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METHOD OF NITRIDING
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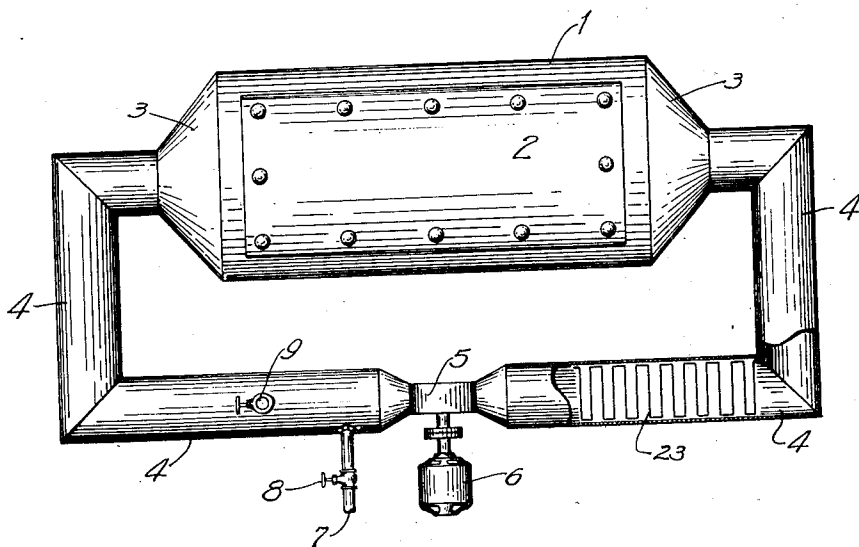


FIG. 1

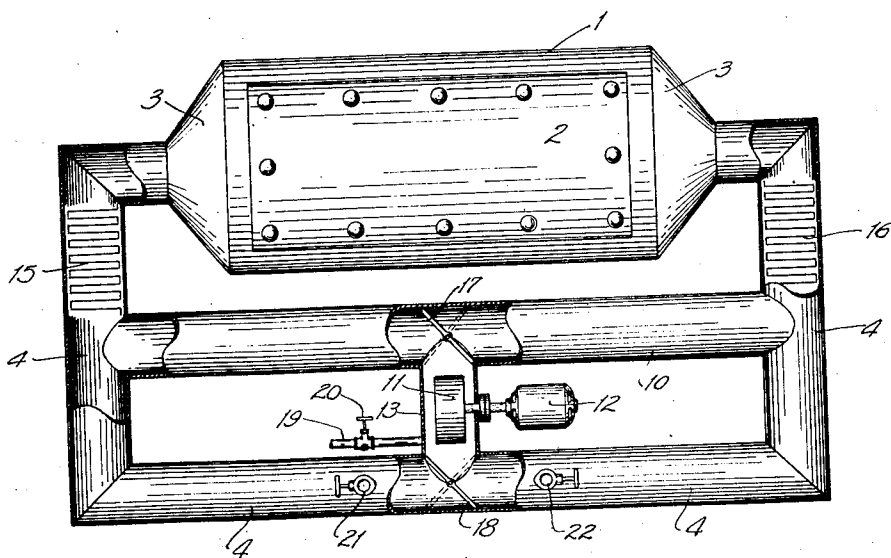


FIG. 2

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METHOD OF NITRIDING

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2 Claims. (Cl. 148—16)

My invention relates to a method for surface hardening materials by the nitriding process. It also contemplates a novel and improved method for heating the materials to be nitrided and maintaining the materials at the proper temperature during the nitriding treatment.

Heretofore it has been the practice to heat the materials to be treated and then pass cold ammonia gas into the nitriding chamber. In my method this procedure is substantially reversed. I first heat the ammonia gas and then heat and maintain the temperature of the materials to be nitrided by circulating the hot ammonia gas through or otherwise in contact with them at comparatively high velocity and within a substantially closed circuit. In this way the formation of pockets of stagnant gases is avoided and a uniformly hardened product is assured.

My invention relates particularly to the hardening by nitriding of hollow objects, such as cylinders and cylinder liners for internal combustion engines. In hardening cylinders and cylinder liners, it is essential that the internal ground surfaces be uniformly hardened. The external surfaces are desirably not hardened and if they are exposed during the nitriding operation and become hardened this results in a needless consumption of ammonia or other nitriding agent employed. It has been customary in hardening such articles to protect the surfaces not desired to be hardened by a suitable coating or covering, which usually must be removed after the nitriding operation, thus involving additional manipulation and expense.

My invention therefore includes the herein-after described method which may be carried out by the use of the elements described below and illustrated in the accompanying drawing in which—

Fig. 1 is a plan view in partial section of a nitriding furnace that may advantageously be employed in practicing the method; and

Fig. 2 is a similar view of a modified type.

Referring principally to Fig. 1 of the drawing, 1 represents the chamber within which the objects to be nitrided are placed and to which access is had by removing the cover, 2. This chamber is preferably but not necessarily cylindrical and is provided at each end with the reducing sections, 3, communicating with the piping system, 4, forming a closed circuit for the passage of the ammonia gas.

Preferably about midway of the piping system a blower, 5, is installed which is driven by motor, 6, and is adapted to circulate the gas at

comparatively high velocity through the piping system and nitriding chamber.

An ammonia inlet pipe, 7, equipped with a valve, 8, is provided on the intake side of the fan, and a valved outlet, 9, is also provided for the spent gas.

Within the piping system, 4, and preferably on the discharge side of the fan, a plurality of electrically heated grids, 23, are provided for heating the ammonia gas as it is circulated over and through them. These grids are of pure nickel or of a nickel alloy adapted to act also as a catalyzer for producing nascent nitrogen.

Referring now more particularly to Fig. 2, I have here illustrated a type of furnace in which the direction of flow of gas through the nitriding chamber may be reversed without reversing the direction of rotation of the motor. I accomplish this by means of the piping system illustrated and by providing therein adjustable dampers or valves for controlling the direction of gas flow. Here the piping system, 4, is substantially identical with the system shown in Fig. 1, but an additional cross pipe, 10, parallel to the nitriding chamber, is provided as shown, and the blower, 11, driven by motor, 12, is located in the short pipe, 13, connecting the center of pipe, 10, with the piping system, 4.

Electrical resistance heating elements, 15 and 16, similar to those above described, are provided in the pipes, 4. Two are here provided because the direction of the flow of gas through the nitriding chamber is reversible and it is preferable to heat the gas just before it enters the chamber.

At each end of pipe, 13, I provide a butterfly valve, 17 and 18, respectively, which may be manipulated to control the direction of flow of gas through the nitriding chamber. When the valves are set in the position shown by the solid lines in Fig. 2 the gas will flow in one direction through the nitriding chamber. When the valves are in the position indicated by the dotted lines in Fig. 2 the direction of the flow of gas through the chamber will be reversed.

As in the species shown in Fig. 1, I provide an ammonia inlet as shown at 19, and a valve, 20, for controlling the same. In this type of furnace two valved outlets, 21 and 22, respectively, may be provided for the release of the spent gas.

From the foregoing it will be apparent that the ammonia gas in passing over and about the electrically heated grids will absorb heat therefrom, carry this to the nitriding chamber and there transmit it to the objects or materials to

be nitrided. In other words, instead of following the usual procedure of heating the objects to be nitrided and then introducing cold ammonia gas into the nitriding chamber, this procedure is, in a way, reversed. By using a preheated ammonia gas in a closed circuit a flow thereof through the nitriding chamber can be maintained at comparatively high velocity, thus eliminating all pockets of stagnant gas which occur in furnaces of the present type and which cause lack of uniformity in the nitrided product.

It will also be apparent that my general arrangement of the heating elements and a fan for circulating the ammonia gas and heating it prior to bringing it into contact with the surface to be nitrided is conveniently adapted for the treatment of cylinders for internal combustion engines and the like. As above stated it is desirable to nitride harden only the interior of the cylinders and this may be done by substituting the cylinder itself, or a plurality thereof, suitably arranged to form a part of the conduit system, for the nitriding chamber, 1. In other words, the cylinder itself would form a portion of the passageway through which the ammonia gas passes.

While I have described my invention in its preferred embodiment it is to be understood that the words which I have used are words of description rather than of limitation and that the drawing is merely illustrative. Hence changes, within the purview of the appended claims, may

be made without departing from the true scope and spirit of my invention.

What I claim is—

1. In the art of nitriding localized portions of articles made of alloys of steel or cast iron, the steps which comprise disposing the localized portion of said article that is to be nitrided so that it forms a portion of a wall of a nitriding chamber, imparting violent motion to a nitrogen-yielding gas in reactive relation to said localized portion by introducing said gas into said chamber under elevated pressure, causing said gas to circulate rapidly through said chamber, repeatedly returning said gas to said chamber in a substantially closed cycle, and supplying heat to said gas in the course of its cyclic flow at a point outside of and in substantially heat isolated relation to said chamber.

2. In the art of nitriding articles made of alloys of steel or cast iron, the steps which comprise disposing a tubular article having interior surfaces to be nitrided, in a conduit system so that it forms a part of said system, causing a nitrogen-yielding gas to pass through said conduit system into contact with said surfaces, and repeatedly returning said gas to said chamber in a substantially closed cycle, supplying heat to said gas in the course of its cyclic flow at a point outside of and remote from said tubular article.

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