This invention relates to the manufacture of seamless pipes and tubes, and more particularly to the prevention of the formation of scale pits and the like.

In the manufacture of metallic seamless pipes and tubes, a solid or tubular workpiece heated to forging temperature is helically advanced over a mandrel or plug to elongate it or to increase its diameter, or both. In this rolling operation, scale previously formed is generally loosened by the action of the rolls on the workpiece as the section approaches the mandrel, by reason of its being forced into a slightly oval-shaped cross section. This scale may be blown from the interior of the workpiece by means of an air blast, but this alone will not prevent some scale from accumulating on the mandrel or plug and being rolled into the workpiece. Since a loose scale is formed behind the plug, the air blast tends to draw the scale forward where it collects on the plug. When this occurs, pits are formed in the wall of the pipe or tube, causing it or a large portion thereof to be rejected. In addition to the foregoing, in the various operations and reheattings through which the seamless pipe and tube pass in the course of manufacture, a large amount of metal is lost due to scaling, amounting to as much as 3 to 5 per cent of the original billet weight.

Accordingly, it is an object of the present invention to provide a method and apparatus for eliminating the foregoing difficulties.

It is a further object of the present invention to produce tightly adhering scale on the interiors of seamless pipes and tubes.

The foregoing and further objects and the method and means of accomplishing same will be apparent from the specification which follows and by reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic view, partly in section, of the rolls and mandrel or plug of a seamless pipe or tube mill.

Figure 2 is a sectional view of the forward end of the mandrel or plug showing the apparatus of the present invention in association therewith.

Referring more particularly to the drawings, the numeral 2 designates a pair of suitably driven metal-working rolls which, in cooperation, are adapted to helically advance a tubular workpiece A over an internally disposed mandrel or plug 3 to thereby reduce the wall-thickness and increase the diameter of the said workpiece.

The mandrel or plug 3 is disposed on a bar cap 4 which is carried on the forward end of mandrel 5. The rear end of the mandrel bar 5 is pivotally disposed, as at 6, in a thrust block 7 which is rotatably carried in a housing 8 by means of suitable bearings 9. Internally disposed in the mandrel bar 5 is a pair of telescoped pipes 12 and 13. The interior pipe 12 is connected to a suitable high pressure air tank 14 and delivers compressed air through the bore 15 in the bar cap 4 to communicating nozzles 16 in the forward end of the said bar cap.

The outer pipe 13 is connected to a source of supply of water or other cooling fluid and terminates adjacent the forward end of the mandrel bar 5. At the rear end of the mandrel bar 5 there is provided a number of apertures 20 for the withdrawal of the cooling fluid.

An annular chamber 21 is provided at the forward end of the mandrel bar 5; and it has a number of discharge orifices 21' closely adjacent the rear end of the mandrel or plug 3. The annular chamber 21 communicates with the interior of the mandrel bar 5 by means of a pipe 22 in which there is disposed a valve 23. The valve 23 is normally held in closed position by means of a spring 24; and is opened by pressure on a piston 25 which operates in a cylinder 26. Air under pressure is admitted to the cylinder 26 by a pipe 27 which is connected to the pipe 12.

In operation, the workpiece A, heated to forging temperature, is introduced into the pass defined by the rolls 2 and the mandrel or plug 3, whereupon the mill operator opens a valve 28 to admit air under high pressure through the pipe 12, bore 15 and jets 16 to the interior of the said workpiece. This blows all loose and loosely adhering scale out of the workpiece, so that the surface thereof approaching the mandrel or plug 3 is substantially scale-free.

In order to produce the desired dense and closely adhering oxide film to protect the interior of the pipe or tube against scaling during this and subsequent operations, such as reeling and sizing, and also to provide protection against corrosion in the finished pipe, it is desired to expose the clean, heated interior surface of the workpiece to steam vapor immediately after it passes over the mandrel or plug and before the usual scale has time to form thereon. This is accomplished by discharging water on the interior of the heated workpiece as closely as possible to the rear end of the mandrel. A certain portion of this water evaporates to steam which becomes superheated and partially disassociates within a very short period of time. The generation of this steam, if sufficient water is admitted...
to the interior of the workpiece, produces an internal pressure which prevents air from entering and prevents undesirable oxidation while the pipe or tube is cooling to below 1000° F. Care must be exercised, however, not to inject too much water into the pipe, as this will cause localized cooling and set up undesirable strains therein.

The cooling water applied to the interior of the mandrel bar 5 flows into the front end thereof from the pipe 13 and exits through the apertures 20 at the rear end of the mandrel bar. Since the mandrel bar is completely filled, water will flow into the annular chamber 21 when the valve 23 is open and be sprayed onto the interior of the workpiece. The valve 23 is normally held closed by the action of spring 24 and is opened by air pressure operating on the piston 25. Since the air pressure is turned on by the mill operator when the workpiece approaches the mandrel 3, and off when it has passed thereover, it will be understood that the valve 23 controlling the entry of water to the chamber 21 is closed except when a workpiece is actually being rolled.

I have shown the appearances of only one specific embodiment of the present invention, it will be seen that I do not wish to be limited exactly thereto, since various modifications may be made without departing from the scope of the invention as defined in the appended claims.

I claim:

1. In a tube rolling mill having a pair of opposed metal-working rolls which are adapted to helically advance a workpiece over an interiorly disposed mandrel to reduce the wall thickness thereof, a mandrel bar, a mandrel plug arranged on the outer end of said mandrel bar, and means arranged on the inner side of said plug for delivering a fluid into the interior of the workpiece on that side of said plug so as to provide pressure within the workpiece immediately on the inner side of said plug to prevent air from contacting the interior surface of the workpiece at this point thereby preventing oxidation by air of said surface while the workpiece cools immediately after the workpiece on the side of said plug so as to provide pressure within the workpiece immediately on the inner side of said plug of an amount sufficient to prevent air from contacting the interior surface of the workpiece at this point thereby preventing oxidation by air of said surface while the workpiece cools immediately after working the same.

2. In a tube rolling mill having a pair of opposed metal-working rolls which are adapted to helically advance a workpiece over an interiorly disposed mandrel, a mandrel bar, a mandrel plug arranged on the outer end of said mandrel bar, means arranged on the outer end of said mandrel bar, and means arranged on the outer end of said mandrel bar beyond said plug for delivering air under pressure into the interior of the workpiece, and means arranged on the inner side of said plug for delivering a fluid into the interior of the workpiece on that side of said plug so as to provide pressure within the workpiece immediately on the inner side of said plug of an amount sufficient to prevent air from contacting the interior surface of the workpiece at this point thereby preventing oxidation by air of said surface while the workpiece cools immediately after working the same.

3. In a tube rolling mill having a pair of opposed metal-working rolls which are adapted to helically advance a workpiece over an interiorly disposed mandrel, a mandrel bar, a mandrel plug arranged on the outer end of said mandrel bar, means arranged on the outer end of said mandrel bar beyond said plug for delivering air under pressure into the interior of the workpiece, said plug having a bore arranged therethrough which communicates with said last mentioned means through which the air is conveyed thereto, and said last mentioned means arranged on the inner side of said plug for delivering a fluid into the interior of the workpiece on that side of said plug so as to provide pressure within the workpiece immediately on the inner side of said plug of an amount sufficient to prevent air from contacting the interior surface of the workpiece at this point thereby preventing oxidation by air of said surface while the workpiece cools immediately after the workpiece on the side of said plug so as to provide pressure within the workpiece at that point of an amount sufficient to prevent air from contacting the interior surface of the workpiece at this point and thereby form a thin, tightly adhering oxide coating thereon which prevents undesirable oxidation.
oxidation by air of said interior surface while the workpiece cools after working the same.

8. A method of reducing scale losses in the manufacture of seamless pipes and tubes, which includes helically advancing a heated workpiece over a mandrel plug to reduce the wall-thickness thereof, and directing a stream of water onto the wall of the tube immediately after it passes over the mandrel plug, said stream being of sufficient volume to form a steam atmosphere within the workpiece on contacting the highly heated walls thereof but insufficient to materially cool the same so as to provide pressure within the workpiece at that point of an amount sufficient to prevent air from contacting the interior surface of the workpiece at this point and thereby form a thin, tightly adhering oxide coating thereon which prevents oxidation by air of said interior surface while the workpiece cools after working the same.

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