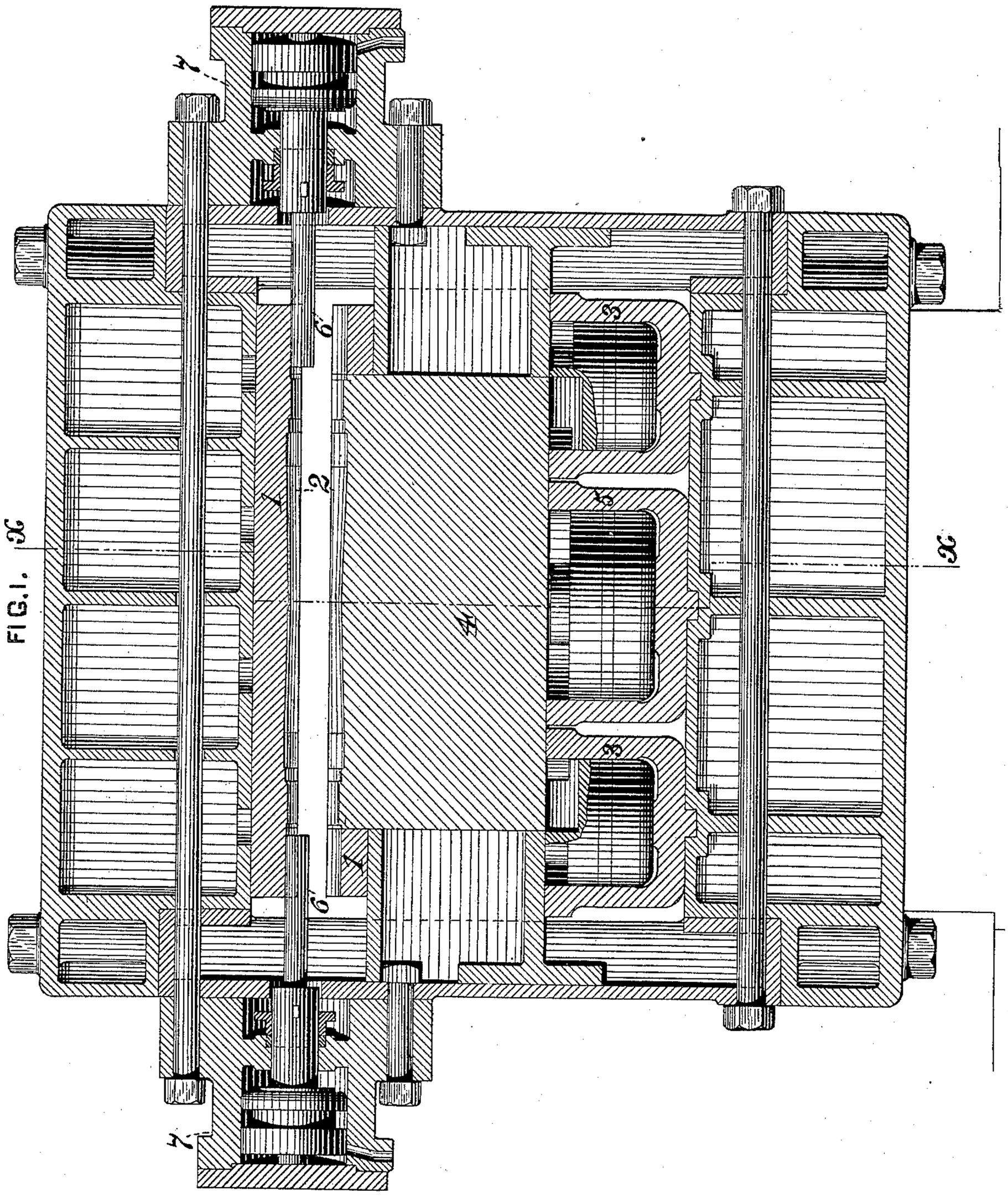
(No Model.) 2 Sheets—Sheet 1.

# H. AIKEN.

## METHOD OF MANUFACTURING AXLES.

No. 426,652. Patented Apr. 29, 1890.




WITNESSES:

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(No Model.) 2 Sheets—Sheet 2.

# H. AIKEN.

## METHOD OF MANUFACTURING AXLES.

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FIG. 6.

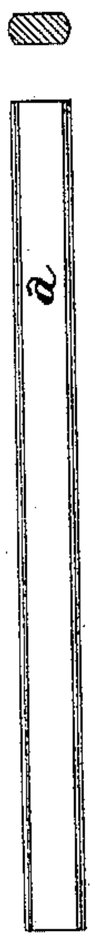



FIG. 7.

FIG. 2.

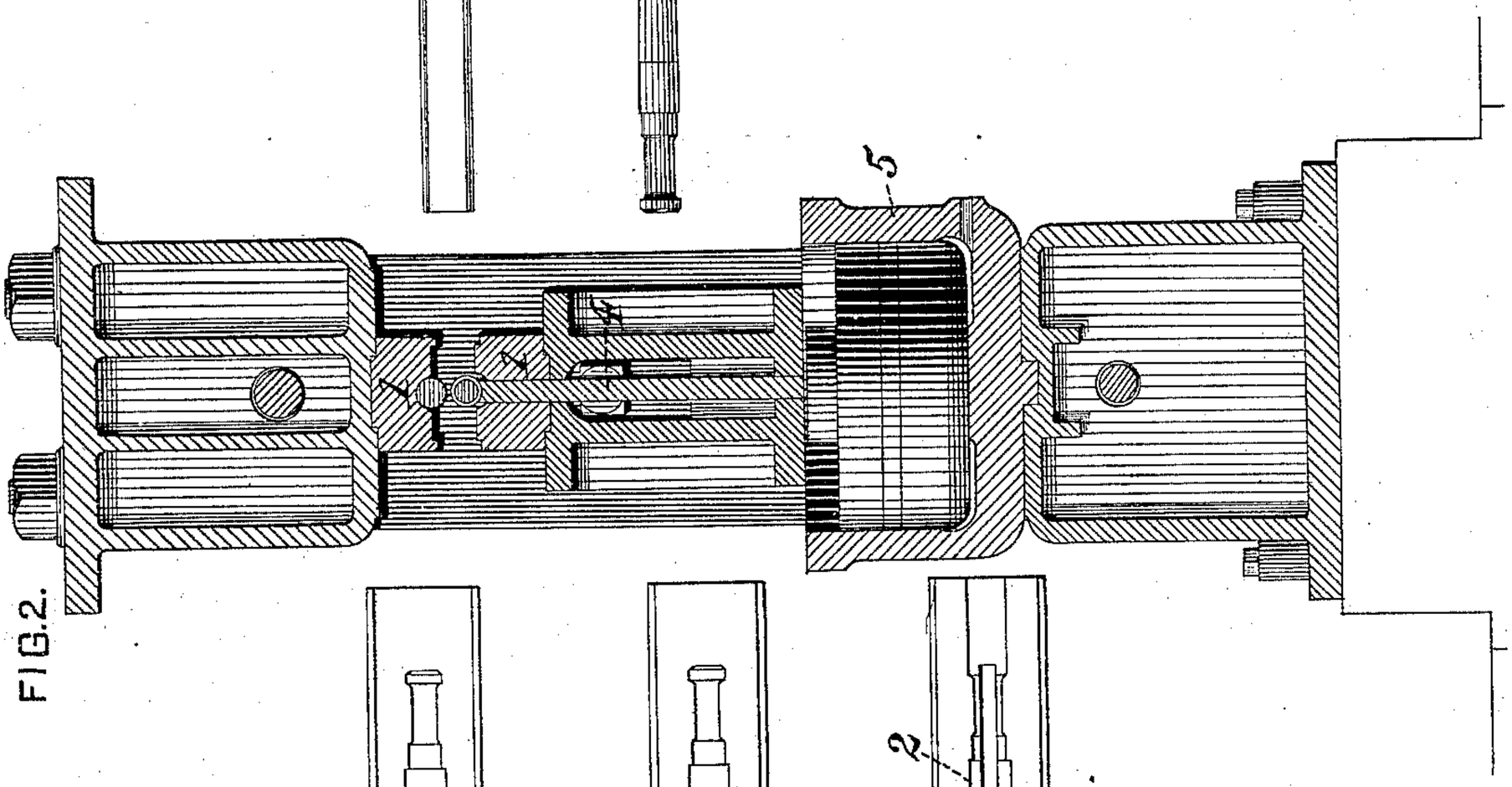



FIG. 3.


FIG. 4.

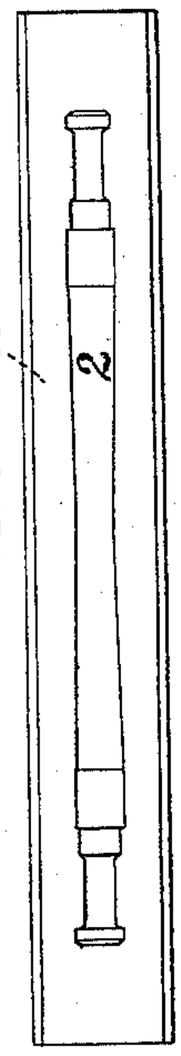
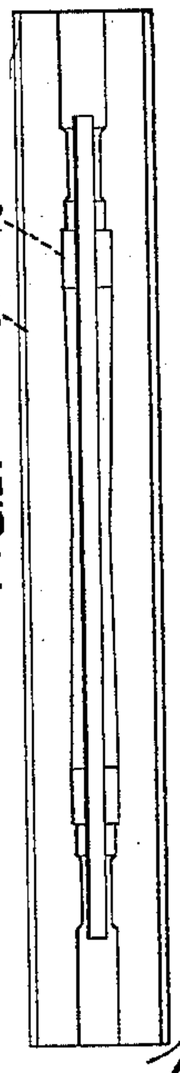



FIG. 5.

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# UNITED STATES PATENT OFFICE.

HENRY AIKEN, OF PITTSBURG, PENNSYLVANIA.

## METHOD OF MANUFACTURING AXLES.

SPECIFICATION forming part of Letters Patent No. 426,652, dated April 29, 1890.

Application filed November 18, 1889. Serial No. 330,649. (No model.)

*To all whom it may concern:*

Be it known that I, HENRY AIKEN, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Methods of Manufacturing Axles, of which improvement the following is a specification.

In an application, Serial No. 315,738, filed June 27, 1889, I have described and claimed a method of manufacturing car-axles, consisting, generally, in forming a bar or blank of uniform cross-sectional area, having a diameter equal to or slightly less than the diameter of the smallest part of the axle to be formed, and of a length greater than that of the axle, and then upsetting such blank by endwise pressure while inclosed in a suitable die.

This method is more especially applicable to the manufacture of axles composed of steel or non-fibrous metal; but the distortion of the fibers of wrought-iron when subjected to the above operation is liable to render the completed axle unreliable.

The invention described herein relates to a method of manufacturing the axles which will not disturb the normal position of the fibers in wrought-iron blanks, and is also as readily applicable to reduction of steel blanks.

In the accompanying drawings, forming a part of this specification, Figure 1 is a sectional elevation of a machine adapted for carrying out my method, the plane of section passing vertically through the axis of the dies. Fig. 2 is a sectional elevation, the plane of section being indicated by the line $x$ $x$, Fig. 1; Figs. 3 and 4, plan views of the forming-dies; Fig. 5, a similar view of a modification of the lower die, and Figs. 6 and 7 are views in elevation of a blank and an axle formed therefrom.

In the practice of my invention I produce by rolling, forging, or otherwise a blank or bar $a$ approximately equal in length to the axle to be produced and oblong in transverse section. The shorter transverse dimension is equal to or preferably less than the diameter of the smallest part of the finished axle, and its other transverse dimension is so proportioned as to provide sufficient metal for the formation of the larger parts of the axle. This blank or bar is then heated, so that the metal will readily flow when subjected to pressure, and placed between dies 1, having matrices 2, suitably shaped for the formation of an axle. These dies are then closed by the operation of the fluid-pressure cylinders 3, a portion of the blank entering a slot formed through the lower die. Within this slot, which extends the entire length of the matrix and is preferably made of a width not greater than the diameter of the matrix at its smallest part, is arranged the upper portion of the plunger 4, whose operative edge is suitably constructed to complete the forming or shaping surfaces of the matrix. The blank or bar, when placed within the dies, rests upon this plunger, which, after closing the dies, is forced upward by any suitable mechanism—as, for example, by the fluid-pressure cylinder 5. This upward movement of the plunger compresses the blank or bar in the direction of its longer diameter, thereby causing it to expand laterally or in the direction of its shorter diameter, and also causing a longitudinal flow of the metal from the smaller parts of the matrix to the larger parts thereof, the smaller parts being first filled.

As hereinbefore stated, the sides of the blank or bar are approximately parallel—that is, its cross-sectional area is approximately the same at all points; hence the smaller parts of the matrix are more nearly filled by the bar before being expanded than the larger parts, and the bar contains more metal at those parts in line transversely with the smaller portions of the matrix than is necessary to fill such portions.

It follows from the foregoing that when the bar is laterally expanded by the operation of the plunger the smaller parts of the matrix will be filled first, and that the surplus metal will flow longitudinally therefrom to the larger parts of the matrix, thereby compensating for any lack of metal at such larger places in the matrix, and, further, in case the blank or bar is cut a little shorter than the matrix or finished axle there will be a longitudinal flow of the metal to compensate for such lack in length.

The operation hereinbefore described is effected in dies having the ends of the matrices closed by stationary walls or abutments, as shown in Figs. 3 and 4; but in order to avoid

any liability of forming imperfect axles by reason of the blank or bar being cut off too short, I prefer to employ movable abutments in the shape of plungers 6 for closing the ends of the matrix, as shown in Figs. 1 and 5. In case the blank, when placed in the matrix, appears to the operator to be too short or otherwise deficient in metal, the plungers 6, which are operated by fluid-pressure cylinders 7 or other suitable mechanism, are forced inwardly, after the operation of the plunger 4, against the ends of the at least partially-finished axle, thereby upsetting the ends and completing the collars 8.

Even when the blanks have the requisite quantity of metal for the formation of complete axles, I prefer to employ the plungers 6 and subject the axle to end compression, so as to insure a perfect filling of the matrix and a compacting or condensation of the metal. It will be understood, however, that the shaping operation is wholly or mainly effected by lateral pressure, causing the metal to flow laterally and then horizontally, the end compression being more in the nature of an auxiliary or finishing operation not absolutely necessary for the successful and practical carrying out of my method.

The distinguishing feature of this invention is the reduction of a blank irregular in cross-section and of suitable length by lateral pressure in a closed die to the shape desired; and by the term "irregular," as used above, I mean other than round or square in cross-section, but more or less nearly approximating a rectangle or oval or a combination of both.

I claim herein as my invention—

1. As an improvement in the art of manufacturing axles and other like articles of circular or nearly circular contour in cross-section, the method herein described, consisting in first rolling or forging a blank of irregular cross-section, but of practically uniform size from end to end, then inclosing such blank in a die-cavity, where, under a subsequently-applied lateral compression, the metal may have a longitudinal and lateral flow or motion, and while so inclosed applying through a wall of such cavity a laterally-acting compressive force thereto sufficient in amount to change the shape of the portions so compressed and cause it to fill and take the form of the die-cavity, substantially as set forth.

2. As an improvement in the art of manufacturing axles and other like articles of circular or nearly circular contour in cross-section, the method herein described, consisting in rolling or forging a blank of irregular cross-section, but of practically uniform size from end to end, inclosing such blank in a die-cavity, where, under a subsequently-applied lateral compression, the metal may have a longitudinal and lateral flow or motion and while so inclosed applying through a wall of such cavity a laterally and a longitudinally acting compressive force thereto sufficient in amount to cause it to fill and take the form of the cavity, substantially as set forth.

In testimony whereof I have hereunto set my hand.

HENRY AIKEN.

Witnesses:
DARWIN S. WOLCOTT,
R. H. WHITTLESEY.