E. T. GREENFIELD.

ART OF METAL WORKING.

APPLICATION FILED NOV. 14, 1913.

1,217,748.

Patented Feb. 27, 1917.

2 SHEETS—SHEET 1.

Fig. 1.

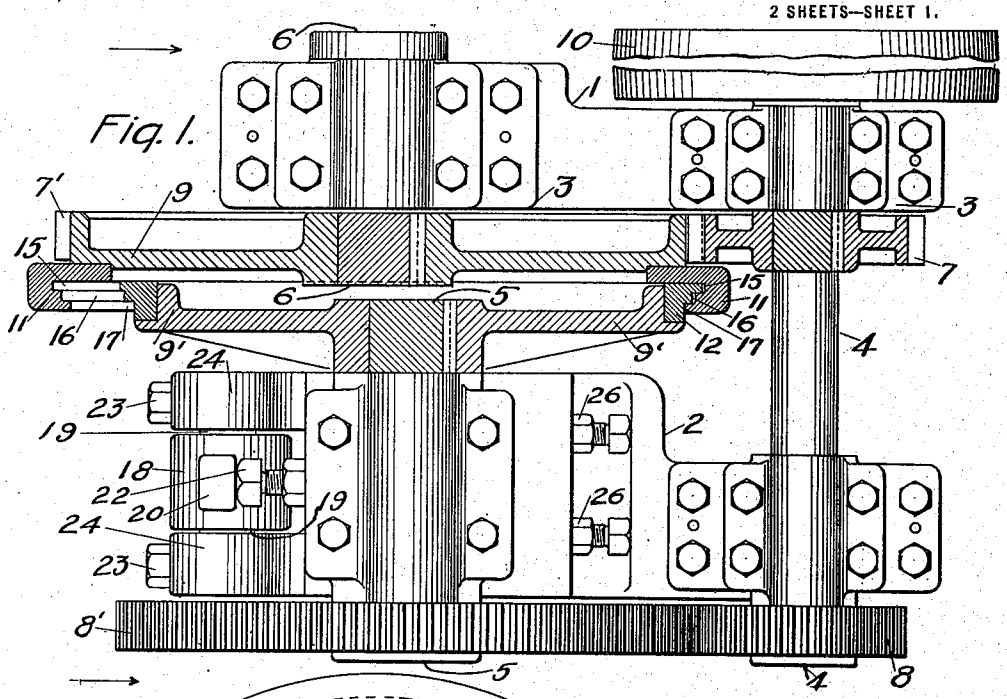
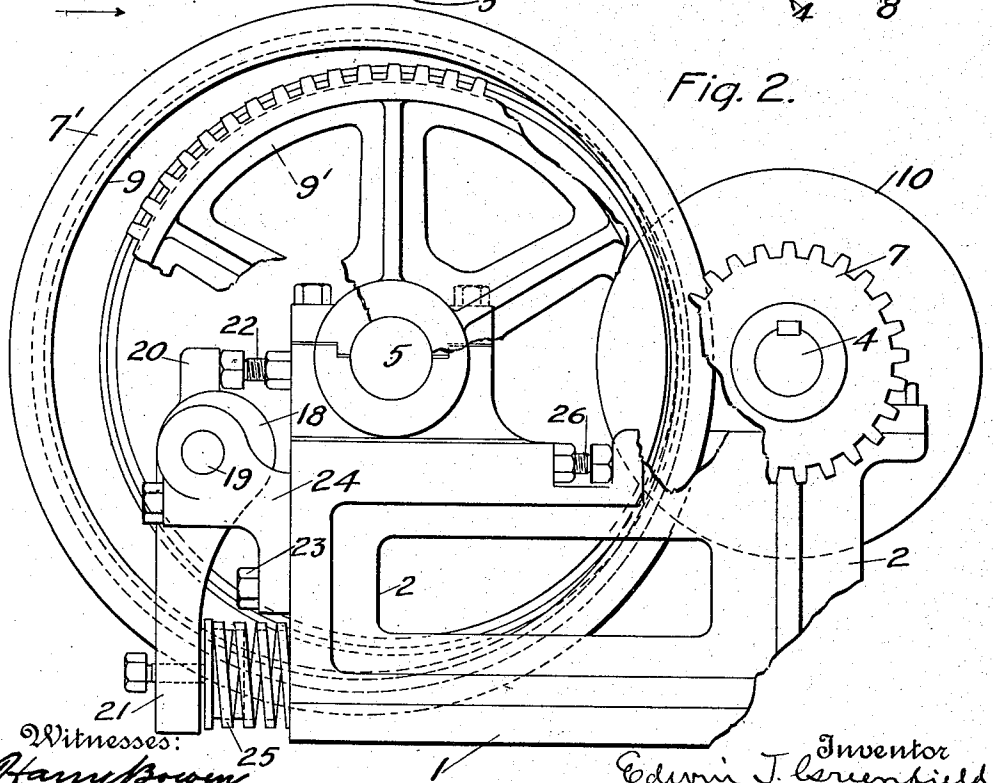



Fig. 2.




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2 SHEETS—SHEET 2.

Fig. 3.

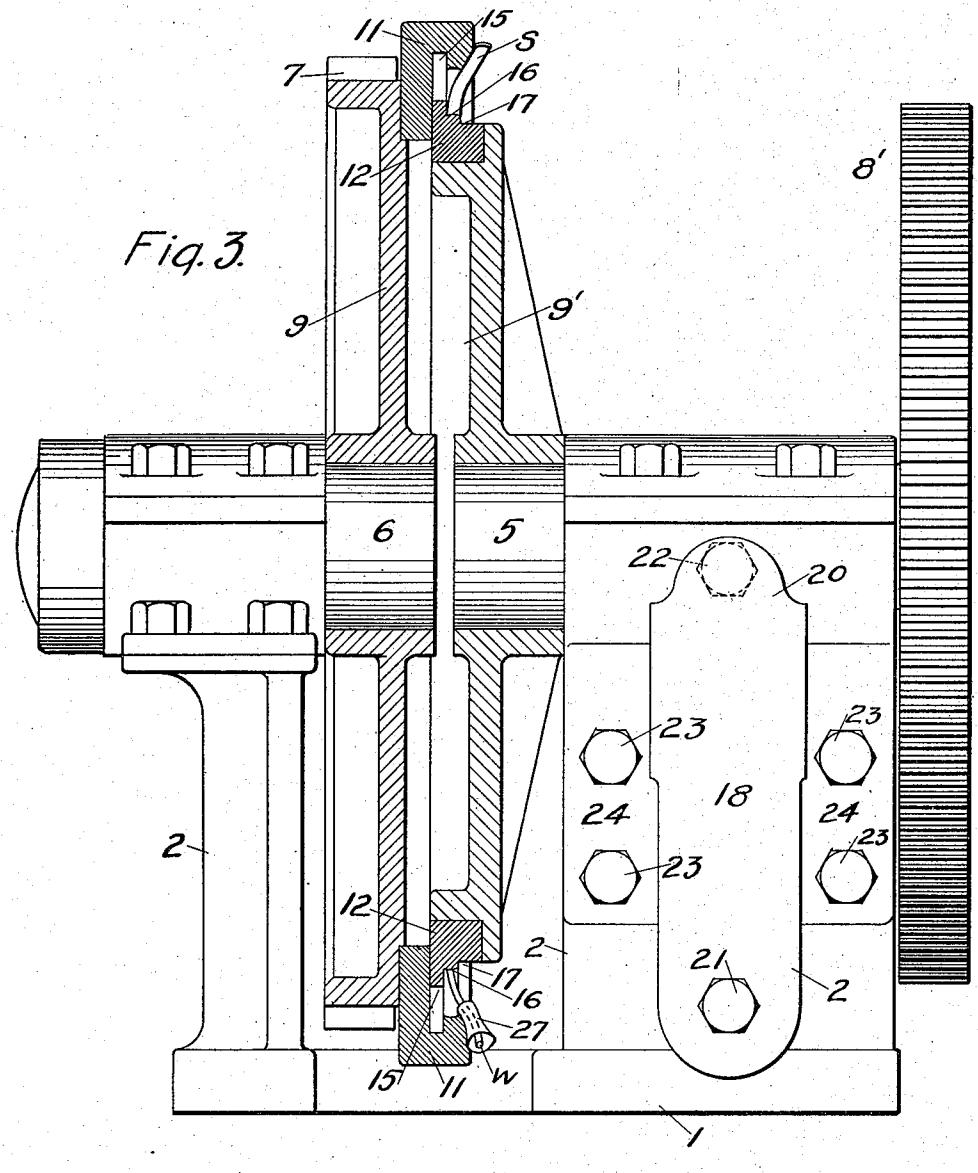
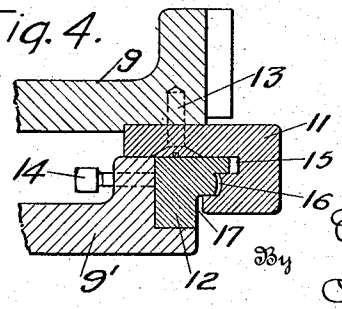



Fig. 4.




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# UNITED STATES PATENT OFFICE.

EDWIN T. GREENFIELD, OF KIAMESHA, NEW YORK.

## ART OF METAL-WORKING.

1,217,748. Specification of Letters Patent. Patented Feb. 27, 1917.

Application filed November 14, 1913. Serial No. 800,992.

*To all whom it may concern:*

Be it known that I, EDWIN T. GREENFIELD, a citizen of the United States, and resident of Kiamesha, county of Sullivan, and State of New York, have made a new and useful Invention in the Art of Metal-Working, of which the following is a specification.

My invention is directed to a novel method of forging metal wires or rods, and it has for its objects—

First, to very greatly diminish the cost of such products.

Second, to increase the speed with which such products are produced.

Third, to produce a product which is better in quality than is produced by methods and mechanism heretofore utilized.

My invention embraces a novel method whereby I produce a forging or rolling effect, so to speak, upon metal wires or rods.

I accomplish this result by continuously heating a wire or rod to be treated, as it is drawn into a machine, to white heat known in the art as putty heat, and feeding the same simultaneously as thus heated into a pair of rolls which are so designed that they forge or roll the wire or rod into definite proportions without increasing the length thereof and without material change of area of the cross section. These rolls are so constructed and proportioned and the relative speed of the driving mechanism thereof is such that the product, as it is forged or rolled by the machine, is varied from the product acted upon, which is generally of circular cross section, and in such manner that it is of equal rectangular, curvilinear, or other flattened cross section without substantially varying the molecular condition and that the length of the wire or rod is not substantially changed, in other words the wire or rod is reduced in thickness and correspondingly caused to flow transversely or laterally so as to produce a comparatively wide flattened strip. This transverse or lateral flow is in a direction at right angles to the direction in which the reducing pressure is applied, that is in a direction parallel to the axes of the rolls.

For a full and clear understanding of the invention, such as will enable others skilled in the art to construct the apparatus and practice the method hereinafter claimed, reference is had to the accompanying drawings, in which—

Figure 1 is a plan view partly in horizontal section of my improved machine; and

Fig. 2 is a side elevational view as seen looking at Fig. 1 from the bottom toward the top of the drawings, parts of the drawing being broken away and parts of the circular dies shown in dotted lines to more clearly illustrate the invention.

Fig. 3 is an enlarged side elevational view as seen looking at Fig. 1 from left to right in the direction of the arrows, the operative parts of the rolls being shown in sectional view with a round or drawn wire entering the same at the bottom of the machine and emerging at the top in completed rolled, flattened, or strip form and substantially slightly curvilinear in cross section.

Fig. 4 is an enlarged cross sectional detail view of the circular dies used with the machine for effecting the rolling, forging operation; illustrating also the connection thereof to the flanges of the gear-wheels which drive the same.

Referring now to the drawings in detail, in all of which like numerals represent like parts wherever used, 1 represents the metal base of the mechanism having strong integral front uprights or standards 2 and similar rear uprights or standards 3 for sustaining the operative parts of the machine. 4 represents a driving shaft journaled in both the front and rear standards 2 and 3 and securely held by strong bolted journal bearings. 5 represents a driven shaft journaled in a single long journal bearing upon the front standards 2; 6 being a second driven shaft similarly journaled upon the rear standards. 7 and 7′ are two rear intermeshing gear-wheels keyed respectively to the shafts 4 and 6, and 8, 8′ are two front intermeshing gear-wheels keyed respectively to the shafts 4 and 5. 9 and 9′ represent the bodies of the two coöperating rolls which bodies are keyed to shafts 6 and 5 respectively and upon different centers. 10 represents the driving pulley upon the driving shaft 4. 11 and 12 represent detachable rolling dies for effecting the mode of operation to be accomplished, said dies being of hardened steel or other very refractory metal and circular in form, the die 11 be-

ing secured to the face of the body 9 by screws 13, so as to be detachable for changing the same or for effecting repairs in the event of injury (see Fig. 4) the die 12 being radially held by the body 9′ by a plurality of radial set-screws 14.

When the machine is assembled these two rolling dies are secured by screws 13 and 14 in the manner indicated with a portion of the die 12 entering a guiding channel at 15 and with a flange portion of die 11 engaging the die 12 adjacent to the reference character 17. The dies 11 and 12 have coöperating rolling surfaces which provide a pass 16 between them of the form it is desired to have the metal assume after the product is completely forged. In the present instance the resulting product is shown to be of curvilinear form, although it may be rectangular or of various angular forms, in accordance with the desire of the manufacturer to make any peculiar form of goods, this matter being one which will suggest itself to those skilled in the art.

In constructing the several parts of the machine it is necessary that the exterior circular die 11, which is in effect the working portion of an annular roll, be of greater diameter than the interior circular die 12, which is in effect the working portion of a companion roll that coöperates with said annular roll, since these dies are adapted to roll the one within the other. In order to prevent frictional drawing of the metal and to produce rolling effect only, it is necessary to make the pitch diameters of the several gear-wheels 7, 7′ and 8, 8′ of different proportions, such that the linear velocities of the two dies shall be the same on their working surfaces. This will be apparent, in view of the fact that the diameter of the interior working face of the exterior die 11 is greater than the diameter of the exterior working face of the interior die 12, and by properly proportioning the pitch circles of the gear-wheels the working surfaces of the two dies may be given exactly or substantially the same linear velocity and not draw the metal but act purely as compressing dies, thus producing a forging effect. 18 is an adjusting lever pivoted at 19 to two supports 24, secured to the uprights or standards 2 by bolts 23, the short arm 20 of which bears against an adjusting screw 22 provided with a lock-nut which bears against a slidable journal bearing of the shaft 5; the long arm 21 bearing against a very strong spiral spring 25 resting against the lower part of the standard 2.

It is the function of this part of the apparatus to slidingly adjust the shaft 5 of the body 9′ of the inner roll and the inner die 12, in the event of the metal, in the act of being forged, becoming suddenly cooled, so as to thereby avoid breakage of the machine, as these parts are all slidable upon the standards 2 and hence adjustable in a reverse direction by two adjusting screws and lock-nuts 26 which bear against a shoulder on the upper part of the standards 2. 27 is an inclined cylindrical tubular guide-way attached to the base 1 of the machine and *w* represents the wire as it is fed therethrough into the dies 11 and 12 from below, *s* representing the completed product in the nature of a strip of curvilinear cross section as it emerges therefrom above.

The operation of the mechanism is as follows—The wire as it is forced forward is heated to white heat in any well known manner and as little tension as possible is exerted thereon as it passes through the guide-way 27 into the dies 11 and 12, it being important that said dies shall act upon the metal solely to compress, that is, thin or reduce, the same between their compressing surfaces, as it is forced forward by the power driven gear-wheels, as clearly shown in dotted lines in Fig. 2. As it is thus forced forward the relative proportions of the drive-wheels of the two dies are such that they act upon the metal solely by pressure and in no sense produce a substantial drawing effect. The pass between the dies is of sufficient width so that the metal can flow transversely or laterally while it is being reduced by the dies and the metal will flow laterally since it is prevented from flowing longitudinally or being elongated due to the bite or resistance of the dies. In other words this flow, transversely or laterally, is a flow substantially parallel to the axes of the rolls, or looked at from a different point of view is a flow in a direction at right angles to the direction in which the reducing pressure of the dies is applied to the work. It is a transverse or lateral flow along the reducing faces of the pass between the rolls. At the same time, when the metal reaches the point shown by the dotted lines, on the extreme right in Fig. 2, it assumes the curvilinear shape in cross section and the area of the dies is such at this point that the product is given the shape shown at the top of Fig. 3 and does not change the relative density thereof; nor does this action in any sense substantially change the length of the wire or rod as it passes through the dies, so that with my improved method I am enabled to produce a product which is made from drawn wires or rods and is not changed substantially in density nor substantially in cross-sectional area during the operation of the entire method, and is produced at a single act, thus very greatly decreasing the time required to bring about this result.

I am also enabled to entirely avoid any process of annealing during the operation, thereby further increasing the efficiency of the product. It will be understood that the

dies may be kept cool by the usual practice of water or cold air jackets, and such devices as are made necessary in keeping mechanism of this kind in working condition, these matters being perfectly obvious to those skilled in the art. Different forms of circular dies may also be provided for making metal strips of various forms or for varying the strips of metal, if desired; these matters being also entirely obvious in view of the hereinbefore described mechanism and method of operation of the same.

While in the claims a rod is referred to still this expression is to be broadly construed so as to include what is known in the trade as a wire or the like, that is, an elongated strip of uniform cross section.

From what has preceded, and also from an inspection of the drawings, it will be noted that when a metal wire or rod is compressed within the opposing dies herein illustrated there is applied to successive portions of the wire or rod an uninterrupted continuous forging pressure, and it will be noted that the dies confine the material which is between them so as to prevent the longitudinal flow of such material whereby a substantial elongation of the wire or rod cannot take place, and that the dies are furthermore shaped so as to permit a transverse flow of the material being then operated upon as the forging pressure of the dies is applied to the top and bottom portions of the wire or rod being treated.

The improvements herein set forth are not limited to the precise construction and arrangement shown and described for they may be embodied or realized in various forms and modifications within the scope of the appended claims without departing from the spirit and scope of the invention.

Having thus described my invention what I claim and desire to secure by Letters Patent of the United States is—

1. The described method of producing a metal strip, consisting in subjecting a rod to a reducing pressure or forging effect which thins and flattens it and simultaneously subjecting it to a reacting pressure which limits the extension as the pressure action takes place while at the same time permitting the material being reduced to flow laterally in a direction at right angles to the reducing pressure whereby the cross-sectional area of the product after it is substantially rolled is the same as the cross-sectional area of the rod before it was rolled.

2. The described method of producing a metal strip from a rod consisting in first heating the rod to white heat, then subjecting successive portions of it to a roll forging action of rolls which reduce the rod and which rolls have a pass between them shaped so that it allows the material being reduced to spread laterally in a direction parallel to the axes of the rolls whereby the resulting strip will be of substantially the same length as the original rod, and simultaneously subjecting said successive portions to a reacting rolling pressure which substantially limits the longitudinal extension of the rod as the roll forging action takes place so that the cross-sectional area of the product after it is rolled is substantially the same as the cross-sectional area of the product after it rolled.

3. The described method of producing a metal strip, consisting in first heating a rod or wire to white heat, then subjecting it to a reducing pressure which flattens and spreads it in a direction at right angles to the line of reducing pressure, and simultaneously subjecting it to a reacting pressure which limits the extension and insures the spreading as the pressure action takes place, so that the sectional area of the product or resulting strip after the rolling is the same as the sectional area of the wire or rod before it was rolled.

4. A method of forging a strip of material from a metal rod, which method comprises the subjecting of said rod to an uninterrupted continuous reducing pressure of opposing dies while confining the material that is between said dies so as to prevent a substantial elongation of the metal in the rod and while permitting a transverse flow of metal in a direction at right angles to the line of reducing pressure as the reducing pressure is applied to said rod by means of said dies.

5. The method of forming a strip of material from a rod, which method comprises the subjecting of successive portions to a continuous forging reducing action between opposing dies that are constructed so as to permit a lateral flow of the material along the reducing faces of the dies whereby there will not be a substantial elongation of the portion being operated upon while said forging reducing pressure is applied by said dies to top and bottom portions of the rod being treated.

6. In the making of flattened strips the method which comprises passing a rod between opposing rolls that are shaped so as to restrain the rod against substantial elongation while applying reducing pressure to the rod and permitting the material being treated to flow laterally at substantially right angles to the line of reducing pressure.

7. A method of forging a strip of material from a metal rod which method comprises the subjecting of said rod to an uninterrupted continuous reducing pressure of opposing rolls while confining the material that is between said rolls so as to prevent any substantial longitudinal flow of the material in the rod and simultaneously permit-

ting a transverse flow of metal in a direction substantially parallel to the axes of the rolls as the reducing pressure is applied to said rod by means of said rolls.

8. The method of forging a strip of material from a metal rod which method comprises subjecting successive portions of the rod to a continuous roll forging reducing action between opposing rolls that are constructed so as to permit a lateral flow of the material in the rod in a direction parallel to the axes of the rolls, said rolls also being constructed so that this reducing action will be carried out without causing a substantial elongation of the portion of the rod being operated upon while said forging reducing pressure is being applied by said rolls to the opposite portions of the rod being treated.

9. In the rolling of metals the method which comprises subjecting successive portions of a rod to the action of opposing dies which restrain the rod against substantial material elongation, applying reducing pressure to the rod and allowing the material of the rod to flow laterally at right angles to the line of reducing pressure while the rod is being successively reduced so as to form a flattened strip.

10. The method of forging a strip of material from a metal rod which method comprises the subjecting of said rod to an uninterrupted continuous reducing pressure of opposing rolls while confining the material that is between said rolls so as to substantially prevent the longitudinal flow of the metal in a direction parallel to the axes of the rolls as the reducing pressure is successively applied to said rod by means of said rolls.

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

EDWIN T. GREENFIELD.

Witnesses:
C. J. KINTNER,
M. F. KEATING.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."