

1

2,941,910

METHOD FOR HEAT TREATING STEEL PIERCER POINTS

Charles A. Turner, Flourtown, Pa., assignor to Selas Corporation of America, Dresher, Pa., a corporation of Pennsylvania

No Drawing. Filed Jan. 24, 1958, Ser. No. 710,841

4 Claims. (Cl. 148—134)

The present invention relates to the heat treatment of metal, and more particularly to the heat treatment of mandrels or piercer points used in the piercing of seamless steel tubes.

In the manufacture of seamless tubes, a hot billet is forced against a mandrel or piercer point that is held stationary. The hot billet is then rotated against the point and forced over it to form the tube. The high temperatures and pressures encountered in this operation would cause the piercer point to weld to the tube blank if it were not for an oxide coating that is formed on the surface of the piercer point, and which acts as a lubricant.

It has been customary in the past to provide a scale on the surface of the piercer point in order to prevent the point from sticking to the billet during the piercing operation. Various methods have been provided for placing the scale on the piercer point, but in general they all consist of heating the point to an elevated temperature in an oxidizing atmosphere, holding it in that atmosphere at temperature until scale of a sufficient thickness has formed on the surface and air cooling. The life of piercer points, or the number of billets that can be pierced is variable depending upon a number of things, but primarily it is dependent upon the type of scale on the point surface.

It is an object of the invention to provide a method of heat treating metal to place a tightly adhering scale or oxide coating on its surface. It is a further and more specific object of the invention to provide a mandrel for use in piercing of seamless tubes and the like which will have a long life, and one having a surface that will produce a smooth inside surface of the tube.

The various features of novelty which characterize my invention are pointed out in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects obtained with its use, reference should be had to the accompanying descriptive matter in which I have described a preferred embodiment of the invention.

Ordinarily the steel used for piercer points is an alloy steel that has high strength and toughness at the elevated temperatures at which it is used. Frequently there is included in the alloy a small percentage, such as 1%, of copper to increase the yield strength of the metal.

In carrying out the method of the invention the steel, already cast in the proper shape, is placed in a furnace that is maintained at a temperature of 2400° F. or higher. The furnace is fired with a fuel-air mixture, the ratio of which is so adjusted that there is no free oxygen in the furnace atmosphere and preferably about 2% combustibles ($H_2 + CO$) formed by the products of combustion. The piercer point is placed in the hot furnace and has its surface temperature raised to 2000° F. to 2200° F. in from five to seven minutes. Naturally the time of heating will vary somewhat with the size of the point, with smaller points requiring less time to heat. The criterion is fast heating obtained with a high temperature differential between the furnace and work. It may

2

be necessary to rotate the point while it is being heated in order to insure that the heating is uniform.

After the piercer points are brought up to temperature they are transferred rapidly to another furnace or portion of the furnace in which they were heated, with the same atmosphere as the heating furnace, which is held at about the temperature to which the points were heated so that the points can be soaked at this temperature. The soaking time at this temperature is from 45 to 120 minutes with the preferred time being from 60 to 90 minutes. After soaking the points are removed from the furnace and air-cooled.

The resultant piercer point has a hard, tightly adherent scale that can be used for piercing two or three times as many tubes as can be pierced by points treated by the usual practice.

The superior scale adherence that is produced by the present invention is attributable to several factors. When steel is heated in an atmosphere produced by burning a fuel with an excess of air over the stoichiometric proportion for the particular fuel used, about 10% of the scale formed adheres. If the steel is heated in an atmosphere produced by burning fuel with a deficiency of air, below the stoichiometric proportions, of about 30% of the scale adheres to the steel. The metal is subjected immediately to the high temperature of the furnace without any preheating. This not only speeds up the heating with a consequent shorter time for the entire cycle, but more importantly, means that the metal is never subjected to low temperature furnace gases. Furnace gases have different oxidizing effects at different temperatures. In a reducing (no free oxygen) atmosphere the CO_2 and water vapor present apparently will not form an oxide at lower temperatures, but will form a tight one at high temperatures. At about 1100° F., scale is loose and easily removed. At 2100° F., the grain boundaries of the steel are strongly oxidized and an interlocking of the scale and the metal promotes scale adherence. This intergranular locking of the scale to the metal is accomplished by rapid heating to the high temperature mentioned.

If copper is included in the steel analysis, its effect on scale formation must be taken into consideration. Because of selective oxidation of the iron, copper tends to concentrate on the surface of the metal beneath the scale when the points are heated under oxidizing conditions. The copper appears to render the iron somewhat more resistant to oxidation and sets up a barrier to the development of grain-boundary oxidation, which promotes improved scale adherence.

At 2100° F. the temperature is above the melting point of copper, and the copper diffuses to the surface of the metal and since the furnace atmosphere is reducing, the copper vaporizes. This is shown by the appearance of a green flame in the furnace stingout. The copper, therefore, cannot interfere with the development of a tight, heavy scale.

As a specific embodiment of the invention an alloy steel piercer point, four and three-quarters inches in diameter, was heated in a 2400° F. furnace having no free oxygen in its atmosphere. The piercer point was heated for six minutes to a surface temperature of 2100° F. and held at this temperature for 90 minutes, and was then allowed to air cool. The piercer point was covered with a tightly adhering scale that had a relatively smooth surface. This scale acts as a lubricant during a piercing operation. In tests of fifteen points heat treated in this fashion, it was found that they were used to pierce an average of 97 billets each, with one point piercing 157 billets. Other points from the same melt of steel that were heat treated in the conventional manner only averaged 20 billets each.

3

While in accordance with the patent statutes, I have described the best embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the embodiment disclosed without departing from the spirit and scope of the invention as set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. The method of heat treating an alloy steel piercer point which comprises placing the steel directly in an atmosphere at high temperature that has no free oxygen and heating the steel to a temperature within the range of 2000° F. to 2200° F. in from five to seven minutes, soaking the piercer point at the temperature to which it was heated and in the same atmosphere for from 45 to 120 minutes, and cooling the piercer point in air to thereby produce a tightly adherent scale on the surface thereof.

2. The method of placing a scale on the surface of a piercer point which comprises placing a piercer point directly in a furnace at a temperature of at least 2400° F. and an atmosphere with no free oxygen, keeping the piercer point in the furnace until its surface temperature is substantially 2100° F., soaking the piercer point at this temperature and in an atmosphere similar to that in which it was heated for from 60 to 90 minutes, and cooling the piercer point in air.

3. The method of placing a scale on the surface of a

4

piece of steel which comprises inserting the piece directly in a furnace having no free oxygen in its atmosphere and at a temperature above 2100° F., keeping said piece in the furnace while its temperature is raised rapidly to 2100° F. plus or minus fifty degrees, soaking said piece of steel at said temperature for not less than sixty minutes or more than ninety minutes and removing said piece from the heat and cooling it in air.

4. The method of placing a tightly adherent scale on the surface of a piece of alloy steel which comprises placing the steel directly in a furnace having a temperature of at least 2400° F. and an atmosphere obtained by burning fuel with a deficiency of air, keeping the steel in this furnace until its surface temperature has been raised rapidly to substantially 2100° F., transferring the steel quickly to a space having substantially the same atmosphere as the furnace and a temperature substantially equal to that of the steel, holding the steel in the space for from sixty to ninety minutes, and removing the steel from the space and cooling it in air.

References Cited in the file of this patent

UNITED STATES PATENTS

2,576,782 Daley et al. ----- Nov. 27, 1951

OTHER REFERENCES

"The Iron Age," November 20, 1952, volume 170, by Turner et al., pages 140-144.

"Industrial Heating," January 1951, volume 18, by Mawhinney, pages 40-44, 172, 174 and 176.