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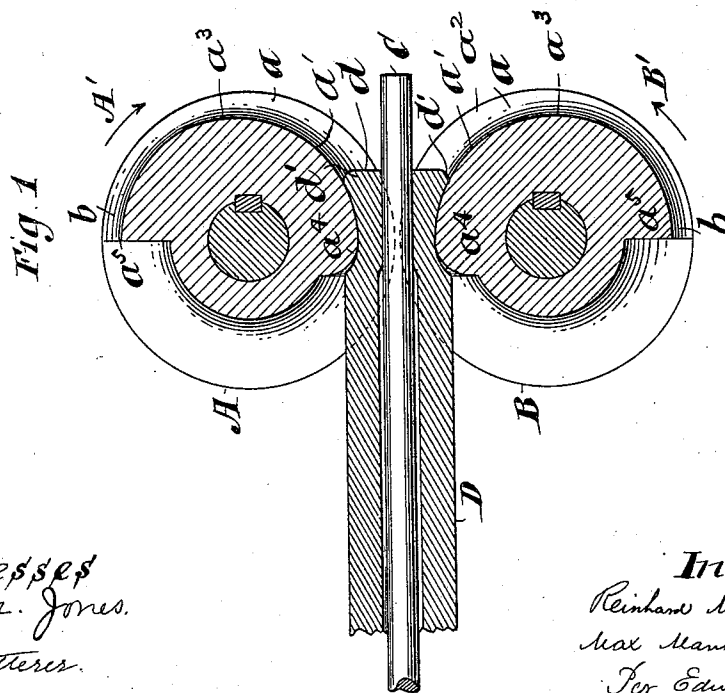
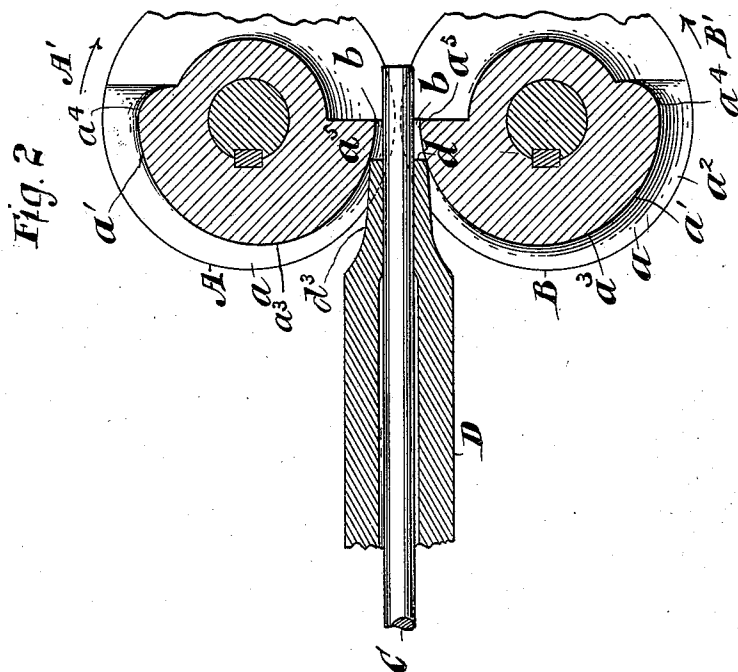
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M. & R. MANNESMANN.

ART OF AND MACHINE FOR ROLLING SEAMLESS METALLIC TUBES.

No. 542,801.

Patented July 16, 1895.



Witnesses
A. M. Jones.
E. Gatterer.

Inventors
Reinhold Mannesmann,
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(No Model.)

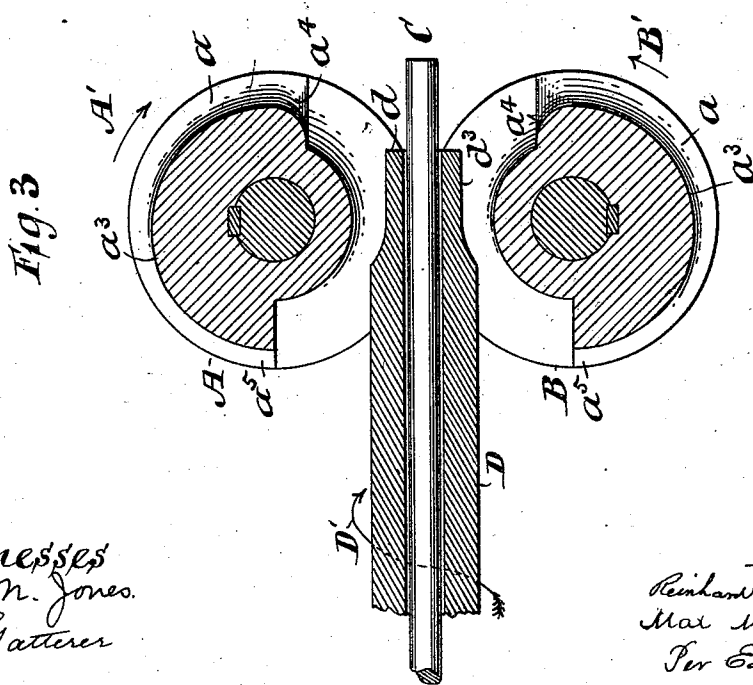
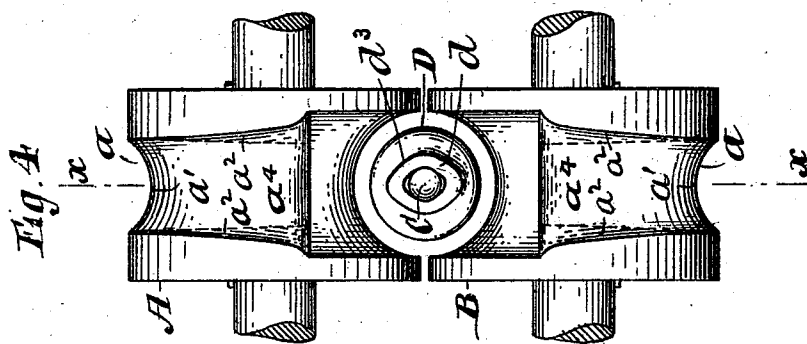
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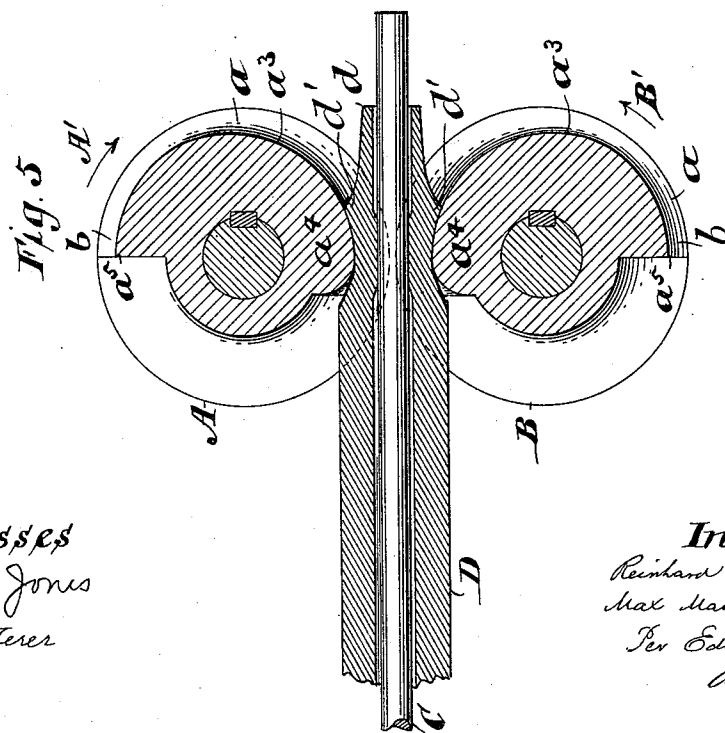
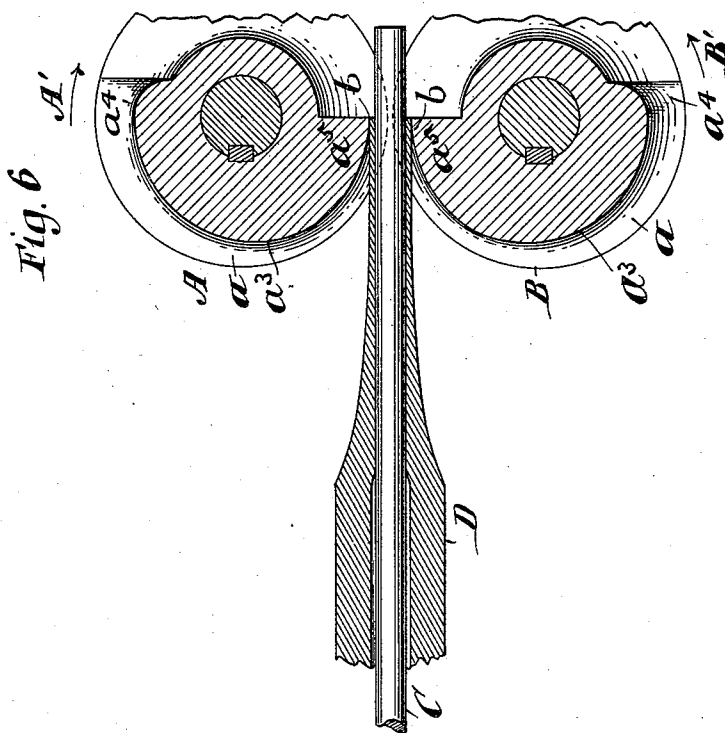
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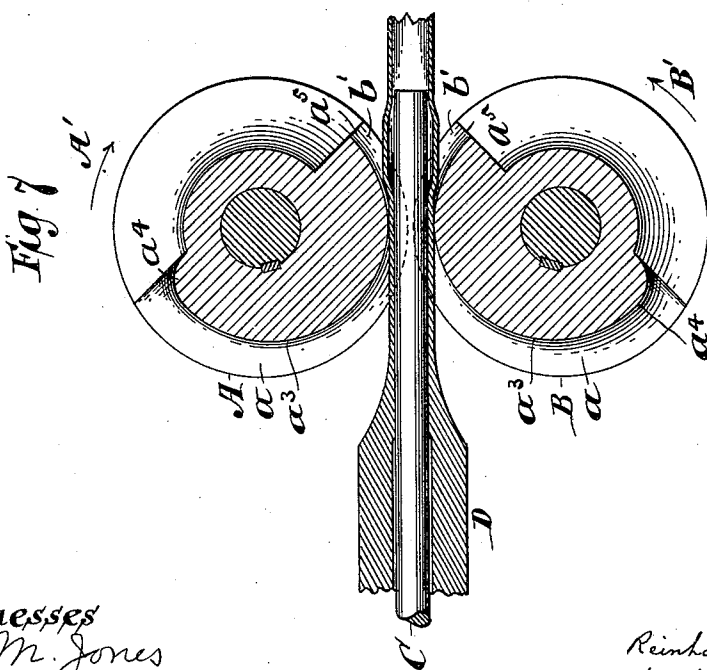
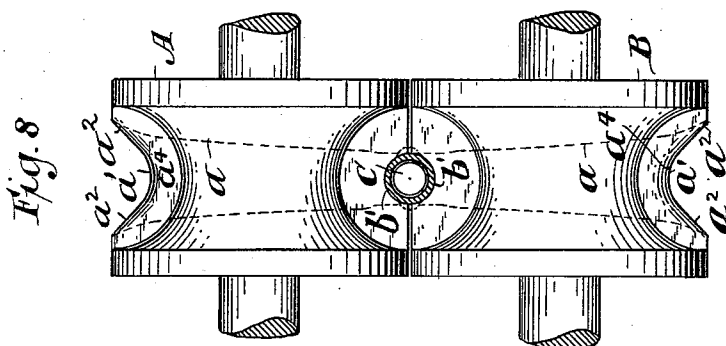
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Fig. 9

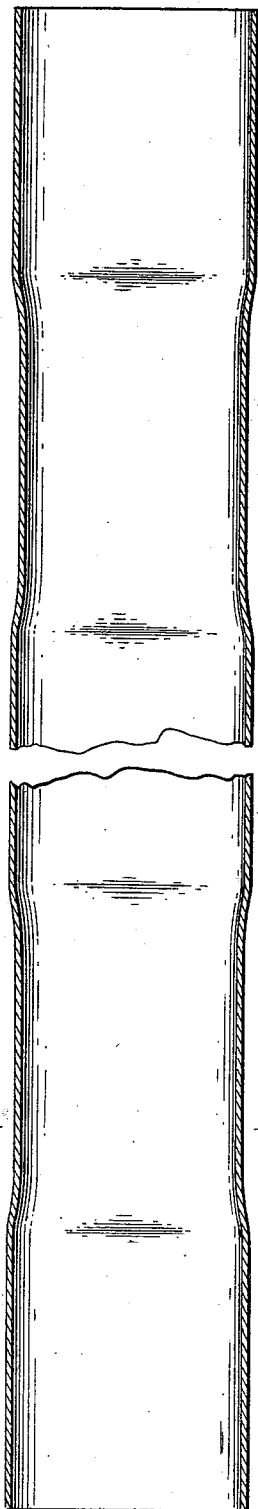


Fig. 11

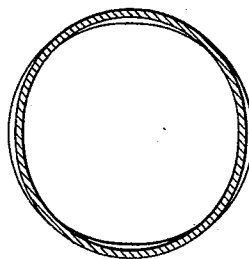
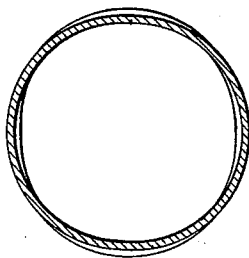


Fig. 10



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UNITED STATES PATENT OFFICE.

MAX MANNESMANN AND REINHARD MANNESMANN, OF REMSCHEID, GERMANY; SAID MAX MANNESMANN ASSIGNOR TO SAID REINHARD MANNESMANN.

ART OF AND MACHINE FOR ROLLING SEAMLESS METALLIC TUBES.

SPECIFICATION forming part of Letters Patent No. 542,801, dated July 16, 1895.

Application filed April 23, 1894. Serial No. 508,609. (No model.)

To all whom it may concern:

Be it known that we, MAX MANNESMANN and REINHARD MANNESMANN, of Remscheid, Germany, have invented certain Improvements in the Art of and Machines for Rolling Seamless Metallic Tubes, of which the following is a specification.

These improvements embrace a method of and apparatus for progressively reducing successive sections of a relatively thick-shelled hollow ingot into integrally-united lengths of relatively thin-shelled tubing and the production thereby, when desired, of the new article of manufacture hereinafter described.

The method consists in rolling down the hollow ingot step by step upon a mandrel into integrally united lengths of tubing, the internal cross-area of which is greater than the cross-area of the mandrel.

The apparatus by which the result is accomplished consists of intermittently-acting rolls, the reducing-faces of which are provided with longitudinally-tapering and laterally-flaring grooves which are approximately semielliptical in cross-section, whereby, during the rolling actions, the roll-pass, while gradually diminishing in width and more extensively diminishing in height, affords room for some outward lateral movement of the compressed metal at the opposite sides of the mandrel, and hence during each action of the rolls there is produced a short length of tubing of elliptical shape in cross-section. The rolls are made to act intermittently during prescribed portions only of their revolutions, either by the provision of cavities or flat places in their peripheries, or by the positive bodily removal of one roll from the other when the working faces have concluded their action. During the remaining portion of each revolution the ingot is turned ninety degrees (90°) more or less upon its longitudinal axis, and is fed forward endwise to the extent requisite for appropriately presenting to the rolls the section of the unacted-upon part of the ingot which is next to be attacked. The working face of each of the rolls embraces a reducing-

segment consisting of the flaring and longitudinally-tapering groove, previously mentioned, and a finishing-segment, the groove in which is not tapered.

If it be desired to produce a cylindrical tube the groove in the finishing-segment is deepened and transformed into semicircular shape in cross-section. When the groove in the finishing-segment is not thus transformed, but is a mere continuation, without material change in shape of the narrow end of the groove in the reducing-segment, the resulting product will consist of integrally united short lengths of tubing, each of elliptical shape in cross-section, but with its longitudinal plane of greatest diameter intersecting a prolongation of the longitudinal plane of greatest diameter of each adjoining length, the angle of such intersection being determined by the extent to which the ingot is turned upon its longitudinal axis while being fed. The resulting product, which may for present convenience be called a "tube" composed of integrally-united staggered elliptical lengths, constitutes in itself a new and useful article of manufacture, because it possesses the advantage of an elliptical tube in respect of capacity of yielding slightly to internal pressure without bursting, while also in a large degree possessing the capacity of resisting compression, which an ordinary elliptical tube is deficient in as respects pressure applied to its flatter sides. The mandrel is loosely contained within the ingot, the difference between the cross-area of the mandrel and the internal cross-area of the ingot being greater or less, according to the size of the ingot and of the tube sought to be produced. In all cases the cross-area of the mandrel is made sufficiently less than the internal cross-area of the ingot to provide for the formation of elliptical lengths of tubing, which are of such greater internal cross-area than the cross-area of the mandrel, that they can cool down without shrinking fast to the mandrel, so that as the lengths of tubing are successively formed they can slide forward

on the mandrel and be slipped off its forward end when the ingot receives its longitudinal feeding motion.

The accompanying drawings, illustrating the invention, are as follows:

Figure 1 is a transverse section of the rolls and a central longitudinal section of the ingot taken through the plane indicated by the dotted line $x x$ on Fig. 4 and illustrating the commencement of the first action of the rolls upon the ingot. Fig. 2 is a similar section illustrating the concluding part of the first action of the rolls and the partial reduction of the end of the ingot. Fig. 3 is a similar section illustrating the stage in the rotation of the rolls during which the ingot is turned upon its longitudinal axis. Fig. 4 is an elevation showing the faces of the rolls and showing the end of the ingot as it appears after it has been turned upon its axis to properly present it for the second action of the rolls. Figs. 5 and 6 are sections, respectively, illustrating the commencement and the conclusion of the second action of the rolls upon the ingot by which the reduction is completed and the first length of finished tube produced. Fig. 7 is a section illustrating the commencement of the operation of the transversely-concentric finishing parts of the grooves in transforming the previously-produced length of oval tubing into cylindrical form. Fig. 8 is an elevation showing the faces of the rolls and illustrating the final effect upon the tube of the transversely-concentric finishing parts of the grooves. Fig. 9 is a longitudinal section of a tube composed of integrally-united staggered oval sections. Fig. 10 is a transverse section taken through the plane indicated by the dotted line $y y$ on Fig. 9. Fig. 11 is a transverse section taken through the plane indicated by the dotted line $z z$ on Fig. 9.

As represented in the drawings, the step-by-step rolling operations are performed by a pair of segmental rolls A and B, working in conjunction with a mandrel C, which is of prescribed smaller cross-area than the interior of the hollow ingot D. The working faces of the rolls are each provided with a laterally-flaring and longitudinally-tapering reducing-groove a , which merges into a finishing-groove b . The middle part of the reducing-groove has in its cross-section the form of a circular curve or arc concentric with the axis of the mandrel, the said arc a' not varying more than thirty degrees either way from ninety degrees in length. The remaining parts or sides $a^2 a^2$ of the reducing-groove extend tangentially from the arc a' , so that in cross-section the reducing-groove may be regarded as semielliptical in respect of having its greatest width rather more than twice its greatest depth. It hence follows that the lateral dimension of the pass formed by the conjunction of two rolls provided with such flaring

reducing-grooves is approximately equal to twice the vertical dimension.

The transverse sections of the rolls exhibited in the drawings are taken through planes intersecting the middle of the grooves. Hence the line a^3 representing the center line of the bottom of the reducing-groove in each roll is not concentric with relation to the axis of rotation of the roll, but has the form of a parabola, because at its heel a^4 the reducing-groove increases in radius rapidly and then more gradually increases in radius to its point a^5 .

The ingot is so presented that the heels a^4 of the reducing-grooves in attacking the previously unacted-upon part of the ingot quickly and deeply impinge upon its opposite sides at short distances back of its forward end d . After the attack the effect of the rotation of the rolls, the directions of which are indicated by the arrows A' and B' , is to force the ingot backward, while the bunches or waves of metal $d' d'$ in front of the reducing-grooves are squeezed more or less convergently toward each other as they are forced toward the mandrel by the ensuing gradual reduction in the vertical dimensions of the roll-pass. Usually the first action of the rolls will only partially reduce the forward end of the ingot, as illustrated in Fig. 2. When the working faces of the rolls have cleared the ingot, the ingot is turned ninety degrees, more or less, on its longitudinal axis, as indicated by the sinuously-curved arrow D' in Fig. 3.

When the finishing-grooves b are mere prolongations without change of the points a^5 of the reducing-grooves, a length of tube is produced which is of elliptical shape in cross-section with its major axis parallel with the axes of the rolls. This result ensues because of the smaller cross-area of the mandrel as compared with the internal cross-area of the ingot and because the flaring side walls of the grooves in the working faces of the rolls permit some lateral movement of the compressed metal. The cross-section of the elliptical length d^3 , produced by the first action of the rolls, is somewhat irregular in contour, usually having its shell indented, as shown in Fig. 4, in which it is represented as having been turned ninety degrees to present it for the second action of the rolls. The complete reduction to the ultimate extent required may necessitate several preliminary actions of the rolls; but it will of course be seen that one or more of such preliminary actions may be rendered unnecessary by casting the ingot with a chamfered forward end of a shape corresponding to the shape given to the forward end by the preliminary actions of the rolls. For example, the ingot might be cast with its forward end of the shape in which it is illustrated in Fig. 2, in which case one less preliminary action would be required.

Assuming that two preliminary actions are necessary, Fig. 5 shows the commencement

and Fig. 6 the conclusion of the action by which there is produced the first length of symmetrically-shaped elliptical tubing of the finished size required. Thereafter each successive action produces an additional length of tubing, which is integral with the length next previously produced.

When the product instead of being finished in the form of staggered short lengths of elliptical tubing is to be finished in cylindrical form, the finishing-grooves are gradually deepened and the flare of their side walls is gradually diminished until their cross-section becomes semicircular and of such radius that the shell of the original elliptical tube when compressed upon its major axis, as illustrated in Fig. 7, just fills the circular finishing pass b' , as illustrated in Fig. 8.

The mandrel employed need not necessarily be cylindrical, but may be prismatic in form, in which case the reducing-grooves will be of corresponding form in cross-section, but so proportioned and having such flare at their sides that opportunity will be afforded for some movement of the compressed metal outward away from the mandrel toward the parting lines of the roll-pass, so that, as hereinbefore explained, the lengths of tubing successively produced by the reducing-grooves will have such greater internal cross-area than the cross-area of the mandrel that they will not bind upon the mandrel. This is of the essence of that part of the invention which resides in the method of operation.

It is not less essential that the described segmental rolls and the mandrel shall be so proportioned with relation to the size of the ingot in cross-section and that the ingot shall be so presented that the heels or attacking ends of the reducing-grooves will make their attack by so deeply impinging upon the previously unacted-upon part of the ingot as to form a wave of metal in front of the rolls, which wave of metal, as the ingot is forced backward, will be detained and squeezed downward toward the mandrel by reason of

the gradually-increasing radius of the reducing-groove, or, in other words, the gradual reduction in the height of the roll-pass.

What is claimed as the invention is—

1. Segmental rolls each provided with a reducing groove which is laterally flaring as herein described, and gradually diminishes in width and depth and merges into a finishing groove, in combination with a suitably proportioned mandrel interposed between said rolls, as and for the purposes set forth.

2. In apparatus for step by step rolling, the combination of two appropriately mounted eccentric rolls, the working faces of which are each provided with a longitudinally tapering groove semi-elliptical, or approximately semi-elliptical, in cross section, as herein described, and increasing in radius from one end to the other, in combination with a suitable mandrel appropriately interposed between the said rolls, as and for the purposes set forth.

3. The improvement in the art of rolling seamless metallic tubes into integrally united lengths of tubing of oval cross section, which consists in placing a mandrel loosely within a hollow ingot, introducing the mandrel and ingot to rolls having a pass of elliptical or approximately elliptical contour as herein described, and turning the ingot ninety degrees more or less as the rolls act step by step to reduce the same, substantially as set forth.

4. As a new article of manufacture, the seamless rolled metal tube herein described, the same composed of integrally united staggered oval sections substantially as set forth.

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REINHARD MANNESMANN.

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Witnesses as to Reinhard Mannesmann:

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