3,572,146
APPARATUS FOR USE IN SIZING CONE STEEL TUBES
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1 Claim

ABSTRACT OF THE DISCLOSURE
Apparatus for use in sizing conical steel tubing including a roll calibrer having a hyperbolic curvature on the rolling surface thereof which contacts the tubing.

This invention relates to an improved apparatus for use in sizing (or shaping) a cone steel tube to the desired diameter. More particularly, the present invention relates to an arrangement for sizing the conical diameter of cone steel tubes by using an improved roll calibrer having a hyperbolic curvature on the surface thereof over which the cone steel tube is passed, so as to increase the areas of contact between the cone steel tube and the roll calibrer.

Recently, tapered steel tubes such as cone tubes have been in a great demand in various fields, for instance, for use as street lamp poles or the like. In the tapered steel tube, e.g., cone tubes, it is difficult to maintain an appropriate rolling reduction to a uniform plastic deformation through the length and breadth of the tube. Furthermore, these difficulties have tendency to increase by degrees when the length of the tube becomes longer. It has been the usual practice in the art to utilize common V-shaped roll calibrers for sizing tapered or cone tubes.

The main object of the present invention is to facilitate the regulation of the reduction pressure of the sizing rolls used during sizing of the cone steel tubes so as to materially reduce the costs of the products manufactured thereby.

SUMMARY OF THE INVENTION
In accordance with the present invention the commonly used V-shaped calibrer is replaced with a new calibrer having a hyperbolic curvature on the surface contacting the tubing being sized.

The present invention enables the contact areas between the tube and the roll calibrer to be more appropriate so as to conform to the degree of the desired taper of the cones. By virtue of these features, the maximum cross-sectional work areas pertaining to the degree of taper can be obtained, and uniformity of rolling reduction in the longitudinal direction of the tube is maintained.

The invention as well as the objects and advantages thereof will be more apparent from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a partial cross-sectional view of a shaping roll calibrer of the present invention acting on a conical steel tube;

FIG. 2 is a partial cross-sectional view of a prior art roll calibrer acting on a conical steel tube;

FIG. 3 illustrates the contacting condition which exists between a mother tube and the shaping roll calibrer according to the present invention for a small sized diameter portion of a conical steel tube; and

FIG. 4 illustrates the contacting condition which exists between a tube and the roll calibrer according to the present invention for a larger sized diameter portion of a conical steel tube.

In the production of tubing, the tubing is generally passed through sizing rolls after forming to provide a tube having the desired outer dimension. When the tube is a cone steel tube, it was heretofore difficult to obtain the desired outer dimension. When the tube is a cone steel tube, it was heretofore difficult to obtain the desired outer dimensions using the known sizing (or shaping) arrangements.

In FIG. 2 the reference numeral 1' is a mother tube formed by another process, such as that of U.S. Pat. No. 3,329,329, 2' shows a prior art V-shaped roll calibrer of the shaping apparatus and 3' is a cross-sectional view of the reduction surface produced by the calibrer 2'. It should be clear that another similar roll calibrer is located above roll 2' in the actual rolling arrangement. It is apparent that the proper rolling reduction per one pass duly corresponding to the degree of inclination of the cone steel tube should be freely arranged and suitably adjusted when passing the tube through the sizing roll calibrer. However, the interior surface of the V-shaped calibrer 2' of the prior art is flat and straight. The contact between the surface of the calibrer and the tube exists at only two points. Accordingly, this fact brings lighter rolling reduction upon the tube and the rolling reduction becomes unequal in the longitudinal direction of the tube. Therefore, with this arrangement, it is necessary to increase the number of roll stands or the number of passes, so as to obtain the desired dimension of the resulting products. In addition to this, in the prior art arrangements of FIG. 2, as the degree of tapering of the tapered steel tube gradually increases, the efficiency of the manufacture decreases, thereby resulting in a higher cost for making the products.

The present invention has succeeded in solving the above-mentioned problems by replacing the known roll calibrer having a V-shaped rolling surface with a new roll calibrer having a rolling surface with a hyperbolic shape.

FIG. 1 shows an embodiment of the present invention wherein the improved interior surfaces (i.e., the rolling surfaces) of the calibrer are shaped as a hyperbola in the cross-section view. It should be clear that another similar roll calibrer is located below roll calibrer 2 in the actual rolling arrangement. In FIG. 1, the numerals 1, 2 and 3 show respectively the corresponding parts of the V-shaped calibrer shown in FIG. 2. As mentioned above, the reason why a hyperbolic shaped calibrer is the main feature of the present invention is based on observations that the areas of contact between the calibrer and the conical tube during a rolling operation defines a spherical surface corresponding to the degree of inclination of the tube. The state of contact at some surface (rather than only at a point) has a great advantage in that it is possible to increase the rolling reduction per one pass. Moreover, an additional merit is that the useful life of the roll calibrer of the present invention is increased. The greatest benefit of the present invention is the remarkable increase of production efficiency.

The method of the present invention applied to actual operations, more than 10% increase of production efficiency is easily obtained.

The curvature of the said hyperbolic shape of the rolling surface must not be established arbitrarily but should be made to correspond with the degree of taper of the conical tube. Accordingly, a hyperbolic shaped calibrer having the same curvature can be used successively. The actual determination of the required curvature is quite difficult. However, by use of a computer, the above-mentioned determination can be made with ease. Once the curvature is determined, there is no need to perform calculations each time as long as a conical tube having the same degree of taper is involved. The roll calibrer of the present invention can be successively used.
FIG. 3 and FIG. 4 shows the actual contact conditions between the tube and the roll caliber having a curvature of hyperbolic shape in its cross-sectional view. In these drawings, FIG. 3 shows contact conditions for a smaller diameter portion of the conical tube and FIG. 4 shows the same situation for a larger diameter portion of the same tube.

In comparison between the present invention and the prior art as mentioned above, actual measurement values under the same rolling force are shown in the following tables.

**RESULTS OF THE COMPARISON TESTS**

<table>
<thead>
<tr>
<th>Contacting surface—Small diameter portion of tube (FIG. 3)</th>
<th>Hyperbolic shaped caliber ¹</th>
<th>V-shaped caliber ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum depth, mm</td>
<td>0.029</td>
<td>0.030</td>
</tr>
<tr>
<td>Length, mm</td>
<td>0.498</td>
<td>0.309</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Contacting surface—Large diameter portion of tube (FIG. 4)</th>
<th>Hyperbolic shaped caliber ¹</th>
<th>V-shaped caliber ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum depth, mm</td>
<td>0.039</td>
<td>0.050</td>
</tr>
<tr>
<td>Length, mm</td>
<td>0.499</td>
<td>0.451</td>
</tr>
</tbody>
</table>

¹ The present invention. ² The prior art.

According to the above tables, it is seen that by using the roll caliber of the present invention, the contacting area between the roll and tube is kept uniform through the whole length of the conical tube. On the other hand, shaping by the prior art method shows irregular (or non-uniform) values under the same rolling force, with the maximum depth reaching 0.030 mm. This demonstrates that the rolling reduction through the whole length of the conical tube is about constant, and that a higher rolling reduction per pass is also possible.

Thus, by means of the present invention, tapered steel tubes e.g. conical tubes can be more easily produced and productivity can be increased.

While there has been described what at present is believed to be the preferred embodiments of this invention, it will be obvious to those skilled in the art that various modifications can be made thereto within the scope of the invention as set forth in the appended claim.

We claim:

1. A roll caliber for use in shaping conical tubing having a rolling surface which contacts said tubing during said shaping, said rolling surface having a hyperbolic curvature.

References Cited

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LOWELL A. LARSON, Primary Examiner

72—366, 367 U. S. Cl. X.R.