STEAM BOILERS---THEIR FORM, CONSTRUCTION, AND MATERIAL.

NUMBER SIX.

Although the attention of engineers, mechanics and others has been directed towards endeavors to acertain the cause, or causes of boiler explosions ever since the introduction of steam as a motive power, it does not yet appear that their efforts have been crowned with very marked success. This result, or want of result, is no reflection upon the ability of those engaged in prosecuting these inquiries; for the circumstances attending explosions are so varied, and even contradictory, that the attempt to single out any one as an adequate cause for all cases must be futile, and it would almost seem that every case must be treated separately. Absence of water, overheating of plates, uneven firing and feeding, corrosion and wear from long use, weakness of form, and imperfection of workmanship and material are each offset by conditions of exactly the opposite character, and under every one of these conditions boilers have exploded, if human testimony can be relied upon.

Under such discouraging circumstances the task of detecting the causes of explosions and suggesting the means of prevention is an exceedingly difficult one. When boilers explode while under the charge of skillful and competent men, it would seem that the causes must be limited, or nearly so, to weakness of form, imperfection of material, or poor workmanship. The first of these has been treated in previous articles. It is manifestly necessary, even if one form should be determined upon as the strongest, that it should be modified to suit varying localities and uses. That which would answer admirably for stationary purposes might be wholly unfit for vessels, and boilers adapted for river boats might be unsuitable for sea going ships. None of these forms would do for the locomotive. We are aware that the Harrison boiler is claimed to be adapted to all situations except the last, and similar claims have been made for others; but these claims have not as yet been generally acknowledged, and we do not propose to discuss them. The broad statement may be honestly made that a form of boiler specially adapted for steam driven vessels is not a form well fitted for stationary uses nor for the railroad. As, therefore, no one shape can be adopted for all purposes, the only remedy for weakness of form is judicious staying.

Imperfection of material must be acknowledged as a prolific source of explosions. The practice of testing the finished boiler by hydrostatic pressure is an exceedingly expensive and, in our opinion, not a satisfactory one. If the boiler fails under the test, either it must be taken to pieces and the whole material condemned, or, as is generally done, the defective plate must be removed and another substituted. If the first course is pursued, injustice is done to the boiler maker and the iron manufacturer; for it might be that the larger part of the material used was what it should be, and if the latter course be taken the purchaser may be the loser; as a boiler which has been so strained as to show its weakness suffers some deterioration, and may have been tested closely to the rupture, while the new plate which replaces the old one may be in an entirely different condition. The test should be made on the iron before it is put into the form of a boiler, and then the test on the boiler itself would be made simply to detect faults of construction. It is not seldom the case that the iron which composes a boiler shows no defect under the severest hydraulic test, but when heated and exposed to the pressure of steam, blisters and cracks exhibit themselves to the gaze of the surprised engineer. Such a preliminary test is proposed by the plan of Richard Montgomery of this city, who corrugates the plates of which a boiler is composed by running them between rollers having circumferential depressions, the cross sections of which exhibit alternately a concave and a convex form. The plates are evenly heated to a bright, cherry red, and then passed between the corrugating rollers, coming out either straight, or, if desired, curved to correspond with the diameter of the boiler. By this method it is claimed the quality of the iron is tested, inch by inch, as it passes through the rolls, so that if any flaw or imperfection exists it will be revealed by the trial. Only the toughest and most homogeneous iron can stand such a test, although the question might be raised whether the iron might not suffer some deterioration from it. The corrugations are about two inches from point to point, giving immense rigidity to the iron and increased heating surface. This plan of testing boiler iron appears to be well adapted to the detection of poor material. It is certain that corrugating iron adds greatly to its rigidity and power of resisting pressure.

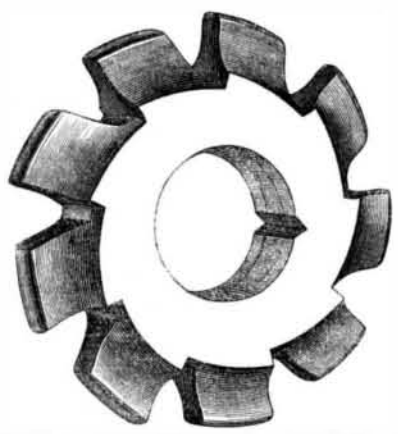
We recommended in No. 5, current Vol., page 69, such a device for strengthening boiler flues, copied from the London *Engineering*, an illustration of which we furnished, giving our reasons for our favorable opinion. If in this case it was—as had been proved—an advantage, why should it not be when extended to the construction of the entire boiler?

Poor workmanship may be called another one of the causes of boiler explosions. Calking with the sharp edged "set" or chisel is often improperly done and the sheet is indented and partially cut through by its injudicious management. The percussion of the hammer transmitted through the chisel will more or less change the texture of the iron and assist any tendency to weakness. The introduction of stays is not always properly managed. Sometimes they are put in as closely as may be, where there is no real need of their services. Every one furnishes a nucleus for the accumulation of scale and it is in these spots where corrosion most readily takes place. In punching the holes for rivets, carelessness or ignorance allows such aberrations that in some cases half the diameter of one hole may overlap the other. Then the "drift" or the reamer is introduced and a rivet put through, the shank of which does not half fill the irregular or enlarged aperture, and the whole dependence of the workman is on the head and riveted end. Manholes cut out of a plate without strengthening rings around them are simply invitations to a rupture. Patching old sheets with new plates and drawing them to place by screw bolts is another fault which must sooner or later show deleterious results.

But there is one cause of boiler explosions to which we have not adverted. That is the custom of purchasing old or discarded boilers to do new work. If a man purchases an engine without a boiler he casts about to find a boiler large enough, and, above all, cheap enough for his purpose. In both respects he can be easily suited. Knowing, perhaps, nothing himself about a boiler, he ventures upon the precarious ground of receiving the statement of the would-be seller because by so doing he may save a few dollars. He buys a boiler perhaps honeycombed internally by corrosion but fair outside, and sets innocent men to work about it. An explosion occurs and the jury of inquest over the victims of this man's credulity or criminal ignorance brings in a verdict of death from accidental explosion. The sale of boilers ought to be regulated by law as well as their manufacture. If they are of good material, good form, good workmanship, and in good condition the purchaser ought to know it and if not the seller or manufacturer ought to suffer for it.

BROWN & SHARPE'S CUTTER FOR THE TEETH OF GEARS.

While improvements have been made in almost every other tool in common use, there seems to have been no change for the better in the construction of cutters for the teeth of gear wheels, which as every machinist knows, are troublesome and expensive to make, and last but a short time, as they soon become dull and then require to be annealed, re-cut and hardened again, the cost of which is nearly equal to that of making new cutters, while the steel is liable to injury from repeated heating.



To overcome these difficulties a cutter has been made as shown in the engraving, by constructing the teeth or blades in the form of segments or curvilinear sections that are mechanically accurate in outline and of equal size and contour throughout their entire length, each of which has a sufficient circumferential inclination with respect to the revolving circumference of the cutter to produce the proper degree of clearance, so that the tooth may be sharpened by grinding away its face until its strength is permanently impaired, and so that it will always present the same cutting contour, each new face and cutting edge produced by grinding being a fresh radial section of an equi-form tooth throughout its whole length.

A cutter made on this plan will outlast many of the old form with the advantage of being always ready for use. If, as frequently happens, the cutter becomes dull before a wheel is completed, it can be taken out, sharpened and returned to its place in a few moments without any risk of altering the form of the teeth to be cut. From want of knowledge of the true principles of gearing or from want of practice in their application many machinists would prefer to purchase cutters rather than to be troubled with making them, especially if they could promptly procure a superior tool at a reasonable price. Those interested can obtain further information by addressing the manufacturers, J. R. Brown & Sharpe, at Providence, R. I.

EXPOSITION NOTES.

A MODEL is exhibited in the French department, of a mine elevator, or a sort of a car pump. A continuous frame reaches to the bottom of the shaft, furnished with catches for the cars at regular intervals. The whole frame rises and falls like the piston of a pump; at each rise bringing up each car caught upon its hooks, the distance of the stroke, and lodging it upon stationary catches, from which it is again taken and elevated a further stage by the next stroke, and so on to the top. The arrangement involves a heavy and extraordinary addition to the weight to be raised.

A WHOLE WELDED BOILER from Dusseldorf is exhibited in the Prussian annex. A steam dome is welded upon the boiler, and so accurately and smoothly is the whole work done as to be hardly distinguishable, superficially, from a casting.

THE ANNULAR BAKING FURNACE invented by Hoffman, of Berlin, is on exhibition. The annular space is divided into compartments, so arranged that the hot draft from the baking of one set of bricks or earthen ware passes into the next compartment to dry another charge, and thus travels the circuit until exhausted of its heat. While the next charge is being burnt, the draft of air therefor is passed through the last-burned pile, cooling the latter and carrying its heat into the adjoining fire. The coal is introduced in fine dust through small orifices in the upper part of the oven, and consumed before it reaches the oven floor.

A MILLSTONE, from Paris, embodies a bolting sieve: radial pieces of wire gauze being let into the nether stone at intervals, through which the flour passes, while the bran is carried to the outer edge.

A UNIVERSAL EVAPORATOR, from Paris, consists of a series of hollow copper disks on a hollow shaft, through which steam, at a high heat, is passed continuously through the whole interior. These disks, all dipping in a trough of the liquid to be evaporated, and revolving, carry a constant film of the liquid upon their hot exterior, which of course passes rapidly into vapor. The plan is not novel. We notice that Mr. H. F. Schroder, of Cincinnati has just re-invented one for the benefit of our sorghum farmers.

EVELYN'S STERN PADDLE (England) consists of a horizontal oar blade, placed transversely to the stern of the ship, and moved up and down in the water; feathering of course to an opposite pitch at each change of direction.

A TWELVE-CHAMBER PISTOL (Paris) has its chambers in the periphery of a vertical wheel, which is so easily removed and and replaced, that an indefinite supply of ready-charged wheels may be carried and used in succession. An old idea but a good one if successfully applied.

A NEW NAIL-CUTTING MACHINE is exhibited by the Wickersham Nail Company, of Boston. In the usual machinery, the plate is turned over alternately to right and left, with manual dexterity, by the feeder, in order to compensate at each cut for the unequal depth taken between the head and point of the nail. To enable the plate to feed directly forward, is a desideratum upon which much inventive pains have been expended by different parties. This machine acts with ten cutters inclined alternately so as to cut alternate nails, "heads to points," and cuts eight nails at a stroke, and nearly 1000 per minute, feeding almost automatically.

TAKEN IN.—The English begin to suspect that they are tricked in the exhibition of war material at Paris. They find that while they have freely showed their hand, placing the best results of their ingenuity and lavish expenditure at the service of all who choose to take drawings and specifications of their ships, guns, and projectiles, other nations, particularly France, have been careful to expose nothing that is of the slightest novelty or consequence. They feel as if their rivals had got the substantial advantage, by leaving them the empty triumph of "walking over the course."

WORKINGMEN'S EXCURSIONS are organized by a Workingmen's Exhibition Committee, in London, which has obtained from the Imperial Commission the use of a large building, comfortably fitted up for the accommodation of the visitors (to be not less than 200 per week), and has made such arrangements for transport, etc., that the entire expense of seeing the exposition for a week (meals excepted) would be only about $7,25.

SUCTION OF WELLS, is a principle patented and illustrated by M. A. Donnet, civil engineer, of Lyons. By closing the well air-tight, and exhausting the air, the water currents reached by the well will be drawn upon, together with their branches and remotest connections, with considerable force, and the flow of water, where insufficient, will be materially increased.

A GREAT H-GIRDER is exhibited from the Chatillon forge, measuring 3 feet 8 inches deep, 1⅛ inches thick in the web, and 12 inches wide in the flanges. The same establishment sends another gigantic beam 110 feet long, 8⅝ inches deep and 4½ inches across the flanges, and exhibits a short strip of 3-in. L-iron, only 140 feet long.

New Recipes.

WHITEWASH AND STARCH.—The *Chemical News* promises that a strong solution of sulphate of magnesia will give a beautiful quality to whitewash, and a little of it used with starch will add considerably to its stiffness and render cotton or linen garments to a certain degree incombustible.

BLEACHING GLUE.—Soak in moderately strong acetic acid for two days, drain, place on a sieve, and wash well with cold water. Dry on a warm plate. This method is given in *Dingler's Journal*.

CEMENT.—A cement particularly adapted for attaching the brass work to petroleum lamps, is made by Puscher, by boiling three parts resin with one of caustic soda and five of water. The composition is then mixed with half its weight of plaster of Paris, and sets firmly in half to three quarters of an hour. It is said to be of great adhesive power, not permeable to petroleum, a low conductor of heat, and but superficially attacked by hot water. Zinc white, white lead or precipitated chalk may be substituted for plaster, but hardens more slowly.

WELDING COMPOSITION.—For iron or steel or both together, calcine and pulverize together 100 parts iron or steel filings, 10 sal ammoniac, 6 borax, 5 balsam copaiva or copæiba. One of the pieces is to be heated red, carefully cleaned of scale, the composition is to be spread upon it, and the other piece applied at a white heat and welded with the hammer.

DRILLING GLASS.—To the old mode of boring glass with a file wet with oil of turpentine, a correspondent of the *Chemical News* adds an amendment from a German source, confirmed by his experience, to the effect that dilute sulphuric acid is much more effective, with less wear of the tool, than oil of turpentine. It is stated that at Berlin, glass castings for pump barrels etc., are drilled, planed and bored like iron ones, and in the same lathes and machines, by the aid of sulphuric acid.