R. C. STIEFEL.

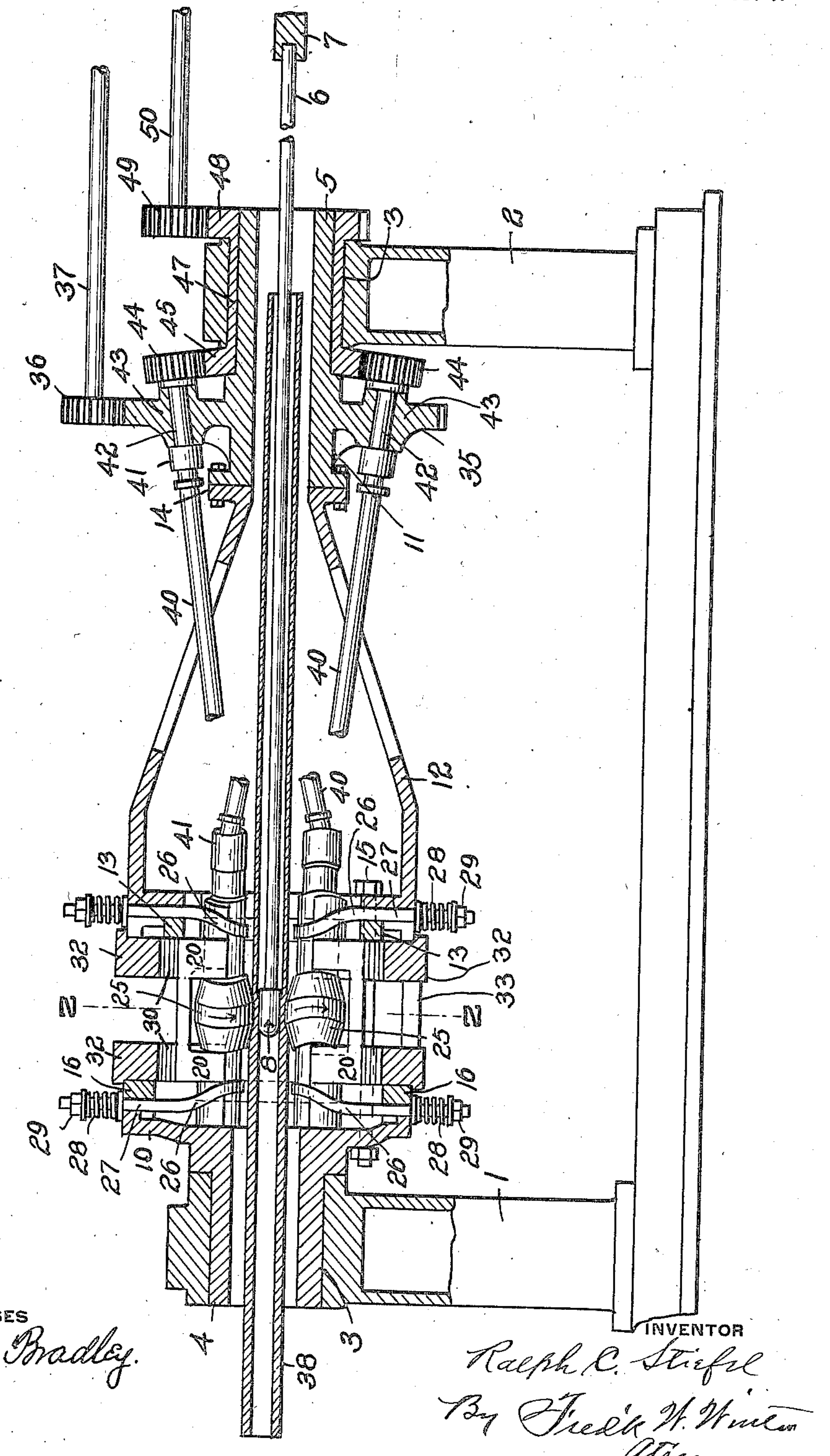
TUBE ROLLING MECHANISM.

APPLICATION FILED MAR. 26, 1919.

1,368,413. **Patented Feb. 15, 1921.**

2 SHEETS—SHEET 1.

FIG. 1.



WITNESSES

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2 SHEETS—SHEET 2.

FIG. 3.

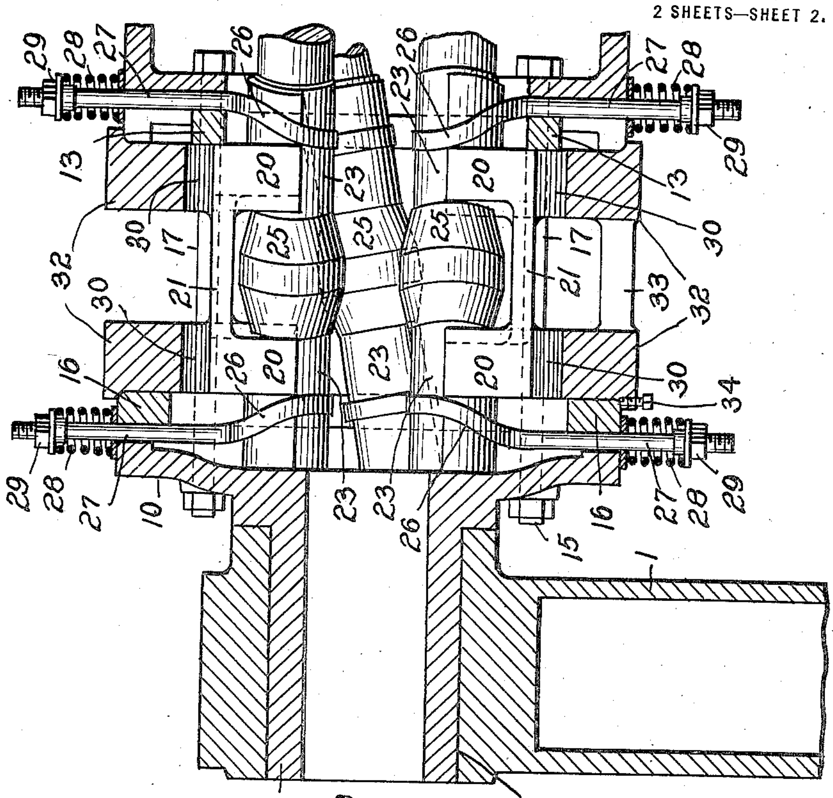
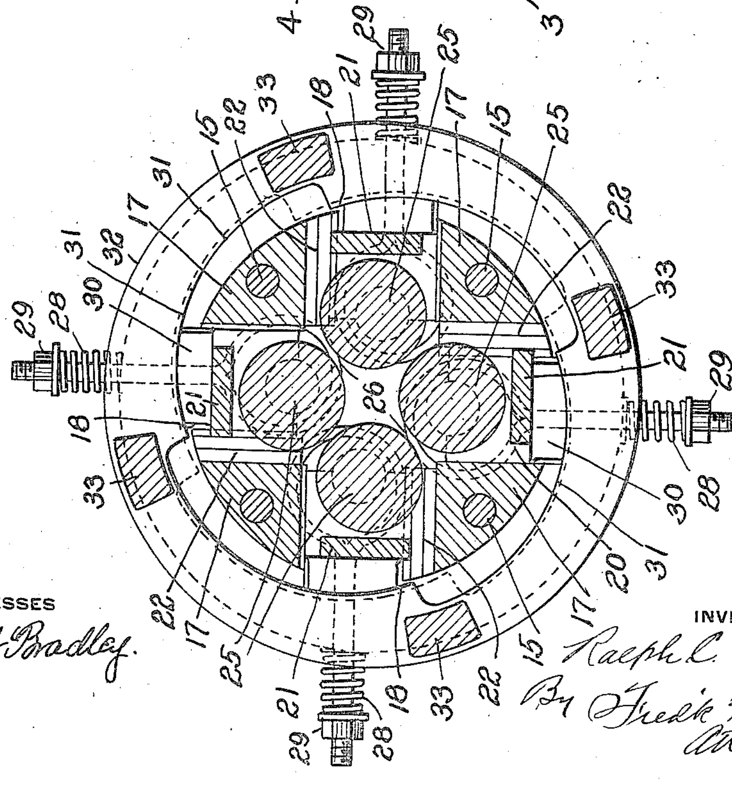


FIG. 2.



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UNITED STATES PATENT OFFICE.

RALPH C. STIEFEL, OF ELLWOOD CITY, PENNSYLVANIA.

TUBE-ROLLING MECHANISM.

1,368,413. Specification of Letters Patent. Patented Feb. 15, 1921.

Application filed March 26, 1919. Serial No. 285,284.

To all whom it may concern:

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

This invention relates to rolling mills, and more particularly to mills for rolling seamless tubing. The object is to provide a mill by means of which it is practical to roll tubes with very thin walls, and also large tubes or tubular bodies.

According to one method of making seamless tubes, a hollow blank is subjected to the action of diagoally acting rolls in combination with an internal mandrel, which have the effect of reducing a thick walled short hollow blank to a relatively thin walled long tube. Such rolls, because of their diagonal relation to the blank, serve to feed the blank through the rolls and at the same time rotate the blank. On account of this rotary action of such rolls, there is a limit to the thickness to which the walls of the tubular blank can be reduced, for the reason that the inertia of the portion of the blank outside of the walls, and the whipping action due to its rapid rotation, causes destruction or mutilation of the blank if it is attempted to reduce the wall to a very thin gage. Consequently it has not been heretofore possible to produce seamless tubes with thin walls, or to produce very large sized tubes or tubular bodies, with the use of such diagonally acting rolls.

The object of the present invention is to provide a rolling mill embodying diagonally acting rolls, and by means of which it is possible to successfully roll tubes with much thinner walls than has been heretofore practical, or roll tubes or tubular bodies of larger sizes than has heretofore been possible.

The mill comprises diagonal acting rolls mounted in a rotary frame whereby they are carried around the tubular blank in planetary fashion, said rolls being driven at such peripheral speed that the blank is given no, or substantially no rotary motion, but nevertheless is fed forward by the rolls in the usual way; as a consequence of which there is no whipping action of the blank, and no part of the blank is subjected to twisting strains due to rotary action on one part thereof and the inertia of other parts thereof.

The invention comprises the combination and arrangement of parts in a mill of the character specified as hereinafter described and claimed.

In the accompanying drawings Figure 1 is a longitudinal section through one form of mill embodying the invention, some of the parts being shown in a diagrammatic, rather than in a physical form; Fig. 2 is a transverse section on the line 2—2, Fig. 1; and Fig. 3 is an enlarged longitudinual section taken on a plane parallel to the axis of the roll pass with the blank omitted.

In the drawings 1 and 2 indicate suitable standards or frames, rising from any suitable bed or support, and provided with bearings 3 for receiving trunnions 4 and 5 of a rotatable or planetary frame or housing which carries the reducing rolls, as hereinafter described. These trunnions are hollow, thus forming an axial pass through the rotatable frame or housing, the hollow billet or blank being entered through the trunnion 4 and the reduced blank passes out through the hollow trunnion 5. Projecting through the hollow trunnion 5 is a mandrel bar 6, adapted to seat against a rotatable mandrel support or rest 7, and at its forward end carrying a mandrel or plug 8 of the usual form employed in rolling seamless tubes, and which lies between the reducing rolls hereinafter described.

The rotatable frame or housing carrying the reducing rolls is constructed in several parts, to-wit a circular forward or inlet section 10, preferably formed integral with the inlet trunnion 4, a circular rear or outlet section 11 which forms the hollow outlet trunnion 5, an intermediate hollow section 12 secured to the outlet section 11 and preferably flaring or being enlarged forwardly from said outlet section, and a skeleton or roll cage section 13 intermediate the sections 10 and 12. These several parts can be secured together in any suitable way. As shown the outlet section 11 and the intermediate section 12 are shown secured together by compression bolts uniting flanges 14 on the meeting ends of said sections, while the skeleton section or roll cage 13 is secured to the sections 10 and 12 by through bolts 15. This manner of constructing the frame however is merely illustrative of one manner of construction.

The skeleton or cage section 13 has substantially annular end portions 16 which fit against the inlet section 10 and intermediate section 12 respectively, said annular portions being connected by a plurality of longitudinal members 17, four such longitudinal members 17 being shown, thus providing a corresponding number of radial openings 18 open from the outside to the axis of the frame. Mounted in each of these openings is a roll chair comprising end portions 20 and a longitudinal connecting portion 21, the end portions 20 being slidable radially in the openings 18 and arranged to be guided therein by suitable guides 22 formed on the side faces of said end portions 20 and the side faces of the longitudinal connecting portions 17 of the skeleton frame section or roll cage. The inner faces of the portions 20 are suitably shaped, such as being concaved, to receive the bearings 23 surrounding the journals formed on ends of rolls 25, and in which bearings said roll journals or necks rotate. The rolls are adapted to be normally held outwardly by means of stirrups 26 surrounding the bearings 23 and provided with stems 27 extending outwardly through openings in the frame, and outside of the frame being surrounded by compression springs 28 interposed between the outer face of the frame and nuts 29 adjustable on said stems. To adjust the position of the rolls relative to the axis of the pass, each roll chair 20 is provided at its ends with outwardly projecting portions 30 whose outer faces are formed slightly eccentric to the axis of the frame, and arranged to be contacted by eccentric inner faces 31 on annular roll adjusting members 32, which surround the skeleton roll frame or cage 13 and which are united by the longitudinal members 33, and are arranged to be adjusted to various positions around the axes of the machine, to thereby move the roll chairs, and the rolls carried thereby, inwardly against the action of the compression springs 28. This roll adjusting member is adapted to be locked in any adjusted position, by any suitable means, such as by the clamping screws 34.

The frame described, together with the rolls carried thereby, is arranged to be rotated by any suitable mechanism. As shown the outlet frame section 11 is provided with a toothed portion 35 which is engaged by a pinion 36 on a suitably driven shaft 37, which latter may be the armature shaft of an electric motor, or a shaft driven from any source of power. It is obvious that through pinion 36 and gear 35 the hollow frame described will be rotated in the bearings 3, and when rotated will carry with it the rolls 25, which will be carried in an orbital path around the axis of said rotary frame and consequently cause the rolls 25 to travel around the hollow blank 38, and compress the same between their surfaces and the internal mandrel 8, thereby causing the usual reduction and expansion of said blank, and by reason of the position of the axes of said rolls diagonally to the roll pass said blank will be fed forward through the mill.

In order to cause the rolls to feed the blank forwardly it is necessary to impart rotation to the rolls themselves. To this end the axis of each roll is connected through a shaft 40 and universal couplings 41, to a short shaft 42 rotating in bearings 43 carried by the outlet frame section 11, and which shafts 42 are provided with gears 44 meshing with a relatively stationary gear 45 which is co-axial with the axis of the rotary frame. It is evident that as the gears 44 are carried around the relatively stationary gear 45, they will be rotated, thus imparting a rotary movement to the rolls 25 to which said gears 44 are connected.

The machine illustrated has four rolls 25, but it is evident that the construction lends itself to various numbers of said rolls. The number of rolls will never be less than two, so as to balance the pressures on the opposite sides of the blank being worked, but obviously can be of any number greater than two. Inasmuch as each roll is set with its axis oblique to the roll pass its driving shaft 40 and driving gear 44 will not lie in the same longitudinal plane as the roll itself. In other words the mill from the rolls 25 to the gears 44 is built on a twist so that the driving gear 44 for any one roll is displaced approximately 90° circumferentially of the mill axis from the roll itself. This displacement is indicated by showing the shafts 40 broken in Fig. 1 of the drawing, which means that the long parts of the shafts 40 illustrated are not connected to the two rolls which are illustrated, but are connected to the two rolls not shown in the drawing, one lying in front of and the other behind the section of vision.

The gears 44 and 45 will be so proportioned as to impart to the rolls 25 a peripheral movement equal to the speed of rolling of said rolls around the tubular blank, thereby preventing any substantial rotary movement being imparted to the blank, but at the same time insuring the positive forward feeding of the blank. These gears 44 and 45 can be so proportioned, for any given size of tube being rolled, that no rotary movement is imparted to the tube, but as the rolls 25 are radially adjustable to roll tubes of different sizes, it is evident than any predetermined ratio of gears 44 and 45, while answering for one size of tube to be rolled, will not answer for all sizes to be rolled. To compensate for this the gear 45 is independently rotatable, but at a relatively slow speed. This may be done in various ways, such as by forming gear 45 on a sleeve 47 on which is another gear 48 engaged by a pinion 49 on a driven shaft 50, which latter preferably is the armature shaft of, or a shaft driven from a variable speed reversing electric motor, which is controlled by a rheostat or controller by means of which the speed of the pinion 49 can be readily controlled in order to rotate gear 45 in one direction or in the other, just enough to compensate for any difference between the ratios of gears 44 and 45 and the sizes of the tubes being rolled, to prevent rotation of the tubular blank. The workman, by observing whether the tubular blank rotates or not, can quickly adjust the speed of the variable motor until there is no rotation of the blank.

The planetary mill described, while positively feeding the blank forwardly, can nevertheless be so operated as to prevent rotation of the tubular blank, and consequently said blank is not subjected to whipping action, and, furthermore, there can be no twisting stress due to the rotating tendency of the rolls acting upon one portion of the blank or tube and the inertia of the portions of the blank or tube not within the bite of the rolls. The result is that it is possible by means of such mill to roll tubes to a much thinner gage than has heretofore been possible, and also to roll tubes or tubular bodies of larger diameters than has heretofore been possible. The construction of the mill is such that various numbers of pairs of rolls can be mounted in the planetary frame, as a result of which a large and rapid reduction of the blank can be secured. A mill designed for rolling large tubes or tubular bodies can readily have more than two pairs of rolls mounted therein. Consequently a very rapid reduction is secured and the rolling of the entire blank, to a very thin gage, can be effected without material difference in its heat between the first and last ends thereof.

It will also be obvious that the mill described, without an internal mandrel, can be used for rolling solid rounds.

I claim:

1. In a rolling mill, the combination of a rotary frame provided with an axial pass, diagonally acting rolls mounted in said frame at the sides of said axial pass, means for rotating said frame in orbital paths around the axial pass, and means for rotating said rolls with a peripheral speed substantially equal to their peripheral travel on the surface of the blank.

2. In a rolling mill, the combination of a rotary frame provided with an axial pass, diagonally acting rolls mounted in said frame at the sides of said axial pass, means for rotating said frame in orbital paths around the axial pass, and variable speed driving means for rotating said rolls about their individual axes.

3. In a rolling mill, the combination of a frame provided with hollow trunnions or journals, bearings in which said trunnions are rotatably mounted, diagonally acting rolls mounted in said frame at the sides of the axis thereof, means for rotating said frame on its trunnions thereby carrying the said rolls in orbital paths around the axis of rotation, a gear concentric with the axis of said frame, pinions meshing with said gear and operatively connected to the individual roll axes, and variable speed means for driving said concentric gear.

4. In a rolling mill, the combination of a rotary frame provided with an axial pass, roll carriers mounted in said frame and movable toward and from the axis thereof, diagonally acting rolls mounted in said roll carriers, spring means for holding said roll carriers outwardly from the axis of the rotary frame, an annular roll adjuster surrounding the roll carriers and adjustable around the frame, connections between said roll adjuster and the roll carriers, and means for rotating said frame and thereby carrying said rolls in orbital paths around the axis of said frame.

5. In a rolling mill, the combination of a rotary frame provided with an axial pass, roll carriers mounted in said frame and movable toward and from the axis thereof, diagonally acting rolls mounted in said roll carriers, spring means for holding said roll carriers outwardly from the axis of the rotary frame, an annular roll adjuster surrounding the roll carriers and adjustable around the frame, connections between said roll adjuster and the roll carriers, means for rotating said frame and thereby carrying said rolls in orbital paths around the axis of said frame, and variable speed driving means for said rolls.

6. In a rolling mill, the combination of a rotary frame provided with an axial pass, roll carriers mounted in said frame and movable toward and from the axis thereof, a diagonally acting roll mounted in each roll carrier, spring means for holding said roll carriers outwardly from the axis of the rotary frame, means for adjusting said roll carriers toward the axis of the rotary frame and forming positive holding means therefor, and means for rotating said frame and thereby carrying said rolls in orbital paths around the axis of said frame.

In testimony whereof, I have hereunto set my hand.

RALPH C. STIEFEL.

Witness:

ALICE A. TRILL.