MANUFACTURE OF ROLLED BARS OR RAILS DIRECT FROM THE MOLTEN METAL.

By the method or process heretofore generally in use for manufacturing railroad rails and other metal bars the molten metal is first cast into an ingot, which is then reheated and rolled and rerolled until reduced to the required size and shape. By this method the molten metal is not subjected to compression in the mould while it is in the act of setting, though it is well known to those skilled in the art that the compressing of the molten or setting metal while it is yet in the fluid or setting state tends to greatly improve the character and quality of the steel produced and to give the castings or ingots a very dense, solid, and homogeneous structure; and where, as heretofore, the metal is cast in a closed mould confined on all sides, excepting at the top or runner, air or gases confined in the molten metal have little opportunity to escape, so that it is difficult in this way to produce an ingot entirely free from air holes and imperfections. The rolling and rerolling to shape of the finished bar or rail tends to densify the metal to a greater or less extent; but this rolling operation does not entirely remove the flaws or imperfections produced in the ingot at the time it is cast. The manufacture of metal bars or rails by this old process also involves considerable time, labor, and expense in the several steps of the process, and requires an extensive and costly plant of machinery.

The invention of Edwin Norton and John G. Hodgson, of Maywood, Illinois, consists in pouring a continuous stream of molten metal from a suitable vessel and simultaneously compressing, setting, and shaping the metal by its contact with chilling and compressing surfaces or rolls, which confine or surround the stream on all sides as it passes such continuously-moving chilling surfaces or rolls. The chilling surfaces or rolls which shape, compress, and set the metal, and thus convert the molten stream of metal into a metal bar or rail, travel or move at the same surface speed as the velocity of the flowing stream of molten metal, so that the molten metal will not dam up or collect between the rolls, and so that the molten metal or bar produced will come in contact with the rolls or chilling surfaces only at a single point, so to speak, at a time.

The metal bars or rails, it will be thus seen, are produced directly from the molten metal, and without first casting the metal into an ingot and heating and rolling and rerolling it; and as the molten metal is poured in a continuous, solid stream into what may be termed a continuously revolving or traveling metal chilling and compressing mould, which comes in contact with only one point, or a very limited length of the metal stream or bar at a time, and is continuously traveling in the same direction with the stream or bar, point after point in the whole length of the metal stream or bar coming successively in contact with this traveling or revolving compressing and chilling mould, the metal bars or rails are of course produced in continuous lengths, and the process or operation is continuous so long as the stream of metal flows.

In practice the molten metal is poured in a continuous solid stream, from a suitable bowl or pouring vessel, between a series of rolls, preferably four in number, having their axes arranged in the same horizontal plane and having a pocket or space between their peripheries at their common meeting point for the reception of the stream of molten metal, so that the stream of molten metal, as it passes between the rolls, will be compressed by the wedging action of the rolls and the molten metal at the same time chilled or set by contact with the rolls. The rolls are made hollow and filled with water, which is made to constantly flow through them, so as to keep them cool or at the proper temperature for chilling or setting the stream of molten metal as it flows between the rolls. The pouring bowl or nozzle is arranged directly over the common meeting point of the series of rolls, so that the stream of molten metal will flow in a direction tangential to all the rolls. Each roll thus comes in contact with the stream of molten metal, or with the metal bar produced, only at a single point, so to speak, of its periphery at a time, thus making it practicable to easily keep the rolls cool, or at a proper temperature for chilling or setting the stream of molten metal as it passes between the rolls. The rolls are revolved at a sufficiently great surface speed, in respect to the velocity of the stream of molten metal and in respect to the space between the rolls or the size of the bar being produced, as to prevent the molten metal collecting or damming up in the space between the rolls. Large surface contact between the molten metal and the chilling rolls is thus prevented, which would tend to heat the rolls rapidly and render it difficult to keep them cool or at the proper temperature, on the one hand, and which, on the other hand, would tend to chill or set the molten metal before it reaches the meeting line or plane joining the axes of the rolls, and where the passage between them is most contracted, thus subjecting the apparatus to greater strain and requiring greater force to revolve the rolls, and interfering, to a greater or less extent, with the proper compression of the metal while yet in a molten or setting state.

STATUE OF LEVERRIER BY M. CHAPU.

[FOR DESCRIPTION SEE NEXT PAGE.]

By employing a series of rolls, the fluid or setting stream of metal passing between the rolls is compressed on all sides, thus densifying or compressing the metal by the wedging action of the rolls, and this densifying or compressing action of the rolls upon the metal aids in solidifying or setting the molten metal, as well as to greatly improve the quality of the steel or metal bar produced. The compressing and rolling action of the rolls upon the fluid or setting stream of metal passing between the rolls also tends to give the metal bar a superior texture, grain, or fiber, and thereby to increase the strength of the bar produced.

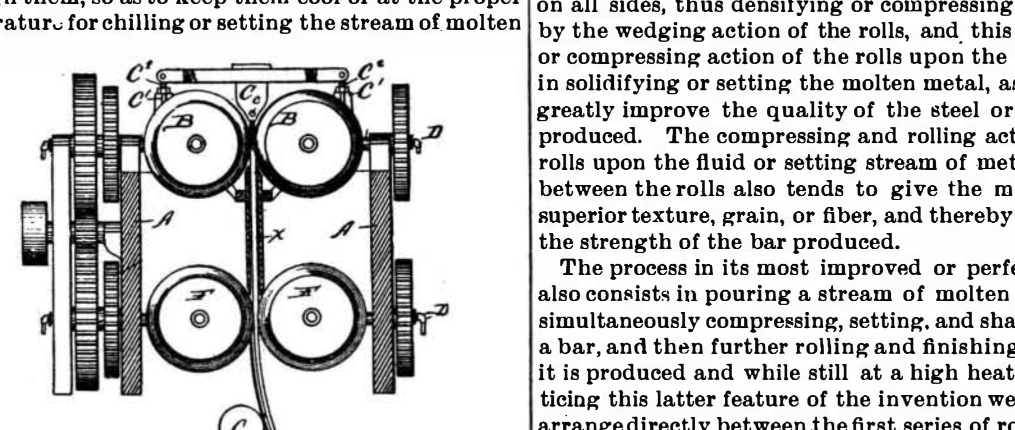
The process in its most improved or perfected form also consists in pouring a stream of molten metal and simultaneously compressing, setting, and shaping it into a bar, and then further rolling and finishing the bar as it is produced and while still at a high heat. In practicing this latter feature of the invention we preferably arrange directly between the first series of rolling, chilling, and compressing rolls or moulds a second series of revolving rolls, which serve to further chill, compress, shape, and roll the rail or bar as it issues. The continuous rail or bar produced is delivered from this second series of rolls by an intermediate curved passage or conveyer, consisting, preferably, of a series of rolls arranged in a curve. As the rail or bar is conveyed out horizontally, it may, while still hot, be passed through finishing and straightening rolls and further rolled to a greater or less extent, as may be desired.

A represents the frame of the machine, on which is journaled a series of rolls, B, preferably four in number, revolving together and having their peripheries shaped or grooved to form a passage or way between them to receive the stream of molten metal as it flows down from the pouring bowl or nozzle, C.

The working or meeting faces or peripheries of the rolls, B, are given a shape or configuration to form an ordinary railroad rail. They may, however, be shaped to give the space or passage any desired cross section, and thus produce a bar of any form required. The rolls, B, have beveled faces, which meet or roll against each other and serve as stops for the several rolls against each other, so that the space or passage for the metal will always be maintained of a uniform size, and thus produce the rail or bar of a uniform cross section throughout. The rolls, B, are each made hollow, and preferably with a central web, and the shafts are also made hollow, so that the water or other cooling fluid or liquid may be made to circulate through each of the rolls for the purpose of keeping them cool or of the desired temperature. The hollow shafts are each furnished with a packing or stuffing box at each end, by which they are connected with the inlet and outlet water pipes, D D′. The pouring bowl or vessel, C, is supported by any suitable means above the rolls, B, during the pouring operation, preferably by standards C′, furnished with adjusting screws, C^2. The pouring nozzle, C, is preferably furnished with a valve or device for opening and closing the discharge passage. The hollow shafts of the rolls are all geared together, so that they revolve or roll together at the same surface speed. The gearing employed may preferably be bevel gears, such as indicated at B^3. Two of the shafts, B^2, are also geared together by spur gears, B^4. E is the driving shaft, having a gear, E′, which meshes with a gear, E^2, on one of the shafts, B^2. The pouring bowl or nozzle, C, is furnished with a guide or shield, extending down to near the meeting point of the rolls. This is designed to prevent the metal from splattering at the beginning of the pouring operation. A greater or less number of rolls than four may be employed.

F represents a second series of rolls arranged, preferably, directly below the chilling rolls, B, and between which the bar, x, passes as it issues from the chilling rolls, B. Rolls, F, are preferably of the same form and construction as the rolls, B, being hollow and having the same connections for passing water through them, so that they may operate as chilling rolls as well as to further roll, compress, and finish the rail or bar produced.

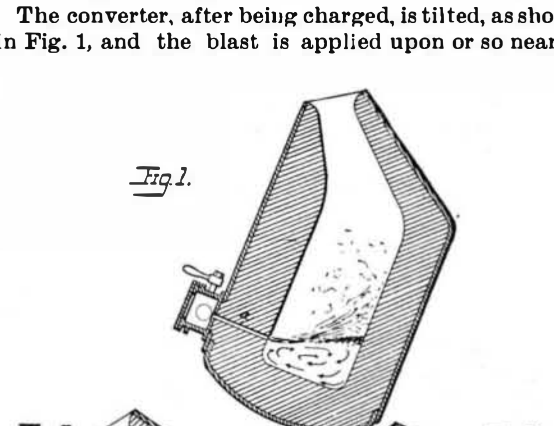
G is a curved guide or conveyer consisting, preferably, of a series of rolls or idle pulley wheels, arranged in a curved path to curve and guide the bar as it issues from the rolls, F, to the horizontal conveyer or series of rolls, H. Some of the rolls, H, are preferably driven and operate to further roll and straighten the rail or bar, as well as to convey it along or away. The curved guide, G, also affords some slack in the rail or bar between the chilling rolls and rolls, H H, to compensate for difference in speed or slipping.



MANUFACTURE OF BARS AND RAILS DIRECT FROM THE MOLTEN METAL.

ROBERT'S NEW PROCESS OF CONVERTING CRUDE IRON INTO MALLEABLE IRON OR STEEL.

The converter, after being charged, is tilted, as shown in Fig. 1, and the blast is applied upon or so near to



THE ROBERT PROCESS.

the normal surface of the metal in the bath and is so directed thereto that it will not enter or penetrate the body of the metal as in former processes, and so that practically no portion of the metal will be above the blast, and in such manner that only a small portion of the metal will be subjected to the action of the blast at any one time. Thus, as the blast passes inward through the tuyere at a point adjacent to the surface of the metal, its rapid forward motion, combined with the tendency to escape upward in the direction of least resistance, gives to the blast and to the portion of metal carried therewith a resultant diagonally upward direction away from the main body of metal, so that small portions only of the metal are thus acted upon and stripped off at one time; but as such small portions are subjected to the impact of the entire blast, a much more violent agitation is imparted thereto by a comparatively light blast than it would be possible to impart to the entire body by a blast of the most powerful character, and as a result of this agitation not only are the particles of impurities separated from the metal, but the latter is so atomized that it is spread or divided into small particles as to present the desired extended surfaces required to effect the speedy and thorough oxidation of all particles. The action of the blast in carrying a portion of the metal to the opposite side of the converter is to pile up the metal at that side, which, together with the impact of the blast on the exterior portion of the body of metal, results in the production of a circulatory or gyratory current in the direction of the arrows, which causes a flow of the metal downward and upward toward the area of violent action, while the metal is prevented from rising above the line of the blast by the impact of the latter, which strips or beats off the particles presented in its path, so that an inclined surface is imparted to the bath at one edge lower and at the other higher than the mouths of the tuyeres. As a result of the more perfect and rapid oxidation from the more thorough admixture of the atoms of air and metal, there is a higher temperature, inasmuch as there is a more complete and uniform conversion, and because, owing to the limited portion of metal acted upon at one time, every portion may be thoroughly oxidized. The temperature of the bath is therefore not only maintained as the result of the action of the blast, but is increased, so that the metal is rendered extremely fluid, thereby facilitating its movements under the action of the blast and preventing its rapid cooling when removed from the converter.

The blast must not be too deep or it will enter into the body of the metal, while on the other hand it must be deep enough to come into sufficiently extensive and intimate contact with the metal to produce the necessary reactions and conversion, or it will escape without producing the desired results; but it must be remembered that the bulk of the metal diminishes during the conversion by reason of the elimination of the impurities. Consequently the level of the surface of the metal falls during the process, and therefore the blast must be varied to maintain its position relatively to the metal. This may be done in various ways, two of which naturally present themselves—first, by bringing the blast down to the metal, and, second, by bringing the metal up to the blast. The former proceeding may be most conveniently accomplished by using a tilting converter and turning it upon its trunnions during the progress of conversion to different positions, as indicated in Figs. 1, 2, and 3, to vary the ferrostatic pressure against the blast as the process continues, or in a fixed coverter, by having the tuyeres movable and dropping them as required. By thus adjusting the relative positions of the blast and metal a continuous supply of new or fresh metal can be brought into the area or zone of conversion in such exactly regulated quantities as will maintain the proportion of the metal acted on relative to the volume of air as is necessary to the production of the best results. The raising of the level of the metal could be effected by adding more metal or by means of a false bottom, which would raise the whole of the metal, or otherwise, so as by occupying part of the space previously occupied by the metal to restore the surface level.

By tilting the converter or otherwise varying the amount of metal presented to the action of the blast, the extent to which the metal is divided or atomized may be regulated at the will of the operator, and by thus throwing the iron by a regulated action into a sort of spray, or minutely subdividing or atomizing it, the largest possible surface is presented to the atmosphere, and the particles of carbon, silicon, and phosphorus, or other combustible matter, are exposed and commingled with the oxidizing agent, and there is a rapid and intense combustion of said combustible elements and such a high temperature is imparted to the metal as renders it extremely fluid and mobile. The extent of the spraying action will depend on the extent to which the metal is presented to the spraying means. As this is regulated at the will of the operator by the means described, the feeding of the metal, the rapidity of the conversion and degree of heat, and the degree of the fluidity of the metal may all be controlled.

INAUGURATION OF THE STATUE OF LEVERRIER.

The statue raised to the memory of the eminent astronomer Leverrier was inaugurated on the 27th of June, in the court of honor of the observatory.

The Minister of Public Instruction and of the Fine Arts, after being received by Admiral Mouchez, director of the observatory, took his place under the tent raised opposite the monument. Among the distinguished spectators grouped around him were remarked all the notabilities of science. Several addresses were made: first, one by Mr. Fizeau, of the Academy of Sciences, who, addressing himself to the minister, offered through him to the state the monument raised by a national subscription begun by a number of scientists and friends of Leverrier.

Admiral Mouchez afterward thanked the committee, and especially Mr. Fizeau, the active president of it, for the monument.

Mr. Tisserand afterward spoke in the name of the Bureau of Longitudes, and finally Mr. Bertrand, perpetual secretary of the Academy, made the apology of Leverrier.

Mr. Fallieres, in a few words, responded to the eloquent and precise discourse of Mr. Bertrand, and, after this, delegations from all the academies and all of Paris' scientists came to salute the minister and the director of the observatory.

The beautiful statue, which stands on the avenue that leads to the central pavilion, is the work of Mr. Chapu. Leverrier is represented standing, with a celestial sphere in front of him. Upon the pedestal, which is of some little height, is engraved the following inscription:

U. J. J. LEVERRIER.
1811–1877.

The bass-reliefs sculptured on the stone represent, the one at the left, Astronomy tracing the orbit of the planets; and showing the planet discovered by Leverrier the one at the right, Meteorology, designating, with the hand, the observatory, whence proceed all discoveries.

This beautiful work has already been much remarked at the Salon, where it figured in 1883.—*Le Monde Illustre.*

LEVERRIER.

Urbain Jean Joseph Leverrier was born in St. Lo, March 11, 1811, and died in 1877. After a course of study at the colleges of St. Lo and Louis le Grand, he graduated at the Polytechnic School. Obtaining a place in the tobacco bureau, and finding that that occupation required some knowledge of chemistry, he pursued the latter science at leisure, and, in 1837, published two memoirs on the combination of phosphorus with oxygen and hydrogen. Mathematics, however, became the principal object of his study, and from his proficiency therein he soon obtained a minor appointment in the Polytechnic School. From this time on he directed his studies toward the elucidation of the highest problems in speculative astronomy, investigating, especially, the irregularities manifested in the course of the heavenly bodies.

Two memoirs on this subject, presented to the Academy of Sciences in 1839, attracted the attention of Arago, who, becoming his friend, induced him to study closely the orbit of Mercury and its perturbations. In 1844, he presented two important papers on comets to the Academy, and the importance of these contributions to science caused him to be elected to the astronomical section of that body. The success that had attended his calculations of the course of Mercury induced him to revise the still more imperfect tables of Uranus. After a thorough study of the subject, he became convinced that the movements of the latter planet could not be explained by the attraction of any known bodies, and he therefore sought further for the cause of its perturbations. At length, on June 1, 1846, he indicated to the Academy, within ten degrees, the place where a new planet might be seen January 1, 1847. This was, in fact, seen by the German astronomer Galle four months before the time indicated, viz., on September 23, 1846. Leverrier had erred, but by a difference of only two degrees.

This discovery caused an immense sensation, and Leverrier received abundant honor. Most of the learned societies of Europe inscribed his name on their lists; the King of Denmark sent him the Order of Dannebrog; Salraudy, the Minister of Public Instruction in France, had his bust erected in public with great ceremony; Arago declared that the new planet should be called Leverrier; a chair of mathematical astronomy was created for him in the Faculty of Sciences; the Royal Society of England sent him the Copley gold medal; and the Grand Duke of Tuscany sent him a splendid bound copy of the works of Galileo. The planet bore the name of Leverrier for but a short time, that of Neptune being subsequently bestowed on it.

In 1848, Leverrier made some ineffectual efforts to become distinguished as a democratic leader, but it was not till 1849 that he was elected to the legislative assembly from La Manche. Modifying his liberal views, he devoted himself to questions of public instruction and laws relative to scientific discovery. Upon a division of the parties in the Assembly, he joined the Imperialists. After the *coup d'etat*, in 1857, he became senator, and subsequently inspector-general of public instruction. In 1849–50 he read to the Academy the result of his new investigations into the movements of the planets, and in 1853 he presented to the same body tables of the sun's rotation, with the complete system of the small planets situated between Mars and Mercury.

On the death of Arago, in 1853, Leverrier succeeded to the title and authority of director of the observatory. In 1859 he communicated to the Academy a movement of the perihelion of Mercury, which could only be accounted for by supposing another planet, or a series of small bodies, moving between it and the sun. This brought out Dr. Lescarbault's assertion of his discovery of a planet in 1859, and which he named Vulcan. Subsequent researches, however, have failed to establish the existence of such a planet. In 1870 Leverrier withdrew from the office of director of the observatory, and was succeeded by Delaunay; but the latter having lost his life by drowning, Leverrier was reappointed in 1872.

During the Franco-German war Leverrier offered his services to the Government of National Defense, which employed him in perfecting a system of optical telegraphy which he had invented, and which was intended to render communication possible with Rouen or Orleans by using the light of the sun reflected from a mirror, and astronomical telescopes sweeping the horizon in a given direction. The illustrious astronomer succeeded, after a few months, in devising a complete system, but the Prussian invasion had driven the French forces to such a distance that the curve of the earth opposed an insurmountable barrier to the working of the signals. This system was afterward presented to the Academy, and has since been used with great success by the British army in Afghanistan and Central Africa.

One of the creations of the latter days of the great French astronomer was the system of transmitting the hour by electricity, so as to obtain a uniformity of time in public clocks.

A Warning for the Bathing Season.

A writer in one of our contemporaries, in summing up the causes for so many bathing accidents, concludes that most of them are mainly or entirely personal, and so far preventable. Chief among these, we need hardly say, is cramp. To a large extent this is practically identical with fatigue, for it is not the fresh and vigorous muscle which most readily passes into spasm. It is that which is wearied with over-action, in which effete products are in excess, nutrition consequently impaired, all molecular changes languid; where, finally, the movement of contraction, once initiated, gives way but slowly, and tends to linger and become tetanic. The numbing influence of cold is another well known obstacle to muscular activity, and for this reason it is not as a rule advisable to remain more than a few minutes in the water. Malnutrition of muscles is a factor which ought not to be forgotten. It supplies a reason why bathing very soon after a meal is not advisable, much of the blood required for muscular exertion being then diverted to the digestive organs. So likewise must it impose a check upon the rashness of those, adult and youth alike, who after a period of town life, with little physical exercise, find themselves at the coast, and insist on trying whether with jaded energies they cannot safely accomplish feats of swimming. Yet one more caution. This is that every bather should know the state of tide, the currents, and the ground. Unless he is thus careful, he may find himself at any time confronted by unexpected dangers, the end of which it is impossible to foresee. It may seem ridiculous to urge that only those who really can swim should bathe in deep water, yet neglect of even this precaution is by no means uncommon.

A Water Spray Electrical Influence Machine.

At a recent meeting of the Physical Society, London, the above instrument was described by Mr. George Fuller. The apparatus is made up of four similar sections, each consisting of a nozzle, a metal ring, and a metal dish or receiver, arranged about a vertical axis. Pressure water issues from perforations 1-100 in. in diameter in the nozzles, and passes through the rings into the insulated receiver below. The rings are placed at such a distance below the nozzles as to be about the point where the streams break into spray, and the receivers empty themselves automatically. Calling the consecutive sections 1, 2, 3, 4, respectively, the rings of 1 and 3 are connected to the receiver of 4, and those of 2 and 4 to the receiver of 1. The discharge points are connected with the receiver 2 and 3, and a rapid succession of sparks passes when the water is turned on. Professor S. P. Thompson inquired whether the length of the spark was limited by leakage along the glass rods or by the spray passing between the receivers, and in reply Mr. Fuller said he thought the former leakage the most important.