March 26, 1968 E. A. COOK, JR 3,374,995

CONTINUOUS HEAT TREATING FURNACE

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FIG. 1

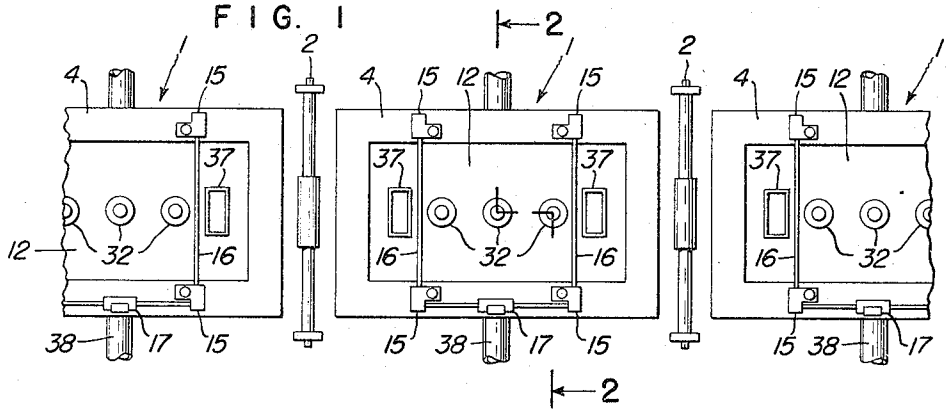
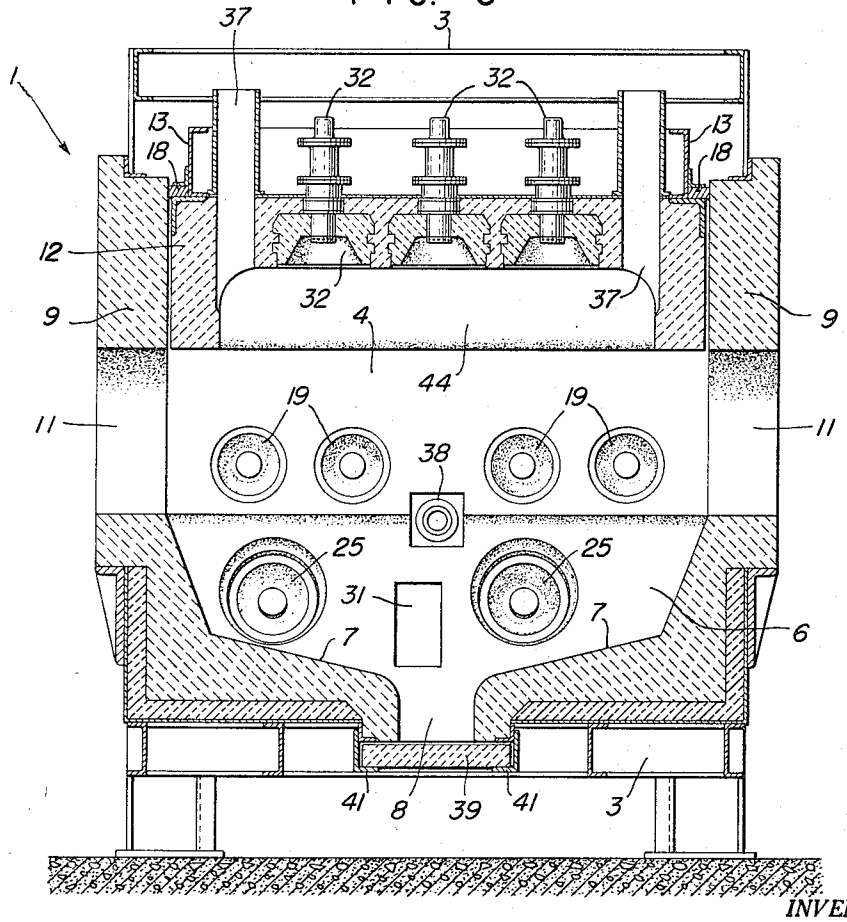


FIG. 3



INVENTOR.
EUGENE A. COOK JR.

BY R. W. Mason

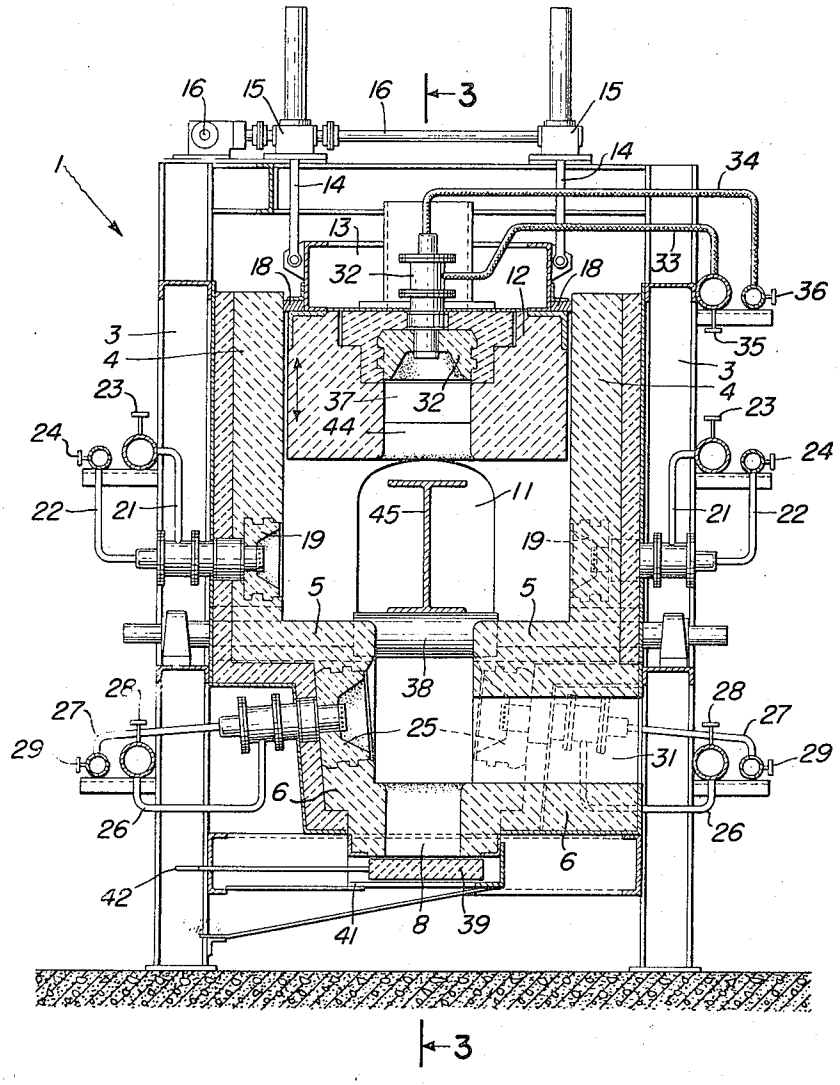
ATTORNEY.

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FIG. 2



INVENTOR.
EUGENE A. COOK JR.

BY E. W. Saxon

ATTORNEY.

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CONTINUOUS HEAT TREATING FURNACE

Eugene A. Cook, Jr., Montgomery County, Pa., assignor to Selas Corporation of America, Dresher, Pa., a corporation of Pennsylvania

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6 Claims. (Cl. 263—3)

ABSTRACT OF THE DISCLOSURE

A barrel type furnace comprising a plurality of furnace units useful for heating structural steel shapes. The work is moved by a conveyor continuously through each unit, each unit having a chamber that is divided by the work into a plurality of substantially separate sub-chambers by the work. Burners firing into each sub-chamber can be individually adjusted to supply different amounts of heat to different portions of the work.

The present invention relates to furnaces, and more particularly to an industrial furnace having a plurality of chambers, and which is designed particularly to heat treat structural shapes.

Structural steel shapes such as I-beams, for example, have webs and flanges that are of different thickness. In order to heat treat such shapes it has been necessary to bring the thin sections up to temperature and hold them for a considerable time while the thick sections were being brought up to temperature. This is not only a time consuming procedure, but can also adversely affect the thin sections due to their relatively long time at temperature.

It is an object of the present invention to provide a furnace that can heat structural shapes having sections of different thickness in such a manner that the entire shape is brought up to the desired temperature at the same time.

It is a further object of the invention to provide a furnace having a plurality of chambers that can have their heat input individually adjusted.

It is a further object of the invention to provide a novel method of heating structural shapes so that the entire cross-section of the shape will arrive at the desired temperature at the same time.

The furnace of the invention comprises one or more axially aligned furnace units through which the work to be heated is passed continuously on a series of rolls. Each unit is so constructed that the interior is divided into a plurality of substantially separated chambers, each of which has its own burners and exhaust flue. The burners of each chamber can be individually adjusted to supply the necessary amount of heat.

The various features of novelty which characterizes my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages and specific objects attained with its use, reference should be had to the accompanying drawings and descriptive matter in which I have illustrated and described a preferred embodiment of the invention.

In the drawings:

FIG. 1 is a somewhat diagrammatic plan view of the furnace;

FIG. 2 is a section through a furnace unit taken on line 2—2 of FIG. 1; and

FIG. 3 is a section through a furnace unit taken on line 3—3 of FIG. 2.

The furnace system can include one or more furnace units. As shown in FIG. 1 there are three furnace units 1 that are aligned axially with each other so that elongated work to be heated can be moved continuously in a path

through them on a conveyor including a series of rolls 2 which are located between each of the units. The furnace units are similar in construction and are shown more in detail in FIGS. 2 and 3.

Each furnace unit is supported in suitable manner by a structural steel frame 3 and includes upper side walls 4 which are parallel to each other and to the path through which the work moves. Below each of the side walls is an inwardly extending floor portion 5 each of which is connected at its inner edge with downwardly projecting side wall portions 6. These portions are joined at their lower ends by floor sections 7 that, as shown in FIG. 3, slope downwardly to an opening 8. The side walls and floor portions are constructed in accordance with ordinary furnace practice which includes steel plate backing and refractory and insulation. The various side wall and floor portions are joined at their ends by end walls 9 each of which is provided with an opening 11. These openings are aligned in each unit and in adjacent units to surround the path through which the work is moved by the conveyor as it is being heated.

The space between the upper side walls 4 and end walls is closed by a roof 12 that is rectangular in shape. This roof is mounted on a frame 13 and can be raised and lowered to change the volume of the space in the interior of the furnace unit. To this end the roof is suspended by four rods 14 which extend upwardly into screw jacks 15 that are located on the framework 3. These jacks are driven in synchronism by suitable drive shafts 16 from a motor 17 that is also mounted at the top of the furnace unit on frame 3. In order to close the joint between the roof and the side and end walls, there is provided a seal 18 of suitable material such as asbestos which is fastened to the roof and engages the side and end walls to close the gap between them.

Each of the upper side walls 4 has in it a plurality of burners 19 of the radiant cup type such as that shown in Furczyk Patent No. 2,855,033. The burners in each side wall are supplied with air through pipes 21 and fuel, preferably gas, through pipes 22 from suitable manifolds which extend along the sides of the furnace. The amount of gas and air supplied to the group of burners in each side wall, can be adjusted by valves 23 and 34 respectively in the manifolds, and which are diagrammatically shown in the drawings.

The lower walls 6 are each provided with burners 25 which similarly are supplied from suitable manifolds by air through pipes 26 and gas through pipes 27 with the supply of air and gas of each manifold being regulated respectively by valves 28 and 29. Each of side walls 6 is also provided with an exhaust opening 31 through which the products of combustion from the burners 25 can be exhausted.

Roof 12 is provided with a recessed portion 44 in which are placed a plurality of burners 32. These burners are connected by flexible air and gas supply hoses 33 and 34 with the supply manifolds of air and gas for the burners, the supplies being adjusted by valves 35 and 36 respectively. The roof is also provided near the ends of portion 44 with upwardly extending exhaust passages 37 through which the exhaust gases from burners 32 are discharged.

As noted above, elongated work to be heated is moved through the furnace and from one unit to the other on rollers 2. At times it may be desirable also to provide rollers in the furnace units. To this end there is shown a roller 38 mounted on suitable bearing blocks, with the roller extending across the central part of the furnace unit perpendicular to the path of travel of the work. Naturally, each of the rollers 2 and 38 will be in the same horizontal plane so that the work will be held level as it is being heated. It is noted that the rollers can be provided

with a wear resisting surface on the portion thereof that is engaged by the work and each of the rollers is also preferably water cooled in any conventional manner. The conveyor rolls are driven together at the desired speed by a suitable drive, not shown.

As the work is being heated, from time to time slag, scale or other dirt will be carried through the furnace and will fall to the bottom thereof. This dirt will slide down the portion **7** of the floor of the furnace where it can be discharged through opening **8**. Normally during the operation of the furnace this opening is closed by a refractory block **39** that is mounted for horizontal sliding movement on tracks **41**. The block **39** can be moved for the discharge of dirt from opening **8** by means of a handle **42**.

A furnace of the type disclosed herein can consist of a single furnace unit or of a plurality of axially aligned units with the number depending upon the speed with which the work is to be heated and, to a certain extent, the temperature. The faster the work is to be heated or the more work that is to be heated in a given time, the greater the number of furnace units that will be required.

As noted above the furnace is particularly designed for the heating of structural shapes such as I-beams, channels and angles, for example. As disclosed in FIG. 2, an I-beam **45** is being heated and is being passed through the furnace on and by rollers **2** and **38**. It will be seen in FIG. 2 that portions of the interior space of the furnace form what amounts to individual chambers that surround the work with a separate chamber for heating each portion thereof. An upper chamber is formed by the roof and in paticular by the recess **44** in front of the burners **23**, which chamber is immediately above the upper flange of the beam. The web of the beam has a side chamber on each side of it, and there is a lower chamber between side walls **6** facing the lower flange of the beam. Each of the chambers can be fired separately by the burners that are located in the side walls of the furnace structure to heat the walls of each chamber, and therefore the chambers to different temperatures. The products of combustion from each of the groups of burners is individually exhausted from the chamber in which the burners are located. The products of combustion from the upper chamber exhaust through openings **37** while those from the lower chamber exhaust from openings **31**. Normally the products of combustion from the two side chambers would exhaust on opposite sides of the work through the axial openings **11**. With this arrangement, if more than one furnace unit is being used, the work is blanketed by hot products of combustion as it is moving from one unit to the next in order to reduce heat loss from the work by radiation. It should be noted, however, that suitable exhaust openings could be placed in the side walls **4** to help exhaust combustion products from the side chambers if it was so desired. Thus, even though the chambers do communicate with each other, they are substantially independent and can be at different temperatures so that each portion of the beam is actually heated by a chamber that primarily affects that portion of the beam only.

In order to keep the chambers of the furnace separate during operation thereof, the roof **12** can be raised and lowered in order to accommodate beams of different sizes and shapes. For a small I-beam, for example, the roof **13** would be lowered. When heating angles, for example, the angles would be turned with their outer edges on roller **38** and the roof would be lowered to a point fairly close to the edge between the sides of the angle.

In many structural shapes and in the I-beam shown, for example, the flanges are considerably thicker than the web. With the present furnace, the supply of fuel to the burners in side walls **4** can be adjusted to have the side chambers at one temperature to heat the web at a certain rate while the burners in roof **12** and in lower side walls **6** can be adjusted to increase the temperature in those chambers and thereby to supply more heat so that the flanges, which are heavier, can be heated to bring them to the same temperature within the same time as the web. Similar chambers in different units can be at different temperatures as required by the gradually increasing work temperature. With this arrangement, an elongated structural shape can be moved continuously through one or more furnace units and the heat supplied to different portions of the shape can be adjusted so that all portions will come up to temperature in substantially the same time. This means that the heating of the shapes can be accomplished in a shorter period of time than is normally required since the thin sections do not have to be held at temperature or be overheated while the thick sections are heating.

The supply of fuel to each of the individual groups of burners can be regulated manually depending upon the amount of heat that is required for a particular section of a structural shape that is being heated. It is also possible to adjust the burners by automatic control means in a conventional manner from control instruments that respond to the temperature of the work. When heating an angle, as opposed to an I-beam, for example, it may be that sufficient heat will be obtained from the upper and lower chambers so that the burners in the side chambers need not be used. The patterning of the heat and the amount of fuel supplied by each of the burner groups will depend on the size, thickness and shape of the work being heated and can easily be determined empirically or by computation.

While in accordance with the provisions of the statutes I have illustrated and described the best form of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit and scope of the invention set forth in the appended claims, and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

What is claimed is:

1. A furnace for heating elongated work including a conveyor to move said work axially through a horizontal path, a pair of vertically extending end walls spaced along and surrounding said path, each end wall being provided with an opening through which the work passes, structure including side walls extending between said end walls substantially parallel to and spaced from said path, said structure forming a plurality of substantially separated chambers surrounding said path and open on the side toward said path, a plurality of burners mounted in said side walls firing into each of said chambers, means forming exhaust openings in some of said side walls to exhaust the products of combustion from the chamber of which said side wall forms a part, said openings in said end walls serving as exhaust openings for others of said chambers, means individually to supply fuel to the burners for each chamber, and means to adjust individually each of said fuel supplys.

2. The furnace of claim **1** in which said side walls include a horizontal floor portion extending along each side of said path and at a level at the bottom thereof, vertical sides extending upwardly from said edge of each of said floor portions remote from said path and a roof between said sides, the space between said floor portions, sides and roof comprising at least two of said chambers, and means to vary the elevation of said roof and thereby the size of said last mentioned chambers.

3. The furnace of claim **2** in which said roof is provided with an axially extending recess, said recess constituting another of said chambers.

4. The furnace of claim **2** in which additional of said side walls extend downwardly from the edges of said floor portions adjacent to said path, the space between said last mentioned walls constituting another chamber below said path.

5. The furnace of claim 1 in which one of the chambers formed by said side walls is above said path, one of said chambers is below said path, and others of said chambers are on the sides of said path.

6. The furnace of claim 1 in which said walls form a chamber above said path, one of said walls being a roof, means to mount said roof for vertical movement, and means to move said roof vertically thereby to vary the size of said chamber.

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CHARLES J. MYHRE, *Primary Examiner.*

JOHN J. CAMBY, *Examiner.*