

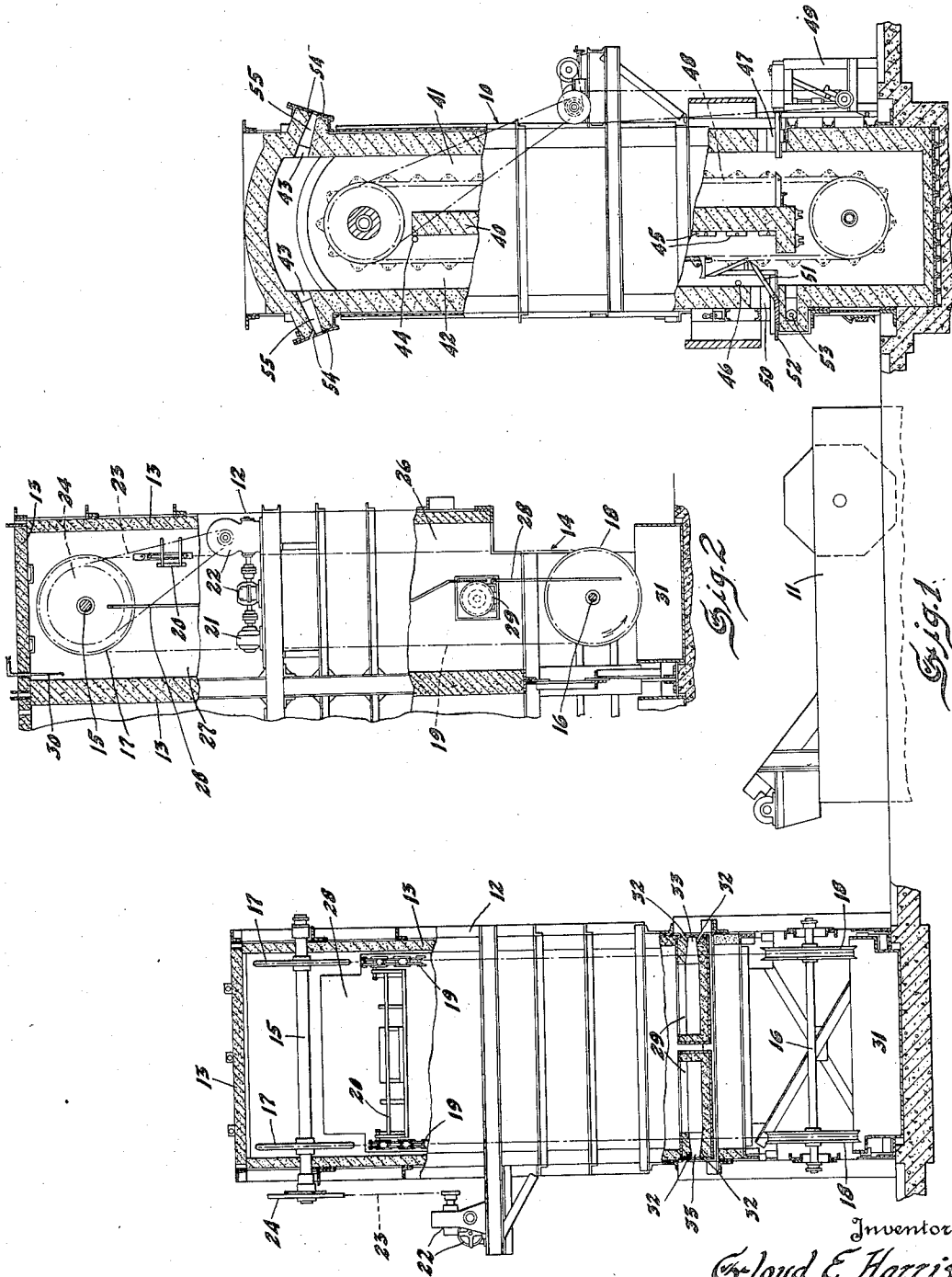
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HEAT TREATING FURNACE

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HEAT TREATING FURNACE

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8 Claims. (Cl. 263—8)

The principal object of this invention is to provide continuous vertical heat treating furnaces in which the stock to be treated may be uniformly and accurately raised to the desired temperature in a minimum length of time without employing temperatures which greatly exceed that to which it is desired to raise the stock.

For a better understanding of the nature, objects and scope of the present invention, reference is made to the following specification in which there are described the preferred embodiments of my invention which are illustrated in the accompanying drawing.

In the accompanying drawing:

Figure 1 is a side elevation, with parts broken away and in section, of an installation in which there are incorporated two vertical heat treating furnaces in which my invention is embodied.

Figure 2 is an elevation, at a right angle to the view shown in Figure 1, with parts broken away and in section, of the low temperature or drawing furnace illustrated in Figure 1.

The installation illustrated in Figure 1 of the drawing was designed for use in hardening, cambering and drawing the leaves of the load-carrying springs of automotive vehicles and includes a high temperature or hardening furnace 10, a combined cambering machine and quenching tank 11 and a "twin" low temperature or drawing furnace 12. The installation is employed in the following manner: The spring leaves to be treated are first passed through the high temperature or hardening furnace 10, in which they are raised to the desired temperature, e. g., 1600° F. Immediately after they leave the furnace 10, the leaves are placed on a conveyor, which forms an element of the combined cambering and quenching machine 11, and thereon bent to the desired form. While they are held in this form, the leaves are carried by the conveyor through a body of oil in the machine. After passing through the body of oil, the leaves are removed from the machine and then passed through the low temperature or drawing furnace 12, in which they are raised to the desired temperature, e. g., 900° F., and then quenched in water to cool them.

Each of the low temperature or drawing furnaces 12 is a tower-like structure whose sides and top are lined with insulating brick 13 and in which there is provided an opening 14 through which stock may be loaded onto and unloaded from the conveyor mechanism hereinafter described. Within each of the furnaces, there is mounted, substantially equidistant from its front and rear walls, a head shaft 15 which is journaled in fixed

bearings and a "floating" foot shaft 16. Over sprockets 17 and pulleys 18, carried, respectively, by the head and foot shafts, there pass a pair of chains 19 which support trays 20 on which the stock to be treated is adapted to be conveyed through the furnace. An electric motor 21, which is connected to the head shaft through speed reducing mechanism 22, a chain 23 and a sprocket 24, is adapted to drive the head shaft in a counterclockwise direction, as viewed in Figure 2 of the drawing, and thus actuate the conveyor mechanism.

The interior of each of the furnaces 12 is divided into an "ascending" leg 26 and a "descending" or "discharge" leg 27 by a metal baffle 28 which is located substantially in the plane of the head and foot shafts and extends from one side wall to the other of the furnace. The baffle terminates, at its upper end, at a distance from the top equal to approximately one-half the depth of the furnace and, at its lower end, at a point slightly above the lowermost part of the conveyor mechanism.

Within the discharge leg of each of the furnaces 12, adjacent its lower end and the baffle 28, there are located combustion pipes 29 to which a combustible mixture of fuel and air is supplied through pilot burners 32 which operate continuously and main burners 33 whose operation is controlled by a thermo-couple 30 which is located directly above the discharge leg.

When one of the furnaces 12 is operating, the stock which is to be treated therein is loaded onto the trays 20 and carried by the conveyor mechanism, successively, through the "heating zone" (the leg 26 and the portion of the furnace above the legs 26 and 27), the "soaking zone" (the leg 27) and the quenching tank 31 which is located below the foot shaft 16. After the stock passes through the quenching tank, the conveyor carries it to the opening 14 where it is removed from the trays 20 to make room for untreated stock.

The hot gases which are supplied by the burners enter the furnace at the lower end of the "soaking zone", travel, successively, through the "soaking zone" and the "heating zone" and are discharged from the furnace through the opening 14. Since the baffle 28 is a good conductor of heat and the temperature differential between the gases in the lower part of the discharge leg and the stock in the lower part of the leg 26 is high, much of the heat in the gases will be transferred by radiation from the baffle to the stock in the lower part of the leg 26 whose temperature will, consequently, be raised rapidly. As the stock travels up the leg 26, the temperature differential

between it and the gases in the opposite portion of the "soaking zone" progressively decreases, as a result of loss of heat by the gases through conduction to the stock in the "soaking zone" and radiation to the stock in the leg 26 and of gain of heat by the stock through radiation from the gases in the "soaking zone" and conduction from the gases in the "heating zone", and, consequently, less and less heat is extracted by it from the gases in the "soaking zone." This characteristic of the furnace tends to maintain the temperature of the gases uniform at all points in the "soaking zone."

The conveying mechanism is driven continuously at such a rate that the stock reaches the "soaking zone" by the time it has attained a temperature which approximates that to which it is desired to raise it. However, since during the time that it is in the "heating zone" the temperature of the stock is raised rapidly, the stock may not be heated uniformly and evenly throughout by the time it leaves the "heating zone." In the "soaking zone", whose temperature is fairly uniform and even throughout and at no point greatly exceeds that to which it is desired to raise the stock, the stock is slowly brought up from the temperature at which it leaves the "heating zone" to the desired temperature and all unevenness and lack of uniformity in heating is eliminated.

Since, in general, the high temperature or hardening furnace 10 does not differ essentially from one of the low temperature or drawing furnaces 12, I will in describing the former confine myself to the features wherein the two furnaces differ.

Because the coefficient of heat transfer by radiation, at the temperature differentials which exist in the furnace, is relatively low, it is possible in the low temperature or drawing furnace 12, with a heat conducting baffle between the two legs of the furnace, to heat both the "soaking zone" and the "heating zone" properly with a single set of burners located in the "soaking zone". However, at the temperature differentials which exist in the high temperature or hardening furnace 10, the coefficient of heat transfer by radiation is so high that if the two legs of the furnace were separated by a heat conducting baffle their temperatures would become so nearly equalized as to preclude the maintenance of separate "heating" and "soaking" zones. Consequently, in the furnace 10, the baffle 40 which separates the "ascending" leg 41 from the "descending" or "discharge" leg 42 is made of a non-conductor of heat, insulating brick, and there are provided separate burners for heating the "heating" and "soaking" zones. The burners 43 for supplying heat to the "heating zone" are located at the top of the furnace and include pilot nozzles 54 which operate continuously and main nozzles 55 which are controlled by a thermo-couple 44 located at the entrance to the "soaking zone". The burners 45 for maintaining the desired temperature in the "soaking zone" are located at the lower end of the "soaking zone" and are controlled by a thermo-couple 46 located opposite them.

Between the low temperature or drawing furnace 12 and the high temperature or hardening furnace 10, there exist, in addition to the differences referred to in the paragraph next preceding this which are made necessary by the difference in heat transfer conditions existing in the two furnaces, certain differences which are not made necessary by the difference in heat transfer conditions but which are dictated by

other considerations. In the furnace 10, there are provided, instead of a single opening through which the stock is loaded onto and unloaded from the conveyor and the gases from the burner are discharged, an opening 47 through which stock is loaded onto the conveyor 48 by the automatic loading mechanism 49 and the gases from the burners are discharged and an opening 50 in the opposite wall of the furnace through which the stock may be removed from the furnace by the automatic unloading mechanism 51. The stock which is removed from the conveyor by the automatic unloading mechanism is deposited on a ledge 52 which is maintained at an elevated temperature by a burner 53. It will be apparent that there is no reason for incorporating a quenching tank in the furnace 10 since the stock discharged therefrom is quenched in the combined cambering machine and quench tank 11.

It is thought unnecessary further to describe the furnace 10 since the features of its construction and operation which have not been specifically referred to will be understood from the description of the construction and operation of the furnace 12.

In concluding this specification, I wish to point out that a furnace of the type designated by the reference character 12 is suitable for use in treating stock at temperatures between approximately 350° F. and approximately 1200° F., but that in treating stock at higher temperatures and, particularly, at temperatures in excess of 1400° F., assuming that the stock enters the furnace at or about the ordinary atmospheric temperature, it is preferable to employ a furnace of the type designated by the reference character 10.

I claim:

1. In a heat treating furnace, a hollow structure within which there is provided a wall which divides the interior into two legs which communicate with each other adjacent one end, means to convey stock from one end of one of the legs to the junction of the legs and thence to the distant end of the other leg, and means to supply heated gases to the interior of the hollow structure so that they flow therethrough in a direction opposite that in which the stock travels.

2. In a heat treating furnace, a hollow structure within which there is provided a wall which divides the interior into two substantially upright legs which communicate with each other adjacent one end, means to convey stock from one end of one of the legs to the junction of the legs and thence to the distant end of the other leg, and means to supply heated gases to the interior of the hollow structure so that they flow therethrough in a direction opposite that in which the stock travels.

3. In a heat treating furnace, a hollow structure within which there is provided a wall which divides the interior into two substantially upright legs which communicate with each other adjacent their upper ends, means to convey stock from the lower end of one leg to the junction of the legs and thence to the lower end of the other leg, and means to supply heated gases to the interior of the hollow structure so that they flow therethrough in a direction opposite that in which the stock travels.

4. The heat treating furnace claimed in claim 3 in which the last-mentioned means includes a heating element which is located adjacent the lower end of the last-mentioned leg.

5. The heat treating furnace claimed in claim 3 in which the last-mentioned means includes a heating element which is located adjacent the lower end of the last-mentioned leg and the mentioned wall.

6. The heat treating furnace claimed in claim 3 in which the mentioned wall is a relatively good conductor of heat and the last-mentioned means includes a heating element which is located adjacent the lower end of the last-mentioned leg and the mentioned wall and whose operation is regulated in accordance with the temperature adjacent the junction of the mentioned legs.

7. The heat treating furnace claimed in claim 3 in which the mentioned wall is a relatively poor conductor of heat and the last-mentioned means includes a heating element which is located adjacent the lower end of the last-mentioned leg and the mentioned wall and whose operation is controlled in accordance with the

temperature adjacent it and a heating element which is located adjacent the junction of the legs and whose operation is controlled by the temperature adjacent it.

8. The method of heat treating which includes conveying stock through one passage and then through another passage which is substantially parallel to but separated from the first-mentioned passage by a wall and causing heated gases to travel through the mentioned passages in a direction opposite that in which the stock travels therethrough so that while in the second-mentioned passage the gases transfer heat to the stock therein by convection and to the stock in the first-mentioned passage by radiation from the mentioned wall and while in the first-mentioned passage transfer heat to the stock therein by convection.

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