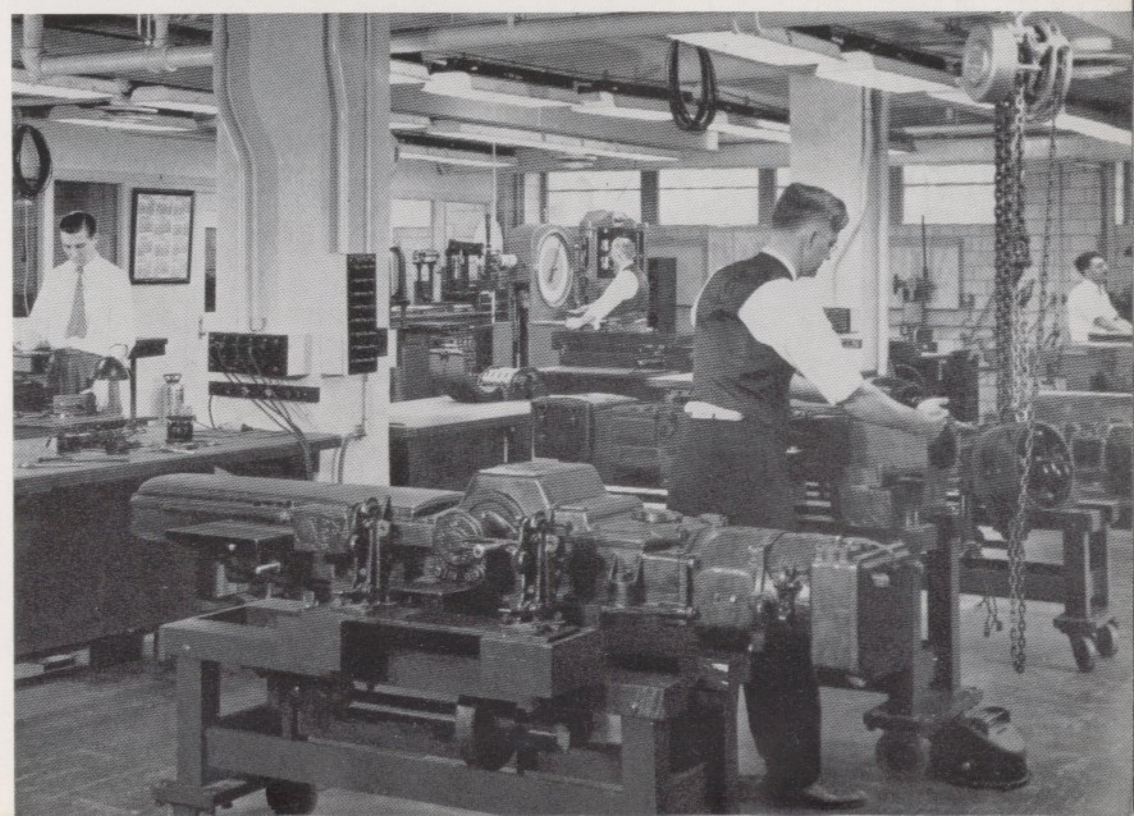


Above: Metallurgical laboratory. Below: Chemical laboratory.





Above: Electronic laboratory. Below: Physical and mechanical laboratories.



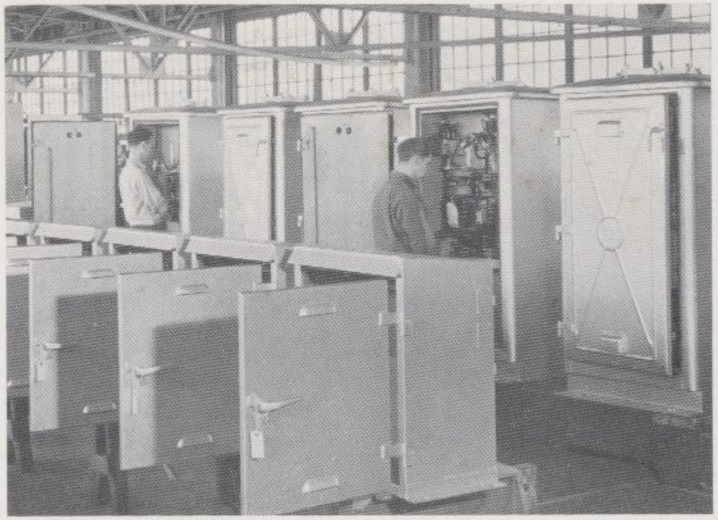
Circuit Engineering

Circuit engineering is a vital part of the railway signaling business. Factory production of a signaling system is dependent upon information furnished by the circuit engineers.

Circuit engineers work in small groups. Each group is trained to design all types of railway signaling circuits.

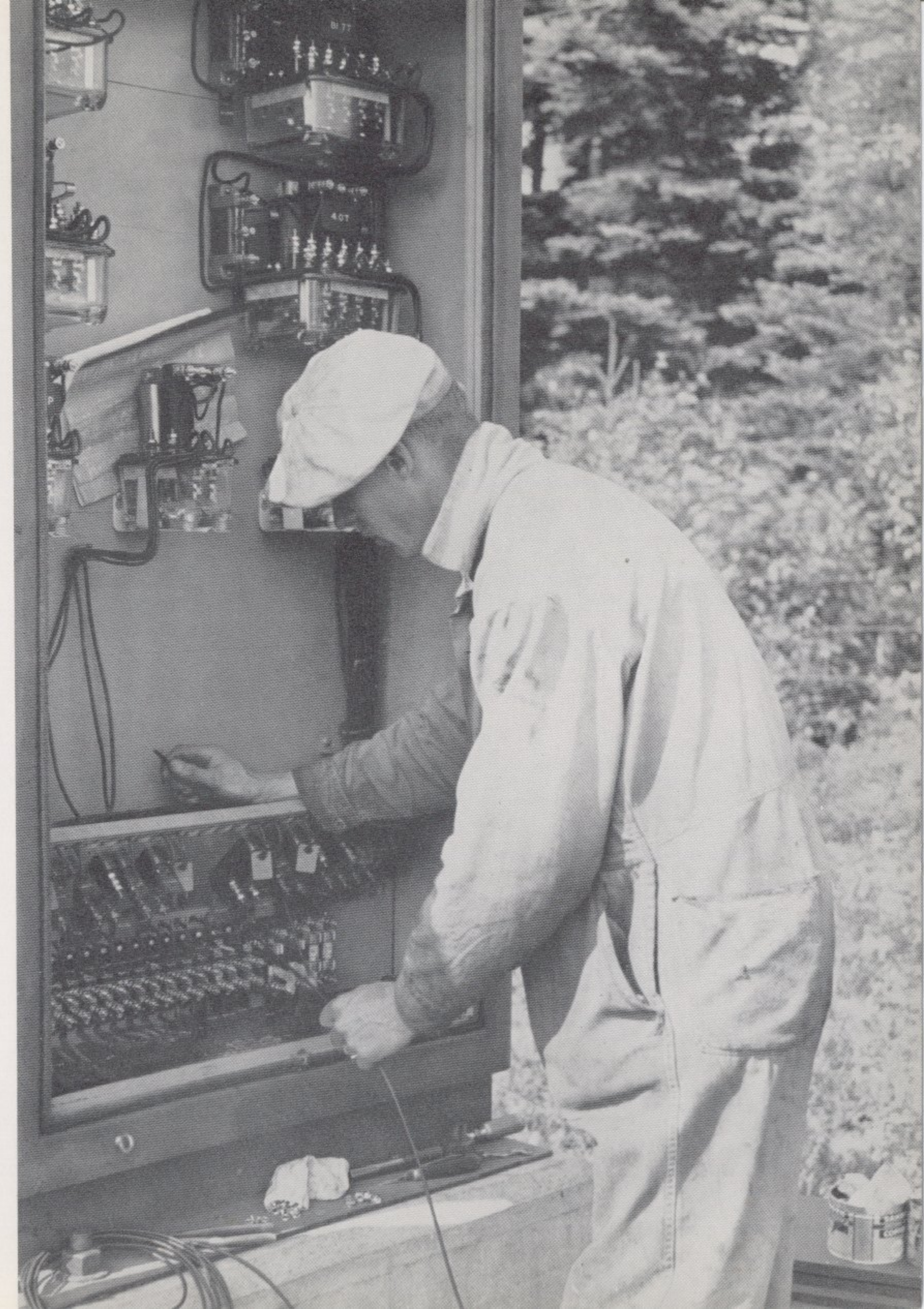
A circuit engineer has a working knowledge of signal apparatus and its use. He combines the apparatus into such systems as block signaling, interlocking, centralized traffic control, car retarders with automatic switching, and train control. He interprets railroad specifications, standards, and requirements in the design of these systems. He estimates and orders materials, and pretests the circuits in the factory before shipment. In some cases, the circuit engineer aids in the installation and field test of equipment on the railroad.

Working in small groups, circuit engineers design each system to the exacting requirements of the railroads we serve.



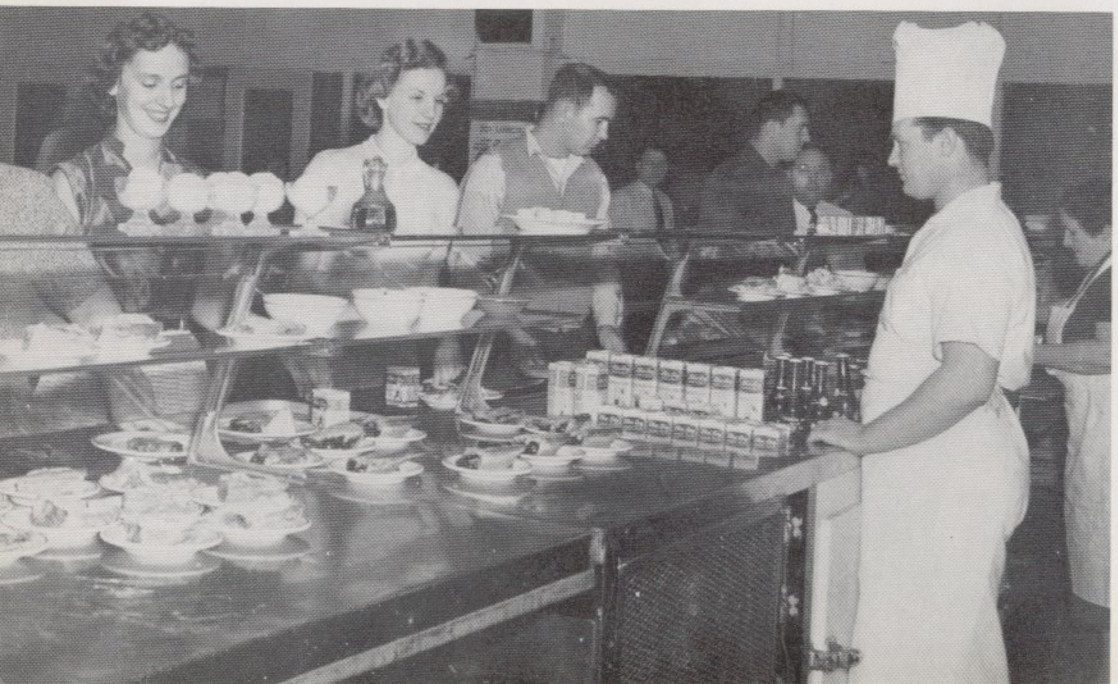
Following circuits designed by circuit engineers, these men are wiring instrument cases in our factory.
Each circuit is carefully checked by a separate group.

A G-R-S circuit engineer connecting field wires to an instrument case on the Canadian National Railway.



Well-equipped medical facilities are available to all employees.

Modern cafeteria offers good meals at cost.



A Good Place to Work

THE General Railway Signal Company, manufacturer of railway and communications systems and appliances, was incorporated in 1904 under the laws of the State of New York, acquiring the business of the Taylor Signal Company, located in Buffalo, and that of the Pneumatic Signal Company, at Rochester. In 1924, G-R-S acquired the assets of the Federal Signal Company, in Albany, New York.

The original plant of the Taylor Signal Company was a two-story building providing 10,000 square feet of floor space. The present plant facilities of G-R-S cover 28 acres and occupy about one million square feet of floor space.

EMPLOYEE BENEFITS

All of the employees at the General Railway Signal Company share in the many benefits which are available. The benefits include: two weeks' paid vacation after one year of employment and three weeks' paid vacation after ten years of employment; six paid holidays per year; a cafeteria serving a wide selection at nominal prices; medical care; convenient bus transportation, and free parking facilities.

A complete group plan, including life, disability, medical, surgical, and hospitalization insurance, is available at group rates. Hospitalization, medical, and surgical benefits under this plan also apply to dependents of the enrolled employee. Sixty percent of the cost of this insurance is paid by our Company. A retirement plan is also available in which the cost is shared by our Company and our employees.

EMPLOYEE EDUCATION

The new engineer is trained on the job in the various methods utilized by our Company in the specialized field of railway signaling. His ability to learn and progress is the basis for his promotion.

The city of Rochester has two educational institutions in which the new engineer can further his education, if he so desires. The Rochester Institute of Technology has a wide variety of undergraduate courses in evening school sessions. Graduate work towards higher degrees can be secured through extension courses in the evening school at the University of Rochester.

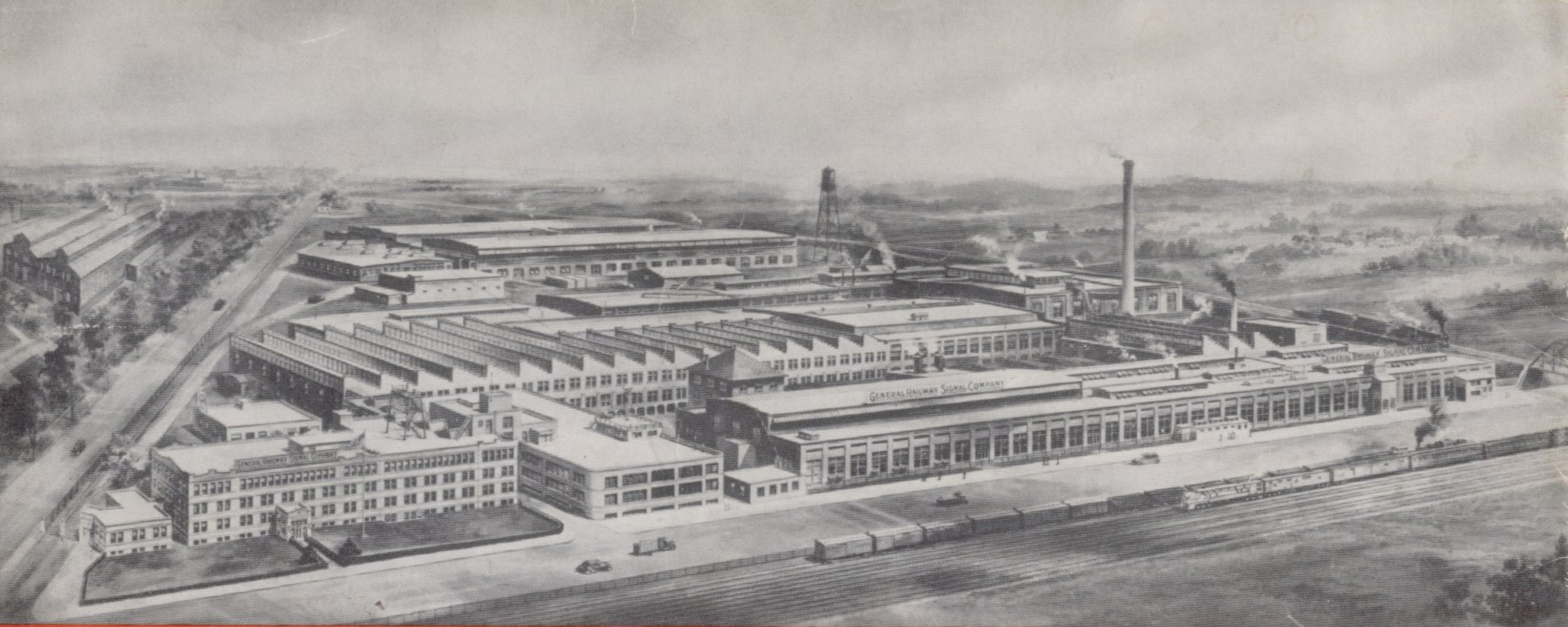
OPPORTUNITIES

Railway signaling, long a vital part of our great railroads, is becoming increasingly important. Currently, G-R-S is seeking men who can qualify as circuit, production, and development engineers.

Our Company pays a better than average wage for beginners in engineering. Salary increases are based on a merit system. All positions have been carefully classified, and each man is advanced as his abilities and responsibilities increase.

FOR DETAILS about opportunities for you at G-R-S, write: Employment Manager, General Railway Signal Company, P.O. Box 600, Rochester 2, New York—or telephone us at GEnesee 1483.

Special in-plant training courses include field trips to G-R-S installations.



Rochester Office and Main Plant

Established 1904

GENERAL RAILWAY SIGNAL COMPANY

P. O. BOX 600, ROCHESTER 2, NEW YORK

DISTRICT OFFICES IN NEW YORK CITY, CHICAGO, AND ST. LOUIS

Associated Companies or Representatives in Argentina, Brazil, Chile, Colombia, Mexico, Uruguay, Venezuela, England, France, Italy, Netherlands, Spain, Federated Malay States, India, Pakistan, South Africa, Australia, New Zealand, and other countries.

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PRINTED IN U. S. A.