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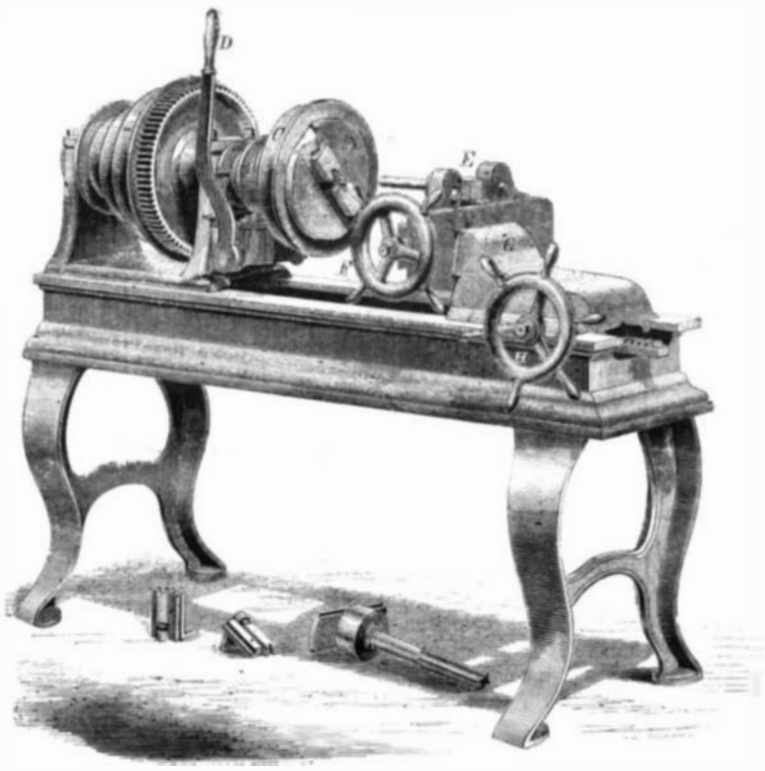
Improved Bolt Cutter.

This machine is designed to cut threads on screw bolts, and is intended to simplify and expedite the process as well as improve the quality of the work. There is no strain on the thread in backing off the dies, and the bolt is cut complete at one operation.

Appended is the inventor's description of his machine:—

"The mandrel is hollow, and on the end of it is fastened the face plate, A; to this is fitted two slides, as shown in Fig. 1; these slides have the dies fitted to them. The sliding ring, C, encircles the face plate and prevents the dies from opening while the bolt is being cut. When it is moved by means of the lever, D, toward the cone it causes the dies to open sufficiently to allow the bolt to be withdrawn without stopping or reversing the machine. The jaws for holding the bolt are shown at E, and are operated by means of a right and left-hand screw, cut upon the shaft of the hand wheel, F. The slide, G, to which the jaws are attached, is worked by means of the hand wheel, H, with a rack and pinion. The tap chuck is shown beneath, with a tap in it. In arranging the machine for cutting nuts the slides in the face plate are removed, and this chuck is slipped into the same place. The ring, C, is then moved over the ends, when it is held firmly.

"The nuts are held by the same jaws that hold the bolt, and are cut by running them across the threaded portion of the tap, on to the plain portion, in numbers sufficient to fill the same. The tap is then removed, the nuts slipped off, and the tap restored to its place for further use. The tap is fitted to a square socket in the chuck, and, consequently, can be removed and replaced without unscrewing or screwing up any bolts. This machine will cut bolts of any size, from one-fourth of an inch up to two inches diameter, by once passing over them, cutting the standard number of threads to the inch on all the sizes."



BABBETT'S BOLT CUTTER.

For further particulars and prices inquire of Avery Babbett, of Auburn, N. Y. A patent is ordered to issue on this machine through the Scientific American Patent Agency.

PUDDLING IRON BY MACHINERY.

At the last meeting of the Mechanical Engineers' Society, of Birmingham, a paper was read by Mr. Henry Bennett, of Wombridge Iron Works, on puddling iron by machinery, from which we take the following extracts:—

DESIRABILITY OF THE IMPROVEMENT.

"In the manufacture of wrought iron from the crude pig iron, the purifying of the metal by the process of puddling involves very heavy and long-continuous hand labor, since the metal, after being melted in the puddling furnace, has to be continuously stirred for a considerable time while boiling, in order to expose it thoroughly to the action of the current of air passing through the furnace, so as to effect the chemical changes required for the separation and removal of the impurities originally combined with the iron. The metal has then to be balled up into separate masses of about ¾-cwt. each for the shingling hammer; and the whole process extends over about an hour, from the time of melting the pig iron for each heat, of which six are worked in the day.

"The application of machinery to puddling has long been felt to be very desirable on account of the laborious nature of the process, owing to the continuous heavy work required, and the great heat to which the men are exposed; and the simple mechanical character of the greater portion of the process, which consists in merely a continuous uniform stirring of the material, renders it very suitable in that respect for the application of machinery. But the high temperature of the furnace, and the necessity for not interfering with the current of air passing through it, which has to be regulated and changed as the process advances, cause great practical difficulties in successfully carrying out the application of machinery in place of hand labor.

OBJECT AIMED AT.

"The object of the writer has been to employ machinery simply to aid the puddler by relieving him of the most laborious part of the work, namely, the stirring or working of the metal in the puddling furnace. At the same time the objects aimed at have been, by a more rapid and uninterrupted process of stirring the metal, to shorten the time of the puddling, thereby economizing fuel; to improve the quality of the iron, by rendering the process more uniform and perfect than with hand labor; and to increase the yield of the furnace, by working larger charges than could be both puddled and balled up at one heat by hand labor alone.

DESCRIPTION OF THE MACHINE PUDDLER.

"The ordinary puddling tool or 'rabble' is worked backward and forward in the puddling furnace by a vertical arm outside the furnace, to which it is connected by a notch in the handle of the rabble, dropped loosely upon a pin at the bottom of the working arm. This arm is cottered at top into a horizontal square bar overhead, sliding longitudinally through two guide sockets, and worked by connecting rods from a long T-iron bar, extending horizontally across a whole row of puddling furnaces, the T bar being carried by anti-friction rollers. A longitudinal reciprocating motion is given to the bar by a crank at one end driven by engine power. The guide frame or sector carrying the guide sockets of the sliding bar is centered on a vertical pin immediately over the door of the puddling furnace, and the outer end is moved transversely from side to side with a slow reciprocating traverse along a guiding quadrant, by means of a connecting rod from a crank, which is driven through a worm wheel and a screw shaft, extending over the furnaces alongside the reciprocating T bar. This bar works at a speed of about fifty strokes per minute, and has a length of stroke of 2 feet 10 inches, carrying the rabble with the same length of stroke across the floor of the furnace. The transverse motion given by the crank, which makes one revolution for every seventy strokes of the rabble, causes the direction of each stroke to change gradually between the two extremes of the guiding quadrant, so that the end of the tool, instead of moving backward and forward always in the same line, is worked successively over every portion of the floor of the furnace, within certain limits, in lines radiating from the working hole in the door of the furnace, corresponding exactly to the action in hand puddling. In the double furnace with a door on each, side, two traversing cranks are set at right angles to each other, so that the two rabbles are always working in different parts of the furnace. The whole of the machinery is kept clear above the furnace outside, and completely protected from the heat, and quite out of the way of the men; nothing being exposed to the heat except the rabble or puddling tool, the same as in hand puddling.

"The double furnace is exactly the same in construction in all respects as the ordinary single-puddling furnaces, except that it is made with a working door at each side and is one foot wider inside.

OPERATION OF THE MACHINE.

"When the charge of pig iron is melted and ready for the commencement of the process of puddling, the apparatus is put into action by simply dropping the notch, in the handle of the rabble, on to the pin in the working arm, which is kept continuously in motion by the horizontal reciprocating T bar working overhead. The puddler changes his tool from time to time, as it becomes heated, by simply lifting the notch in the handle off the pin in the working arm and replacing the tool with a fresh one, without stopping the machine; and when the iron begins to thicken, he takes the opportunity of each change of tool to make a few strokes by hand, in order to collect the metal from the extreme sides of the furnace into the center, which is found to insure the whole charge being uniformly worked. The usual time of working with the machine is about 25 minutes with ordinary forge pig iron, the tool being changed five or six times; but with gray iron the time of working is much prolonged. In the latter case the machine is especially serviceable, since the iron keeps in a fluid state much longer, and requires, consequently, so much more working; which causes the labor to be so much more severe in the case of hand puddling that there is great difficulty in getting the men to work any iron that is very

gray. With the machine, however, this causes no increase of labor to the men, and only increases the time of the process.

"When the iron begins to thicken, or, as it is termed, is 'coming to nature,' the machinery is disconnected without stopping it, by simply knocking out the cotter that fixes the upper end of the vertical working arm; the arm then drops out, leaving the furnace door entirely clear for the puddler to ball up the iron, which is done exactly in the same manner as in ordinary puddling furnaces, without the man being in any way inconvenienced by the machinery continuing at work overhead.

ECONOMICAL RESULTS.

"The machine is applied to ordinary single puddling furnaces without any alteration being required in the furnace, the frame of the apparatus being merely attached to the top of the furnace. The double furnace is preferable, however, as it effects a great economy in the consumption of fuel, as compared with a single furnace, and puddles double the quantity of iron in the same time. With the single furnaces at the writer's works, and charges of 5 cwt., the consumption of coal is 28 cwt. per tun of puddled bar made; but with the double furnace and charges of 10 cwt., the consumption of coal is only 17 cwt. per tun of puddled bar, being a reduction of 39 per cent. The number of heats or charges worked in the single furnace is six heats of 5 cwt. each, and, in the double furnace, five heats of 10 cwt. each, per turn of from nine to ten hours. In working the double furnace it is found best to have one puddler only and two underhands, to avoid the division of responsibility that would arise in the case of two puddlers working the same charge of iron.

"The yield of iron in working 5-cwt. charges in the single furnaces is 12 cwt. 2 qrs. 81 lbs. per tun of pig, or 93½ per cent, and with the double furnace working 10-cwt. charges, the yield is 18 cwt. 2 qrs. 9 lbs. per tun of pig, or 93 per cent.

SIX MONTHS' EXPERIENCE.

"Mr. W. Fisher, manager of Mr. Bennett's works, said, in answer to inquiries, that the puddling machines had now been at work constantly during the day for the last six months at the Wombridge Iron Works, and continued to work as well now as they did when they were first started; and there had been no occasion to repair any of the working parts since then, as the machines had been found very simple and strong. A man went round twice a day, and put a little oil on morning and evening; and they could be worked night and day when desired. At first there had been a little difficulty in introducing the machine; but now the men felt its advantage, and were anxious to have it employed on night work also.

"The six months' experience of the working of the machine had shown that 5 cwt. of iron had been puddled by it in the time that a man would take to puddle 4 cwt.; and it was also found that the machine made a great improvement in the quality of the iron. This was accounted for by the fact that, while in hand puddling there was the liability of the underhands frequently neglecting their work, the machine went steadily on, working the tool constantly to and fro in the furnace, without any intermission, and kept the iron well stirred during the whole time that the work was required to be put into it. The consequence was, that very seldom was a bit of raw iron seen from the puddling furnaces worked by the machine; and the puddling bars were very seldom found to break off short in the rolling, unless the iron were a little too hot. In the heavy operation of puddling, it was impossible for any puddler to stand up to his work as the machine did, since the machine never tired, but kept on steadily at the work without rest, and at a quicker rate of working than in hand puddling. By using the machine to do the heavy part of the work, it was only required for the puddler occasionally to disengage the tool and draw the iron from the sides of the furnace into the center, leaving the machine during the rest of the time to perform its work alone. When the iron was ready for balling up, the puddler came fresh to the work; and from the men being relieved of the severest part of the labor, the furnaces worked by the machine turned out about 5 cwt. at each heat, and six heats during the day, with the same quantity of fuel as was used for ordinary heats only 4 cwt. in hand puddling, with six heats per day. The average result of the day's work with the machine was about 28¾ cwt. of puddled iron from 30 cwt. of pig iron, as compared with about 22¼ cwt. of puddled iron from 24 cwt. of pig iron, by hand puddling. The improvements effected by the machine were, therefore, that it produced a better quality of iron, with a decreased consumption of fuel, and turned out more iron in the same time. The machine did not interfere with the wages of the underhands, as they had to be employed the same as without the machine; whilst the puddler's wages were increased by his being enabled to turn out more iron in the same time."

APPLICATION OF THE SPECTRAL ANALYSIS TO ASTRONOMICAL PHENOMENA.

This was the subject of an inaugural address delivered on the 25th of September, to the Midland Institute, by the President, Lord Wrottesley. As this is the most sublime discovery of the century, the brief history of its progress given by Lord Wrottesley may be interesting.

HISTORY OF THE DISCOVERY.

The celebrated German optician, Fraunhofer, had perceived that the solar spectrum was crossed at right angles to its length by dark bands. Fraunhofer published a description of these, accompanied by a map, in which he represented more than 600 of these lines. Finding that they always occupied the same invariable position on the spectrum, he designated the more important by letters of the alphabet, and the lines so designated still bear his name; thus we say, the line D of Fraunhofer, and so forth. But Sir D. Brewster and M. Kirchhoff have discovered that more than 2,000 of these dark lines exist in the solar spectrum. Fraunhofer observed that when the source of light was changed a different set of lines appeared; but he discovered nothing more. He was unable to account for the appearance of these lines, and, probably, was very far from suspecting the significant part which they would play in future discoveries. Sir David Brewster, and subsequently Professors Miller and Daniell, discovered that certain colored vapors had the power of absorbing the sun's rays, and producing a series of dark bands in the light transmitted through them. In 1822, Sir John Herschel described the spectra of muriate of lime, nitrate of copper, and other substances; and in 1827, in his article on "Light," he states "that the salts of soda give a copious and purely homogeneous yellow, those of potash a beautiful pale violet. The colors thus communicated by the different bases to flame afford, in many cases, a ready and neat way of detecting extremely minute particles of them." Chloride of sodium, or common salt, is so extensively diffused in nature, that it is difficult to procure a spectrum without the line which denotes its presence. The mere stroke of the hand on a garment will throw molecules of this substance into the atmosphere of the laboratory, and thereupon this intensely yellow line immediately appears. In 1835 Wheatstone examined various spectra produced by the electric spark, and in his report to the British Association in that year he says:—"The spectrum of the electro-magnetic spark, taken from mercury, consists of seven definite rays only, separated by dark intervals from each other. These visible rays are—two orange lines close together, a bright green line, two bluish green lines (near each other,) a very bright purple line, and, lastly, a violet line. The spark taken in the same manner from zinc, cadmium, tin, bismuth, and lead in the melted state, gives similar results; but the number, position, and colors of the line vary in each case. The appearances are so different that by this mode of examination the metals may be readily distinguished from each other" It was by experiments of this kind that the new metals, cœsium and rubidium, were discovered by Kirchhoff and Bunsen. The two lines of cœsium in the blue may be seen, when a quantity of the chloride of cœsium not exceeding 1-170,000 of a grain of the pure salt is thrown into the flame by which the spectrum is produced. A distinguished French savant, M. Foucault, to whom I had the pleasure of presenting the Copley medal of the Royal Society in 1855—M. Foucault, in 1849, wrote as follows:—"I caused a solar image, joined by a converging lens, to fall upon the (voltaic) arc itself, an arrangement by which I was able to observe simultaneously the superposed solar and electric spectra; and I observed myself in this manner, that the double brilliant line of the arc coincided exactly with the double black line D of the solar light." Here we have the germ of that glorious discovery, which, if it be completely established, will constitute a new era in astronomy. But M. Foucault failed to perceive the full significance of the words he had traced. Our sun is surrounded by a vast luminous atmosphere, called the photosphere, which envelopes a solid or liquid nucleus; and, arguing from analogy, we may presume that the stars are so formed also. They must at all events be self-luminous bodies, or their light could never reach us. We have now gone through all the preliminary matter, which it was necessary to state before I even attempted to give you some idea of the nature of the method by which we believe we have arrived at that astounding piece of knowledge—the knowledge of many, at least, of the elements of which the sun and stars are composed.

KIRCHHOFF'S THEORY.

The theory is due to the distinguished German philosopher, Kirchhoff, above mentioned. It is stated as follows by Professor Miller:—"The spectrum produced by the ignition of a solid or liquid always yields a continuous band of light, containing rays of all degrees of refrangibility within the range of its two extremes; but the same body, when converted into vapor, may produce a luminous atmosphere, which may emit rays of certain definite refrangibilities only, so as to produce a spectrum consisting of a series of bright bands of particular colors, separated from each other by intervals more or less completely dark. * * * And the same substance, vapor, or gas, has the power of absorbing rays of these identical refrangibilities"—that is, rays whose vibrations are in harmony with their own. "Now, Kirchhoff supposes that in the luminous atmosphere of the sun the vapors of various metals are present, each of which would give its characteristic system of bright lines; but behind this incandescent atmosphere, containing metallic vapor, is the still more intensely heated solid or liquid nucleus of the sun, which emits a brilliant continuous spectrum, containing rays of all degrees of refrangibility. When the light of this intensely heated nucleus is transmitted through the incandescent photosphere of the sun, the bright lines which would be produced by the photosphere are reversed (that is to say, extinguished); and Fraunhofer's black lines are, therefore, the reversed bright lines of which the spectrum, due to the gaseous atmosphere of the sun, would consist, if the intensely heated nucleus were no longer there." This beautiful and most fascinating theory, rife in important results, has not, I believe, been yet universally received, on the ground that it does not explain facts known respecting the vapors of hydrogen and some others; but this has been the fate of all theories, and pre-eminently that of the wave theory of light, which, after a time, was found in harmony with many facts, which at first appeared fatal, and ended by suggesting experiments which proved its truth, and which otherwise had never been made.

KIRCHHOFF'S EXPERIMENTS.

Kirchhoff constructed a delicate apparatus by which the solar spectrum and the spectra given by the various metals could be compared together, and thus he discovered that the dark line, B, in the orange of the solar spectrum corresponds to a line given by the spectrum of potassium; in like manner C in the orange corresponds to hydrogen; D in the yellow to sodium; E in the green to iron; *b* in the green to iron and magnesium; F in the green to strontium (?), iron and hydrogen; G in the blue to iron; H in the violet to calcium. It must be borne in mind, however, that many of the metals have a great many other lines which characterize their spectra in addition to those above named. Thus, iron has seventeen such lines, magnesium three, and chromium three, in the small space contained between E and *b* of the spectrum. By observations of this kind diligently, carefully, and skillfully carried on—that is to say, by a comparison of the bright lines in the spectra of various metals with the dark lines of the solar spectrum, Kirchhoff concluded that the following metals were present in the sun's atmosphere, viz., potassium, sodium, magnesium, calcium, iron, nickel, chromium, manganese, and perhaps cobalt; and Angstrom believes that he has discovered in