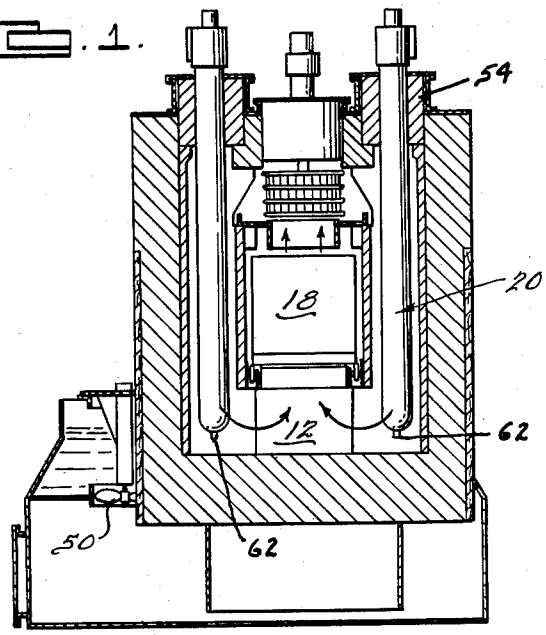
April 15, 1958 F. E. HARRIS 2,830,805

HEAT TREATING APPARATUS.

Original Filed Aug. 29, 1952

FIG. 1.



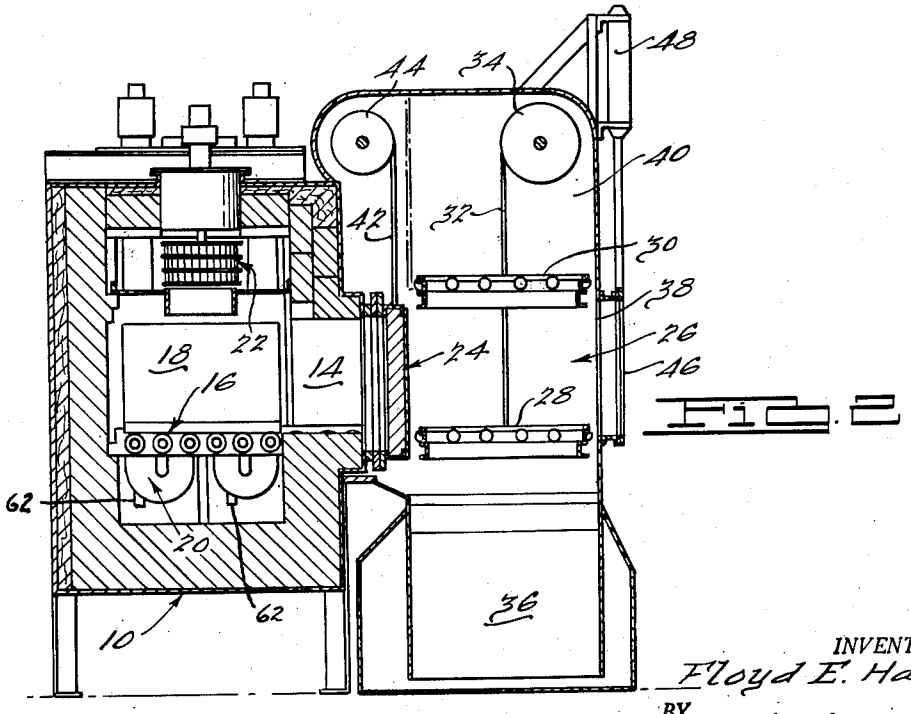


FIG. 2.

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HEAT TREATING APPARATUS

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1 Claim. (Cl. 266—4)

This invention relates to heat treating furnaces and has particular reference to a novel and efficient vestibule and quench arrangement for batch type, controlled atmosphere, heat treating furnaces of the type disclosed in Dow U. S. Patent No. 2,639,138, of May 19, 1953.

The arrangement herein disclosed provides numerous advantages in charging and treating work processed in a batch type controlled atmosphere furnace.

A principal object of the invention is to provide a novel and efficient vestibule and quench arrangement for batch type furnaces which greatly increases the utility thereof.

Other and further objects of the invention will be apparent from the following description and claims and may be understood by reference to the accompanying drawings, of which there is one sheet, which by way of illustration show a preferred embodiment of the invention and what I now consider to be the best mode in which I have contemplated applying the principles of my invention. Other embodiments of the invention may be used without departing from the scope of the present invention as set forth in the appended claims.

In the drawings:

Fig. 1 is a vertical cross sectional view of a heat treating furnace embodying my invention; and

Fig. 2 is a vertical sectional view of the furnace taken at right angles to the view shown in Fig. 1.

A heat treating furnace embodying my invention comprises as shown heat insulating walls **10** defining a furnace chamber **12** provided with an access opening **14**. A roller track indicated generally at **16** forms a support for a work box **18**, the box having a perforate bottom and being open at the top and adapted for holding a batch of pieces of work to be heat treated. Depending upon the size of the furnace chamber **12** and the heating temperature desired therein, there is provided one or more radiant heater tubes **20**, there being four shown, arranged two on each side of the furnace chamber **12** with the track **16** extending horizontally therebetween so that the work box **18** may be positioned between the two pairs of radiant heater tubes **20**.

An electric motor driven centrifugal type of fan, indicated generally at **22**, depends from the roof of the furnace chamber **12** and is arranged to draw atmosphere in the furnace chamber upwardly through the batch of work contained within the work box **18** and to discharge the same radially outwardly where the furnace walls and cooperating baffles cause such atmosphere to flow downwardly over the heating tubes **20** so as to be heated thereby, and thence upwardly through the track **16** and through and over the work contained in the box **18**. The atmosphere is recirculated within the furnace chamber for a sufficient length of time, depending upon the specifications of the treatment desired, so as to bring the work contained within the box **18** to control temperature and then to effect the desired surface treatment thereof.

Before the work is inserted into the chamber **12**, such chamber is brought to the desired temperature and provided with the desired controlled gaseous atmosphere which is maintained during furnace operation at a slight pressure above atmosphere.

The work box **18** is inserted in and removed from the chamber **12** through the access opening **14** which is closed by a door **24**. A vestibule **26** encloses the door and the outer end of the access opening **14** and is provided with a pair of vertically movable roller tracks **28** and **30**, commonly referred to as elevators. The tracks **28** and **30** are supported upon chains **32** which are adapted to be wound upon or unwound from a motor driven drum **34** so that either of the tracks **28** or **30** may be arranged in line with the track **16** in the furnace chamber so that work may be pushed into or removed from the furnace chamber, or inserted into or removed from the vestibule through opening **38**.

Work in the box **18** on the track **28** may be lowered into a quench tank **36** for quenching the work before removal from the vestibule through the door controlled opening **38**. On the other hand, work in the box **18** on the track **30** may be elevated in the vestibule so as to slow cool the same, the upper part of the vestibule forming a slow cool chamber indicated generally at **40**. The bottom end of the vestibule is sealed by the liquid in the quench tank, and the vestibule may be provided with the same atmosphere as in the furnace, or with any other desired atmosphere.

The furnace door **24** is mounted on chains **42** which may be wound upon or unwound from a motor driven drum **44** for closing or exposing the access opening **14**. The vestibule door **46** may be moved between its open and closed positions by an air operated cylinder **48**. The liquid in the quench tank may be circulated over the work in container **18** by a motor driven propeller **50**, and the temperature of the liquid in the quench tank may be controlled so as to obtain any desired temperature thereof.

Each of the heater tubes **20** comprises a U-shaped metal alloy tube mounted on a plug **54** which is removably secured within the roof of the furnace chamber. Gas is burned within each of the tubes to heat the same, and the tubes are fired so as to heat the furnace chamber and the work to be processed therein. Each of the tubes **20** has a tube **62** projecting therefrom. Each of the tubes **62** may comprise a supply passage through which the controlled gas atmosphere is supplied to the furnace chamber **12**, or it may form the retort of a catalytic gas generator inside of a tube **20**, and in which latter event the tube **62** will be filled with a mass of catalytic material so that the interior of the tube **62** will form a retort in which the gas supplied thereto in the presence of the catalyst and under the influence of the heat generated in the tube **20** will produce a gas of proper analysis for the process being carried out in the furnace chamber **12**, and such gas is discharged into the furnace chamber **12** through the opening defined by the lower end of the tube **62**. This latter type of construction is disclosed in British Patent No. 648,329/51, issued to John A. Dow on May 18, 1951.

For carbo-nitriding or cyaniding, the controlled gas atmosphere in the furnace chamber may have approximately the following composition: 40% hydrogen; 40% nitrogen; 19½% carbon monoxide; and a trace of carbon dioxide and ammonia.

The gas supplied to the furnace chamber **12** through the generator tubes will maintain the atmosphere within the furnace chamber **12** at the desired composition, although other components of such atmosphere might be introduced into the furnace chamber otherwise. The products of combustion evolved inside the tubes **20** are not liberated inside the furnace chamber but are vented from the tubes **20** through the exhaust legs thereof.

The vestibule 26 preferably is supplied with atmosphere from the furnace chamber 12 so as to maintain in the vestibule, the same atmosphere and pressure as in chamber 12. For this purpose door 24 may be provided with an aperture (not shown) for venting chamber 12 into vestibule 26. Vestibule 26 may be provided with a pressure relief vent (not shown) for venting atmosphere therefrom when door 46 is closed.

It will be observed that the upper and lower elevators 28 and 30 are arranged relative to each other so that when one of the elevators is in line to receive work which moves through either the access opening of the furnace chamber or the access opening of the vestibule, the other of the elevators is in a position to support work either within the quench tank or chamber 36 or the slow cool chamber 40. The vestibule and quench arrangement disclosed makes the following procedures possible:

Oil quenching procedure

Assuming a batch of work is being processed in the furnace chamber 12 and a batch to be processed, hereinafter referred to as a green batch, is positioned on the upper elevator with the elevators arranged as shown in Fig. 2, and with the doors 24 and 46 arranged in their closed position, when the door 24 is opened the heated batch may then be transferred to the lower elevator 28. Since the atmospheres in the vestibule and furnace chamber are the same, no contamination of the atmosphere in chamber 12 occurs when the door 24 is open. After the door 24 is closed, the elevators may be lowered, thus moving the batch on the elevator 28 into the quench tank for quenching the same and leaving the green batch on the elevator 30 in loading position. After the door 24 is opened the green batch may be charged into the furnace chamber and the door 24 closed. Since the green batch of work will be purged of air while in the vestibule, it will not contaminate the atmosphere of chamber 12 when charged into such chamber. After the batch in the quench tank is cooled, the outer door 46 is opened. Purging gas is then supplied in any suitable manner to the vestibule and ignited and a new batch to be processed is charged onto the upper elevator 30. The elevators are raised and the quenched load is then removed from the lower elevator 28, the door 46 is closed, and the purge gas for the vestibule may then be shut off. The purge gas is supplied to the vestibule to protect the heated stock and to purge contaminated atmosphere therefrom. After the batch of work in the furnace has been processed to the desired extent the cycle may be repeated. The storage of the work to be processed in the upper chamber 40 before being charged into the furnace chamber 12 serves to preheat such work and to purge contaminating atmosphere therefrom and thus reduces the time required to bring such work to control temperature after being charged into the chamber 12, and to prevent contamination of chamber 12 when a green batch of work is charged into the furnace.

Slow cool procedure

Assuming a load of work in the furnace chamber 12 and with the elevators in their lower position and both empty, when the inner door 24 is opened, the heated batch may be transferred to the upper elevator 30 which is then raised after the door 24 is closed. Thus there is now a heated batch of work in the upper chamber 40 with the vestibule atmosphere undisturbed while the lower elevator 28 is empty and in loading position. Preferably a wait of two or three minutes is advisable before the reloading operation begins so as to permit a slight drop in the temperature of the heated parts of the load on the elevator 30—say a drop to 1400° F. to prevent any possible decarburization of the surfaces. Before or as the door 46 is opened, the purge gas should be turned on so as to protect the heated stock on the elevator 30. At the end of two seconds, which is the time required to fully open the door 46, a fresh batch of work to be processed and positioned on a loading tray just outside the door 46 is rolled into the vestibule onto the elevator 28, and the door 46 is immediately closed. It should be possible to open the door, charge the load onto the elevator 28, and close the door in approximately six seconds. After the door 46 is closed the purge gas may be discontinued, the inner door 24 opened, and the batch on the elevator 28 moved into the furnace chamber 12 after which the door 24 is closed. After the work on the elevator 30 has cooled down to the desired extent the elevators may be dropped to their lower positions and the batch of work on the elevator 30 removed. The cycle as indicated may then be repeated.

Where an atmosphere quench is possible— that is, where a file hard surface is obtainable with low core properties—it is necessary that the ammonia concentration in the cooling chamber be quite high. For this reason additional ammonia is introduced directly into the vestibule during the cooling cycle, and it is not advisable to recharge the furnace during such cycle. However, the cycle for cooling will be quite short since below 800° F. stock temperature the nitrogen absorption is negligible, and further cooling in an ammonia atmosphere is not necessary.

The vestibule 26 and the chambers 36 and 40 are constructed so as to exclude air therefrom when the door 46 of the vestibule is closed and the atmosphere in such vestibule and chambers normally is the same as in the furnace chamber 12. Depending upon the process being carried out in the chamber 12, the temperature thereof may be as high as 1800° F. The vestibule and chamber 40 are not independently heated but will be heated to some extent because of their close proximity to the front wall of the furnace and, as previously noted, the quenching fluid may be maintained at whatever temperature is most suitable for the particular type of surface treatment desired.

This application is a division of my prior copending United States application Serial No. 307,035, filed August 29, 1952, now abandoned, for "Heat Treating Furnace."

While I have illustrated and described a preferred embodiment of my invention, it is understood that this is capable of modification, and I therefore do not wish to be limited to the precise details set forth but desire to avail myself of such changes and alterations as fall within the purview of the following claim.

I claim:

A batch type heat treating apparatus useful in the art of heat treating metal work comprising a plurality of heat insulating walls defining a batch type heat treating chamber having a vertically extending access opening through which work is charged into and removed from said chamber, a door for closing said opening, a vestibule formed in part by one of said walls and communicable with said heat treating chamber through said access opening, said vestibule having a single vertically extending access opening through which work is charged into and removed from said vestibule, a door for closing said access opening to said vestibule, a quench chamber below and communicating with said vestibule and a work receiving chamber above and communicating with said vestibule, said access openings to said heat treating chamber and vestibule being at the same elevation and disposed vertically between said quench and work receiving chambers, quenching fluid in said quench chamber for quenching work lowered into said quench chamber from said vestibule, upper and lower elevators each adapted for supporting work thereon and arranged for vertical movement in said vestibule for moving work from said vestibule into either of said chambers and back to said vestibule, said upper and lower elevators being arranged relative to each other so that when the upper one

of said elevators is in position to receive work which moves through either of said access openings, the lower one of said elevators is in a position to support work within said quench chamber, and when said lower elevator is in position to receive work which moves through either of said access openings, the upper elevator is in position to support work within said work receiving chamber, said upper and lower elevators having the work supporting surfaces thereof constructed and arranged to permit circulation of the vestibule atmosphere into said quench and work receiving chambers.

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