W. A. SHAW.

Hardening, Tempering, Annealing, and Straightening Wire.

No. 211,938. Patented Feb. 4, 1879.

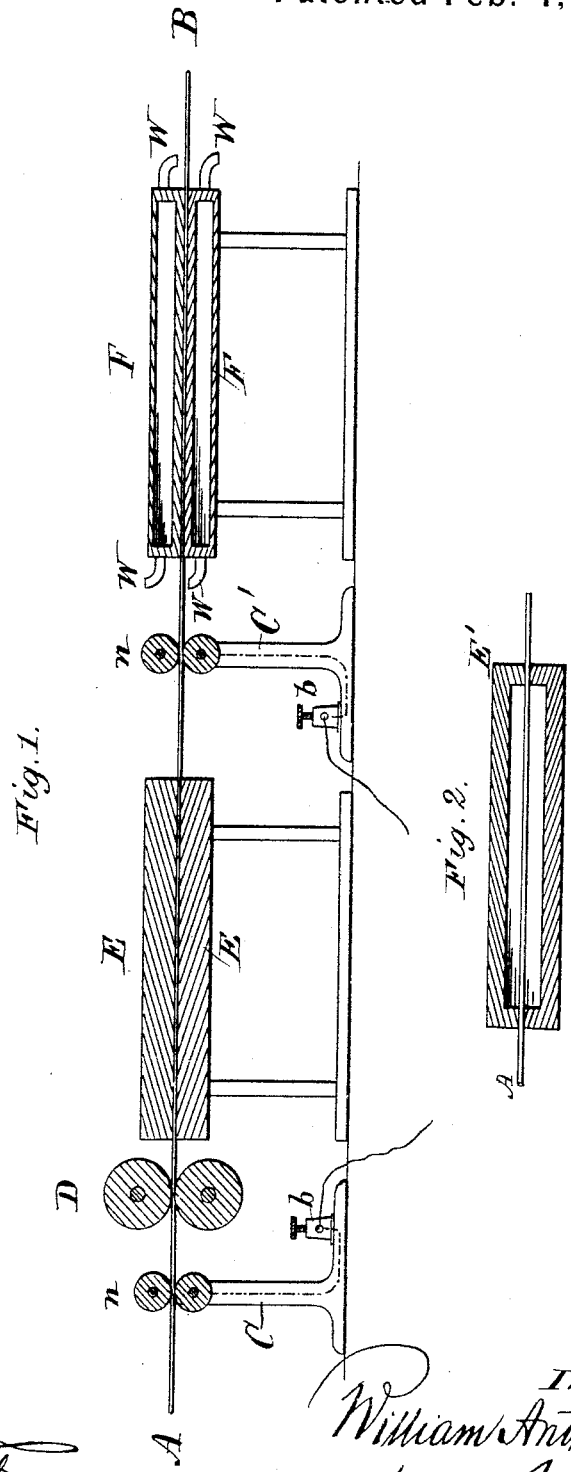

Fig. 1.

Fig. 2.

Witnesses:

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UNITED STATES PATENT OFFICE.

WILLIAM A. SHAW, OF NEWPORT, RHODE ISLAND, ASSIGNOR OF ONE-HALF HIS RIGHT TO L. H. ROGERS, OF NEW YORK, N. Y.

IMPROVEMENT IN HARDENING, TEMPERING, ANNEALING, AND STRAIGHTENING WIRE.

Specification forming part of Letters Patent No. **211,938**, dated February 4, 1879; application filed November 30, 1878.

To all whom it may concern:

Be it known that I, WILLIAM ANTHONY SHAW, of Newport, in the county of Newport and State of Rhode Island, have invented certain new and useful Improvements in Hardening, Tempering, and Annealing Wires, Rods, Ribbons, Plates, &c.; and I do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to hardening, tempering, and annealing wires and other forms of steel and iron, such as rods, ribbons, plates, &c., and may be used for straightening long lengths of those metals.

Very great accuracy and uniformity are attainable by this process, and a great economy is effected in fuel and materials usually consumed. No lead, oil, or other material need be used, and broken or waste products are avoided. There is no contact of the metal under treatment with fire or the products of combustion, which have a deteriorating influence upon steel, and, if required, the heated metal can be protected from the atmosphere.

In this invention electric currents are used for the purpose of heating the metals, and there can be maintained by this means an absolutely uniform temperature readily adjustable to the quality or grade of metal operated upon, and capable of being regulated to an exact degree. The passage of the electric current causes a homogeneous arrangement of the molecular or crystalline structure of the metal, and by heating it uniformly—the interior as well as the exterior—a perfect result is attained. All tension in the metal under treatment is dispensed with, which obviates the loss and waste occasioned by the frequent breaking of the steel while undergoing the common process of tempering under tension. It has been found to be practically impossible to keep a steady unvarying tension upon the wire by the machines hitherto employed. The irregularity destroys the uniformity of the wire both in temper and quality.

The following description will enable those skilled in the art to which it appertains to make and use my invention.

Figure 1 of the drawings represents a side view, partly in section, of the apparatus to be used in carrying out my invention; and Fig. 2, a cross-section of a plate having a tube or channel therein.

A B represent the wire to be tempered, straightened, or annealed. D is a pair of driving or feed rollers to push the wire through the machine. They are connected to any convenient source of power. The rollers D are insulated at their journals.

C C′ are posts carrying conductors from the binding-screws *b b* to small brass or copper rollers *n n*, which convey electric currents to the wire, A B, under treatment.

E E are straight plates having accurately-grooved channels to keep the wire straight as it passes through the apparatus. In place of or in addition to passing through the accurately-grooved plates, the wire may be passed through channels or tubes exhausted of air, or filled with any gas having no action upon the wire, to prevent the injurious action of the atmosphere. E, Fig. 2, represents in cross-section a plate having such a tube or channel therein.

F F are hollow boxes having grooved faces to be traversed by the wire, and are kept cool by a constant circulation of cold water through hose or pipes connected to the valves at W.

The electrical currents pass from a suitable source of electrical energy, through a suitable conductor, to one of the binding-posts *b*, and, after traversing the wire, heating it in the passage, are conducted back to the source of electrical energy by a conductor attached to the other binding-screw *b*, thereby completing the circuit.

The conducting-rollers *n n* may be replaced by spring-clips bearing lightly on the wire. The plates E E, which should be insulated, and boxes F F, may be mounted upon ways and given a reciprocating motion, like the bed of a planing-machine. This would dispense with the feed-rollers D.

In operation, a coil of wire is placed upon a drum, from whence it is taken between rollers

or grooved plates, or both. While fed along by the rollers or plates the wire is heated by means of electric currents derived from any suitable source. These currents are sent directly through the wire, or they may traverse the grooved plates or rollers before mentioned. Heat from other sources may be used in combination with electricity. The wire, heated as described, is then passed between grooved plates or rollers cooled by a circulation of cold water, and hardened to the degree required. By this means it may be hardened at one operation. The metal under treatment can be carried through oil, water, or other cooling or hardening media; or cold blasts of air can be used for hardening.

In some cases it may be reheated by a duplication of the apparatus first mentioned, for the purpose of annealing. The wire, while it is being heated through the agency of electric currents alone, or combined with heat from other sources, may traverse tubes or passages in which a vacuum is maintained; or these may be filled with gases or fluids having no deteriorating action upon the metal.

The wire, as it enters and leaves these tubes, passes through a suitable stopper or other device arranged to allow the passage therethrough of the wire, but to prevent the entrance of air or the escape of the gas or other fluid. The vacuum may be maintained by means of an air-pump or other well-known means, and the tubes or passages may be filled with the innocuous protective gas or fluid in any desirable way from a reservoir through a suitable connecting tube or pipe in communication with the interior of said tubes or passages, the gas or fluid being forced thereinto and expelling the air, or the air being first exhausted.

When curved forms are desired, the grooved plates or tubes are curved to the shapes wanted, or are made with spirals for springs and like articles. The form and arrangement of the feeding and other rollers in contact with the article under the treatment are altered to correspond therewith.

The electric currents are by preference derived from dynamo-electric machines, which may be driven by any waste or surplus power not needed for other operations in the shop. Constant currents can be used or the electric spark employed. The wires may traverse between electrodes similar to those used for the electric light.

The entire apparatus is extremely compact, and where power is in use for other work there is little or no expense in operating it.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In hardening, tempering, annealing, or straightening wire and other articles of steel and iron, the process of heating the same by electric currents while the article is held between accurately-grooved plates, substantially as described.

2. In the hardening, tempering, and annealing or straightening of wire and other articles of steel or iron, the process of heating the same by the combined action of electric current and heat from other source, substantially as described.

3. The combination, with mechanism for feeding wire, of supporting-posts provided with means for conveying electric currents, and causing the same to traverse wire passing between said posts, and hollow boxes or rollers with grooved faces provided with means for maintaining therein a circulation of cooling medium, substantially as described, whereby the wire, being first heated by the electric currents, is subsequently and at one operation cooled by aforesaid circulation of cooling medium, as set forth.

4. The process of treating wire and other articles of steel or iron out of contact with fire or deteriorating agencies, the same consisting in heating the wire or other article by electric currents while it is passed through a chamber exhausted of air, or filled with an atmosphere which will not injuriously affect the metal of the wire or other article, substantially as described.

5. The process of hardening, tempering, annealing, or straightening wire and other articles of steel or iron without tension, which consists in driving or forcing the wire or other article by power applied to push it through the apparatus, substantially as described.

6. The combination, with heating and cooling appliances, of feeding mechanism, substantially as described, arranged to act upon wire or continuous lengths of metal before it has passed through said appliances, as set forth, whereby the wire or length of metal is propelled instead of drawn through the apparatus, as specified.

In testimony that I claim the foregoing as my own I affix my signature in presence of two witnesses.

WILLIAM ANTHONY SHAW.

Witnesses:
M. J. ARMINGTON,
H. E. ARMINGTON, Jr.