F. L. O. WADSWORTH.

METHOD OF AND APPARATUS FOR TREATING METALS.

APPLICATION FILED JULY 16, 1908.

988,915. Patented Apr. 4, 1911.

2 SHEETS—SHEET 1.

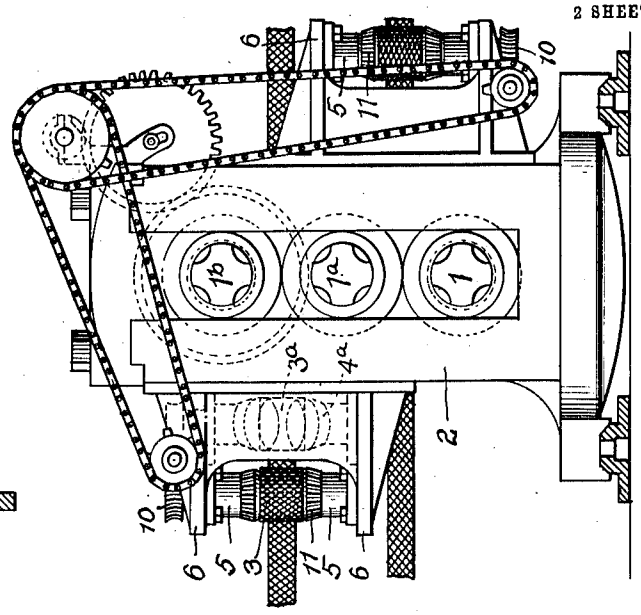

FIG. 2.

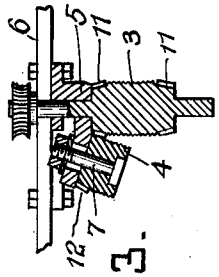

FIG. 3.

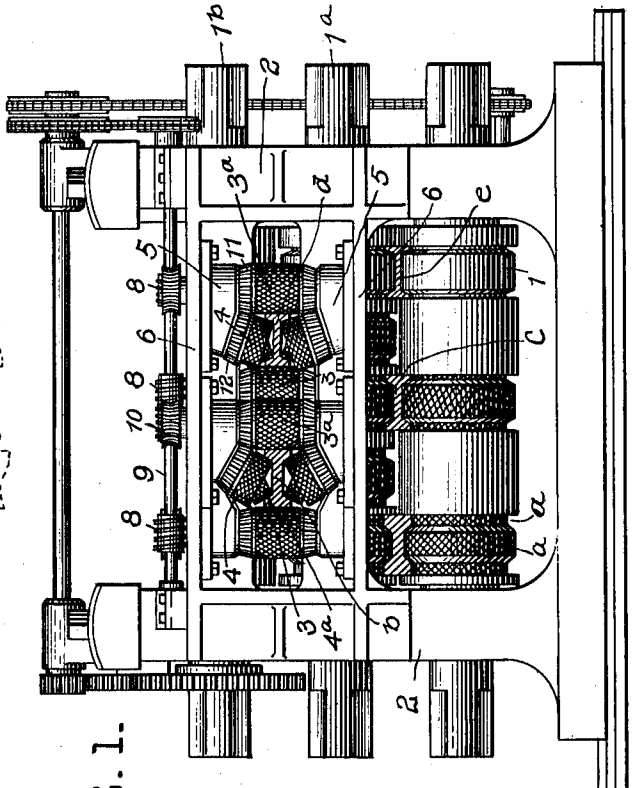

FIG. 1.

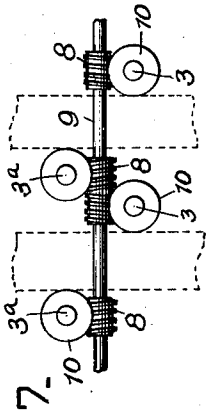

FIG. 7.

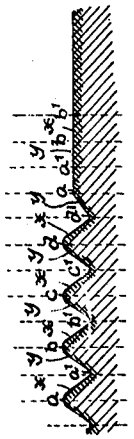

FIG. 8.

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2 SHEETS—SHEET 2.

FIG. 4.

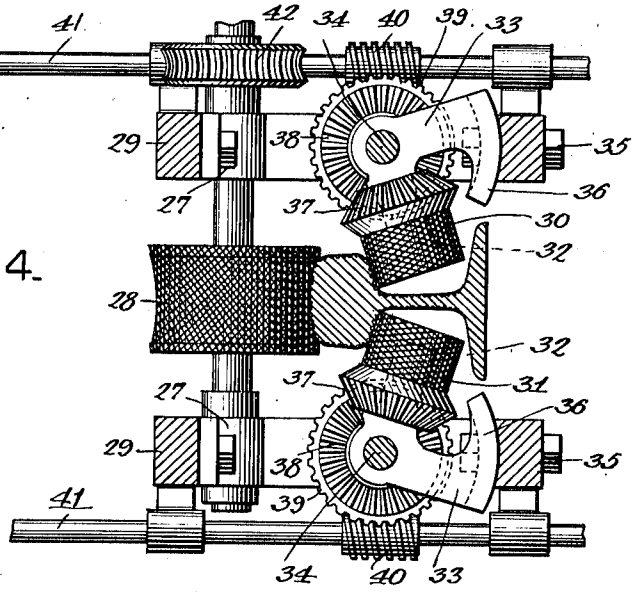


FIG. 5.

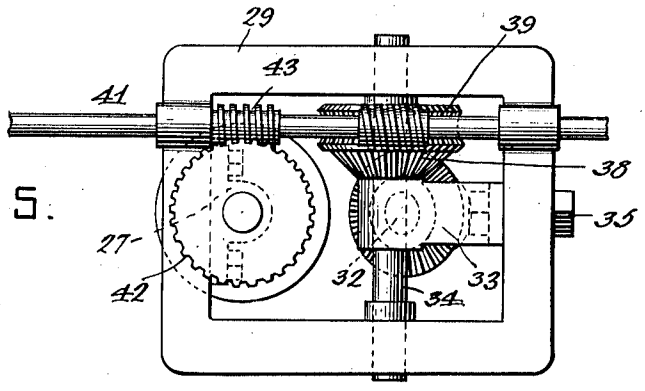


FIG. 6.

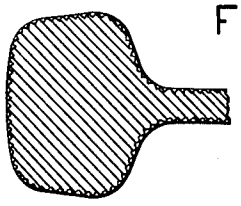
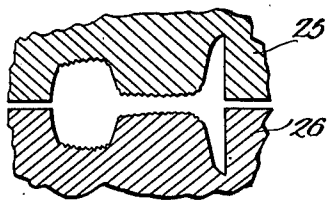


FIG. 9.



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UNITED STATES PATENT OFFICE.

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METHOD OF AND APPARATUS FOR TREATING METALS.

988,915. Specification of Letters Patent. Patented Apr. 4, 1911.

Application filed July 16, 1908. Serial No. 443,913.

To all whom it may concern:

Be it known that I, FRANK L. O. WADSWORTH, residing at Sewickley, in the county of Allegheny and State of Pennsylvania, a citizen of the United States, have invented or discovered certain new and useful Improvements in Methods of and Apparatus for Treating Metals, of which improvement the following is a specification.

In the manufacture of metal plates it has heretofore been found possible to mechanically effect a densification of the metal at and adjacent to their flat surfaces, by first rolling upon said surfaces closely arranged angular projections and corresponding depressions, and then rolling down said roughened surfaces between smooth rolls. It has not however, so far as I am aware, been found possible to mechanically densify, with continuity and uniformity, the angularly related surfaces of articles of irregular shape, such as rails, I-beams, channels, angle-bars, etc. The difficulties in the way of so doing have been found to be many and various. Thus if adjacent surfaces of such articles are each roughened and smoothed separately in the way above outlined, while local surface densification may be accomplished, a continuous and uniform densification will not be secured, particularly at and adjacent to the lines of junction of the angularly related surfaces. Where it has been attempted to roughen such angularly related surfaces simultaneously or in one roll-pass, the result has lacked continuity and uniformity of densification in individual surfaces, which have been subjected to the roughening action portions of the roll or rolls lying at an angle to the axis thereof. Since the portion of such roll surface at a greater distance from the axis moves at a higher speed than the portion nearer thereto, it is impossible to evenly mark the surface of the piece going through. And since individual projections upon such roll surface operate upon the surface of the piece in a line at an acute angle to the line of forward movement of the piece, the result is often a tearing of the metal of the surface of the piece, and a consequent break in the continuity of the projections formed thereon.

It is the object of the invention to overcome these difficulties, and to produce articles of irregular shape the angularly related surfaces of which shall be uniformly and continuously densified. To that end the new method herein described, generally stated, consists in forming the closely adjacent projections upon such angularly related surfaces of the piece by pressure applied normally to the point on each surface where each projection is formed, and evenly in lines transversely of each surface, in order to attain uniformity and continuity of the projections upon each individual surface; and then by compressing and smoothing the adjacent surfaces simultaneously or in one pass, I am able to secure continuity of the densified skin throughout all portions of the surface of the finished piece.

In the accompanying drawings there is illustrated a suitable apparatus for the practice of the said new method, and which also forms a part of the present invention.

Figure 1 is a view in elevation of a universal rolling-mill for the production of I-beams. Fig. 2 is an end elevation of the same, showing the beam blanks being rolled in passes *c* and *d* but not showing any blank in pass *e*. Fig. 3 illustrates a detail of the arrangement of the auxiliary rolls for operating upon the inner surfaces of the flanges of an I-beam or other irregular shape. Fig. 4 illustrates an arrangement of auxiliary rolls for operating upon the upper and under surfaces of the head of a rail. Fig. 5 is a top plan view of the construction shown in Fig. 4. Fig. 6 illustrates the surface of a portion of a partially formed rail which has been marked in accordance with this invention. Fig. 7 is a partial plan view illustrating the arrangement of the vertical rolls shown in Fig. 1. Fig. 8 is a diagrammatic view illustrating the manner of producing the densified skin. Fig. 9 shows conventionally a pass between a pair of horizontal rolls arranged in advance of the rolls shown in Fig. 4, and in which the edges of the head and the web of the rail are roughened.

In the practice of the invention the mill as regards the main reducing rolls 1, 1^a and 1^b, and the housings 2, will be constructed and arranged in the usual or any suitable manner. The number of passes will of course depend upon the extent of the reduction to be accomplished, or two or more stands of rolls may be used. The surfaces *a* of one or more passes in the main rolls, (these surfaces being those which when in

contact with the piece move in a direction substantially parallel with the direction of feed, and therefore apply pressure normally to the surfaces upon which they operate), are cut by indentations or grooves so as to form intersecting angular ridges closely adjacent to each other. The depressions thereby formed in the surfaces of the piece will thus have the required contiguity, so that the intervening projections or ridges will mutually bear against and support each other in the operation of rolling these projections down to a smooth surface. In this way is accomplished the densification of the metal of the flat surface of the finished article, by means of the lateral compression of the particles which compose the surfaces of the projections, the metal *y*, (see Fig. 8), on one side or wall of a projection acting as an abutment to oppose the spreading of the metal *x* of the walls adjacent thereto, and vice versa.

In order to form the projections upon the outer surfaces of the flanges of the beam, the vertical rolls 3, 3^a are provided, and for the inner surfaces of the flanges the auxiliary rolls 4, 4^a, which are inclined at the proper angle to apply their rolling pressure normally to said surfaces. The said vertical rolls and inclined rolls are cut to form projections upon their operating surfaces, in the manner above described, and they are preferably arranged on the exit sides of the passes in the main rolls.

By reference to Figs. 1, 2 and 7 it will be seen that the members of each pair of vertical rolls, 3, 3^a are somewhat out of line with each other, being placed at different distances from the main rolls, in order to provide room for placing the inclined rolls 4, 4^a so that the two inclined rolls and the one vertical roll which operate upon each flange of the beam, shall operate thereon together, the two inclined rolls and the vertical roll acting in opposition. The vertical rolls have their journals mounted in blocks 5, adjustable on rails 6 secured to the housings of the mill, and the journals 7 of the inclined rolls are mounted in the same blocks. The vertical rolls are driven by worms 8 on the shaft 9, which engage worm-wheels 10 on the journals of the vertical rolls, said journals being also provided with pinions 11 intermeshing with pinions 12 on the journals of the inclined rolls.

In operation the beam-blank is fed forward through the left-hand roughing pass between the middle and lower rolls, back through pass *b* between the middle and upper rolls, forward through pass *c* between the middle and lower rolls, and back through pass *d* between the middle and upper rolls. In a mill having the passes thus arranged, it is preferred that in each of said four passes all of the rolls, or the portions thereof which operate normally to the surfaces of the piece going through, shall be patterned in the manner described. Thus in each of said passes, the web of the beam and the edges of its flanges being marked in the main rolls, and the inner and outer faces of its flanges being marked in the adjacent vertical and inclined rolls, the marking is performed, during reduction, upon all portions of all surfaces of the beam at each point throughout its length, so that the markings upon adjacent angularly related surfaces run up to and merge into each other. Thus when the beam is run through the final smooth pass or passes, as at *e*, a uniform densified skin will be produced, and there will be no lines or patches of undensified metal at and adjacent to the lines of junction of adjacent surfaces. The use of smooth vertical and auxiliary rolls in connection with pass *e* will ordinarily be unnecessary, since the projections upon all surfaces of the piece may be compressed and smoothed by the smooth contacting surfaces of said pass *e* in the main rolls. Also by reason of the fact that the projections are formed upon all surfaces of the piece solely by pressure applied normally to each surface, and evenly transversely of each surface, uniformity and continuity of the projections upon each surface, and the consequent uniformity and continuity of the densified skin over all portions of each surface, are attained.

The pattern and size of the projections formed in the successive passes may be varied, in order to more thoroughly act upon the surfaces of the piece. It will also be understood that the invention is not limited with respect to the number of passes in which projections shall be formed. Good results can be attained by forming the projections upon the piece in one pass, and then, before smoothing, chilling the surfaces by applying thereto a cooling fluid. But where the only surface cooling effected is by contact with the rolls, it is considered better practice to subject the article to a plurality of passes the operative portions of which are roughened as described.

In Figs. 4, 5 and 9 is shown an arrangement of rolls for forming the described projections upon the head and web of a rail, it being understood, as described in connection with Fig. 1, that the roll pass illustrated in Fig. 9 between the horizontal rolls 25 and 26, is arranged in advance of the rolls shown on Fig. 4.

Referring to Figs. 4 and 5, the bearings 27 for the journals of the vertical roll 28 are secured to the frame 29, adjustably mounted adjacent to the horizontal rolls 25 and 26 as already described. The inclined rolls 30, 31 are loosely mounted on

pins 32, formed on the arms 33, which are pivotally mounted on shafts 34, having bearings in the frame 29. The arms 33 are movable to permit of the adjustment of the inclined rolls at the proper angle to the vertical roll. They may be held in position by bolts 35 passing through the frame 29 and through slotted lugs 36 on the arms 33. The inclined rolls are provided at one end with bevel pinions 37, intermeshing with corresponding bevel pinions 38 mounted on the shafts 34, and provided with worm wheels 39 driven by worms 40 on the shafts 41, which may be operated as already shown and described in connection with Figs. 1 and 2. The vertical roll is driven by means of the worm wheel 42, engaging the worm 43 on the upper shaft 41.

I claim as my invention:

1. The method of densifying a plurality of angularly related surfaces of a metallic article, which consists in rolling upon said surfaces, by pressure applied normally and evenly throughout the length of the bearing surfaces of the rolls, a substantially continuous series of closely arranged angular projections, and then rolling the same to substantially smooth surfaces.

2. The method of densifying a plurality of adjacent angularly related surfaces of a metallic article, which consists in rolling upon said surfaces, by pressure applied normally and evenly throughout the length of the bearing surfaces of the rolls, a substantially continuous series of closely arranged angular projections, and then rolling the same simultaneously or in one pass to substantially smooth surfaces.

3. In a mill for rolling shapes, the combination of a plurality of rolls arranged with their respective axes substantially parallel with the corresponding portions of the article upon which the rolls operate, the faces of the rolls operative upon the metal being patterned whereby the entire surfaces operated upon are roughed.

In testimony whereof, I have hereunto set my hand.

FRANK L. O. WADSWORTH.

Witnesses:
CHARLES BARNETT,
FRANCIS J. TOMASSON.