SCIENTIFIC AMERICAN

A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS. CHEMISTRY, AND MANUFACTURES

Vol. XX.---No. 15. [NEW SERIES.] NEW YORK, APRIL 10, 1869. $3 per Annum [IN ADVANCE.]

Improved Adjustable-Jaw Vise.

The machinist, the blacksmith, the jeweler, and the workers at some other trades, know the value of a good vise. The vise-man in the machine shop who has a clean, well-ordered bench, a drawer of well-assorted files, gages, straightedges, etc., and above all, a reliable vise, ought to be satisfied with his means of working or—ought to quit the business. Yet, although each variety of vise with which we are acquainted possesses some advantage peculiar to itself, we have never seen one that appears to combine them all so completely as the one herewith represented.

The inventor cites these as the principal objections to the parallel vises now in use: " So constructed that a loss of squeezing power of about twenty per cent is sustained; not adapted to the same hight in all vises, while the rule for the elevation of the top of jaws is the level of the bend of the workman's elbow; the strain, concentrated at one point, increasing the possibility of easy breakage by hard use, having no elasticity, too much rigidity, and considerable wear to screw and nut; having nothing to receive the concussion of a blow; loss of motion, the screw sometimes making an entire revolution or more, before the jaws answer."

It is a leg or post vise, sustained both by the bench and floor, making it solid and firm, by which the full force of the blow is obtained, while it is adjustable in every direction required by the necessities of the work. The foot pivots in a step screwed to the floor, and the rear jaw has a semi-circular ear through which passes a screw bolt, the head of which moves in the segmental slot of a plate screwed to the top of the bench. This permits the whole vise to be swung in a horizontal plane, so as to present the jaws to the edge of the bench at any angle desired, when it may be held firmly by the bolt. The advantage of this is too apparent to the workman to require more than a reference to it.

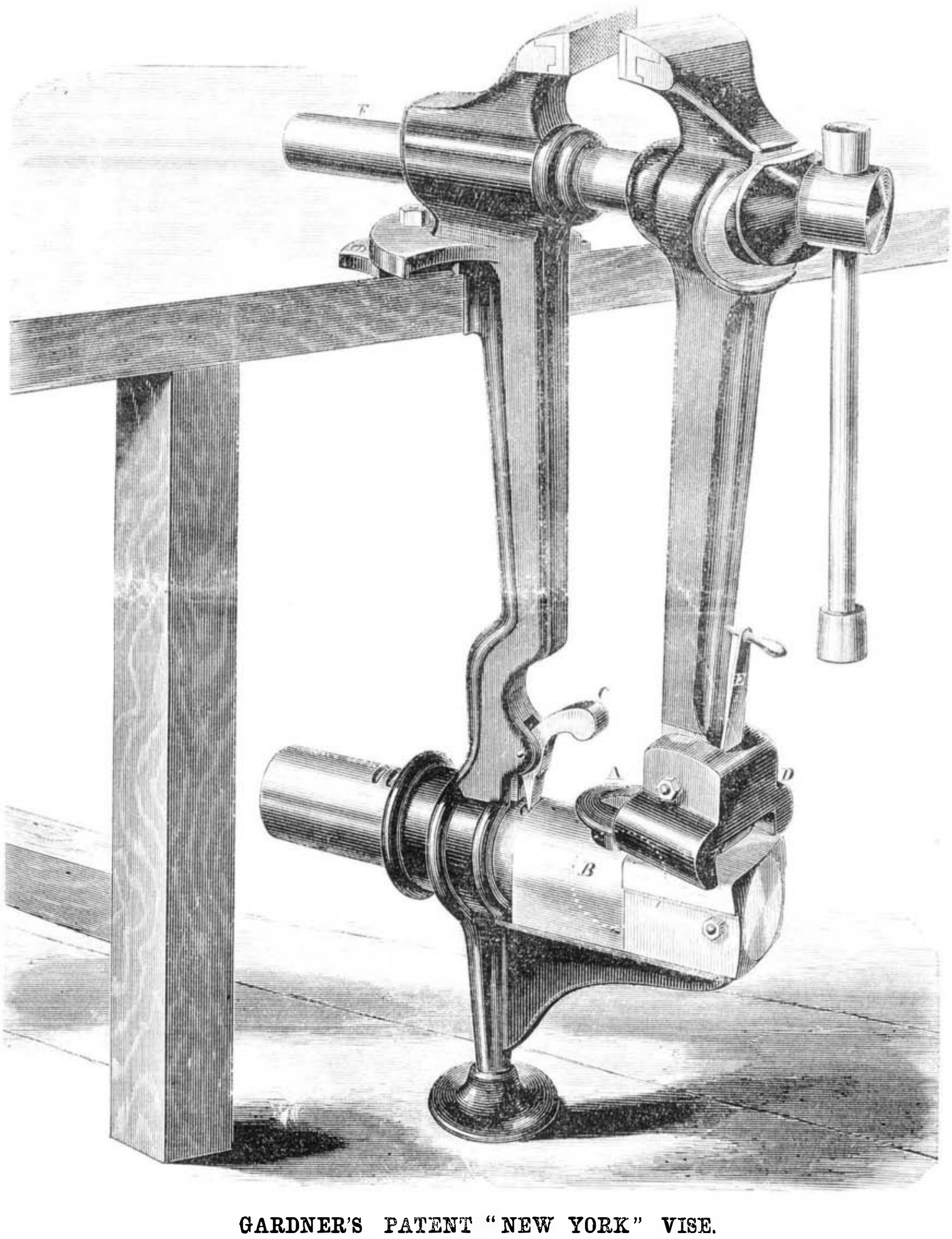
The front jaw has an offset, A, carrying a ball and socket joint inside the hollow sliding bar, B, that permits the jaw to swing in the usual manner, and also to be turned at an angle to the back or fixed jaw, this latter movement being intended for holding work, the sides of which are not parallel, as a key, etc. To permit this motion, the eye of the front jaw through which the screw sheath passes is made flaring, or trump-shaped, at the front. On the front jaw, encircling the screw, is a saddle washer, the inside of which is made to conform to the outside of the jaw face, so that in whatever position the jaw may be placed, this washer has a perfect bearing.

The sliding bar, B, may be moved in or out by sliding it through the collar in the lower part of the fixed jaw, and is held in position by a pivoted dog, C, the point of which engages with notches cut on the top of the sliding bar. This allows the foot of the movable jaw to be kept parallel with the faces of the jaws, and to be accommodated to the diameter of the work to be held. The spring that throws this jaw out is concealed in the hollow bar, B, and it acts in whatever position the jaw may be. The bar is sustained by a projecting shelf forming a portion of the fixed jaw, strengthened, as seen, by a flange underneath.

When the jaws are parallel they are held in that position by a clutch, D, on the front jaw that slides down and embraces, with its side projections, the squared portion of the sliding bar. When raised to permit the jaw to be set at an angle, it is held by a spring catch, E. The screw is at all times protected from chips, filings, or dirt, by the sheath, F, which is rigidly secured in the back jaw. The offset, A, does away with lost motion, the instant the screw is started the jaws moving simultaneously

The jaws proper are of the best cast steel, reinforced with Swedish iron, and milled to a gage. They are fastened with tapering steel pins and are made interchangeable, so that if they break or wear out they may be replaced at half the cost of annealing, re-cutting, and re-tempering the old style.

It will readily be seen that the strain is equally distributed from the top to the bottom of the vise, and the friction in working is reduced to the minimum. In strength, durability, handiness, and elegance, this vise has certainly no superior. These vises are made of all sizes from eight-inch jaws to jewelers' size. They are made of a combination of Lake Superior, and other ores well known for their toughness, strength, and resistance to percussion. Every vise is put to a test, three times as much as it is intended for in use, before it is sold.



GARDNER'S PATENT "NEW YORK" VISE.

Patented by O. H. Gardner, and made by the Fulton Manufacturing Company, to whom all orders should be addressed at Fulton, N. Y.

ON THE THEORY OF THE LUMINOSITY OF FLAMES.

In 1817, Sir Humphrey Davy published his theory on the causes of the illuminating property of flames. He stated that this phenomenon was due to the presence in the midst of the flame of solid particles which, undergoing partial combustion only, were rendered incandescent. In a candle these were supposed to be solid particles of carbon.

Recent experiments made by Dr. Edward Frankland seem to have entirely overthrown this theory. According to the researches of this eminent chemist many very brilliant flames exist in nature which cannot possibly contain any solid matter whatever.

If, says he, metallic arsenic be burned in oxygen gas it produces a most intense white light. It is, however, well known that metallic arsenic is volatilized at a temperature of 180° C., and that the product of its combustion itself, arsenious acid, is also vaporized at 218° C., while the temperature of incandescence of all solids has been proved to exceed 500° C., so that in this instance no solid particles could possibly exist in the flame.

The vapor of sulphide of carbon burned in oxygen gas or oxygen burned in sulphide of carbon produces a light so intense that the eye can scarcely bear it, and yet we are certain that no solid particles of matter are to be found here. The temperature of ebullition of sulphur, 440° C. is much below that of the flame produced in the above case.

If protoxide of nitrogen be substituted for oxygen in this experiment the result is identical; the light created possessing sufficient intensity for the taking of instantaneous photographs or for producing the phenomena of fluorescence.

Few bodies ignited in oxygen gas emit a more powerful light than phosphorus. The product of this combustion is phosphoric acid, which is gaseous at a red heat, and which could not possibly have contained solid particles at the temperature of a flame which is capable of melting platinum.

The conclusions arrived at by Dr. Frankland are that it is not solid particles which produce luminosity, but that the intensity of a flame depends on the radiation of dense but transparent hydrocarbon or other vapors. As a corollary to this theory he expresses his opinion, based on experimental researches, that a flame becomes luminous at a lower degree of temperature the denser the gases which enter into its composition, and he further infers that this luminosity is to a great extent independent of the nature of the vapor or gas, so that a gas which would burn without producing light at the pressure of the atmosphere, would become luminous, if submitted to a sufficient degree of compression.

In order to prove these facts, Dr. Frankland caused the combustion of jets of hydrogen gas and of carbonic oxide gas to take place in oxygen gas under gradually increasing tensions up to twenty times that of the atmosphere. This he did in very strong iron vessels furnished with thick glass windows which allowed him to witness what occurred in their interior.

Hydrogen gas, when burned in oxygen at the pressure of the atmosphere, gives a very feeble light. Under a pressure of two atmospheres this light is very noticeably increased, and at ten atmospheres a newspaper can be read at a distance of two feet without a reflector. Examined with the spectroscope the spectrum of this flame was bright, perfect, and continuous, from the red to the violet.

The intensity of an electrical spark sent through a gaseous medium is also proportional to the density of the gases, being weak in hydrogen gas, greater in oxygen, and very considerable in chlorine, sulphurous acid gas, etc.

A series of sparks from a powerful induction apparatus passing through air confined in a closed glass tube connected to a force pump, becomes brighter and brighter as the compression of the air is increased, and diminishes gradually in brilliancy as the air is allowed to escape.

The electrical arch, produced by fifty couples of a Grove battery, is much increased when the vapor of mercury is allowed to intervene between the points of carbon of the electric lamp.

The experiments of Frankland have elicited great attention from men of science, and a controversy is at present taking place on the subject at the Academy of Sciences, in Paris, where M. Sainte-Claire Deville affirms that H. Davy's theory is not subverted by the new discoveries, but that the facts observed may be satisfactorily explained if we admit, as he believes to be the case, that the temperature of a flame is increased in the same ratio as the increased pressure or density under which the gas is ignited.

The final verification of this physical law will need further elaborate and dangerous experiments, for the purpose of determining the temperature of combustion of various gases in oxygen, under various conditions of pressure higher than the atmospheric.

These conclusive experiments will soon be begun in France at the Ecole Normale, by order of the Emperor Napoleon III. The operators will be placed within a strong cylindrical iron chamber, where they will be surrounded by air, compressed to at least three times the weight of the atmosphere. Let us here remark that this pressure has been shown by the experiments of the bridge at Kehl to be harmless to the human organization.

The results of these experiments may eventually have a very important practical bearing on the use of gas and of liquid fuels in our furnaces and under our boilers, the heating surfaces of which they may tend to diminish. They may also furnish us with an easy means of working platinum and of producing an indefinite amount of heat, and will probably be the means of suggesting some useful hints for the increase of the illuminating power of our ordinary lighting materials.

EXPLOSIVE COMPOUNDS FOR ENGINEERING PURPOSES.

NO. II.

On page 167, we quoted from Mr. Nursey's paper on the above subject, read before the Society of Engineers, of London. The facts therein stated are so valuable for reference, and withal so interesting, that we continue our extracts. Mr. Nursey describes, by the aid of an engraving, a simple apparatus for determining the ignition point of explosives, by which their absolute and relative temperatures are ascertained at the instant of explosion. It is simply a contrivance similar to a portable retort stand. An upright fixed in a weighted base, to stand upon a bench or table, sustains two transverse adjustable sliding bars, secured at any point desired by set screws. From the upper one depends a thermometer graduated to 650° Fah. The lower arm holds a cup of oil into which the bulb of the thermometer dips. A miniature cup containing a small quantity of the explosive mixture, floats on the surface of the oil. Heat is applied by a gas jet under the oil bath, or by a spirit lamp. By this apparatus, Mr. Horsley has ascertained the ignition point of various explosives, and the following are among some of his results: Gunpowder ignites at a temperature of 600° Fah. A sample of Horsley's powder gave 430° as the ignition point. Gun cotton of a powerful character, prepared by Horsley, ignited at 325°, while some of Prentice's sporting gun cotton exploded at 410°. Trials of Schultze's sporting powder gave 385° as the ignition point. It is as well, at a time like the present, when new explosive compounds are constantly being brought under notice, that experimenters should know the character of the material they are dealing with, and which they will be enabled to ascertain by means of the above simple apparatus.

Another, and perhaps safer, application of chlorate of potash to the purpose in question was made some nine years since by M. Hochstädter, a German chemist. Unsized paper was thoroughly soaked in, and coated with a thin paste consisting of chlorate of potash, finely-divided charcoal, a small quantity of sulphide of antimony, and a little starch, gum, or some similar binding material, water being used as the solvent and mixing agent. The paper was rolled up very compactly and dried in that form. In this manner, very firm rolls of an explosive material are obtained, which burns with considerable violence in open air, and the propelling effect of which, in small arms, has occasionally been found greater than that of a corresponding charge of rifle powder. Moreover, the material, if submitted in small portions to violent percussion, exhibits but little tendency to detonation. But, as no reliance can be placed on a sufficient uniformity of action, in a firearm, of these explosive rolls, this alone sufficed to prevent their competing with gunpowder. The same description of explosive preparation, differing only from that of M. Hochstädter in a trifling modification of its composition, was again brought before the public in this country in the early part of 1866, having been patented by M. Reichen. The author has used this gun paper with very good results in rifle shooting, but nothing practical appears to have been done with the material.

The mixture previously referred to as German, or white gunpowder, consists of chlorate of potash, ferrocyanide of potassium, and sugar. Many years since it was proposed and tried without success as a substitute for gunpowder. Since then various preparations of similar character have been suggested for employment, either as blasting and mining agents, or for use in shells, or even for all the purposes to which gunpowder is applied. The most recent of these mixtures with which the author is acquainted, is a white gunpowder made by H. W. Reveley, of Reading. This mixture is a perfectly white impalpable powder resembling flour, powdered chalk, or magnesia in appearance. Reveley recently informed the author that he has constantly made and used it in preference to the ordinary gunpowder, both on account of its superior propelling power—which is at least one-third greater—and its perfect cleanliness. It produces neither smoke nor flash of flame at the muzzle on discharge, and can be used in a casemate with perfect comfort to the gunners. Mr. Reveley has used it for every purpose to which ordinary gunpowder is applicable, and invariably with the most perfect success. He has made many parcels of the white gunpowder during the last ten years, and has always found them uniform, both as regards strength and other properties, and he has never met with the slightest accident, although he has tested it very severely. The composition of white gunpowder is as follows:

Chlorate of potash	48
Yellow prussiate ditto	29
Finest loaf sugar	23
Parts by weight	100

In manufacturing this powder the yellow prussiate is dried in an iron ladle until it is as white as the chlorate. The ingredients are ground separately to very fine powder, and are then mixed by means of a conical sieve until they are thoroughly incorporated, but not by trituration. For small quantities, Reveley uses a common Wedgewood mortar and pestle, which must be perfectly dry and clean. The operation does not take many minutes, and with the above precautions, its manufacture is free from danger. In loading, it is treated in the same way as ordinary gunpowder, being pressed down by hand solid, but not hard. The charge is ignited in the usual way, with a common cap and nipple. In actual use, it does not appear to possess a bursting so much as a propulsive power, and Mr. Reveley has obtained some of the highest penetrative results in his rifle practice with it. The economy of this powder will at once be apparent, when it is stated that its wholesale cost is about 86s. per cwt., but as its strength is at least one-third greater than that of ordinary powder, its cost may be comparatively estimated at about 60s. per cwt. One important feature in the manufacture of white gunpowder is that it does not require to be—indeed, it cannot be—granulated, which process is the great source of danger in powder mills. The universal use of the cartridge entirely obviates any objection that may be made to white gunpowder on that score, or on the score of similarity in appearance to other substances, and, owing to its compact form, it only occupies half the usual space. Beside the foregoing, there have been several cruder applications of chlorate of potash in the production of explosive compounds, which it is unnecessary here to notice more particularly.

Among other materials, wood has been pressed into service to aid in superseding gunpowder as a practical explosive. Soon after Schönbein's discovery of gun cotton, a Prussian artillery officer, Captain Schultze, while investigating the subject, conceived that a finely divided wood could be converted into a controllable explosive agent more readily than cotton. He produced the substance known as gun sawdust, the explosive properties of which are mainly due to its impregnation with a large proportion of an oxidizing agent. In preparing the gun sawdust, the wood is purified from all resinous substances, and is digested in a mixture of sulphuric and nitric acids. This gives a very feeble explosive material, which is further strengthened for ultimate use by impregnation with nitrates, by which it is made to acquire great explosive power. Here, then, is a powder which may be preserved in a comparatively harmless condition until required for use, when it may be rendered powerfully explosive by impregnation with the nitrates. Although its properties are somewhat similar to those of gun cotton, many of the advantages of which it possesses, it is open to one very fatal objection. To be within the limits of safety, the completion of its manufacture must be delayed until the moment it is required for use; and, moreover, the final ingredients are the most dangerous, and require refined manipulation. It is needless to point out how incompatible the conducting this completing process is with the ordinary details of mining; the care and nicety required in such a chemical operation, must be referred to the skilled operator, and not trusted to the rough-and-ready hand of the miner. Practical safety can only be attained by an explosive agent into which the stray spark may fall without producing more than a gush of flame, a gradual burning, or without causing ignition at all, but which, nevertheless, when properly rammed home and tamped, may be fired with results at least equal, if not superior to ordinary gunpowder.

Utilization of High Falls of Water.

Glynn's "Power of Water," contains the following in regard to the utilization of high falls of water:

"Attempts have been made to employ a high fall of water by placing one wheel above another; this was tried many years ago at Aberdare, in South Wales, where two wheels, each forty feet in diameter, were so placed, like the figure of 8, and were connected by teeth on their respective rims—the lower wheel receiving the water after it left the upper one, and revolving in the opposite or reverse way. The result was not satisfactory; but in another case, a drawing of which lies before the writer, wherein Messrs. Charles Wood and Brothers, of Macclesfield, had two overshot water wheels, each of twenty-six feet in diameter, and six feet wide, placed over each other, they succeeded in a somewhat different arrangement of the toothed-wheel work. The two wheels were not connected immediately with each other, but by means of *pinions*, which worked into teeth upon the rims of the two water wheels, causing them both to revolve in the *same* direction, so that the water, on leaving the buckets of the upper wheel, was more easily and readily received by the buckets of the lower wheel.

"In either of these cases, however, the employment of the turbine, or the *pressure engine*, would have been much less costly and more effective. The like may be said of all the contrivances to substitute endless chains with buckets applied to high falls instead of water wheels.

"Where the quantity of water is large and variable, and the fall such as may be termed an intermediate hight, but varying also with the supply, it is found advantageous not to lay the water upon the top of the wheel, so that it may work overshot, but to make the diameter of the wheel greater than the mean hight of the fall, and to lay the water, as it were, '*on the shoulder*' of the wheel, or at forty-five degrees from the perpendicular; that is, half way between the horizontal line and the perpendicular, or, as millwrights say, 'at nine o'clock.' Very little mechanical effect is produced in the upper eighth of the circle as compared with the next quarter, on which the descent of the water is nearly perpendicular, and when the wheel is fitted with toothed segments at or near its circumference, acting on a pinion placed on a level with the axle, the weight of the water is brought to bear at once upon the pinion teeth, the stress is taken off the arms of the wheel, and the axle becomes, as it were, merely a pivot on which the wheel turns. By this arrangement, the late Messrs. Hughes and Wren, of Manchester, were enabled to make the arms of their wheels of simple tension rods of bar iron, by which the rim of the wheel was tied and braced to the center, a plan which, with some modifications and improvements, is still in use, and sometimes the segments have interior teeth, which render the wheel-work more compact.

"In the best constructed wheels, the water is laid on in a thin sheet of no greater depth than will give it a somewhat greater velocity than that of the wheel, the difference being just sufficient to pour into the succeeding buckets the proper supply of water. The buckets should be so capacious that they need not be full when the wheel carries its maximum load, in order that no water may be wasted, and that they may retain the water in them till the last moment that its weight on the wheel is effective, and yet empty themselves as soon as it ceases to be so. It is also expedient in practice to make the width of the sheet of water less than that of the wheels; if the wheel be broad on the face, the stream may be four inches shorter than the length of the buckets; the air escaping at the ends is thus prevented from blowing out the water; and all these precautions, though small in themselves, tend to produce smoothness, regularity, and increased effect in the working of the machinery.

"There is, however, one mode of using water power—acting by its gravity—in buckets upon a chain, much employed in South Wales, which is found very useful in raising ore from the pits. An endless chain is passed over a wheel of sixteen feet in diameter, placed between two shafts. The chain passing down each shaft, and through an opening at the bottom between the two, two large buckets, or rather shallow tubs of wrought iron, are fixed upon the chain, so that the suspension is by the center of the tubs, and they are so placed that when one tub is at the top of its shaft, the other is at the bottom of its shaft. Each tub or bucket is covered by a strong platform, which fills and closes the pit's mouth when hoisted up, and carries the small wagon or tram containing the ore upon it; and each is also fitted with a valve at the bottom to discharge the water. A branched pipe, communicating with an elevated reservoir, is laid to the mouths of the shafts, and fitted with stop-cocks or valves. The tub at the surface being filled with water, overbalances the empty tub at the bottom, and raises it, with its tram load of ore, to the top. When the full bucket has descended the shaft, the valve is opened and the water discharged; the other being filled in like manner, descends, and thus alternately each raises the other with its load of oar. The water finds its way out of the mine by a drift or adit into the valley; the long loop or bight of slack chain below the buckets, and hanging to the center of each, equalizes the weight of chain at all times; and a brake applied to the large wheel regulates the speed of the descending bucket. In some places the two buckets work in one shaft of an oblong form; the diameter of the wheel is reduced to seven feet; it is fitted with toothed segments, working into a pinion, fixed upon a second axle, on which the brake wheel is placed, in order to gain the requisite power to control the descending weight. Drawings of both these plans lie before the writer, but the principle and construction are so simple that a description will probably suffice. It may be proper to mention that the buckets generally work in guides, that the discharging valves are opened by striking upon a point or projecting spike at the bottom of the shaft, and that upon the platforms which cover the buckets, there is a portion of the rail or tramway laid to match with the lines of way at the top and bottom of the shaft, so that the tram or carriage may run from the platform to its destination."

Dr. Mallet's Opinion of the Heaton Process.

The following is Dr. Mallet's opinion of the reality and commercial value of Heaton's process:

"This process for converting crude pig iron into wrought iron and into steel, by the employment of nitrate of soda in Heaton's patent converter, has been repeated at Langley Mills many times in my presence. I have examined minutely into its details as applicable in practice on a large scale, and its results; and I have also considered the chemical researches made as to the materials used and products obtained, by Professor Miller, of King's College, and I have been present at experiments, conducted by Mr. David Kirkaldy, at his Testing Works, at Southwark, as to the physical qualities of the products which were obtained by this process, in my own presence, at Langley Mills. In view of all the facts that have come before me, I can affirm the following as truths established beyond question:

"1st. That Heaton's patent process of conversion by means of nitrate of soda, is at all points in perfect accord with metallurgic theory. That it can be conducted upon the great scale with perfect safety, uniformity, and facility, and that it yields products of very high commercial value.

"2d. That in point of manufacturing economy or cost it can compete with advantage against every other known process for the production of wrought iron and steel from pig iron.

"3d. Among its strong points, however, apart from and over and above any mere economy in the cost of production are these: It enables first-class wrought iron and excellent steel