

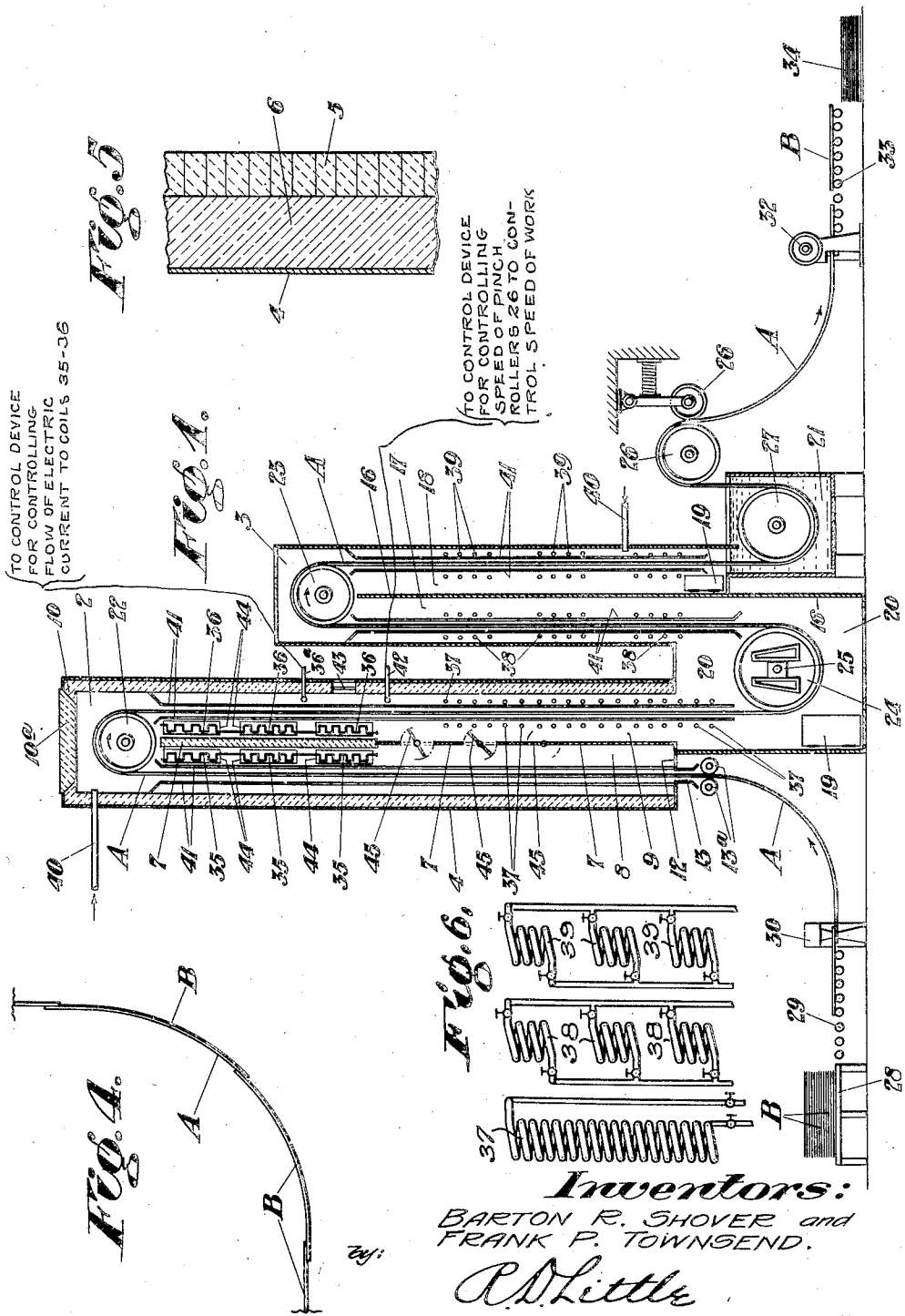
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B. R. SHOVER ET AL

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FURNACE

Original Filed Jan. 22, 1929 2 Sheets-Sheet 1



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Fig. 2.

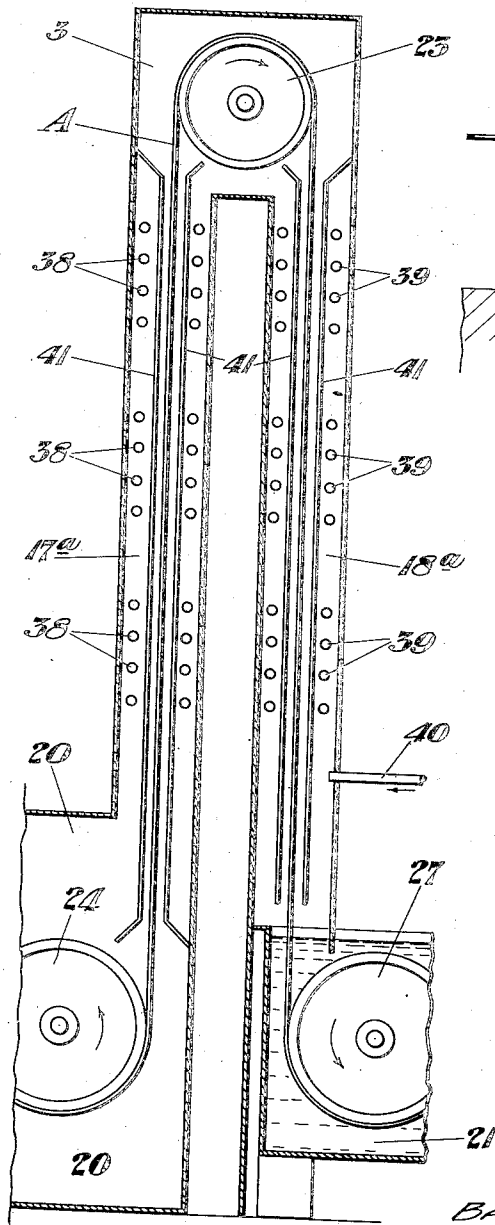
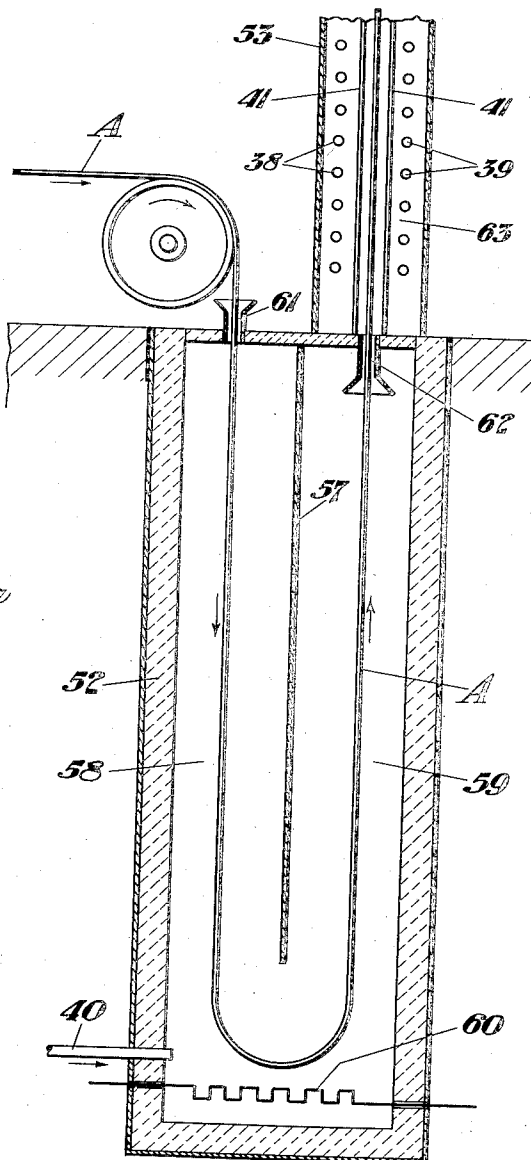


Fig. 5.



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UNITED STATES PATENT OFFICE

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FURNACE

Refiled for application Serial No. 334,203, filed January 22, 1929, and in France November 17, 1930. This application filed May 14, 1931. Serial No. 537,408.

This invention relates to heat treating furnaces and, while not limited thereto, relates more particularly to a furnace primarily designed for continuously annealing metal sheets, strips, wire and the like and has for its object the provision of an improved furnace for this purpose.

This invention provides a continuous heat treating furnace for treating a single thickness of material with controlled heating and cooling, and is so designed that the material is moved through the furnace and uniformly treated throughout its section. Means are also provided for controlling oxidation of the material while it is being passed through the furnace:

In the most common present form of apparatus for continuously heat-treating some materials, the work-piece is moved through the furnace in a horizontal direction by resting on driven rollers, and at high temperatures the surface of the work-piece is frequently marred by scratches or pitting.

With our invention, the design may be such that the material to be treated will not come in contact with solids at such temperatures.

Another object of our invention is to subject the work-piece to the minimum strain in suspended material.

Still another object is to provide a furnace in which oxidizing, neutral or reducing gases can be readily and safely used.

In the drawings:

Figure 1 is a sectional elevation of a furnace constructed in accordance with this invention.

Figure 2 is a sectional elevation of a modified cooling stack.

Figure 3 is a partial sectional elevation of a modified form of furnace, the heating stack being below the floor level.

Figure 4 is a fragmentary elevation showing one way of connecting the plates.

Figure 5 is a fragmentary detail section through the heating stack wall.

Fig. 6 shows the construction of the cooling coils.

Referring more particularly to the drawings, the numeral 2 designates a vertically disposed heating stack or unit and the nu-

meral 3 designates a vertically disposed cooling stack or unit.

The heating stack or unit 2 is composed of a metal shell 4, a brick or other refractory lining 5 and an intervening layer of heat insulating material 6. A partition wall 7 extends vertically in the heating stack 2 from the lower end thereof, upwardly to a point adjacent but short of the upper end thereof, so as to divide the heating stack into up and down-travel chambers 8 and 9. The upper end of the heating stack 2 is closed by a wall 10 having a normally closed opening 10^a for access to the chamber, and the lower end of the chamber 8 is closed by a wall 12, except for a work-entering port 13 in the form of a slot. Guide-rollers 13^a are preferably provided on each side of the port 13 to prevent scratching of the work on the edges of the port.

The lower part of partition wall 7 is made of good heat conducting material such as sheet metal, while the upper part has relatively poor heat conducting quality such as brick.

The cooling stack 3 is composed of a simple metallic shell, since it is desired that the heat radiate from this stack during the cooling part of the cycle. The stack 3 is mounted adjacent the stack 2 and is also provided with a partition wall 16 which extends vertically from the lower end thereof upwardly to a point adjacent but short of the upper end thereof, so as to divide the cooling stack into up and down-travel chambers 17 and 18.

The lower sections of each of the chambers 9 and 18 are provided with hinged doors, as at 19, or otherwise arranged so as to permit said sections to be opened for access to the lower ends of the stacks.

The lower end of the side wall of the stack 3 adjacent the stack 2 is cut away to form a communicating passage 20 between the stacks. The lower end of the down-travel chamber 18 of the cooling stack 2 terminates in a liquid seal box 21.

A pulley 22 is provided in the upper end of the stack 2 above the partition wall 7 and a pulley 23 is provided in the upper end

of the stack 3 above the partition wall 16. A third pulley 24 is journaled in suitable, vertically movable bearings 25 in the passageway 20 between the stacks 2 and 3.

5 The work-piece A to be annealed is adapted to be threaded upwardly through the entering port 13 in the lower end of the chamber 8 and then upwardly through the chamber 8 and over the pulley 22 and downwardly through the chamber 9. From the chamber 9 the work-piece is passed under the pulley 24 and then upwardly through the chamber 17 and over the pulley 23, and then downwardly through the chamber 18.

15 A pulley 27 is journaled in the liquid seal box 21 and a pair of pinch-rollers 26 is provided at a point above the seal box 21. The work-piece is passed through the seal box 21 and under the pulley 27 as it leaves the cooling stack 3 and then is passed between the pinch-rollers 26 which serve to pull the work-piece through the stacks 2 and 3.

20 The work-piece A passing through the furnace is shown as composed of relatively short length sheets B which are secured together to form a continuous strip.

25 The relatively short length sheets B are adapted to be supported on a table 28 and to be fed over a roller-table 29 into a standard form of welding apparatus 30 which will secure the sheet to the end of the work-piece, successive sheets being thus secured to the work-piece A to provide a continuous train of the sheets for passage through the furnace. 35 As the work-piece passes from the welding apparatus it is looped loosely over to the inlet port 13 so as to provide a more or less flexible supply of material at the entering port.

40 The annealed work-piece A, as it leaves the pinch-rollers 26, passes downwardly in a loop form and enters a shearing apparatus 32 which cuts out the welded connections between the sheets B which make up the work-piece. The separated sheets B pass from the shearing apparatus 32 onto a roller-table 33 and are then moved from the table 33 onto a pile, as at 34.

45 The heating stack 2 is provided with electrical heating coils or resistance units 35 and 36 mounted adjacent the upper ends of the chambers 8 and 9, respectively, which are adapted to provide sufficient heat to raise the work-piece to the required temperature. A standard control device (not shown) is provided for controlling the flow of electric current to the coils 35 and 36 so as to vary the heating effect of said coils, and this control device is adapted to be operated by a heat responsive device 36^a. 55

60 A series of cooling coils or other similar devices 37, 38 and 39 are provided adjacent the lower end of the chamber 9 of the stack 2 and in the chambers 17 and 18 of the cooling stack, respectively. A cooling medium is adapted

to be circulated through the coils 37, 38 and 39, as required, to accelerate cooling of the work-piece A after it has been raised to annealing temperature.

Suitable valves (not shown) are provided by which the flow of the cooling medium through the several coils is controlled so as to control the rate of cooling of the work A at different points, and thereby control the quality of the treated product. 70

Suitable gas supply conduits 40 are provided for supplying gas to the stacks 2 and 3 to control the oxidation of the material being annealed. Suitable guides 41 are also provided in the chambers 8, 9, 17 and 18 to prevent packing of the work-piece A should the work-piece break during its travel through the furnace. 75

Should the temperature in the heated parts of the chambers 8 and 9 drop below normal and the speed of the work-piece remain constant, it is evident that the desired temperature will not be reached in the work-piece. To prevent such occurrences a standard heat responsive device 42 is provided in the chamber 9 and used to energize a suitable standard control apparatus (not shown) for controlling the speed of the work in relation to the temperature in the heating chamber. 80

Suitable openings or gas-tight "peep holes" 43 are provided at various locations for the purpose of inspecting conditions within the furnace. 85

Normally closed openings 44 are provided for removing or changing the heating units. 90

In practice, various modifications may be made in the construction and detail design of the furnace to adapt it for heat-treating or annealing various materials. 95

The object of making the lower part of wall 7 out of good heat conducting material is to utilize part of the heat given off by the work-piece when cooling to heat the cold incoming portion in the lower part of chamber 8. For some uses of this furnace it is desirable to vary the amount of said heat transfer and thereby also vary the rate of cooling of the material being annealed. To accomplish this variation, means are provided, such as shutters 45 operated from outside the furnace, to change the heat flow resistance between the lower parts of chambers 8 and 9. 100

If desired, the cooling stack 3 may be dispensed with and all the cooling may be done in the lower part of the chamber 9 of the stack 2. In other cases it may be desirable to provide quicker cooling than possible to obtain in the cooling stack of Figure 1, and in such case a cooling stack composed of separate legs 17^a and 18^a, connected at their upper ends, such as shown in Figure 2, may be provided. In this modified construction of cooling stack the radiation of heat is increased so as to hasten the cooling action. 105

The heating units or coils 35 and 36 may be 110

positioned, grouped or arranged in any part or parts of chambers 8 and 9 in the top around pulley 22 in order to obtain the desired rates of heating at different points in the work-piece during its progress through the furnace. For like reason the number and position of the cooling coils can be varied to suit the cooling requirements.

Although electrical heating units are shown as preferable, any other suitable means of supplying the required heat may be used.

Instead of using a liquid seal box 21 at the lower or outlet end of the chamber 18 of the stack 3, this end of the chamber 18 may be constructed similar to the lower end of the heating chamber 8 and provided with a narrow slot or port and guide rollers similar to the port 13 and guide rollers 13^a.

If necessary or desirable, pulley 22 or 23, or both, may be driven to assist pinch-rolls 26 in moving the work-piece through the furnace.

In the description, the word "vertical" is used to mean chambers whose heights are greater than their lengths, but both the chambers and the path of the work-piece may depart from exact right angles to the horizontal so long as the work-piece moves through the furnace in essentially up and down consecutive directions.

In describing the action of the furnace and in the claims the path of the material is described as "up" and "down". It is to be understood that, if desirable, the material may be entered into the furnace so that its progress is first "down" and then "up." The material may be entered or taken out of the furnace at any desirable point between the bottom and top of the furnace. Likewise the furnace may be entirely above, entirely below or part above and part below the working floor level.

In Figure 3 we have shown a modified form of furnace comprising a heating stack 52 and a cooling stack 53. The stack 52 is preferably positioned below the floor level and is divided into down and up-travel chambers 58 and 59 by a dividing wall 57. At least one heating unit 60 is located at the bottom of the stack 52. The upper end of the chamber 58 is provided with an inlet port 61 while the upper end of the chamber 59 is provided with an outlet port 62.

The cooling stack 53, which is generally similar to the stack 3 of Figure 1, is positioned above the floor level and has one chamber 63 overlying the chamber 59 of the heating stack 52, so as to receive the heated work-piece directly from the outlet port 62 of the chamber 59. The downward travel chamber of the stack 53 is not shown since the structure of this stack is similar to the stack 3 of Figure 1 and the construction may be seen in this figure.

It will be understood that the position of

the heating and cooling chambers relative to the floor level is immaterial and may be varied to suit various mill conditions.

Instead of welding the consecutive parts of the work-piece can be attached to each other by riveting, stitching, hooks or any other suitable method, and instead of shearing out the weld, the pieces may be separated after leaving the furnace by punching out the spot welds, rivets or stitches. Long pieces of wire, or what is commonly known as "strip" can be coiled instead of piled flat.

Any suitable medium may be used in the cooling coils. For example, if rapid cooling be desired the coils could be connected to a standard type of refrigerating apparatus.

Also, when desirable or necessary, suitable standard heat responsive devices may be used at various points in the furnace to provide temperature readings, and in some cases may be used to provide automatic temperature control.

We claim:

1. A continuous heat treating furnace comprising a pair of vertically disposed units, one of said units constituting a heating unit and having walls of relatively low heat conductivity, the other of said units constituting a cooling unit and having walls of relatively high heat conductivity, said units being connected at one end so that the work-piece being treated may pass continuously from one unit to the other, each of said units being provided with a division wall extending from one end thereof to adjacent the other end thereof so as to divide each of said units into up and down-travel chambers, and a source of heat in at least one chamber of said heating unit.

2. A continuous heat treating furnace comprising a pair of vertically disposed units, one of said units constituting a heating unit and having walls of relatively low heat conductivity, the other of said units constituting a cooling unit and having walls of relatively high heat conductivity, said units being connected at one end so that the work-piece being treated may pass continuously from one unit to the other, each of said units being provided with a division wall extending from one end thereof to adjacent the other end thereof so as to divide each of said units into up and down-travel chambers, a source of heat in at least one chamber of said heating unit, and cooling means in at least one of the chambers of said cooling unit.

3. A vertically disposed heat treating furnace comprising at least one stack divided by a vertically disposed partition to form up and down-travel chambers for the material to be treated, said materials being in the form of a continuous strip, means for movably suspending said material in said chambers, heat radiating means adjacent the upper end of said chambers below said material sus-

pending means, and means for causing a flow of gas through said furnace counter-current to the direction of travel of the material being heated.

5 4. A vertically disposed heat treating furnace comprising at least one stack, a partition wall disposed vertically throughout at least a portion of the length of said stack so as to divide said stack into up and down-travel chambers for the material to be treated, said material being in the form of a continuous strip, means above said partition for movably suspending said material in said chambers, said partition having at least its upper portion composed of poor heat conducting material, heat radiating means in at least said down-travel chamber adjacent the upper end thereof, and means for causing a flow of gases through said chambers in a direction counter to the direction of travel of said material.

5. A vertically disposed heat treating furnace comprising at least one stack, a partition wall disposed vertically in said stack for at least a portion of its length so as to divide said stack into up and down-travel chambers for the material to be treated, said material being in the form of a continuous strip, means for suspending the material in said furnace, means for causing said material to continuously travel through said furnace, means for heating said material during its passage through said furnace, means for cooling said material before it exits from said furnace, and means for controlling said heating and cooling means so as to vary the rate of heating and cooling of the material passing through said furnace independent of each other and of the rate of travel of the material.

6. A vertically disposed heat treating furnace comprising at least one stack, a partition wall disposed vertically in said stack so as to divide said stack into up and down-travel chambers for the material to be treated, said material being in the form of a continuous strip, means above said partition for suspending said material in said chambers, said partition having its upper portion composed of poor heat conducting material and its lower portion composed of good heat conducting material such as metal, heating means opposite the upper part of said partition wall in each of said chambers, cooling means in the lower part of said down-travel chamber, and regulable means for varying the heat flow resistance between the lower ends of said chambers.

7. A vertically disposed heat treating furnace comprising at least one stack, a partition wall disposed vertically in said stack so as to divide said stack into up and down-travel chambers for the material to be treated, said material being in the form of a continuous strip, means above said partition for

movably suspending said material in said chambers, said partition having its upper portion composed of poor heat conducting material and its lower portion composed of good heat conducting material such as metal, heat radiating means opposite the upper part of said partition wall in each of said chambers, cooling means in the lower part of said down-travel chamber, and means for providing a flow of gases through said chambers in a direction counter to the direction of travel of the material.

In testimony whereof, we have hereunto set our hands.

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