(No Model.)

A. H. EMERY.

MANUFACTURE OF EYE LINKS.

No. 322,048. Patented July 14, 1885.

Fig: 1

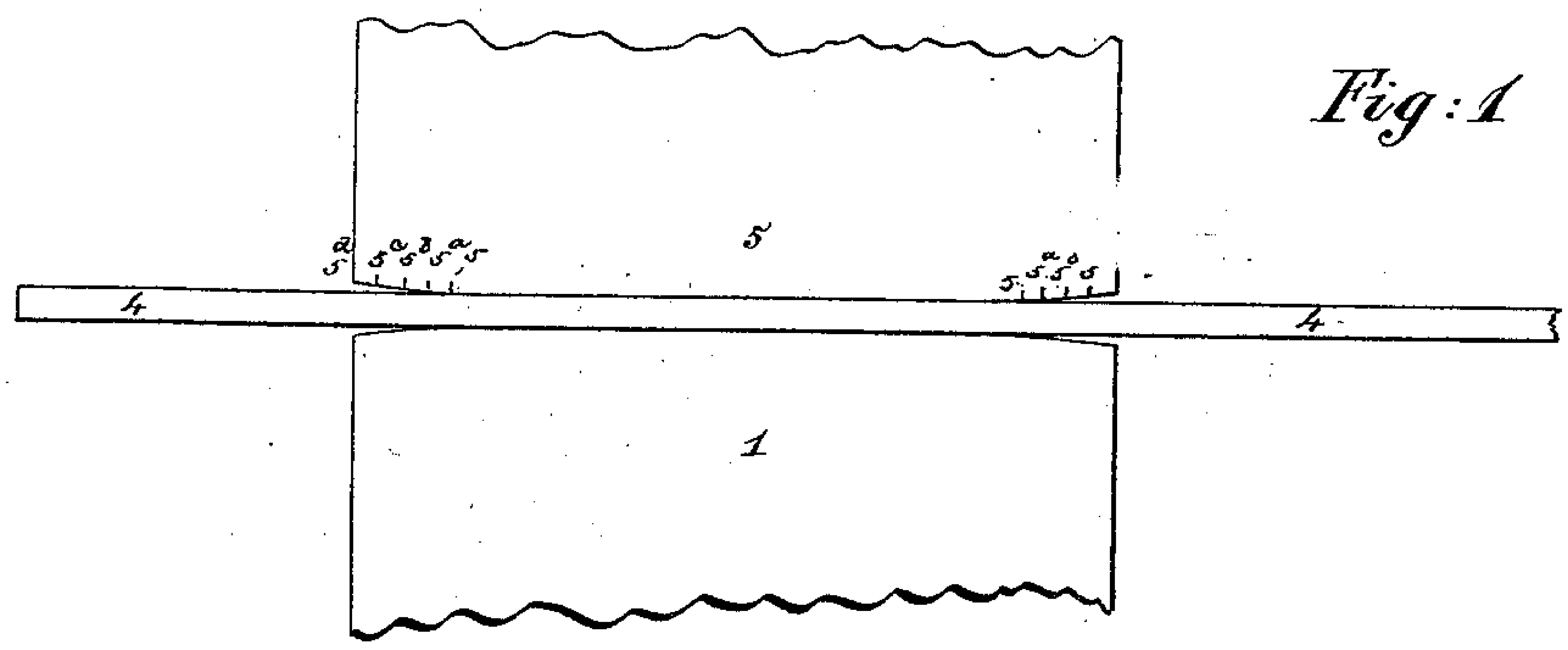


Fig: 2.

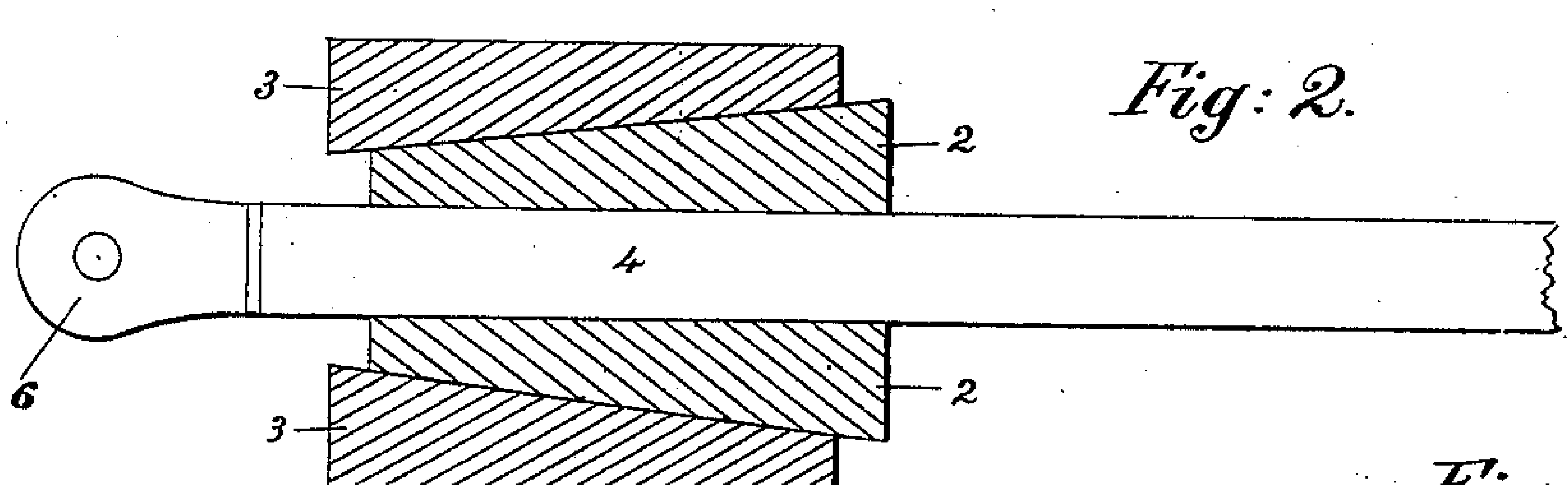


Fig: 3.

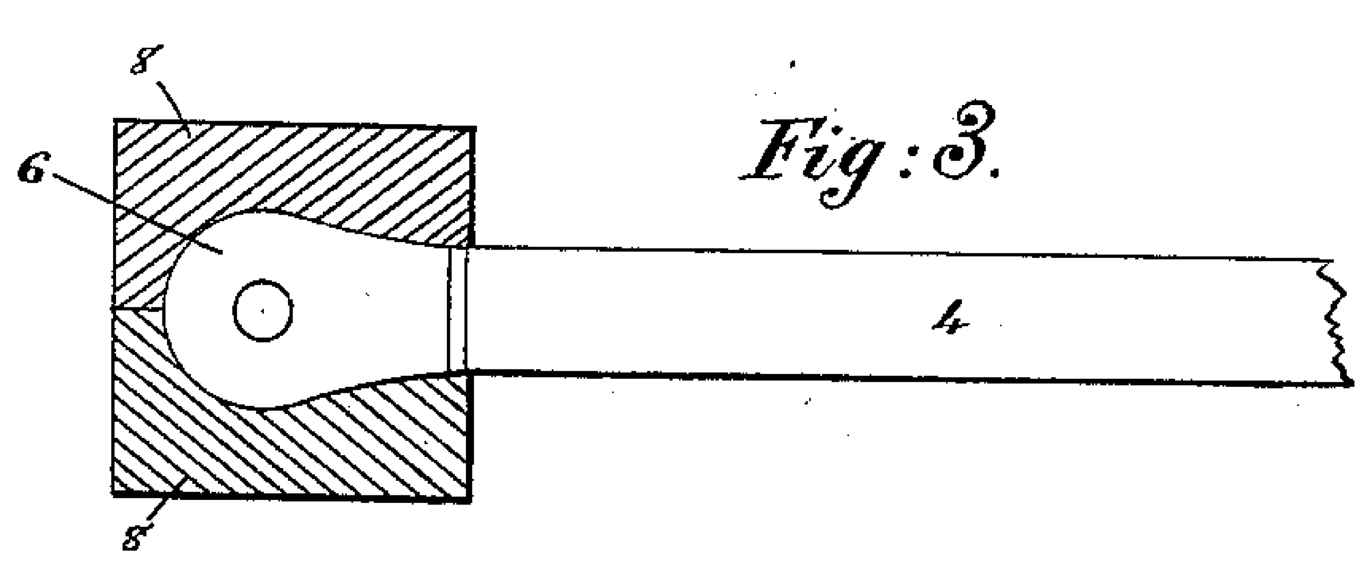


Fig: 4.

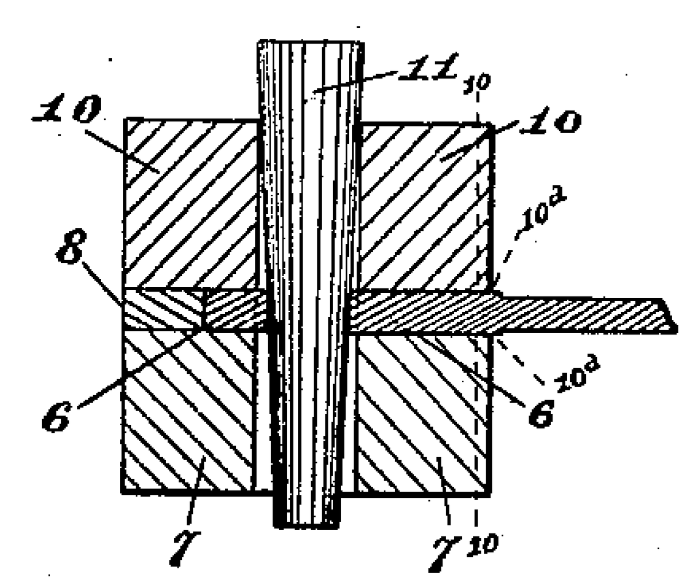
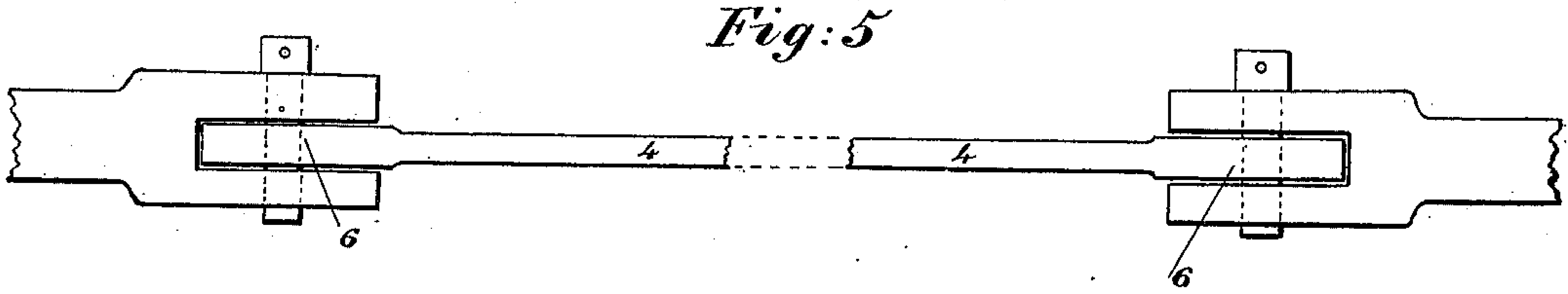


Fig: 5



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MANUFACTURE OF EYE-LINKS.

SPECIFICATION forming part of Letters Patent No. 322,048, dated July 14, 1885.

Application filed April 2, 1883. (No model.)

To all whom it may concern:

Be it known that I, ALBERT H. EMERY, of Stamford, in the county of Fairfield and State of Connecticut, formerly of New York, in the State of New York, have invented an Improvement in the Manufacture of Eye Links or Bars and other Tension Members for Bridges and other Structures, of which the following is a specification.

The object of my invention is to increase the tensional rigidity and ultimate strength of those members of bridges and other structures which are subjected to tensional strains. To this end I take such links or bars after manufacture by the ordinary methods and compress them between dies or rolls while in a cold or moderately-heated state, so as to permanently condense the metal, the body of the eye-link and the eye thereof being preferably compressed at separate operations, but with the maximum pressure-surface of the dies or rolls acting on a sufficient length of the link, and having such form as to prevent the flow of metal from under such pressure-surface and the consequent attenuation of the link. For the same reason the dies by which the eyes of the link are compressed extend to a short distance over the body of the link. While the eye is under pressure between the dies it is expanded by forcing through it a tapering mandrel, so as to stretch the eye circumferentially beyond the limit of elasticity, giving it a permanent set and putting the metal on the interior of the eye under an initial strain of compression, and that on the exterior under an initial strain of tension, thus placing the metal in the most effective condition to resist the strains to which it will be subjected in use. The body and eye of the link having been compressed to condense the metal and the eye stretched as above explained, the link is stretched considerably beyond its limit of elasticity and held in this condition for a sufficient period to allow the particles of metal to permanently assume their new relations. The link is thus brought to its required length by condensation and stretching, each of which serves to impart a much higher limit of elasticity and ultimate strength.

In order that my invention may be more fully understood, I will proceed to describe the preferred mode of carrying it into effect, with reference to the accompanying drawings, in which—

Figure 1 is an elevation of the upper and lower dies employed for compressing the link-body. Fig. 2 is a horizontal section of the side dies employed for holding the link while under pressure, showing the link in plan view. Fig. 3 is a section of the dies employed for the compression of the eyes. Fig. 4 is a section showing in elevation a tapering mandrel employed for expanding the eye. Fig. 5 is an elevation illustrating the final stretching operation.

The eye-link having been forged in any usual or customary manner, but with such reduced length that its proper permanent length will be imparted by the stretching to which it is subjected under my improved process, the compression and condensation of the metal may be produced by rolling while in a cold or moderately-heated state; but the rolls must be of large diameter and moved slowly in order that the metal may be condensed as required and may not flow out under the pressure of the rolls, and care must be exercised not to repeat the pressure sufficiently to render the metal brittle. It is preferable to condense the metal by pressure between dies instead of by rolling, for the reason that in rolling the part compressed is loaded only momentarily, while in cold-pressing it is retained under the load for a considerable length of time, such sustained and continued pressure causing a rearrangement of the particles of the metal, so that the structure permanently assumes a more dense condition, resulting in a large increase of its limit of elasticity and ultimate strength. Pressing between dies is preferable to rolling, for the further reason that the adjoining particles are simultaneously compressed over a considerable area, avoiding the abrading action and violence caused by local compression on a short or small surface, and a flow of metal from the point of pressure, which is liable to occur where the pressure-surface is of small area. In practice, dies are employed with parallel faces of considerable area where the maximum pressure is exerted, and very slightly rounded portions on each side of the parallel maximum pressure-surfaces, such reduced portions exerting a less pressure on the metal, but sufficient to imprison and prevent the outward flow of the metal in the part subjected to the maximum pressure. In shifting the link to bring one section after another of its length under pressure, it is moved each time to a less extent than the length of the maximum pressure-surface, so that the dies at each pressure may overlap the part or section previously compressed.

In Figs. 1 and 2, 1 represents a suitable bed or table, and 2 a pair of dies adjustable thereon to and from each other, and formed with concave faces to embrace the body of the link 4. The link being set between the side dies, 2, the latter are forced together against the body of the link, and firmly supported and held by wedge-shaped followers 3.

5 is the upper or pressure die, the central portion of which extending to a sufficient length is made parallel with the surface of the table 1, while at each side of this central parallel surface the surfaces recede or fall back to a very slight extent, the curvature being scarcely perceptible on the scale on which the drawings are made, but being exaggerated for the purpose of illustration, the upper die, 5, being forced down by any adequate machinery—as, for example, the hydraulic presses or rams.

The formation of the bearing-surface of the die is such as to give over the central portion, 5 to 5, the maximum pressure, which may be, for example, fifty thousand pounds to the square inch, while the pressure from 5 to 5^a may be forty thousand pounds to the square inch, from 5^a to 5^b thirty thousand pounds, from 5^b to 5^c twenty thousand, and from 5^c to 5^d ten thousand, for example, thus tapering off gradually, so as to avoid any violence or abrading of the metal, while each zone of pressure effectually prevents outward flow of metal from the adjoining zone of greater pressure, and the zones of gradually-reduced pressure from 5 to 5^d effectually imprison the metal subjected to the maximum pressure between the points 5 and 5. Supposing the portion of the die from 5 to 5 to be thirty inches long and the part from 5 to 5^d at each end five inches, the link may be shifted after each operation twenty-five inches, so that there will be an overlap of five inches in the successive maximum pressure-surfaces, and the portion of metal subjected to the maximum pressure will be at each operation imprisoned by the pressure of the slightly curved and receding surfaces from 5 to 5^d on the fresh metal at the advancing end of the die. The pressure at each operation is maintained steadily for a considerable period, so as to permit the particles of metal to permanently assume their new relations. The entire body of the link having been in this manner compressed while in a cold or moderately-heated state, their successive ends or the eyes 6 thereof are in like manner compressed by placing them on bed-dies 7, forcing against their sides concave-faced side dies, 8, pressed up and held by followers, as illustrated in Fig. 2, and then bringing down the top die 10, to compress and condense the metal. These dies for condensing the eye ends of the link are formed to extend for a short distance over the body of the link, and, as already described with reference to the top dies 5, are formed with very slightly-receding faces from 10 to 10^d, so as to prevent violence to the metal and prevent the outward flow of metal from the portion subjected to the maximum pressure.

The dies for compressing the eyes or ends of the link are of annular form, giving access to the interior of the eye in order to permit the insertion and pressing through the eye of a tapering mandrel, 11, the outward pressure of which, while the eye is in a cold or moderately-heated state and confined on all sides by the dies 7 8 10, condenses the metal by radial pressure from the interior outward, stretching the entire eye and subjecting the metal on the inner part of the eye to initial strains of compression, and that on the exterior to initial strains of extension. This load of compression is maintained, as already described in reference to the body of the link, for a sufficient period to permit the particles of metal to permanently assume their new conditions and relations. The entire eye-link having in this manner been subjected to compression while in a cold or moderately-heated state, the link is next stretched, as illustrated in Fig. 5, considerably beyond its limit of elasticity, so as to impart a permanent set with increased length, the increase being in many instances from two to five per cent. or even more.

The eye may be polished after stretching of body by second mandrel, to bring it to size and to circular shape, or by reaming or broaching.

It frequently happens that the most advantageous stretching of the link will result in imparting a set to the eye. In this case the final finishing of the eye is deferred until after stretching.

I am aware that chains or parts of chains have been stretched to bring them to a certain standard of length, and that bars have been placed under tension for the purpose of straightening them or keeping them straight.

I am aware that the compression of metal while in a cold state is in itself old and well known.

By the term "moderately heated" in this specification I refer to such heating as does not change the texture of the iron or steel and temporarily render it plastic. While it is my practice and intention to treat the metal in a cold state, it is evident that heating it to a moderate extent, up to 200° or 300° Fahrenheit, or even more, so long as it is not rendered plastic, would not change my novel process or work any departure from my invention; but any heat which would disturb the crystallization, or relax the condensation to which the metal has been subjected, or prevent the condensation of the metal would defeat the object of my invention. Heating even to such a degree as to show color would prevent the effects to be produced, as the metal would not then acquire the increased limit of elasticity or condensation desired.

Having thus described my invention, the following is what I claim as new therein and desire to secure by Letters Patent:

1. The process of strengthening eye-bars and like tension members of bridges and other structures, which consists in compressing the body of the bar while cold, or nearly so, between dies formed as herein described, to confine the metal subjected to maximum pressure by the application of reduced pressure to the metal on either side of it, as explained.

2. The process of treating eye links or bars to increase their strength, which consists in compressing the eyes while in a cold state, or nearly so, between dies formed as herein described, preventing the flow of metal from the part subjected to maximum pressure by the application of reduced pressure to the adjacent parts.

3. The process of treating eye links or bars to increase their strength, which consists in compressing the eyes subsequently to forming them by the ordinary method, and when in a cold or moderately-heated state, between dies extending partly over the body of the link.

4. The process of treating eye links or bars to increase their strength and limit of elasticity, which consists in pressing the eye from the interior outward subsequently to forming it by the ordinary method, and while in a cold or moderately-heated state, so as to put the metal under an initial strain of compression on the interior and tension on the exterior.

5. The mode or process of increasing the strength and limit of elasticity of eye links or bars, and like members, which are required to endure tensional strains in bridges and other similar structures, the same consisting in stretching each separate link or bar permanently to a considerably-increased length, while in a cold or moderately-heated state, subsequently to forging.

6. The mode or process of increasing the strength and limit of elasticity of eye links and bars, and like members, which are required to endure tensional strains in bridges and other similar structures, the same consisting in stretching each separate link or bar and holding it for a considerable period under tension sufficient to impart a considerable permanent increase in length.

7. The process of manufacturing and treating eye links or bars, which consists in forging the bar and eyes in any customary or suitable manner, and after the same is completed for use, as ordinarily made, and when cold, or nearly so, compressing the links or bars or parts thereof between dies or rolls, compressing the eyes from the interior outward, and stretching the links or bars beyond the limit of elasticity, so as to impart a permanent set with considerable increase of length.

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