

(No Model.)

H. A. WILLIAMS.
METHOD OF ROLLING WIRE.

No. 446,497.

Patented Feb. 17, 1891.

Fig. 1.

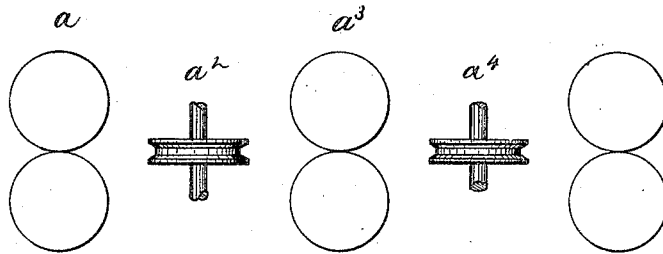


Fig. 2.

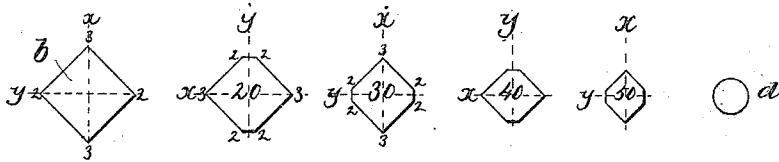


Fig. 4.

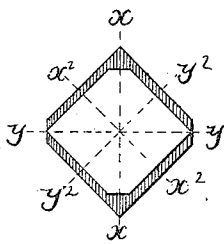


Fig. 3.

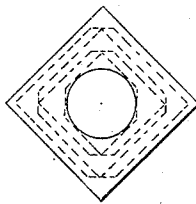
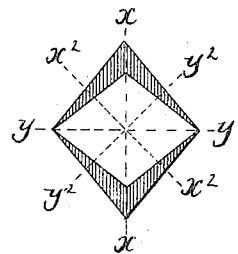


Fig. 5.



Witnesses.

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UNITED STATES PATENT OFFICE.

HENRY ALEXIS WILLIAMS, OF TAUNTON, MASSACHUSETTS.

METHOD OF ROLLING WIRE.

SPECIFICATION forming part of Letters Patent No. 446,497, dated February 17, 1891.

Application filed June 23, 1890. Serial No. 356,374. (No model.)

To all whom it may concern:

Be it known that I, HENRY ALEXIS WILLIAMS, of Taunton, county of Bristol, State of Massachusetts, have invented an Improvement in Methods of Rolling Wire, of which
5 the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

10 My invention relates to a method of reducing and shaping metal rods to form wire by rolling, it being possible by this method to produce wire by rolling the metal when cold.

Attempts have been made to produce wire
15 by cold rolling; but such attempts have, I believe, been unsuccessful, and the cold rolling of wire has not come into commercial use.

In the process of cold rolling as heretofore suggested and attempted the metal acted
20 upon becomes hardened and brittle in the successive reductions, so that it finally splits or cracks longitudinally, and thus fails to produce a commercially-valuable product. I have discovered that by applying the com-
25 pressing force to the metal in a certain definite way the latter is reduced in sectional area and elongated without any tendency to become hard or brittle or to split, but on the
30 contrary with an actual annealing effect, so that rods which are originally quite hard and have but little malleability come out after
the successive reductions annealed and with their tensile strength increased, and by this
35 process it is possible to produce wire of any sectional shape and gage without drawing and annealing, as has been heretofore necessary in order to produce a similar product. The effect of the rolls on the metal in any
40 rod-rolling or wire-rolling process is, first, to diminish the sectional area of the metal at the point acted upon by the rolls, and, second, to elongate the metal as the portion that is displaced in reducing the diameter or sectional area increases the length of the rod.

45 In the rolling processes as heretofore generally practiced the sectional shape of the rod is varied at each successive action, one pair of rolls, for example, decreasing one diameter without varying the other, and the
50 next pair of rolls decreasing the diameter transverse or at right angles to that on which the compression previously took place. For

example, if the rod were originally square the first reduction would act mainly at two diagonally-opposite corners, reducing the
55 metal to a lozenge shape with the obtuse angles at the corners which have been acted upon by the rolls. The next pair of rolls would compress, mainly, on the line connecting the acute angles of the lozenge produced
60 by the preceding pair, and would reduce the same to a similar lozenge of smaller size, the obtuse angles of the new smaller lozenge taking the place of the obtuse angles of the preceding larger lozenge. In this plan the com-
65 pression toward the axis of the blank is unequal, being greatest across the middle diameter on the line of compression, and being substantially nothing at the ends of the transverse or shorter diameter. This action pro-
70 duces a greater flow of the metal in some parts than in others, the metal displaced at two opposite corners of the lozenge being far greater than at the intermediate corners, so that the tendency to elongate is greater
75 at the first-mentioned corners than at the others. In other words, in elongating the rod, for example, ten per cent., or extending a piece originally ten inches long to a piece
80 eleven inches long, the tendency to stretch or elongate in certain portions is far greater, so that the elongation of these parts would naturally be more than twenty per cent., or two
85 inches in ten, while other parts are only slightly reduced laterally, and consequently have but little tendency to elongate; but by their connection through the body of the metal with the parts that tend to have greater
90 elongation they tend to resist that greater elongation, and consequently severe internal strains are brought upon the rod, which finally disrupt it, and even if the metal is not finally broken up or split longitudinally the strains
95 are such as to make it brittle and of a very inferior quality for wire. I have discovered that this internal strain on the metal, tending to disrupt the same, can be wholly obviated and the compressing action caused to act with
100 uniform tendency to elongate the metal in all parts of the section area of the rod, thus causing the metal to flow uniformly, easily, and naturally in the direction parallel with its axis, the tendency being rather to increase the tenacity or integrity of the fiber of the

metal than to disrupt the same. This result is effected in accordance with the present invention by applying the pressure and reducing the metal substantially uniformly over the entire surface of the part acted upon by a pair of rolls. In other words, all parts of the surface acted upon by the rolls approach the diameter of the blank at right angles to the plane of the rolls substantially equally instead of having the middle portion of said surface approach the diameter far more than the end portions, as has always been practiced heretofore in rolling metal.

In operating upon metal in accordance with this invention a continuous train of rolls is employed, the rod passing from one pair of rolls directly to the next pair, so that the heat which is generated by the flow of the metal itself is to a certain extent preserved and the flow of the metal at the several successive actions is nearly continuous, and better results are attained than if the metal had time to cool and come to rest, as it were, between the successive reductions.

Figure 1 is a diagram representing the successive pairs of rolls employed for rolling wire in accordance with the method forming the subject of this invention. Fig. 2 is a diagram view showing the sectional shape of the rod after the several successive reductions; Fig. 3, a diagram showing, on a larger scale, the several sectional outlines of the rod in the several reductions; and Figs. 4 and 5, illustrative diagrams, the former showing the mode of reducing the metal in accordance with this invention and the latter showing the mode heretofore commonly adopted.

The reduction of the metal is effected by a train of rolls a a^2 a^3 a^4 which may be operated in any suitable manner, being driven at the proper speed to act on the metal which passes between them, reducing the same in diameter and elongating it while it is carried forward by the rotation of the rolls.

In the diagram illustrated in Fig. 2 the method is shown as applied to the reduction of a square rod b , which is finally reduced to a round wire.

For convenience in description the diagonals or diameters of the rod will be marked x y , the one marked x in each case being on the line of the pressure of the rolls by which the blank is about to be acted upon, and the one marked y at right angles to the line of said pressure or parallel with the axis of the rolls acting on the metal at that point, being the line of pressure of the rolls that have just previously acted upon the blank to bring it to the slope shown. The first pair of rolls acts upon the blanks b on the line of the diameter x , the compression being applied practically evenly over the sides 2 3 in the direction parallel to the line x , and the bottom of the groove in the roll being truncated, so as to produce additional compression just at the corner 3, flattening the same down, and thus bringing the blank to the shape shown at 20. The sec-

ond pair of rolls acts on the blank 20, compressing the same on the line x and acting uniformly over the entire sides 2 3, so that the points 2 approach the line y in the compression practically the same amount as the point 3, except for the fact that the rolls are also slightly truncated, so that the corner 3 is flattened again, as before described, bringing the blank to the shape shown at 30. The same operation is repeated on the blank 30, reducing the same to the shape shown at 40, which is again acted upon and brought to the shape shown at 50, which is nearly the minimum reduction required, so that the final action is merely to bring the blank to the required sectional shape shown at d without further reduction than is necessary to change it from the shape shown at 50 to that shown at d . Except for the slight truncating action at the point or apex of the parts acted upon by the rolls, the rolls compress the blank evenly and uniformly over their entire width. In other words, the line 2 3 of the blank at 20 is moved with a parallel movement to the position shown in 3 2 in blank 30, and so on, and in such compression as this the flow of the metal is entirely lengthwise and substantially equal in all parts of the blank, so that the rod is elongated at each pass without tendency to split. Except for the slight truncated portions 2 2, it will be seen that the sectional shape of the rod is exactly the same at each successive pass, while in the process of rolling as heretofore practiced the sectional shape changes at each pass. In other words, in the former process the compression, instead of being applied uniformly in all parts of the sides corresponding to those marked 2 3, is greatest at the point 3 and nothing at the point 2, and the side 2 3, acted upon by the roll, instead of being moved parallel with itself toward the diameter y , moves with what may be called a "pivotal movement" around the point 2, the end 3 being carried in toward the diameter y , while the end 2 is not carried in at all. This difference in operation is readily understood from Figs. 4 and 5, in which the shaded portions show the amount of metal displaced in making one pass, and the difference in effect on the metal will be easily recognized.

In the plan illustrated in Fig. 4 an equal amount all over the blank (except for the slight amount inclosed in the triangles at x) is displaced and flows longitudinally, causing a corresponding elongation of the rod, while in the plan shown in Fig. 5 a very large amount of metal is displaced at the point x and almost none at the point y . There is thus great tendency to elongate the blank at the ends of the diameter x , while there is almost no elongation at all at the ends of the diameter y , except what is produced by the dragging action of the particles at x , exerted through the body of the metal to those at y . In other words, instead of elongating all parts of the rod equally, and consequently without inter-

nal strain, as is the case in the method forming the subject of this invention, the elongation was in the former plan confined to certain portions in the metal, which elongation was resisted by the tensile strength of the parts not displaced by lateral pressure, thus producing internal strains by which the rod was made brittle or even entirely torn apart and split.

The difference in effect between the two plans of operation can be easily understood by dividing the sectional area into four parts on the lines $x^2 x^2 y^2 y^2$.

In the plan shown in Fig. 4 it will be seen that the amount laterally displaced to go into the increased length is substantially the same in each of the four sections, all of which will be elongated substantially equally, while in the plan represented in Fig. 5 a very large percentage of the quarters $x^2 y^2 x$ will be displaced laterally and tend to elongate the said quarters, while only an extremely small portion of the quarters $y^2 x^2 y$ will be displaced laterally. Thus the first-mentioned quarters will tend to elongate far more than the last mentioned, which latter will hold back or resist such tendency, bringing an internal strain, which tends to shear or split the metal longitudinally, and after a number of successive passes of this kind will do so, or at any rate will bring the metal to such condition that it is unfit for use as wire. If the rods were made of a bundle of four separate rods, instead of a single integral one, as shown, the elongation of all four would be nearly equal with the reduction shown in Fig. 4, those opposite the letter x having only a very small percentage greater elongation (owing to the truncation of said corners) than those opposite to the letter y , while with the plan represented in Fig. 5 the two opposite the letter x would have several times as great reduction and consequent elongation as those opposite the letter y , and it is this unequal elongation in different parts of the rod, or rather the tendency to elongate unequally, resisted by the internal strains in the rod itself that has been undoubtedly the reason for the failure to produce wire by cold rolling in the plans heretofore tried. The same action of course takes place when the metal

is treated hot, as in the case of reducing the rods preparatory for making wire; but as the hot metal flows more readily the internal strains are not so great and their effects are not so objectionable, although there would undoubtedly be an advantage arising from applying the reduction in accordance with the herein-described method even in hot rolling.

The invention is not necessarily limited to the square sectional shape of the rod herein shown for the purpose of illustration, as the same plan might be applied with other shapes, the essential feature of the invention being that the lateral compression or displacement is substantially uniform on all parts of the surface, so that all parts are subjected to equal tendency to elongate, or substantially so.

In operating upon circular shapes in accordance with the improved plan the circular shape would be retained at each pass, except for a slight flattening or truncation at the ends of the diameter in line with the compression applied, while with the old plan of rolling substantially circular shapes the rod is brought to elliptical shape at each pass, that which was the longer diameter of the ellipse before a given action of the rolls becoming the shorter diameter of the ellipse after the wire has passed through the rolls, so that the portions near the ends of the longer diameter tend to elongate far more than the portions near the ends of the shorter diameter, producing the objectionable internal strains above mentioned.

I claim—

That improvement in the art or method of rolling wire which consists in subjecting all the parts of the surface acted upon at a given pass to substantially uniform pressure and displacing substantially equal amounts of metal at all points acted upon by the rolls, substantially as and for the purpose described.

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

HENRY ALEXIS WILLIAMS.

Witnesses:

M. E. HILL,
JOS. P. LIVERMORE.