

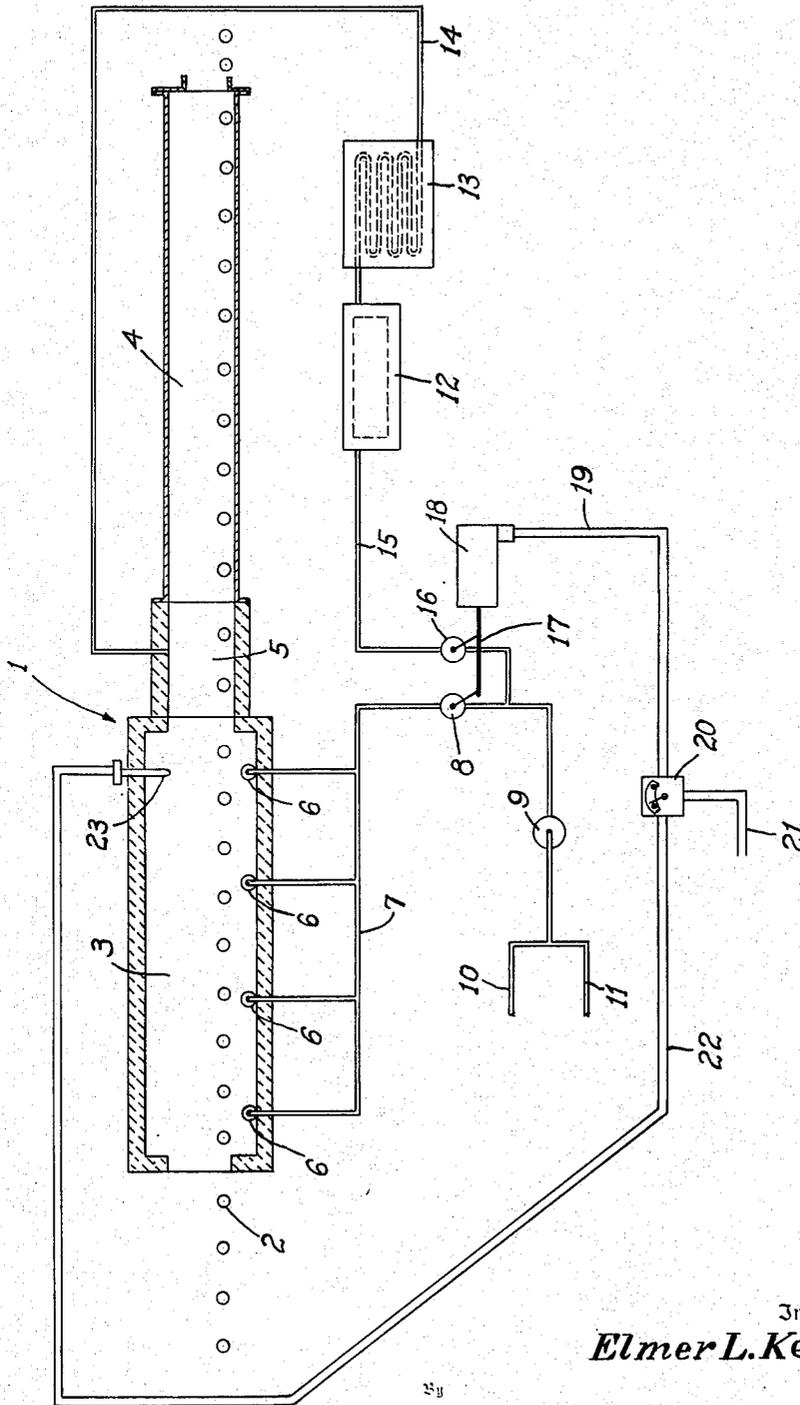
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CONTROLLED ATMOSPHERE ANNEALING FURNACE

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## CONTROLLED ATMOSPHERE ANNEALING FURNACE

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5 Claims. (Cl. 266-5)

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The invention relates generally to furnaces and more particularly to a direct-fired furnace operated over a wide range of heat demand and supplied with a special atmosphere primarily provided by the products of combustion of the fuel in the furnace.

Furnaces frequently used for annealing copper are direct-fired with fuel burners and have a wide range of heat demand from "standby" operation at low temperature to "full production" at high temperature. These furnaces may be of a type known as roller hearth furnaces in which the fuel is fired directly into the furnace heating chamber usually below the roller hearth through burners connected with fuel pre-mixing equipment which supplies fuel-air mixture to the burners in the desired proportions or ratio.

It is usually required that a bright annealing operation be carried out in such a furnace, in which case a special atmosphere, preventing oxidation of the copper or other metal treated therein, is maintained in the furnace heating and cooling chambers. Usually the products of combustion of the fuel directly fired into the furnace provide such special atmosphere. However, when such a furnace has a low fuel demand, as during "standby" operation, there may not be enough special atmosphere produced in the furnace chambers by the products of combustion to prevent atmospheric air from entering the furnace chambers.

In order to avoid this difficulty, such a furnace usually has been equipped with a combustion-type special atmosphere producer or generator which supplies additional amounts of special atmosphere to the furnace at all times so as to assure that the furnace heating and cooling chambers are completely filled with the special atmosphere.

Such producers must have the capacity to supply special atmosphere to the furnace when the furnace is idle in sufficient volume to keep the furnace chambers completely filled with special atmosphere. Usually such a producer is direct-connected with the furnace and supplies a uniform amount of special atmosphere to the furnace at all times. Thus, when the furnace is operating at "full production" and at high temperature, and when the products of combustion are supplying a sufficient amount of special atmosphere for the furnace, the additional supply of special atmosphere from the producer is unnecessary and constitutes fuel waste.

Accordingly, it is an object of the present invention to provide a new arrangement and co-

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ordination of facilities for a controlled atmosphere annealing furnace in which the required amount of special atmosphere is supplied to the furnace chambers at all times throughout a wide range of heat demand, from idle or standby operation to full production operation, without wasting fuel or special atmosphere produced therefrom during the operation of the furnace in any heat demand range.

Furthermore, it is an object of the present invention to provide a new coordinated equipment arrangement for a controlled atmosphere annealing furnace in which the required amount of special atmosphere for filling the heating and cooling chambers of the furnace is supplied selectively, without waste, from either or both of the products of combustion of fuel fired directly into the furnace or burned in an auxiliary combustion type special atmosphere producer.

Also, it is an object of the present invention to provide a direct-fired annealing furnace and an auxiliary combustion type special atmosphere producer for the furnace with a common supply of fuel-air mixture and with selective fuel supply control means for the furnace burners and the producer, actuated by the furnace fuel demand, for supplying special atmosphere to the furnace heating and cooling chambers without waste at all times during furnace operation and in sufficient amount to maintain the furnace heating and cooling chambers completely filled with special atmosphere.

Finally, it is an object of the present invention to provide a new controlled atmosphere annealing furnace arrangement for maintaining the desired amount of controlled atmosphere in the furnace heating and cooling chambers in a simple and effective manner, while avoiding the foregoing difficulties, and solving long standing problems in the art and attaining the many new results and advantages herein set forth.

These and other objects and advantages obvious to those skilled in the art from the following description and claims may be attained, the stated results achieved, and the described difficulties overcome, by the discoveries, principles, apparatus, parts, combinations, sub-combinations and elements which comprise the present invention, the nature of which are set forth in the following general statement, a preferred embodiment of which—illustrative of the best mode in which the applicant has contemplated applying the principle—is set forth in the following description, and which are particularly and dis-

tinently pointed out and set forth in the appended claims forming part hereof.

By way of example a preferred embodiment of the improved controlled atmosphere annealing furnace apparatus is illustrated in the accompanying drawing forming part hereof wherein:

The single figure of the drawing illustrates diagrammatically a furnace, fuel burners, a special atmosphere producer, and control equipment for a common source of fuel air mixture for the burners and special atmosphere producer coordinated and interrelated in accordance with the present invention.

In the drawing a roller hearth furnace is indicated generally at 1 having a roller hearth 2, a heating chamber 3, a cooling chamber 4 and a vestibule 5 connecting the heating and cooling chambers 3 and 4.

The furnace heating chamber 3 is direct-fired by gas burners 6 supplied through a common conduit 7, controlled by a valve 8, with the desired fuel-air mixture from blower 9 connected with the fuel line 10 and an air line 11.

A combustion type special atmosphere producer is indicated at 12 which discharges through a cooling coil 13 and is connected by line 14 with the vestibule 5 whereby special atmosphere generated in the producer 12 is supplied to the furnace heating and cooling chambers 3 and 4. The producer 12 is supplied with a fuel-air mixture from blower 9 through line 15 controlled by valve 16. Thus the producer or generator 12 and the burners 6 are supplied with fuel-air mixture from a common source of supply.

Valves 8 and 16 are tied together by operating rod 17 driven by a motor drive 18 so that as valve 8 opens, valve 16 closes, and as valve 8 closes, valve 16 opens. Valve drive motor 18 is controlled through line 19 by a control pyrometer 20 supplied with power through line 21. Control pyrometer 20 in turn is actuated through line 22 by a thermocouple 23 in furnace chamber 3.

In operation, when the furnace fuel demand is low as during standby operation, the furnace temperature rises and thermocouple 23 actuates control pyrometer 20 to operate motor 18, to partially close valve 8 and open valve 16 wider. Thus an increased amount of special atmosphere is generated in producer 12 and is supplied to the furnace heating and cooling chambers 3 and 4 through line 14 to make up for the reduction in the amount of special atmosphere provided by the products of combustion from burners 6, because of partially closing valve 8.

When the furnace fuel demand rises, the temperature falls and control pyrometer 20 actuated by thermocouple 23 operates motor drive 18 to open valve 8 wider and partially close valve 16. Thus the amount of special atmosphere supplied from generator 12 is reduced because a sufficient amount of special atmosphere is produced directly in the furnace heating chamber 3 from the increased amount of products of combustion of the fuel burned by burners 6.

Since the controlled atmosphere completely fills the heating and cooling chambers 3 and 4 of the furnace 1 at all times, produced from the products of combustion of the fuel fired in varying amounts in heating chamber 3, or in generator 12, a bright annealing atmosphere is maintained in the furnace chambers whereby a bright annealing operation can be carried out upon material passed through the furnace 1 on roller hearth 2.

In case the furnace has several heating

zones, the line 14 from generator 12 is preferably connected with the zone having the greatest fuel demand to assure the maintenance of special atmosphere completely filling the furnace chambers at all times.

Accordingly the present invention provides for supplying both the furnace and the special atmosphere producer with fuel-air mixture from the same fuel-air mixing equipment, and provides for controlling the flow of special atmosphere to the furnace from the producer by pyrometer control means actuated by the furnace temperature and in accordance with the furnace fuel demand. Thus the present invention simplifies the operation of a controlled atmosphere bright annealing furnace, reduces the fuel consumption of such a furnace, overcomes prior art difficulties and solves long standing problems in the art.

In the foregoing description certain terms have been used for brevity, clearness and understanding; but no unnecessary limitations are to be implied therefrom beyond the requirements of the prior art, because such terms are used for descriptive purposes herein and not for the purpose of limitation and are intended to be broadly construed.

Moreover, the description of the improvements is by way of example and the scope of the present invention is not limited to the exact details of construction shown somewhat diagrammatically herein.

Having now described the features, discoveries and principles of the invention, the arrangement and operation of the new apparatus, and the advantageous, new and useful results obtained thereby; the new and useful discoveries, principles, apparatus, combinations, parts, sub-combinations and elements, and reasonable mechanical equivalents obvious to those skilled in the art, are set forth in the appended claims.

I claim:

1. In a controlled atmosphere annealing furnace, walls forming a heating chamber, fuel burners in said chamber the products of combustion from which provide special atmosphere for said chamber, a combustion type special atmosphere generator, means connecting the generator with the chamber, fuel-air supply means for said burners, fuel-air supply means for said generator, drive means selectively simultaneously opening one valve and closing the other valve or closing said one valve and opening said other valve, and furnace-temperature-responsive control means actuating said drive means.

2. In a controlled atmosphere annealing furnace, walls forming a heating chamber, fuel burners in said chamber the products of combustion from which supply special atmosphere for said chamber, a combustion type special atmosphere generator, a common source of fuel-air mixture supply for said burners and generator, means for selectively supplying either or both of said burners and generator with fuel-air mixture from said common supply source, and means actuated by the furnace temperature for operating said last-mentioned means to simultaneously reduce the rate of fuel-air supply to one of said burners and generator and increase the rate of fuel-air supply to the other.

3. Apparatus for completely filling the heating and cooling chambers of an annealing furnace with special atmosphere at all times throughout a wide range of furnace heat demand from idle to full production operation with minimum fuel

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waste including, fuel burners for the furnace heating chamber, a combustion type special atmosphere generator connected with the furnace heating chamber, valve controlled fuel-air supply means for the burners, valve controlled fuel-air supply means for the generator, means selectively simultaneously closing one valve and opening the other or opening said one valve and closing the other, and furnace-temperature-responsive control means for said last-mentioned means, whereby the furnace heating chamber is supplied selectively with minimum waste with special atmosphere from either or both of the products of combustion of fuel fired into the furnace or burned in the generator.

4. In a controlled atmosphere annealing furnace, walls forming a heating chamber, fuel burners in said chamber, a combustion type special atmosphere generator for the furnace, a common fuel-air mixture supply for said burners and generator, and selective fuel supply control means

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actuated by the furnace fuel demand for simultaneously reciprocally varying the rate of fuel supply to said burners and generator.

5. In a controlled atmosphere annealing furnace, walls forming communicating heating and cooling chambers, direct fired fuel burners for said heating chamber, a combustion type special atmosphere generator connected with said chambers, fuel-air supply and mixing means, a valve controlled line leading from said mixing means to said fuel burners, a second valve controlled line leading from said mixing means to said generator, a valve drive mechanism operating said control valves reciprocally in unison, and pyrometer controlled means actuated by the furnace temperature controlling operation of the valve drive mechanism.

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No references cited.