No. 721,213. PATENTED FEB. 24, 1903.

M. MANNESMANN.

ART OF ROLLING TUBES.

APPLICATION FILED OCT. 10, 1901. RENEWED SEPT. 17, 1902.

NO MODEL.

Fig. 1

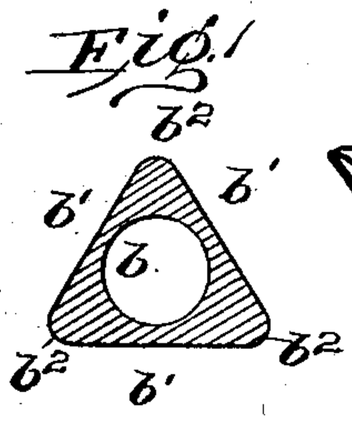


Fig. 2

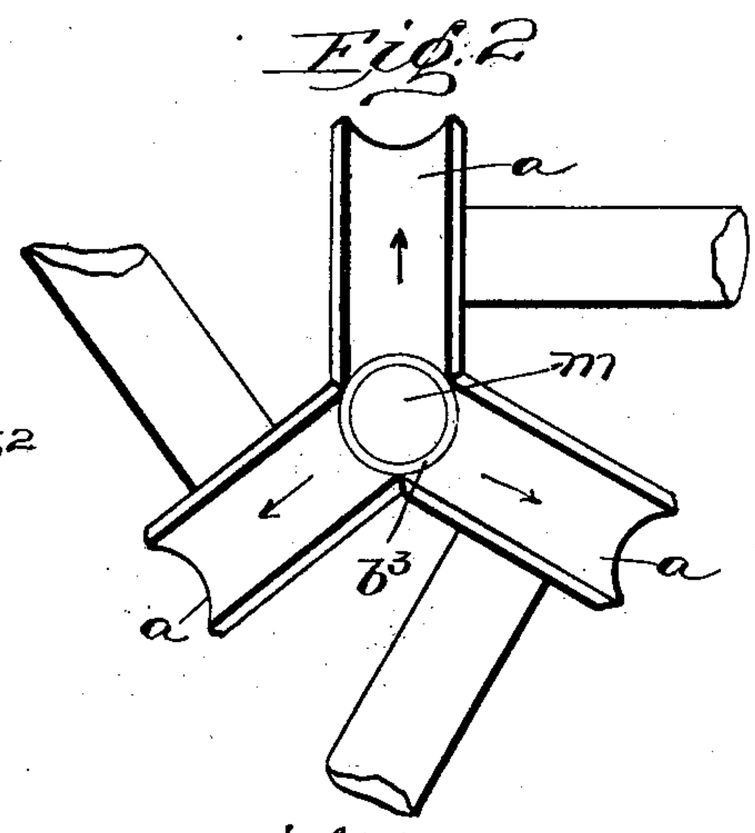


Fig. 3

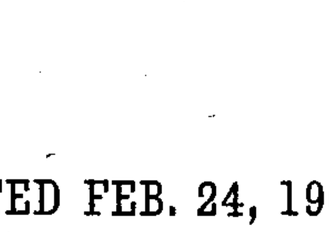


Fig. 4.

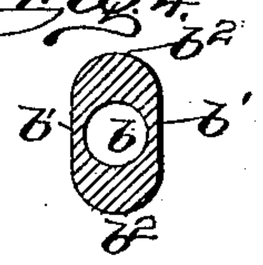


Fig. 5

Fig. 6

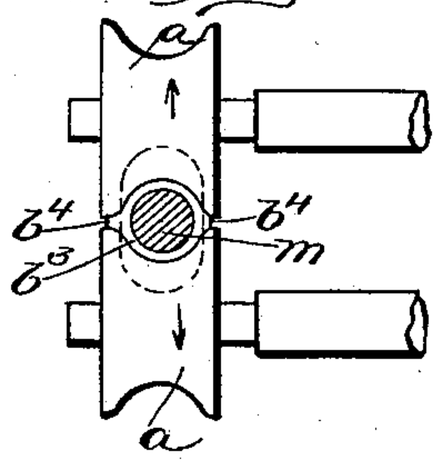


Fig. 7.

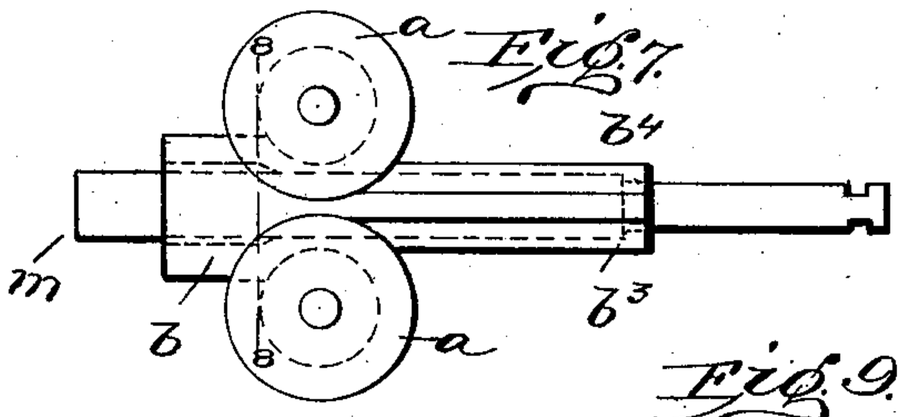


Fig. 8

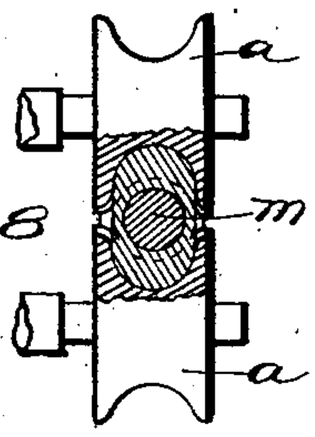


Fig. 9.

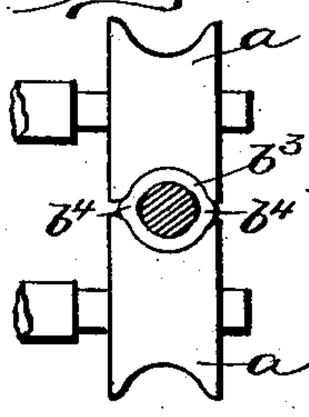


Fig. 10

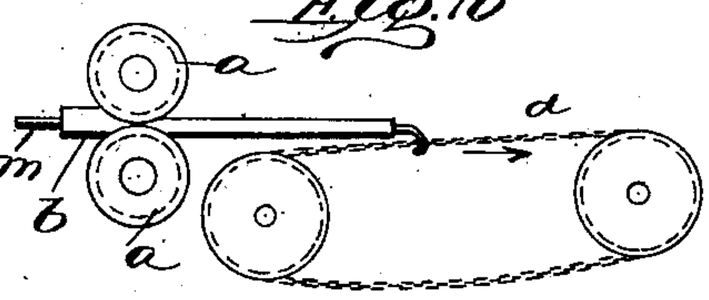
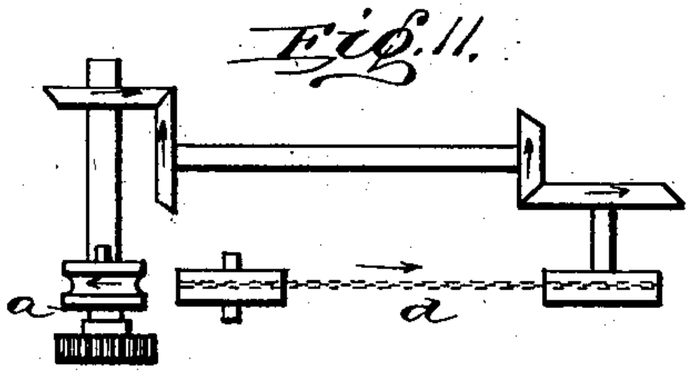


Fig. 11.



Witnesses:
J. M. Fowler Jr.
D. E. Wilson

Inventor:
M. Mannesmann

UNITED STATES PATENT OFFICE.

MAX MANNESMANN, OF REMSCHEID-BLIEDINGHAUSEN, GERMANY.

ART OF ROLLING TUBES.

SPECIFICATION forming part of Letters Patent No. 721,213, dated February 24, 1903.

Application filed October 10, 1901. Renewed September 17, 1902. Serial No. 124,813. (No model.)

To all whom it may concern:

Be it known that I, MAX MANNESMANN, a citizen of the Empire of Germany, residing at Remscheid-Bliedinghausen, Germany, have invented certain new and useful Improvements in the Art of Rolling Tubes, of which the following is a specification.

In rolling tubes and other hollow articles from hollow blanks or billets over a mandrel in a rolling-mill the tubes can be formed with longitudinal ribs having rough edges upon their outer circumference by suitably shaping the rolls, as described in my pending applications, Serial Nos. 68,988, 68,992, and 70,745. The size of these ribs increases in height with the reduction of the cross area, the pressure used, and the elongation produced in the passage of the tube through the calibrated rolls.

The object of this invention is to reduce the size of these exterior longitudinal ridges or prevent their formation by an improved process of rolling tubes, which consists in first producing a hollow blank or billet with longitudinal flattened parts on the exterior of the same and then rolling down the thicker portions between the flattened parts. This may be done by rolling out first the hollow blank with a plurality of exterior longitudinal flattened parts and then elongating the blank by a second rolling and converting it into a relatively thin tube, the longitudinal flattened parts coinciding with the edges of the rolls. It is obvious that two, three, or more rolls may be used for rolling out the hollow blank or billet. If two rolls are used, two first portions are formed in the blank in such a way that during the process of stretching by the second rolling each flat part is opposite to those points where the rims of the different rolls touch or approach each other. The same result is produced when three or more rolls are used, in which case three or four flattened parts have to be employed.

In the accompanying drawings, Figure 1 represents a cross-section of a hollow blank or billet with three longitudinal flattened parts after the same has passed through a first set of rolls ready for the second rolling or stretching process. Fig. 2 shows an end elevation of a rolling-mill with three rolls. Fig. 3 represents a vertical cross-section of the tube produced in one pass by the rolling-mill shown in Fig. 2 from the blank shown in Fig. 1. Fig. 4 is a vertical transverse section of a hollow blank or billet provided with two flattened parts and two thicker parts between them. Fig. 5 is a finished tube rolled in one pass from the blank shown in Fig. 4. Fig. 6 is an end view of a rolling-mill with two rolls and a mandrel in the opening between the rolls. Fig. 7 is a side elevation of the rolling-mill shown in Fig. 6. Fig. 8 is a vertical transverse section on line 8 8, Fig. 7. Fig. 9 is an end view of a two-roll rolling-mill seen from the out-going end of the rolls; and Figs. 10 and 11 are diagrams showing side elevation and plan view of a pair of rolls, a hollow blank, and a mandrel, which is converted with a draw-bench.

Similar letters of reference indicate corresponding parts.

Referring to the drawings, $a\,a$ are the rolls; b, the hollow billet; b', longitudinal flattened parts on the blank; b^2, longitudinal thicker parts between the flattened parts.

b^3 is the rolled-out tube.

b^4 represents longitudinal ribs, feathers, or protrusions on the tube b^3.

m is the mandrel, and d the drawing-chain.

In Fig. 1 a hollow blank or billet is formed with three thicker parts and with three flattened parts between the thicker parts. This hollow blank is rolled out in the three-roll rolling-mill shown in Fig. 2. When this hollow blank is passed through the rolling-mill, having rolls as shown in Fig. 2, a tube is obtained which is provided with three small longitudinal ribs or protrusions on the outside of its relatively thin wall, as shown in Fig. 3.

Instead of using three flattened parts and three thicker portions the hollow blank or billet may be produced with two flattened, straight, or convex portions and intermediate thicker portions, as shown in Fig. 4. In this blank the flattened portions or sides form the equivalent of the flattened parts, as shown in Fig. 1. This blank is rolled out by the two-roll rolling-mill, as shown in Figs. 6 and 7. The hollow blank is introduced in the rolling-mill in such a position that the thick parts are opposite to the two working parts of the rolls and the thin-walled flattened parts touch the rolls at the edges of the calibers.

The finished tube (shown in Fig. 5) is rolled out in one pass from the blank shown in Fig. 4 and is provided with two exterior longitudinal ribs or protrusions b^4 of small size.

The rolling-mill shown in Fig. 6 is formed of two rolls, the tube being formed between said rolls and on a mandrel which is located within the opening of the rolls. The dotted lines in Fig. 6 indicate the cross-section of the hollow blank or billet. The rolls employed are preferably of circular shape and the edges slightly rounded off. The mandrel may be held in fixed position or it may be drawn with the blank through the rolls. In order to produce a considerable stretching of the tube, it is advantageous to rotate not only the rolls, but at the same time to draw or push the mandrel with considerable force through the rolls, as shown in the diagram Figs. 10 and 11. The small longitudinal ribs or protrusions that are formed on the exterior of the tube may be rolled or pressed down, whereby the tube on the mandrel may loosened for removing the latter, or they may be cut away in order to produce a smooth surface.

The blank or billet may be produced with the exterior flattened parts from the rough ingot, or round or other hollow billets may be formed in the desired shape by rolling, pressing, or otherwise. The hollow blanks with flattened parts thus obtained are then passed through the rolls in Fig. 2 or 6 or 7, so as to be rolled out into tubes of regular shape. When four or more rolls are employed for rolling out the tube, the hollow blank must be provided with four flattened parts. When two gripping-rolls are employed, it is best to give the hollow blank a form in which the thickness of the wall at those parts where the grooves or flattened portions are is not considerably greater than the thickness of the finished tube rolled from the same. The rolls when taking up the hollow blank touch the blank at the moment of contact on a somewhat elliptical line when the calibers of the rolls are cylindrical, for the reason that the plane parallel to the axes and crossing the calibers of the rolls on line 8 8, Fig. 7, will touch the blank on an approximately elliptical line. The more that part of the hollow blank which is taken up or gripped by the rolls approaches the narrowest point between the rolls, Fig. 7, the more the elliptical form approaches that of a circle. At the narrowest point between the rolls the rolls grip the blank on a circle. Those portions of the blank where the flattened parts are are not so strongly pressed between the rolls; but the molecules of the material are drawn along with the thicker portions of the blank and are thereby likewise stretched out. When the total resistance of the portions between the edges of the rolls in a two-roll rolling-mill against being drawn along is so great that the stretching out of the hollow blank is largely prevented, then the material partly flows sidewise and strong outside feathers and even inside folds are formed. When, on the other hand, the blank has deep flattened portions, so that the above-mentioned total resistance against the drawing-along tendency is not so great, then even with two rolls the whole hollow blank is stretched out by the pressure of the rolls. When the caliber of the rolls is cylindrical and only the edges of the calibers are slightly cut away and the depth of the flattened parts is properly chosen, a tube is formed in one pass, as shown in Fig. 5; but this tube may have no ribs on the sides, but only two slight bosses, which permit the mandrel to be easily drawn out of the tube.

By the described process hollow blanks or billets can be rolled out in one pass to a finished tube. Of course the same rolling process may be used twice or more, which is especially useful when hollow blanks with very thick walls are to be rolled out; but in performing my invention in one pass the hollow blank must be stretched out to at least twice the length that had the flattened blank before the stretching process. The maximum of elongation at one pass can be obtained in using positively-driven rolls, flat parts of considerable depth, and a mandrel which is longer than the hollow billet and drawn through the rolls by a draw-bench or other suitable device to perform the positive endwise movement of the mandrel through the rolling-mill.

I am aware that it is well known to roll tubes in oval outside form and cylindrical hole and then rolling this oval tube by means of rolls with cylindrical caliber into a round tube. (See United States Patent No. 397,724, Kellogg, Sheet 4.) In such rolling, however, the elongation at one pass between the rolls is very limited, as in strong stretching out of the two thicker parts of the tubes simultaneously the thin parts of the tubes, being located near the edges of the rolls, are likewise stretched out. As in said oval hollow blank the thin parts are almost equal in thickness for a considerable portion of the circumference the distance between the thick portions and the middle of the thin portions is comparatively large. The material cannot easily flow from the thick parts to the thin to fill out the lack of material produced at these points by the elongation without compression and without reduction of thickness of wall. A tearing of the wall crosswise to the axis of the tube takes place in case the same in one pass is elongated to twice or three times its length before the pass. In my described process the material in the circumference of the blank can easily flow from the thick parts to the thinner or flattened parts, as the latter are small and closely located to thick portions. Thereby in compressing the thick parts between the rolls the material flows under the strong compression to the thinner parts and fills up the wall of the tube. A stretching out of the hollow blank in one

pass to twice or three times its length and even more can therefore be obtained. In such a strong stretching it is especially useful to employ a positively endwise actuated mandrel and positively-driven rolls, whereby the hollow blank with flattened parts is drawn in the reducing-space between the rolls and the mandrel by the combined action of the rolls and the mandrel, and an enormous elongation of the tube in one pass is obtained.

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

1. The improvement in the art of rolling tubes, which consists in forming a hollow blank or billet with longitudinal flattened parts and intermediate thicker portions on the outside of the blank, and then rolling the blank in one pass into a tube or other hollow body of at least twice the length of the blank before the passing through the rolls, substantially as set forth.

2. The herein-described improvement in the art of rolling tubes, which consists in forming a hollow blank or billet with longitudinal flattened parts and intermediate thicker portions on the outside of the blank, and then rolling out the same over a mandrel in one pass into a tube, or other hollow body of at least twice the length of the flattened blank, the flattened parts of the blanks coinciding with the edges of the rolls, substantialy as set forth.

3. The improvement in the art of rolling tubes, which consists in forming a hollow blank or billet provided with longitudinal flattened parts and intermediate thicker portions on the outside of the blank, and then rolling out the same between positively-driven rolls and a positively endwise actuated mandrel in one pass into a tube or other hollow body of at least twice the length of the flattened blank, the flattened parts of the blank coinciding with the edges of the rolls, substantially as set forth.

4. The herein-described improvement in the art of rolling tubes, which consists in forming a hollow blank or billet provided with longitudinal flattened parts on the outside of the blank, and thicker portions between the same and then rolling out the grooved blank by means of positively-driven rolls and a positively-actuated mandrel in one pass into a tube of at least twice the length of the flattened blank, or other hollow body, so as to stretch out the thicker portions and form longitudinal ribs or protrusions on the circumference of the finished tube, the flattened parts of the blank coinciding with the edges of the rolls, substantially as set forth.

5. The herein-described improvement in the art of rolling tubes, which consists in forming a hollow blank or billet provided with longitudinal flattened parts and intermediate thicker portions on the outside of the blank, and then rolling out the same between positively-driven rolls and a positively endwise actuated mandrel in one pass into a tube or other hollow body of at least twice the length of the flattened blank, so as to stretch the thicker portions and form a tube with longitudinal ribs or protrusions on the circumference of the same, the flattened parts of the blank coinciding with the edges of the rolls, and then rolling or pressing down said ribs or protrusions on the mandrel, substantially as set forth.

6. The improvement in the art of rolling tubes, which consists in forming a hollow blank or billet with longitudinal thinner parts and intermediate thicker portions on the outside of the blank, and then rolling the blank in one pass into a tube or other hollow body of at least three times the length of the blank before the passing through the rolls, the thinner parts of the circumference of the blank being so closely located to the thicker parts that the material under the compression of the rolls flows to the thin parts in order to fill up their lack of material produced by the elongation of the blank, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

MAX MANNESMANN.

Witnesses:
T. BLAIR SHOEMAKER,
EMORY H. BOGLEY.