Dec. 7, 1965 K. FRITZ 3,222,042

ANNEALING FURNACE

Filed Sept. 6, 1963 2 Sheets-Sheet 1

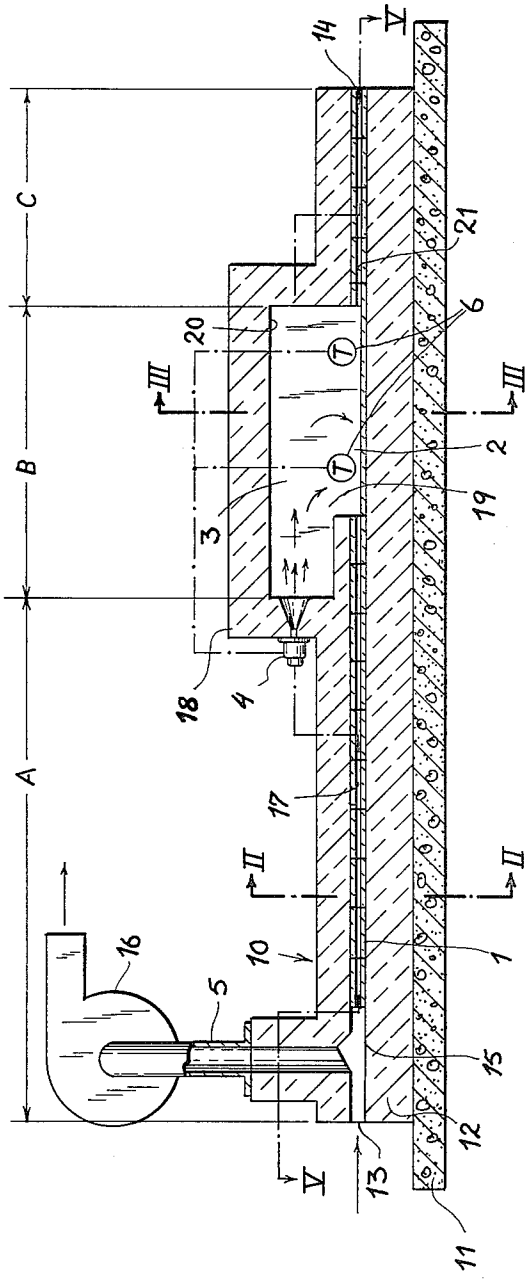

Fig.1

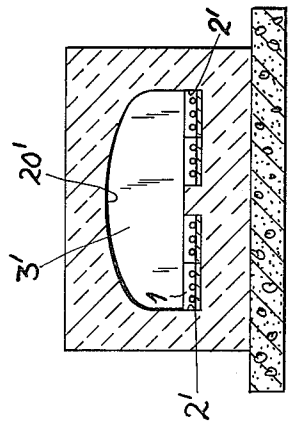

Fig.4

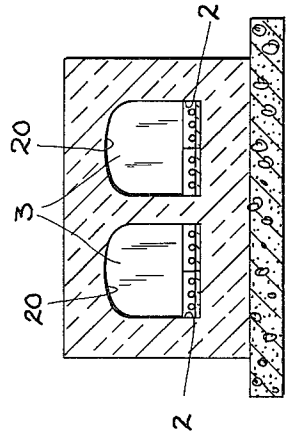

Fig.3

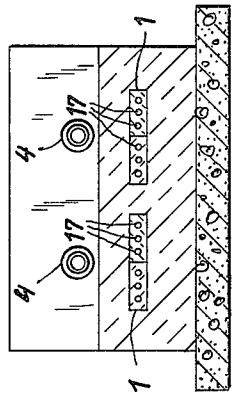

Fig.2

KARL FRITZ
INVENTOR.

BY Mestern, Ross & Mestern

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ANNEALING FURNACE

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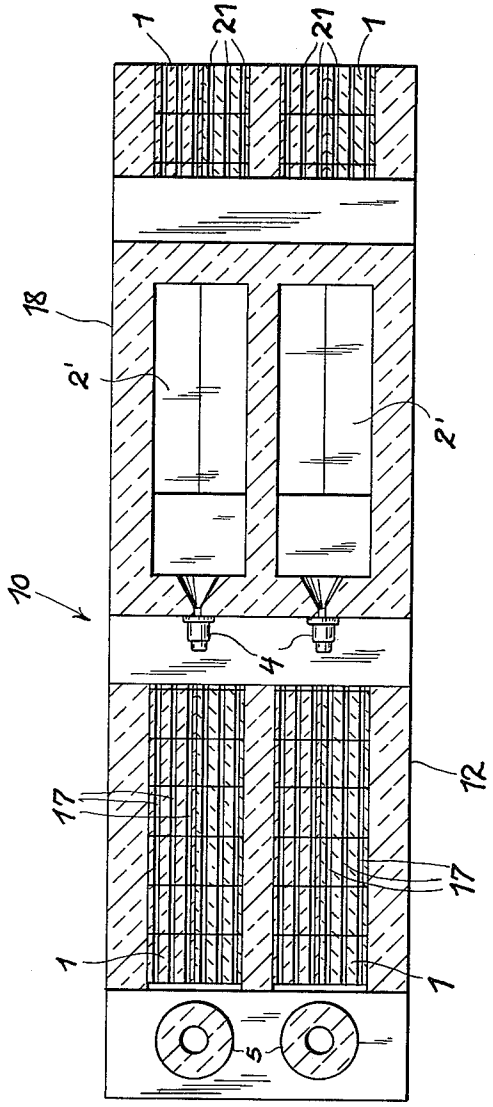

Fig. 5

KARL FRITZ
INVENTOR.

BY Mestern, Ross & Mestern

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3,222,042

ANNEALING FURNACE

Karl Fritz, Feithstr. 25, Hagen, Westphalia, Germany

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6 Claims. (Cl. 263—3)

The present invention relates to annealing furnaces for the heat treatment of elongated metal stock and, more particularly, to oil- or gas-heated continuous annealing devices through which the stock is drawn in a more or less continuous manner.

Earlier furnaces of this type have generally comprised a multiplicity (e.g. six or twelve) of relatively narrow canals or passages through which individual elongated workpieces (wire, strip, bands and rods) were continuously drawn, these passages then feeding into a common channel. In this channel there were generally provided a plurality of burners spaced therealong in juxtaposition with the stock, whose combustion products and heat were directed against the latter and which frequently caused overheating thereof. Devices of this type required many burners to gain uniformity of the heat treatment and were not capable of use with automatic temperature-control devices. In an effort to eliminate such overheating, it had also been preposed to provide the plurality of burners in respective shafts perpendicular to the common channel and spaced therealong. Again, these arrangements involved considerable construction cost and were only limitedly capable of reducing nonuniform heating of the stock.

It is the principal object of the present invention to provide an annealing furnace of the continuous type described above wherein, however, the disadvantages of earlier devices are eliminated.

A subsidiary object of the invention is to provide an annealing furnace of this character whose construction and operating costs are relatively low and which is capable of treating elongated metal stock with a minimum of overheating.

Yet another object of the invention is to provide an annealing furnace of this type with automatic devices to control and monitor the temperatures applied to the metal stock.

These objects and others which will become more apparent hereinafter are attained, in accordance with the present invention, by providing an annealing furnace whose housing forms an elongated transport path for the metal (e.g. steel) stock from an inlet end to an outlet end of the housing, the latter including at least one and, preferably, a plurality of generally horizontal, longitudinally extending circumferentially confined passages for the stock, these passages extending between approximately one third and two thirds of the length of the furnace. An essential feature of this invention resides in the provision of an upwardly open channel, forwardly of the passages along the transport path, through which the stock passes, the channel being in communication from above with a downwardly open burner chamber formed in the housing at a location offset from i.e. above) the channel. The burner chamber extends at least along the entire length of the channel which can occupy between, say, one fourth and one half of the furnace length and can be provided with a burner means offset from direct juxtaposition with the metal stock for the generation, by combustion of liquid or gaseous fuels, of hot gases directed against the metal stock in the channel; the gases are thereafter drawn through the passages in a direction opposite the direction of displacement of the stock. To this end, the furnace housing can be provided,

at its inlet end, with an exhaust blower in communication with the passages for drawing the hot gases therethrough from the burner chamber.

According to a more specific feature of this invention, a single burner is provided for each of the chambers, which can be in communication with one or more channels, the burner means being mounted in a wall of the chamber transverse to the transport path of the stock and spaced therealong away from the opening at which the burner chamber joins the channel or channels. In this connection, it must be noted that the circumferentially confined passages may extend along the transport path beyond the commencement of the burner chamber so as to shield the stock displaced along the path from direct heating by the burner means. It has been found to be desirable to mount the burner means upon a transverse wall of the chamber which is rearwardly in the junction between the channel and the passages communicating therewith so that initially the hot gases are displaced in the direction of movement of the metal stock and thereafter deflected into the channel and the passages as previously noted.

In accordance with a further feature of this invention, the burner chamber is provided with vaulted roof adapted to reflect radiant energy onto the stock disposed therebelow in the upwardly open channels, the metal stock thus being heated by conduction from the hot gases, radiation from the walls and roof of the burner chamber, convection from the gases and even radiation therefrom.

According to yet another feature of the invention, the means forming the circumferentially confined passages include a longitudinal array of contiguous blocks having throughgoing apertures in registering relationship, the blocks extending beyond the wall of the burner chamber in which the horizontally oriented burner is disposed. While each of the aforementioned channels can be provided with a respective burner chamber individiual thereto, it should be noted that an arrangement wherein a single burner chamber is provided for a plurality of channels is also possible. Since only a single burner is required for each chamber (more can be provided if desired), and is effective over the entire length of the channel communicating with the chamber, temperature-sensitive means can be provided in the region of the channel or between the latter and the burner chamber for controlling the burner and thus prevent overheating. Several temperature-sensitive devices (e.g. thermostats) can be positioned along the transport path in the region of the channels.

The above and other objects, features and advantages of the present invention will become more readily apparent from the following description, reference being made to the accompanying drawing in which:

FIG. 1 is a longitudinal cross-sectional view, taken on a vertical plane, of a continuous annealing furance according to the invention;

FIG. 2 is a cross-sectional view thereof taken along the line II—II of FIG. 1;

FIG. 3 is a cross-sectional view taken along the line III—III of FIG. 1;

FIG. 4 is a cross-sectional view similar to FIG. 3 illustrating a modification of the invention; and

FIG. 5 is a cross-sectional view taken along the line V—V of FIG. 1.

In FIGS. 1–3 and 5 of the drawing there is shown a furnace **10** having a preheating zone A, a main heating or annealing zone B and a cooling or outlet zone C. From FIG. 1 it may be seen that the zone A occupies approximately one half of the length of the furnace while zone B occupies between one quarter and one third of the length, and zone C is somewhat less than a quarter of the length of the furnace. The furnace basically comprises a foundation **11** and a housing **12** mounted thereon; the housing being provided with an inlet end **13** and an

outlet end **14** between which a continuous transport path for the metal stock is provided. The housing **12** defines a longitudinal cavity **15** which, at the inlet end **13**, has risers **5** communicating therewith and terminating in exhaust blowers **16** of the usual type, A plurality of apertured ceramic blocks or stones **1**, forming the "first" means of the invention, are disposed in a longitudinally contiguous array to define passages **17**, a plurality of which are provided. These passages are circumferentially confined and receive the metal stock with only limited clearance, the combustion gas being drawn through the gaps between the stock and the wall of the respective passage by blowers **16**.

In the embodiment illustrated in FIGS. 1–3 and 5, six passages **17**, three formed by each longitudinal array of blocks **1**, merge into a common upwardly open channel **2** above which is formed the respective burner chamber **3**. Each of these burner chambers is provided with a horizontally oriented burner **4** adapted to combust a gaseous or liquid fuel and produce a hot combustion gas (arrows in chamber **3**) which initially travels in the direction of displacement of the stock since the blocks **1** extend below the lateral wall **18** of the chamber in which the burner is mounted. A plurality of thermally sensitive elements **6** (i.e. thermostats) are disposed in the opening **19** between the burner chambers and the respective channels to control the heat output of burner **4**. It is another feature of this invention that the burner chamber **3** is provided with a vaulted roof **20** to reflect radiant energy onto the metal stock traversing the upwardly open channel **2** below the burner chamber. From channels **2**, the stock enters confined passages **21** prior to the removal from the furnace. The device of FIG. 4 is similar to that of FIG. 3 except that two channels **2'**, each fed by six passages, communicate with a common burner chamber **3'** with a vaulted roof **20'**.

The invention described and illustrated is believed to admit of many modifications within the ability of persons skilled in the art, all such modifications being considered within the spirit and scope of the appended claims

What is claimed is:

1. A furnace for continuously annealing elongated metal stock passing longitudinally through said furnace, comprising:

a housing forming an elongated transport path for said stock from an inlet end to an outlet end of said housing;

first means defining in said housing a plurality of generally horizontal, parallel, longitudinally extending, circumferentially enclosed passages for said stock, said passages having respective entrances generally in the region of said inlet end and extending over a relatively major fraction of the length of said path;

second means defining a generally horizontal, upwardly open channel for said stock communicating with said passages forwardly thereof along said path and remote from said entrances;

a downwardly open burner chamber formed in said housing at a location above said channel and communicating therewith while extending therealong over a length of said path less than the length of said passages;

burner means in said chamber for generating a heating gas by combustion of fuel; and

means including an exhaust compartment at said inlet and communicating with said passages and an exhaust blower for drawing said gas from said chamber in a direction counter to the direction of displacement of said stock whereby substantially all of the gas generated in said chamber is withdrawn therefrom along said passages.

2. A furnace for continuously annealing elongated metal stock passing longitudinally through said furnace, comprising:

a housing forming an elongated transport path for said stock from an inlet end to an outlet end of said housing;

first means defining in said housing a plurality of generally horizontal, parallel, longitudinally extending, circumferentially enclosed passages for said stock, said passages having respective entrances generally in the region of said inlet end;

second means defining a generally horizontal, upwardly open channel for said stock communicating with said passages forwardly thereof along said path and remote from said entrances;

a downwardly open burner chamber formed in said housing at a location above said channel and communicating therewith while extending therealong, said chamber having a lateral wall;

substantially horizontal burner means in said chamber offset from direct confrontation with said stock in said channel for generating a heating gas by combustion of a fuel; and

means including an exhaust compartment at said inlet end communicating with said passages and an exhaust blower for drawing gas from said chamber in a direction counter to the direction of displacement of said stock whereby substantially all of the gas generated in said chamber is withdrawn therefrom along said passages, said burner chamber being disposed directly above said channel and communicating therewith through an opening formed in said housing between said channel and said chamber, said chamber having a vaulted roof for reflecting radiant energy upon stock disposed in said upwardly open channel, said lateral wall extending transversely to said transport path and defining a front extremity of said chamber, said first means extending along said path beyond said wall whereby said gas is initially displaced in the direction of movement of said stock and is thereafter deflected into said channel and drawn through said passages.

3. A furnace as defined in claim **2** wherein said first means includes at least one longitudinal array of contiguous blocks of ceramic material having registering throughgoing apertures forming said passages.

4. A furnace as defined in claim **2**, further comprising temperature-sensing means disposed between said chamber and said channel for controlling said burner means.

5. A furnace for continuously annealing elongated metal stock passing longitudinally through said furnace, comprising:

a housing forming an elongated transport path for said stock from an inlet end to an outlet end of said housing;

first means defining in said housing a plurality of generally horizontal, parallel, longitudinally extending, circumferentially enclosed passages for said stock, said passages having respective entrances generally in the region of said inlet end and extending over a relatively major fraction of the length of said path;

second means defining a plurality of generally horizontal, upwardly open channels for said stock, each of said channels communicating with some of said passages forwardly thereof along said path and remote from said entrances;

a downwardly open burner chamber formed in said housing at a location above said channels and communicating therewith while extending therealong over a length of said path less than the length of said passages;

burner means in said chamber for generating a heating gas by combustion of a fuel; and

means including an exhaust compartment at said inlet end communicating with said passages and an exhaust blower for drawing said gas from said chamber in a direction counter to the direction of displacement of said stock whereby substantially all of the

gas generated in said chamber is withdrawn therefrom along said passages.

6. A furnace for continuously annealing elongated metal stock passing longitudinally through said furnace, comprising:

a housing forming an elongated transport path for said stock from an inlet end to an outlet end of said housing;

first means defining in said housing a plurality of generally horizontal, parallel, longitudinally extending, circumferentially enclosed passages for said stock, said passages having respective entrances generally in the region of said inlet end said passages extending between approximately one-third and two-thirds of the length of said furnace,

second means defining a plurality of generally horizontal, upwardly open channels for said stock, each of said channels communicating with some of said passages forwardly thereof along said path and remote from said entrances;

a downwardly open burner chamber formed in said housing at a location above said channels and communicating therewith while extending therealong, said chamber having a lateral wall;

substantially horizontal burner means in said chamber offset from direct confrontation with said stock in said channels for generating a heating gas by combustion of a fuel; and

means including an exhaust compartment at said inlet end communicating with said passages and an exhaust blower for drawing said gas from said chamber in a direction counter to the direction of displacement of said stock whereby substantially all of the gas generated in said chamber is withdrawn therefrom along said passages.

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WILLIAM F. O'DEA, *Acting Primary Examiner.*

CHARLES SUKALO, *Examiner.*