June 2, 1936. M. ROECKNER ET AL 2,042,552

PROCESS FOR PRODUCING SEAMLESS TUBES

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Fig. 1

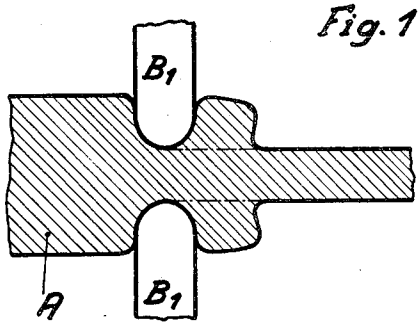


Fig. 5

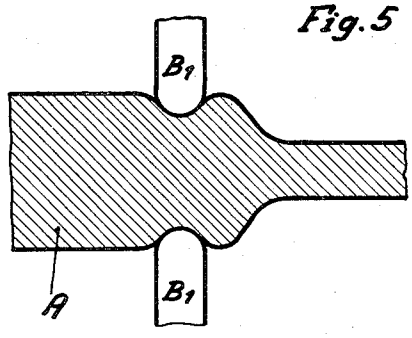


Fig. 2

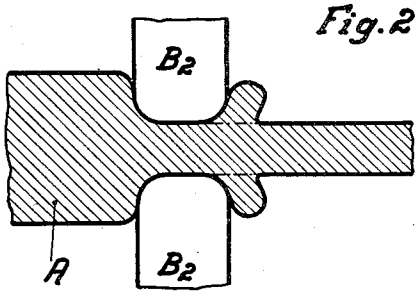


Fig. 6

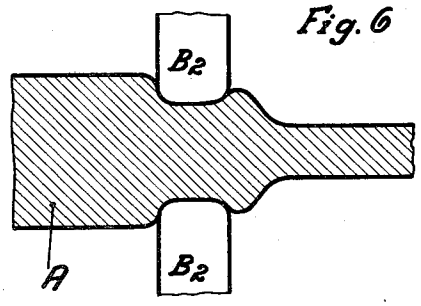


Fig. 3

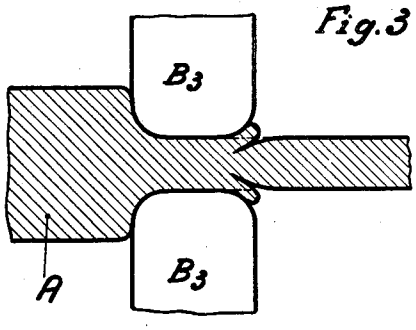


Fig. 7

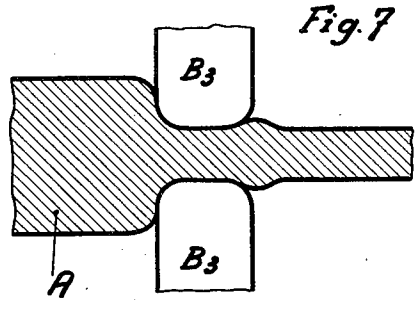


Fig. 4

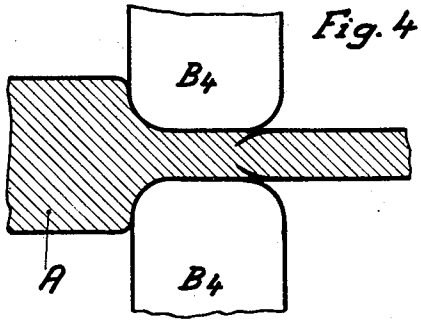
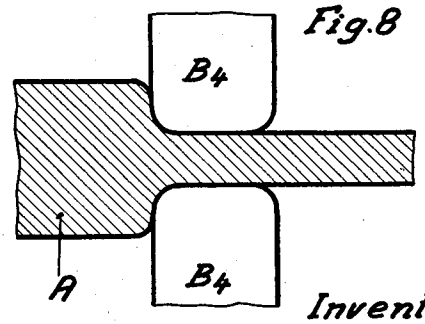


Fig. 8



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PROCESS FOR PRODUCING SEAMLESS TUBES

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Fig. 9

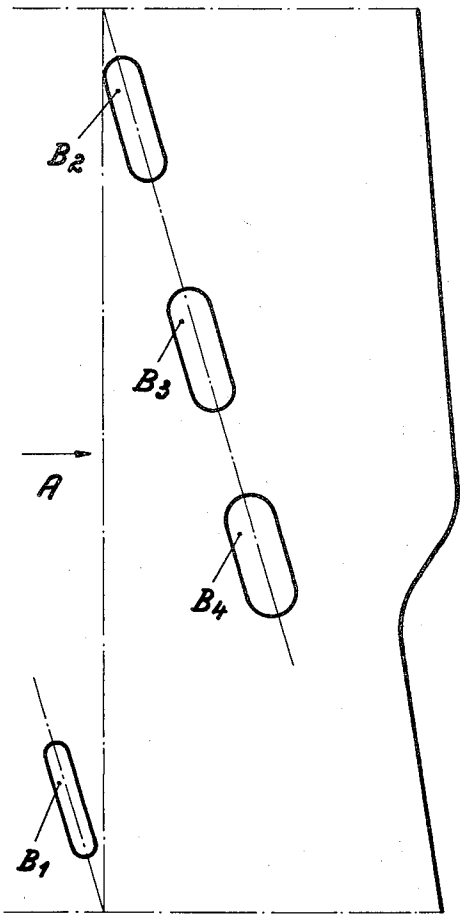
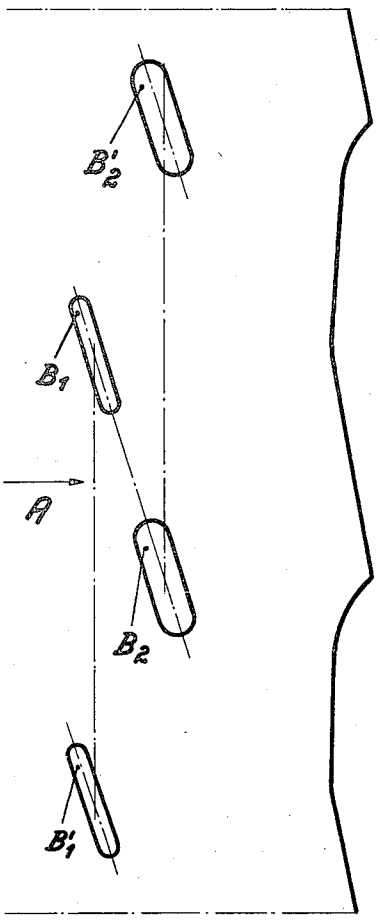


Fig. 10



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PROCESS FOR PRODUCING SEAMLESS TUBES

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Fig. 11

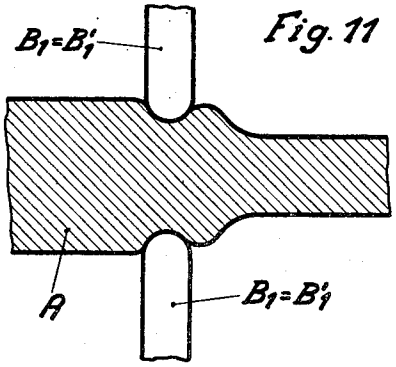


Fig. 12

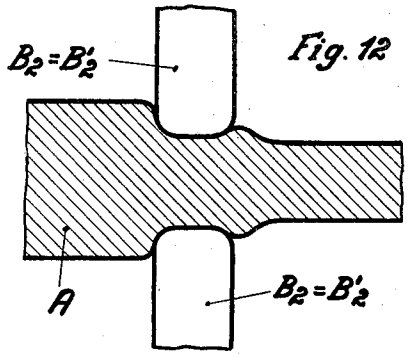


Fig. 13

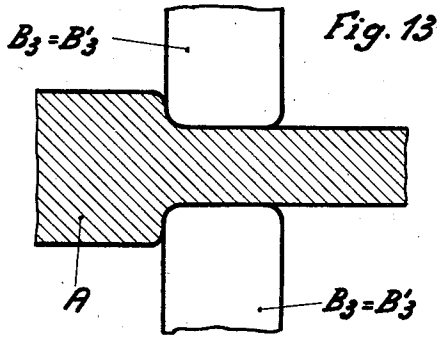
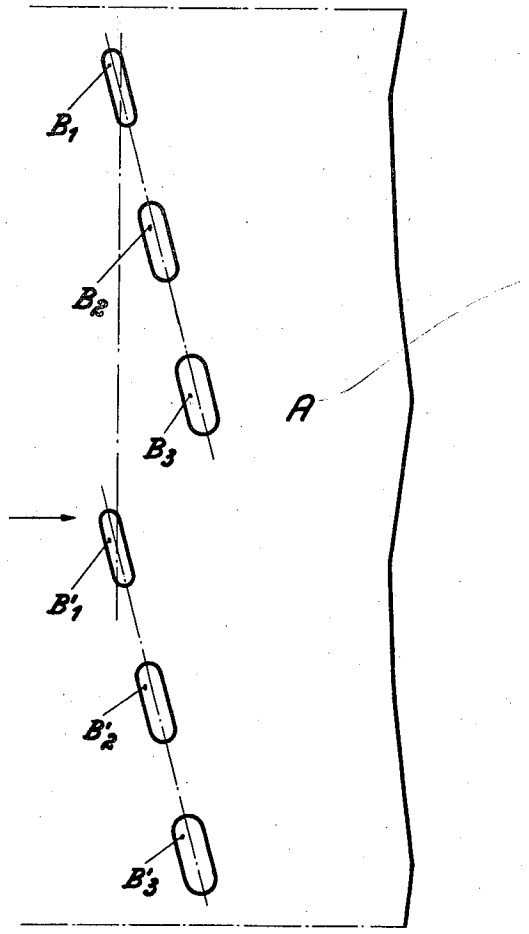


Fig. 14



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UNITED STATES PATENT OFFICE

2,042,552

PROCESS FOR PRODUCING SEAMLESS TUBES

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Application November 9, 1934, Serial No. 752,282
In Germany November 27, 1933

5 Claims. (Cl. 80—62)

It is known to produce tubes from a hollow billet by means of several pairs of rolls arranged around the billet a certain distance from its axis, one roll of each pair acting on the wall from the inside and the other on the wall from the outside. In this known construction the rolls have different widths or profiles; thus, the first pair of rolls cuts a groove into the billet, the groove being widened by the successive pairs of rollers, so that a part of the billet reduced by the first pair of rolls is gradually stretched in the direction of one end of the hollow billet. The inside and outside rolls of the pairs of rollers are in the known construction so provided that they roll on the outer and inner faces of the billet on single track helical lines. The greater the pitch of the helical lines selected, the larger is that part of the billet which is reduced by the cutting of the shoulders on the first pair of rolls and which must be stretched towards the end in a single rotation of the hollow billet, by the next pair of rollers. The pitch must be such that the pairs of rolls can, according to their width, stretch the reduced part of the billet in a single rotation. The greater the pitch of the helical lines, the greater becomes the force which is required in effecting the change of shape. Furthermore, the depth of the impression made by the shoulders of the pairs of rolls must be such that the part of the billet reduced by the first pair of rolls can be stretched smoothly by the succeeding pairs of rolls. The consumption of power increases as the depth of the groove and the pitch of the helical lines grow. It follows that the width of a roll, which has been designed for use with a particular number of pairs of rolls for a particular thickness of wall of the hollow billet and a particular depth of groove, must be used with one particular pitch only. If one of these dimensions should be changed, it would theoretically be necessary for some other form of roll to be selected—otherwise there is the possibility that with a change in the consumption of power the change in shape will proceed irregularly. The speed at which the hollow billet is shaped to produce the finished tube is dependent upon the pitch of the helical line track made upon the working rolls and also by the depth of the groove. As the pitch is possible of variation only within relatively small limits, considerable depths of groove are frequently selected in order to effect the necessary shaping more rapidly. This means that, with a given source of power, the pitch of the tracks made by the working rolls must be small and the consequence is that the part reduced by the first pair of rolls is high and narrow. The great disadvantage of this is that the metal of the billet at the reduced part does not move in the way that was intended towards the neutral plane of the wall of the tube that is to be rolled, but tilts over sideways. The result is that the metal of the billet moves, under the pressure of the succeeding pairs of rolls, less and less in the manner intended and that at the position of change into the portions of the billet already rolled out a crease is formed at the base of the reduced part; this crease formed in the passage of the billet between the several pairs of rollers, gives rise to excessive rolling, which is damaging to the finished article and affects its capacity for use.

In the accompanying drawings Figures 1 to 4 illustrate the steps of the operation hereinbefore described. In these figures A is the wall of the hollow billet that is to be rolled, and B_1, B_2, B_3 and B_4 are the peripheral portions of the working rolls.

The purpose of the present invention is to avoid these disadvantages. According to the invention the shoulders of the first pair of rolls make a groove, which is not, however, as deep as is required but is quite shallow; it is then deepened by the succeeding pairs of rolls until the desired depth is reached.

Figures 5 to 8 illustrate how, with the same final depth of groove and the same pitch, the metal at the reduced position moves smoothly, as desired, towards the neutral plane of the wall of the tube. According to the invention the first pair of rolls B_1 (Figure 5) makes a groove, but less deep than required; the second pair of rolls then both widens and deepens the groove towards the end. The third pair of rolls continues both operations, and finally the fourth pair of rolls (Figure 8) stretches the metal to the final thickness required for the wall.

The process of the invention not only affords protection against the tilting of a high narrow ridge of metal that has been produced by the first pair of rolls, but it also ensures uniform treatment right through the material by reason of the absolutely uniform movement of the metal during the whole working operation. For this reason the process of the invention admits of the better utilization of the possibilities provided by an available source of power having a limited output. Thus, for example, the pitch of the helical line style of track for the working rolls may be increased while retaining the final depth of groove produced according to the

prior process, or the depth of the groove may be increased pitch of the helical lines and producing the same depth of groove the rolling mill is able to run more rapidly. Thus, in the process of the invention there is afforded a large number of possible ways of increasing the output.

In applying the same idea, namely, the avoidance of the tilting of high, narrow shoulders by causing the working portions of the pairs of rolls to be forced gradually more deeply into the metal with continuously increased stretching—it is, according to the invention, further proposed to place the pairs of rolls on a plurality of helical lines, and, if necessary, to place several pairs one behind the other. By this means when the rolls are disposed in, for example, two helical lines the pitch may be doubled, so that the rolls penetrate only to half the depth with the same effort for each operation. By reason of the uniform change of form due to the lesser depth of impression the speed of the rolling mill can be increased, so that notwithstanding the lesser depth of impression and the consequent increase in the requisite length of passage through the rolling mill for the material being rolled, the total working time is reduced. Particularly advantageous is the disposition of the pairs of rolls in a plurality of helical lines, if the shallow grooves pressed by the first pair of rolls of the same helical lines are increased to the desired depth by the subsequent pairs of rolls.

By operating in this manner with rolls disposed in multi-track helical lines a further disadvantage is avoided, which has made itself objectionable in connection with the known rolling method with rolls disposed on a single track helical line. When working with several pairs of rolls, for example with four pairs of rolls on a single track helical line, as shown in Figures 1 to 8 of the accompanying drawings, the stretching of the work after its passage through the pairs of rolls results in a wavy formation of the end face of the oncoming tube. If the plant be, for example, so selected that when there are four pairs of rolls each pair effects one-quarter of the total stretching, and if the billet be able to move freely towards the end then, if the rolling operation is interrupted at any particular moment, the distances between the working portion of each roll and the rear end face of the work measured on lines parallel to the axis of the tube, would necessarily differ,—that is to say, the distance would, in the case of the fourth pair of rolls be of necessity greater than in the case of the first pair of rolls by three-quarters of the total stretching. As, however, in the known processes the distance between the first and the fourth pair of rolls is only one-quarter of the periphery of the tube, considerable forces must operate within this quarter of the periphery of the tube, striving to adjust themselves to the differences in length referred to. This is actually effected in practice and involves the upsetting of the rolled-out part of the hollow billet, so that the thickness of wall of the rolled tube when finished is always greater by several tenths than that which is calculated from the setting of the rolls.

This very important disadvantage of the known process as well as the danger of the over-turning of the reduced part of the billet are avoided or reduced to a practically negligible extent by the selection of multi-track helical lines for the working rolls. The considerable difference of stretch before referred to, which exists, for example, in the case of four pairs of rolls within one-quarter of the periphery of the tube, can be halved by selecting two helical lines for the rolls instead of the one, without, however, there being any reduction in the total stretching, which stretching is obtained by traversing the two-track helix the axial distance previously covered in the one-track helix. The advantages of having multi-track helical lines for the setting of the working rolls are made more fully evident as the number of pairs of rolls increases.

Figure 9 illustrates the differences of length which are theoretically produced at the advancing end face of the work by four pairs of rolls disposed on a single helical line. The letter A represents a development of the outside of the tube being rolled. Figure 10 indicates the formation of the advancing end face of the work A where the pitch is the same for two-track helical lines as for the single helical line, and the same stretch is obtained as in the example according to Figure 9.

Figures 11 to 14 show the means according to the invention for obtaining the desired grooving or impression in a rolling mill built for six pairs of rolls, for increasing of the depth to which the single pairs of rolls penetrates and further, the multi-track helical lines. In this connection there are provided two helical lines each having three pairs of rolls operating one behind the other. The disposition of the two helical lines with respect to each other is shown in Figure 14, again in the development of the work A, and the influence of this disposition upon the reduction in the differences of stretching in the advancing end face can be recognized.

The separate pairs of rolls are so disposed on their respective helical paths that the pairs of rolls B_1, B_2, B_3 and B_1', B_2', B_3' are spaced at intervals of $\frac{1}{6}$th of the periphery of the work and each set of rolls is in close sequence. They may, however, be arranged in staggered relationship in such manner that the pair of rolls B_1' is separated by $\frac{1}{6}$ of the periphery of the work being rolled from the pair of rolls B_1, naturally, however, only in such a way that the pair of rolls B_1 remains on one line of the two helical lines selected and the pair of rolls B_1' remains on the other line. Similarly the pair B_2' would be disposed behind the pair B_2, and B_3' behind the pair B_3.

We claim:

1. A process for producing tubes from hollow billets by stretching principally in the axial direction by means of a plurality of pairs of rolls, consisting in subjecting the hollow billet intended to form the tube to rolling by pairs of rolls, the units of which are respectively disposed on the inside and on the outside of the hollow billet, the axis of the said rolls being out of alignment with the axis of the hollow billet and the said rolls being set to roll upon the outer and inner faces of the hollow billet in a helical direction, the rolls of the respective pairs of rolls being in succession of different and increasing width and of different and increasing depth of engagement, whereby a groove is formed in the metal of the hollow billet by the first pair of rolls and is widened and deepened successively by a successive flow of the metal produced by each of the succeeding pairs of rolls so that the part of the billet reduced by the first pair of rolls is gradually stretched towards one end of the hol-

low billet without the formation of fissures or overturnings until the desired thickness of the work is attained.

2. A process for producing tubes from hollow billets according to claim 1, wherein the grooving of the hollow billet and the widening and deepening of the said grooving are produced by a plurality of pairs of rolls arranged one behind the other.

3. A process for producing tubes from hollow billets according to claim 1, wherein the grooving of the hollow billet and the widening and deepening of the said grooving are produced by a plurality of pairs of rolls disposed upon a plurality of helical lines.

4. A process for producing tubes from hollow billets according to claim 1, wherein the grooving of the hollow billet and the widening and deepening of the said grooving are produced by a plurality of pairs of rolls arranged one behind the other and on a plurality of helical lines.

5. A process for producing tubes from hollow billets according to claim 1, wherein the grooving of the hollow billet and the widening and deepening of the said grooving are produced by pairs of rolls arranged on a plurality of helical lines which deepen as far as required the groove formed in the surfaces of the billet by the first pair of rolls on the same helical line.

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