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METHOD OF TAPERING METALLIC RODS AND THE LIKE

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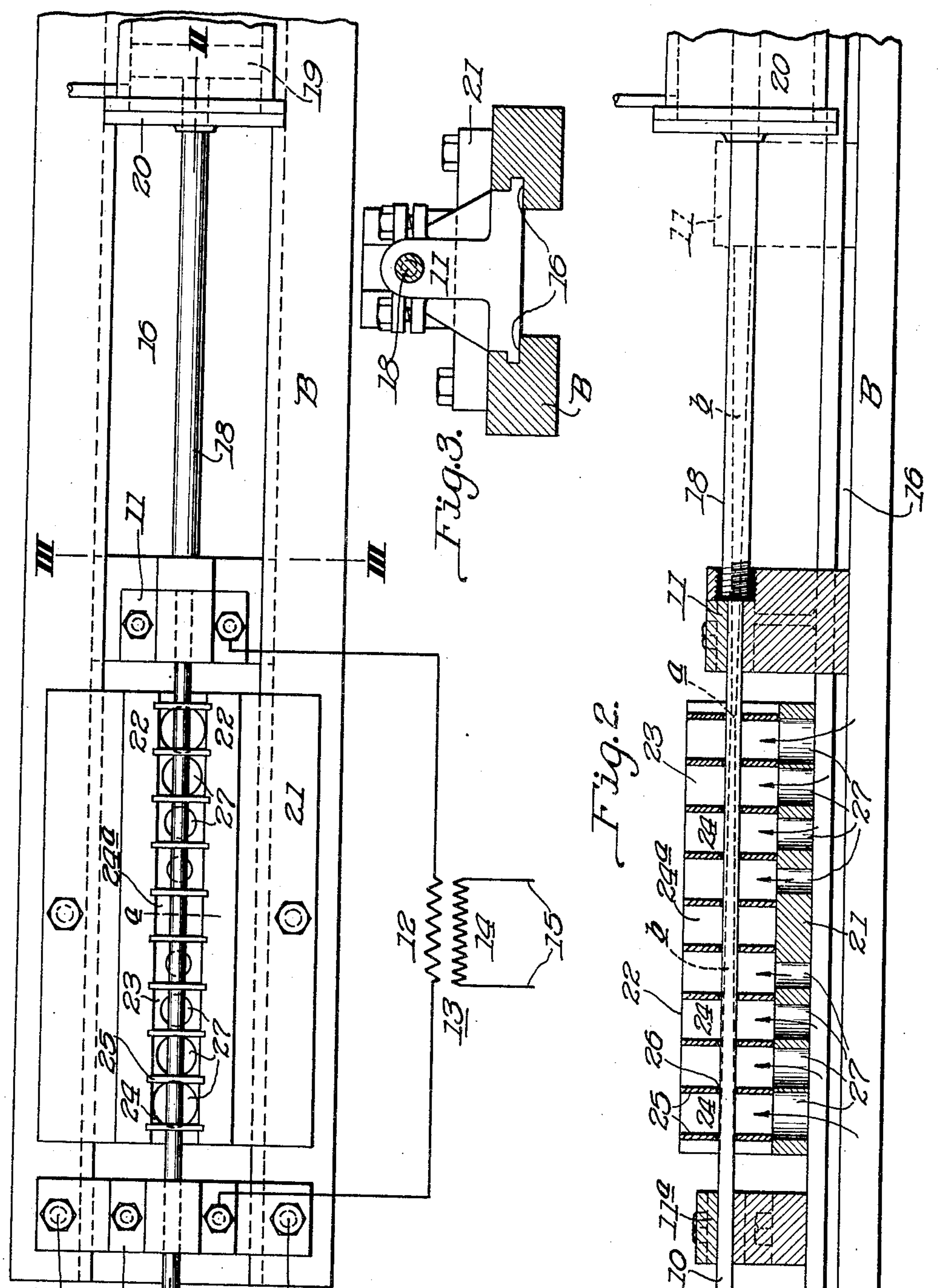

Fig. 1.

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METHOD OF TAPERING METALLIC RODS AND THE LIKE

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This invention relates to a method of producing tapers on metallic rods and the like.

It is a prime aim of the present invention to provide a method whereby longer tapers than were heretofore thought possible from a practical standpoint may be produced, and a method whereby tapers of any length may be more expeditiously and inexpensively formed than heretofore.

An important object is to provide a method whereby the article or rod, or the portion thereof to be tapered, will be reduced in strength proportionately from a given point and then subjected to longitudinal stretching whereby it will be stretched in proportion to the strength, these operations resulting in the desired taper.

Another object is to provide for heating the rod or portion to be stretched, in order to proportionately reduce the strength thereof as mentioned above, through the use of a transformer in an electric circuit having the terminals of the secondary in conducting relation to the rod at the limits of the portion to be tapered.

A still further object is to provide ventilating means for accurately controlling the relative temperature of the different parts of the rod during the heating process, to produce a more uniform taper upon the drawing thereof. Further, it is aimed to provide a method whereby the taper may be provided by reducing the strength of a portion of a rod between two clamps or the like engaging the rod and from a point midway of the clamps and progressively decreasing in degree of reduction toward the clamps, and in subsequently moving one or both of the clamps away from the other while attached to the rod to stretch the rod, which accordingly produces the taper.

The method and the apparatus therefor are illustrated in the accompanying drawing, wherein:

Fig. 1 is a plan view of an apparatus constructed in accordance with my invention, showing the parts in the position assumed at the start of an operation and during the reduction of the strength of the rod;

Fig. 2 is a sectional view taken on the line II—II of Fig. 1, also indicating in dotted lines the parts in position at the end of an operation; and

Fig. 3 is a cross section on the line III—III of Fig. 1.

Referring specifically to the drawing, 10 designates a metallic rod which is to be formed into two rods each having a taper of any length desired. Such rod is usually round in cross section, but may be square or any other shape.

Secured rigidly to the rod 10 in spaced relation, and extending completely therearound, are jaws or clamps 11 and 11*a* of any desired construction, to enable application and removal thereof.

Such clamps 11 are of electrical conducting material, and have the terminals of a secondary coil or winding 12 of a transformer 13 connected thereto. Said transformer has its primary coil or winding 14, through its leads 15, adapted for connection with any source of alternating electric current of suitable voltage and frequency.

I have shown, as a preferred embodiment of my invention, a base member B of non-conducting material as, for example, wood, having a longitudinal T-slot 16 therein for slidably mounting the clamp or jaw 11, as clearly shown in Fig. 3. The clamp 11*a* is fixedly secured to the base by means of bolts or screws 17.

For the purpose of translating the clamp 11 to taper-draw the rod 10, I have provided a connecting rod 18 suitably insulated from and secured to said clamp at one end, and having a piston 19 on its other end, said piston adapted for reciprocation in a cylinder 20 by the application of compressed air or other fluid thereto, as will be readily understood.

In practicing the invention, the parts are initially connected as in Fig. 1, and electric current is supplied to the primary winding 14 and low voltage current of large volume or amperage is induced through the secondary winding 12, flowing through the clamps 11 and 11*a* and the portion of the rod 10 located between them. By adjusting the amount of the current and the length of time it flows, the middle point of the rod between the jaws, which is indicated at *a*, will be raised to a temperature very much higher than that of the other parts of the rod or the surrounding medium, the temperature or degree of heating from the said point *a* progressively decreasing in opposite directions toward the clamps 11 and 11*a*. This results in correspondingly reducing the strength of the metal between said clamps; that is, the portion of rod 10 between the clamps has maximum weakness at the point *a* and progressively increases in strength in opposite directions therefrom to said clamps.

The clamp 11*a*, as described, is preferably held stationary at this stage, while compressed air or other fluid is applied to the cylinder 20, thereby moving piston 19 and the clamp 11 to the right to the position shown in the dotted lines of Fig. 2, and, as it is rigidly connected to the rod, stretching the portion of the rod 10 between such clamps into the shape also indicated in dotted lines in Fig. 2, a shape including uniform oppositely tapered portions *b* which may be readily severed at their connecting apices. The tapered portion *b* may be of any length desired, since the present invention overcomes those obstacles in previous methods permitting only short tapered portions to be formed.

Attention is called to the fact that the stretching of the rod does not have to immediately follow the heating and reducing of the strength thereof since the essential step is to reduce the strength as described. The rod reduced in strength may even be cooled before the stretching step is practiced.

Taking a specific example, suppose a rod of hard drawn aluminum were that represented at 10. Its ultimate strength would be approximately 24,000 pounds per square inch. However, if the rod were annealed dead soft in a furnace, then allowed to cool, and tested, it would be found that the ultimate strength was reduced to about 12,000 pounds per square inch. If, therefore, a rod 10 of hard drawn aluminum is engaged by clamps 11 and 11*a*, as illustrated, and the current is applied for a proper length of time, the center point *a* of the rod can be heated up to the full annealing temperature of the rod.

If the adjustment of the current and time is maintained correct, it will be possible to cut off the current, thereby at that instant leaving the temperature of the rod at the jaws or clamps 11 practically the same as that of the surrounding air, and leaving the temperature of the middle point of the rod at a very much higher temperature, say, for example, 700 degrees F. or more. This temperature can, of course be adjusted for any value desired within the melting point of the material. When the current is cut off and the rod quickly cooled, as by means of an air blast or water spray, or even if it were allowed to cool off itself in the air, the rod would, after it cooled off, be annealed at the center point and have progressively varying annealed conditions at other points from opposite sides of the point *a* to the jaws. At the jaws, the rod would remain hard drawn because of the cooling effect of the jaws.

It has been found in practice that the method just described may be carried out with better results providing the air surrounding the rod 10 is stationary while said rod is being heated by the electric currents.

The amount of energy which is developed by the current in the rod is the same at every point throughout its length between the jaws when the current first begins to flow. The middle point between the jaws increases more rapidly in temperature than the other successive points between the middle and the jaws, for the reason that the heat which is developed by the current flows away through the wire or rod into the heavy and relatively cool jaws. As the temperature of the rod increases, the air immediately surrounding the rod becomes heated and it rises, thereby displacing the cooler air and convection currents are set up which tend to cool the rod.

If the rod were entirely enclosed in an air chamber so that the air could not get away from the rod, it would heat more rapidly and also the desired effect would be more readily obtained. However, if the central portion of the rod is positioned within a tightly enclosed chamber, and then each successive section of the rod between the middle and the jaw were enclosed in a separate chamber, the ventilation of which was controlled, the relative temperatures of the different parts of the rod may be regulated accurately.

To this end, I provide a ventilating or cooling regulating device consisting of a base member 21 adapted to be positioned on the base B, and having longitudinally extending spaced-apart side members 22 secured centrally of the base member 21. The rod 10 is passed through the chamber 23 between the members 22, said chamber being divided into a series of smaller chambers 24 by means of vertical partitions 25, preferably formed of asbestos or other heat resisting material, the latter having central openings 26 therethrough to receive the rod 10.

As shown and as preferred, I have provided an unequal number of small chambers 24 to uniformly control the heat of the rod 10 from its middle point *a* outwardly in both directions to the clamps or jaws 11 and 11*a*. The chamber 24*a* is closed at the bottom for the purpose of minimizing the convection currents, tending to cool the rod during the heating thereof. The remaining chambers 24 are provided with openings 27 at the bottom thereof for the purpose of introducing air around the remaining portion of the rod 10 during the heating process.

It will be noted that the openings 27 increase in size toward the jaws or clamps 11 and 11*a* to uniformly reduce heating of the rod from the high temperature at the point *a* outwardly in both directions to the cool sections of the rod contained in said clamps.

I claim:

1. Means for tapering a metallic body including spaced-apart clamp members, an interposed cooling regulating device for directing air currents at spaced intervals onto the body to effect a non-uniform cooling of the body, means for subjecting said body to an electric circuit, and means for moving a clamp member to effect stretching of said body.

2. Means for tapering a metallic body including spaced-apart clamping members, an interposed cooling regulating device including a plurality of longitudinal spaced chambers in which the body is disposed for directing spaced air currents onto the body, means for subjecting said body to an electric circuit, and means for moving a clamp member to effect stretching of said body.

3. Means for tapering a metallic body including spaced-apart clamping members, an interposed cooling regulating device including a plurality of longitudinally spaced chambers in which the body is disposed, means for subjecting said body to an electric circuit, and means for moving a clamp member to effect stretching of said body, one of said chambers having a closed bottom and one of said chambers open at its bottom.

4. Means for tapering a metallic body including spaced-apart clamping members, an interposed cooling regulating device including a plurality of longitudinally spaced chambers in which the body is disposed, means for subjecting said body to an electric circuit, and means for moving a clamp member to effect stretching of said body, said chambers having bottom openings of varying diameters to direct non-uniform currents onto the body.

5. The method of imparting taper to a metallic body consisting of reducing the body in strength by heating the body and then imparting a stretching tension to said body characterized in that the reduction in strength of the body is controlled by causing controlled air currents to be directed onto the body.

6. In the method of imparting taper to a metallic body consisting of reducing the body in strength by heating the body and then imparting a stretching tension to said body, the feature that in order to obtain a gradual taper in said body reduction in the strength of the body is controlled by establishing and subjecting the body to controlled air currents.

7. In the method as specified in claim 6, the feature that the air currents directed to different portions of said body are non-uniform.

In testimony whereof I affix my signature.

THEODORE VARNEY.