HOW STEAM ENGINE VALVES ARE FINISHED.

Scraping for fits in the machine shop, is quite modern. It is the present practice to make all rubbing fits, of whatever form, by scraping. Formerly fits were made by grinding the two moving surfaces together after planing, or turning, and filing. Emery and oil were used on iron and sand and water on brass. There were two serious objections to this method. One was that the sharp particles of emery or sand would become embedded in the metal and continue the grinding or cutting operation long after it should have ceased; and another was that by grinding the two surfaces together each imparted to the other its imperfections, the protuberance on one producing a corresponding depression on the other, thus perpetuating the evil the process was intended to remedy, if not to remove.

Of late years a finished fitter is expected to understand practically the work of scraping, and to know the use of the surface plate and straight edge Steam valves especially are fitted in no other way than by scraping.

The usual method of making a fit by scraping is to coat the two surfaces which are ultimately to work together with red lead thinned with oil, and then rub them together. Wherever the bearing comes, there the paint is removed and the scraper should be applied. But there are objections to the use of this pigment, as gradually it fills the pores of the metal and reduces the entire surface to a dull reddish gray color not admitting of any shading. A better method and material is a quick wipe over with a rag saturated with spirits of turpentine. After rubbing, the salient points will show bright, while a dry film will remain in the hollows. The surface will always remain clean, and no change of color will occur during the entire process of scraping.

It is obvious to the least consideration that the fitting of two rubbing surfaces at the usual heat of the atmosphere and their fit under a very much higher temperature may not be uniform, especially if the mass of one of the moving bodies is much greater than that of the other, as in a valve and a steam chest.

Here then was a puzzle: how to make a cold scraped fit be also a fit under steam temperature. When it is considered that 70° may be considered general shop temperature, and that 65 pounds pressure of steam is about 316° temperature, it is evident that here is room for apprehension that a scraped fit of steam valves under ordinary circumstances would not be a good fit under working circumstances. And so it has proved in experiments.

A test was carefully made on the main valves of a new engine. The valves were scraped to a *perfect* fit—perfect humanly speaking—and tested by air at the normal temperature. They were tight. Then steam was let on, and in a short time the valves leaked a perfect sheet of steam.

The main valves of steam engines are now tested—and marked for scraping—by steam at full pressure. At least this is the practice at the Hartford (Conn.) Engineering Company's Works. A pipe is led from the boiler to the cylinder and steam chest of an engine "in progress;" the steam chest is temporarily covered in, the valves, valve rod, and necessary appurtenances in place. The valve rod is attached to an adjustable slotted arm, set to represent the traverse of the valve for that particular engine, the arm or crank being fixed to a shaft with belt and pulley driven by a countershaft. Steam is let on, the valve set in motion, and run for a few minutes. When the steam is shut off and the valves removed, it is found that the steam heat and the rubbing has shown the places of bearing as well as would the red lead or the turpentine cold, and two expert scrapers go at the faces of the valves while they are still hot. The final result is as near perfection as human skill can expect.

The Pressure of Gaseous Explosions.

MM. Mallard and Le Chatelier have contributed to the *Comptes Rendus* a note upon the instantaneous pressures produced during the combustion of gaseous mixtures. According to observations made by these experimentalists upon explosions of gas in long tubes, when a flame is propagated along a pipe containing a combustible gaseous mixture, there is a development of great pressure, which only lasts during a very short time. A pressure that will pulverize a glass tube three centimeters in diameter and three millimeters thick, so that the fragments shall be less than a millimeter in size, must be enormous; but the apparatus at the disposal of the experimentalists has not enabled them to measure it.

It has been ascertained, however, that the shock is of extremely short duration. Photographs of an explosion under these conditions show that the ignited luminous gas is projected to a distance of three meters from the end of the tube in less than the one-thousandth of a second. The maximum pressure cannot exist longer than a few thousandths of a second. A similar effect has recently been found to attend an explosion of gas in a closed vessel. It has been discovered that the pressure obtained under these circumstances far exceeds, for a short time, that due to the temperature of combustion.

With a mixture of oxygen and hydrogen the shock exceeded by more than nine atmospheres the normal pressure due to the heat of combustion, although this excess was obtained only during a period of less than the ten-thousandth part of a second. This phenomenon is only observed with explosions of quickly burning mixtures, such as light carbureted hydrogen and hydrogen with oxygen. Mixtures of light carbureted hydrogen and carbonic oxide with air do not appear to give rise to the effect in question. The cause of the abnormal pressure is accounted for by the hypothesis that the explosive mixture takes fire by layers, and that the explosion of the first layer compresses the second just before it is ignited. This excess of pressure would produce an augmentation of temperature which would be repeated in the next layer, and so on until the maximum is reached. The reasonableness of this supposition is apparently confirmed by the discovery of the "explosion wave" by MM. Berthelot and Vieille. It is believed by MM. Mallard and Le Chatelier that the explosion of a mixture of hydrogen and oxygen by successive layers may bring up the maximum shock to one hundred atmospheres; but as it only endures for perhaps the millionth part of a second, the effect of this pressure on a movable or elastic body would be inappreciable.

Forging a Rudder for the Steamer City of Berlin.

The rudder of the City of Berlin was carried away in a recent storm, and a new one was forged at the works of the Paterson Iron Company. The superintendent of the works described the job as the largest of the kind ever undertaken here. "The shaft is forty feet long," he said to a *Sun* reporter, "the blade is twenty-five feet long, and the shape of the whole is so irregular that we have to put on counterweights every time it is handled in order to run it over under the hammer. It will weigh about nine tons. The blade is made of sheet iron plates, bolted on each side of the frame. The frame is made of iron about eight inches square. The open space between the two plates forming the blade is sometimes filled in with resin. This, when melted and poured in, forms the most durable and solid filling. Some, however, use plaster of Paris. Others fill in the space with wood. Finally, others perforate the plates and let water run in. This is probably as good as anything. The frame gives the rudder the desired strength. The plates are only to give a surface. A rudder six feet broad will steer a steamship 400 feet long."

While the reporter was listening, the building was lighted with the brilliant glow of a red hot bow of iron about fifteen feet long and eight inches square, just taken from the furnace. It was in fact, a part of the outer rim of the curving rudder. In the mean time, a corresponding piece projecting from the rudder shaft, which had likewise been heated, was brought from a furnace to be welded on. The two ends that were brought together were like two letter Vees pointing toward each other, thus: > <. Then several men with great tongs took from the fire two small pieces also shaped like letter Vees, made to fit on the space between the two ends to be welded. These smaller pieces, were held in place until a blow or two of the great hammer, giving a 4,000 pound stroke, caused the half melted masses to adhere. Next the whole mass was twisted and turned, and the blows rained faster and harder, until in a few minutes the weld was completed. A similar operation welded the other end of the bow to the post.

"A single false blow;" said the superintendent, "might spoil the whole thing. A bit of dirt in it might make a flaw that would cost us thousands of dollars for damages. It takes a good mechanic to boss such a job, and we have to pay him good wages—$12 a day. He is the most important man in the shop."

Importance of Small Industries.

Speaking in Congress the other day of the need of encouraging certain relatively small industries, Senator Miller referred to the city of New York, the greatest manufacturing city in America—he might have said in the world—and "yet she has not a cotton mill, a blast furnace, or a rolling mill within her borders. Her manufactories are small," he said, "but they employ more than a quarter of a million people."

It is worthy of notice in this connection that while recent patents have much to do with the means and methods of the great staple industries, such as steel and iron production, iron milling, cotton and woolen manufacture, and the like, the smaller yet in the aggregate immensely important industries are almost wholly based upon and due to the development of recently patented inventions.

Cork Shavings for Vinegar.

The wood shavings commonly employed in vinegar factories preserve their activity for a certain length of time, and then become useless. Bersch explains this on the supposition that the shavings becoming saturated with liquid, get heavier, and press down on those beneath so hard as to prevent the air from circulating through them. He therefore recommends the substitution of the waste cork from which stoppers, etc., have been cut, for the wood chips. The elasticity of the cork is increased by moisture, so that they cannot pack together even in the tallest tanks. Small organisms exist in the pores of the cork, and among these many vinegar bacteria, so that the cork is very active in making vinegar. P. N.

Bordeaux Red, a New Wine Color.

A new red substance that has been introduced for coloring wines, under the name of Bordeaux red, or *Rouge vegetal*, has been analyzed by Guichard, who reports (*Jour. de Pharm.*) that it is a naphthaline dye. It is said that one gramme (fifteen grains) is sufficient to color five liters of wine a deep red (three grains to the quart).

For the detection of this dye in wine, Thomas makes use of its action toward silk and ammonia. It dyes the silk a granite red, and is turned brown by ammonia.—*Polytech. Notizblatt.*

How to Fire Steam Boilers.

Young engineers, if not some more experienced ones, will find some useful hints on a very important subject in the following article from the *Milling World:*

By the application of a little skill and care, very unusual results may not unfrequently be attained by ingenious mechanics. This is especially the case with firing steam generators when the fuel used is salt coal or sawmill offal Careless firemen fill in the coal haphazard, as long as any can be got into the fire box, causing great volumes of dense, black, unconsumed smoke to issue from the stack, giving evidence to all who see it, and know anything about what is going on, that a large percentage of the fuel is being thrown broadcast into the air, not only wasting the money of the owner, and the labor of the fireman, but contaminating the atmosphere for the use and enjoyment of the public.

Nothing would seem to be more plain than that it is the duty of the fireman, for his own sake, if not for that of his employers, to use as little fuel and labor as possible, to do his duty a little better than any one else. To effect this, only a little care, combined with such knowledge and skill as may easily be acquired by any fireman, is necessary. In burning coal, the grates should be much nearer the bottom of the boilers than in burning sawmill offal, the fire should be much more spread out, and kept shallower, and in feeding coal the lumps should be well broken up to hickory nut size, and only a small quantity thrown on at once and well spread out, so that the flames may attack it on every side and thoroughly consume all the carbon and bitumen of which ordinary coal is composed. It is of vital importance that all the air needed to thoroughly burn the fuel up should be applied under the grate as directly as possible, and as hot as it can be made. Not a little of the waste in fuel is caused by too much air passing through the furnace in various ways, all of which consume heat in unnecessary quantity. The furnace walls should be as near airtight as possible, and no useless air should be allowed access except through the proper spaces, otherwise the draught is injured and much of the fuel is wasted.

The back ends of the grate bars ought to be several inches lower than the front, that the air going up to consume the fuel may not meet with so short a curve. It is also best, in many cases, to leave the ashes banked up in the back of the ash pit and at the sides, that the air currents may be concentrated into a steady stream, carefully avoiding all eddies. The best method for each separate furnace can only be ascertained by trial and experimental tests, which the fireman must make for himself, and which he will be sure to do if he wishes to excel in his business.

A fire room should always be kept closed up tight, be kept as hot as possible, and free from cold air currents and blasts. It is very poor economy to spend labor and fuel to make steam only to condense and lose it before it is used. The boilers ought to be completely covered with an air and heat tight casing. Formerly it was supposed that the boiler would be injured if the flames had access to the steam space in the upper part above the water, but this has long ago been proved to be a great mistake. Where the boilers are fired inside, mineral wool covered over the exterior flagged with wood or metal is excellent as long as it is kept dry. A boiler thus covered can be touched by the hand without any unusual or uncomfortable heat being experienced. Even in warm climates, boilers ought always to be well protected under weatherproof sheds or buildings covering up perfectly tight all the rear parts, even using a bulkhead or partition just at the front, outside of which the fireman may stand if the heat is too much for him. It must stand to reason that a boiler room cannot be made too hot, or kept so, for economy and efficiency. How to do so cheapest and easiest, is the problem which both employer and operator should unite in striving to attain.

Not long ago the writer saw a portable engine at a fair, that burned only 2¼ lb. of coal per horse power an hour. The coal was broken up chestnut size, screened and washed, and fed into the furnace a pound at a time, being carefully spread over the bed of glowing fuel in the fire box. No smoke could be seen issuing from the stack, and the object, that of entirely consuming the fuel, seemed to be attained. But this is not practicable in ordinary use, though it may be approximated more nearly than it is, in almost every case.

The use of steam in very minute jets in front of the fire box inside may be made to contribute largely toward heating up furnaces and consuming smoke, when intelligently and skillfully used. But when applied in excess it dampens down a fire and does much more harm than good.

Water, it is well known, is composed of two highly combustible gases, oxygen and hydrogen. When steam is injected into a very hot fire, the water of which it is composed is decomposed, or separated into these gases, which add greatly to the heat of the furnace.

These suggestions are made largely for the attention of firemen and engineers, who can readily see what a margin for improvement is before them.

The Manufacture of Bessemer Steel.

Official statistics show that the production of Bessemer steel ingots in the United States last year was 1,696,450 tons, being an increase over 1881 of 10 per cent. The quantity of Bessemer steel rails produced in 1882 by the fourteen completed works was 1,334,349 tons, and an increase of 6 per cent as compared with that of 1881. These figures do not cover rails made from imported steel blooms and open hearth steel rails.