J. S. WORTH & W. F. HARRISON.

MILL FOR COLD ROLLING LAPPED TUBES.

APPLICATION FILED DEC. 31, 1907.

**991,407.**

**Patented May 2, 1911.**

2 SHEETS—SHEET 1.

Fig. 1.

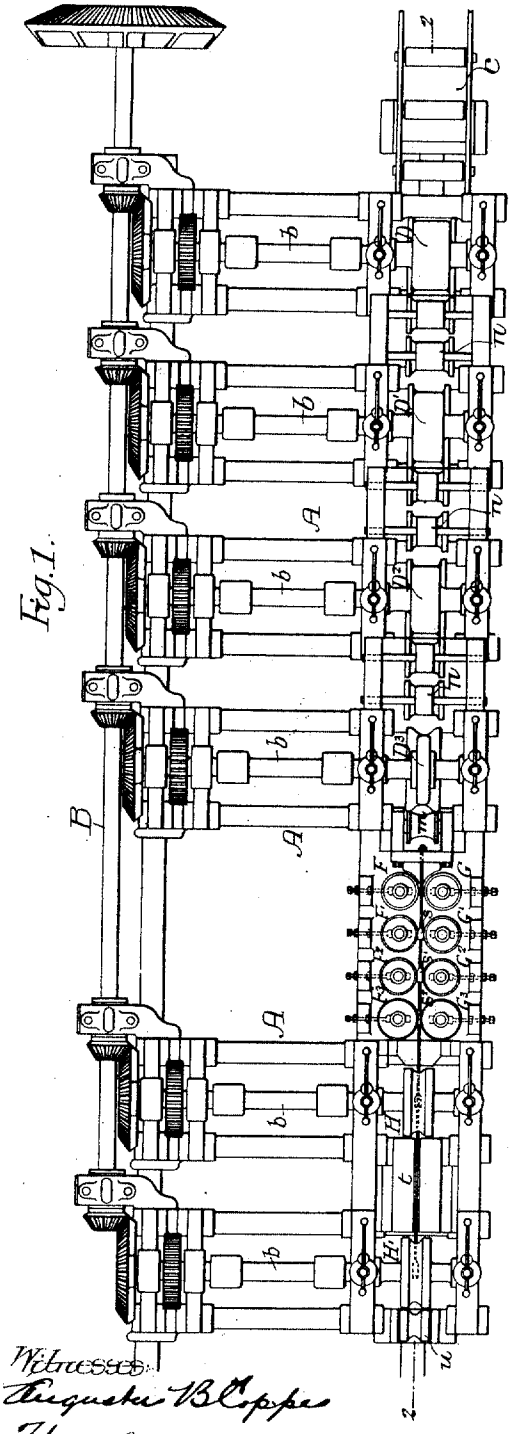
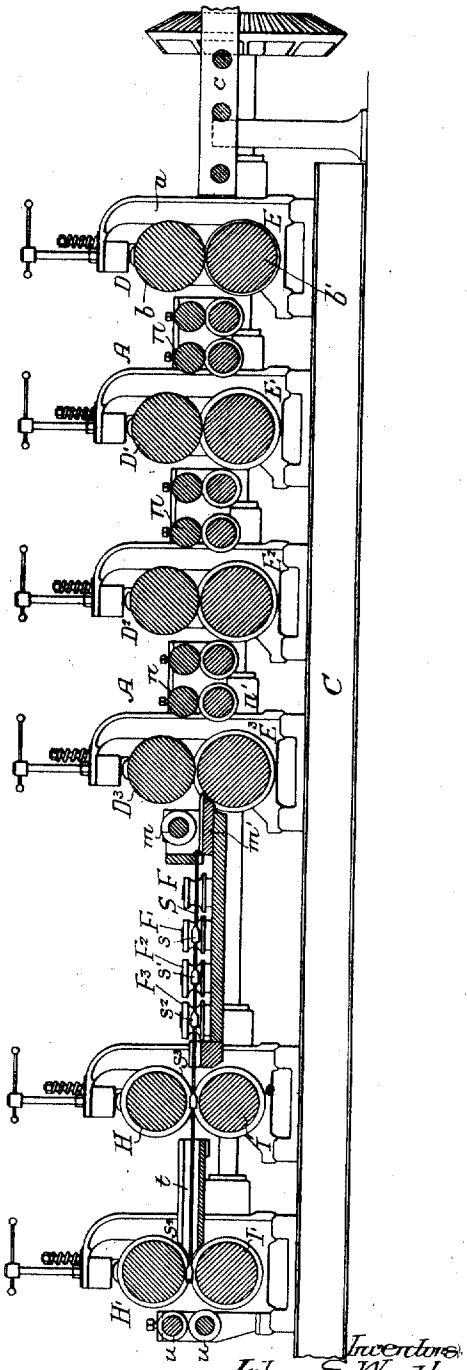


Fig. 2.



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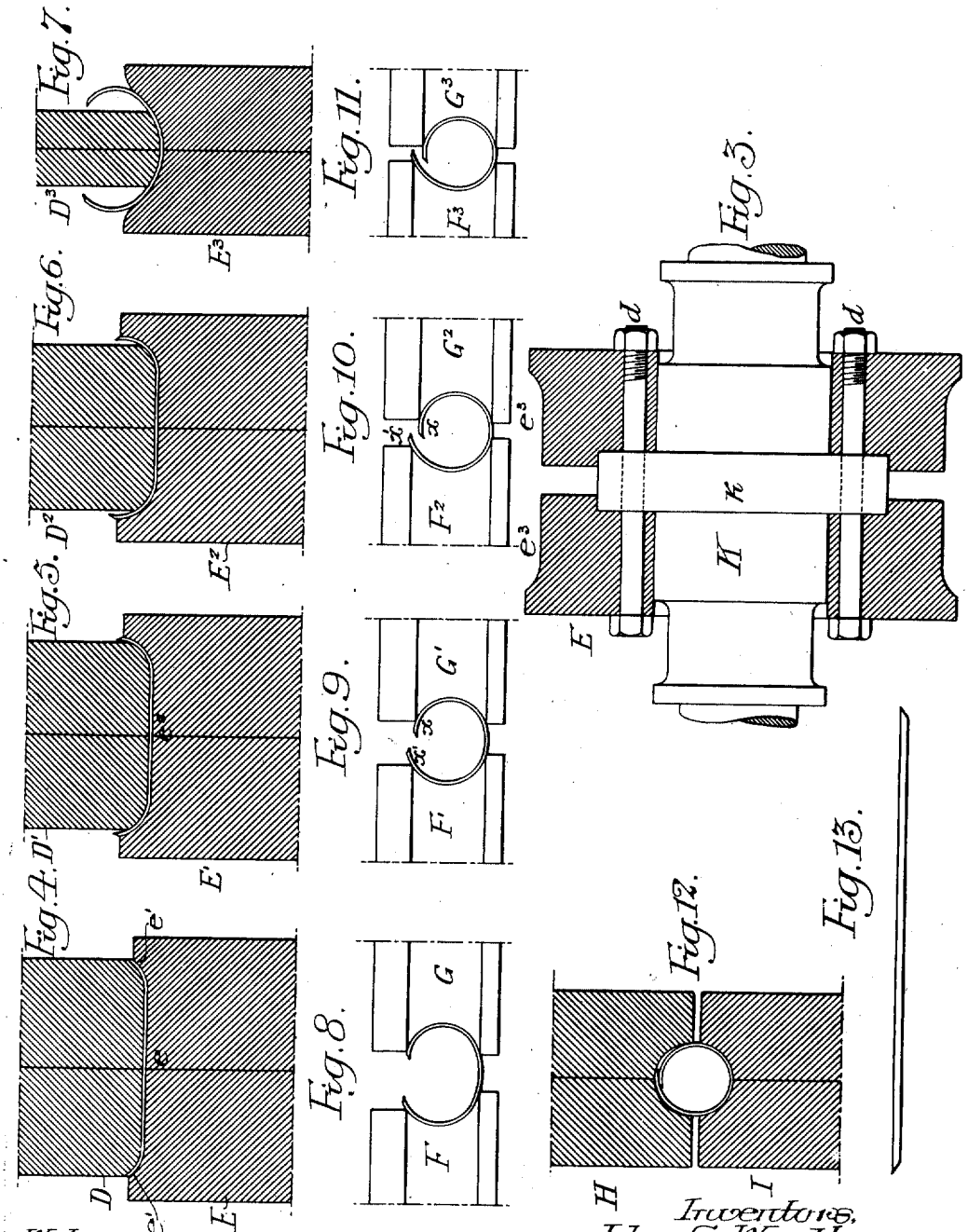


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# UNITED STATES PATENT OFFICE.

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## MILL FOR COLD-ROLLING LAPPED TUBES.

991,407. Specification of Letters Patent. Patented May 2, 1911.

Application filed December 31, 1907. Serial No. 408,853.

*To all whom it may concern:*

Be it known that we, JOHN S. WORTH and WILLIAM F. HARRISON, citizens of the United States, residing in Coatesville, Pennsylvania, have invented certain Improvements in Mills for Cold-Rolling Lapped Tubes, of which the following is a specification.

The object of our invention is to construct a mill for converting a flat skelp having scarfed edges into a tubular form without injuring the scarfed edges during the process of forming the tube. This object we attain in the following manner, reference being had to the accompanying drawings, in which:—

Figure 1, is a plan view of a tube rolling mill illustrating our invention; Fig. 2, is a section on the line 2—2, Fig. 1; Fig. 3, is a sectional view through one of the rolls; Figs. 4 to 12, inclusive, are diagrammatic views illustrating different steps of the process; and Fig. 13, is a sectional view of the skelp before being bent.

The rolling mill in the present instance is composed of a series of elements A each mounted upon foundation beams C and these several elements can be adjusted with respect to each other on the foundation.

Mounted in the housing *a* are several shafts *b* driven from a longitudinal shaft B through gearing as shown. All the horizontally arranged rolls are driven, but the vertical rolls are not driven. Motion is imparted to these rolls by the skelp as it is passed between them.

The above will give a general idea of the mill itself and the particular invention relates to the rolls for bending the skelp into the form of a tube, as it will be understood that other forms of mills may be used to carry out our invention.

Referring to Fig. 4, D is the first upper roll and E is the first lower roll and this latter roll is grooved as shown at *e*, the groove being slightly rounded at each end *e'*. The upper roll is shaped to conform to the groove *e* in the lower roll; the skelp is passed between these two rolls and the body portion of the skelp remains flat while the edges are slightly bent. The flat skelp is of the form illustrated in Fig. 13, which shows an end view of the skelp. As the skelp passes between the rolls D and E it will be noted that the edge of the skelp does not come in contact with any portion of either roll and is, therefore, not injured as in the ordinary methods of rolling scarfed tubes. The skelp as it passes between the rolls D' and E' is given a still further bend at each edge. This bending operation is continued and as the skelp passes between the rolls $D^2$ and $E^2$, Fig. 6, the edges are still unconfined and the skelp near its edge is curved almost to the curve of the tube to be formed.

In Fig. 7, the lower roll $E^3$ is grooved so as to slightly curve the body portion of the skelp and the roll $d^3$ is much narrower than the preceding roll and is shaped to conform to the center portion of the groove in the roll $E^3$. This pass is the last pass of the horizontal rolls.

The rolls in Figs. 8 to 11 inclusive are side pressure rolls used for forcing the skelp into tubular form after it leaves the rolls $D^3$ and $E^3$. The rolls F and G, Fig. 8, are arranged on a vertical axis and are each grooved so as to force the edges of the trough-shaped blank toward each other. In Fig. 9, the rolls F' and G' are arranged closer together and the groove in the roll G' is a trifle less in width than the groove in the roll F', causing the edge *x* of the skelp to be depressed slightly more than the edge *x'*. The two edges are brought almost together as the skelp passes between these rolls and in Fig. 10 the rolls $F^2$ and $G^2$ are so arranged in respect to each other and the groove in the roll $G^2$ is much narrower than the groove in the roll $F^2$ that the edge *x* of the skelp will pass under the edge *x'* and form the first lap. In Fig. 11, the lap is still continued until the skelp is bent so as to give the lap required. In all of these figures (8 to 11 inclusive), the bases of the grooves in the several rolls are in the same line and the difference in the width of the grooves is at the upper edge, and in each one of these figures it will be noticed that the scarfed edge of the skelp does not come in contact with any portion of the roll so that it cannot be injured in passing between any of the rolls, Figs. 4 to 11 inclusive. The skelp in its lapped condition passes from the rolls $F^3$ and $G^3$ between rolls H and I, Fig. 12, where it is given its final form. These rolls are horizontally arranged and each roll has an annular groove; the grooves aline one with the other and as the tube passes between these rolls the lapped edges of the skelp are brought toward each other and this

is preferably repeated in the rolls H′ and I′, which are provided in the present instance so as to insure the proper lapping of the edges of the tube before the tube is heated and transferred to the welding rolls.

In order to prevent collapsing of the tube as it passes between the rolls, Figs. 9 to 12 inclusive, we preferably secure a rod S to a fixed point on the housings and extend the rod through the space between the rolls F′ and H′ and mount thereon balls $s$, $s'$, $s^2$, $s^3$ and $s^4$ of a diameter about the same as the inner diameter of the tube to be formed, so as to prevent collapsing of the tube in case it has a tendency so to do, and also to insure the tube having a given diameter. These balls are especially essential in the pass between the rolls H and I where the tube is given its final form. Thus it will be seen that we are enabled to take a skelp in which the edges are scarfed and pass it between the rolls bending it into tubular form with the scarfed edges overlapping, without the edges coming in contact with any portion of the rolls, thus preserving the sharp edge of the scarf so desirable in tube manufacture. Furthermore, in this method of making a tube we are enabled to properly lap the skelp completely at each end, so that the entire length of the skelp can be used as a tube, as when the skelp is properly lapped at each end it can be readily welded from one end to the other, which is not the case in the present method of making lap welded tubes where several inches at each end have to be cut off and discarded, owing to imperfect lapping.

Referring now to Figs. 1 and 2, we preferably space the several rolls D and E to $D^3$ and $E^3$ a given distance apart and place between the rolls guide rollers $n$ and $n'$. The lower rollers $n'$ are grooved, conforming as near as possible to the grooves in the preceding roll of the mill and the upper roll $n$ is slightly narrower than the preceding roll of the mill but is of sufficient width to keep the skelp in a straight line so that it will properly enter the space between the next pair of rolls. There are preferably two of these rolls between each pair of main rolls but this construction may be modified and bearing plates may be used in place of the rollers, if desired. There is also placed back of the rolls $D^3$ and $E^3$ a presser roll $m$ which tends to keep the skelp down upon its seat $m'$ as it is transferred from the rolls $D^3$, $E^3$ to the rolls F and G. Between the two sets of rolls H′ and I′, we place a trough $t$ and there is a final pair of rolls $u$, $u$ between which the tube passes after it leaves the last pair of rolls H′ and I′.

We preferably make all of the horizontally arranged rolls in two sections, as illustrated in Fig. 3, which, in the present instance is a detail view of the lower roll E. The axle K of this roll has a flange $k$ extending between the two sections $e^3$ of the roll E and transverse bolts $d$, $d$ extend through the sections and through the flange. In the event of wear these sections can be detached, the groove re-cut in the periphery of the sections and secured by the bolts in position on the axle. This arrangement enables us to re-dress the rolls and to replace a portion if it should be necessary.

We have shown means for adjusting any one of the rolls but it will be understood that any means for adjusting the rolls may be used without departing from the main features of the invention.

It will be seen that by the use of our improved mill a skelp can be scarfed at each edge and placed upon the roller table $c$ and fed cold through the passes between the several rolls; the skelp near its edges being bent in the several passes so as to conform somewhat to the shape of the finished tube without the edges of the skelp coming in contact with the rolls, and the trough-shaped skelp is then forced through the passes of the other set of rolls which gradually force the edges of the trough-shaped skelp together, bending one edge below the line of the other so that the edges will pass each other, forming a lapped tube which can be introduced into a furnace and heated and then welded, producing a weld that is perfect throughout the entre length of the tube.

While we have shown only the horizontal rolls driven, both the horizontal and vertical rolls may be driven if desired, or any number of each set may be driven to properly pull the skelp through the several passes.

We claim:—

1. The combination in a continuous mill for rolling scarfed skelps into lapped tubes without the use of formers, of a series of horizontally arranged rolls for first bending the skelp near the edge and then the body of the skelp while the edges are free from engagement, a series of vertically arranged grooved rolls shaped to bend the skelp so that one edge will pass the other, a horizontally arranged set of final rolls, and a ball between the rolls whereby the skelp receives its final shape.

2. The combination in a mill for cold rolling scarfed skelps into lapped tubes, of a series of two high primary rolls spaced a given distance apart, means for driving said rolls, the said rolls being shaped substantially as described, guide rolls between the sets of forming rolls, a series of vertically arranged secondary rolls for pressing the previously formed blank into a tube with lapped edges, a presser roll between the primary and secondary rolls, one or more sets of horizontally arranged final rolls, a rod extending through the secondary and

final rolls, and balls on said rod over which the skelp is shaped.

3. The combination in a rolling mill roll, of an axle having a flange, the roll being made in two sections bearing against the flange, and transverse bolts passing through the two sections and the flange.

4. The combination in a two-part rolling mill roll, of an axle having a central flange extending between the two parts of the roll, each part of the roll being grooved to receive the flange, and transverse bolts extending through each part of the roll and flange.

In testimony whereof, we have signed our names to this specification, in the presence of two subscribing witnesses.

JOHN S. WORTH.
WILLIAM F. HARRISON.

Witnesses:
WILLIAM S. G. COOK,
W. FRANK WARE.