June 16, 1931. S. E. DIESCHER 1,810,698

APPARATUS FOR MANUFACTURING SEAMLESS TUBING

Filed June 11, 1925 4 Sheets-Sheet 1

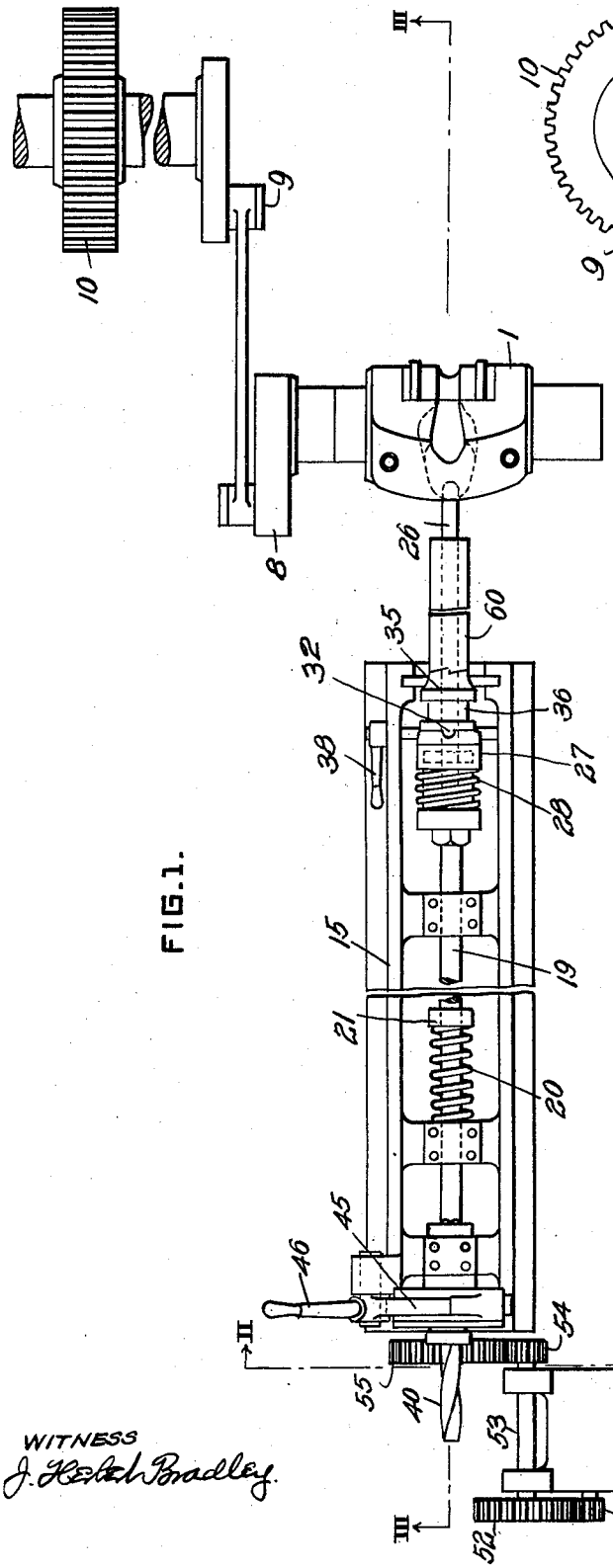


FIG. 1.

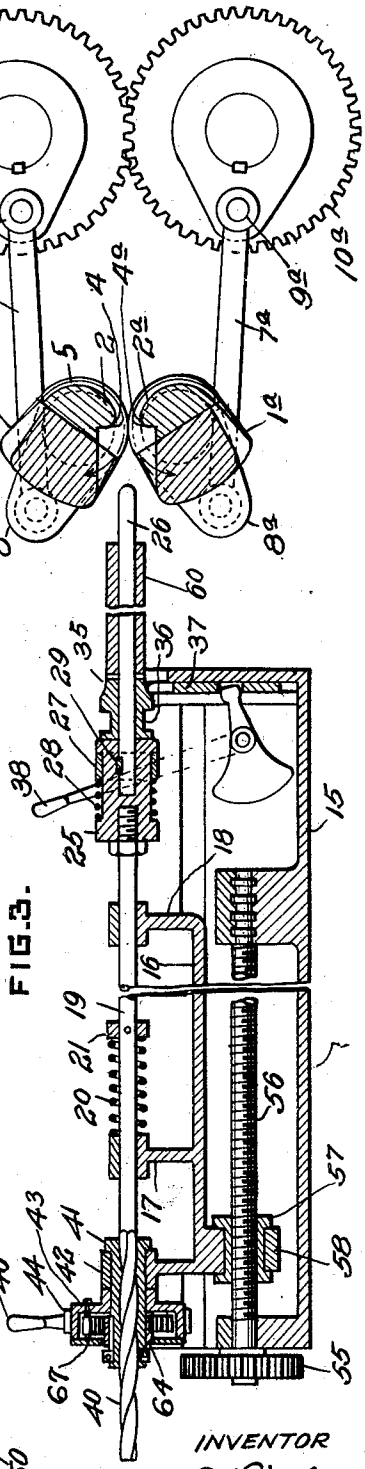


FIG. 3.

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APPARATUS FOR MANUFACTURING SEAMLESS TUBING

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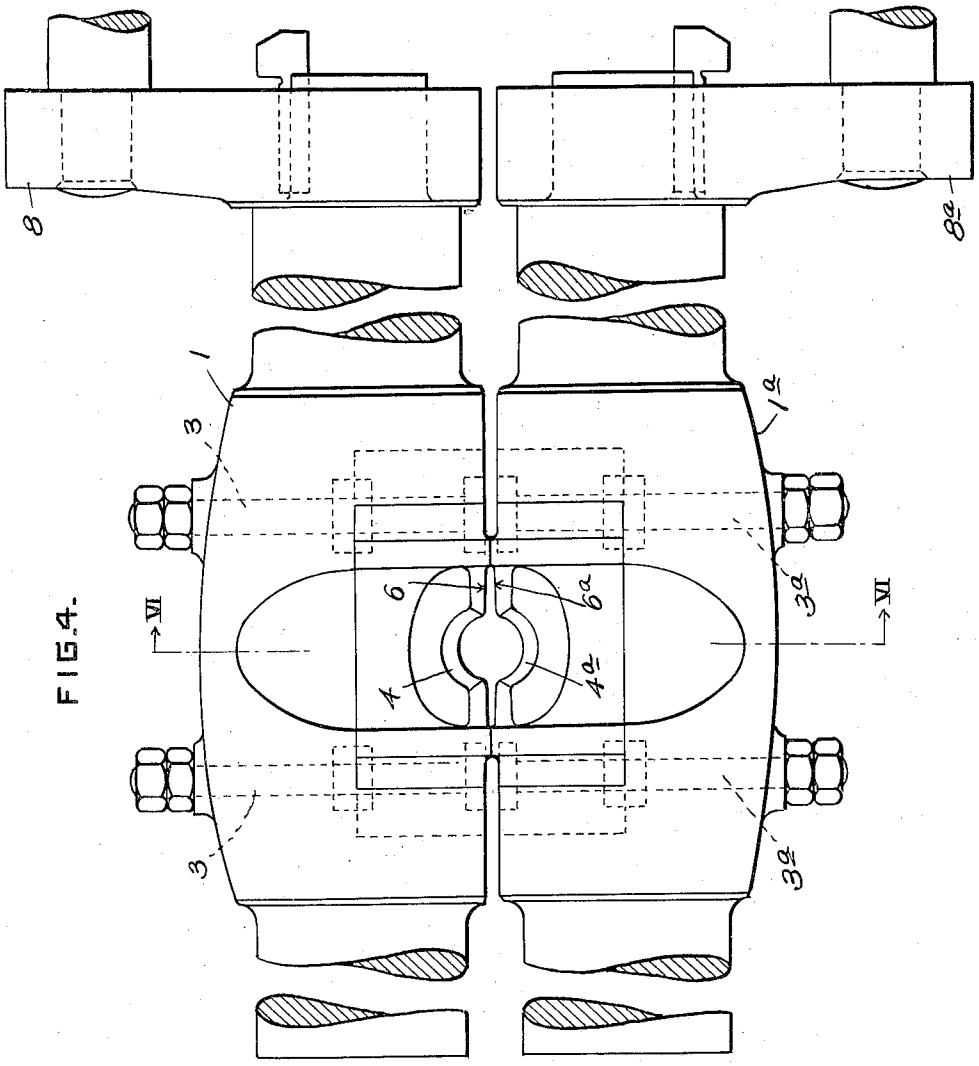


FIG. 4.

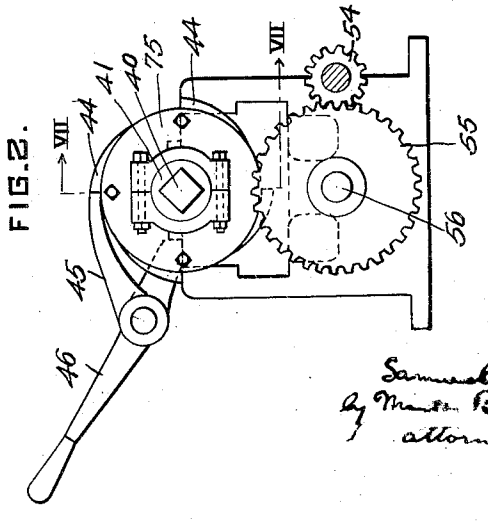


FIG. 2.

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June 16, 1931. S. E. DIESCHER 1,810,698

APPARATUS FOR MANUFACTURING SEAMLESS TUBING

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FIG. 5.

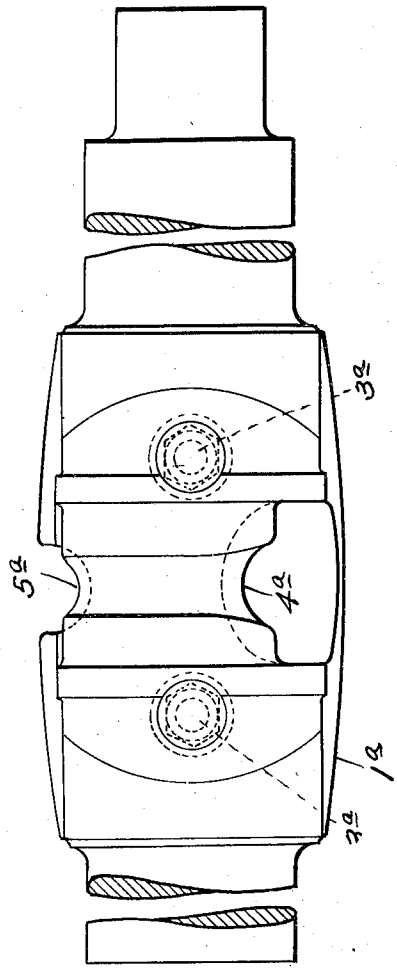


FIG. 10.

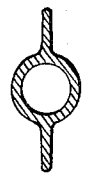


FIG. 9.

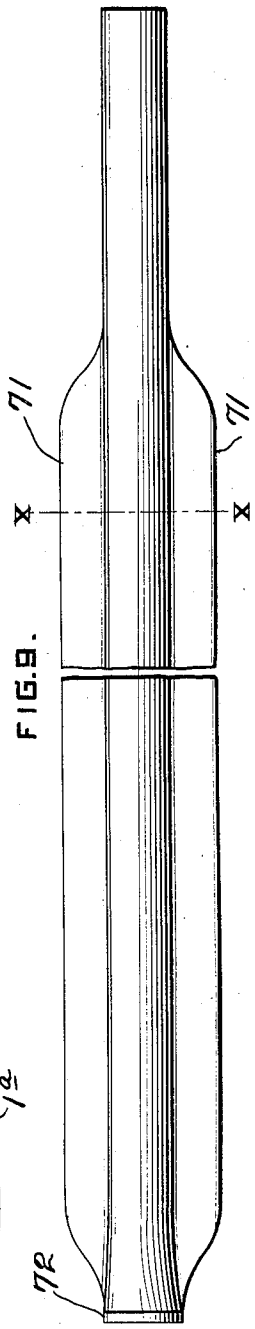
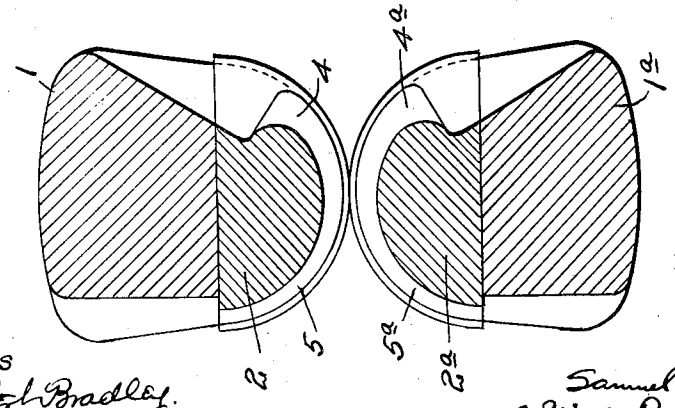


FIG. 6.



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APPARATUS FOR MANUFACTURING SEAMLESS TUBING

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FIG. 7.

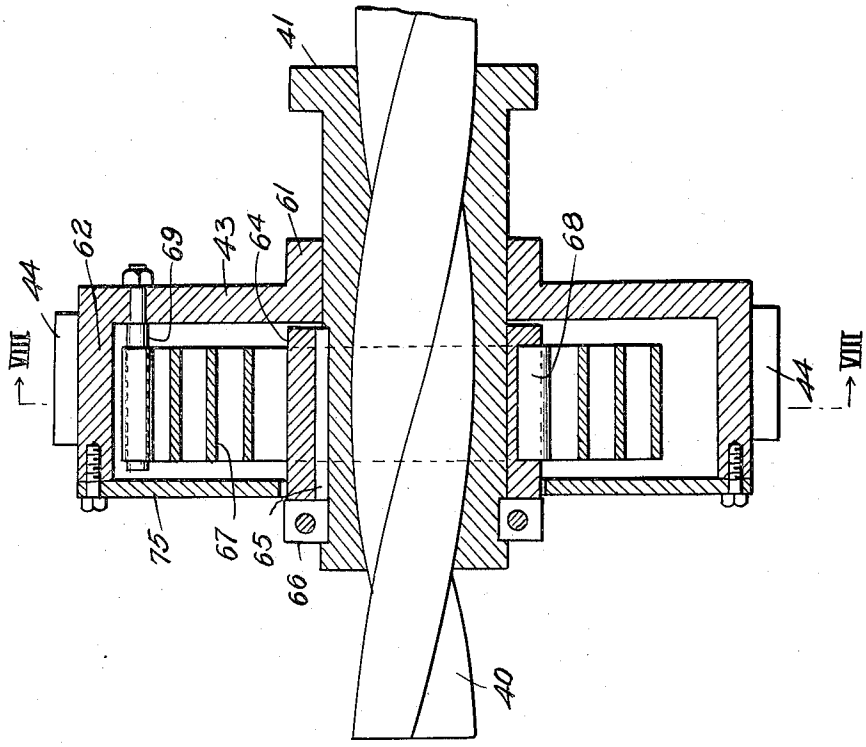
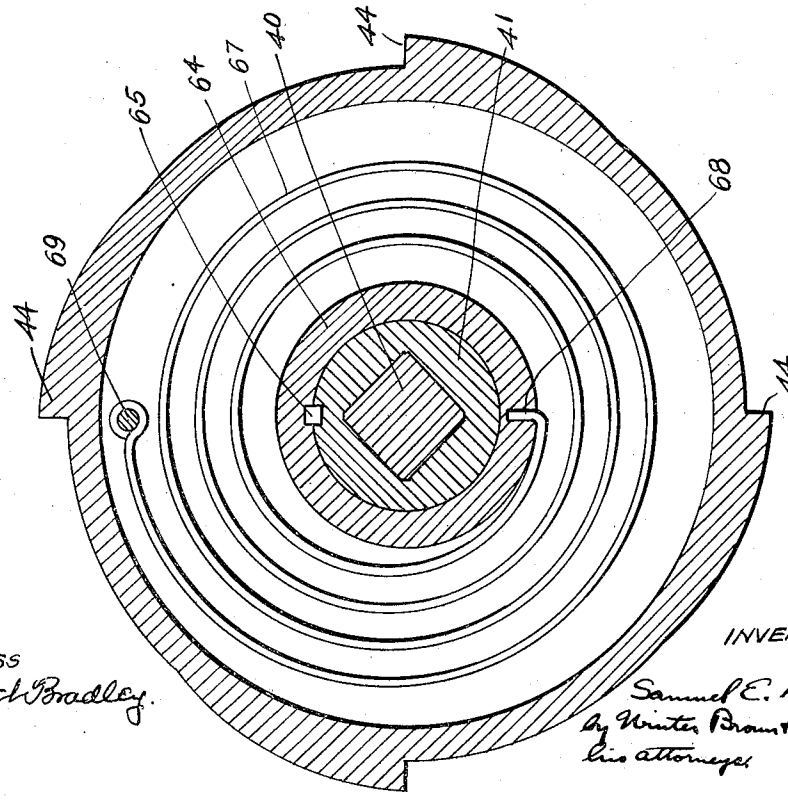


FIG. 8.



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Patented June 16, 1931 1,810,698

UNITED STATES PATENT OFFICE

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APPARATUS FOR MANUFACTURING SEAMLESS TUBING

Application filed June 11, 1925. Serial No. 36,392.

The invention relates to the manufacture of tubing provided exteriorly with longitudinally extending vanes, the vanes being used, among other things, for the conduction of heat to the walls of the tubing when the tubing is used for heating liquid, as for example in steam boilers, preheaters and the like, and for the conduction of heat from the walls of the tubing when used for cooling liquids, and the invention has particularly to do with rolled seamless tubing, by which is meant tubing manufactured by roll-working heated metal billets to the desired diameter and wall thickness.

As rolled seamless tubing has been heretofore manufactured, the tubes and vanes have been formed separately, and the vanes then welded upon the tubes. As is well known the local heating of the walls of the tubes consequent upon this procedure changes the characteristics of the steel and weakens the walls at the weld sections or lines, with the result that the ordinary strength of the tubing cannot be relied upon, and is not assumed. Because these tubes are usually of long lengths and are usually bent, it is impractical to heat treat them by annealing to remove the changed characteristics of the locally heated metal. Furthermore, this local heating which changes the characteristics of the metal has the additional prejudicial consequence of rendering the walls of the tube at and adjacent to the weld sections subject to rapid corrosion when they are used for carrying heated water, as in steam generators where they are customarily used.

Because the welding operation is a separate step, and because for a required strength the walls of the tubing must be thicker than if the tubing is used without vanes, tubing manufactured in the manner stated is necessarily quite expensive. Furthermore, because of the change in the characteristics of the metal forming the interior of tubing having welded vanes, and the resultant rapidity of deterioration through corrosion, the tubing is short lived.

The object of this invention is to provide an apparatus for manufacturing rolled seamless tubing having external longitudinally-extending vanes, whereby the vanes may be formed integrally with the tubing and while the tubing is being formed, thereby producing in a single operation a vaned tube the wall of which at and adjacent to the juncture of the vanes with the tube is as strong as the remainder of the tube wall, and a tube the wall of which is uniform and resistant to corrosion.

It has heretofore been proposed to manufacture rolled seamless tubing with lateral vanes formed integrally with it during the course of manufacture by placing pierced or otherwise formed tubular billets upon mandrel bars and passing the bars and billets through a succession of pairs of grooved rolls having vane-forming recesses adjacent to their tube-forming grooves. It is possible to so manufacture seamless tubing without vanes only where thin walled pierced billets are fed to the rolls. But vaned tubes must be formed from heavy or thick walled pierced billets because it is necessary to effect a wide spread of metal to fill out the vanes, and this can only be accomplished with considerable longitudinal displacement. Further, in attempting to roll vaned tubing by a series of grooved pairs of rolls the reduction in wall and vane thickness is so great that by repeated rolling, even with rolls arranged one pair immediately after the other, heat is lost so rapidly that the vanes cannot be properly formed.

This invention is predicated upon my discovery that its stated object may be attained by forming the tubing from a pierced billet in a swedging mill, the swedges or swedging rolls of which are provided with vane-forming grooves adjacent to the tube-forming grooves, and the mill being constructed and operated in such a manner that billets are not rotated on their longitudinal axes between swedging operations while vanes are being formed.

A swedging mill of the type here contemplated comprises a pair of rolls each provided with a working pass having a bell or reducing section and a finishing section adjoining it. Provision is made for either rotating or oscillating the rolls to cause their working

passes to intermittently form successive increments of a heated pierced billet into a tube. The pierced billet or work piece is borne by a mandrel attached to feed mechanism which is constructed and operated to progressively place unswedged increments of the billet in the bite of the swedging bell of the rolls, and as heretofore constructed the feed mechanism in addition to intermittently moving the work piece forwardly also turns it angularly through an angle of 90° between each and every swedging operation.

According to this invention provision is made for feeding a work piece forwardly without turning it angularly while vanes are being formed on a tube, and at the edges of the working pass of the rolls there are grooves so shaped as to form vanes of desired proportions on the outer wall of a tube while the tube is being swedged from a billet. Also, in the practice of this invention the swedging rolls are preferably oscillated, rather than being rotated. By this procedure vanes are completely formed integrally with a tube in comparatively short sections from a heated billet, the wall of which is so thick that it retains its heat until the complete tube is formed.

In the further explanation of the invention reference will be made to the accompanying drawings, of which Fig. 1 is a plan view of a swedging mill embodying the invention; Fig. 2 a left end elevation taken on the line II—II, Fig. 1; Fig. 3 a vertical longitudinal sectional view taken on the line III—III, Fig. 1; Fig. 4 an elevation of the entering side of the swedging rolls, when in the position shown in Fig. 6; Fig. 5 a plan view of the lower swedging roll; Fig. 6 a vertical sectional view of the swedging rolls taken on the line VI—VI, Fig. 4; Fig. 7 a vertical sectional view to enlarged scale of a spindle turning mechanism, the plane of view being indicated by the line VII—VII, Fig. 2; Fig. 8 a sectional view on the line VIII—VIII, Fig. 7; Fig. 9 an elevation of a tube immediately after being formed according to this invention; and Fig. 10 a transverse sectional view of the tube taken on the line X—X, Fig. 9.

Having reference first to the construction of the swedging rolls shown particularly in Figs. 4, 5 and 6, rolls 1 and 1*a* are mounted for oscillatory movements in a suitable housing. Preferably, although not necessarily, the swedging passes of the rolls are formed on blocks 2 and 2*a* which may be detachably connected to the main bodies of the rolls by bolts 3 and 3*a*, respectively. The working or swedging pass in block 2 comprises a flaring bell section 4 and a finishing pass section 5 immediately adjoining it, the finishing pass section being cylindrical and uniform throughout, as is customary. Block 2*a* is similarly provided with a working pass 4*a* and 5*a*, and adjoining the tube-forming portions of the working pass the blocks are provided with vane-forming groves 6 and 6*a*, which are preferably of the general shape indicated, but which may vary to form vanes of different sizes and shapes on the outer surfaces of tubes while the latter are being formed from a heated pierced billet.

As seen particularly in Fig. 3, the swedging rolls may be oscillated by connecting rods or pitmen 7 and 7*a* which are pivotally connected at their ends to cranks 8 and 8*a* attached to the outer ends of the rolls, and connected also to pins 9 and 9*a* which project from the faces of cranks mounted on shafts projecting from inter-meshing pinions 10 and 10*a*, which pinions are adapted to be simultaneously driven by a suitable motor or other source of power. The rotation of pinions 10 and 10*a* cause rolls 1 and 1*a* to oscillate to periodically effect swedging operations in the manner well understood by those skilled in the art. It is noted that Fig. 3 shows the swedging rolls in the positions in which their bells 4 and 4*a* are most remote from a billet being fed to them. In this position of the rolls the bells have been moved from engagement with the billet and such portion of a tube as may have been previously swedged from it, and accordingly in this extreme position of the rolls, and until the entering ends of the bells return to a vertical plane through the axes of the rolls, the billet may be turned, providing no vanes have been formed on the swedged tube. The significance of this will presently appear.

Various forms of mechanism may be used in conjunction with the swedging rolls to feed unswedged increments of a heated pierced billet to the rolls. However, it is essential in such feeding mechanism as may be used that provision be made for maintaining a billet against rotation on its longitudinal axis while vanes are being formed on the tube. Because vane tubes usually have plain end sections, that is to say sections at their ends which are unprovided with vanes, so that the tubes may be readily attached to the headers of boilers, the feeding mechanism preferably includes provision for properly rotating a mandrel 90° between each swedging operation at the beginning of the formation of a tube.

Having reference now to Figs. 1, 2 and 3, the feeding mechanism is borne by a fixed housing 15, and includes a carriage 16 mounted for longitudinal movement in the frame. The carriage is provided with arms 17 and 18 in which there is mounted for rotation and for longitudinal movements a spindle 19 which may be yieldingly urged towards the swedging rolls by a spring 20 arranged between carriage arm 17 and a collar 21 attached to the spindle. At the outer end of spindle 19 there is a chuck 25, which may be screw-threaded upon the spindle, and

which is adapted to receive and hold the inner end of a mandrel bar 26. For this purpose chuck 25 may be provided with a longitudinally movable sleeve 27 normally pressed to its indicated position by a spring 28, the sleeeve, when in its indicated position, being adapted to hold a key 29 against withdrawal, which key locks the mandrel bar 26 in the chuck.

At the outer end of chuck 25, and mounted for longitudinal movement upon a mandrel bar, there is a stripping sleeve 35 provided with a groove 36 adapted to receive a stripping block 37 mounted for vertical movement at the end of housing 15, and adapted to be moved to and from engagement with the stripping sleeve by a hand lever 38. The stripping block is moved upwardly to engage groove 36 at the end of a tube-forming operation so that the rearward movement of spindle 19 may, through the stripping block 37 and stripping sleeve 35, strip a finished tube from a mandrel. The outer end of the stripper sleeve may be serrated as shown to grip the end of a pierced billet and prevent it from turning upon the mandrel bar, and its inner end may be provided with a projection 32 adapted to engage a corresponding recess or groove in chuck 25 to prevent the stripper block from rotating upon the mandrel bar.

It has previously been explained that the feeding mechanism includes provision for rotating the mandrel 90° between each swedging operation at the beginning of the formation of a tube and before the vanes are formed. When the tubes are formed by oscillating swedging rolls, they remain in the bite or grip of the swedges except when the swedges, in their cycles of oscillation, have been moved to positions indicated in Fig. 3. At such positions of the swedges spindle 19 may be turned 90° to cause the billet, and such unvaned tube as may have been swedged from it, to turn a similar amount.

A suitable mechanism for thus turning spindle 19 is shown at the left end of spindle 19 in Figs. 1 and 2, and is shown to enlarged scale in Figs. 7 and 8. Having reference to these figures, the rear end of spindle 19 is provided with a long-pitched helix 40 which is engaged by a sleeve 41 having a corresponding helical interior, which sleeve is mounted for rotation in an arm 42 of carriage 16. Rotatably mounted on sleeve 41 there is a disc 43 having a hub 61 and a peripheral flange 62, the outer face of the flange being provided with four ratchet teeth 44 spaced at intervals of 90°. Adjacent to disc 43 a ring 64 is keyed to sleeve 41 by a spline 65, which, together with the ring, is held in position on sleeve 41 by a split collar 66. Surrounding ring 64 there is a heavy clockspring 67, the inner end 68 of which is attached to the ring, and the outer end of which is attached to a pin 69 secured to disc 43. To enclose spring 67, a plate 75 may be attached to the outer edge of flange 62 of disc 43. Pivotally mounted on carriage 16 there is a pawl 45 provided with a hand operating lever 46 so that the pawl may be readily moved to and from engagement with the teeth 44 on flange 62. The operation of this mechanism for effecting a quick turn of spindle 19 when the swedges release a billet will be explained in connection with the operation of the machine as a whole.

Carriage 16 is preferably moved forwardly to feed a mandrel and its supported pierced billet to the swedging rolls by a reversible variable speed motor 50, which, through a pinion 51, gear 52, shaft 53, pinion 54, and gear 55 has a driving connection with a feed screw 56 rotatably mounted in the lower portion of frame 15. This feed screw is engaged by an interiorly threaded block 57 borne by an arm 58 projecting downwardly from carriage 16.

In the operation of the swedging mill to form a vaned tube, a heated pierced billet 60 is placed upon a mandrel 26, the end of which is attached to chuck 25 by moving sleeve 27 rearwardly and inserting a key 29 through the chuck to engage the end of the mandrel. The carriage is then fed forwardly until the outer end of a billet is in a position to be operated upon by the swedging blocks 2 and 2*a* of rolls 1 and 1*a*, which rolls are oscillated in the manner explained. Since at the begining of the tube-forming operation it is not desired to form vanes on the tube, it is necessary to turn spindle 19 through an angle of 90° between each operation of the swedging rolls. During this initial period of the formation of a tube, pawl 45 is thrown into engagement with teeth 44 of disk 43. When the swedges engage a blank being operated upon and swing from the position in which they are shown in Fig. 3 to their opposite extreme position, helix 40 turns sleeve 41, and in consequence thereof also turns ring 64, through an angle of 90°, or slightly more than 90°, the pitch of helix 40 being designed with reference to the working pass of the swedges to effect a turning of this amount. This turning of ring 64 acts backwardly through spring 67 to turn disc 43 90° so that pawl 45 lies back of the next ratchet 44. When the swedges swing to the right, as viewed in Fig. 3, helix 40 through sleeve 41 causes ring 64 to rotate 90° in a direction opposite to its former movement, and such rotation winds spring 67, whose outer end is held in fixed position by pawl 45 which engages one of the ratchet teeth 44. When the swedges reach their extreme right hand position shown in Fig. 3, they no longer engage the blank to hold it against turning, as has been previously explained. Spindle 19 being therefore free, spring 67 causes it to turn 90° to rotate the work piece a like amount. This

operation is repeated until it is desired to form vanes on the side of a tube, at which time pawl 45 is thrown out of engagement with ratchet teeth 44 with the result that there is no turning of spindle 19 between the swedging operations.

During the swedging operation motor 50 is operated at such speed as is necessary to cause carriage 16 to advance to place the pierced billet increment-by-increment in the bite of the swedging rolls, with the net result that a tube is progressively rolled having vanes formed integrally with it, the vanes being formed simultaneously with the sections of the tube as it is rolled. The tube proper is formed in the working pass or grooves 4, 5 of the swedging rolls, and the vanes in the grooves 6 adjoining the tube-forming grooves.

When a tube has been completely formed, the motor 50 is reversed to move carriage 16 rearwardly, and during this operation stripper block 37 is moved upwardly by lever 38 to engage stripper sleeve 35 so that the further rearward movement of carriage 16 strips the finished tube from the mandrel on which it was formed.

By so constructing and operating a swedging mill, rolled seamless tubes of the character shown in Figs. 9 and 10, having lateral vanes 71 formed integrally with them, may be manufactured in a single operation as quickly and as cheaply as tubes without vanes may be manufactured. When formed, the rear end of each tube has a small section 72 of the pierced billet attached to it. This may be turned down to form a plain unvaned end, or may be entirely removed. The method of manufacture eliminates a large part of the cost of producing vaned tubing. Furthermore, because the vanes are formed integrally with the tubing, it is much stronger and more durable than the vaned seamless tubing which has heretofore been produced by welding vanes upon tubes.

According to the provisions of the patent statutes, I have explained the principle and operation of my invention, and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as particularly described herein, and with apparatus other than that specifically illustrated.

I claim as my invention:

1. A swedging mill for the manufacture of seamless tubing having external longitudinal vanes formed integrally with it, comprising a pair of swedging rolls having a tube-forming pass and vane-forming grooves adjacent to said pass, means for oscillating the rolls, feed mechanism for moving a billet into the bite of the rolls, means effective at the beginning of a swedging operation for rapidly rotating a billet on its longitudinal axis when the swedging rolls swing to a position remote from the feeding mechanism, and means for rendering said rotating means inoperative while forming vanes on a tube.

2. A swedging mill for the manufacture of seamless tubing, comprising a pair of oscillatory swedging rolls, a spindle provided with a mandrel bar for supporting a billet and mounted for reciprocation in coordination with the oscillation of said rolls, said spindle being provided with a helix, a sleeve engaging said helix and rotatable by the longitudinal reciprocation of said spindle, a spring attached to said sleeve and adapted to be stressed by the reciprocation of said spindle, and means for rendering said spring when so stressed effective to rotate said spindle on its longitudinal axis when the swedging rolls release their grip upon a blank.

In testimony whereof, I sign my name.

SAMUEL E. DIESCHER.