Feb. 16, 1943. A. W. MACHLET 2,311,344

MEANS FOR BATHING WORKPIECES IN A CONTROLLED ATMOSPHERE

Filed March 4, 1941 2 Sheets-Sheet 1

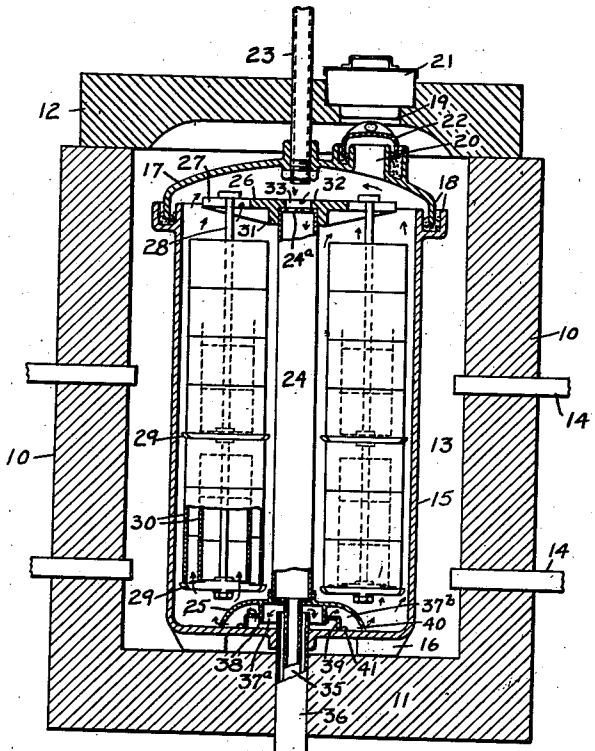
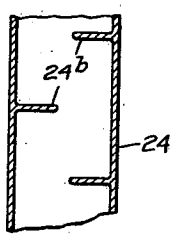
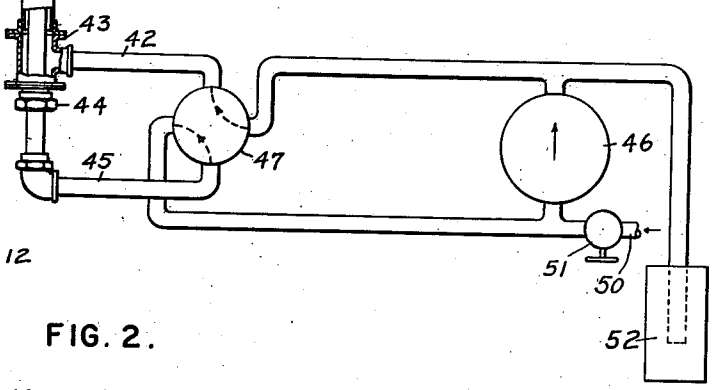


FIG. 1.

FIG. 3.





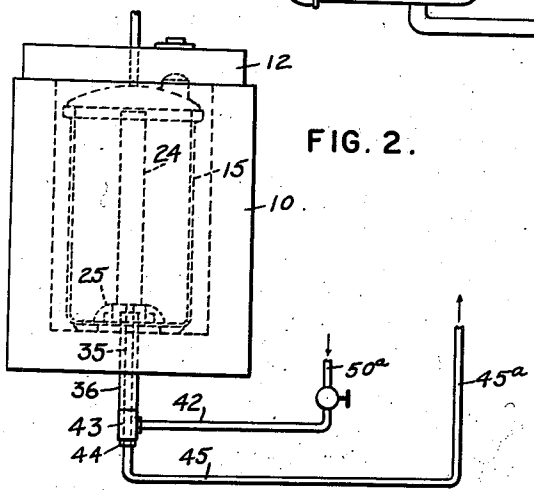


FIG. 2.

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FIG. 4.

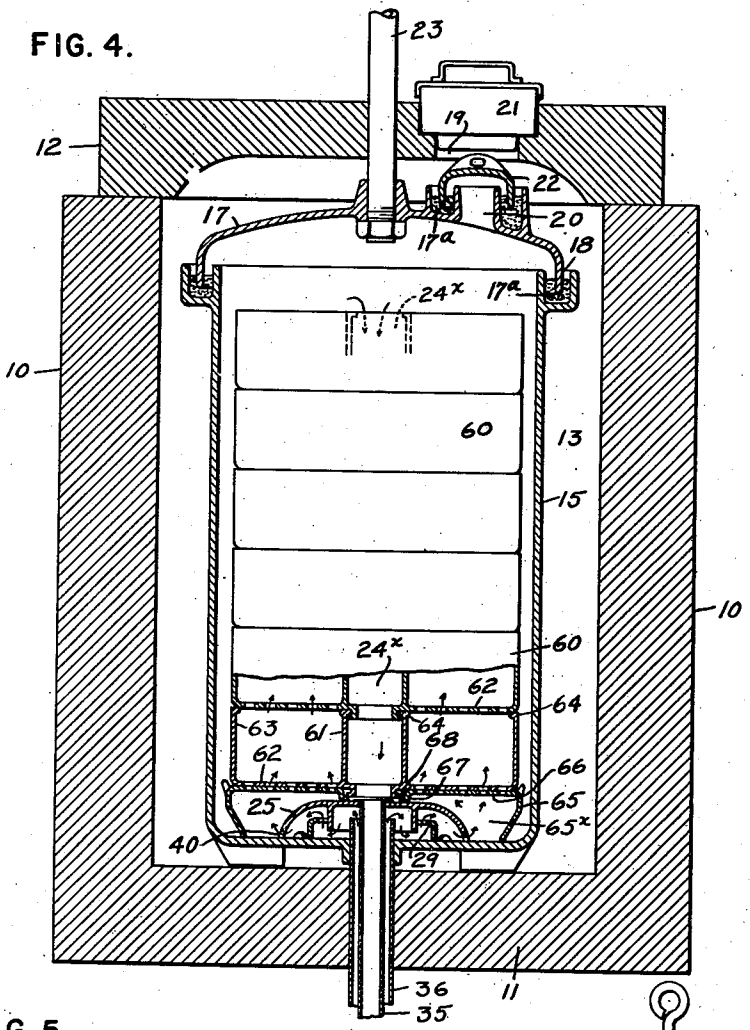


FIG. 5.

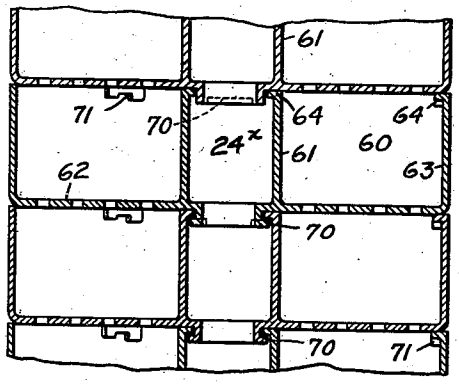
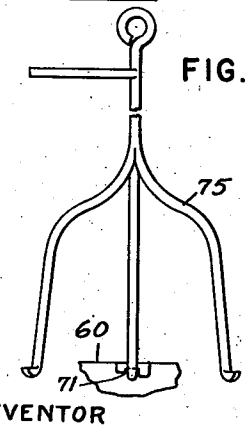


FIG. 6.



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Patented Feb. 16, 1943 2,311,344

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2,311,344

MEANS FOR BATHING WORKPIECES IN A CONTROLLED ATMOSPHERE

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Application March 4, 1941, Serial No. 381,638

8 Claims. (Cl. 266—5)

This invention relates to improvements in apparatus useful in heat treating processes for ferrous and non-ferrous articles and is concerned more particularly with an improved furnace and means for maintaining the work placed therein for treatment isolated from the atmosphere of the furnace oven and simultaneously bathed in a controlled atmosphere which may be kept continually in a state of motion.

A primary aim of the invention is to insure continuous movement as well as uniformity in the rate of flow of a given treating atmosphere about the work to be heated, without regard to the atmosphere that exists within the furnace proper, to the end that substantially the entire surface areas of the workpieces will be reached by the moving currents of the selected medium during the treating process, to the exclusion of air or gases from other sources.

A further aim of the invention is to effect substantial uniformity in the rate of circulation of the atmosphere about and in contact with the workpieces by an improved method and means that further insures circulation of a medium preheated to a temperature that does not chill the work when the medium employed is first brought into contact with the workpieces. And by way of an additional refinement the invention aims to extract a substantial portion of the heat units from the circulating medium as it is conducted away from the workpieces and to utilize the heat units so extracted in the warming of the incoming supply of new gases before or as they are introduced into the zone or vicinity of the workpieces.

A further objective of the invention is to render available a closed circulating system for a furnace that may, when the occasion requires, have the direction of flow of the atmosphere in the immediate vicinity of the workpieces reversed at will, and notwithstanding such reversals in movement, to effect a heating of the atmosphere before or as it flows into the region adjacent the work to be treated.

Still another object of the invention is to provide a furnace with a circulating system that may be maintained under appropriate pressure and which is closed to the direct atmosphere of the heating means and/or heating chamber of the furnace and which is efficient in operation and economical in its consumption of treating gases, and a system that requires relatively few parts each of simple design and inexpensive to manufacture and install.

In attaining the objectives of this invention, it is proposed to support the workpieces or pieces to be treated in a relatively tall normally closed retort or work chamber. Preferably the retort is cylindrical and is spaced from the walls of the heating chamber of the furnace to allow circulation of heat therearound. Located preferably at the center of the retort, an open topped tube or tubular chamber is constructed that communicates at its lower end with a conduit that extends through the bottom of the retort and also through the bottom of the furnace proper. A removable cover normally overlays and seals the top of the chamber containing the work but which leaves sufficient space between the underside of the cover and the upper end of the central tubular duct to permit free flow of air or gases through the duct to or from the work chamber proper.

At the lower end of the work chamber, a second conduit communicates therewith and projects through the bottom thereof and also through the furnace wall. This second conduit has its open end within the work chamber and overlaid by a system or series of baffle plates, also within the work chamber, that serve to impede the flow of the atmosphere to or from the conduit to the interior of the retort work chamber.

Preferably the two tubes or conduits just mentioned telescope one another beginning at a region within the retort to a region some distance beyond the outer wall of the furnace proper where they connect respectively with a source of supply of treating gas and a chimney or other circulating apparatus.

With such an apparatus, the treating gas or gas mixture is caused to flow through one of the tubes into the closed retort at one end thereof, and is gradually forced through and about the work that may be stacked therein, and is withdrawn from the other end of the retort and away from the furnace through the other concentric tube. During the circulating cycle, the system of baffles at the lower end of the retort impede the flow of the gases from the supply conduit associated therewith and effectively prevent the stream of entering gases from blasting the workpieces. Simultaneously, the baffle plates which become heated along with the retort and work therein, serve as a preheating means for the gases as and when the treating gases are introduced and dispersed into the closed work chamber at the bottom. When the system is so operated, the hot gases leaving the top portion of the retort, flow downward through the central

tube and as the incoming and outgoing conduits telescope each other for a substantial distance, the outgoing stream of hot gases gives up a large part of its heat to the incoming and relatively cool stream of treating gases. In this way, the entering treating gases become heated before they are caused to contact the work, first during their passage through the concentrically arranged tubes and again during their flow through the labyrinth of passageways afforded by the baffle plates.

When the circulating system is operated in the reverse direction, the incoming gases are again heated during their flow through the concentrically arranged tubes and again during their flow through the conduit that extends centrally of the work chamber to the upper regions thereof. This central tube will, of course, become heated indirectly throughout its length, and to increase its effectiveness as a heater for incoming gases, it may be provided with inwardly projecting fins or baffles. Such devices further serve as a flow retarding medium so that again the incoming gases do not blast the workpieces. The baffles at the lower end of the retort, which in this instance will be the discharging end, also function as a flow retarding medium, and the two baffle systems cooperate to maintain the interior of the retort free of swiftly flowing gas streams and otherwise insure uniform distribution of the atmosphere about the work.

A preferred apparatus for effecting movement of the gases through the retort consists in connecting the supply and exhaust gas conduits to opposite sides of a blower and therewith insure continuous forced circulation of the atmosphere about the work enclosed in the retort. With such a closed system, improved results are attained with the use of a pressure regulating device in the system, together with means for introducing a fresh quantity of treating gas to compensate for the gases consumed or vented during the heating and treating process.

Alternatively, the retort exhaust conduit may connect directly with the stack or chimney of the shop and the current or draft effected may be utilized to provide the means for circulating the atmosphere within the retort about the work. In any circulating arrangement, however, a reversing valve may be connected in the supply and discharge conduits leading to the retort wherewith the operator may conveniently reverse the direction of movement of the gases through the retort, i. e., to cause the new supply to enter the retort at the bottom and to be drawn off at the top, or reversely.

Other objects and advantages will be in part indicated in the following description and in part rendered apparent therefrom in connection with the annexed drawings.

To enable others skilled in the art so fully to apprehend the underlying features hereof that they may embody the same in the various ways contemplated by this invention, drawings depicting a preferred typical construction have been annexed as a part of this disclosure and, in such drawings, like characters of reference denote corresponding parts throughout all the views, of which:

Figure 1 is a sectional view of a furnace embodying the principles of this invention.

Fig. 2 is a detail view of a furnace with a more simplified form of mechanism for obtaining circulation of the atmosphere in a work chamber.

Fig. 3 is a fragmentary view of a baffle system for a conduit.

Fig. 4 is a sectional view illustrating a construction whereby the work baskets themselves are constructed as to form the central tube or duct when assembled within the work chamber.

Fig. 5 is a detail view of a work basket interlocking means, and Fig. 6 a tool for manipulating the baskets.

Referring more particularly to the apparatus illustrated in Fig. 1, the furnace is composed of side walls **10**, a bottom wall **11**, and a removable cover member **12**. The chamber **13** thereof may be heated in any well known manner, such as gas, oil, electricity, and the heaters are in this instance represented by the numeral **14**.

A substantially hollow container or retort **15** is lowered into the work chamber and rests upon short legs **16**. The retort also has a removable cover **17** which normally is sealed around its rim by means of the interdigitating rim flanges **18** and a suitable sealing medium such as sand **17a**. Each of the covers **12** and **17** are provided with aligned openings **19** and **20** having covers **21** and **22** respectively which may be removed when necessary to inspect the work, to take the temperature thereof, etc. without removing the larger covers or losing any substantial amount of furnace heat or treating gas. The retort cover **17** is also provided with a central staff **23**, which may be hollow for the insertion of a pyrometer and or for introducing or venting measured volumes of a treating gas when desired, and which serves as a convenient means for lifting the retort cover off its seat and out of the heating chamber. When used as a vent, this staff or tube **23** besides being provided with means for regulating the volume of spent gas or gases to be vented must be provided with a check valve to prevent entrance of atmospheric air into the retort.

The retort **15** may be of any convenient external shape, preferably however it is cylindrical to avoid corner pockets and, in the embodiment illustrated in Fig. 1, is provided with at least one centrally disposed tubular conduit **24**. The tube **24** rests upon an arched plate **25** at the bottom end, and carries at its top end a multi-slotted work supporting bracket member **26**. A plurality of radiating slots **27** are provided in the bracket **26**, through which the heads of work supporting rods **28** pass and are suspended. Each rod may carry one or more work baskets or as illustrated in Fig. 1, be provided with one or more star-like brackets **29** on which hollow workpieces, such as those indicated at **30**, may be stacked.

The center portion **31** of the main work supporting bracket **26** extends downwardly over the conduit **24**, a distance sufficient to provide a good bearing, and has an inwardly extending flange **32** that overlies the end of the tube **24**. The very center of the bracket is apertured at **33** to provide a passageway for air or gases to or from the interior of the tube **24**. The end **24a** of the tube **24** may be open to afford a free flow of the gases therethrough, but it is preferred to use a perforated end, as illustrated, to break up and to slightly impede the flow therethrough, for a purpose later to be explained.

The lower end of the central tube **24** is in open communication with a pipe line **35** which extends through the bottom of the retort, through the furnace wall **11**, to elements of a circulatory system located at a region well removed from the furnace.

The pipe **35**, however, is surrounded throughout the major portion of its length by a larger second pipe **36**, the upper end of which is spaced

from the under side of the arched plate 25 and is in open communication with the chamber 37a under the plate. The chamber 37a is divided into at least two substantially separate compartments 37a and 37b by a partition wall 38 which depends from the ceiling of the plate 25 to a region near the floor of the retort, leaving, however, sufficient space thereunder for the flow of gases between the pipe 36 and the chambers 37a and 37b. A similar partition wall 39 extends upwardly from the floor of the chamber 37b and has an inwardly turned flange which terminates short of the partition wall 38 and spaced from the ceiling of the plate 25. The partition 39 thus effectively divides the chamber 37b into two further compartments which communicate with each other through a system of restricted passageways of irregular contour. The chamber 37b also communicates with the interior of the retort 15 through a series of openings 40 dispersed around the lower margin of the arched plate 25. The plates 25 and 39 are arranged for easy removal and may be held in their concentric spaced relation, illustrated in Fig. 1, by a series of lug elements 41.

As illustrated by the arrows a gas or gas mixture flowing upwardly through the space between pipes 35 and 36 is caused to enter the work chamber through a labyrinth of passageways formed by the baffle members just described which have an impeding effect upon the rate of flow of the entering air or gases.

The pipe 36 also extends through the bottom of the retort and through the wall 11 of the furnace and externally communicates with a conduit 42 through the medium of a T-member 43 that is sealed at 44 about the inner conduit 35. The pipe 35 connects with a pipe 45 which, in the system represented by Fig. 1, leads to the intake side of the circulating blower or exhauster mechanism 46. The discharge side of the blower mechanism 46 communicates with the pipe line 42. When the blower is in operation, air or treating gases are forced through the pipe 42 to the pipe 36 and thence through the baffle system situated at the lower end of the work chamber to the interior thereof. Simultaneously air or gas is drawn off at the top of the retort through the opening 33 in the work supporting bracket and the perforated end 24a of the central tube, thence downwardly through the tube 24 to the pipe connections 35 and 45. By the piping arrangement just described, continuous circulation at a moderate rate of any selected or desired retort atmosphere may be effected.

It will further be observed that the baffle system, comprising plates 25 and 39, performs a plurality of functions, one of which is to impede and disperse the flow of gases entering the work chamber through the pipe line 36, and another of which is to afford a practical and efficient means for heating the gases before they are so dispersed into the work chamber. When the furnace is in operation the baffle plates 25 and 39 acquire substantially the same heat as the interior of the retort and as the entering gases are caused to be repeatedly deflected and agitated during their flow through the reversing passageways, they are caused to become cracked or preheated to a temperature approaching that of the work chamber, before they are discharged thereinto. Were the treating gases to pass through the heating chamber as part of the circulatory system they would be at substantially greater heat than the temperature of the work as they contacted it, and they would blast projecting or thin portions of it causing uneven heating and warpage which might or might not be corrected as the mass of the work became heated to the desired temperature.

The hot gases which are drawn from the top of the work chamber downwardly through pipe 24 and pipe 35 also heat the pipe 35. Accordingly, new air or gases flowing between the walls of pipes 35 and 36 extract some of the heat from the outgoing stream of heated gases flowing through pipe 35 and are caused to become heated to some extent before they reach the main preheating and dispersing system 25, 39 within the closed work chamber.

Should it be desirable or should the nature of the work undergoing treatment require a reversal in the direction of flow of the treating atmosphere through the work chamber, a reversing valve such as illustrated by the numeral 47 in Fig. 1, may be connected in the lines 42 and 45 and set in a position to effect a reversed flow of the atmosphere. With like effect the blower 46 may be reversible in character thereby dispensing with a reversing valve. When the system is operated reversely, the new gases will enter the work chamber at the top thereof, through the pipe lines 35, 24, and be deflected downwardly about the work therein. Simultaneously gases leaving the work chamber will proceed through the baffle system 25, 39 and through the outer concentrically arranged pipe 36.

During this reversed flow, the gases entering through the inner pipe 35 take up part of the heat of the hot gases flowing through the outer pipe 36 before entering the central conduit 24, and as the conduit 24 also will acquire substantially the same temperature as the work chamber, it provides a second heating stage for the entering gases before they are dispersed into the work chamber.

While a smooth bore tube 24 having a perforated end wall 24a has been found to produce good results as a preheater for incoming gases, its effectiveness as a preheater may be increased by the provision of inwardly extending fins or baffle members 24b such as illustrated in Fig. 3.

During normal operation of a closed circulating system of this character, a portion of the air or gas being circulated will be consumed or vented during the treating process and this deficiency may be made up by bleeding into one side of the system, preferably the suction side, a fresh supply of the desired gases. In Fig. 1 of the drawings the line 50 is connected to a suitable source of supply (not shown) of the gas or gases used during the treating process, which flow through a valve 51 set to pass the amount required into the suction side of the system.

At the pressure side of the system, a combined pressure regulator and trap 52 may be provided to maintain a given pressure in the system and which is also constructed to prevent the entrance of harmful air or gases into the circulatory system. In the present arrangement, the pressure in the system may be adjusted by the regulator 52, and or by the sand seal 17a. That is, the seal 17a may be constituted to act as a total seal whereupon the regulator 52 functions exclusively, or it may be constituted to act as a bleeder and permit a limited outseepage of gases from the container to occur.

In the event that a reversible circulator 46 is employed, as alluded to above, a reversing valve similar to the valve 47 may be connected

in the system between the circulator and the supply 50, 51 and the regulator trap 52 for reversing their connections in correspondence with reversals in the circulator.

In Fig. 2 of the drawings a variant form of circulating system is disclosed. In this form, the supply line 42 may connect directly with the source of supply 50a of the gases to be circulated about the work, or as illustrated in Fig. 1, be connectible therewith through the medium of a reversing valve 47. Also, the exhaust line 45 may connect directly with a flue or chimney line 45a, or connect therewith through the aforesuggested reversing valve. In the Fig. 2 embodiment of the invention there is a natural circulation of the atmosphere within the retort and about the work by virtue of the draft created by the chimney supplemented by the current produced by the pressure of the incoming gases. In this system also the gases entering the work chamber pass through the first and second preheating stages, explained above in connection with Fig. 1, and are gradually dispersed at a moderate rate to the interior of the work chamber irrespective of the direction of movement of the medium being circulated. It will be understood that the system represented by Fig. 1 is also operable should it be desired to omit the mechanical circulating unit 46 and connect the pipe line 45 directly with a chimney, and supply line 50 with the line 42.

In the embodiment of the invention illustrated in the furnace shown in Fig. 4, heat is applied to the container 15 in a known way (not illustrated) and the same circulatory and preheating principles for the gas or gases within the container, discussed in connection with Figs. 1–3 are, it will be understood, carried out. In this instance, however, the central conduit 24× within the work chamber is made up or constituted by the work baskets 60 themselves, each of which has an upstanding inner flange 61 that forms a section of a tube. When the baskets are stacked one upon another, they construct, in the aggregate, a centrally disposed tubular conduit. As illustrated in this figure, each basket 60 is preferably ring-like in character and has a perforated bottom 62 and imperforate sides 61 and 63 provided with top resting flanges 64.

The lowermost basket 60 is arranged to rest upon a ring-like support 65 whose top surface 66 is also perforated to permit the flow of gases therethrough, to or from the work baskets. The outer margin of the support 65, which extends to the floor of the retort, forms a continuous closed ring about the support and effectively confines the flow of the treating gas through the work baskets and about the workpieces therein. The inner ring portion of the support 65 is provided with an annular flange 67 which fits over a collar 68 on the arched supporting plate 25 and effectively prevents the flow of the gases to or from the conduit 24× and the chamber 65× at that juncture.

In this embodiment of the invention, incoming gases are warmed during their flow through the pipe 36, and again heated during their flow through the heated baffle system 25, 39 before being discharged into the chamber 65×. The heated gases are then forced upwardly through the perforations in the top 66 of the support and enter the work baskets thru the apertures in their perforated bottoms. The gases continue their upward progress from basket to basket, as illustrated by the arrows, until they overflow from the topmost basket and are drawn or otherwise forced downwardly through the central tube 24× and out through the inner telescoping pipe 35. Pipes 35 and 36 are, it will be understood, connected with units of the circulating system, or combinations thereof, as explained above in respect to Figs. 1 and 2.

When the direction of flow of the treating atmosphere is reversed, air or gases that are being introduced into the work chamber are initially warmed during the flow through the pipe 35 and again heated during the flow through the central conduit 24× (which may also be provided with baffle plates). The heated treating gases then pass downwardly through the work baskets and are exhausted from the bottom of the retort through the baffle system 25, 39 and pipe 36.

For convenience in stacking or removing the work baskets, the baskets are provided with a simple form of interlocking connections, such as illustrated at 70, and also with notches 71 preferably in their outer rims. By engaging a three-pronged hook 75 or similar tool, with the rim notches each basket may be given a part turn to lock or unlock it from the others. With such an arrangement, one or several baskets may be lowered into the retort or removed therefrom in a single operation.

To insure that all unwanted gases are expelled from the system after reloading the work chamber, the circulation of the medium may be started after the work chamber cover is closed on the work but before the work has reached a temperature such that any entrapped gases would be harmful.

It will be evident from the foregoing that the invention possesses many advantages among which may be noted that the user or operator is assured at all times that the workpieces are being bathed in an atmosphere kept continually in a state of motion by means located some distance away from the treating chamber. When distantly located, the several units of the circulating means and all moving parts thereof, are not subjected to or affected by the heat of the furnace.

Moreover, a circulatory system so conceived, is entirely closed, self-contained, and certain in its effects upon the work, without regard or consideration to the possible effect of the air or gases that may exist in the furnace proper. According to the present invention, no part of the medium being circulated comes in contact with the furnace heating means or with the direct heat of the furnace proper. Fumes and gases given off by the heating means and the conditions produced thereby in the heating chamber of the furnace are definitely excluded from entering the work chamber and from coming in contact with the workpieces undergoing a specific treatment.

Another important advantage of the invention lies in the fact that the gases entering the work chamber, whether they be wholly or partially new or old, may have the direction of flow reversed at will, and irrespective of direction of flow are caused to acquire substantially the same temperature as that of the work being treated before the gases come into contact therewith and in consequence have no chilling effect thereon. And conversely, by isolating the atmosphere of the heating chamber 13 from the work container 15 and from the circulating system herein proposed, the work undergoing heating and treating is not blasted by moving currents of a high heat that might be injurious to the work

particularly thinner sections thereof. It will be further seen that the work to be treated in the closed container, in accordance with this invention, is not blasted by the in-rush of gas, for the incoming gas is caused, by reason of the baffle systems arranged at the lower end of the work chamber, as well as at the top end thereof, to be dispersed gently into the work chamber.

The entire system is constructed along simple uncomplicated lines and renders itself capable of relatively inexpensive manufacture and installation in existing furnaces.

Without further analysis, the foregoing will so fully reveal the gist of this invention that others can, by applying current knowledge, readily adapt it for various utilizations by retaining one or more of the features that fairly constitute essential characteristics of either the generic or specific aspects of this invention and, therefore, such adaptations should be, and are intended to be, comprehended within the meaning and range of equivalency of the following claims.

Having thus revealed this invention, I claim as new and desire to secure the following combinations and elements, or equivalents thereof, by Letters Patent of the United States:

1. A container for maintaining workpieces bathed in a preheated atmosphere kept in a state of motion, comprising a box section and a removable cover section, a tube in open communication with the lower region of the box section, and a second tube in open communication with the upper region of the box section, said tubes having portions in telescoping relation with one another; baffle means in the said box section placed in overlying spaced relation with the open end of said first named tube for heating gases introduced through the tube before said gases contact the workpieces; means for heating said container and indirectly the baffle means therein; and means removed from said box section for withdrawing the atmosphere from within the box through the second mentioned tube and for returning same to the container through the first named tube and the heated baffle means associated therewith.

2. A furnace in which workpieces may be bathed in a preheated treating gas or gases during the heating and treating process comprising a heating chamber, a normally closed container within said chamber adapted to contain the work to be heated and treated, a conduit communicating with the interior of said container at the bottom thereof, a second conduit communicating with the interior of the container at the top thereof, said second conduit extending downwardly through the interior of the container and having a reduced end portion arranged in telescoping relation with said first mentioned conduit, means for forcing a relatively cool treating gas through one of said conduits into the container and for withdrawing the excess and relatively hot treating gas from the container through the other of said conduits, the telescoping relation of said conduits functioning as a heat transferring means whereby the treating gas entering the container becomes heated before it contacts the work therein by extracting part of the heat from the withdrawn gas.

3. An apparatus for bathing workpieces in a treating gas or gas mixture comprising a normally closed container adapted to receive the workpieces to be treated, a conduit communicating with the interior of said container at one side of the workpieces to be treated, a second conduit leading out of said container and being in open communication with the interior thereof at the other side of the workpieces to be treated, said second conduit being centrally disposed in said container and extending the major portion of the length thereof, and said second conduit also having one end portion thereof arranged in concentric spaced relation with said first named conduit, means for passing a treating gas through one of said conduits into said container and for withdrawing the unused portion of the gas through the other of said conduits, and means for sealing said conduits against flow of the treating gas therebetween except by way of the interior of the container in which the work to be treated is placed.

4. An apparatus useful in the heat treatment of workpieces in a controlled moving atmosphere comprising an upright container adapted to receive and enclose the pieces to be heat treated, an upright tubular column located centrally in said container and having its upper end in open communication with the upper portion of the interior of the container and its lower end extending through the bottom of the container, a second tubular column member also extending through the bottom of the container and having one end in open communication with the container interior at the end thereof opposite the open end of said first named column, means and connections exteriorly of the container for passing a treating gas through one of said column members into the interior of the container and through the length of the work receiving space in the container interior and for withdrawing the treating gas from the container through the other of said conduits, reversing means operatively connected with said last named means for selectively reversing the direction of flow of the treating gas through said tubular columns thereby selectively to reverse the direction of flow of treating gas through the work container, and means connected with the exhausting side of the container for injecting a fresh supply of treating gas to make up for the amount consumed during the heat treatment process.

5. The combination set forth in claim 4 in which baffle means are provided within the container adjacent the open end of the said conduits for effecting a preheating of the treating gas prior to its discharge into the zone occupied by the work, said preheating means being effective as such when either of said column members is functioning as the gas supplying conduit.

6. A mechanism and system for maintaining workpieces bathed in a preheated atmosphere isolated from the atmosphere of the combustion chamber of a furnace, comprising a normally closed container having a work receiving box section and a removable cover section, a pair of telescoping conduits for conveying a treating gas into and out of said container, said conduits passing through the bottom wall of the container and opening into the interior thereof, one of said conduits opening into the interior of the container at the bottom end, and the other of said conduits extending centrally within the container to the upper and opposite end thereof and at said opposite end opening to the interior of the container, baffle means also within the container adjacent the open end of one of said conduits for shielding the work against

the direct discharge of treating gas from the said conduit and for heating within the container the treating gas prior to its contact with the workpieces; a furnace for heating said container and indirectly the said baffle means contained within the container; said baffle means including a hollow member having finned portions projecting into the hollow interior adapted and arranged to intercept and deflect the entering gas into heat transfer relation with the walls thereof; and means for effecting a flow of treating gas through one of said conduits, through the said shielding and heating baffle means within the container, thence through the interior of the container about the workpieces to the opposite end thereof and an outflow of the gas from the container through the other of said conduits.

7. The combination set forth in claim 6 characterized by the provision of means located exteriorly of the furnace for returning said outflowing gas back to the interior of said normally closed container through the first mentioned conduit, and means connected with the conduit conveying the outflowing gas for injecting a fresh supply of treating gas thereinto to compensate for the amount consumed during the work treating process.

8. An apparatus for heat treating workpieces combining a furnace providing a work heating chamber and means for heating same, a normally closed work container within said heating chamber, said container having a removable cover member at its upper end, a gas inlet and a gas outlet conduit opening into said container below the cover member, one of said conduits opening into said container at the bottom thereof and the other of said conduits opening into the container interior at the upper region thereof and both of said conduits passing through the bottom wall of the container, gas heating means within the container interior adjacent the open end of one of said conduits adapted to heat the gas flowing thereinto before the gas enters the work treating area of the said container, said heating means including a hollow member having finned portions projecting into the hollow interior adapted and arranged to intercept and deflect the entering gas into heat transfer relation with the walls thereof; and means at a distance from the furnace for connecting said outlet conduit with said inlet conduit and for effecting a recirculation of the gas flowing through the outlet conduit back to the work treating area of said container through said inlet conduit and the gas heating means associated therewith within the container.

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