

United States Patent

Petersen et al.

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- [54] **METHOD OF ROLLING HOLLOW STOCK**
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- [58] Field of Search **72/78, 208, 370, 96, 100, 209; 29/527.7; 164/270**

[56]

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[57] **ABSTRACT**

Continuously cast, hollow ingots are rolled in a rolling mill of the skew rolling type, whereby the ingot is prevented from turning on its longitudinal axis, and the rolls roll on the ingot.

6 Claims, No Drawings

METHOD OF ROLLING HOLLOW STOCK

The present invention relates to a method of rolling, for stretching or draw rolling a hollow ingot made by continuous casting and cut from the casting. Hollow ingots of this type have unusual dimensions, and their particular grain structure poses problems for further shaping. Particularly, conventional rolling techniques for manufacturing of seamless tubing from continuously cast, hollow stock cannot be employed.

The rolling process and method in accordance with the preferred embodiment of the invention, therefore, considers particularly these unusual dimensions and grain structure. It is suggested to stretch a hollow, continuously cast ingot by means of hot rolling, using at least three rolls that work in a common plane and have axes that are not at right angles to the direction of rolling. During rolling for stretching, the hollow ingot is restrained to prevent its turning and rotation about the longitudinal axis of the ingot, and the rolls roll on the hollow ingot. A particular tool, such as a mandrel, may be inserted in the ingot for cooperation with the rolls.

As a consequence, the rather heavy hollow ingot rests essentially motionless during stretching. During conventional diagonal rolling an ingot usually turns about its axis and may impact rather forcefully upon guiding structure and transport rolls. If the ingot is restrained, equipment of the mill is protected. Moreover, fissures and rupture of the material are avoided; it must be observed that the rather coarse, spiky grain structure of a continuously cast product is particularly amenable to rupture at the onset of stretch forming.

For economic reasons, the invention is particularly important for making tubes from hollow ingots of rather large weight. The tubes that can be made by the inventive method have actually length that is not obtainable by means of pierce rolling, extrusion molding or by driving a mandrel into a solid ingot.

In accordance with the invention, a mandrel is also used and inserted in the ingot, and it is essential to prevent turning of the ingot during rolling, e.g. on the mandrel. The hollow ingot is then rolled off the mandrel, so that the length of the mandrel does not impose a limit upon the length of the rolled tubes.

Towards the end of the rolling process, turning of the ingot is directly impeded due to adhesion to the mandrel, and, possibly, also to guide elements. Also, particular equipment may be provided to lock the stretched tube so as to prevent its turning. Now, the initial restraining equipment can be removed so as to extend the rolling process over the entire ingot. This way, the restraining as initially effective and produced, does not become an impediment for completing the process. If a cylindrical mandrel is being used, it may be advisable to withdraw the mandrel gradually during rolling without, however, complete withdrawal from the operating plane of the rolls.

It is also possible to employ a mandrel with a tapered front end. The tapered end cooperates particularly with the rolls as they roll the tube off the tapered portion of the mandrel. The

mandrel remains stationary relative to the rolls (i.e. relative to axes of the rolls). This method leads to tubing of particularly small dimensions.

The construction of the rolls itself is per se not a significant aspect within the context of this invention. Known rolling equipment can readily be used and adapted for practicing the invention. Rolls can be used as employed in regular skew rolling mills for piercing mills or in tube expanding rolling mills. Rolls that are usable are particularly disclosed in German Pat. No. 646,162. The present invention is particularly directed to tube rolling mills of that type, such as a tube expander rolling mill, as disclosed in that German Pat. No. 646,162. The mill is to have at least three rolls, which (a) operate in common plane (b) are not at right angles to the direction of rolling, (c) roll on the hollow ingot for stretching and draw rolling of the continuously cast ingot, whereby the ingot is restrained from turning on its axis, in a manner as is, for example, known per se and used in rod erecting machines.

The invention is not limited to the embodiments described above but all changes and modifications thereof not constituting departures from the spirit and scope of the invention are intended to be included.

We claim:

1. Method of stretching a continuously cast hollow ingot as cut from the casting by means of hot rolling, comprising the steps of:

using at least three rolls, which operate in a common plane and have axes which are inclined to but do not extend perpendicular to the direction of rolling; and restraining the hollow ingot to prevent its turning on its axis during rolling so that the rolls roll on the hollow ingot.

2. Method as in claim 1, including the step of disposing the hollow ingot upon a cylindrical mandrel in loose, clearing relation; rolling the ingot off the mandrel; and gradually withdrawing the mandrel during the rolling.

3. Method as in claim 1, including the employment of a mandrel having a cylindrical portion and a tapered portion, the ingot being disposed upon the cylindrical portion of the mandrel, the ingot being rolled off the tapering portion of the mandrel, the tapered portion remains stationary, relative to the axes of the rolls.

4. The method of using a tube expanding rolling mill having at least three rolls that operate in a common plane and roll on the rolled stock; of using a mandrel inserted in the ingot; of using hollow ingots made by continuous casting and cut from a casting string, the rolls of the mill rolling on the ingot and rolling the ingot off the mandrel; and of securing the ingot to prevent its turning on an axis that is the axis of the tube to be made.

5. The method as in claim 4, the rolls having axis inclined to the direction of rolling by angles that are not right angles.

6. The method as in claim 5, including rolling the ingot off the mandrel as inserted in the hollow ingot, the mandrel being tapered where the ingot is rolled off the mandrel.

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