F. N. SPELLER.

METHOD OF ROLLING STEEL.

APPLICATION FILED MAY 29, 1906.

1,006,601.

Patented Oct. 24, 1911.

2 SHEETS—SHEET 1.

*Fig. 1.*

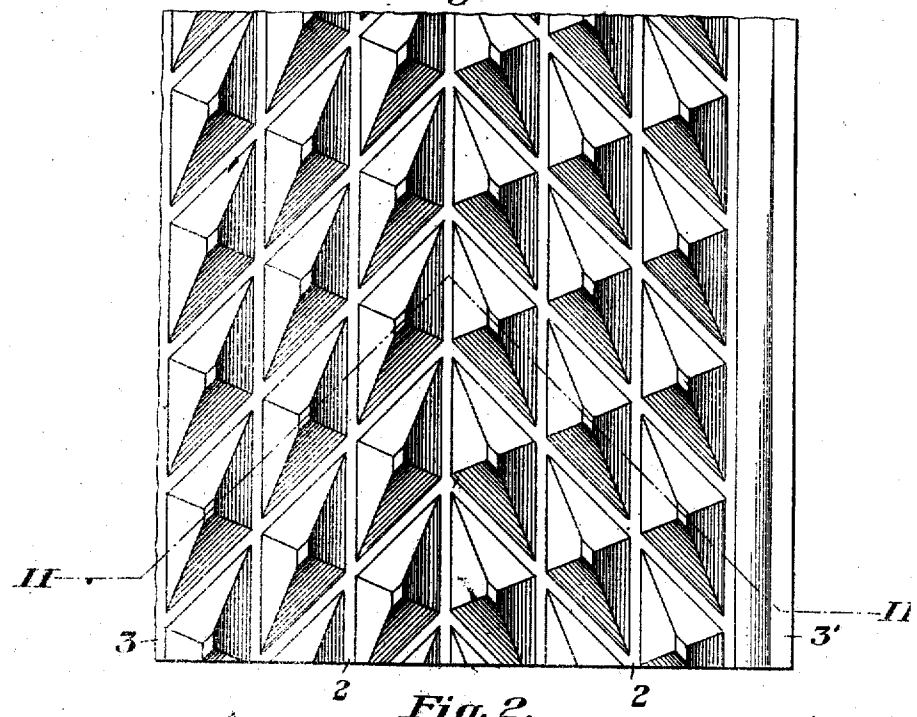



*Fig. 2.*

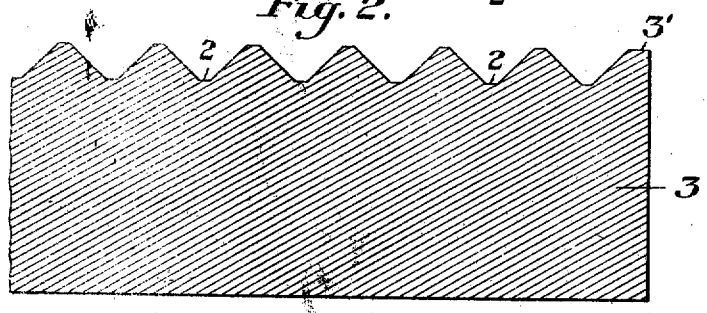
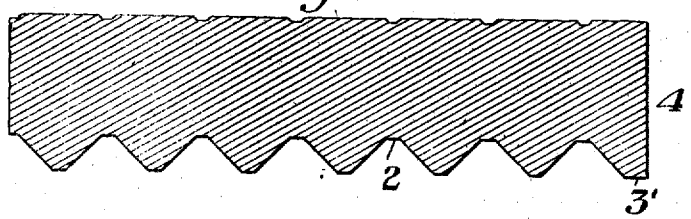



*Fig. 3.*




WITNESSES

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2 SHEETS—SHEET 2.

*Fig. 4.*

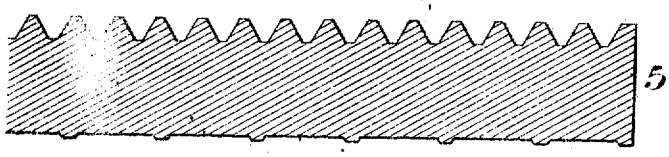



*Fig. 5.*


*Fig. 6.*


*Fig. 7.*

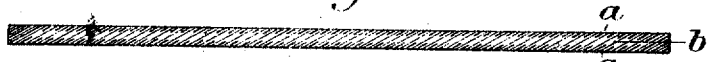
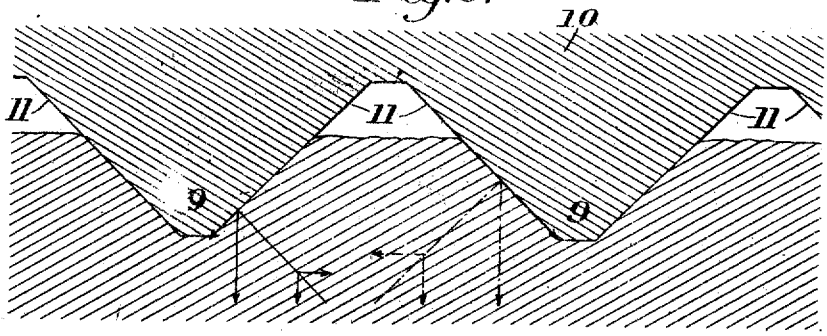



*Fig. 8.*




WITNESSES

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# UNITED STATES PATENT OFFICE.

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## METHOD OF ROLLING STEEL.

1,006,601. Specification of Letters Patent. Patented Oct. 24, 1911.

Application filed May 29, 1906. Serial No. 319,298.

*To all whom it may concern:*

Be it known that I, FRANK N. SPELLER, of McKeesport, Allegheny county, Pennsylvania, have invented a new and useful Method of Rolling Steel, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a plan view showing the surface of a metal bloom or blank during the use of my invention; Fig. 2 is a cross-section on the line II—II of Fig. 1; Figs. 3, 4, 5 and 6 are cross-sections similar to Fig. 2 showing the metal in successive passes; Fig. 7 is a cross-section of skelp showing the character of the plate which can be formed by my process; and Fig. 8 is an enlarged view showing the wedge action of the preferred form of projections.

My invention relates to the rolling of steel, and is particularly useful in the manufacture of steel plates used in the manufacture of welded pipes. It is a well-known fact that welded pipes will corrode and become pitted under unfavorable conditions.

The object of my invention is to reduce this liability to corrosion and pitting, and to improve the surface portion of the steel plate, and the pipe, where my process is used in such manufacture.

The invention is broadly applicable to the rolling of blanks, plates, shapes, or any finished steel products; although it is of especial advantage in pipe manufacture.

I have discovered that by breaking up one or both surfaces of the steel blank or article during the rolling by wedge-shaped projections on the roll or rolls acting throughout the surface to be treated, and then flattening, the outer portion so treated is improved in quality, being densified and rendered less subject to corrosion. I attribute this quality to the wedging action of the roll projections, and to the rolling in or retaining of a greater portion of the scale or oxid than formerly; but whatever the exact action may be, the result is that the outer or surface portion is improved, being in fact made practically homogeneous, and the product of the mill is rendered more uniform in character.

In carrying out my invention in the manufacture of steel plates for making welded pipe, the rolls by which the slab or billet is reduced, are not formed with substantially smooth faces as heretofore, but one or both of them is provided with a series of angled wedges which form wedge-shaped indentations as indicated at 2, 2 in the blank 3, shown in Fig. 1. The indentations are sufficiently close so that they break up and rework substantially the entire face of the plate or substantially the entire portion to be treated; but as shown a small edge portion 3′ is preferably left at the opposite edges of the rolls, to prevent spalling of the roll or rolls.

Ordinary rolls which have substantially smooth surfaces do more work lengthwise than crosswise on the plate, except where the rolls are so wide that the piece may be turned around and rolled in various positions as in a plate mill. In my rolls the wedge surfaces are preferably so placed as to cause the metal to be worked sidewise, thereby closing up seams and other breaks in the surface portion, rendering the same uniformly compact and better in every way.

In case the plate is to be treated on both sides, the wedges may be applied simultaneously or successively; that is, the plate may be passed between a pair of rolls, each of which is so shaped, or it may be passed through rolls, only one of which is so shaped, and then through another pass, of which the other roll so shapes the other face of the plate. If the successive method is used, the plate may be passed through a two-high mill, one of whose rolls is so shaped, and the plate may then be passed through another two-high mill in which the other face of the plate is so treated; or the plate may be passed through the top and bottom passes successively of a three-high mill in which the middle roll is provided with the wedges. After thus treating one or both faces of the plate, the plate may then be rolled out in the ordinary manner to flatten it, and the operation is repeated two or more times until the metal surface becomes plain or nearly so. I prefer, however, after the first wedge action to further break up the surface by changing the shape or otherwise altering the projections or broken surface. For this purpose, I preferably use further rolls in which depressions are formed in the apices of the wedge ridges. I may thus increase the number of indentations and reduce their original size,

or I may otherwise change the shape, size or number of the indentations which were previously formed. If this second indenting or breaking up is employed it also may be applied to one or both faces and one or both surfaces may be indented at a time.

In the drawings, where I have shown the manufacture of skelp according to my invention, starting, for example, with a bloom 8¾ inches in thickness, this would be passed between the middle and lower roll of a three-high mill having the middle roll provided with the projections or indentations. This would result in the blank 3 of Fig. 2, which for example is reduced to 2⅝ inches in thickness. In this instance I have used depressions about ½ inch deep, with angles of about 90 degrees between their opposite sides. The indentations are preferably blunted so as to present no sharp corners. Thus the bottoms of the valleys or indentations are preferably about ⅛ of an inch wide, the tops of the projections being about the same width. In the next pass the metal is fed between the middle and upper rolls of the three-high mill and may be reduced to about 1⅝ inches in thickness, as shown at 4 in Fig. 3. In this pass the depressions in the upper face are nearly removed while depressions corresponding to those of the upper face are formed in the lower face. In the third pass of Fig. 4, the metal piece 5 may be reduced to 1¼ inches in thickness, the indentations formed in the second pass on the lower face being removed or substantially removed, while indentations smaller than those first formed are made in the upper face. In this case the depressions are about ¼ inch deep, and the angle between the opposite sides of the depressions is about 90 degrees, the corners being blunted as before. In the next or fourth pass through this second three-high mill, the metal piece 6 shown in Fig. 5, may be reduced to the form of Fig. 6, the upper depressions of the third pass being removed while corresponding depressions are formed in the lower face. In the fifth pass of Fig. 6, the metal piece 7 may be reduced to ⅜ of an inch thick, and from this point the skelp may be rolled in the ordinary manner with plain-faced rolls. The blank is rolled as a single blank throughout the rolling operations, as distinguished from what is known as pack rolling.

As indicated by the enlarged showing of Fig. 8, the projections 9 on the roll 10 are of wedge shape provided with inclined or curved sides 11. These inclined substantially parallel faces of the projections bring pressure to bear upon the metal in the directions indicated by the arrows in Fig. 8. They thus increase the work done on the plate to a considerable amount, making the surface more uniform and dense. The horizontal components of the forces act upon the metal caught between the projections, and the metal is squeezed into the space between them as the full draft of the rolls is brought to bear. These wedge-shape projections of a substantial depth compared to the thickness of the blank, are important in obtaining my improved result. I preferably indent the rolls as deeply as possible within certain practical limits. Their depth will of course be limited by structural considerations as to weakness of the roll, and also by ability to remove the marks by smooth rolls in the after-treatment.

The treatment to which the metal blank is subjected modifies the outer or surface portion, so that when the original blank is of soft or open structure, if the edge of the finished plate be etched, it will show a well defined and substantial outer layer or layers *a* of denser and more resistant substance than the inner or body portion *b*. This I illustrate in Fig. 7.

In rolling plates for skelp, the indenting action must be stopped at such a thickness, that the plate will have an even or commercially finished surface. My plates, however, may be made slightly rougher than the ordinary rolled plates by continuing the indenting action and confining the use of ordinary smooth rolls to one or two of the finishing passes.

The breaking-up of the surface or surfaces by wedging and then smoothing, changes the structure of the outer portion of the metal and improves it. In slabs or plates of ordinary thickness, I may use indentations on both sides, each indentation being approximately one-eighth or more of the thickness of the blank, so that the combined depths of the indentations on both sides are practically 25 per cent. or more of the thickness of the blank.

The advantages of my invention will be appreciated by those skilled in the art. Not only do the plates or articles better resist corrosion, but their outer portion is also made of higher quality for many other purposes. At the same time the cost of rolling is increased very little, if any, since no additional passes are ordinarily required, and the only added cost is that of shaping the roll or rolls having the surface which forms the indentations.

The method is broadly applicable to the rolling of steel. It may be used on rails, shapes, plates, car wheels, bars, or rolled products of all kinds, which are either finished products or afterward worked into finished products. The method may be applied to one or any number of faces of the article or blank, depending on its shape and character, and many other variations may be made without departing from my invention.

I claim:—

1. The method of treating metal which consists in subjecting a heated blank to the action of die elements, thereby forming on the blank adjacent projecting portions, and then compressing the projecting portions into a skin having a surface parallel with the general surface of the blank by applying pressure simultaneously and equally to a plurality of said projecting portions without reheating and while the body of the metal is still hot, said projecting portions being of such height, shape and distance apart that the particles of the projections under pressure will spread laterally and mutually crowd the particles of the adjoining ones, substantially as described.

2. The method of treating metal which consists in taking a hot metal blank having a plurality of closely arranged projections thereon, compressing said projections into a skin having a surface parallel with the general surface of the blank by applying rolling pressure simultaneously and equally to a plurality of adjoining projections, the projections being of such height, shape and distance apart that the particles of the projections under pressure will spread laterally and mutually crowd the particles of the adjoining ones, substantially as described.

3. The method of improving metal which consists in subjecting a heated blank to the action of rolling instrumentalities, thereby forming projections on said blank, and then compressing the projections into a skin having a surface parallel with the general surface of the blank while the body of the metal is still hot by applying rolling pressure simultaneously and equally to a plurality of the projections, the projections being of such height, shape and distance apart that the particles of the projections under pressure will spread laterally and mutually crowd the particles of the adjoining ones, substantially as described.

4. The method of treating metal which consists in die-forming on a hot plastic metal blank a plurality of wedge-shaped projections arranged in proximity, adjoining projections having their opposing base lines substantially parallel, and then, without reheating and while the body of the blank is still hot, compressing said projections into a skin having a surface parallel with the general surface of the blank by applying pressure simultaneously and equally to a number of adjoining projections, substantially as described.

5. The method of increasing the surface density of a body of metal by first forming on such body chilled projections of such height and of such proximity that when compressed into parallelism with the general surface of the blank a continuous compression of the skin will be produced, and then before the chilling effect disappears and while the body of the metal is hot, reducing the area of this skin by compressing the projections into parallelism with the general surface of the blank.

In testimony whereof, I have hereunto set my hand.

FRANK N. SPELLER.

Witnesses:
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H. M. CORWIN.