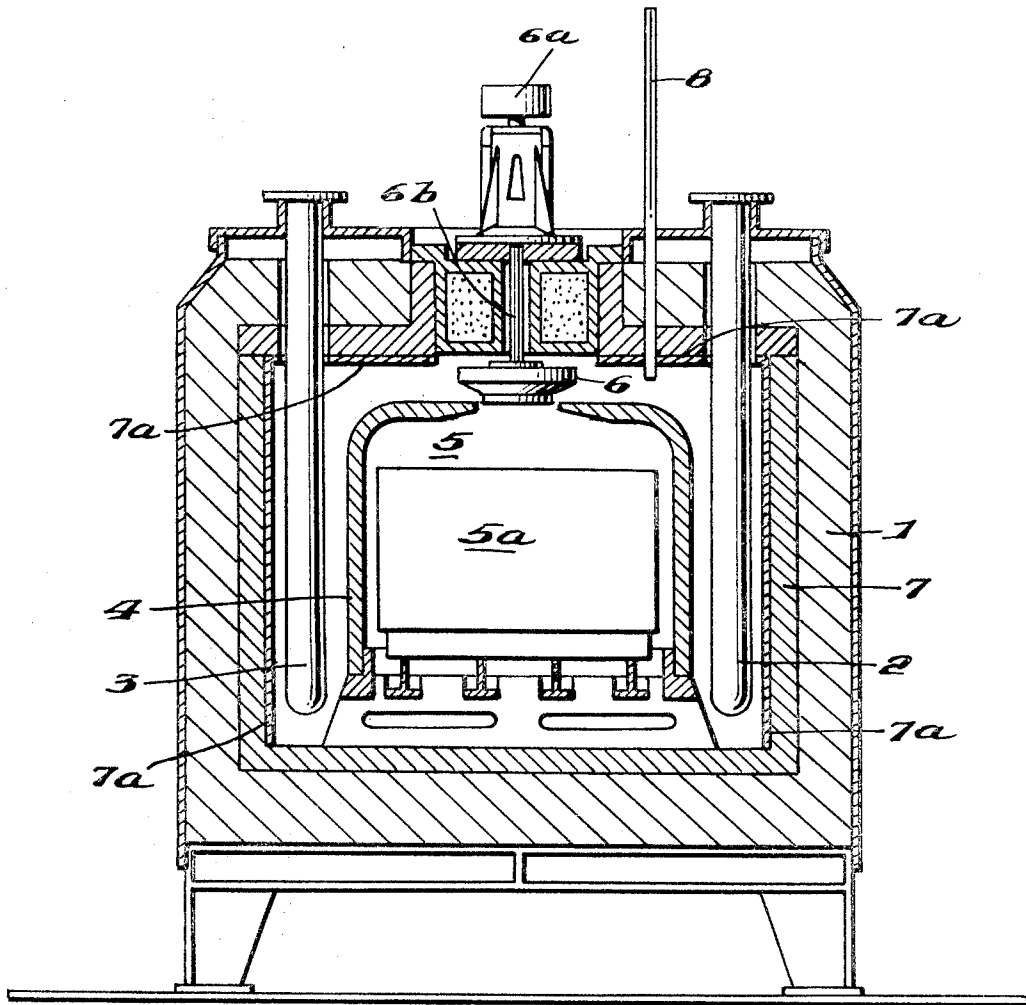


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PROCESS FOR THE TREATMENT OF SURFACES OF WORKPIECES IN
AN ANNEALING FURNACE
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PROCESS FOR THE TREATMENT OF SURFACES OF WORKPIECES IN AN ANNEALING FURNACE

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ABSTRACT OF THE DISCLOSURE

Gases which are to be used in various processes in annealing furnaces are produced in situ with the aid of catalysts applied to the inner walls of the furnaces.

BACKGROUND OF THE INVENTION

Field of the invention

The invention relates to annealing furnaces in which gases are employed.

Description of the prior art

Protective gases or carrier gases which are used in chemical processes such as the gas carburizing, gas carbonitriding and bright hardening processes, for the treatment of the surfaces of various types of workpieces including metals such as steel and steel alloys, have been produced, in general, in special generators. These gases are produced, generally, in exothermic or endothermic processes in which a hydrocarbon fuel is partially or completely combusted in air. Thus, in order to produce a protective gas endothermically, the hydrocarbon fuel is mixed with such an insufficient amount of air or oxygen for combustion that the combustion of the fuel is not as complete as would be the case in an exothermic combustion of the fuel. The protective gas generators in which these endothermic reactions are conducted have an additional heated reaction chamber in which a catalyst is placed in order to provide for improved decomposition of the fuel, particularly when the heavier hydrocarbon materials are used for this purpose.

It has been proposed several times that the protective gases be produced in suitable annealing furnaces in which they were to be used in the gas carburizing, gas carbonitriding or bright hardening processes conducted in such furnaces. When these processes were conducted, however, in the furnaces prepared in accordance with such proposals, undesirable carbon black formed on the surfaces of the workpieces which rendered the surfaces of the workpieces inactive. In addition, the dependability of the operation of the furnaces was jeopardized by the carbon black.

SUMMARY OF THE INVENTION

The object of the present invention is to provide a process and device in which various types of gases may be formed in situ in annealing furnaces, and without the attendant formation of carbon black.

The essence of the present invention resides in the use of an annealing furnace which has a catalytically active surface therein for use in the in situ formation of gases.

BRIEF DESCRIPTION OF THE DRAWING

The drawing shows an annealing furnace in which the process of the present invention may be conducted.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

It has now been found, in accordance with the present invention, that various types of protective gases can be produced without difficulty by supplying air for combustion and fuel to an annealing furnace, if the wall of furnace, preferably a ceramic wall, is treated with a catalyst, for example nickel oxide, in such a way as to provide the wall with a layer of catalyst as, for example, by applying nickel oxide in a liquid carrier to the wall, and then vaporizing off the liquid so as to leave behind a layer of nickel oxide. Since the ceramic walls of annealing furnaces have large surface areas, the treatment of the wall with the catalyst in this way will provide a sufficiently large active surface area for the purposes of the present invention. In addition, the treatment prevents the formation of carbon black on the walls of the furnace.

The drawing shows an annealing furnace device of the present invention. The device has an outer wall 1. The inside of the furnace is heated by steel heating rods 2 and 3. Within the furnace there is located a gas containing muffle 4 in which there is located area 5 in which workpiece 5a is placed when it is to be processed in the furnace. The atmosphere within the furnace is agitated by means of a rotating ventilator 6 which is turned by means of knob 6a which is attached to ventilator 6 by rod 6b. On the inner wall 7 of the furnace there is a layer of catalyst 7a. The catalyst layer can, for example, as mentioned above, be formed by placing a layer of nickel oxide on wall 7. However, if desired, another catalyst can be used, such as platinum or palladium. Through inlet tube 8 there can be introduced into the furnace a mixture of air and fuel, such as a heavy hydrocarbon such as butane or propane. When this mixture is partially combusted in the furnace, in contact with the catalyst, a gas which can be used for carburizing the workpiece is formed. If it is desired to form a gas for carbonitriding, then ammonia can also be introduced into the furnace, simultaneously, with the hydrocarbon material.

It has proved advantageous to use catalyst preparations containing nickel, generally with a content of Ni of 3 to 6%; but catalysts containing precious metals may also be applied, i.e. metal catalysts, preferably a nickel or a precious metal catalyst on a suitable carrier material, e.g., finely divided aluminum oxide.

The protective or carrier gas is formed in the furnace during the operation of the furnace under the conditions commonly employed for such processes, i.e.,

Process	Operating conditions	
	Temperature (° C.)	Pressure (Torr)
Carburizing	800-1,100	0.2-4,000
Carbonitriding	750-1,100	0.5-3,000
Bright hardening	750-1,100	0.5-3,000

The time of treatment varies between 1 and 10 hours according to the desired carbon content, depth of carburization and the strength of the nitriding layer.

The workpieces that may be treated during such processes in accordance with the present invention include all those types of materials that are commonly treated in such processes, such as, ferrous materials including steel and steel alloys. To improve hardness and resistance against wear and tear all technical parts of machinery, parts of gear, working parts, the surfaces of which may be carburized, gas carbonitrided and bright hardened, may be treated accordingly.

To carburize the surfaces of metal, city gas, generator gases, coke oven gas, methane, propane, butane and mixed

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power gases deriving from the aforementioned kinds of gas may be used. Furthermore, the necessary gas atmospheres may also be furnished by liquid hydrocarbons such as fuel oil, diesel oil, benzene, alcohol and the like. For nitriding or carbonitriding purposes NH₃ may also be applied in addition of the aforementioned gases.

The gases that can be formed in the furnaces in accordance with the present invention include all those commonly employed in annealing furnaces, and preferably those formed in endothermic reactions. A listing of the types of such gases, the precursors which are reacted to form such gases, and the catalysts to be employed in such reactions is as follows:

Type of gas	Precursors	Catalyst
Carburizing.....	(a) C ¹ to C ¹⁰ hydrocarbon+oxygen.	(a) NiO, Pt, or Pa
Carbonitriding.....	(a) C ¹ to C ⁸ hydrocarbon+oxygen+ammonia.	(a) NiO, Pt or Pa
Bright hardening.....	(a) C ¹ to C ¹⁰ hydrocarbon+oxygen.	(a) NiO, Pt, or Pa

When used as a coating on the wall of the furnace the catalyst should be applied thereto so as to provide an adherent, continuous active catalyst layer. The manner of applying the catalyst is not important as long as the continuity and adherence of the catalyst is not disturbed during the operation of the furnace. The inner wall may be ceramic, or other materials.

The following examples are merely illustrative of the scope of the present invention and are not intended as a limitation thereof.

EXAMPLE

Gas carbonitriding of gear wheels for automobiles.
 Working temperature—870° C.
 Initial depths of hardness—0.5 mm. (HV 525)
 Carbon content—0.8% C.
 Heating to a temperature of about 870° C.—about 60 min. with a CO₂ value of about 0.6% in a mixture of propane and air in a ratio of 1:9

Time of carbonitriding—about 90 min. with a CO₂ value of about 0.3%.

During the carbonitriding process the aforementioned gas-air mixture is kept and an additional amount of 100 1 NH₃ passed into the mixture. Subsequently, the workpieces are quenched in oil.

We claim:

1. In a process for treating a workpiece in an annealing furnace in an atmosphere of a protective or carrier gas selected from the group consisting of a carburizing gas, a carbonitriding gas and a bright hardening gas, the improvement comprising forming the gas for such treatment in said furnace by combusting a mixture of fuel and oxygen while contacting said mixture with a catalyst adapted to catalyze the formation of said gas and selected from the group consisting of nickel oxide, platinum and palladium.

2. A process according to claim 1, wherein the catalyst is nickel oxide.

3. A process according to claim 1, wherein the gas is a carburizing gas.

4. A process according to claim 3, wherein the catalyst is nickel oxide.

5. A process according to claim 1, wherein the gas is carbonitriding gas.

6. A process according to claim 5, wherein the catalyst is nickel oxide.

7. A process according to claim 1, wherein the gas is a bright hardening gas.

8. A process according to claim 7, wherein the catalyst is nickel oxide.

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