ENGINEERING-CHEMISTRY

Shineless Stainless Steel

New black rustless steel has many applications both for military purposes, where its unreflecting surface affords safety against the enemy, and for jewelry.

By ANN E. EWING

See Front Cover

➤ A FLASHING, stream-lined railroad train. The speedy X-2 experimental jet plane that flies faster than sound. The shiny spoon on your table or the mirror-like sink in your kitchen.

Rustless, all of them, because they are made of stainless steel, these metal objects in our modern world are symbolic of permanence and untarnished beauty. They are metallurgical science applied and shining most brightly.

Less known and newer is black steel that is rustless. It is steel that has a surface that does not reflect like a mirror and yet resists the inroads of greedy oxygen that rusts and eats away ordinary iron.

Shineless stainless steel is the latest thing in the steel world.

For military purposes where a glint of light might reveal a waiting army, it has obvious advantages.

Novel Jewelry

It is even being used for novel jewelry —dark, somber contrast to more gaudy metals.

Black or shiny, stainless steels are "stainless" because chromium is added to the iron. Stainless steels, technically known as corrosion-resisting, must have at least 11% chromium before they will resist rust.

Shiny stainless steel has a very thin, tight chromium oxide film on the surface. This film is invisible with a powerful microscope as well as to the eye. Even though it can't be seen, this invisible layer is responsible for the corrosion resistance of stainless steels.

The film, if scratched or broken, forms again instantly just as soon as the stainless steel is exposed to the oxygen ordinarily present in the air. Stainless steel is, therefore, corrosion resistant all the way through.

Black stainless steel also has a thin chromium oxide coating. This film is visible to the eye because of its color, although it is only a hundred-thousandth of an inch thick.

Stainless steel is blackened by placing the metal in a molten bath of dichromates at a temperature of 730 to 750 degrees Fahrenheit. After 15 to 30 minutes, the metal is removed from the bath, cooled and rinsed. Its once-gleaming surface is now black, and it is ready for use.

Familiar, shiny stainless steel was once known as the "jewel" of the steel industry because of its high price and silver-like appearance. Last year over 600,000 tons of the metal were produced in the United States alone. Production of stainless steel grows annually as new uses are found for the 35-year-old marvel metal.

One of the most recent uses for bright stainless steel is for fire extinguishers. Sold at a lower price than the ordinary red fire extinguisher, the gleaming model is lighter, requires less maintenance, and need not be replaced as often.

Ever since the discovery of iron, man has been trying to find some way of outwitting the villain, rust. In 1913, Harry Brearley, hunting for a steel that would withstand continuous fire from naval guns, made many experimental alloys. Some of these were of iron and chromium.

He tested the samples, as usual, in hot sulfuric and hydrochloric acids. For some reason, he decided to test them also in nitric acid. Nitric acid is a very powerful oxidizing agent. To his amazement the iron-chromium mixtures were not affected by the nitric acid.

Immediately Brearley realized that he had made a great discovery. Rust is a product of oxidation. A metal which resists nitric acid should therefore resist rust. After centuries of vain search, man had found a rust-resisting steel.

At the time of the discovery, Brearley was working for Sheffield, a famous cutlery firm in England. It is not surprising, therefore, that the first commercial use of the new metal was for knives and other utensils.

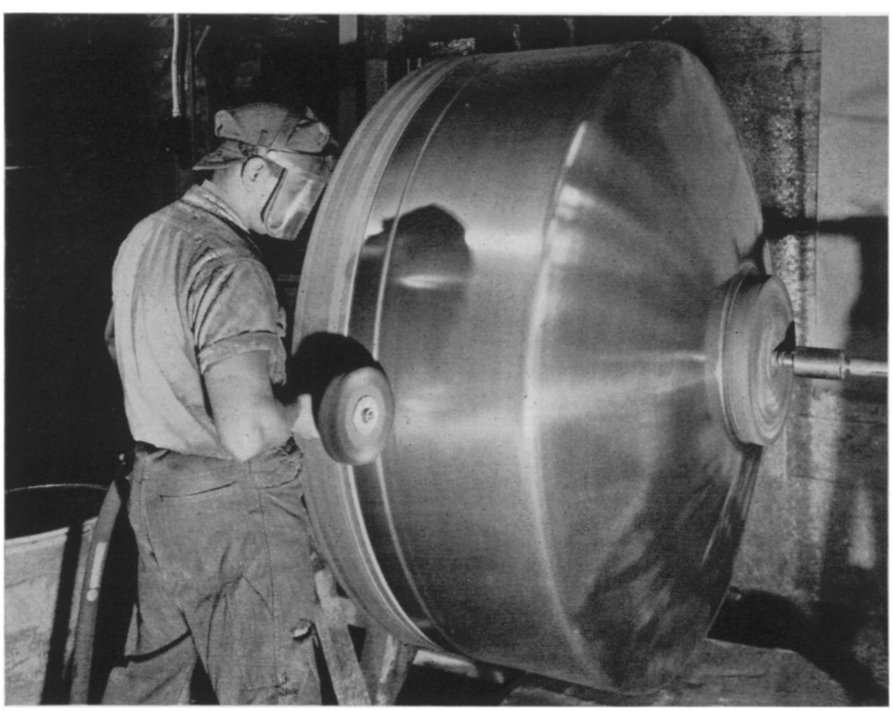
Cutlery-Type Steel

This original cutlery-type steel contained about 12% chromium and about .3% carbon. Approximately these same percentages are in use today for the stainless steel knives in kitchens and for other stainless steel cutlery.

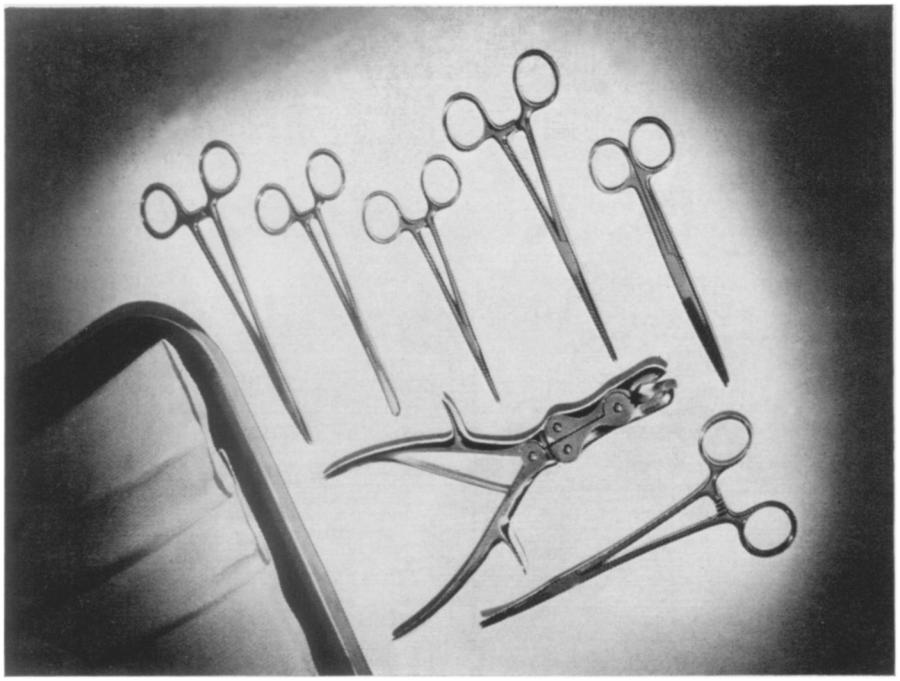
At about the same time as the British development, Benno Strauss, working in Germany, tested the combination of chromium and nickel with iron. He found that the percentages of these metals which resisted rust the best were 18% chromium and 8% nickel.

Stainless steels of this composition are in wide use today. They are known as 18-8 stainless steel because of the percentages of added metals.

The term stainless steel denotes not just one type of steel, but a large family of almost 30 alloy steels. These alloy steels



FOR INDUSTRY—A stainless steel mill cover is being polished for a corn products refining plant.



FOR THE OPERATING ROOM—Here stainless steel makes it possible to keep surgical instruments spotless and ready for action.

divide into three major classes. Two of the major classes, cutlery-type stainless steel and 18-8 stainless steel, were developed by Harry Brearley and Benno Strauss, respectively.

The third major class is an alloy containing 16-30% chromium and a very small percentage of carbon. This type is between the cutlery type and the chromium-nickel type in its resistance to corrosion.

The metallurgists who discovered stainless steel were looking only for corrosion resistance. By adding chromium and/or nickel to the iron, however, they also increased the tensile strength of the steels.

Tensile Strength

The tensile strength of ordinary structural, sheet and plate steels is 50,000 to 60,000 pounds per square inch. Tensile strengths of stainless steels vary from 85,000 to 200,000 pounds per square inch. Through special treatment, stainless steel wires can get tensile strengths up to 350,000 pounds per square inch.

After its introduction through cutlery, the next large-scale consumer use of stainless steel came in 1930 when Henry Ford trimmed the radiators of his model A with the new metal. On today's auto, it gleams not only from the radiator, hub caps, running board, trim and headlights outside the car; but from the dashboard, lamp shells and door fixtures within the car.

There are hidden uses of stainless steel in the modern automobile. Looking inside the engine, you would find stainless steel guarding many "hot spots." It was chosen for these vital parts because it is outstanding in its resistance to heat.

Stainless steel is more expensive than common steel, but it pays for itself in labor, paint, and maintenance costs saved by its use. On this week's cover of the SCIENCE NEWS LETTER a huge chemical vessel is spot welded. Fewer replacement parts are required when stainless steel equipment is used.

An example of this is the dairy industry. With poor cleaning and constant wetting, the pitting of carbon steel in dairy equipment was a serious problem. Frequent replacement of most equipment was required when ordinary steel was used.

The milk that is delivered to your door today almost never touches anything but stainless steel during its trip from the cow to you. Higher cost of the original equipment is more than offset because fewer replacements are needed and maintenance costs are lowered.

Another place where stainless steel pays for itself is in kitchen equipment. Stainless steel is not easily dented or chipped. It is easy to keep clean. It is not stained by food acids. Many factory, cafeteria and institutional restaurants, therefore, use stainless steel for kitchen and counter equipment. It is also being used more and more in home kitchens.

Other elements such as sulfur, columbium and molybdenum are sometimes added to stainless steel to give it particular properties. Molybdenum, for instance, improves the corrosion resistance of stainless steel used in the textile, paper and chemical industries.

Stainless steel has been used for architectural trim for both office and home. Such famous buildings as the Chrysler tower and the Empire State are protected at key places by this metal.

Your home of the future may have stainless steel panels which will slide to make your rooms big or small as you desire. An architectural exhibit which opens in Washington this fall will feature such a home.

Samples of stainless steels, carbon steel, nickel and ferrochrome (iron and chromium melted together in an electric furnace) have been collected by Science Service. Several experiments you can perform with these metals are explained in a leaflet which accompanies the samples. Write Science Service, 1719 N Street, N. W., Washington 6, D .C., for one of these stainless steel kits at a nominal charge of 50 cents.

Science News Letter, June 18, 1949

SAFETY

Night Traffic Deaths Four Times Daylight Rate

➤ FOUR times as many deaths from traffic accidents per car on the road occur at night as during the day, the President's Highway Safety Conference was told in Washington by Edmond C. Powers, Street and Traffic Safety Lighting Bureau, Cleveland, Ohio. The increased night death rate is chargeable, he said, to defective tail lights, defective headlights, fatigue, fog, alcohol and inadequate visibility.

The four-to-one ratio of night to day deaths is the result of these six factors, he said, which not only increase the chances of accidents at night but which also increase the chances that a night accident will be fatal when it does occur. Inadequate street lighting, particularly in urban areas, is the primary factor.

The analysis presented by Mr. Powers was based on extensive research and detailed study of over 8,000 fatal accidents reported by 20 states for the year 1948. The analysis eliminates the accident factors which are the same day and night and thereby segregates those factors which apply strictly to night accidents.

On this basis, there were 13,800 night traffic deaths during 1948 in the United States due to the factors applying to night accidents. Of these, nearly 10,000 were due to inadequate visibility and 2,636 due to the use of alcohol. Fog was responsible for 516 deaths, and fatigue for 447. The others were due to defective tail lights or headlights.

Some 32,000 human lives were lost during 1948 from traffic accidents. Comparing the 18,400 persons killed in night accidents with the 13,800 killed in daylight is not particularly shocking, he said. But when it is remembered that night traffic is only one-third daylight traffic, and a comparison is made on the basis of the number of vehicles operating, the result is