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HEAT TREATING FURNACE

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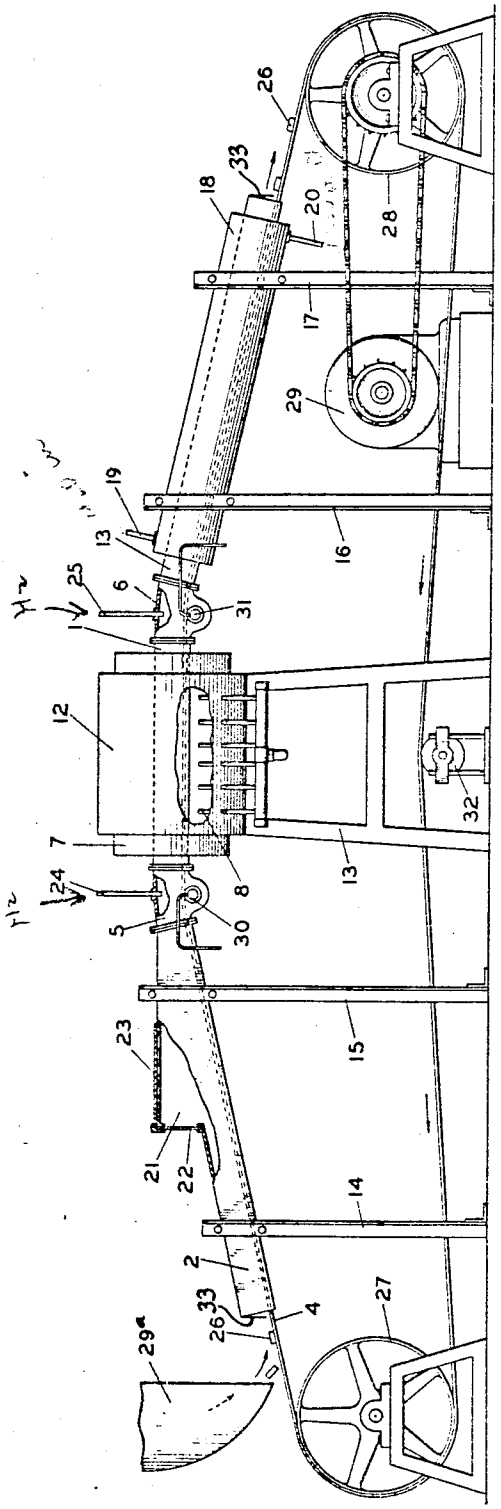


Fig. 1.

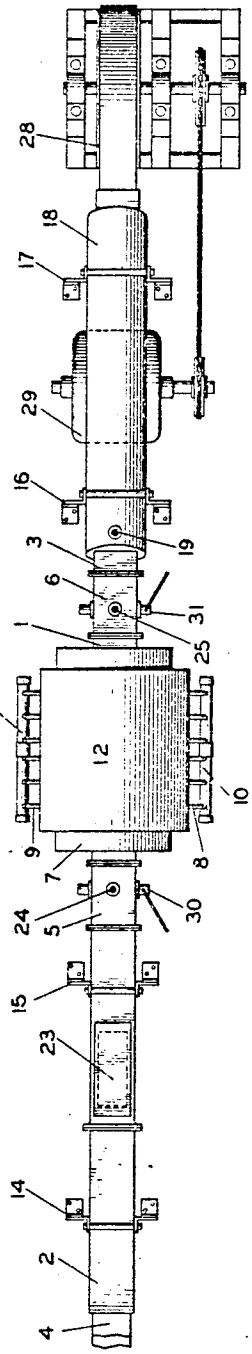


Fig. 2.

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HEAT TREATING FURNACE

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6 Claims. (Cl. 263—8)

This invention relates to heat treating furnaces and particularly, although not necessarily limited thereto, to a furnace for heat treating the metal parts of electric lamps, radio tubes and similar devices.

A principal object of the invention is to provide an improved furnace in which the parts to be heat treated, may be subjected to a relatively high temperature in the presence of a non-oxidizing atmosphere.

Another object is to provide a furnace in which metal parts may be heat treated in an atmosphere of hydrogen or other similar reducing gas.

Another object is to provide a conveyor type furnace for heat treating parts in an atmosphere of a gas which is highly explosive when mixed with air, the furnace being designed to prevent such an explosive mixture.

A feature of the invention relates to a furnace for heat treating objects in the presence of a reducing gas such as hydrogen, the furnace being so designed that the specific gravity of the hydrogen is utilized to prevent the formation of an explosive mixture within the furnace.

Another feature of the invention relates to a continuous heat treating furnace employing an atmosphere of hydrogen or other similar explosive gas, the furnace being designed so that the charging and discharging ends are unsealed, but without the danger of the gas forming an explosive mixture within the furnace.

A still further feature relates to a heat treating furnace of the conveyor type employing an atmosphere of hydrogen the furnace being provided with a main heat treating chamber and ingress and egress ducts so proportioned and arranged with respect to the main chamber that the hydrogen seals itself within the chamber and insufficient air is admitted to the higher temperature parts of the furnace to form an explosive mixture.

A still further feature relates to the novel organization, arrangement and relative location of parts which go to make up a safe and efficient heat treating furnace employing an atmosphere of hydrogen or similar gas or mixture of gases.

Other features and advantages not specifically enumerated will be apparent after a consideration of the following detailed descriptions and the appended claims.

In the drawing which represents one preferred embodiment of the invention,

Fig. 1 is a front elevational view of the furnace embodying features of the invention.

Fig. 2 is a top plan view of the furnace shown in Fig. 1.

In certain of the arts, particularly in the electric lamp and radio tube arts, it is necessary to employ metal parts which are free as much as possible from surface contamination as well as from occluded gases in the body thereof. Accordingly it is the usual practice to subject such parts to a heat treatment whereby they are raised to a sufficiently high temperature to drive out the entrapped or occluded gases. In order that this heat treatment may not oxidize or otherwise destroy the surface of the metal parts it has been customary to effect the heat treatment in the presence of a non-oxidizing atmosphere. It has also been found desirable to effect this heat treatment in the presence of a reducing atmosphere such as hydrogen but one of the difficulties of using hydrogen is the danger of its forming an explosive mixture with air at high temperatures. For this reason it has not been found practicable to build a continuous or conveyor type heat treating furnace with a hydrogen atmosphere in the furnace. I have found that by specially designing the arrangement and proportions of the furnace parts it is possible to take advantage of the very great lightness of the hydrogen so that the formation of an explosive mixture within the furnace is avoided. In carrying out this phase of the invention the furnace is provided with a main heat treating chamber which is filled with an atmosphere of hydrogen, and ingress and egress ducts are provided for the main chamber of such length and inclination with respect to the main chamber that the hydrogen which is supplied to the main chamber in the manner set forth, remains effectively sealed within the furnace even though the ingress and egress openings for the furnace are not air sealed. Consequently it is practicable to carry the parts to be heat treated through the furnace on a continuous conveyor the speed of which may be accurately regulated. As a result, the parts such for example as the metal parts of a lamp or tube, are given a uniform and efficient heat treatment.

Referring to the drawing the furnace comprises in general a main heating chamber 1 preferably of a refractory metal and preferably although not necessarily, rectangular in cross section. The main chamber is united to inclined duct portions designated generally by the numerals 2 and 3, respectively, the duct 2 arranged to act as the ingress duct for the conveyor belt 4, while the duct 3 is the egress duct, it being understood of course that the ducts are her-

metically joined to the opposite ends of the main chamber by suitable fittings 5, 6 as shown. The main chamber 1 is surrounded by an oven 7 which is adapted to be heated by a series of gas burners 8, 9 connected to corresponding manifolds 10, 11 leading to a source of suitable burner gas. Preferably the oven is surrounded with a casing 12 of asbestos or other heat insulating material. The oven and its associated parts are supported on suitable standards 13, while the ducts are supported on standards 14, 15, 16 and 17. Preferably the egress duct 3 is surrounded with any well known form of cooling unit 18 such for example as a series of cooling coils having a water inlet 19 and outlet 20.

The duct 2 is provided intermediate its ends with an offset portion 21 the vertical end of which is provided with a window 22 of mica, glass or other similar refractory transparent material, this window being in horizontal alignment with the main chamber 1 so that the parts that are being subjected to heat treatment therein may be viewed from the exterior. As a safety precaution the top wall of the portion 21 may be closed by a relatively thin sheet 23 of metal such as aluminum, so that in the event an explosive mixture should reach the section 21 this sheet will be broken to relieve the pressure within the furnace. It will be understood of course that any other well known form of safety valve or the like may be used in place of, or supplementary to the member 23.

In accordance with the invention, the hydrogen gas is admitted to the main chamber 1, at the top thereof through the inlet pipes 24, 25 it being understood that any well known mechanism may be inserted in the hydrogen supply line to limit the pressure of the hydrogen admitted to the furnace. Preferably also, the furnace is provided with one or more pyrometers (not shown) for the purpose of limiting the temperature of the furnace to a predetermined maximum. For the purpose of conveying the articles 26 to be heat treated, through the furnace, there is provided an endless conveyor belt 4 preferably of foraminous wire mesh, this belt being provided with suitable pulleys 27, 28 driven by motor 29 at the required rate of speed. If desired the articles to be treated may be fed into a hopper 29a from which they may be automatically discharged on to the moving conveyor belt by any well known mechanism. In order to guide the conveyor belt through the main chamber and to maintain it in spaced relation to the bottom of the said chamber suitable water-cooled roller bearings 30, 31 may be provided adjacent the entrance and exit openings to the main chamber, and if desired a vertical adjustable roller 32 may be provided to regulate the tension on the conveyor belt. After the articles 26 emerge from the furnace they may be removed from the conveyor belt by any well known means, for example by blowing air through or across the belt.

As will be seen from the drawing, the hydrogen is fed into the furnace at a point which is very much higher than the ingress and egress ends of the ducts 2, 3 and I have found that by properly designing the inclination and length of the ducts, the difference in level between the main chamber and the ends of the ducts is sufficient to prevent the air mixing with the hydrogen at an explosive temperature or in sufficient quantities to form an explosive mixture. This is probably due to the fact that the hydrogen being many times lighter than air, remains trapped within the main chamber 1 and to a certain extent within the ducts 2, 3. I have also found that by making the ducts the proper length there is sufficient resistance to the passage of air upwardly through the ducts to prevent the formation of an explosive mixture within the furnace. Preferably therefore the ducts should be of sufficient length that the ingress or egress ends are removed from the main chamber so that they are at all times below the temperature necessary to cause an explosion, even if a small quantity of air should enter the ducts. If desired the ends of the ducts may be provided with flexible curtains 33 which do not disturb the articles in passing but which nevertheless prevent sudden drafts from forcing air into the furnace. Preferably also the hydrogen is fed into the chamber 1 in smooth streamlike fashion so as to agitate the contents of the chamber to the least possible extent.

In one furnace that has been constructed and found to work satisfactorily without any danger of explosion the chamber 1 was approximately 40 sq. ins. cross section and 40 ins. in length. The ducts 2 and 3 were approximately 108 ins. in length and the ends were disposed approximately 16 ins. below the chamber 1. The gas burners 8, 9 were adjusted to maintain the temperature within the chamber at approximately 1700 degrees Fahrenheit, the hydrogen atmosphere being at approximately 15 ins. H_2. In such a furnace when the parts to be treated were ordinary metal parts such as the nickel or iron electrodes of a radio tube, the conveyor belt was run at a speed of from 6 ins. to 60 ins. per minute. Because of the small heat content of the belt the speed of heat treatment may be increased and if the parts to be treated are disposed in a single layer on the conveyor, they are treated substantially uniformly over their entire surface and at a uniform temperature.

Various changes and modifications may be made in the particular embodiment described, without departing from the spirit and scope of the invention.

What is claimed is:

1. In a furnace of the character described the combination of a main heating chamber, an oven for heating said chamber, means for supplying said chamber with a filling of hydrogen, an inlet duct for said chamber, an outlet duct for said chamber, a movable conveyor passing through said chamber and said ducts, the ends of said ducts being open to the air and situated beneath the level of said chamber, said ducts being proportioned in length with respect to the main heating chamber to prevent the air adjacent the open ends of the ducts from forming an explosive mixture with the hydrogen therein and a flexible curtain disposed over the open end of each duct to prevent the formation of sudden drafts within the ducts.

2. A furnace according to claim 1 in which the hydrogen is fed into the main chamber from the top in a smooth stream so as to agitate the contents of the main chamber to a minimum.

3. A furnace according to claim 1 in which the heating chamber is horizontal and the inlet and outlet ducts are approximately twice the length of said chamber and are disposed at an angle of the order of 10 degrees to the horizontal axis of said chamber.

4. A hydrogen firing furnace comprising a main heating chamber, a pair of ducts leading to and

from said chamber, an oven for heating only the said chamber, a cooling coil surrounding the outlet duct, both of said ducts being open to the air at their ends only, a foraminous conveyor belt arranged to pass through said chamber and said ducts, and a pair of hydrogen supply pipes adjacent the top ends of the main chamber, the ducts being of sufficient length and being inclined to the main chamber as to prevent the formation of an explosive mix within the furnace, and a flexible draft-preventing curtain over the end of each duct.

5. A furnace for heat treating articles in a gas which forms an explosive mix when mixed with air at an elevated temperature, comprising a main heating chamber, a pair of inclined ducts leading to and from said chamber, means to supply the gas to said chamber at the upper ends of said ducts, a conveyor for conveying the articles through said chamber, said ducts having their inlet and outlet ends unsealed whereby the articles can enter and leave the furnace without being wetted, said ducts being of such length and inclination that the temperature adjacent the open ends is below that necessary to form an explosive mix, and a draft-preventing flexible curtain covering the open end of each duct.

6. A furnace for heat treating articles in hydrogen without wetting the articles either at their ingress to or egress from the furnace, comprising a main heating chamber, a pair of inclined ducts leading to and from said chamber, means to feed hydrogen into said chamber at the upper ends of said ducts, said ducts having their ends open to the air, a conveyor belt passing through said ducts and chamber, said ducts being sufficiently inclined and being sufficiently long so that the temperature adjacent the duct ends is below the temperature necessary to form an explosive mix with the hydrogen.

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