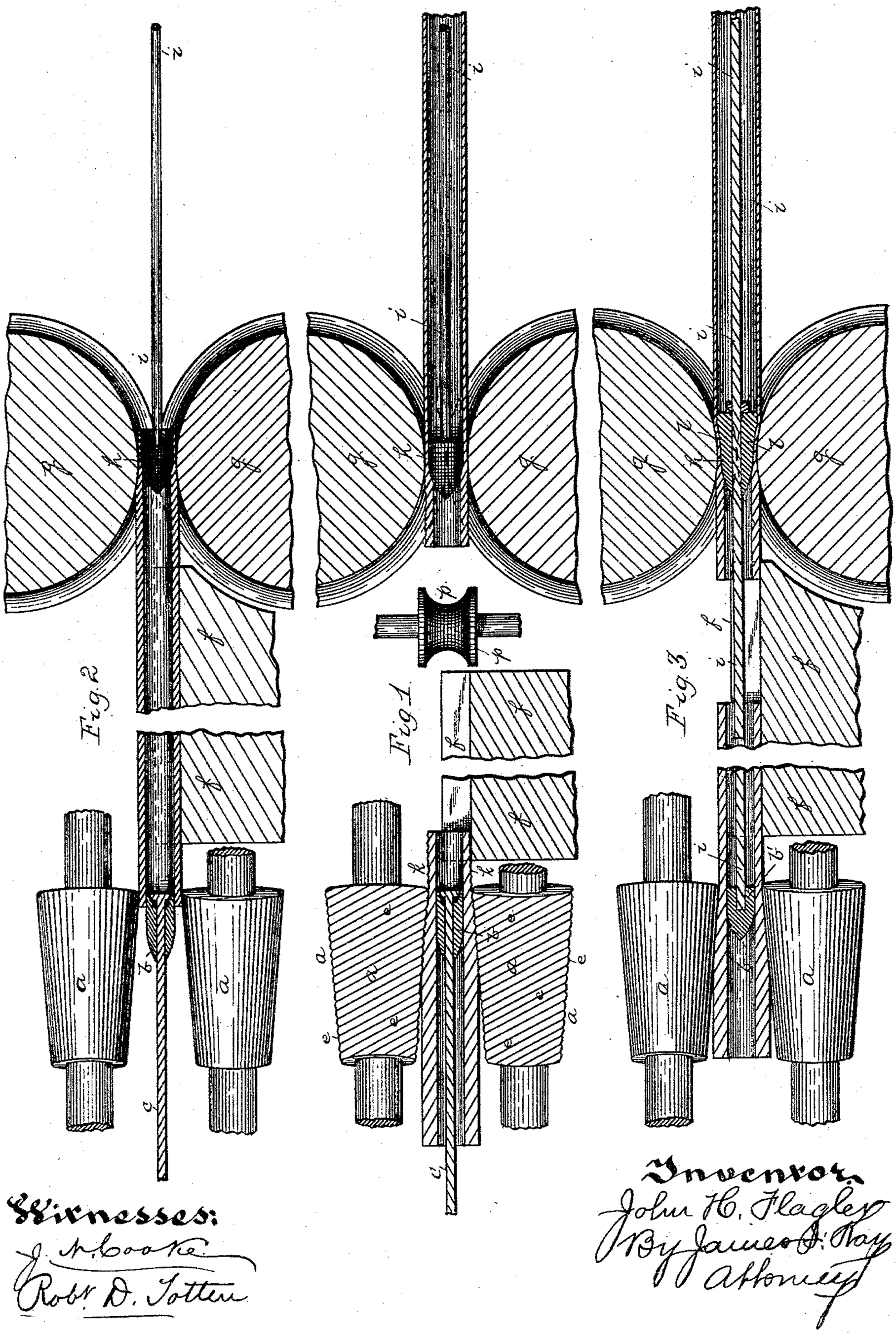
(No Model.)

J. H. FLAGLER.

METHOD OF MAKING METAL TUBING.

No. 401,142. Patented Apr. 9, 1889.



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METHOD OF MAKING METAL TUBING.

SPECIFICATION forming part of Letters Patent No. 401,142, dated April 9, 1889.

Application filed December 17, 1887. Serial No. 258,161. (No model.)

To all whom it may concern:

Be it known that I, JOHN H. FLAGLER, of New York, in the county of New York and State of New York, have invented a new and useful Improvement in the Manufacture of Wrought-Metal Tubing; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to the manufacture of tubing, and more especially to seamless tubing—that is, tubes produced without welding—its object being to produce a thin seamless tube in which the interior surface is highly finished, and in which the fibers are arranged spirally around the tube on the interior as well as the exterior thereof, and the strength of the finished tubes therefore relatively increased. To these ends I form the tube from a hollow ingot or blank by spirally rolling the same to reduce the thickness of the walls and to elongate it by drawing out its external fibers spirally, and I then roll the tube thus produced longitudinally over a rotating mandrel to further reduce the thickness of walls and to impart a spirality to the fibers of the interior of the tube, while at the same time the tube is reduced to the required thickness and the interior thereof brought to a high finish.

In practicing my invention I may also increase the diameter of the interior, or both the interior and exterior, of the tube in the second rolling thereof, so not only laying the internal fibers thereof in a spiral course, but producing a highly-finished tube of greater diameter.

I have also improved the manufacture of the tubing in other particulars, as hereinafter fully set forth.

To enable others skilled in the art to make and use my invention, I will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 shows a view, partly in section, of the apparatus employed in carrying out my invention and the manner of operating the same. Fig. 2 shows a similar view in which the tube is leaving one pair of rolls and entering the pass of the next pair, and Fig. 3 shows a view of the apparatus in which the diameter of the finished tube is increased.

Like letters refer to like parts in each of the figures of the drawings.

In practicing my invention I cast or otherwise produce a hollow ingot or blank, the thickness of the walls and the length of which are proportioned to the length and weight of the finished tube to be made. I generally prefer to cast the ingot of homogeneous iron or low-grade steel, and then reheat it and roll it to the desired diameter through rolls having a series of reducing-passes, whereby the ingot is brought to the proper diameter and the metal compacted, all imperfections or porosity of metal being thus overcome and a fiber induced therein, after which the hollow bloom so formed is cut to the desired length, proportioned to the length of the finished tube and the desired reduction and elongation thereof. The ingot may, however, be cast to the proper shape for feeding direct to the rolls. This hollow blank is then heated in a suitable furnace to a proper working temperature and passed between diagonally-acting rolls, so that the walls of the blank will be reduced in thickness, and at the same time the blank is elongated by the spiral rolling action of the rolls thereon, and a spirality imparted to the fibers of the tube produced. To effect this rolling action any diagonally-acting rolls of suitable shape having converging faces may be employed, the rolls shown in the drawings being what may be termed "diagonally-acting converging conoidal rolls." In said drawings two or more conoidal rolls, *a a*, are mounted in suitable housings, so that the ingot or blank may be passed between the working-faces of said rolls over a suitable mandrel held between them. I have not shown the housings in which these rolls are mounted, as their construction is well known to those skilled in the art, and the gearing and means of supporting them form no part of my invention. The axes of the rolls *a* are placed in parallel horizontal planes, while the vertical planes which pass through the same are at an angle to each other. By this arrangement of the axes of the rolls, and by having the working-faces converge toward one another, produced in this case by conoidal rolls, a reducing-pass is formed, and the metal as it passes into the space between the rolls is

acted upon on opposite sides by working-faces which are moving in opposite directions, and which gradually converge toward each other. The effect of this rolling is to gradually reduce the diameter of the blank and at the same time draw or force the metal forward by a spiral movement, which is greatest on the exterior surface of the blank, and as the blank turns with the rolls it is gradually drawn out by the action of the rolls into a tube of less external diameter than that of the blank, and with its walls of less thickness and the outer fibers arranged spirally around the tube. This spiral arranging of the outer fibers is obtained by the increased speed of the roll-surfaces proportionately to the surface speed of the blank as it passes through the rolls, the blank being decreased in diameter and surface speed, while the diameter and surface speed of the rolls at the point of discharge is greater, or at least as great as, at the point where the blank first engages therewith. To prevent the crushing in of the blank and decreasing of its internal diameter, and also to form an anvil or support for the metal and facilitate the reduction of the blank, as well as in some cases slightly increase its internal diameter, I prefer to employ a mandrel, *b*, between the working-faces of the rolls. This mandrel may be supported from the forward end of the rolls—that is, the entering end for the ingot—in which case the support for the mandrel-rod *c* must be so constructed that the rod can be removed therefrom, so that it may be thrust through the heated hollow blank and be again secured to its holder when the blank is fed to the rolls. In some cases, however, the mandrel may be supported from the opposite or delivery end of the rolls by the same rod or shaft which supports the mandrel between the second set of rolls, hereinafter described, as shown in Fig. 3.

The mandrel is arranged to enter the blank before it is reduced to any great extent, and its forward end is generally formed slightly tapering, as shown, to direct the blank onto the parallel portion of the mandrel and to spread the metal of the blank where it is increased in internal diameter. It is also desirable in some cases that the surface of the rolls *a* have formed thereon a series of spiral ribs or corrugations, *e*, as the rolls obtain therefrom a better grip on the metal of the blank, their drawing action is increased, and at the same time the tube produced by this first rolling operation has a series of spiral ribs formed on it, as indicated in Fig. 1, which facilitate the operation of the direct-acting rolls, hereinafter described. The blank, after being fed into the diagonally-acting rolls, is gradually reduced and fed forward, and the tubular blank thus produced passes along a suitable guide, *f*, to a pair of plain concave rolls, *g g*, the pass of which is directly in line with that of the diagonally-acting rolls, and its distance from the latter is so arranged that the direct-acting rolls will begin to act on the tubular blank just as its rear end leaves the pass of the diagonally-acting rolls. The pass of these concave rolls forms a perfect circle, and the roll-faces meet and are held in contact by a heavy pressure, so that there is no liability of the metal "finning" between them. Supported in the pass of these direct-acting rolls is a mandrel, *h*, which is attached to a rod or shaft, *i*, that extends from a suitable support at the rear end of the apparatus in line with the pass of the rolls, and which is rotated at a proper speed by any suitable mechanism. This mandrel *h* has a tapering forward end, and is preferably rotated in the same direction as the blank is caused to revolve by the action of the rolls *a a*, so acting to assist the blank in rotating if caught by the rolls *g g* before it leaves the rolls *a a*, as well as imparting the spirally-laid fibers to the interior of the tube, as hereinafter referred to.

As before stated, the same mandrel-rod which supports the mandrel *h* between the rolls *g* may support the mandrel *b* between the rolls *a*, in which case the latter mandrel is generally loosely mounted on the rod, so that it can turn with the ingot while the latter is being drawn through the rolls.

In front of the rolls *g g* are the concave feeding-rolls *p p*, which are preferably mounted on vertical axes, and are arranged in the line of feed between the rolls *a a* and *g g*, but do not in their normal position engage with the blank as it passes out of the rolls *a a*, the pass between the feed-rolls being wider than the diameter of the blank. One or both of these rolls is driven by suitable gearing, and the journals of one or both of these rolls are mounted in a suitable slide operated by a lever. In case the blank when passing out of the diagonally-acting rolls *a a* does not feed into the direct-acting rolls *g g*, the feed-rolls *p p* may be drawn together, when they will grasp the blank and feed it into said rolls *g g*, so insuring the continuous feeding of that blank through the apparatus. The second step of the process generally acts to increase the internal diameter of the tube, while the external diameter is held the same or slightly decreased, the tube being thus drawn out between the direct-acting rolls and rotating mandrel and its walls reduced in thickness, while it is correspondingly elongated, such steps being shown in Figs. 1 and 2. During its pass through these rolls the rotating mandrel rolls or laves aside the metal on the interior of the blank, while the rolls force the blank slowly forward, and therefore the combined action causes a spiral rolling over the interior surface of the tube, such action imparting a spiral fiber to the interior of the metal tube, and so increasing greatly the strength of the tube, and, with the spiral fiber imparted to the exterior of the blank by the rolls *a a*, forming as strong a tube as can be obtained. Though the longitudinal rolling of the tubular blank through these rolls stretches the outer fiber

somewhat, yet as the principal action is on the interior of the blank the exterior spiral fiber is preserved. The fiber of the metal is thus laid in spiral lines on the exterior of the blank by the first step of the process and on the interior by the second step thereof. By the second step of the process the interior of the tube has also a high finish or polish imparted thereto by the rapidly-revolving mandrel. In some cases the tube may not only have its walls reduced in thickness by the second step, but the tube may also be expanded, as shown in Fig. 3, in which case the rotating mandrel *h* is made of such size as to expand the tube to the desired internal diameter, while the rolls *g g* force the metal up the enlarged mandrel and in connection therewith reduce it to the desired thickness of wall, the rolls being set slightly forward of the largest diameter of the mandrel, and the tapering mandrel being so curved as to coact with the rolls in thinning the blank.

Where the tube has formed on its exterior surface by the rolls *a a* the spiral ribs, as at *k*, as heretofore described, these ribs are drawn out by the direct-acting rolls *g g*, and the surface of the tube made smooth, these ribs causing a considerable elongation of the tube, and also assisting the second set of rolls to grasp the blank, and, especially where the tube is enlarged, giving the rolls a firm hold and providing metal for such enlargement.

Where the finished tube is to be of an internal diameter about that of the tube produced from the blank by the rolls *a*, the mandrel *h* is about the same diameter as that of the interior of the tube coming from these rolls. In this case the pass formed by the direct-acting rolls *g* is smaller than the external diameter of the tube coming from the rolls *a*, and the metal of the tube is pressed down against the rotating mandrel *h*, which as it is rotating tends to impart to the fibers of the metal the circular movement as opposed to the longitudinal or forward movement imparted by the rolls, the result of which is that the fibers of the metal are arranged spirally, as above referred to, and both the exterior and interior of the tube are given the required finish, as well as the desired reduction in the thickness of the walls of the tubes.

The result of the treatment of a hollow ingot or blank in the manner heretofore described is a light seamless tube which has its fiber arranged spirally around the tube, both internally and externally, and a high degree of finish imparted thereto.

I do not claim in this application the apparatus heretofore described, as that forms the subject-matter of a separate application filed by me of an even date herewith.

Having now described my invention, what I claim is—

1. The method of making tubing which consists in spirally rolling and reducing a hollow ingot or blank to draw out the metal into a tube and arrange the fibers of the same spirally, and then longitudinally rolling said tube over a mandrel to further decrease the thickness of the walls of the same, substantially as and for the purposes set forth.

2. The method herein described of making tubing, which consists in spirally rolling and reducing a hollow ingot or blank to draw out the metal into a tube and arrange the exterior fibers thereof spirally, and then longitudinally rolling and internally rolling said tube to further draw out the metal and to arrange the interior fibers thereof spirally, substantially as and for the purposes set forth.

3. The method of making tubes which consists in spirally rolling a hollow ingot or blank to draw it out into a tube and arrange the fibers of the same spirally, and then rolling said tube longitudinally over a rotating mandrel to decrease the thickness of walls of said tube and give the desired finish to the same, substantially as and for the purpose set forth.

4. The method of making tubes which consists in spirally rolling a hollow ingot or blank to draw it out into a tube, and then rolling said tube longitudinally over a rotating conical mandrel of larger diameter than that of the interior of said tube to increase the diameter of the same and decrease the thickness of its walls, substantially as and for the purpose set forth.

5. The method of making tubes which consists in spirally rolling a hollow ingot or blank, and thereby drawing it out and forming spiral ribs on the surface thereof, and then rolling said tube longitudinally over a mandrel, and thereby smoothing and elongating said tube, substantially as and for the purpose set forth.

In testimony whereof I, the said JOHN H. FLAGLER, have hereunto set my hand.

JOHN H. FLAGLER.

Witnesses:
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