T. H. MATHIAS.

PROCESS FOR REMOVING DEFECTIVE SURFACES OF STEEL BARS.

APPLICATION FILED JULY 1, 1913.

1,120,831. Patented Dec. 15, 1914.

2 SHEETS—SHEET 1.

Fig. 1.

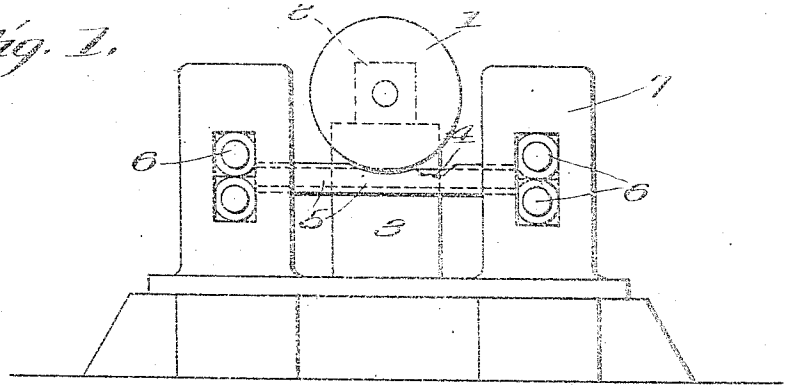


Fig. 2.

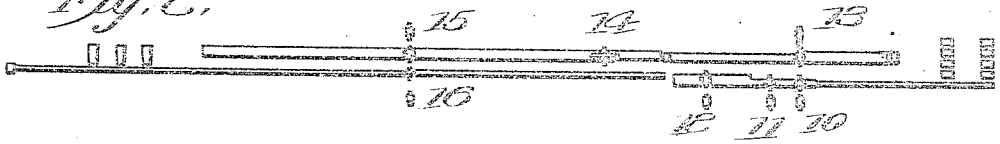


Fig. 3.

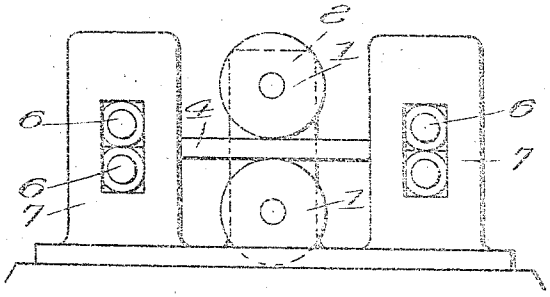


Fig. 4.

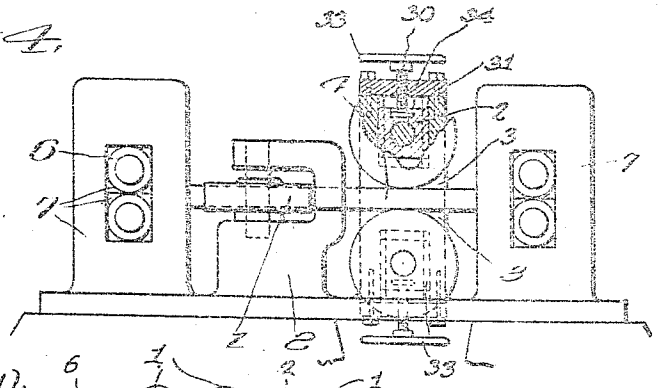
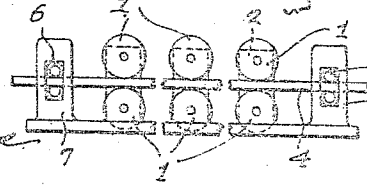


Fig. 10.



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2 SHEETS—SHEET 2.

Fig. 5.

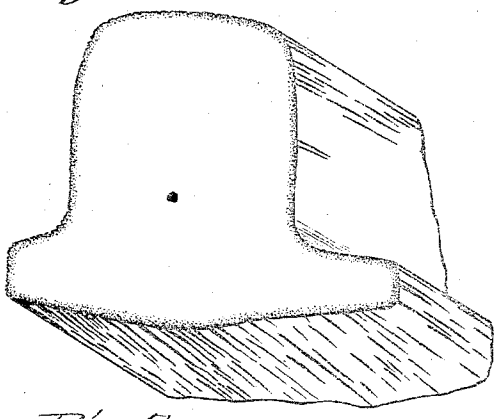


Fig. 6.

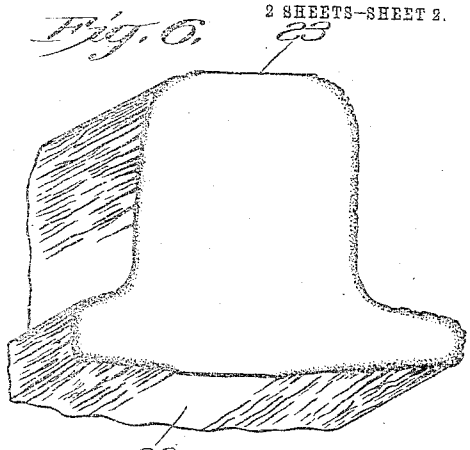


Fig. 7.

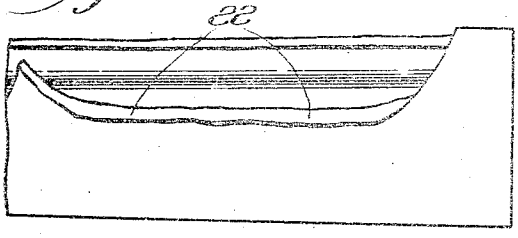


Fig. 8.

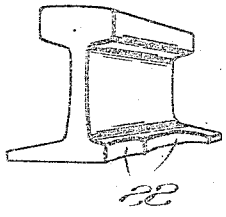
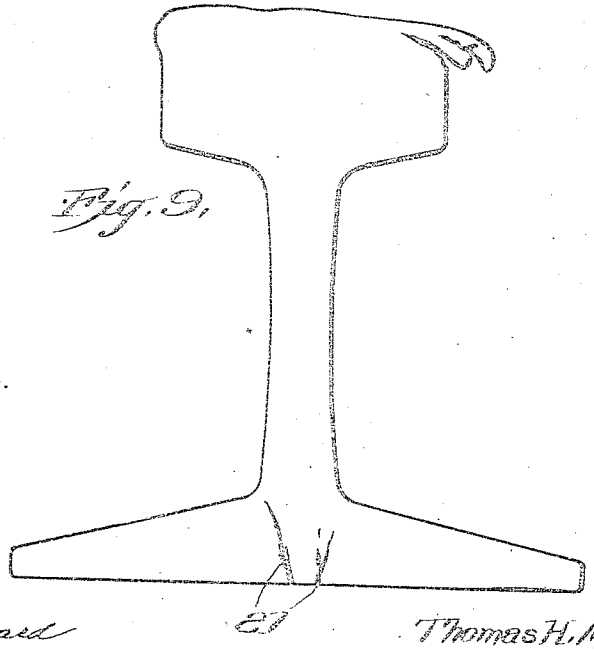


Fig. 9.



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UNITED STATES PATENT OFFICE.

THOMAS H. MATHIAS, OF BUFFALO, NEW YORK, ASSIGNOR TO LACKAWANNA STEEL COMPANY, OF LACKAWANNA, NEW YORK, A CORPORATION OF NEW YORK.

PROCESS FOR REMOVING DEFECTIVE SURFACES OF STEEL BARS.

1,120,331. Specification of Letters Patent. Patented Dec. 15, 1914.

Application filed July 1, 1912. Serial No. 707,000.

To all whom it may concern:

Be it known that I, THOMAS H. MATHIAS, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Processes for Removing Defective Surfaces of Steel Bars, of which the following is a specification.

My invention consists in a new process for treating the bar steel for railroad rails, whereby the condition of the rails is much improved, their life prolonged and the number of breaks greatly reduced.

As is well understood, the ingots from the soaking pit show a superficial skin, or shell, substantially lower in carbon than the body of the steel. This differs greatly in depth from very thin to 5/8 inch or even deeper, but is well defined and is probably formed in the soaking pit where an oxidizing atmosphere prevails, and the conditions are such that a thick oxid is always formed on the surface of the ingot. When the rolling operation is applied to the ingot this skin becomes thinner by elongation at each reduction made but is still present in the finished rail varying in degrees of thickness from 1/100 to 1/6 inch or even deeper, and is a source of weakness, for it is evident that it would be much better if the rail as it is put in the track, could present to the wheel loads the highest carbon material, surface hardened by the rolling action. Furthermore as the shape is rolled, seams develop in this skin extending longitudinally and substantially parallel, from a fraction of an inch to eight or ten inches or possibly more in length. These seams are due undoubtedly to the weak condition of the outer shell of the ingot, which may be caused in various ways. If the ingot contains blow-holes at or near the surface, they will open during the heating and rolling and will not be entirely welded during the rolling. Possibly scale may be rolled in, possibly when the blow-holes are uncovered there is instantaneously formed a film of pure oxid of iron, which prevents welding. But, whatever may be the cause, the seams are always present in the finished rail to a greater or less extent, and are a source of great weakness so far as the bearing surface of the head member and the under surface of the base-member are concerned—in the other surfaces of the rails their effect is of minor importance. So far as the head-member is concerned these seams result in failures by reason of the metal crushing, battering, and flowing; and, in the base-member, result in broken sections and broken flanges, particularly in the widely prevalent crescent shaped breaks. Probably many of the failures, to-day attributed to segregation or piping, are caused by the seams. I have conceived of removing the skin from the bar and thereby avoiding these failures in the rails, and I have successfully accomplished this result by my process in which the bar is heated at least to a red heat, but better to a higher or rolling temperature, and the skin removed therefrom by any suitable machine or tool such as a miller, or by any other suitable means.

My process is very simple and economical and desirably is practised while the bar is being rolled down into the rail. Preferably the ingot or bloom is first put through roughing passes and rolled down to a certain extent, the skin is then cut, or milled, from the entire surface of the bar, or from so much thereof as may be desirable and the rolling then completed, whereby, not only are the seams removed, but the portion of the bar from which the softer skin has been milled, is subjected to the "rolling action", and therefore this "rolling action", which condenses and hardens the surface, is applied to the high carbon steel of the body of the bar where it is most desirable.

The skin might be removed initially in the bloom or at any convenient time but it is not desirable to do it too early in the rolling operation, for a deep cut would be necessary; if the bar were too hot, it might become plastic, gum up the tool; if done too late, the long contact of the miller with the bar would be objectionable and the rapid cooling of the bar would make it too hard to cut, therefore I suggest that my process be applied to the bar when it is about 75% rolled, more or less, for, at about this point, in the rolling operation, neither are the seams too deep nor is the bar to long. But I do not limit myself to any particular point in the rolling operation for this is not essential and is merely a question of convenience.

Any suitable mechanism may be used to practice my process and I do not limit my-

self to any particular machine or form of machine, but I have shown herewith diagrams of a suitable machine, in order better to explain my invention.

Figure 1 is a side elevation of a suitable milling, or cutting, machine to be used in my process. Fig. 2 is the plan of a rail mill showing where the milling machine may be located and its relation to the various stands or sets of rolls. Fig. 3 illustrates an arrangement of two opposite cutters, or millers when it is desired to cut the skin from opposite sides of the bar simultaneously. Fig. 4, an arrangement with two pairs of millers, one pair set in advance of the other to cut the skin from the entire surface. Fig. 5 shows the seams in a partially rolled bar. Fig. 6 is a similar view after the skin has been milled from the center of the base and of the head. Figs. 7 and 8 show crescent breaks in a rail flange. Fig. 9 shows how these breaks start from the seams and illustrates a rail head that has begun to flow. Fig. 10 illustrates in elevation the use of a plurality of millers.

In the figures 1 is the miller, or tool, of suitable thickness, for instance three inches more or less, for removing a sufficient width of skin from the bar to be operated on, for instance from the rail base portion of the bar. The miller is carried in a bearing 2 which may desirably be adjustable vertically on the base 3, to make the proper depth of cut in the bar 4, (or in bars of various sizes), guided in guide 5 between the pinch-rolls 6, in usual housings 7 and operated by usual means. Means for adjusting the miller vertically is illustrated in Fig. 4 wherein the axle of the miller is journaled in a bearing block 2 fitted to a suitable vertical slideway in the bearing 3 to be raised and lowered by rotation of the supporting screw 30 threaded to a support 31 on the base 3. A hand wheel 33 may be provided on the adjusting screw 30 and at its end it may be provided with a flange 34 fitted to a slot in the bearing block 2 whereby the screw and block are connected to move together vertically. These pinch-rolls are slow driven rollers merely provided for passing the bar through the miller. If one miller is not enough to keep up with the speed of the mill rolls, then two or three may be used to cut each thirty or twenty feet of the bar, more or less. When each has milled its own section of the bar, then the rolls may be speeded up to carry the bar through quickly to avoid delay. For my process may be practised without substantial delay in the mill.

In Fig. 2, the plan of a mill, 10, 11 and 12 indicate respectively the first, second and third blooming rolls, through which the bar is put any suitable number of times; then it is transferred to the roughing rolls 13 for sufficient passes and at 14 is put through the milling, or cutting machine to mill off the skin on one or both sides. Next the bar goes to the first and second finishing rolls 15 and 16 to produce the finished rail. Of course this arrangement is not prescribed but may be modified as convenient. Figs. 3 and 4 are merely diagrams showing respectively two and four millers arranged to mill two opposite sides or the four sides of the bar.

Little further explanation of the remaining figures is necessary. Fig. 5 is a section of a partially rolled bar, and is drawn from an actual bar, showing the seams before they have been cut away. Fig. 6 is the same bar from which the skin has been milled at the center of the base 20 for a sufficient width to remove those seams, which develop into the base cracks 21 of Fig. 9, whereby are caused the crescent breaks 22 of Figs. 7 and 8. In Fig. 9 is also shown how the softer steel skin on the heads flows or shells off in long ragged fragments, and to remedy this the skin has been removed from the head at 23.

As aforesaid, the bar for the removal of its defective surface must be heated to at least a red heat, and the most desirable heat is what is known as rolling temperature, and therefore it makes it possible to practice my operation in connection with the process of rolling. I consider this one great merit of my process name that it may be applied during the rolling, for while it might be practised as a separate process it would then be too expensive.

To sum up, by my process of removing the skin I do two things which I believe have never before been even attempted. I eliminate the seams and also the partially decarburized surface, so that the breaks due to the seams are avoided, and so that the higher carbon steel of the body of the rail, the "true steel" so to speak, is finished for the bearing surface of the rail. The strength of rails is and has been heretofore calculated on "true steel", but, on account of the seams and the partially decarburized surface skin, the calculated result is never attained. By my process the true result may be approximated. It may be said that by removing the skin from the head there is a gain in service, by removing from the base, a gain in safety.

This process is of particular value for improving the condition of rails and I have therefore described it in connection with rails, but I have used the rolling of rails merely as an illustration, for my process may be applied to any form of rolled bar from which it may be desirable to remove the skin in whole or in part, for instance bars which are not to be machined, such as drop forgings, etc., and particularly bars exposed to vibration, and alternating stresses, as rails.

I do not limit myself to any particular

form of machine or of miller or tool. The drawings show diagrammatically a machine that has been practically used, but that may be much varied without departing from the spirit of my invention, for my process may be practised by different forms of machines.

I claim,

1. The process of treating iron or steel bars to eliminate the partially decarburized surface and the defects therein, which consists in working down the ingot into a bar and removing the surface from at least a portion of the bar, while the bar is at a temperature of at least a red heat.

2. The process of treating iron or steel bars, which consists in working down the ingot into a bar and removing the surface from at least a portion of the bar, along the length thereof, while the bar is at a temperature of at least a red heat.

3. The process of treating iron or steel bars during the operation of rolling and while the bar is at a rolling temperature, which consists in partially reducing the bar by rolling, then removing at least a portion of the surface, then completing the rolling operation.

4. The process of treating iron or steel bars during the operation of rolling to remove the softer, partially decarburized surface and to eliminate the superficial seams, which consists in heating the bar to a rolling temperature, partially reducing the bar by rolling, cutting at least a portion of the surface from the bar, along longitudinal lines substantially from end to end, then completing the rolling operation.

5. The process of removing the surface from bars of iron or steel to eliminate the partially decarburized, softer surface portion and the defects therein, which consists in performing about seventy-five per cent. of the rolling operation on the bar, then immediately cutting at least a portion of the surface from the bar in longitudinal lines from end to end then immediately completing the rolling operation.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

THOMAS H. MATHIAS.

Witnesses:
W. J. BRYAN,
JOHN BURRY.