Machinery and Manufactures.

"Case-Hardening."

Case hardening is the superficial conversion of iron into steel, and combining the hardness of the latter with the toughness and cheapness of the former. Iron is tenacious and ductile, but by case-hardening it has this same tenacious body with an exterior coating of steel, produced by the action of heat on animal carbons, shrunk, as it were, over its surface, compressing the iron body, thereby producing a greater strength. It is not for economy alone that articles of iron are case-hardened. They are stronger and more durable than if made wholly of steel.

The most common articles of case-hardening that are met with are the locks, mountings, etc., of guns and rifles. To make the lock-plates and hammers of steel would be attended with many disadvantages as well as an advanced cost, not only the price of steel over that of iron, but the difficulty of working requiring more care and more experienced workmanship. If these parts were made of steel they would require to be hardened, and, as steel can only be hardened throughout its entire thickness, there would be great risk of breakage from accidental blows and changes of atmosphere. But being made of iron and case hardened, it has the tenacity of the iron and hardness of tempered steel; the steel surface extending to a greater or less depth according to the time it remains in the hardening material.

Cast-iron is as easily case-hardened as wrought-iron, and drill-chucks or face-plates thus treated are rendered of as much utility as if made of tempered steel, and at scarcely one-tenth the cost. Malleable iron has also the same properties of case-hardening that wrought-iron has, and the greater portion of gun and rifle trimmings are thus made and case-hardened.

Prussiate of potash answers a very good purpose for superficial case-hardening, but it produces only a thin film or skin or hardened surface. Any animal charcoal will answer. Burnt horns, hoofs, bones, etc., will make animal charcoal. Scraps of leather, old boots and shoes, burned in a pan in the common forge fire and reduced to a powder with a hammer, are a ready means for producing this carbon. Ground bone-dust as it comes from the agricultural stores is the most ready as well as the cleanest form of material. The bone or ivory dust does not need burning. The articles to be hardened are put in iron boxes and the bone-dust well packed around them. Care should be taken that the articles do not touch each other. The box must be tightly closed, luted with clay, inserted in the fire, and brought gently to a red heat. If the articles are large they require more time than if they were small or thin. After the box becomes hot, it will require to remain from half an hour to two or three hours, the mechanic exercising his own judgment as to time in the size of the articles. When properly heated, draw from the fire and quickly empty the contents into a bucket of cold water, taking care that the work comes to the air as little as possible.

A very good substitute for iron-boxes are short pieces of gas-pipe, with a plug screwed into one end and the other end covered with an iron cap and luted so as to be air-tight. When the articles can be conveniently packed in pieces of pipe they are preferable to iron boxes for the reason that they are more readily turned in the fire and are more easy to handle. After the work is hardened, if it is required to polish it, proceed the same as with iron or steel. When the work is polished or burnished before it is case-hardened it will, after the operation is completed, present a variety of mottled tints that are pleasing to the eye. Many prefer the work left in this condition, as it will not rust so readily as if polished.

If a portion of an article is to be kept in a soft state and the remaining part to be case-hardened, the portion to be left soft can be covered with a thick coat of moist clay, so as to prevent the material in which it is packed from coming in contact with it. If there is thought to be danger of small articles cracking by the immersion of them in the water, a film of oil poured on the water, which must not be too cold, will prevent a too sudden contraction of the metal and the articles will not crack.—*American Artizan.*

The Acid Test of Iron.

Although there can be no doubt but that the only way of obtaining accurate information respecting the strength of any particular kind of iron or steel is to subject it to directly applied strain, yet there are many circumstances under which such a test cannot be conveniently carried out, and where any test which does not require special machinery would be extremely useful. One rough test of this kind which is frequently used, is that of breaking a sample of the material and judging of its quality by the fracture; and another, which is not so generally known or employed, is the "acid test," which is carried out by subjecting samples to the action of dilute nitric or sulphuric acid, and noticing the result. This acid test is particularly applicable when it is desired to ascertain the capabilities of the material for resisting wear, as, for instance, in the case of railway tires, and we know of at least one railway company by whom the test is used for this purpose with advantage. Thin slices are cut from the tires to be tested, and the surfaces polished, and these samples are then placed in dilute nitric acid for about twelve or fourteen hours. At the end of that time it is found that the structural formation of the tires is very clearly developed, the manner in which the piles were built up being plainly shown in the case of the iron tire, while in the case of those of steel the surface presents a more or less honeycombed appearance, according to the fineness of the grain of the material. We have known samples of Krupp's steel tires only exhibit a frosted appearance on the surface after a whole night's submersion in the dilute acid, whilst some slices of iron tires 3-16 inch thick submitted to precisely the same test, were eaten completely through in some places. Speaking generally, it may be said that the power of resisting wear varies very much in the same proportion as the power of resisting the action of the acid, and