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PROCESS AND PREPARATION FOR HEAT TREATING OF STEEL

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This invention relates to an improved process and preparation for heat treating of steel.

In heat treating steel it is desirable that the degree of carburization and of carbon penetration be varied depending upon the qualities which it is desired to obtain in the steel. Controlling the treatment so as to obtain the desired percentage of carburization and depth of penetration and so as to obtain the desired degree of uniformity in carburization is exceedingly difficult and presents many problems.

It is the object of the present invention to overcome the problems and difficulties heretofore encountered, and to provide an improved process and preparation for heat treating of steel which enables the operator to control in a relatively simple and convenient manner the percentage or degree of carburization and the depth of penetration, and to provide a substantially uniform degree of carburization.

A further object is the provision of an improved preparation of the above character which may be packed, transported and stored in liquid form for convenience in handling, but which is converted into gaseous or vapor phase when introduced into a heat treating chamber so as to provide the desired type of atmosphere. By varying the proportions of the components employed, as hereinafter described, the gaseous or vapor atmosphere thus provided, may vary from a substantially neutral atmosphere to an atmosphere which is of a highly carburizing character.

In carrying out my invention, I propose to provide a preparation which may be packed, transported and handled in liquid phase, but which will change to a vapor or gaseous phase when subjected to heat treating temperatures in the range of 1500° F. or higher. This preparation consists primarily of a mixture of two other components. The first of these components is a liquid hydrocarbon carburizing agent which will vaporize, decompose and crack when introduced into a heat treating chamber at heat treating temperatures to release carbon monoxide (CO) and carbon dioxide (CO_2) in such proportion as to cause carburization of the steel being treated.

The second component may be referred to, for convenience, as an oxidizing agent and is a material which, when introduced into a heat treating chamber at heat treating temperatures, will release free oxygen and will thereby serve as an oxidizing agent to oxidize the carbon resulting from decomposition or cracking to produce carbon monoxide (CO) and carbon dioxide (CO_2), while excess of oxygen over precipitated carbon reacts with the carbon monoxide (CO) to produce carbon dioxide (CO_2).

As the first component, I may employ any one of the known carburizing agents which are normally in liquid phase and which vaporize and crack when introduced into a heat treating chamber at heat treating temperatures so as to produce a carburizing atmosphere. Examples of this type of material are the aliphatic alcohols such as ethyl, methyl, propyl and butyl alcohol, and also dipentine. Various liquifiable members of the paraffin series may also be employed in which event those materials which are in gaseous phase under normal atmospheric conditions may be compressed to produce a liquid for the convenience of packing, transportation and use.

In determining which materials are suitable for use as a carburizing agent, I have found that the material should be one that can be handled and shipped in liquid phase and which, when subjected to heat treating temperatures in a heat treating chamber, will vaporize and crack to produce an atmosphere having both carbon monoxide and carbon dioxide in it, the carbon monoxide being in a proportion in excess of 12½ parts to 1 by volume of the carbon dioxide. In this connection I have found that carburization takes place when the carbon monoxide is in excess of substantially 12½ parts to one part of carbon dioxide and that the maximum degree of carburization takes place when the atmosphere includes carbon monoxide in the proportion of substantially 45 parts to 1 by volume of the carbon dioxide present.

As the second component of my preparation I may employ any material which is in liquid phase or which can be converted into liquid phase for shipping and handling, and which is cracked or chemically decomposed when subjected to heat treating temperatures in a heat treating chamber so as to release free oxygen. For this purpose I prefer to employ nitro-methane.

The two components may be mixed together in such proportions that when they are introduced into a heat treating chamber at heat treating temperatures, they will produce an entirely neutral atmosphere or, by varying the proportion they will be caused to produce a highly carburizing atmosphere. By decreasing the percentage of the second component or oxidizing agent, the carburizing characteristic of the atmosphere is increased. By increasing the proportion of the second component, the carburizing characteristic of the atmosphere is decreased. When the percentage of components are so ar-

ranged that the atmosphere resulting in the heat treating chamber at heat treating temperatures contains carbon dioxide and carbon monoxide in the proportion of substantially 45 parts to 1 by volume of carbon monoxide to carbon dioxide, the highest degree of carburization is obtained. On the other hand, by arranging the proportions of components so that the atmosphere contains less than 12½ parts of carbon monoxide by volume to each part of carbon dioxide, a substantially neutral atmosphere is obtained. The proportions may also be varied to obtain any degree of carburization which may be desired between these two extreme limits.

As one specific example of the components that may be used in my preparation, I may employ butanol, or butyl alcohol as the first component or carburizing agent. As the second component or oxidizing agent, I may employ nitro-methane. Both of these materials are in liquid phase under normal atmospheric conditions, and are readily mixable with each other in any desired proportions. When butanol is introduced into a heat treating chamber at heat treating temperature, it will vaporize and crack to produce a carburizing atmosphere. When nitro-methane is introduced into a heat treating chamber at heat treating temperature, it likewise will vaporize and break down, releasing free oxygen.

The proportions of the butanol and nitro-methane in the preparation may be varied. When substantially 30 percent by volume of butanol, and 70 percent by volume of nitro-methane are mixed together, the resulting preparation produces a neutral atmosphere when introduced into a heat treating chamber at heat treating temperatures, which will neither carburize or oxidize the steel being treated. When substantially 90 percent of butanol and 10 percent of nitro-methane are mixed together, the resulting preparation when introduced into a heat treating chamber at heat treating temperatures, produces an atmosphere having the highest carburizing characteristic.

Varying the proportions between these two extreme results in preparations producing atmospheres having varying intermediate carburizing characteristics. Decreasing the percentage of nitro-methane below 10 percent also results in decreasing the carburizing characteristic.

In using my improved preparation the two components are mixed together so as to produce a liquid preparation having the desired carburizing characteristic. Due to the fact that the preparation is in liquid form, it may be conveniently packed, transported, stored and used.

In the heat treatment of steel, the steel is treated in the usual heat treating chamber and the preparation is introduced into the chamber in liquid form in some suitable fashion as by dropping it or spraying it in. The heat treating temperature causes the preparation to vaporize, decompose and crack, producing an atmosphere having the desired neutral or carburizing characteristic depending upon the proportions of the components used in the preparation. Various types of heat treating preparations having different carburizing characteristics will be required, and those skilled in the art will readily be able to select the preparation having the desired neutral or carburizing characteristic. By increasing the percentage of butanol to substantially 90 percent, an atmosphere is produced having a high carburizing characteristic having approximately 45 parts of carbon monoxide to 1 part of carbon dioxide. By increasing the proportions of nitro-methane to approximately 70 percent, the proportion of carbon monoxide is decreased to less than 12½ parts of carbon monoxide to each part of carbon dioxide resulting in a substantially neutral atmosphere.

Instead of mixing the components together to form a unitary preparation before introducing the preparation into the chamber, it is possible that, under certain circumstances the two components may be introduced simultaneously into the chamber without being first mixed together.

Various modifications may, of course, be made in the described embodiment of my invention without departing from the invention as set forth in the accompanying claims.

I claim:

1. A preparation for use in heat treating steel comprising a liquid mixture of butanol and nitro-methane.

2. A preparation for use in heat treating steel comprising a liquid mixture of butanol and nitro-methane, the nitro-methane comprising no more than substantially 70 percent of the mixture.

3. A preparation for use in heat treating steel comprising a liquid mixture of approximately 30 percent butanol and approximately 70 percent nitro-methane.

4. A preparation for use in heat treating steel comprising a liquid mixture of between approximately 30 and 90 percent of butanol and between 70 and 10 percent of nitro-methane.

5. In the process of heat treating steel, the step which comprises introducing into the heat treating chamber when it is at heat treating temperature, a carburizing agent which is liquid at atmospheric conditions and which vaporizes and cracks at heat treating temperatures to produce a carburizing atmosphere, and nitro-methane.

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