

THE STEEL RAIL and the FLANGED WHEEL

The steel rail and the flanged wheel are the common denominator of all railroads. Improve them and you improve all railroading — whether for the fast passenger streamliner, or for the heavy freight. The University of Illinois, through its research, has improved them. And it continues to improve them, and to study other problems fundamental to railroad progress.

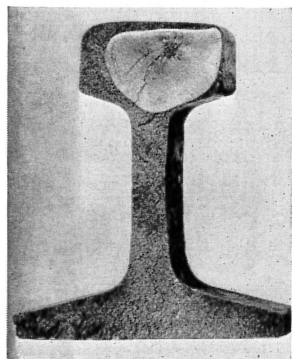
An important railroading date is 1891, when Professor Arthur Newell Talbot of the University designed the first spiral for easing curves — so that trains would gradually increase the amount of turn, instead of whipping sharply around them.

Professor Talbot headed the American Railway Engineering Association committee for research on stresses of railway track for 27 years. Laboratory work was done at the University, and field work was done along the railroads. The project is a classic example of engineering research. And results from the project have reduced costs, and have provided better and smoother pathways for faster and heavier trains. They have also helped build better locomotives.

The work goes on today. By now, for example, the Engineering Experiment Station at the University has published 53 bulletins and circulars on specific research in the railway field.

RESEARCH IN RAILROAD RAILS began at Illinois in 1931 under Prof. H. F. Moore, who as far back as 1927 had investigated fatigue cracks in railway car axles. The problem in 1931 was that of rail breakage, which had been increasing for two decades and had reached the total of 12,000 rails a year on the lines of the United States and Canada.

Scientists at the University found that the breaks started in microscopic "shatter cracks" hidden inside the rail head. They found that the shatter cracks resulted from uneven cooling when the rails were made. From this finding, they developed what is called "controlled cooling" of the freshly-rolled rails. Not a single rail of the millions of tons which have since been made in that way has failed from a shatter crack!



Broken rail, showing internal flow

This one finding alone has saved many lives and millions of dollars. The rail research project has gone on to study other problems of rails.



Illinois research on flanged wheels goes on

RESEARCH IN RAILWAY CAR WHEELS began at Illinois in 1915. One result of the work was complete redesign of the chilled iron freight car wheel of 1928 to the standard single-plate type.

Along with the study of wheels has been the study of brakes. Railway car wheels and brakes work together. The brake shoes press directly against the wheel tread to slow or stop the train, and the wheels of a train being eased down a long grade may become red hot. Sometimes the heat may actually weld brake shoe metal onto the wheel.

This heating, which may be uneven and from which the wheels may cool unevenly because of different thickness of metal in various parts, is one of the problems which have been studied at Illinois. Another problem has been that of making the brakes themselves better. Such University findings have been incorporated in railway practice, but the research always goes ahead to plan for the future.

They've grown together . . .

Railroads and the University of Illinois have grown up together. When the University opened in 1868, only 20 years had passed since the first locomotive ran out of Chicago. The famous "golden spike" had not yet linked the two ends of the first railroad line across the United States.

University of Illinois graduates have become railroad builders and leaders since the first professor walked into a classroom. Today you can find them among railroad workers and railroad presidents, among executives and engineers and specialists.

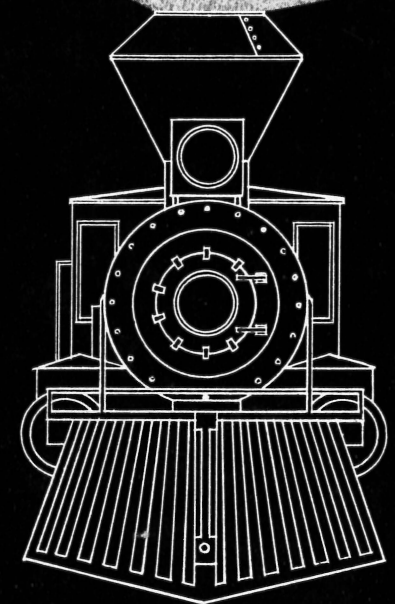
The University has gone along with the growth of railroads in the United States in three ways . . .

● **IN EDUCATION** More than 200,000 people have studied at the University of Illinois since it opened in 1868, and now more than 38,000 are studying there every year. Many of the courses, not only in Railway Engineering, but also in all the fields of human endeavor, have contributed educated people to railroading. And many of those who aren't in railroading itself are in industries (such as the soybean industry) which provide traffic to keep the railroads going.

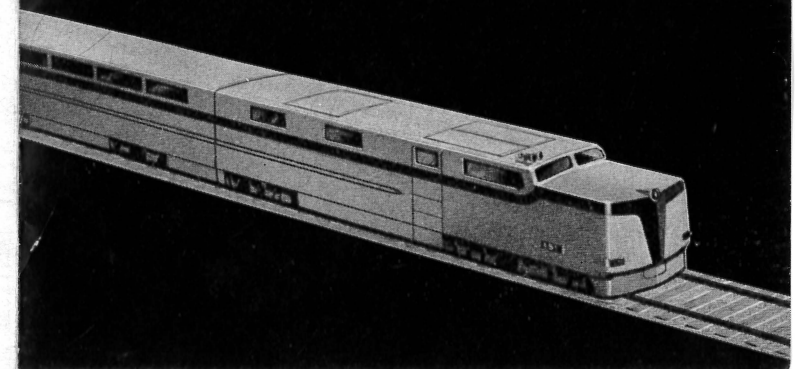
● **IN RESEARCH** This pamphlet has told you about railroad research. The other research that the University of Illinois is famous for — research in heating and ventilation, in highway construction, in soils, in movie-making, in medicine, in atomic science, in synthetic rubber, in mining, in chemistry, in government, to name only a few areas — has not only contributed to society, but also to railroads.

● **IN SERVICE** The scope of the University of Illinois is not limited to classroom lectures and laboratory exercises. It spreads its knowledge to every corner of the state by radio, publications, extension courses and specialists, demonstrations, clinics, and correspondence courses — in fact, some of the correspondence courses go to people in all parts of the world. These extension and information services provided by the University do both direct and indirect good to railroads. The services bearing directly on railroading are obviously beneficial. The others play important parts in bringing information to the railroads, their employees, and to the people the railroads do business with.

RAILROADS



AND
THE
UNIVERSITY
OF
ILLINOIS

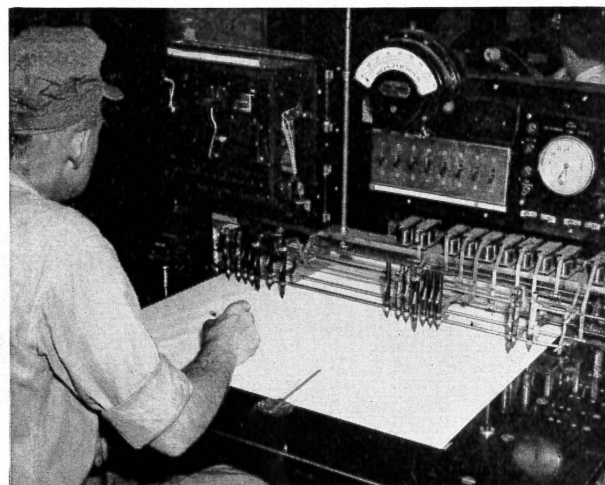


Testing the Iron Horse . . .

WHILE HE WORKS

The principal job of a railway dynamometer test car is to measure the pull that a locomotive exerts against the resistance offered by a train. Other things are measured also, and recorded, by a modern test car and its equipment, but these are secondary to measuring the pull.

You can get an idea of the car's primary function by hooking a rubber band onto a toy wagon full of

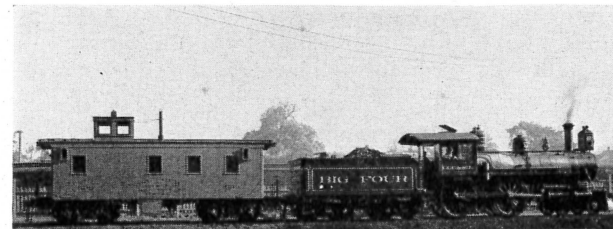


Nerve center of the test car — the recording table

blocks, and watching the rubber stretch as you pull the wagon along. The load will influence the stretch. On a smooth floor the stretch will be less than over a rug or up an incline. The length of the stretched rubber will give some indication or measure of the amount of effort you exert in pulling the wagon.

A dynamometer car, like the rubber band, is coupled between the motive power and the load to measure the effort being made by the engine to pull the train. The force involved is tremendously greater than for the toy wagon, but this test car measures it much more accurately than the rubber band can, and at the same time it records the measurements on a paper tape.

The dynamometer test car owned jointly by the



World's first Hydraulic Dynamometer car; 1898

University of Illinois and the Illinois Central Railroad has what is known as a hydraulic system for measuring this pull. The University originated this hydraulic system in 1898 when it built its first railway test car in conjunction with the Peoria and Eastern Railway.

This was one of the first 10 such cars in America. Another of the first 10 was the original University of Illinois-Illinois Central car, built in 1900. The present car was built in 1944.

The hydraulic system is so sensitive that it can indicate the force exerted by a man pulling on the coupling at the front of the car; yet it is so strong that the car has been used as the link between a powerful locomotive and a 14,000-ton train of 213 loaded cars of coal.

The coupling at the front of the car — connected to the locomotive when tests are being made — is attached by a U-shaped yoke to a piston which pushes into a strong oil-filled cylinder under the car. This cylinder is built into the car frame, so that all of the force is exerted through the oil in the cylinder. As the locomotive pulls harder, the piston presses harder against the oil. This increases the oil pressure. Changes in that pressure are indicated by gauges inside the car and are recorded.

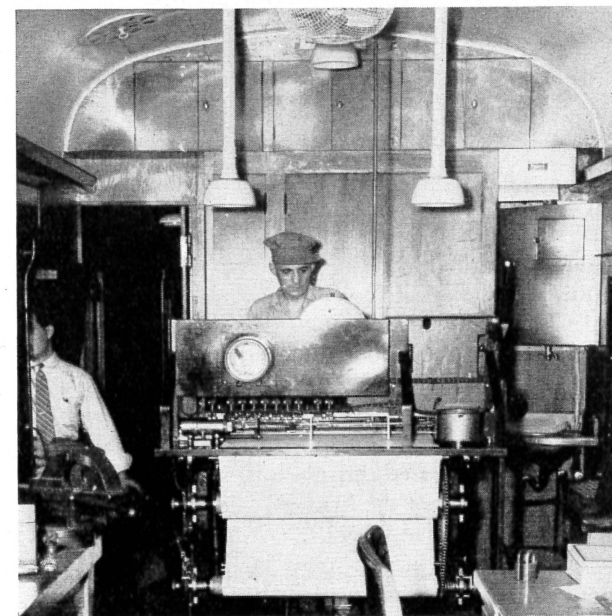
The central piece of equipment in the operating compartment of the test car is the recording table, over which a 30-inch wide paper tape moves when the car is in operation. Electrically controlled pens make a continuous record of the engine pull and other related data on this tape.

Mechanism, which is geared to the car wheels, moves the paper so that distance on the record tape is directly related to distance of train travel. The paper can be set to move 3, 13, or 53 inches for every mile of track or, if necessary, at any other ratio depending upon the purpose of tests.

One of the special pens on the chart table makes a mark every five seconds so that information on the tape can be related to time, while another relates the tape to location along the railroad by making a mark whenever an observer in one of the side bay windows of the car sees a station, mile-post, or other identifying point and pushes a button. The observer at the same time calls to a worker seated at the chart table who writes an identification alongside the check mark. For night runs, each bay window is equipped with a spotlight to help in reading signs and mile-posts.

The man at the chart table also is connected by telephone with a man in the engine cab, and can write down any of his observations. Train speed, wind velocity and direction are automatically marked on the chart.

A cable which carries the telephone wires to the engine also carries wires connecting automatic pens on the chart table with counting or reporting devices on the engine. These show steam pressure, back pressure, air brake pressure, throttle setting, cutoff setting, fuel use — by noting every turn of the stoker as it feeds fuel into the firebox — and water consumption,



The recording crew at work, as seen from the front of the car



University of Illinois-Illinois Central Dynamometer car; 1949

through very accurate water meters placed into the water supply lines.

The dynamometer car is a rolling laboratory to test the iron horse while he works. It is a workshop for studying the findings and for making adjustments or repairs to equipment. Also it provides living quarters for the test crew, whose job may last long hours, and may end or start at odd times and far from home. The crew can live with their work.

The dynamometer test car has three sections. At the front is the 22-foot long operating compartment, containing the chart table, observer's bay windows, and work benches. Next are two staterooms, each with space to sleep four people, a toilet, shower, washbowls, and lockers. At the rear of the car is a well-equipped galley. Electrical current for mechanism and lights is provided by an axle-driven generator and storage batteries, supplemented by an engine-driven generator to provide current when standing still or running in a slowly moving train.

Operation of the car is an advantage and source of information for both railroad and university. It is a part of the University's engineering laboratory equipment, and affords facilities for making practical railroad tests which cannot otherwise be made. It is used not only on the Illinois Central, but also on other lines.

Results from more than a half-century of work by the University with its railway test cars are of value to all railroads. The facts of train resistance learned in this work are internationally recognized. Many railroads use the principles of tonnage rating presented by the University in 1910. In recognition of ever-increasing speeds, these were extended to higher speed ranges in 1948. New equipment and ideas have been tested in actual use by means of the car. Nine bulletins of the University's Engineering Experiment Station report on the test cars and their work.

