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PREVENTING WASTE OF HEAT IN BOILERS.

When the temperature of the atmosphere is very low and dry, persons do not feel the effects of cold so sensibly as when it is damp and more elevated in temperature. This is attributable to two causes. One is the great capacity of moisture for heat, which affords a reason for the heat of the body being carried off so quickly when the atmosphere is charged with moisture. The other consists in the superior non-conducting qualities of dry air, by which the heat of the body is prevented from being carried off so rapidly when the atmosphere is dry. The fur of the quadruped is furnished by nature as a non-conducting covering, to enable the creature to withstand the cold of winter. There is no more heat in fur than in iron; it is only a superior agent to iron in preventing the conduction of heat, hence the reason why it feels warmer in a cold day. Air is one of the very best non-conductors, and the so-called warmth of fur, wool, and feathers is really owing to the air that is confined within their interstices. In order to economize the heat of the human body during cold weather, it should be covered with the best non-conducting material that is obtainable, and the same advice is applicable to the covering of steam boilers, cylinders, &c. In setting a steam boiler, the walls should be made double, so as to include an air space. A solid wall of brick surrounding a boiler will radiate twice as much heat outside, as a double wall of the same thickness of brick. In Constantinople where fuel is scarce and high in price, all the baths are situated between double sides with air spaces between, so as to economize the heat. Furnace doors should also be made double, to prevent radiation of heat outside. Marine boilers are usually covered with felt, which is a good non-conductor, but all such coverings are put on without due regard to an air space, which is the best non-conductor. Every boiler, stationary and marine, should be entirely covered, including an air space in the covering, for confined air is by far the cheapest non-conductor and economizer of fuel that can be employed in all such cases.

HOW TO USE CALLIPERS.

It may be safely assumed that comparatively few mechanics use callipers properly. There are many different forms of callipers with which all mechanics are familiar, such as those having springs, and those which are secured, when set, by set-screws biting on an arc. While all these have their several merits, commend us after all to the old-fashioned sort made with two legs, two washers and a good rivet. Now what is the reason that one man will always make a good fit when turning a shaft to fit a bore, or the reverse, while another man makes a botch of it? The reason is that the former knows how to take a size, while the latter is ignorant of that duty. Sizes when turning are generally taken either with a pair of callipers or a standard gage. It would naturally be supposed that with the gage, inaccuracy of measurement would be impossible. It is possible, however, and frequent, because the workman has not sufficient delicacy of touch to use the gage properly. Callipers are very sensitive and are often used for extra nice work; if, however, the work has to be multiplied many times, then the use of callipers is not economical, and we must substitute some other method; moreover, gages are costly tools, and but few shops are able to own complete sets; for general work, therefore, we must rely upon the callipers. Blacksmiths have tools which resemble callipers, but they are uncouth and rude. The majority of men of that calling, when using them, set their callipers somewhere near the size they want, and then upon comparing the work with them, *jab* them over the rod or shaft, as if they were going to cut it in two. The consequence is that the size of the work finished depends very greatly upon the resistance which the joint opposes to the blacksmith's strength. It is needless to remind the machinist that violence or pressure, applied to tools of this kind, only distorts the measurement and results in "bad jobs." The object with some workmen seems to be to find out how much the callipers will spring in going over a shaft without altering; not to ascertain how much metal must be removed before the requisite dimensions are attained. It is safer to go by the sense of sight than it is by the sense of feeling, in all cases where it is practicable to do so. When we can see that the callipers barely touch the object measured, we know it is of the proper size, but when we only feel of it, accuracy depends almost wholly upon a delicacy of feeling which all persons do not possess. When we say accuracy, we do not mean hap-hazard accuracy, that will admit of being somewhere in the neighborhood of the right size, but we mean absolute mechanical integrity, such as is obtained in the sewing machine and in the manufacture of our best steam engines. Many new inventions are rendered useless and thrown aside as impracticable, solely because rudely made; let us then endeavor in the use of all tools, but more especially in the employment of those upon which the proper working of other parts depends upon good fits, to be as faithful as our abilities will allow us to be.

DESTRUCTIVE EFFECTS OF IRON RUST.

The last published report of the Smithsonian Institution contains a translation from a German publication on the above subject, which affords considerable information of a useful and interesting character, some of which we shall present in a condensed form. It states that it has been frequently observed that in the timber of old ships the wood in the proximity of iron bolts is entirely altered in its character. Around each bolt for a space exceeding one inch, part of the wood is dissolved away, and the remainder is quite brittle and easily broken. The appearance of such wood is such as if it were produced by driving in red-hot iron bolts. This injurious effect of iron rust is one of the principal causes of the want of durability in iron-fastened ships. Rust not only originates where the iron is alternately exposed to water and the air, but also where the iron is permanently submerged under water. It is generally known that rust is an oxide of iron, but as soon as it comes into contact with wood it gives off part of its oxygen, and becomes the protoxide. The latter takes up a new portion of oxygen and transfers it to the wood, and by the uninterrupted repetition of this process, a slow decay of the wood is effected. The protoxide of iron in this case plays a part similar to nitric oxide in the manufacture of sulphuric acid.

In order to demonstrate the fact that oxide of iron is reduced by mere contact with organic substances (such as wood) not yet in a state of putrifaction, M. Kuhlman, of Lille, has instituted different experiments, the results of which confirm the correctness of this assertion. When hydrated oxide of iron, for example, was mixed with cold solutions of logwood, cochineal, corcuma and mahogany, they were decolorized, and the iron was found in a state of protoxide, the oxide having lost a portion of its oxygen by the action of the coloring matter. In every-day life the destructive effects of the oxide of iron have been noticed. For example, linen or cotton cloth containing ink stains becomes tender in its texture in the stained spots after repeated washings, and the spots ultimately fall out, leaving holes in the fabric. When cloth that is colored with copperas to form a black, is submitted to an alkaline ley, the protoxide of iron is changed into an oxide, and the cloth becomes feeble in the texture; and the usual saying in such cases is, "It is burnt in dyeing." According to Kuhlman, the oxide of iron transfers oxygen directly to the cloth, producing slow combustion of the fiber. This is useful information for dyers, as it explains the cause of an evil connected with preparing cotton cloth, which has hitherto baffled much scrutiny and experiment to discover. It is also well known to bleachers that when pieces of cotton cloth become stained with iron rust they are liable to drop out, leaving holes, as if they had been sprinkled with sulphuric acid. Every spot of iron rust should, therefore, be immediately discharged when noticed, by the use of dilute hydrochloric acid and warm water, or oxalic acid and warm water.

In shipbuilding, iron nails and bolts should never be used. In all cases copper or brass fastenings should be employed where first cost is not an essential object. In cases where the expense will not warrant the use of copper bolts, the iron bolts should be galvanized. Recently we have noticed with much satisfaction the extended use of zinc-covered iron bolts by our shipbuilders. This is a step in the right direction; but so far as we are informed, such bolts are confined to the construction of sea-going vessels. All our river boats and schooners should be fastened with the same kind of bolts, because they are nearly as essential for vessels running on fresh water as those on salt.

GUN COTTON FOR ARTILLERY.

When gun cotton was discovered by Schonbein, in 1847, it was hailed as a most valuable invention for war and other purposes in which gunpowder is used, but upon repeated trials with it in fire-arms, it was found unsuited. The following defects were attributed to it:—It was very hygrometic, and attracted so much moisture during wet weather as to render it useless. It was also deficient in granular construction. To explain this second defect, it is necessary to state that different kinds of fire-arms require powder of a different grain. Thus for fowling-pieces a fine-grained quick powder is required; for rifles, a much coarser powder, and for cannon a very large-grained powder. Every variety of fire-arm, whether the variation be as to length, twist of grooves or caliber, involves a special size in the grains of powder to obtain the best results. Gun cotton possesses no such variable qualities. It also explodes so rapidly that it could not be used in common fire-arms, because of its bursting effects; the best steel barrels of rifles having been shattered by common charges.

There are quite a number of fulminating agents which it would be convenient to use in place of gunpowder, were it not that they are violently explosive, without producing great projectile results; that is, they will shatter strong steel barrels to pieces with a small charge, but they cannot project missiles to such great distances as gunpowder. This is the case with the fulminates of mercury, silver and gold. The propulsive force of any material, such as gunpowder or the fulminate of mercury, depends on two qualities, namely, the volume of gas which it liberates when it explodes, and the time involved in the liberation of this gas. These are important distinctions. If the substance liberates its gas at once, or in a space of time infinitely short, like the fulminates of mercury and silver, it is not suitable of application for discharging projectiles, because the bursting or shattering effect of those is prodigious, while their projectile effect is small, as the volume of gas liberated by these fulminates is less in volume than the gas of gunpowder, hence the latter is a superior projectile agent. As water expands into 1,700 volumes of steam, it is evident that it must be a superior expansive motive agent to alcohol, which does not expand in vapor to more than 640 of its original volume. Gun powder and the fulminates are governed by the same law. Gun cotton, owing to its complete ignition, and leaving very little residue, was held to be superior to gunpowder in projectile effect; but its want of granular construction, its rapidity of combustion and its affinity for moisture were defects which till now have prevented its adaptation to firearms and artillery. All these defects have been overcome (it is stated in the *Austrian Gazette*) by Baron Lenk, and it is now used in the Austrian army. The method employed to prevent it from absorbing moisture is by immersing it, when being manufactured and before it is dried, in dilute soluble glass, which