METHOD OF PRODUCING A STEEL PACKING STRIP

8 Claims, 1 Drawing Fig.

ABSTRACT: A steel packing strip with a tensile strength of around 95 to 125 kp./mm.², an elongation of 85 of 10 to 17 percent and a yield point ratio of 0.7 to 0.9 is produced from rolled steel strip with a thickness of 0.30 to 1.3 mm. and a composition of about 0.10 to 0.20 C, at most 0.50% Si, possibly as much as 0.060% of P and S, 0.3% to 1% Mn, and the balance substantially all iron which is subjected to a continuous austenitizing annealing at a temperature of more than 820°C. and thereafter quenched in water to produce a structure with discrete particles of stress-laden ferrite.
METHOD OF PRODUCING A STEEL PACKING STRIP

BACKGROUND OF THE INVENTION

1. Field of the Invention
The invention relates to a process for producing a steel packing strip of high strength with a tensile strength of about 95 to 125 kp/mm², an elongation of 10 to 17 percent and a yield point ratio of 0.7 to 0.9.

2. The Prior Art
It is known to produce packing strip with a tensile strength of less than 95 kp/mm² by the relaxation and recovery annealing of cold rolled strip of a steel of the type of DIN 1624, as well as deoxidized, de-oxidized, or completely deoxidized structural steel with additives corresponding to DIN 17100 with the desired tensile strength value. The relaxation and recovery annealing can be carried out in continuous, pot or cupola annealing ovens. The high-strength packing strip with a tensile strength of more than 95 kp/mm² has been produced in a known way through a continuous or intermittent tempering in two heat treatments from a steel with a composition of about 0.20 to 0.40% C, 0.15 to 0.35% Si, up to 1.5% Mn and, at times, as much as 0.035% P and S.

A disadvantage of packing strips with a tensile strength of less than 95 kp/mm² is that they require a quite large cross section and for the same reason also are of substantial weight, in order to have adequate packing characteristics. The disadvantage in the production of packing strips with a tensile strength of more than 95 kp/mm² is that the heat treatments are required.

SUMMARY OF THE DISCLOSURE

The purpose of the present invention is to overcome these disadvantages in the known process for the production of packing strips and to produce a packing strip which has a tensile strength of 95 to 125 kp/mm², an elongation of 10 to 17 percent and a yield point ratio of 0.70 to 0.90 and to provide a simple procedure by which this can be done with only one heat treatment.

This is achieved according to the invention by starting with a steel strip with a thickness of 0.3 to 1.3 mm, and a composition of about 0.10 to 0.20% C, at most 0.50% Si, possibly up to 0.06% P and S, 0.30 to 1.0% Mn, balance substantially all iron which is subjected to a continuous austenitizing annealing at temperatures of more than 820°C, and a subsequent quenching in water for the production of a structure with discreet particles of stress-laden ferrite.

The quenching can advantageously be carried out also by means of cooled, for example, water-cooled, quenching plates, or by quenching rolls, because in this way an especially flat and strain-free product is obtained. By using a protective gas in the heating zone it is further possible to obtain a completely scale- and tarnish-free surface. In a similar way as with the steel band with the specified components it is also possible in general to use a steel deoxidized with the addition of aluminum.

In order to avoid the formation of a thicker scale layer on the steel band by the austenitizing annealing, according to the invention it is proposed to carry out the annealing by direct current heating, inductive or resistance heating in as short as possible a space of time. The layer of scale produced by the heating on the band can then be completely cracked off by the subsequent quenching. By changing the length of the passage of the band being annealed through air, the thickness of the scale layer can be so controlled that upon dipping in water it cracks completely off and a clean contact surface for example by resistance heating is assured. In gas or electrically heated annealing ovens as well as when using induction or resistance heating it is advantageous to use a neutral protective gas for the austenitizing annealing. In order also to avoid a wavy and rough-edged band, to be produced after the treatment, it is proposed to carry out the quenching operation under tension, which is accomplished by the use of plain or S-shaped rolls arranged in a water bath.

Because the exact reaching of the required tensile strength value by a simple quenching with water can be attended with difficulty, the procedure of the invention is carried out advantageously by quenching or produce a higher tensile strength than is required and thereafter allowing the band to dry. In this way, the required tensile strength of the band at the end of the treatment can be kept exact.

In general the quenching in water can be carried out in a single width or in several widths. A subsequent splitting of arrow strips is made possible by the mechanical characteristics set out above. In addition several narrow strips can be produced simultaneously by the provision of corresponding reels.

It is an important feature of the invention that the aforesaid mechanical characteristics of the packing strip are achieved through the production of a structure of stress-laden ferrite. In order for a partial or even a complete conversion of the structure to stress-laden ferrite, to attain the desired mechanical characteristics of the packing strip, the relation of the carbon content to the manganese content is determined depending on the speed of quenching. By quenching in flowing water, for example with a very high quenching intensity, a carbon content of 0.10 to 0.12 percent with a manganese content of 0.40 to 0.60 percent is enough to produce drastically stress-laden ferrite in the steel band. If the quenching is carried out in more or less cold water between room temperature and 100°C, that is, with a correspondingly reduced quenching intensity, the carbon content must lie at about 0.20 percent and the manganese about 1 percent. The mechanical characteristics can be kept in the desired ranges through an exchange of manganese through the carbon or of carbon through the manganese.

The advantages gained with the process according to the invention lie particularly in the fact that in contrast to the known packing bands with a tensile strength of less than 95 kp/mm², the new packing band can be loaded more highly and besides in contrast to the packing band of the intermediate stage structure the same mechanical characteristics are obtained with only one heat treatment.

Further objects and advantages of the invention will appear more fully from the following description particularly when taken in conjunction with the drawings which is a part thereof.

BRIEF DESCRIPTION OF THE DRAWING

The drawing shows diagrammatically an apparatus for carrying out the process according to the invention. From a feeding reel 1 a cold rolled steel strip 2 of about 0.30 to 1.30 mm, thickness, which is welded to the preceding steel strip 3 by means of a welding machine 4 for continuous operation, is rolled off and is passed through an austenitizing arrangement 5 over bending roller 6 through a water bath 7 and the reel 8. It is further advantageous to between the outlet of the water bath and the wound-up reel 8 to provide an arrangement 10 for drying and/or annealing of the band and a lacquering arrangement 11. With a steel band which has the following composition

<table>
<thead>
<tr>
<th>Element</th>
<th>C</th>
<th>Si</th>
<th>Mn</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.13%</td>
<td>0.16%</td>
<td>0.61%</td>
<td>0.013%</td>
</tr>
</tbody>
</table>

which is austenitized for 5 minutes and quenched in a water bath at 20°C, it is possible at various thicknesses and austenitizing temperatures (Tₘₜ) to obtain the following characteristics:
A further steel band of 0.5 mm. thickness with an analysis of

\[
\begin{array}{cccccc}
C & Si & Mn & P & S & A1 \\
0.15\% & 0.04\% & 0.83\% & 0.025\% & 0.018\% \\
\end{array}
\]

is subjected to an austenitizing annealing at 800°C and water quenched at 20°C and shows the following characteristics:

\[
\begin{array}{cccc}
\sigma_s & \sigma_y & \delta & \% \\
kp/mm² & kp/mm² & & \\
\end{array}
\]

We claim:

1. Process for the production of steel packing strip with a tensile strength of 95-125 kp/mm², an elongation δ of 10-17 percent and a yield point ratio of 0.70 to 0.90, in which a steel strip with a thickness of 0.30 to 1.3 mm. and a composition of about 0.10-0.20%C at most 0.50%S and 0.30-1.0%Mn is subjected first to a continuous austenitizing annealing at more than 820°C. followed directly by quenching with water to obtain a structure with discrete particles of stress-laden ferrite.

2. Process according to claim 1 in which the composition includes up to 0.60 percent P and S.

3. Process according to claim 1 in which the quenching is accomplished by the use of water-cooled quenching surfaces.

4. Process according to claim 1 in which the steel has been dezoxidized by the addition of aluminum.

5. Process according to claim 1 in which the austenitizing annealing is carried out in the shortest possible time.

6. Process according to claim 1 in which the austenitizing annealing is carried out in a protecting atmosphere of a neutral gas.

7. Process according to claim 1 in which the strip is stretched during quenching.

8. Process according to claim 1 in which during the quenching the band is given a higher tensile strength than is required and is thereafter relaxed during drying.