Feb. 4, 1964 E. DVORAK 3,120,139

COOLED MANDREL FOR CONTINUOUS TUBE ROLLING MILLS

Filed Feb. 1, 1961

Fig. 1

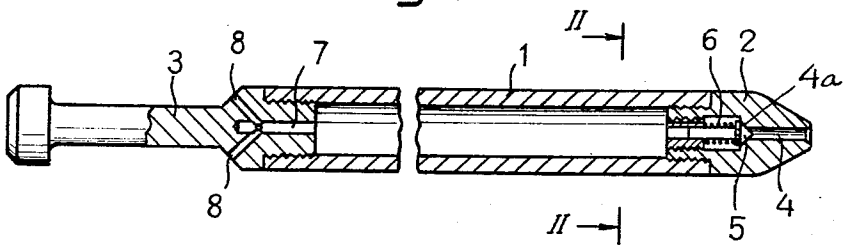


Fig. 2

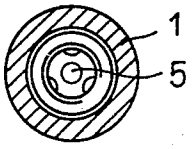
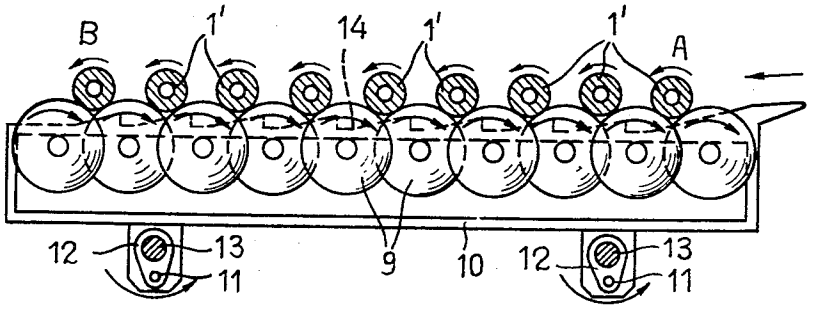


Fig. 3



United States Patent Office

3,120,139
Patented Feb. 4, 1964

3,120,139

COOLED MANDREL FOR CONTINUOUS TUBE ROLLING MILLS

Emilio Dvorak, Milan, Italy, assignor to Innocenti Soc. Gen. per l'Industria Metallurgica e Meccanica, Milan, Italy

Filed Feb. 1, 1961, Ser. No. 86,500
Claims priority, application Italy Apr. 21, 1960
1 Claim. (Cl. 80—11)

This invention relates to a mandrel for hot continuous tube rolling mills, which can be easily cooled after each working cycle without giving rise to cracks, or deformations.

In hot continuous rolling mills for weldless steel tubes the problem arises of cooling the mandrel, after removal of the latter from the tube at the end of the rolling process.

Cooling is normally effected by placing the mandrels on a cooling table where they are allowed to stand a certain time so as to assume a temperature suitable for starting a fresh working cycle.

Since the mandrels are of alloyed steel, sudden cooling thereof is inadvisable, as it might lead to surface cracks. Considering the normal processing rate which is of the order of at least 4 blanks a minute, a rather high number of mandrels, such as about 20 to 25 usually has to be employed. This is possible as long as the mandrels are of a relatively small diameter, below 125 mm., while with larger diameter mandrels practical difficulties increase because the dwelling time on the cooling table has to be still longer, requiring a larger number of mandrels, thereby entailing operational and economical difficulties hardly to be overcome.

This invention provides a mandrel for hot continuous tube rolling mills, which can be easily cooled without giving rise to difficulties.

According to this invention, the mandrel is of tubular construction and is provided at one end with an axial passage controlled by a valve for admission of cooling water and at its opposite end with holes for discharging steam from vaporization of water.

Cooling of the mandrel is practically effected by placing it at the starting station on a rotary roll table, injecting a measured water quantity into the mandrel to gradually cool the same from the inside by effect of vaporization of water, while the mandrel rotates about its longitudinal axis and is translated over the consecutive stations on the roller table. The successive mandrels are finally picked-up from the end station on the roller table for use in a following working cycle.

The invention will be described in detail with reference to the accompanying drawings which diagrammatically show by way of a non-limiting example an embodiment thereof.

FIGURE 1 is an axial sectional view of a mandrel according to this invention,

FIGURE 2 is a cross-sectional view on line II—II of FIGURE 1, and

FIGURE 3 is a diagram showing the arrangement for cooling the mandrels.

Referring to FIGURES 1 and 2, the mandrel for rolling weldless tubes comprises a middle section **1** of tubular shape having its outer diameter corresponding to the inner diameter of the rolled tube and having secured thereto a nose portion **2** of frusto-conical shape adapted to facilitate introduction of the mandrel into a blank and a tail portion **3** with attachment means of a shape known per se, adapted to facilitate removal of the mandrel from the tube on completion of rolling.

The nose **2** of the mandrel has bored therethrough an axial passage **4** reduced in cross-section with respect to

the bore in the middle tubular portion **1**. The inner end of the passage **4** is provided with a seat **4***a*, and has co-operating therewith a non-return valve **5** normally kept closed by a spring **6** urging the valve member against this seat.

The tail portion **3** has bored therein a blind axial bore **7** connecting with substantially radial passages **8** capable of discharging steam resulting from evaporation of the cooling water injected into the mandrel through the nose passage **4**.

Referring to FIG. 3 each mandrel, diagrammatically denoted for the sake of convenience by reference numeral **1'**, is horizontally placed after removal from a just rolled tube on the starting station A of a roller table, the rollers **9** of which rotate in the direction of the arrows. A measured quantity of cooling water is injected into the mandrel without reaching by its level that of the bore **7**. By reason of the high mandrel temperature the water vaporizes and is discharged as steam through the conduits **7**, **8** bored at the opposite end of the mandrel, thereby removing from the mandrel the necessary quantity of heat to cause the mandrel to resume its desired temperature. The non-return valve **5** prevents steam from escaping through the nose passage **4** in a form of a jet which might be dangerous for the water-injector operator.

The mandrels placed on the roller table **9** are steadily rotated at a constant speed so that they cool down gradually and uniformly without undergoing cracks. At the final station B on the roller table the mandrels have been brought to a low temperature suitable for use in a fresh working cycle.

As soon as a mandrel is picked-up from the end station B on the roller table for use in a further working cycle, the remaining mandrels on the roller table are fed forward by one step leaving free the initial station A at which a fresh mandrel to be cooled is placed.

Displacement of the mandrels is effected by a pair of follow-up plates **10** adjacent the opposite ends of the rollers **9** and connected by pivots **11** to cranks **12** on shafts **13** which perform one revolution at each step.

The top side **14** of each plate **10** is of saw-tooth shape in order to improve the forward movement of the mandrels towards the final station B on raising of the plates by the cranks **12**.

During travel from the initial station A to the final station B the cooling water vaporizes wholly or almost wholly, because the ideal final temperature of operation of the mandrels exceeds 100° C. The water quantity is conveniently measured to ensure the desired end temperature of the mandrel.

Cooling of the mandrel from the inside avoids the formation of cracks in the outer surface, which would otherwise arise if cooling were effected from the outside. In the latter case on ceasing of the cooling effect of the water the internal mandrel mass, which is hotter than its outer surface, would tend to transmit heat to its outer portion causing expansion thereof. The outer surface would be consequently dangerously stressed at each cooling cycle so that cracks will form with time and gradually grow till the mandrel becomes unserviceable.

By cooling from the inside according to this invention the outer mandrel surface never tends to expand, so that stresses which might cause it to crack are avoided. The stressing effect affects the inner surface of the mandrel by a much smaller extent, first because the inner surface is smaller in diameter and is initially cooler than the outer surface. Secondly, cooling occurs more slowly because the water quantity initially supplied is not renewed and gradually heats up till it evaporates. Finally, the consequences of any internal cracks are practically negligible.

By the use of the mandrels and cooling method described above the number of mandrels associated with a rolling mill can actually be considerably reduced to about 10 or less, which results in a considerable economy.

What I claim is:

An internally fluid cooled mandrel for a continuous tube rolling mill, the mandrel comprising; a cylindrical hollow body having an outer diameter corresponding to the inner diameter of the rolled tube and forming a central section of the mandrel, a nose section attached to and closing one end of the hollow cylindrical body of the mandrel, a tail section attached to and closing the other end of the hollow body of the mandrel, an axial passage in the nose section connecting the inside of the hollow cylindrical body with the outside, a seat situated at the inner end of said passage, a valve member situated at the inner end of said passage and cooperating with said seat, spring means urging said valve member against said seat so that said passage is normally closed and can be opened when pressurized fluid is introduced into the passage from the outside, and a passage in the tail section connecting a central level of the inside of the hollow cylindrical body with the outside.

References Cited in the file of this patent

UNITED STATES PATENTS

1,445,139	Jenkins	Feb. 13, 1923
1,819,257	Multhaupt	Aug. 18, 1931
2,167,424	Novack	July 25, 1939
2,182,910	Bannister	Dec. 12, 1939
2,385,140	Knowles	Sept. 18, 1945
2,447,249	Hill	Aug. 17, 1948
2,866,545	Honkala	Dec. 30, 1958