PUBLISHED
MAY 4, 1943.
BY A. P. C.

H. DÖRN
TUBE ROLLING SYSTEM
Filed Sept. 24, 1940

Serial No.
358,173
2 Sheets-Sheet 1

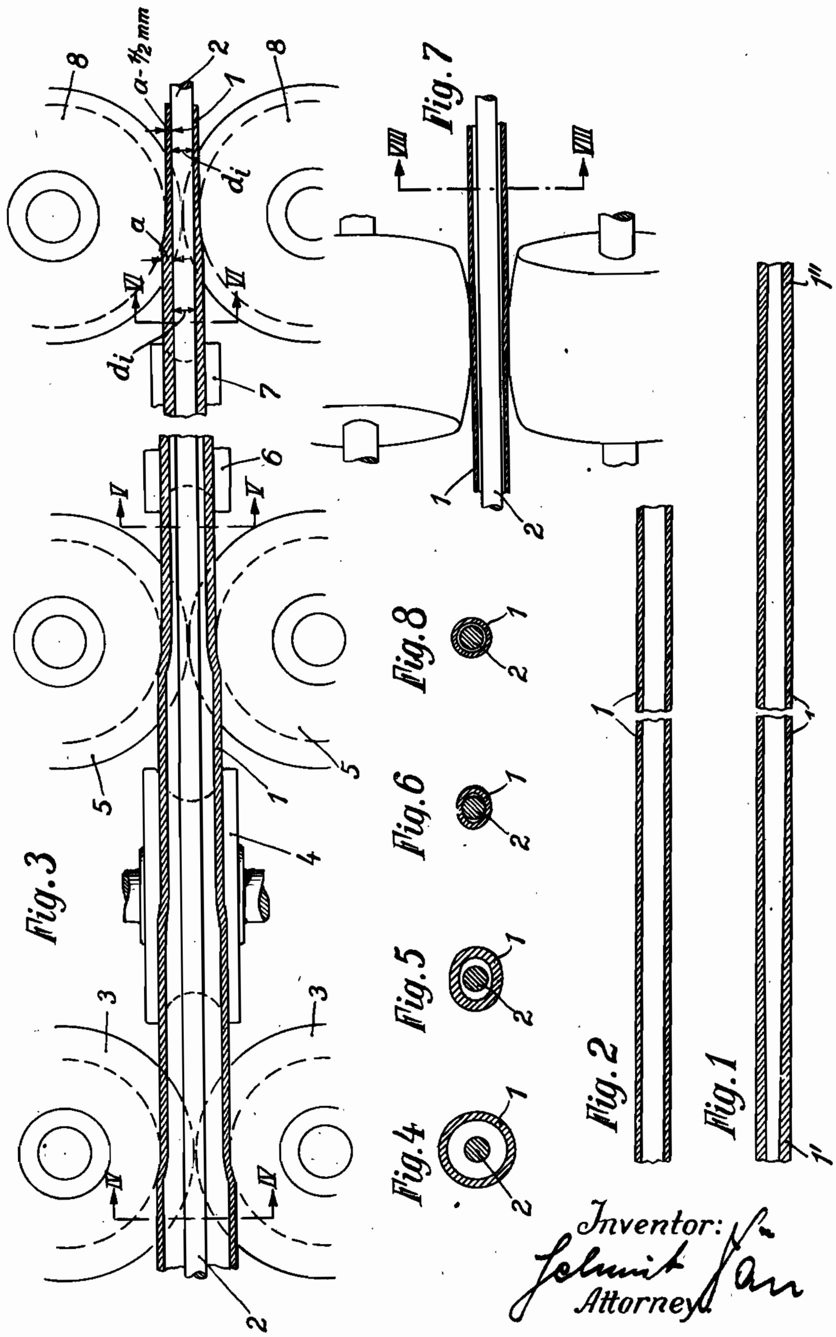

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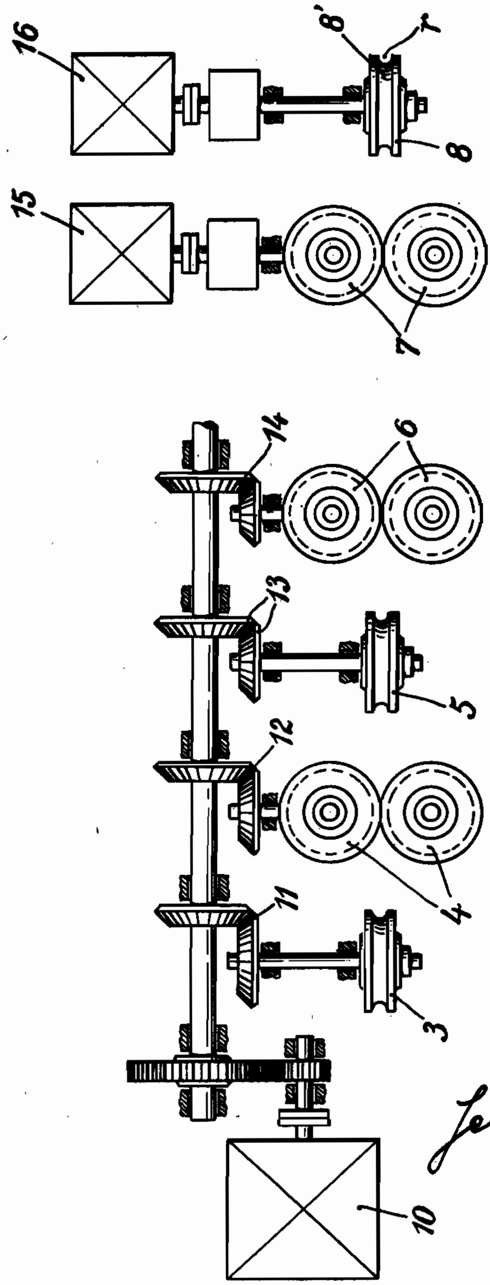
Fig. 9



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Published May 4, 1943

Serial No. 358,173

ALIEN PROPERTY CUSTODIAN

TUBE ROLLING SYSTEM

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Application filed September 24, 1940

This invention relates to a method of producing tubes or pipes on a continuous reducing rolling mill.

Such processes have gained an ever increasing importance, more particularly for the manufacture of tubes of small diameter, although the tubes obtained by this process have thickened end portions. The varying wall thickness of the tubes gradually decreasing from both ends to the centre of the tube is due to the fact that the flattening or stretching during the clamping of the tube causes a uniform deformation, and it is further due to the self-thickening of the freely passing tube ends. This important drawback is inherent to reducing rolling mills of the two-or three roll caliber type as well as to those of the four roll caliber type.

Another drawback of the known reducing rolling mills resides in the fact that the amount of reduction per frame must be kept within certain limits to avoid excessive upsetting or pushup or polygonal shape of the inner cross section of the finished tubes.

In order to obviate these difficulties, it has been proposed to provide idle running caliber parts, or rollers with free motion, or different spacing between the frames etc., but no satisfactory solution has been achieved by these proposals. This applies equally well for the known universal rolling mills provided to bring about a balance between the different roller speeds in the various frames. Even by the provision of an adjustable individual drive for each frame of the continuous rolling mill the thickened tube ends cannot be avoided. Therefore, it has been further suggested to provide the tube lump or bloom with a reduced wall thickness at the points where upsetting is to be expected. This method, however, is difficult, inaccurate and costly and therefore has not been adopted in practice.

The present invention has for its object to provide a method of the kind referred to for producing tubes having a uniform wall thickness, without thickened end portions.

With this and further objects in view, as may become apparent from the within disclosures, the invention consists not only in the structures herein pointed out and illustrated by the drawings, but includes further structures coming within the scope of what hereinafter may be claimed.

The character of the invention, however, may be best understood by reference to certain of its structural forms, as illustrated by the accompanying drawings in which:

Fig. 1 is a longitudinal section through a tube made after the known reducing process.

Fig. 2 is a longitudinal section through a tube made in accordance with the invention.

Fig. 3 is a longitudinal section through a portion of a tube as it is being subjected to the process according to the invention.

Figs. 4, 5 and 6 are cross sections of the tube of Fig. 3 on lines IV—IV, V—V and VI—VI, respectively.

Fig. 7 is a longitudinal section of a portion of the finished reduced tube during its passage through a smoothing and loosening or separating rolling mill.

Fig. 8 is a cross section on line VIII—VIII of Fig. 7.

Fig. 9 is a diagrammatic view of the drive for the various frames.

Similar characters of reference denote similar parts in the different figures.

As here shown, the process according to the invention comprises the introduction into the rolling mill of a rolling rod which as to its length is adapted to the length of the finished tube and has a uniform exterior diameter from end to end corresponding to the interior diameter of the finished tube. The rod may be introduced into the tube before or after the same has entered into the rolling mill, or during its entry, and the tube is then finished.

It will thus be noted that the tubes are at first rolled in conventional manner down to their final interior diameter. When this diameter is reached, the rolling rod having the same diameter comes into action to remove the resulting thickened tube ends by flattening or stretching.

The rolling rod which consists of a material of appropriate strength may be introduced from the forward or rear end of the tube. The process may be carried out on continuous or subdivided continuous reducing rolling mills. In the latter case the tube to be rolled out may be passed at first through the first group of the rolling mill and then finished in the second group after introduction of the rolling rod.

It is already known to roll thick-walled lumps on rods, whose outer diameter corresponds to the inner diameter of the lumps. The known plants are mere flattening rolling mills having the exclusive purpose of reducing the wall thickness. The present invention on the contrary is concerned with a reducing rolling mill in which the diameter of the pipe is reduced while maintaining constant the wall thickness.

According to a further feature of the invention the tube leaving the reducing rolling mill may be passed through a smoothing and loosening rolling mill, for smoothing the surface of the finished tube and facilitating the withdrawal of the rolling rod or mandrel.

In some instances the wall thickness of the reduced tubes may be reduced within certain limits, after the reduction of the tubes to the desired diameter, by suitable choice or design of the final rolling calibres. It will thus be appreciated that it is even possible in my novel process to reduce the wall thickness at the same time while the rest of the tube length is still being subjected to the pure reducing operation.

Referring now to the drawings in greater detail, it will be noted from Fig. 1 that the wall thickness of the tube 1 grows from its center to the two ends 1′, 1″. In order to avoid these thickened end portions, I introduce into the tube a rolling rod 2, Fig. 3, whose outer diameter is uniform over its entire length and corresponds to the inner diameter of the finished tube, and is at least of the same length as the same.

The initial tube 1 with the rolling rod 2 introduced into it is passed into and through a continuous reducing rolling mill, Fig. 3, which may be of known type and has been indicated schematically only. The pairs of rollers 3, 4, 5, 6, 7, and 8 of each frame are relatively staggered by 90°, as shown in Fig. 3, their number depending on the dimensions of the tubes to be reduced. The pairs of rollers may be separately driven but I prefer an arrangement indicated in Fig. 9, in which the pairs of rollers 3, 4, 5, and 6 are provided with a common drive 10 including bevel gears 11, 12, 13, 14, while the pairs of rollers 7 and 8 where the inner wall of the tube has already come into engagement with the rolling rod 2 are driven separately by motors 15 and 16, these motors preferably being adjustable d. c. motors.

As best seen in Figs. 3 and 4, the interior diameter of the initial tube 1 is substantially larger than the exterior diameter of the rolling rod 2. The tube is now reduced in diameter by the consecutive pairs of rollers, as shown in Figs. 3 and 4 to 6, as in conventional reducing rolling mills, with the exeception, however, that the amount of reduction per frame may be in excess of that hitherto possible, whereby the number of frames can be reduced. This, of course, leads to the production of tubes with particularly much thickened portions, but this is of no importance since the thickened portions are rolled down by the pairs of rollers 7 and 8 owing to the engagement of the rod 2 with the inner wall of the tube 1.

Where it is intended in addition to the removal of the thickened portions at the tube ends to reduce the wall thickness a of the reduced tubes 1, Fig. 3, for instance, by 1/2 mm, the caliber of the last pair of rollers 8 may be designed accordingly by reducing by 1/2 mm the radius r of the annular groove 8′ of the rollers 8 which forms the profile of the tube 1, as indicated in Figs. 3 and 9. The radius r thus will be

$$r=\frac{di}{2}+a-1/2\ mm$$

(di being the final inner diameter of the tube.) On the other hand, where this reduction is not required but it is merely intended to remove the thickened portions at the tube ends, the rollers 8 will have an annular groove 8′ being 1/2 mm larger

$$\left(r=\frac{di}{2}+a\right)$$

By the passage between the last pair of rollers 8 the finished tube 1 already obtains a round cross section permitting withdrawal of the rolling rod 2 from the finished tube. In order to further facilitate this withdrawal and to smoothen the surface of the tubes, the tube may be subsequently passed through a smoothening and loosening rolling mill of known type, as indicated in Fig. 7, whereby the distance between the surface of the rolling rod 2 and the inner wall of tube 1 will be somewhat increased and the tube 1 will be given a perfectly round cross section, as shown in Fig. 8.

The method and apparatus of the present invention have been described in detail with reference to specific embodiments. It is to be understood, however, that the invention is not limited by such specific reference but is broader in scope and capable of other embodiments than those specifically described and illustrated in the drawing.

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