Science Staunch Ally of 'Big Steel'

Research Aids Market Drive; New Fields Seen

By BARROW LYONS
New York World-Telegram Writer

"Big Steel," which some have thought slow to blaze new paths of progress, today is in the forefront, pioneering. Some years ago a combination of factors—including both an appreciation of future trends and the competition from lesser companies producing alloy steels—pricked the industrial giant to bestir himself, and now he is out ranging for fresh fields to conquer.

Through scientific research into the very fundamentals of steel-making the United States Steel Corp. has discovered principles that are being used in developing new products. Some of these metallic creations are as different from the steel made a few years ago as the modern automobile is from the chug-wagon of Olds.

These products are tougher, more ductile, less corrodible. In the last two years, for example, the Steel Corp. has sold its Cor-Ten steel for the making of 16,000 freight cars and more than 1,000 passenger cars. This year it is offering its "Brunorized" rails, which promise to wear better than the standard rails now in use, and are tougher and safer particularly in regions where temperatures run low in winter.

Root of Progress

Also, its process of "Austempering," by which certain grades of carbon steel may be made as resilient and tough as many alloy metals, is finding for itself new uses, and promises to develop a large quality market, officials of the company report.

The co-operative research making this expansion possible has been done partly in the laboratories of the subsidiary manufacturing companies, from which many of the practical applications emanate, and partly in the research laboratory of the corporation at Kearny, N. J. The scientific study of the internal structure of steel in all stages of its manufacture, which is at the very root of progress made, has been one of the principal concerns of the central research laboratory.

Rufus E. Zimmerman, vice president in charge of metallurgy and research, supervises the research work throughout the organization. The corporation and its subsidiary companies have allowed about $7,000,000 a year for technological activities, including "research and development" work. Dr. John Johnston is in charge of the Kearny laboratory, where basic explorations into the internal structure of steel are going forward.

Technique Developed

In Dr. Johnston's laboratory an experimental technique has been developed which enables the research worker to get microscopic pictures of the granular and crystalline structure of steel in all stages of its manufacture.

These studies started with the knowledge that there are two distinct crystal forms, or atomic arrays, of the element iron—the change from one to the other is usually taking place as the metal passes through the range of temperatures between approximately 1,300 and 1,650 degrees Fahrenheit. But, it was not clear until recent years just what happens in the structure of steel when this change takes place.

Size of Crystals Important

Steel is not one thing. Each kind of steel has a different internal anatomy. The laboratory studies have revealed just how the crystalline structure of a steel differs with change in the temperature at which it is caused to transform. This has proved tremendously important in controlling the heat treatment of steel required to develop the desired combination of properties suited for each particular purpose.

Another thing the studies have shown is the importance of the size of the crystalline granules, of which steel is composed. This depends partly upon the other chemical elements present in the steel besides the iron, partly upon the heat treatment, and partly on how it has been rolled or forged. The finer the granules, the tougher the steel is likely to be.

As a result of these studies, it has been possible to produce steel of qualities to satisfy many demands without hit-or-miss experimentation.

Cor-Ten steel was developed in the laboratories of the American Sheet & Tin Plate Co., at Pittsburgh and Vandergrift, Pa., now a subsidiary of the Carnegie-Illinois Steel Corp.

In experimentation thousands of samples, comprising 500 different compositions of steel, were tested for resistance to atmospheric corrosion. One of these showed marked superiority to the others, and in prolonged exposure the rate of formation of rust on this steel was only one-fourth to one-sixth of that on ordinary carbon steel. This steel, which has a low carbon content, contains copper, chromium, silicon and phosphorus, all in relatively small proportions.

New Material Stronger

Rust resistance is not the only merit of this material. It also develops 1½ times the strength of ordinary steel, the company claims. It is sold at little more than 50 per cent above the price of plain steel, so it really costs no more per unit of strength, the company asserts.

This suggested that the new product was the kind of steel engineers were seeking for freight car construction and many other applications. It was figured that in railroad rolling stock its use not only would reduce maintenance, which has averaged $235,000,000 a year on freight cars for the last ten years, but would materially cut operating costs by paring down weight.

The new steel was able to do just that, it is claimed. In addition, lighter cars can carry more load, and therefore fewer cars are needed. This, it was felt, would reduce the number of trains necessary resulting in further operating economies. In fact, it has been figured that an ultimate saving of $154,000,000 a year can be effected in handling freight and passenger cars by reducing their weight by one-fourth.

Goes Into Many Products

The new steel, christened Cor-Ten, is now going not only into freight and electric cars but into the high-speed Diesel-driven streamlined fliers, into gasoline tank wagons, into mine cars—into numerous products in many industries where strength and lightness must be combined and corrosion resistant qualities are desirable.

And now comes the process for rails known as "Brunorizing," which makes the steel ribbons far tougher by relieving internal stresses in their structures, so that they can better withstand the greater wear and tear of the modern streamlined expresses. Curiously enough, the streamlined train may be lighter, but the saving in dead weight by the use of high-strength steels is compensated by more payload. Moreover, faster running schedules increase the impact and the side pressure on the rails. The term "Brunorize" is derived from the name of one of the inventors, the late John Brunner, and the metallurgical term "normalize."

Special Furnace Used

The critical temperature of a steel is that at which the marked change in its grain structure, referred to above occurs. For rail steels this is usually in the range 1,350 to 1,450 Fahrenheit. In "Brunorizing," when rails as delivered from the rolling mill have cooled to 900 to 1,100 degrees F., they are transferred from the cooling bed to a roller table and delivered to the reheating furnace.

This is 9½ feet wide and 252 feet long and holds at one time six groups of eight rails. In this furnace the rails are given a heat treatment which changes their internal structure in such a way as to eliminate most of the internal stresses which tend to hasten failure by fatigue.

The research work of the Steel Corp., however, has not been confined to the development of new products. Much of it has enabled the company to improve the uniformity of its standard products by devising better methods of control of the whole series of operations involved in the production of the finished article.

Big Saving Effected

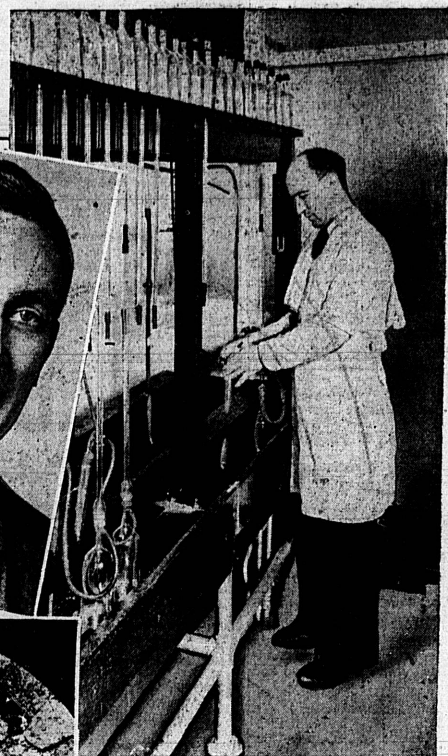
One device alone saves the company $500,000 a year in the cost of refractories. Another bit of research—on the brick linings of coke ovens—revealed that the ovens could be cooled off, if held for some time at the proper temperature, without smashing the linings to smithereens. Because of this discovery, the company saved itself hundreds of thousands of dollars during the depression, when many of the ovens were closed down.

When Dr. Johnston was brought from Yale University by "Big Steel" ten years ago, the operating heads of the corporation were well convinced that the last word had not been spoken in the making of steel. Today they continue to welcome the help of the research laboratory. And, according to Dr. Johnston, science is on the threshold of research into what can be done with steel and other metals.

Today the laboratory at Kearny is making a study of what happens to various types of steel under long-sustained tension at high temperatures. This type of deformation, or "stretching," which takes place at high temperatures under load, is known as "creep" to the metallurgist. The result is expected to throw considerable light on the manufacture and use of steels for steam turbines, high temperature steam pipe lines, oil cracking stills, and other types of elevated temperature service.

LEADERS IN STEEL RESEARCH

R. E. Zimmerman (left, below), is vice president in charge of metallurgy and research of the U. S. Steel Corp. Under him is the laboratory system of the company. Dr. John Johnston (right, below), director of research, heads the Kearny laboratory from which has come revolutionary discoveries, which "Big Steel" expects will broaden its market vastly.



Above is the set-up for hydrogen evolution tests for evaluation of tin plate. The microphotograph (left) shows cracks in steel occur along the surfaces of crystallization formed at high temperatures, indicating the crucial importance of heat control.

Shortest Co-ed

BERKELEY, Cal. (U.P.)—Miss Gertrude Feleman, of the University of California, is out for the crown as the world's most diminutive co-ed. She is 57 inches tall.