(No Model.)

R. MANNESMANN.

MANUFACTURE OF SEAMLESS TUBES.

No. 361,955. Patented Apr. 26, 1887.

Fig. 1.

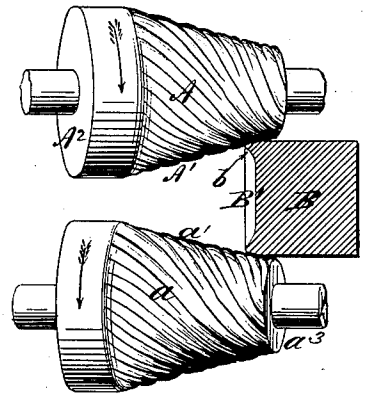


Fig. 2.

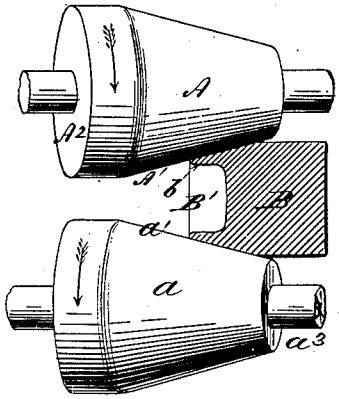


Fig. 3.

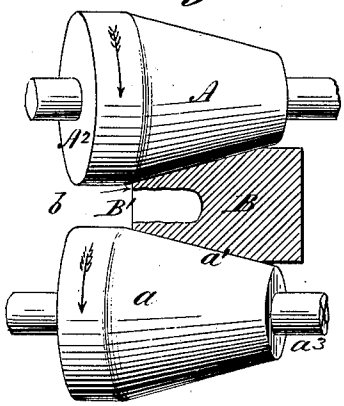


Fig. 4.

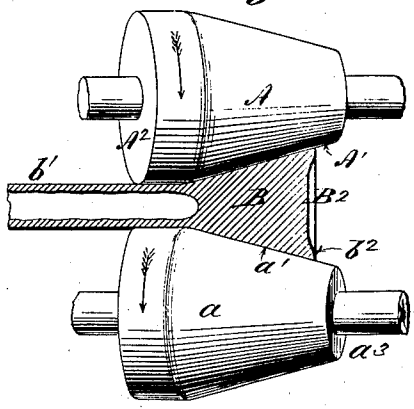
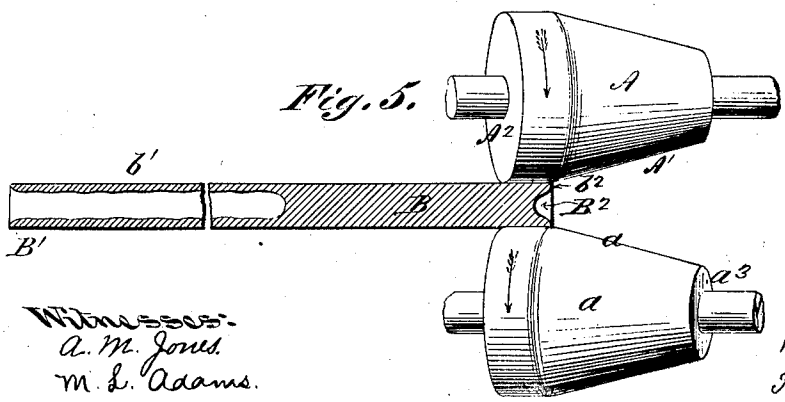


Fig. 5.



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UNITED STATES PATENT OFFICE.

REINHARD MANNESMANN, OF REMSCHEID, GERMANY.

MANUFACTURE OF SEAMLESS TUBES.

SPECIFICATION forming part of Letters Patent No. 361,955, dated April 26, 1887.

Application filed March 28, 1887. Serial No. 232,790. (No model.) Patented in England January 27, 1885, No. 1,167; in France January 27, 1885, No. 163,433; in Germany January 27, 1885, No. 31,617; in Italy January 26, 1886, No. 7,925; in Spain August 21, 1886, No. 9,537, and in Austria-Hungary September 18, 1886.

To all whom it may concern:

Be it known that I, REINHARD MANNESMANN, of Remscheid, Germany, have invented certain Improvements in the Manufacture of Seamless Metallic Tubes, of which the following is a specification.

Seamless tubes have heretofore been made from hollow ingots of metal by passing such ingots between the opposed faces of diagonally-placed rolls, by the oblique compressing and rolling action of which such ingots have been compressed and elongated into tubes of prescribed length. Rolls or rolling dies revolving on oppositely-inclined axes, or "skew-rolls," as they are sometimes called, have also been used for polishing the surfaces of cylindrical objects or blanks which have been passed endwise between their working-faces. In addition to imparting rotation to the blanks, such rolls, owing to the opposite inclination of their axes, also tend to impart a bodily endwise movement to the blank. Assuming that the rolls have a uniform rate of rotation, the speed of bodily endwise movement which they impart to the blank upon which they act increases or diminishes accordingly as the axes of the rolls are more or less inclined in relatively-opposite directions from the transverse plane of the axis of the blank. The extent to which the blank is elongated by the action of the rolls depends, of course, upon the amount of reduction which the rolls effect in the diameter of the blank.

The present invention is based upon the discovery that a tubular formation may be given to a portion of a solid ingot or bar of metal solely by the action upon the solid ingot of diagonally-operating rolls, the working-faces of which converge sufficiently to hold back the unacted-upon portion of the blank, and provided the angles of inclination of the axes of the rolls are properly adjusted with reference to the production of the effects sought for. The main body of the blank is held back more or less effectively, according to the degree of abruptness with which the working-faces of the rolls converge. If the convergence is sudden and if the axes of the rolls are so inclined that the rolls exert considerable pulling action upon the blank, the metal displaced from the perimeter of the blank by the impingement of the rolls will be compelled to flow forward and to necessarily assume a tubular shape. By this process tubes closed at one end may be produced from solid blanks by suitably adjusting the angles of convergence of the working-faces of the rolls and the angles of inclination of the axes of the rolls and properly proportioning the thickness of the blank which is to be operated upon.

For the sake of simplicity of description it is assumed that the blank travels endwise along a horizontal path between two rolls which are respectively on either side of it. As a matter of fact, however, when cylindrical or conical rolls are used, three, and sometimes four, rolls are commonly employed for simultaneously acting upon different sides of the blank.

The accompanying drawings respectively represent, in central longitudinal section, a metallic blank at various stages in its progress between a pair of conical rolls, the working-faces of which converge and the axes of which are oppositely inclined from the horizontal plane of the path through which the blank travels.

In detail the drawings are as follows: Figure 1 is a top view of a pair of conical rolls arranged on either side of a metallic blank, which is represented in horizontal section, the working-faces of the rolls shown in Fig. 1 being represented as spirally corrugated. Fig. 2 is a top view of a similar pair, showing the blank in horizontal section and at a further stage of its progress than the stage at which it is represented in the preceding figure.

The same description applies to Fig. 3 as compared to Fig. 2, and to Fig. 4 as compared to Fig. 3, and to Fig. 5 as compared to Fig. 4. The spiral corrugations are shown only in Fig. 1.

No attempt is made in the drawings to represent the gearing by which the rolls are driven, nor any organized machine in which the rolls are placed, because the machine forms no part of the present invention, and because diagonal-rolling machines are well known.

When three or more rolls are employed for acting simultaneously on as many different sides of the blank, they serve to centralize the

blank; but if only two rolls are employed suitable guides must be provided for properly supporting and guiding the blank during its passage through the rolls. Such guides, however, having been heretofore used in machines of analogous character, are not shown in the drawings.

For the sake of simplicity it is assumed that the conical rolls A *a* are arranged on either side of a horizontal path along which the blank B travels between the convergent working-faces A′ *a*′ of the rolls.

It is assumed that the vertical planes of the axes of the rolls A *a* are parallel, but that the axes of the rolls incline respectively in opposite directions from the horizontal plane of the path through which the blank travels. These opposite inclinations of the rolls are approximately shown in the drawings, which represent the rolls respectively as tipped in opposite directions, so that the large end A^2 of the roll A and the small end a^2 of the roll *a* are seen.

Although not absolutely necessary, it is strongly advisable that the working-faces of the rolls shall be provided with spiral ribs or corrugations, as shown in Fig. 1. These ribs or corrugations give the working-faces of the rolls a more effective hold upon the parts of the blank against which they impinge, and, owing to the fact that they gradually become coarser in pitch from the part of the roll which first engages the blank to the part of the roll which effects the greatest reduction in diameter, the spiral ribs have the effect of progressively drawing the metal from the outer portion of the blank inward and forward and thereby greatly assisting in the development of the tubular formation.

In Fig. 1 the blank B is represented as having just been engaged by the rolls A and *a*. The pinching effect produced by the rolls is illustrated by the annular flange *b*, by the forward projection of which from the front end, B′, of the blank the tubular formation is initiated.

In Fig. 2 a larger quantity of metal is represented as having been forced to flow forward by the action of the rolls, whereby the flange *b* is correspondingly lengthened.

A still further lengthening is represented in Fig. 3.

In Fig. 4 the tubular formation is represented as completed, and the cylindrical shell *b*′ of the tube as issuing from the narrower side of the space between the rolls. The rear end, B^2, of the blank is represented in Fig. 4 as having been carried forward between the rolls, and as exhibiting around its edge a slight annular projection, b^2, which has been produced by the pinching action of the rolls.

Fig. 5 illustrates the concluding portion of the operation, and shows the solid rear end of the blank reduced to the same diameter as the external diameter of the tube.

On reference to the drawings it will be seen that the exterior portion of the blank is drawn inward and forward by the action of the converging working-faces of the rolls, and that the interior portion of the blank remains solid and is to some extent elongated by the rolling down of the metal immediately adjacent to it.

The product may be used for any purpose for which a more or less elongated cylinder which is hollow for a portion only of its length is adapted. Any part of the tubular portion or any part of the solid portion may be cut off from the remainder, and in the manufacture of tubes by this process the entire tubular portion is cut off, in which case the remaining solid portion may be used for any purposes for which metals in the form of solid bars are adapted. By making the blank of large diameter in proportion to its length the solid portion of the product will be comparatively inconsiderable.

What is claimed as the invention is—

1. The herein-described improvement in the art of developing a tubular formation from solid metallic blanks for the production of seamless metallic tubes and for other purposes, which consists in passing a solid metallic blank endwise between two or more rolls the working-faces of which abruptly converge in a prescribed degree, and the axes of which are so inclined that a prescribed obliquity is given to the direction in which the working-faces of the dies act, respectively, upon different sides of the blank, whereby the metal composing the outer portion of the blank is progressively drawn and rolled inward and forward and thereby made to assume a tubular shape.

2. In diagonal tube-rolling apparatus, diagonally-acting rolls, the working-faces of which are provided with spiral ribs or corrugations, which progressively become coarser in pitch, as shown and described.

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GUSTAVE ALBERT OELRICHS.