Apr. 24, 1923.

1,453,203

R. C. STIEFEL

TUBE ROLLING MILL

Filed June 16, 1920 2 Sheets-Sheet 1

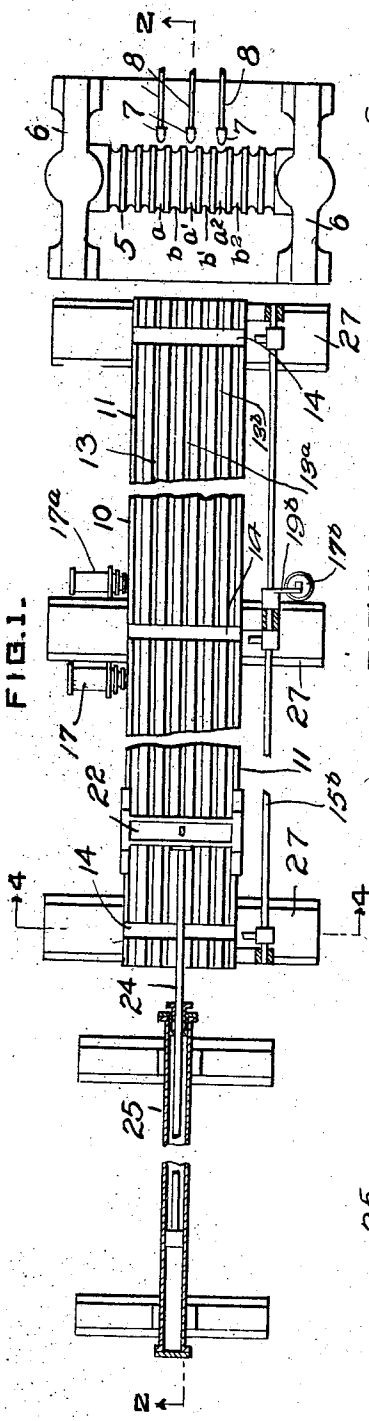


FIG. 1.

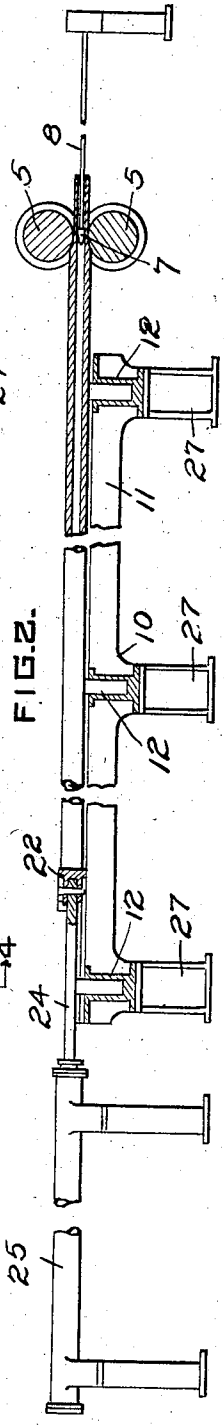


FIG. 2.

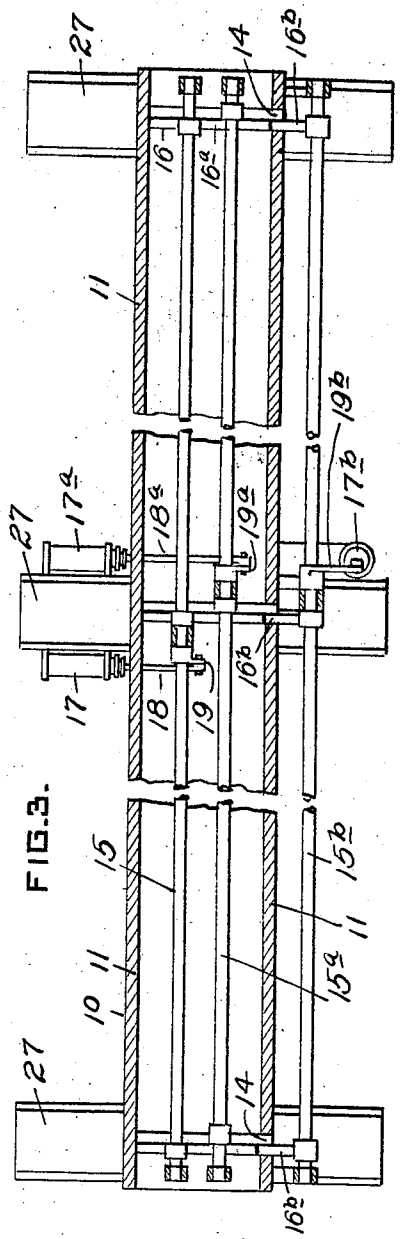


FIG. 3.

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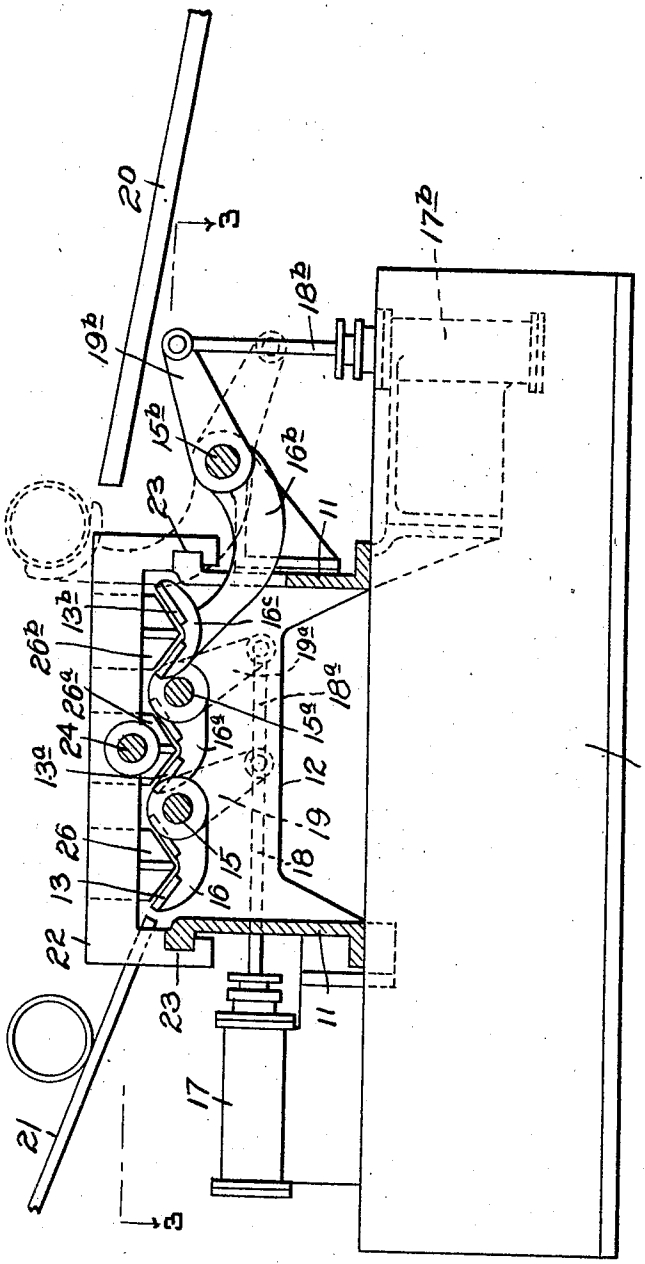
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FIG. 4.



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UNITED STATES PATENT OFFICE.

RALPH C. STIEFEL, OF ELLWOOD CITY, PENNSYLVANIA.

TUBE-ROLLING MILL.

Application filed June 16, 1920. Serial No. 389,347.

To all whom it may concern:

Be it known that I, RALPH C. STIEFEL, a resident of Ellwood City, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Tube-Rolling Mills, of which the following is a specification.

This invention relates to apparatus for rolling tubes, of the type known as plug rolling mills, that is, in which the tube is rolled longitudinally in grooved rolls over a stationary plug or mandrel.

The object of the invention is to provide a mill of this character whereby the longitudinal rolling of tubes may be effected more speedily and economically than with similar mills heretofore used, and, further, in which rounder tubes are produced than in prior mills of this character, so as to dispense with subsequent reeling.

In general the mill comprises grooved rolls having a plurality of substantially circular passes of progressively decreasing diameters, and through which the tube is successively passed, in combination with mechanism for quickly transferring the blanks sidewise from one pass to an adjacent one. The invention also comprises a pusher arranged to push the blank into any one of the series of passes, as well as the mounting of the transferring and pushing mechanism as a whole in a manner to permit the same to be shifted sidewise to cooperate with another series of passes in the rolls.

In the accompanying drawings Fig. 1 is a plan view of the apparatus; Fig. 2 is a longitudinal sectional view on the line 2—2, Fig. 1; Fig. 3 is a horizontal sectional view of the tube transfer means taken on the line 3—3, Fig. 4; and Fig. 4 is a transverse sectional view on an enlarged scale on the line 4—4, Fig. 1.

The reducing mill comprises a pair of grooved rolls 5 mounted in suitable housing 6 and provided with a series of passes. In order to adapt a single set of rolls to roll tubes of different sizes, each of the rolls is provided with a considerable number of semi-circular or substantially semi-circular grooves arranged in several series of different sizes. For instance, the grooves a, a^1 and a^2 constitute one series, while grooves b, b^1 and b^2 constitute another series; or any different arrangement of sets or series of grooves may be provided. Each set, however, will comprise two, three or more passes which will be successively of slightly decreasing size, and preferably also successively more and more approaching a true circle, so that by passing a tube through the set of passes it is not only reduced, but made more and more circular.

Cooperating with the passes of the rolls are suitable mandrel plugs 7, which are held by mandrel bars 8 in the usual way. Heretofore in mills of this character the tube has been successively passed through the same groove and over the same mandrel bar, the rolls being adjusted closer together between passes. The result has been that a solid mandrel bar becomes very hot and loses the necessary rigidity to stand the thrust of the reducing operation. This has required special and expensive water-cooled mandrel bars.

With my arrangement the blank is not completely rolled in a single pass over the same mandrel bar, but is rolled in successive grooves, each of which has its own mandrel bar. Generally the tube is passed each time over a separate mandrel bar, but in cases where a large number of passes are necessary to accomplish the total reduction, the tube may be given more than one pass through each groove of the series; but even here a plurality of passes and a plurality of mandrel bars are utilized in the complete plug rolling of a single blank, so that each mandrel bar is necessarily subjected to a considerable period of inactivity, during which it can cool.

In order to return the tube to the front of the rolls to be passed through a new groove, the rolls are made to be quickly separated, and suitable return mechanism for the tube is provided. This may be of the character shown in patent to Stiefel and Nicholson No. 770,195 of September 13, 1904, or Belgian patent to Otto Heer, No. 167,463, Feb. 16, 1903, but as it forms no part of the present invention it is not illustrated. Suffice it to say that after the tube has passed through a groove, the rolls are separated and the tube returned to the front of the rolls in the same axial line, and is then either passed again through the same groove, or transferred sidewise to the next pass of the series and again fed through the rolls over a new mandrel bar, and, if a further pass is necessary or desired, the rolls are again separated and the tube returned to the front thereof in the same axial line, again passed

through the same pass or transferred sidewise in line with the next pass of the series and is fed therethrough, and so on. The roll separating means and tube returning means may be of the kind above described and will be readily understood without specific illustration.

The mechanism for transferring the tubes sidewise into line with the next pass of the series will now be described: In front of the rolls is a suitable frame or bench 10, sufficiently long to support the entire length of the tube and provided with a plurality of tube supports, sufficient in number to provide one in line with each of the passes of a complete series in which the tube must be rolled. In the particular embodiment illustrated, the tube is intended to be passed not to exceed three grooves, and consequently three tube supports on the bench 10 are illustrated. As shown this bench comprises longitudinal frame members 11 with suitable cross connecting members 12 having mounted thereon the series of tube supports, illustrated as sloping plates which form in effect troughs for supporting the tubes, the three tube supporting troughs being designated as 13, 13^a and 13^b respectively. These troughs are spaced apart (in the embodiment illustrated) the distance between the centers of alternate grooves in the rolls 5, but this obviously is merely in order to enable a single set of rolls to carry a large series of passes. The trough members 13 extend from end to end of the bench 10, except for a number of transverse gaps or openings 14, in which operate the tube transferring means. Mounted longitudinally in the bench are a number of rocking shafts, two such rocking shafts being shown and marked 15 and 15^a respectively, the former cooperating with the trough 13 and the latter with the trough 13^a. Each of these rocking shafts is provided with a suitable number of curved arms, marked 16 and 16^a respectively, which normally lie below the bottoms of the troughs and in the transverse openings or gaps 14, so that when the shafts 15 and 15^a are rocked these arms swing upwardly and describe an arc of a circle and carry a tube out of trough 13 or 13^a and deposit the same in the next succeeding trough. The shafts 15 and 15^a are independently operated, from a pair of power cylinders 17 and 17^a, said cylinders having their piston rods 18 and 18^a connected respectively to crank arms 19 and 19^a on the shafts 15 and 15^a respectively. A similar mechanism is provided for transferring the tube out of the last trough to a suitable place of delivery, this being shown as a longitudinal rocking shaft 15^b provided with a series of arms 16^b terminating in curved end portions 16^c, said shaft being rocked from a power cylinder 17^b whose piston rod 18^b is connected to a crank arm 19^b on the shaft 15^b; said last named transfer mechanism delivering the tubes to inclined skids 20. Inclined skids 21 are provided on the other side of the bench upon which the tubes to be rolled are received and delivered to the first trough 13.

Cooperating with this bench is a suitable pusher arranged to push a tube out of any one of the troughs into the rolls. This pusher comprises a transverse member 22 extending cross-wise of the bench above the tube supporting troughs and being guided on the longitudinal frame members 11, by the inter-engaging guide faces 23, as shown in Fig. 4. The interengagement between this pusher head and the frame member 11 is of considerable length longitudinally of the bench in order to prevent the pusher from becoming askew. This pusher head is actuated by the centrally connected rod 24 which forms the piston rod of a power cylinder 25. The pusher head is provided with a series of downwardly extending pusher members 26, 26^a and 26^b, which cooperate with the tube supporting troughs 13, 13^a and 13^b respectively.

The bench 10 as a whole is mounted for sidewise movement, the same being mounted upon transverse guide means 27, and bodily movable sidewise thereon. This bodily sidewise movement is provided in order that the bench can be brought into line with any set of grooves in the rolls 5. As shown in Fig. 1 the bench is in position to cooperate with grooves a, a^1 and a^2 of the rolls, but obviously it can be shifted in both directions from this central position to cooperate with any other three sets of grooves. This bodily sidewise shifting of the bench will obviously be made only occasionally that is, when changing from one size of tube to another and hence the bench can be shifted with the use of hand bars, but if desired, power mechanism may be applied for this purpose, such as screws, power cylinders or the like. In the rolling of any given tube, however, there is no sidewise shifting of the bench, but instead the tube itself is transferred sidewise, this transfer being effected much more quickly than if the bench as a whole had to be transferred sidewise, so that the tube can be quickly reduced with a minimum loss of heat.

In the use of the apparatus described the bench 10 will be moved to bring its tube supporting troughs into line with the particular series of passes in the rolls which are adapted to roll the desired tube; and the mandrel plugs and mandrel bars on the delivery side of the rolls will be adjusted in each of these passes. The tubular blank, such as a pierced blank, is delivered from the guides 21 into the trough 13, is pushed by the pusher 22 into the rolls and over the plug lying in the first pass of that series and

passed over the mandrel bar in the usual way. The rolls 5 are then separated and the partially reduced blank stripped off the mandrel bar and returned to the front of the rolls, in the line of its feed, that is, back into the trough 13. If necessary it can be again passed through this first groove and again returned to the trough 13, but if not, the power cylinder 17 is actuated, rocking shaft 15 and causing arms 16 to lift the tube out of trough 13 and into trough 13^a. The pusher is then again advanced and the tube pushed through the next pass of the rolls and over the next mandrel bar. Rolls 5 are then again separated and the tube is returned to the front of the rolls again in the line of its feed, that is, back into the trough 13^a. If the tube need not be again passed through the second groove, power cylinder 17^a is actuated, thus rocking shaft 15^a and causing arms 16^a to lift the tube out of trough 13^a and into trough 13^b. Pusher 22 is again advanced and pushes the tube through the third groove of the series and over a new mandrel bar. The rolls 5 are then again separated and the tube returned to the front of the rolls, into the trough 13^b. When sufficiently reduced, power cylinder 17^b is actuated thus rocking shaft 15^b and causing arms 16^b to lift the tube out of trough 13^b and deposit the same upon the skids 20. This completes the operation upon the particular tube described.

The transfer of the tubes from one pass into line with the next pass is accomplished very rapidly and the entire operation of giving the tube several passes through the rolls is effected expeditiously, so that there is a minimum loss of heat in the blank, and the same is maintained at a good rolling temperature throughout. The tube passes over a number of mandrel bars and consequently the mandrel bars do not become overheated, thus allowing of the use of simple solid mandrel bars.

The several tube transferring means described are entirely independent, so that the transfer of one tube sidewise is in no way interfered with by another tube. Consequently it is possible to have more than one tube in action at any time. For instance, after the tube has made its first pass (or passes) and been returned to the front of the rolls and transferred into line with the second pass, another tube can be delivered to the first trough 13 and the two tubes pushed through the rolls simultaneously, and likewise when these two tubes have been both transferred sidewise in trough 13^b and 13^a respectively, a new blank may be delivered to the first trough, and all three blanks pushed through the rolls simultaneously. The independent transfer of the blanks from pass to pass is therefore a great advantage.

Inasmuch as the tubular blanks are not wholly reduced in a single groove, but in successive grooves, these grooves can of course be formed successively more and more circular, so that the tube when it leaves the final pass will be substantially round. This is a very considerable advantage over prior mills, where the reduction has been made by successive passes through the same groove, and which groove, for practical reasons, had to be made somewhat elliptical in order to permit the entry thereinto of the rough blank, and became more and more elliptical as the rolls were adjusted closer and closer together between successive passes. As a consequence with the old type of mill, the tube after plug rolling was decidedly elliptical, with decided bulged and thickened walls at diametrically opposite points, which has required reeling or cross rolling in order to true up the wall thickness. In the improved mill however the tube becomes more and more circular and leaves the plug rolling mill sufficiently circular and with the wall thickness sufficiently uniform so that it can be either directly taken to the cold draw bench, or in the case of hot finished tubes, passed through an expanding mill to further reduce its walls and at the same time correct any variations in the gage of the tube walls and also smoothen the same interiorly and exteriorly.

While the mill has been described particularly for the rolling of seamless tubing, it is obvious that it also has advantages for rolling rounds, by merely eliminating the mandrel plugs and mandrel bars.

I claim:

1. In a rolling mill, the combinaton of grooved rolls provided with a large number of working grooves arranged in several series each comprising a plurality of grooves, a table in front of said rolls and provided with a plurality of blank supports corresponding in number to the number of grooves in the rolls which comprise a single series, said table being arranged to be bodily shifted sidewise to bring its blank supports into line with any one of the series of working grooves in the rolls, and means mounted on said table for transferring blanks from one blank support to an adjacent one.

2. In a rolling mill, the combination of grooved rolls provided with a large number of working grooves arranged in several series each comprising a plurality of grooves, a table in front of said rolls provided with a plurality of blank supports corresponding in number to the number of grooves in the rolls which comprise a single series, said table being arranged to be bodily shifted sidewise to bring its blank supports into line with any one of the series of working grooves in the rolls, and a plurality of independently actuated means corresponding

in number to the number of blank supports on said table for transferring blanks sidewise from one blank support to an adjacent one.

3. In a tube rolling mill, the combination of a single set of grooved rolls having a plurality of passes, mandrel bars on the delivery side of the rolls in line with the passes therein, a plurality of tube supports at the front of the rolls in line with the passes therein, means for transferring the blanks from the delivery side of the rolls to the front side thereof in line with the feed therethrough, and means for transferring a tube sidewise from one of said tube supports to an adjacent one.

4. In a tube rolling mill, the combination of a set of grooved rolls having a plurality of passes, mandrel bars on the delivery side of the rolls in line with the passes therein, a table in front of said rolls provided with a plurality of tube supports in line with the passes in the rolls, said table being arranged to be bodily shifted sidewise, means on said table for transferring a tube sidewise from one of said tube supports to an adjacent one, and means for transferring the blanks from the delivery side of the rolls to the tube supports on the front side thereof in line with the feed of the blanks through the rolls.

In testimony whereof, I have hereunto set my hand.

RALPH C. STIEFEL.

Witness:
HOWARD L. SNIVELY.