

- [54] **ATMOSPHERIC FURNACE APPARATUS**
 [75] Inventor: **Keishichi Namba**, Yokohama, Japan
 [73] Assignee: **Tokyo Netsushori Kogyo Kabushiki Kaisha**, Kanagawa-ken, Japan
 [22] Filed: **Apr. 9, 1973**
 [21] Appl. No.: **349,323**

- [30] **Foreign Application Priority Data**
 Apr. 7, 1972 Japan..... 47-34917
 [52] U.S. Cl..... 432/203, 432/19, 432/26, 432/205
 [51] Int. Cl..... F27b 1/08, F27b 3/02
 [58] Field of Search..... 432/19, 26, 198, 200, 201, 432/202, 203, 205

- [56] **References Cited**
UNITED STATES PATENTS
 2,039,429 5/1936 Lydon..... 432/203 X

2,152,154	3/1939	Robiette	34/36 X
2,283,982	5/1942	Germany	432/202 X
2,869,848	1/1959	Dickie et al.	432/198

Primary Examiner—John J. Camby
Attorney, Agent, or Firm—Robert E. Burns;
 Emmanuel J. Lobato; Bruce L. Adams

[57] ABSTRACT

A gas atmospheric furnace is provided which is used for carburizing or carbonitriding treatment of steel articles. A gas inlet for introducing an atmosphere gas into the furnace communicates with a passageway formed around the shaft of a fan which is used to agitate the gas. A different kind of gas is also introduced into the gas inlet through the same passageway. Another gas inlet is disposed in opposing relationship with the first mentioned gas inlet, and gases supplied through both gas inlets serve to maintain the temperature within the furnace constant.

5 Claims, 3 Drawing Figures

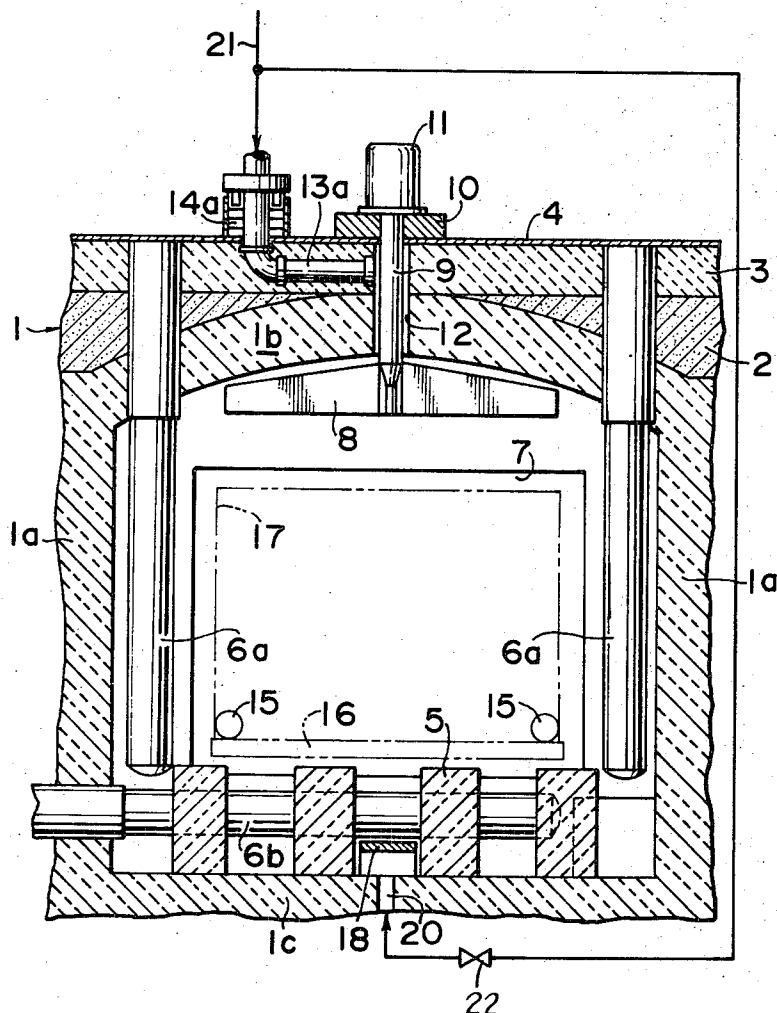


FIG. 2

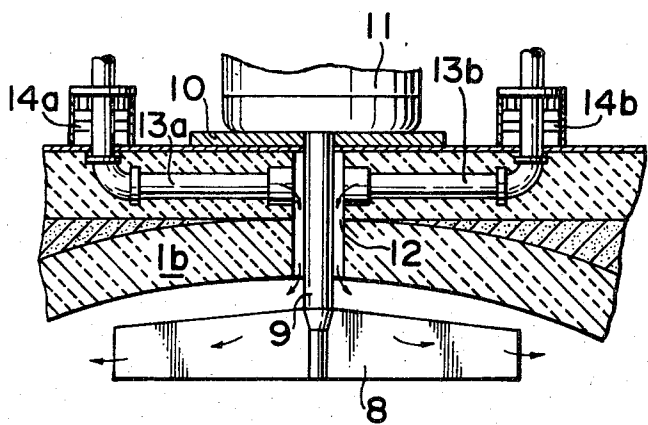
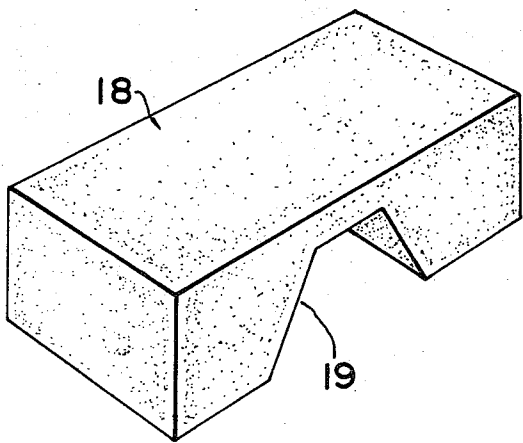


FIG. 3



ATMOSPHERIC FURNACE APPARATUS

The invention relates to a gas atmospheric furnace and more particularly to a heat treatment furnace having improved gas inlets.

Gas carburizing processes and gas carbonitriding processes are now well known in the art of case hardening of steel articles. In the long known gas carburizing process, a carburizing gas including natural gas or propane gas is fed into a heat treatment furnace which is hermetically sealed for carburizing an article to be treated under heat within the atmosphere. Gas carbonitriding process involves heating in a gas atmosphere which comprises the carburizing gas to which is added ammonia gas, and has been developed recently as demonstrated by the disclosure in British Pat. No. 1,034,157 published June 29, 1966. Surface hardening achieved by carburizing is a transformation hardening, while the nitriding hardening is attributable to the formation of a compound and it is recognized that the thickness of a hardened layer has a close relationship with the nature of gas used as well as the heating temperature. For this reason, proper maintenance of the furnace atmosphere and the furnace temperature is of primary importance.

Batch type furnaces have been used with the gas carburizing and gas carbonitriding treatments, and recently a continuous furnace also finds its application in these treatments. These furnaces generally include a heating element disposed therein along the opposite side walls and the base, with a fan mounted on the ceiling. An atmosphere gas is introduced in a horizontal direction toward, the blades of the fan through the furnace wall. Thus the fan stirs the atmosphere gas supplied through the gas inlet while the resulting forced circulation enables heat from the heating element to be conveyed throughout the space within the furnace.

However, it is seen that the relative position of the fan and the gas inlet is such that there exists a location within the furnace which always remains under the influence of cold gas, thereby precluding a uniform temperature distribution throughout the furnace from being achieved. While fluid resistance governed by the furnace structure is involved with this problem, it is believed that the major difficulty is caused by the directional flow of the atmosphere gas produced by rotation of the fan.

A similar drawback of unevenness in heating is found in attempting to mix different gases within the furnace, as may be required, for example, when mixing the carburizing gas with ammonia gas in the carbonitriding process. Because ammonium carbonate, $(\text{NH}_4)_2\text{CO}_3$, which is formed upon reaction of carbonic acid gas (CO_2) contained in the carburizing gas with ammonia (NH_3), is in the form of white crystals, below 58°C , both gases cannot be mixed under normal temperature conditions before being fed into the furnace.

Therefore, it is an object of the invention to provide an atmospheric furnace having improved gas inlets capable of feeding an atmosphere gas toward a stirring fan in a manner which avoids a directional flow of the gas.

It is another object of the invention to provide an atmospheric furnace having a first gas inlet for feeding an atmosphere gas toward a fan and a second gas inlet located in opposing relationship with the first gas inlet for directing another atmosphere gas, the nature of which is

the same as that of the first mentioned gas, to be merged with the first mentioned gas diffused by the fan, thereby improving the thermal balance within the furnace.

It is a further object of the invention to provide an atmospheric furnace having a common gas inlet for different gases which is effective to effect an even mixing of the gases within the furnace.

In accordance with the invention, the atmospheric furnace comprises a gas inlet which opens into the furnace from a passageway formed along and around the shaft of a fan. The passageway communicated with a source of gas through a guide pipe. Where more than one gas is introduced into the furnace, separate guide pipes are provided to conduct the respective gases independently and communicate with the passageway. The atmosphere gas fed into the furnace through the gas inlet is diffused as the fan rotates, thereby preventing a directional flow. The fan and its shaft are directly exposed to the flow of the atmosphere gas directed from the guide pipe into the passageway, but the gas in this area is under normal temperature and hence provides a cooling function, which is highly effective to prevent corrosion of these parts by hot atmosphere gas.

The above objects and other objects and features of the invention will be better understood from the following detailed description of several embodiments thereof taken together with the drawings, in which:

FIG. 1 is a fragmentary section of the atmospheric furnace according to the invention.

FIG. 2 is a fragmentary section of a modified atmospheric furnace of the invention, and

FIG. 3 is a perspective view of a gas flow deflector shown in FIG. 1.

Referring to FIG. 1, the furnace constructed in accordance with the invention is shown in a cross section through a plane which extends vertically through the center of the fan and viewing toward the discharge opening of an article being treated. While the furnace is illustrated as one used for batch operation, it should be understood that the invention is not limited to such furnace, but is equally applicable to a continuous furnace. Indeed, the illustrated furnace portion may be taken as representing one zone such as a carburizing zone of a continuous furnace. The furnace is generally shown at 1 and is of conventional design in that it comprises a side wall 1a, ceiling 1b and base 1c, all of which are formed of refractory brick and which are externally covered with a shaped body 2 and board 3 both formed of conventional heat insulating material, with the outermost surface being lined with a shell of steel sheet 4. A plurality of mounts 5 formed of refractory brick are arranged on the base 1c in an array along mutually perpendicular axes, with a constant spacing between adjacent mounts, and are adapted to carry an article to be treated thereon within the space 7 of the furnace. Specifically, skid rails, not shown in the drawings are provided and guide a tray 16 on which is placed a basket 17 mounting the article being treated.

The heat source of an atmospheric furnace usually comprises an electrical heating element, which in the present example is shown at 6a and 6b positioned along the opposite side walls 1a and the base 1c of the furnace. The heating elements 6b are located intermediate adjacent rows or columns of the mounts 5. While the invention is not limited to any particular construction

and lay-out of the electrical heating elements, their arrangement shown is most customary and is known to be desirable.

A fan 8 is mounted on the ceiling 1b so as to have its shaft 9 extending therethrough to be connected with an external electric motor 11. A refractory seal 10 is provided around the shaft 9 between the shell 4 and the motor housing.

In accordance with the invention, a gas inlet passage way 12 is formed around and along the shaft 9 of the fan, and opens into the space 7 at its one end, while its other end is blocked by the refractory seal 10. A gas supply system 21 is connected with a guide pipe 13a including a gas seal 14a and which is connected with the inlet passage way 12. Thus, in the atmospheric furnace shown, an atmosphere gas supplied from the system 21 is conducted through the guide pipe 131 into the inlet passage way 12, and thence to the fan 8 while turning around the shaft 9 together therewith, and is diffused into the space 7 as a result of rotation of the fan 8. The atmosphere gas at normal temperature has a cooling effect on the fan 8 and the shaft 9 thereof, which effect prevents corrosion of the parts upon being heated to high temperatures and results in reduced durability of these parts from occurring. The atmosphere gas introduced into the furnace 7 through the gas inlet 12 is exhausted through suitably located outlets, which in the present example are shown at 15, 15 adjacent to the discharge opening of the article being treated. As is known, the fluid resistance presented by the heating elements 6 and the location of the gas outlets 15 must be deliberately taken into consideration when determining the gas flow, but in the atmospheric furnace of the invention, the uniform diffusion afforded by the fan 8 causes the atmosphere gas to flow toward the base 1c generally in a helical pattern. As a consequence, the speed of flow reduces as the base 1c is approached, whereby the degree of convection imparted to the heat from the heating element 6b is reduced. In certain instances, this may upset the thermal balance. Such a disadvantage can be eliminated in accordance with the invention by the provision of a second gas inlet.

The second gas inlet is shown by reference numeral 20 and is positioned in the base 1c so as to be opposite to the gas inlet 12 around the shaft 9 of the fan. The second gas inlet 20 is also connected with the gas supply system 21 through a branch circuit which includes a flow rate control valve 22, thereby allowing sufficient flow rate of the atmosphere gas to be supplied through the second gas inlet 20 to maintain the thermal balance within the furnace. The second gas inlet 20 may directly open into the space 7 of the furnace, but preferably is provided with a gas flow deflector 18 at its inner end. As shown in FIG. 3, the deflector 18 has a notch 19 opening in a particular direction. This enables cold gas to be directed to a desired location for recovering

the thermal balance within the furnace.

FIG. 2 shows a gas inlet arrangement useful in a carbonitriding furnace for mixing more than one gas therein. Like parts as in FIG. 1 are represented by corresponding reference characters. The reference characters 13b and 14b, not appearing in FIG. 1, represent an additional guide pipe and an additional gas seal, respectively. Thus, the arrangement is essentially the same as in FIG. 1, except that a pair of guide pipes 13a and 13b are provided, which are connected with the gas inlet passage way 12 for introducing different gases, for example, carburizing gas and ammonia gas, into the furnace. As mentioned previously, the mixing of these gases at normal temperature involves difficulties because of formation of ammonium carbonate, which are readily avoided by providing the common gas inlet 12 in the furnace. This is possible because the inlet passage way 12 can be maintained above the temperature at which formation of crystals of ammonium carbonate occurs as a result of its exposure to heat from the space 7 where a high temperature on the order of 400° to 600°C prevails. This is also assisted by the fan 8 which completely mixes and uniformly diffuses the different gases.

Having described the invention, what is claimed is:

1. A gas atmospheric furnace for carburizing and carbonitriding treatment of steel articles comprising a first gas inlet for introducing an atmosphere gas into the furnace under forced pressure, a fan for stirring the atmosphere gas introduced by said first gas inlet, said first gas inlet leading into a passageway formed along and around the shaft of the fan, and a second gas inlet located on the opposite side of the furnace from the first gas inlet, said second gas inlet introducing an atmosphere gas of normal temperature to cool the then relatively elevated gas adjacent the second gas inlet to thus maintain an even temperature of the gases within the furnace.

2. A gas atmospheric furnace according to claim 1, further including a guide pipe connected with the passage way for conducting the atmosphere gas from the first gas inlet therethrough to the passage way.

3. A gas atmospheric furnace according to claim 2, further including another guide pipe, the two guide pipes conducting different gases to the passage way.

4. A gas atmospheric furnace according to claim 1 in which said second gas inlet is connected with a gas supply system through a flow rate control valve.

5. A gas atmospheric furnace according to claim 1, further including a gas flow deflector located within the furnace adjacent to said second gas inlet to direct the gas entering said inlet to a desired location in said furnace to recover or maintain the thermal balance of gases therein.

* * * * *