MANAGEMENT OF STEEL.

We have given considerable room to communications on this subject, but as it is one which is not surpassed in importance by any other process in the mechanic arts, it is proper that the suggestions and experience of practical men should be laid before our readers whenever they contain any new facts or support disputed theories. Below are extracts from three communications, each of them from practical steel workers. The first is from "C. H.," of Collinsville, Conn. He says:—

I have read with pleasure the articles on working and tempering steel in Nos. 7, 12, 15, and 16, current volume, and while agreeing with many of the statements of your correspondents, there are others to which I should take exceptions. In the one by "E. M. F.," in No. 16, he says: "We can neither depend upon the degree of polish nor color of surface. The secret lies in the working of the steel and in the proper degree of heat given the steel to be hardened." This is true in a certain sense, and yet when the steel has been properly worked, and hardened at a proper heat, some guide is needed in bringing it to the right temper, and I know of none so sure as the color. But all tools do not require the same degree of hardness. Take for instance, a bar of steel of the proper quality for wood-cutting tools, and make from it an ax, framing chisel, carpenter's hatchet, drawing knife, and turning chisel. Work it carefully, harden in brine as strong as salt will make it, at the lowest heat that will thoroughly harden it through, wash off the salt in fresh water, scour with a piece of common grindstone, just sufficiently to remove the scale, and draw the temper of the turning chisel to a light straw, merely changing the color; drawing knife, a bright copper; carpenter's hatchet, copper with purple spots; framing chisel, purple; chopping ax, deep blue; and we shall have tools that will stand any reasonable amount of strain, and carry at the same time a keen, smooth edge. Of course if a higher or lower grade of steel is used it will be necessary to vary somewhat from this.

One cause of trouble among the workers of steel is that they do not get steel adapted to the different kinds of tools they make. To illustrate this point, some years since I was making cast-steel hoes. I wanted a pair of blades for trimming shears, and having nothing else of the right size at hand, I made them from a bar of hoe steel, leaving them at the usual temper. But although the steel was of the very best quality of its grade, they would not stand; the edges would roll. I hardened them again, leaving them much higher. Then they would crumble and after several ineffectual attempts to make them cut I gave it up as a bad job, and made a pair from steel adapted to that kind of work, and afterward had no trouble. From my experience of more than thirty years, I am convinced that three things are absolutely needed to make good tools: 1st, steel of a grade adapted to the required tool; 2nd, a proper working of the steel in making, not heating too hot nor hammering too cold; 3d, proper hardening and tempering. Now if any man expects to succeed in the business and make a uniformly good tool without proper attention to each of the points named, I think he is doomed to disappointment.

"R. F. S.," also of Collinsville, the seat of an immense manufacture of axes, scythes, etc., gives some opinions on color and heating. He says:

E. M. F. has a good article in No. 16, but thinks steel should only be heated to a dark cherry red to harden. Now this is too indefinite, as cherries differ materially in color. Eyes also differ in judging of color. A cherry-red heat on a forge under the window and one on a forge in a shady place are two very different heats. Again the heat required by high and low steel cannot be governed by the color of the same cherry, nor can a piece of steel one-eighth of an inch thick be properly hardened with the heat required by a piece one-half of an inch in thickness. I am of the opinion that the only proper test as to the amount of heat required is to be had by experiment. Now we find that the most approved brands of steel are nearly uniform in themselves; then we are safe in taking a piece and find the lowest point of heat at which it will receive a thorough hardening and the experienced eye must follow the lead thus indicated, often applying the test to keep the eye right. In the article of "W. S. D.," in May 11th, he speaks of tempering by one process, or of giving steel just the desired hardness without the necessity of drawing the temper, but thinks it is a matter of such nicety as to be impracticable. I differ somewhat from him.

Assuming that a piece of good steel has been properly forged and the desired refinement given it by a judicious hammering, my experience is that the steel receives an additional refinement by a thorough hardening, and in proportion as it lacks in being made as hard as it can be by the hardening process, just so much it is lacking in its perfect refinement; and when I speak of steel being made as hard as it can be I repudiate the idea that an extra high heat will produce an extra hardness; a high heat may produce an extra brittleness which some mistake for hardness, but the fact is such brittle steel will file easier than if hardened at just the proper heat.

"H. G.," of Mansfield, Ohio, gives some practical hints drawn from an experience of twenty years. He says:

In ordering my steel I always state the use for which it is intended, as all know that much depends upon the quality of the material, and we cannot make a fine tool from a coarse steel. Steel should never be heated above a degree sufficient to work it into the required shape; at the same time it should never be hammered when lower than a cherry as it becomes hard and brittle, and in most cases will check or become flawy. When hardened, steel should be worked in a good clean fire (charcoal fire is the best) and should be hammered sufficiently to thoroughly work the steel, but should never be drawn from a large bar to a small one, as it will invariably crack or spring in hardening; it should be hammered as smooth as possible, especially when it is to be hardened without finishing, as a smooth piece of steel is less liable to crack in hardening than one that may be full of hammer marks or scales. When heated to harden, heat very slowly and just sufficiently to take the temper, and when plunged into the water under no circumstances should it be withdrawn until cool, or not one degree above the water in which it is plunged, as it will crack and fly then if ever, and there are several instances where people have lost the use of an eye by withdrawing steel from the water before it was thoroughly cool. After the steel has been hardened it should be polished even and fine, always in one direction, and be drawn as slowly as possible, and for the finer qualities of work should never be cooled while drawing, but should be drawn gradually enough to lay it down and let it cool off without checking, as it will make it tougher, and not so liable to crack. Many smiths use tallow to bring out the color, but the utility of this I very much doubt except in some few cases where the work is very small and difficult to polish. I think, owing to the difference in steel and the nature of the work for which the tool is intended, that the exact color cannot be laid down with any degree of accuracy and is only to be ascertained by experience and careful study of the nature of the steel and the work to be performed, as the lower the steel the higher temper it will bear with safety and *vice versa.* After all my experience I have come to the conclusion that it is an impossibility to make a good cutting tool without polishing the steel to draw the temper.

BOILER FEED PIPES, CHECK VALVES, AND CAST-IRON HEADS.

From a correspondent, G. W. D., of Providence, R. I., we have received some account of a boiler explosion which lately took place in Massachusetts. One of the boilers in a nest of eight, burst, displacing the remaining seven and carrying destruction in the path of its fragments. The boiler was rent in two parts, one part imbedding itself in the chimney and the other flying two hundred feet, cutting through a telegraph pole, damaging a railroad embankment, tearing up the rails and plowing a furrow in the ground, after striking, two feet deep and two hundred feet long. The superintendent of the works attributed the explosion to excess of water in the boiler, but our correspondent thinks it was occasioned rather by absence of water.

The nest of boilers was fed with water by a common pipe, having branches leading to each boiler, and one check valve on the main pipe between the pump and nearest boiler. Our correspondent believes that unequal firing disturbed the equilibrium of the water; in other words that firing under one boiler more than under another will create a greater pressure of steam in that boiler, forcing the water out into the cooler boilers, thus leaving the boiler which bears the most intense heat without an adequate supply of water.

He approves of introducing a check valve to every boiler to prevent the water from being driven out of one boiler into another, and, better than that, to employ competent men to manage boilers in sets.

It seems as though there could be only one place to which the check valves could be applied, and that would be in the branch pipes leading from the main feed pipe to each boiler. If placed in the main horizontal pipe they would prevent the water from backing into one boiler, but not into that on the other side. If the water-feed pipes are large enough and the connection between the steam spaces ample, it seems there should be but little trouble in equalizing the pressure and the level of water in the different boilers without any check valves. Preferably, independent feed pipes to each boiler should be employed; then each boiler could be treated as a separate generator. If not, would it not be well to introduce cocks between the boilers to be attended to by the fireman or engineer? Sometimes one or two boilers of a nest are used while the others remain idle. In this case there is a means to stop both water and steam communication between those in use and those at rest. Under such circumstances the equilibrium must depend upon the knowledge, carefulness, and attention of the fireman, or the constant oversight of the engineer.

A similar explosion to that mentioned by G. W. D. is described by a correspondent from Jacksonville, Fla. In this case the boiler that exploded was the middle one of three plain, cylindrical boilers, forty feet long and forty inches diameter. The cast-iron head blew out, the disk cut from the flange as evenly as though turned off in a lathe. The head itself merely blew out and lodged at the foot of the chimney directly behind the boiler, while the shell went at least three hundred feet, cutting timbers off clean and dragging its two companions from their beds about their own length. The writer attributes the blowing out of the cast-iron head to its vibration by alternate expansion and contraction, or bulging by being heated during the day and cooled during the night. This is undoubtedly the reason why it gave way as it did, but why should that particular boiler head yield and not either of the others? More internal pressure was exerted on this boiler than on the others or all would have gone and at the same time. Our informant does not describe the means of communication or of separation between the boilers, but only says "there was abundant means of communication both for water and steam between all these boilers, and no greater pressure could exist in one boiler than in the others." The explosion took place in the morning before the machinery had been put in operation. The watchman states that there was plenty of water and the steam gage stood at seventy pounds. The engineer says he left the boilers the night before with three gages of water, and our correspondent deemed the sound of the whistle which he heard a few minutes before the explosion not to indicate a high pressure of steam. All this may be and yet there may be circumstances in regard to the communication between the boilers which are not mentioned by our correspondent which would, in a measure at least, afford a probable reason for the explosion. We knew a case where a boiler in a set was exploded when ample means of communication existed, but the steam and water connections could be closed by cocks. Notwithstanding the asserverations of the fireman, it was evident that the exploded boiler was without a proper supply of water. If the steam communication was closed and the water communication open between the different boilers, and one boiler was fired harder than another, it would not require a very great preponderance of steam pressure to empty the water from the heated boiler into the others, leaving that one in a most dangerous condition.

As to making cast-iron heads thick enough to prevent springing, it may be questionable whether this would be as effectual and economical a remedy as making them of wrought iron and of hemispherical form as is the practice in England. This is a far better form to resisti nternal pressure than the flat disk head. In flue boilers the flues themselves are usually the only stays employed in retaining the heads in position, but the expansion of the flues is sufficient to exert an enormous force on the heads. It is no wonder that explosions occur from this cause; the wonder is that they are not more frequent.

The Repeating and Breech-loading Rifle.

Captain Majendie, an assistant superintendent prominently employed in the trials of arms and ammunition in England, lately delivered a lecture before the Royal Institution, in which he reviewed the progress of breech-loading rifles, concluding with the decided opinion that the final solution of the problem would not be reached until the magazine or repeating rifle should be so simplified and perfected as to meet all exigencies of service, at the same time as a single loader while carrying its magazine complement ready in reserve. The alteration of the Spencer repeating rifle to meet this requirement was the subject of an interesting trial on the 26th of April, at Vincennes, France, where it is reported to have elicited the warmest approbation from the French military authorities, none of whom were previously well disposed toward it. In fact, says the *Mechanics' Magazine*, the only draw back to this arm for general military purposes, has been that it could only be used as a repeater, and now that it can be used thus or as a direct breech-loader, at will, the French authorities are convinced of the efficiency of the rifle every way: the remarkable accuracy and unparellelled rapidity of fire—21 shots a minute—having extorted unqualified admiration.

Very interesting characteristics of warfare with the Indians, as modified by this weapon in the hands of our troops, are recalled from the testimony of Lieut. McMurray, of the 1st artillery. One day in the fall of 1865, two mountain men and tnine soldiers, armed with this rifle, fought their way steadily on foot through an encircling force of not less than 1200 to 1500 Sioux and Cheyennes. The moral effect of the constant fire from so few arms, and its accuracy at long range, kept the Indians out of arrow range as effectually as the dreaded "shooting wagons" of the artillery, and the party regained the command without a wounded man. On another occasion two men out hunting were pursued by twenty or twenty-five Indians: one of them was killed, but the other took shelter in a little gulch and commenced pouring in his fire from the magazine rifle, and after killing and wounding four Indians and two horses, the rest galloped away, when he pursued his way to the command unmolested. The Indian bow is more deadly within range than any non-repeating rifle, as they can handle their arrows rapidly enough to keep from five to seven in the air following one another at once, with an almost unerring aim. But the Spencer rifle is too much for the bow, from its equal rapidity and longer range; and too much for the archer likewise, as yet, for the Indians have been seen to pick up the rifles of men they had killed, load them by the muzzles, and after many ineffectual attempts to fire them, throw them away.

The Cere Viaduct.

This fine structure, crossing the valley of the Cere and carrying the Paris and Orleans railway at a hight of 181½ feet from the water, is another and more complex and lofty specimen of the modern style of bridges supported on tubular piers. Each of these consists of eight cast iron columns, grouped in an ellipse, united by cross bracing, and resting on a base of brickwork. The piers taper upward from a base of about 8x16 feet, at the rate of 1 in 30 toward the major axis and 1 in 15 toward the minor axis of the ellipse. Their hights, we are unable to state precisely, but the highest cannot be far from 150 feet. There are five spans of lattice girders, the three central spans being 164 feet each, and the end spans 145 and 139. The abutments are of stone. The erection of this viaduct was conducted in the same bold manner as that adopted at Fribourg, the girders being first put together on the abutments, and then pushed forward until the overhanging ends were over the brickwork base of the first of the iron piers to be erected. They were then braced, and used as the jib of a crane for hoisting into place the successive joints of the tall iron limbs upon which they were to rest. When one of the piers was thus completed, the girders were again pushed forward until the foremost end rested on it and projected forward over the base of the second pier, and the same process as before was repeated until the structure was complete. The total cost was about $150,000.

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