Dec. 15, 1936. L. WILSON 2,064,095

METHOD AND APPARATUS FOR HEATING

Filed June 8, 1935 2 Sheets-Sheet 1

Fig. 1.

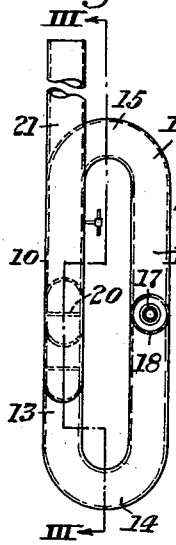


Fig. 2.

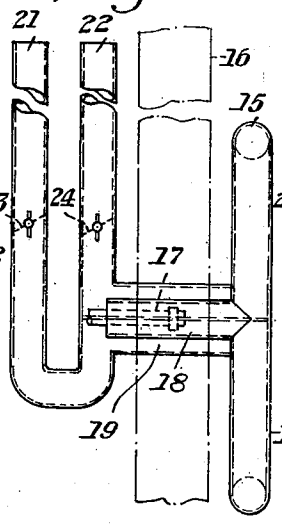


Fig. 3.

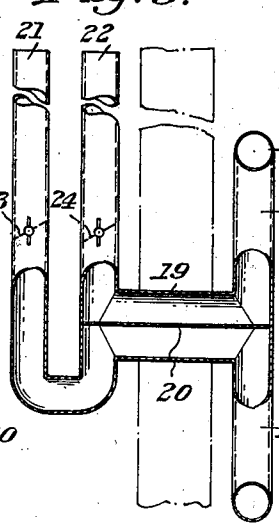


Fig. 4.

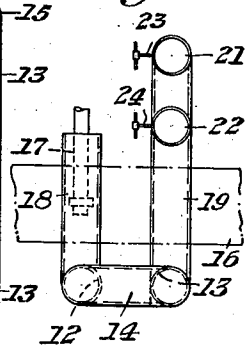


Fig. 5.

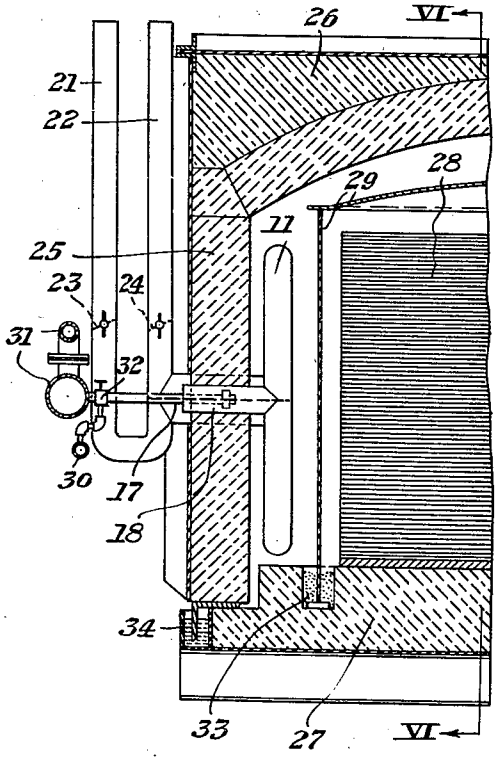
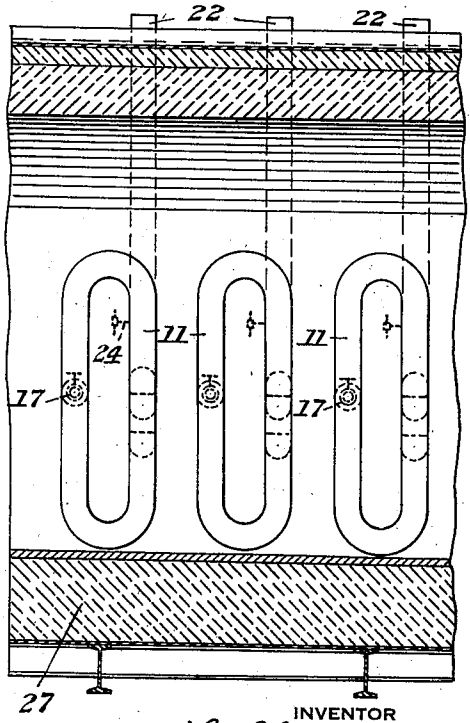


Fig. 6.



INVENTOR

Lee Wilson

by his attorneys

Byrnes, Stebbins & Blenko

Dec. 15, 1936. L. WILSON 2,064,095

METHOD AND APPARATUS FOR HEATING

Filed June 8, 1935 2 Sheets-Sheet 2

Fig. 7.

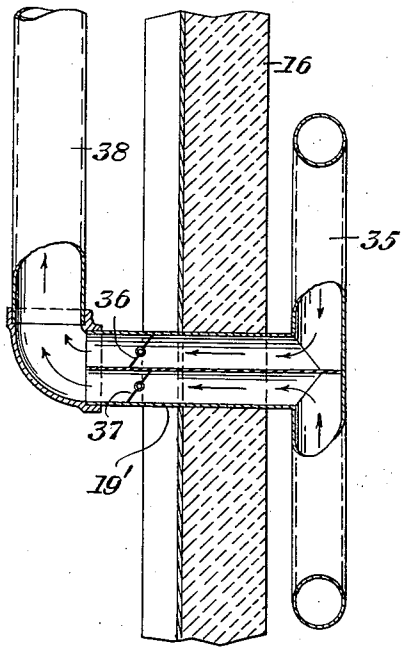


Fig. 8.

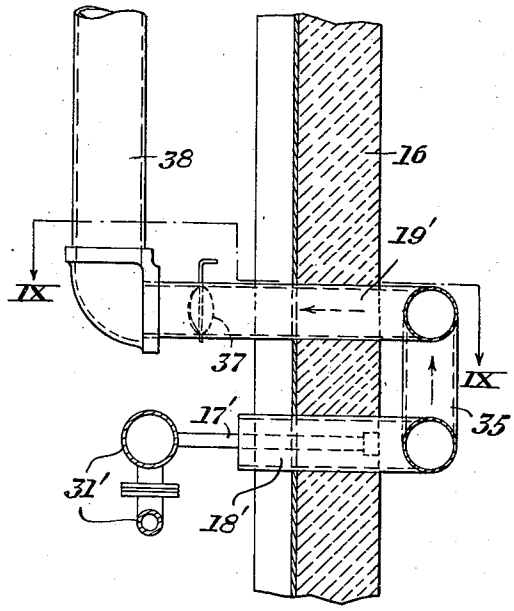


Fig. 9.

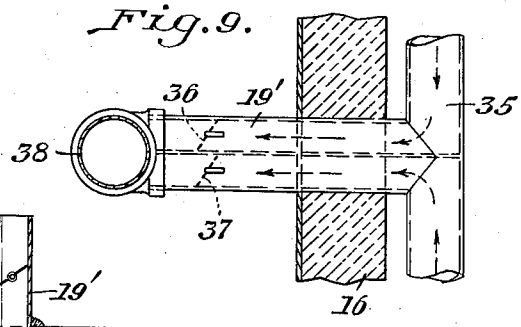
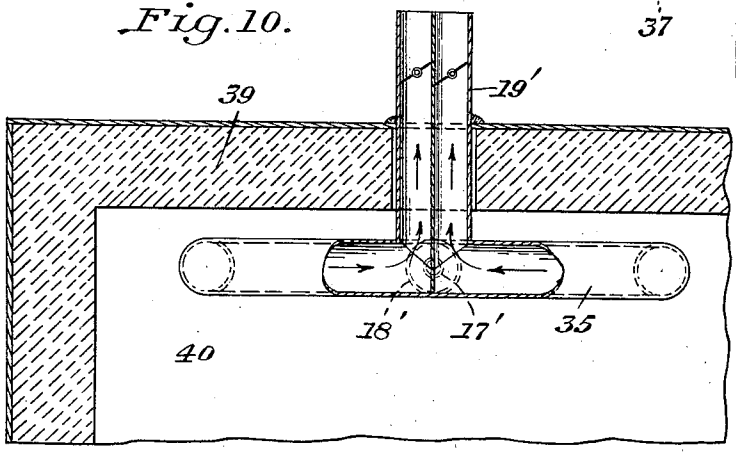


Fig. 10.



INVENTOR

Lee Wilson

by his attorneys

Byrnes, Stebbins & Blenko

Patented Dec. 15, 1936 2,064,095

UNITED STATES PATENT OFFICE

2,064,095

METHOD AND APPARATUS FOR HEATING

Lee Wilson, Cleveland, Ohio

Application June 8, 1935, Serial No. 25,624

8 Claims. (Cl. 266—5)

My invention relates broadly to the art of heat exchanging and, in particular, to the delivery of heat by a fluid medium. The invention will be described herein as applied to the art of heating annealing furnaces, although it has other applications.

In my United States Patent No. 1,952,402, I have illustrated an annealing furnace of the so-called bell or cover type, including a base and a cover disposable thereon, the cover being provided with a plurality of heat-exchange tubes through which hot combustion gases are circulated to heat the interior of the cover. The hot combustion gases are supplied to the tubes adjacent the bottom of the cover and flow upwardly therethrough. Because of the tendency of the gases within the furnace to rise when heated, I find that the upper part of a charge disposed within the furnace for annealing is heated to a temperature higher than the bottom portions thereof. This causes the product to lack the highly desirable quality of uniformity in characteristics.

I have invented a method and apparatus for heating which overcomes the aforementioned objection and is characterized by additional novel and advantageous features. In accordance with my invention, I introduce the heat-conveying fluid adjacent the middle of the side wall of the furnace or other enclosure to be heated, circulate portions thereof in opposite directions from the point of delivery, and independently control the flow of such portions to regulate the amount of heat delivered to various portions of the space being heated. The apparatus of my invention includes a plurality of heat-exchange tubes mounted in the furnace or the space to be heated, each tube having means adjacent its middle for supplying heated fluid thereto for flow in opposite directions therealong. In a specific form of the invention, I employ heat-exchange tubes which are closed upon themselves in substantially the form of an oval, and dispose a burner at about the middle of one of the straight sections of the oval, and an exhaust at a corresponding position on the other straight portion. The oval heat-exchange tubes may also be conceived of as a pair of U-shaped tubes disposed end to end.

The accompanying drawings illustrate a present preferred embodiment of the invention with certain modifications and a specific application thereof. In the drawings:

Figure 1 is a side elevation of a heat-exchange tube showing the part in section;

Figure 2 is an end elevation;

Figure 3 is a sectional view taken along the line III—III of Figure 1;

Figure 4 is a top plan view;

Figure 5 is a partial transverse sectional view through a furnace having the invention applied thereto;

Figure 6 is a partial longitudinal section taken along the line VI—VI of Figure 5;

Figure 7 is a view similar to Figure 3 showing a modified form of the invention;

Figure 8 is a similar sectional view showing a different arrangement of heat-exchange tube;

Figure 9 is a sectional view along the line IX—IX of Figure 8; and

Figure 10 is a sectional view showing a further modified mounting of the heat-exchange tube.

Referring now in detail to the drawings and, for the moment, to Figures 1 through 6, I provide a heat-exchange element 10 comprising a tube 11 closed upon itself in substantially the form of an oval, having straight portions 12 and 13 connected by elbows 14 and 15. The heat-exchange tube 11 may also be conceived as composed of a pair of U-shaped tubes disposed end to end. The tube 11 is adapted for mounting adjacent the wall of an enclosure to be heated. Such a wall is indicated in chain lines at 16 and may be the wall of a furnace or any other suitable enclosure.

Adjacent the mid-point of one of the straight sections of the tube 11, such as that shown at 12, is the means for supplying heated fluid to said portion for flow in opposite directions therealong. As an example of such means, I have shown a gas burner 17 projecting into a nipple 18 communicating with the straight portion 12 of the tube 11. The burner 17 supplies fuel for combustion in the nipple 18 and the tube 11 with the air induced thereby into the nipple. The combustion gases flow in opposite directions along the straight portion 12 of the tube 11 and thence around the elbows 14 and 15 and along the straight portion 13.

The other straight portion 13 of the tube 11 is provided with an exhaust pipe 19 extending outwardly through the wall 16. The pipe 19 has a central partition 20 separating opposite ends of the straight portion 13 of the tube 11. Stacks 21 and 22 are connected, respectively, to the ducts formed in the pipe 19 by the partition wall 20. The stacks 21 and 22 have independent dampers 23 and 24 enclosed therein which can be adjusted to control the flow of gases from the nipple or inlet pipe 18 in opposite directions through the tube 11. If it is found, for example, that the upper portion of the tube 11, in-

cluding the elbow 15, is delivering an excessive amount of heat, the damper 24 may be closed to restrict the flow of hot gas therethrough. Similar adjustment of the damper 23 controls the amount of hot gases flowing through the lower part of the tube, including the elbow 14. In his way, a highly flexible control of the heat supplied by the upper and lower portions of the tube 11 is provided.

Figures 5 and 6 illustrate the application of the invention to an annealing furnace of the same general type as disclosed in my prior patent aforementioned. The tubes 11 are preferably disposed side by side along the side walls 25 of the cover 26 of the furnace, although they may be disposed also along the end walls, or even the roof, in accordance with a modification to be described later. The cover 26 is disposable on a base 27 adapted to support the charge 28 being annealed, which is enclosed in a protective inner cover 29. Fuel is supplied to the burners 17 of all the tubes from a header 30, and air under pressure may also be supplied thereto from headers 31. The amount of fuel delivered to any one tube may be controlled by a burner valve 32. By my invention, it is thus possible to deliver different amounts of heat at different points along the length of the furnace, as well as to deliver different amounts in the upper and lower portions thereof. A nice control of the annealing operation is thus afforded, which makes for a product characterized by a high degree of uniformity as to all its qualities.

Sand and oil seals 33 and 34 close the joints between the inner cover 29 and the furnace cover 26, respectively, and the base 27.

Figure 7 illustrates a heat-exchange tube 35 which is similar in general to that shown at 11 except that it has dampers 36 and 37 mounted in the exhaust pipe 19', for controlling the flow of hot gases through the upper and lower portions of the tube. With this arrangement, a single stack 38 is sufficient to discharge the combustion gases flowing through both portions of the tube.

Figure 8 shows a tube of the type shown in Figure 7 mounted horizontally. The burner 17' is supplied with fuel from headers 31'. By adjusting the dampers 36 and 37 appropriately, the amount of heat delivered to points adjacent opposite ends of the tube 35 may easily be varied.

Figure 9 further shows the arrangement of the tube 35 in horizontal position.

Figure 10 illustrates the tube 35 mounted in the roof 39 of an enclosure 40 which might be the cover of a cover-type furnace, or an ordinary annealing furnace with fixed walls and hearth. The exhaust pipe 19' projects through the roof 39. The burner 17' and the nipple 18' project through a side wall of the furnace but if the tube 35 is remote from any side wall, the burner and nipple may project downwardly through the roof parallel to the exhaust pipe 19'.

It will be apparent from the foregoing description that the invention provides a nicety of control for heating operations which has not beeen attainable heretofore and is particularly applicable to the annealing of material such as sheets in stacks, where it is necessary that the temperature of the material shall be substantially constant throughout the entire mass.

While I have illustrated and described herein but one preferred embodiment of the invention and the application thereof to a specific problem, that of annealing, and certain modifications, it will be understood that many changes in the method and apparatus described may be made without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. A heat-exchange element comprising a closed tube of substantially oval shape including a pair of straight portions substantially parallel and a pair of elbows connecting them, means for supplying a heat-conveying medium to the tube at a point on one of said straight portions, and an exhaust for said medium at a point spaced from said means.

2. The apparatus defined by claim 1 wherein said means and said exhaust are located on the straight portions, respectively.

3. Heat-exchange apparatus comprising a pair of U-shaped tubes disposed end to end, common means therebetween for supplying a heat-conveying medium to said tubes, and means for controlling the flow of said medium through said tubes.

4. In a method of heating a furnace cover having a roof and side walls, the steps including supplying a heating medium to points intermediate the top and bottom of the side walls and diverting flow thereof in opposite directions along said walls.

5. A furnace comprising a base, a cover disposable thereover having side walls and a roof, and heating means mounted inside the cover including a heat-exchange tube, means for delivering hot gases to the tube at a point between the top and bottom of the side walls, for passage upwardly and downwardly along said walls, and independent means for controlling the flow of gases in both directions from said point.

6. A heat-exchange element comprising a tube closed on itself in substantially oval form, a burner discharging thereinto at a point between the curved ends of the oval, an exhaust for gases discharged from the burner at a point between the curved ends of the oval, and independent means for controlling the flow of gases in opposite directions from the burner to the exhaust.

7. In a furnace having a roof and side walls, a heat-exchange element comprising a tube bent and closed upon itself and mounted on said walls but positioned inwardly thereof, means for supplying a heat-conveying medium to the tube at least one point thereon, and an exhaust for said medium at another point spaced from the first point, providing two paths for flow of said medium from the point of supply to the exhaust.

8. A furnace as defined by claim 7 characterized by said heat-exchange element being elongated and disposed with its longer dimension vertical, said means comprising a burner intermediate the top and bottom of said element.

LEE WILSON.