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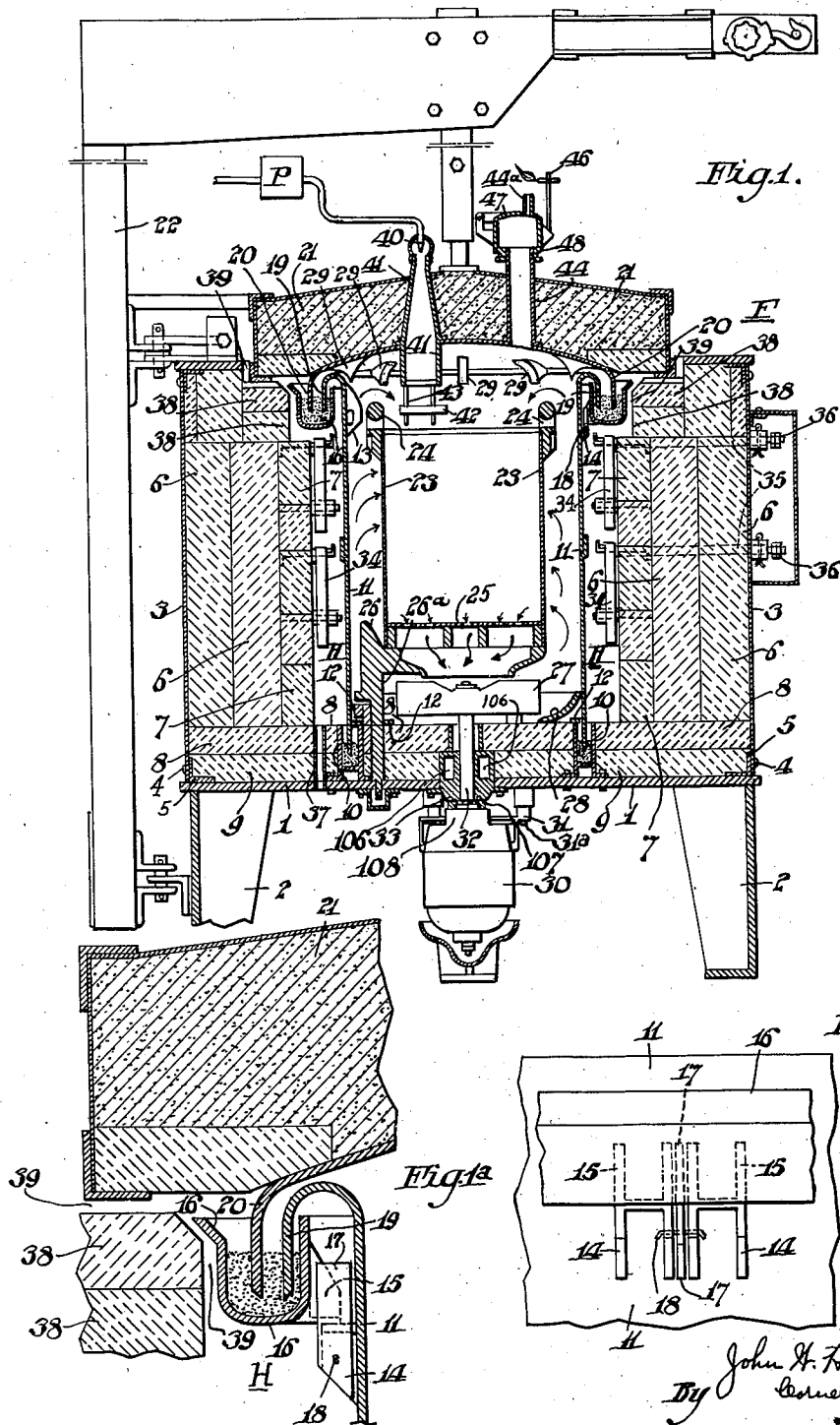
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2,168,028

HEAT TREATING SYSTEM

Filed Jan. 12, 1938

5 Sheets-Sheet 1



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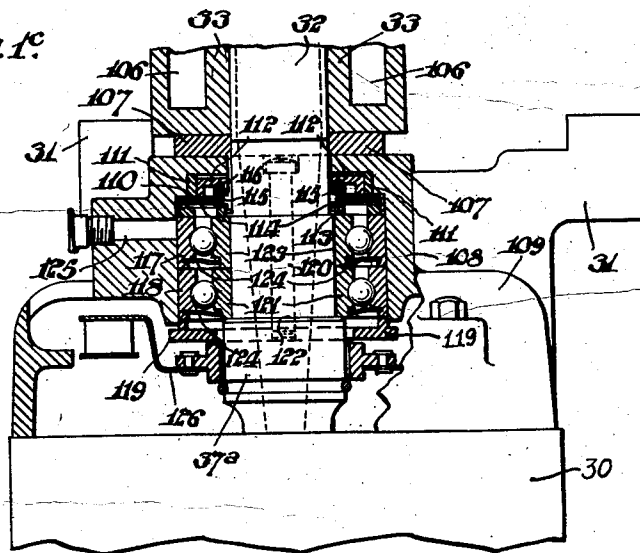
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HEAT TREATING SYSTEM

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Fig. 1c



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HEAT TREATING SYSTEM

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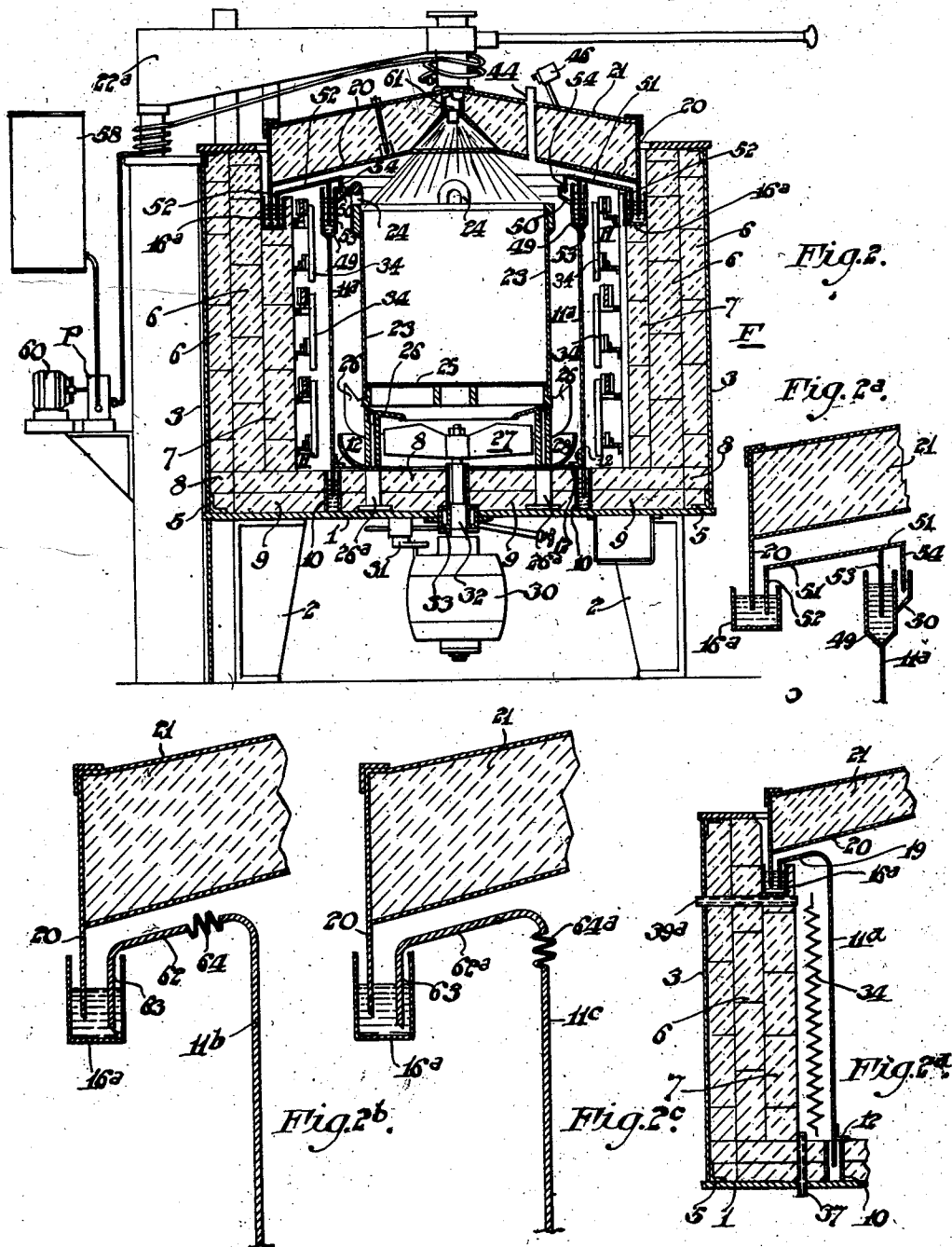


Fig. 2.

Fig. 2a.

Fig. 2b.

Fig. 2c.

Fig. 2d.

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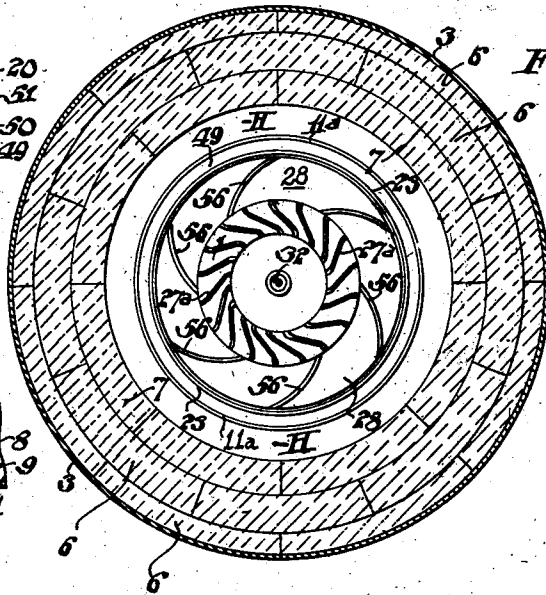
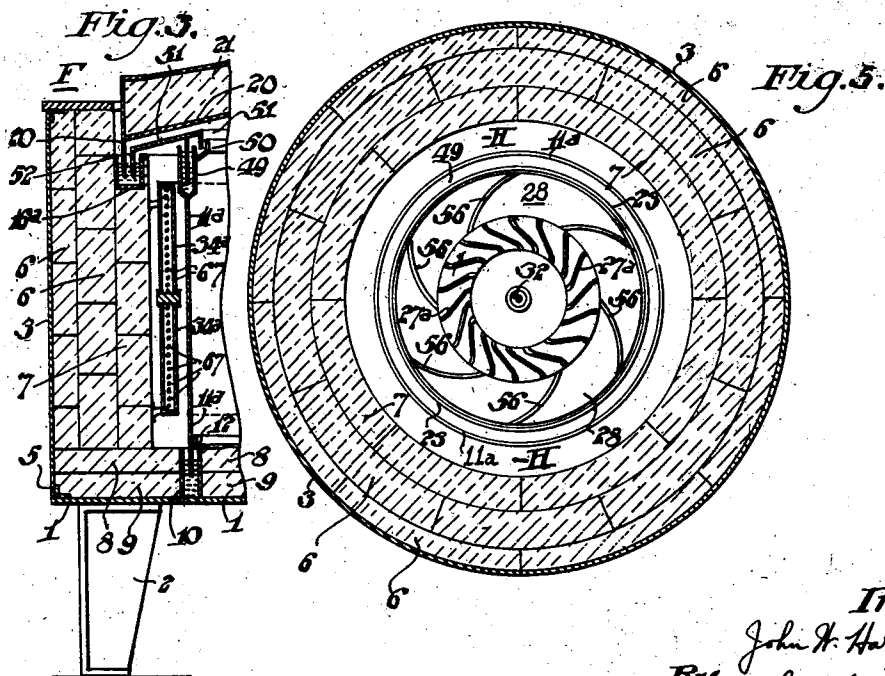
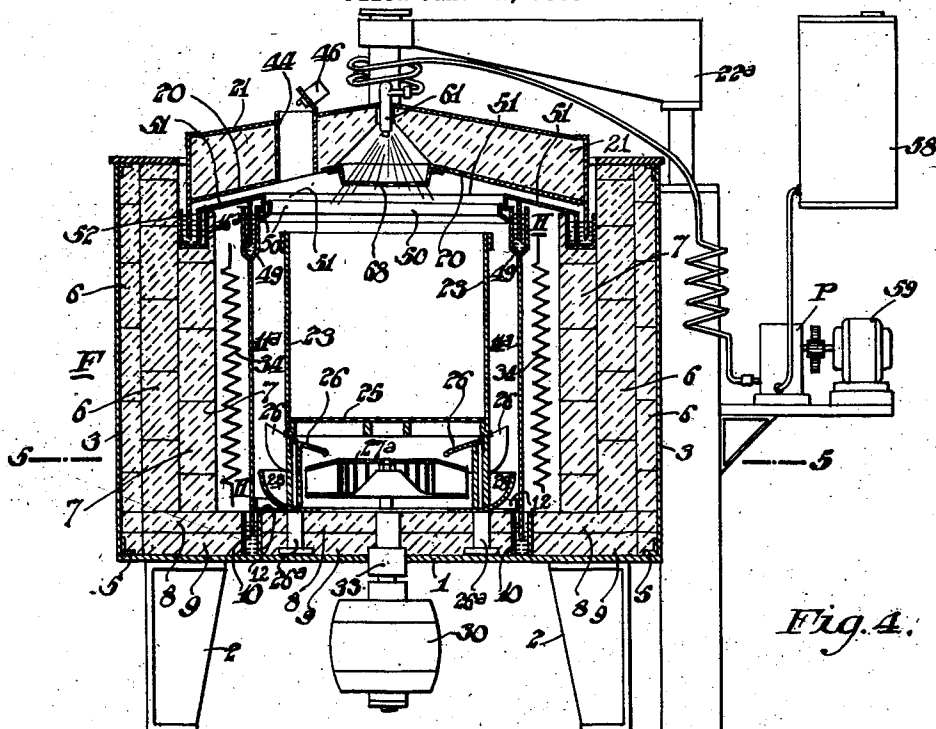
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HEAT TREATING SYSTEM

Filed Jan. 12, 1938

5 Sheets-Sheet 4



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2,168,028

HEAT TREATING SYSTEM

Filed Jan. 12, 1938

5 Sheets-Sheet 5

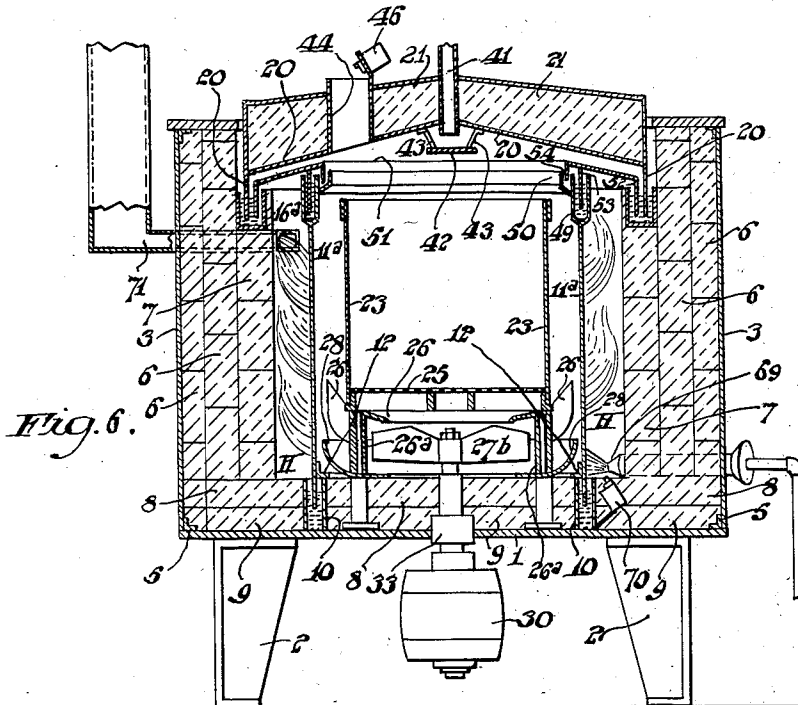


Fig. 6.

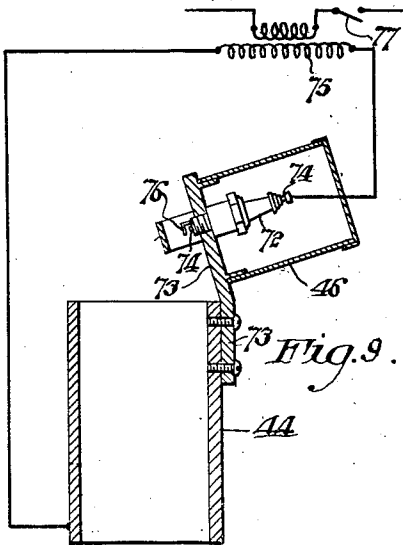


Fig. 9.

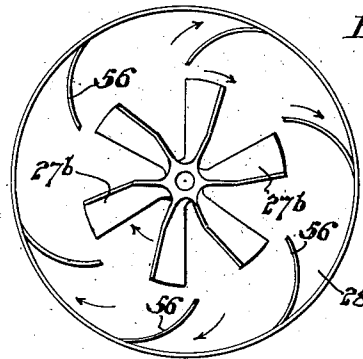


Fig. 7.

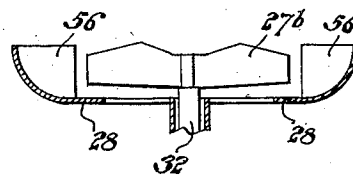


Fig. 8.

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UNITED STATES PATENT OFFICE

2,168,028

HEAT TREATING SYSTEM

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Application January 12, 1938, Serial No. 184,554

11 Claims. (Cl. 266—5)

My invention relates to heat-treating systems and particularly to furnaces suited for carburizing or other heat-treating processes involving high-temperature application of suitable chemically-active gas to work pieces under treatment.

In accordance with one aspect of my invention, the retort for containing the work pieces remains in the furnace during loading, treatment, and unloading, and the sealing arrangement, for preventing ingress into the retort of atmospheric air or leakage from the heating chamber of the furnace, or leakage from the retort of gas therein, is constructed to allow the retort to expand and contract, without appreciable restriction by the retort cover, the seal structure or stationary parts of the furnace, and without impairment of the efficacy of the seal.

Further in accordance with my invention, sealing of the retort is effected by fluidic material, such as fine sand having suitable, generally low, angle of repose, and suitable baffles are provided to prevent entrainment of particles of the sealing material by the retort atmosphere, especially when forcibly stirred or circulated.

Preferably, a floating member of the seal structure additionally serves as an inner cover or wall which more or less completely closes the heating chamber when the outer or retort cover is removed, with effect to conserve heat between successive runs of the furnace.

My invention further resides in the features of construction, combination and arrangement hereinafter described and claimed.

For an understanding of my invention and for illustration of various forms thereof, reference is to be had to the accompanying drawings, in which:

Fig. 1 is a front elevational view, mainly in section, of a heat-treating furnace;

Fig. 1a is a detail view of a sealing ring mounting shown in Fig. 1;

Fig. 1b is a detail view, on enlarged scale, of a part of seal structure shown in Figs. 1 and 1a;

Fig. 1c is a detail view, largely in section, of a fan shaft seal shown in Fig. 1;

Fig. 2 is a front elevational view, largely in section, of a heat-treating furnace utilizing a modified seal construction;

Fig. 2a is a sectional view on enlarged scale of seal structure shown in Fig. 2;

Figs. 2b, 2c and 2d are detail sectional views showing other sealing arrangements;

Fig. 3 is a fragmentary, front elevational view, largely in section, of a heat-treating furnace showing a modified form of heater construction;

Fig. 4, in general similar to Fig. 2, illustrates a different fan construction and modified form of agent-introducing device;

Fig. 5 is a horizontal sectional view taken on line 5—5 of Fig. 4;

Fig. 6 is a vertical sectional view, partly in elevation, of a furnace heated by combustion;

Fig. 7 is a plan view of the fan and associated vane construction of Fig. 6;

Fig. 8 is a front elevational view, partly in section, of Fig. 7;

Fig. 9 is a sectional view, with electrical diagram, showing an arrangement for igniting exhausted treating gases.

Referring to Fig. 1, the furnace F comprises a metal base plate 1 supported at suitable height above the floor by the standards or legs 2. The outer metal shell member 3 suitably attached to the base member 1, as by screws 4 and angular members 5, surrounds the layers of bricks 6, 6 of suitable heat insulating material such as diatomaceous earth brick and a layer of bricks 7, preferably of suitable refractory material, such as firebrick, which line or form the side wall structure of the heating chamber H of the furnace. The bottom wall of the heating chamber and of the furnace comprises a plate 8 of suitable refractory material, which rests upon the plate 9 of suitable heat-insulating material which, in turn, is supported by the base plate 1.

The channel member 10 in the base of the furnace is adapted to receive the lower end of a tubular retort member 11, preferably of generally of circular cross-section, which, in the construction specifically illustrated, is comprised of several short sections secured, as by welding, to each other. Preferably the retort, as well as other metal parts of the furnace interior, is of nickel-chromium alloy or the like. Near its lower end the retort is provided with an inwardly directed flange 12 which rests upon the upper inner edge of the channel member 10 and prevents the sealing material from being drawn from the channel into the retort when the atmosphere therein is forcibly circulated, as hereinafter described.

Near its upper end the retort is provided with circumferentially spaced inwardly directed lifting hooks or eyes 13 to facilitate withdrawal of the retort from the furnace for replacement or repair. Normally, however, the retort remains in the furnace during loading, treatment, and unloading of the work.

The channel member 10 in the base of the furnace holds a suitable quantity of sealing material which, for the particular purposes herein specif-

ically described, is preferably sand, fine-grain aluminum-oxide, fine-grain "Carborundum," or like material capable of withstanding high temperatures and "fluidic" in the sense it is capable of flowing about the lower edge of retort 11 during expansion and contraction of the retort and upon insertion into or withdrawal from channel 16 of the lower edge of the retort. Preferably, the sealing material is granular, or crystalline, about 100 mesh or finer, and should be devoid of powdered material so that it will readily flow; otherwise stated, the sealing material, if comprised of solids, should have a low angle of repose; alternatively, the fluidic sealing material may be of any liquid capable of maintaining integrity of the seal under the conditions, physical and/or chemical, obtaining during the particular mode of heat-treatment.

From the exterior of the retort, near the upper end thereof, project several pairs of abutments 14 for engaging the members 15 projecting inwardly from the channel member 16 which normally surrounds the retort 11. As shown in Figs. 1a and 1b, the channel 16 is retained in the position shown in Fig. 1 by keys 17, each of which extends vertically between a pair of abutments 14 on the retort and a pair of abutments 15 on the channel, the wire or cotter pin 18 preventing the key from dropping from place. By this construction, the retort and the channel member 16 may move relatively with respect to each other during their heating and cooling without production of strain due to differences in expansion and contraction of these two members. The channel member 16 is mounted upon or removed from the retort while the retort is out of the furnace. To remove the channel 16, the keys 17 and their retaining wires 18 are first removed; then channel 16 is rotated sufficiently to effect disengagement between the pairs of lugs 14 on the retort and pairs of lugs 15 on the channel to allow the channel to drop clear of the retort. To position a channel member 16 on the retort the operations are performed in reverse sequence.

The channel 16 provides support for another body of sealing material which is preferably of the same fluidic character as that retained by channel 16. When channel 16 is in position in the furnace, Figs. 1 and 1a, it receives the outwardly and downwardly directed flange 19 at the upper end of the retort, and also receives the lower end of the flanged member 20 depending from the cover 21 which may be raised with respect to the supporting member 22 pivotally mounted on one side of the furnace to afford access to the furnace retort for loading.

By the construction described the retort 11, the channel member 16, and the cover plate 20 are each free to move with respect to the other and to the main body of the furnace, when subjected to thermal stresses arising from their expansion and contraction during heating and cooling of the furnace, without any impairment of the seals at either end of the retort whose purpose is to prevent leakage into the retort from the heating chamber or from outer atmosphere, and to prevent leakage from the retort to the heating chamber or to atmosphere. The absence of any rigid connection between the retort and stationary structure of the furnace, between the cover and the retort, and between the cover and stationary structure of the furnace, results in increased life of these furnace parts and freedom from breakdown of the seals during a run with consequent adverse effect upon the work under treatment.

In particular, the floating mounting of the channel 16 permits the retort to expand and contract without restraint imposed by the channel or the cover flange 20.

For supporting the work pieces within the retort, and to facilitate loading and unloading, there is preferably provided a removable work basket 23 having lifting eyes 24 at the upper end thereof and provided at the bottom with a grid or grating 25 which supports the work pieces.

The lower end of the work basket 23 is supported by the member 26 having several legs 26a which extend through the base of the furnace and rest upon the base plate 1. The central portion of the member 26 is open and shaped to provide a duct from the underside of the work basket to the fan 27 in the base of the retort. The deflection plate 28 which rests upon the bottom of the furnace is suitable curved to direct the atmosphere circulated within the retort by the fan toward or from the fan depending upon the direction of circulation. Preferably, as shown in Fig. 1, the direction of circulation is such that the atmosphere in the retort passes downwardly through the work basket to the fan and thence upwardly around the work basket to the top of the retort.

When the fan 27 is of the blower type or of the propeller type with high blade angle to obtain blower characteristics, the gases swirl about the work basket as they advance axially toward the top of the retort. Since the deflection plate 28 is of diameter suitably less than the internal diameter of the retort to avoid any restriction of the retort during its contraction, there is tendency for the swirling gases to draw the small particles of sealing material from the channel 16 into the treating chamber but this depletion of the seal is precluded by the inwardly directed flange 12 of the retort.

The swirling action of the gases also tends to draw particles of sealing material from the upper channel 16 into the retort but this is effectively prevented by the small vanes or swirl-breakers 29 depending from the cover plate 20 near its region of approach to the upper rim of the retort 11.

The fan 27 is driven at suitably high speed, for example, 1800 revolutions per minute, by the motor 30 suspended from the base plate 1 of the furnace by the brackets 31.

The fan shaft 32 extends loosely through the member 33, mounted in the base of the furnace and, preferably, as shown, provided with a passage 106 for circulation of water or other cooling liquid. At its lower end the member 33 is engaged by the packing ring 107 (Figs. 1 and 1C) of rubber or the like, compressed between the bottom of member 33 and the housing of motor 30 when the latter is drawn into place by bolts 31a. The upper bearing of the motor comprises the housing 108 preferably integral with the top cap 109 and mounting brackets 31. Within the recess 110 of the bearing housing is disposed, at the upper end of the recess, the packing or sealing ring 111, of suitable material, preferably "Duprene" or like material, unaffected by oil or grease, whose upper edge and outer periphery engage the inside of the housing. The inner periphery of ring 111 engages the outer periphery of the upper part of the metal seal member 112 having a shoulder which engages the lower edge of the packing ring 111; the inner diameter of member 112 is slightly greater than the diameter of motor shaft 32a. Within a recess in the lower face of the member 112 is disposed the thrust washer 113 of thickness somewhat less than the depth of the recess. Between the upper face of ring 111 and

the member 112 is disposed a thin metal annular diaphragm 114, specifically copper, the inner edge of which is pressed downwardly by a plurality of springs 115 disposed in recesses 116 in the upper part of member 112; the outer periphery of diaphragm 114 is brazed or welded to sealing member 112 and the inner periphery thereof is similarly fastened to the thrust ring 113 thus to form a gas-tight seal. The lower lapped surface of ring 113 and the upper lapped surface of race 123 rotatable with shaft 32a provide a sliding gas-tight seal lubricated as described hereinafter. The stationary races 117, 118 of the two ball bearings shown lie within the housing 108 below the rings 112 and 113 and are held in place by the ring 119 held in position by a plurality of bolts 120 which pass downwardly through the housing 108 and which, at their lower ends, threadably engage the ring or plate 119. The rotating race 121 of the lower ball bearing abuts against a shoulder 122 on the motor shaft 32a.

Preferably each of the ball bearings is provided with a thin metal ring 124 secured as by welding to the associated stationary race and extending almost into contact with the outer periphery of the corresponding rotating race to serve as a grease retainer. The passageway 125 through the housing permits the upper motor bearings to be filled with a suitable lubricant.

Transfer of gases to or from the interior of the retort along the fan shaft is prevented by the packing rings 107 and 111, the bronzed or welded connections of diaphragm 114, and the lubricated, lapped, engaging surfaces of thrust bearing 113 and bearing race 123.

Attached to the upper end of the motor shaft 32a within the cap 109 is the fan 126 for cooling the motor windings and the upper bearing.

Preferably, as shown in Fig. 1C, the fan shaft and the motor shaft though functionally integral are disconnectable to facilitate assembly and replacement of either the fan or the motor; specifically, the motor shaft 32a is hollow and is provided at its upper end with an internal taper to fit the taper of the fan shaft 32.

The space between the outside of the wall structure of the retort and the inner face of the heating chamber is heated in any suitable manner; in the particular arrangement shown in Fig. 1, the ribbons 34 of suitable resistance material, such as nickel-chromium alloy, are hung from the refractory blocks 7 lining the heating chamber and suitably connected as by conductors 35 to terminals 36 connected to a source of electric current.

Preferably, as shown, there are provided several passages 37 for admitting air at suitably low rate to the lower end of the heating chamber, and at the upper end of the heating chamber the blocks 38 are slightly spaced from the outside of the channel 16 and from the lower side of the cover 21 to afford for the heated air an exhaust passage 39 from the heating chamber. Consequently, during heating of the furnace there is movement of hot air about the channel 16 which is effective to minimize differences of temperature in different portions of the channel and thus reduce strains tending to shorten the life of the channel member 16.

Since the channel member 16 substantially closes the top of the annular heating space about the retort even when the main cover 21 is removed for loading or unloading of the retort, the heat of the heating chamber is to substantial extent conserved. The air admitted to the heating chamber by passages 37 is also effective to com-

bust any carbonaceous material which may leak into the heating chamber and which otherwise might be deposited on the electrical heating elements and cause trouble by short circuits or grounds.

For carburizing the pieces in the work basket, a suitable carburizing agent, for example, fusel oil, dipentene, butane, or natural gas, is fed, preferably at metered rate as by a positive displacement pump P, to the nozzle 40 from which it drops, through the tubular member 41 extending through the cover 21, into the upper region of the reaction or treating chamber defined by the retort, the cover member 20 and the seal construction. The carburizing agent when introduced into the furnace in liquid phase is vaporized in the region immediately adjacent the top of the work basket and the vaporized liquid is immediately brought into contact with the load in the work basket. By introducing the carburizing agent, in liquid, gaseous or vapor phase, in this region of the path of the circulating atmosphere of the retort, it is insured that the zone of primary dissociation or cracking shall extend through the load, affording carburization at high rate and without need to supply the agent in such excessive quantity that deposits of soot occur which deposits not only defeat the purpose of high rate of feed of the carburizing agent but also produce non-uniformity of the carburized case upon the work. This and other herein described constructions are suited for performing the methods of carburization described and claimed in my copending application Serial No. 183,618, filed January 6, 1938.

To prevent, when the agent is introduced into the furnace in liquid or vapor phase, impingement of unvaporized carburizing agent upon the top of the load, which would tend to produce a cold spot during treatment and consequent inferior carburization of the work within the cold spot, there is provided, as described and claimed in my aforesaid copending application, the vaporizing plate 42 directly below the tubular member 41 and supported therefrom by the spaced members 43. During operation of the furnace the plate 42 is at high temperature sufficient immediately to vaporize any of the carburizing agent which reaches it in liquid or vapor form. The vaporized agent is immediately entrained by the circulating atmosphere and passes therewith downwardly into contact with the work to effect carburization thereof.

The pipe 44, through the cover of the furnace, provides for continuous discharge of the exhausted treating gases which, for purposes of safety to the operator, are burned as they issue from the pipe 44a, adjacent the open end of which there is preferably provided a continuously operating igniting device 46, for example, a gas flame or an electric spark.

During operation of the furnace, and particularly at the region adjacent the lower end of pipe 44, the furnace pressure is slightly higher than atmospheric; consequently, there is no tendency for atmospheric air to enter the retort through pipe 44. Preferably, the exhaust pipe 44 is of substantial diameter, much larger than pipe 44a which is carried by the cover 47 for the chamber 48 at the upper end of pipe 44. When it is desired to lift or replace the retort cover 21, the cover 47 for chamber 48 is opened to permit the pressure in the retort rapidly to assume equality with the atmosphere; otherwise, there is tendency for the sealing material in the channel 16 to be sucked into the retort upon lifting of the retort cover or

blown from the channel into the heating chamber during lowering of the retort cover.

Though particularly suited for carburizing, the furnace of Fig. 1, and of all the other figures of drawing, is suited for other modes of heat treatment such as nitriding, bright annealing, tempering, hardening, toughening and the like, in which the work, while heated, is subjected to an atmosphere comprising a vapor or gas which obtains or preserves the desired characteristic composition of the surface, or the surface and subsurface of the work pieces.

When any of the furnaces disclosed are used for carburizing, the agent may be any suitable carbonaceous compound, for example, a hydrogen, carbon compound, such as butane, propane, hexane, ethane, or a hydrogen, oxygen, carbon compound such as fusel oil, diethylene-glycol, furfural, diethyleneglycolmonoethylether, or a mixture of such compounds.

Since, in many respects, the furnace construction shown in Fig. 2 is the same as that shown in Fig. 1, those elements corresponding to like elements of Fig. 1 are identified by the same reference characters; discussion of Fig. 2 is confined to features not present in Fig. 1 or therein appearing in modified form.

The retort 11a of Fig. 2 is provided at its upper end with a channel 49 containing a body of suitable sealing material, preferably of the character previously herein mentioned, and with an inwardly and upwardly directed baffle member 50 (Fig. 2a). The stationary channel member 16a at the upper end of the wall structure of the heating chamber contains another body of suitable sealing material, for example, of the fluidic character previously specified. The floating seal member 51, which closes the top of the annular space between the outside of the retort 11a and the inner wall of the heating chamber H, is provided at its outer edge with a flange 52 received by the sealing material in the channel 16a and near its inner edge is provided with a flange 53 received by the sealing material in channel 49 at the top of the retort.

Desirable swirling of the gases about the retort and within the annular heating space is produced or enhanced by the vanes 56 (Fig. 7) attached to the deflection plate 28 in the bottom of the retort.

The flange 54 extending downwardly from the floating seal member 51 between the adjacent faces of members 49 and 50, provides a tortuous path effective to prevent the swirling action of the circulating atmosphere from drawing particles of sealing material from channel 49 into the retort. The lower edge of flanged member 20 of the furnace cover 21 is also received by the sealing material in the channel 16a.

When the cover 21 is in closed position, the atmosphere within the retort is effectively isolated from the heating chamber and from the atmospheric air; when the main cover 21 is moved to its open position for insertion or withdrawal of work, the floating seal member 51 serves as an auxiliary cover for the annular heating chamber to conserve its heat energy and so reduce the time and cost of the next run.

The cover 21, the floating seal member 51, and the retort are all free to move with respect to each other and with respect to the stationary structure of the furnace; each of these members is free to expand and contract during operation of the furnace without distorting or being distorted by any of the other members and with-

out impairment of the seal construction which remains effective to prevent pollution of the treating atmosphere in the retort by leakage from the heating chamber or from the atmosphere external to the furnace.

For feeding carburizing agent to the reaction chamber comprising the retort 11a, the floating seal 51 and the cover 21, there is provided, in the particular arrangement of Fig. 2, a tank 58 for holding a suitable carburizing liquid, a positive displacement pump P, preferably of the type utilized for feeding fuel to a Diesel nozzle, a motor 60 for driving the pump, and a nozzle 61, preferably of the type used to inject fuel into a Diesel engine, mounted upon the cover 21 and extending through it to project a jet or spray of carburizing agent into the region above the work basket 23. The hot gases circulating in the reaction chamber entrain and vaporize the introduced carburizing agent, raise it to cracking temperature, and carry it and products of its dissociation downwardly through the load. By injecting the fresh carburizing agent immediately above the load, the direction of circulation of the gases being as indicated by the arrows, it is provided, in accordance with my aforesaid copending application, that the primary cracking of the agent shall continue throughout the load, affording high rate of carburization.

In the sealing arrangement shown in Fig. 2b, the annular sealing member 62, whose flange 63 generally corresponds to the flange 52 of sealing member 51 of Fig. 2, is connected to the upper end of the retort 11b by the annular corrugated member 64 which permits the retort to expand or contract without distorting or being distorted by the sealing member 62. The floating sealing member 62 prevents communication between the heating chamber and the atmosphere in the retort, and serves to conserve the heat of the heating chamber when the cover 21 is removed for loading or unloading of work.

The construction shown in Fig. 2c is quite similar to that of Fig. 2b, the difference being that the bellows or expansion member provided by the corrugated member 64a is disposed vertically at the top of the retort 11c instead of substantially horizontally as in Fig. 2b. In both modifications, the annular sealing member 62 or 62a and the retort are floatingly mounted to permit them to move with respect to the retort during expansion and contraction of the seal and the retort. Both the seal and the retort are also free to move with respect to the flanged cover member 20 whose movement, during expansion and contraction, does not restrict the movement of the retort or the sealing member. The nature of the sealing material in the flange 16a is such that it flows upon movement of the flanges 20 and 63 incident to their heating and cooling during operation of the furnace to preserve the sealed relation of the reaction chamber with respect to the heating chamber and atmospheric air; specifically, the sealing material may comprise any of the substances herein mentioned as suitable.

In the modification shown in Fig. 2d, the top of the retort 11d, is provided, like the retort of Fig. 1, with an integral outwardly and downwardly directed flange 19. In this modification, however, the flange is received by the stationary channel 16a at the upper end of the heating chamber wall. With this construction there is greater movement of the sealing flange in the body of the sealing material.

To minimize temperature differences in the sealing channel 16a conducive to its distortion, there are provided a multiplicity of outlets 39a extending from the top of the heating chamber adjacent to or in contact with the channel 16a to atmosphere; provision of these passages 39a and inlet passages 37 at the bottom of the heating chamber provide for circulation of air, the heated gases from the annular heating space pass adjacent the sealing channels 16a and so reduce the difference in temperature between the outer and inner portions of the channel.

The furnace construction shown in Fig. 3 is similar to that of Fig. 2 except for the heater construction. In this modification, the electric heater 34a is made in two or more sections, each comprising an annular ring of refractory in which are embedded the turns 67 of a helix or spiral of resistance wire. The several heating sections are suitably secured to each other and suspended from the furnace wall without attachment to the retort which, as in all modifications, floats between seals at the bottom and upper ends thereof.

The heat treating system shown in Fig. 4 is substantially the same as that shown in Fig. 2 except there is provided a perforated vaporizing plate 68 on the under side of the cover 21 below the injection nozzle 61 to prevent impingement of unvaporized heat-treating agent upon the top of the load in the work basket 23. This plate which performs generally the same function performed by plate 42 of Fig. 1 may be omitted if the carburizing agent is introduced in gaseous form.

The fan 27a shown in this modification is, as clearly appears in Fig. 5, of the blower type; any of the other fan constructions herein shown or described may be substituted therefor. The hot gases discharged by the fan are caused to swirl, as by vanes 56, as they advance axially in the annular space between the outside of the work basket and the inner face of the retort. In the region above the top of the work basket the swirling gases entrain the freshly introduced carburizing agent and move it downwardly through the load. Entrainment of the sealing material by the swirling gases is prevented at the lower end of the retort by flange 12 and at the upper end of the retort by baffle 50.

The furnace construction shown in Fig. 6 is substantially the same as, or similar to that of, the other modifications except for the method of heating the retort. In this modification, the retort is heated to the desired temperature, depending upon the nature of the heat-treatment, by combustion in the annular heating chamber H of the furnace. Specifically, one or more burners 69 supply a suitable combustible mixture, for example, a mixture of fuel gas, or liquid fuel, and air to the bottom of the chamber H where it is ignited, as by a jump spark device 70. Preferably, the burners 69 enter the heating chamber tangentially to cause the burning gases and products of combustion to swirl around the retort as they advance upwardly and axially thereof toward the outlet duct 71 at or near the upper end of the heating chamber.

The fan 27b for forcibly circulating the atmosphere within the reaction chamber into contact with the retort for absorption of heat for subsequent transfer to the work to raise its temperature to heat-treating temperature, and for equalization of the temperature throughout the load, may be of the type, shown in Figs. 7 and 8, having both blower and propeller characteristics;

the fan 27b, Fig. 7, rotates in clockwise direction to cause the gases to swirl in that direction as they advance upwardly in the retort. By reversing the direction of rotation of the fan, the gases may be caused to circulate in reverse direction in the reaction chamber, i. e., the gases will be forced upwardly through the basket rather than downwardly. It is not desirable, however, that this direction of rotation be utilized, particularly when the furnace is used for carburizing, because primary cracking of the carburizing agent would occur outside of the work zone and result in deposition of soot on the bottom of the load and low carburizing power of the atmosphere surrounding the top of the load.

In Fig. 9 there is diagrammatically shown a suitable arrangement for igniting the gas issuing from the retort of any of the carburizing furnaces herein described. Briefly, a spark plug 72, such as ordinarily utilized to ignite the charge of internal combustion engines, is screwed into a metal bracket 73 attached to the outer end of the exhaust pipe 44 of the furnace. One electrode 74 of the spark plug is connected to one terminal of the high tension transformer or spark coil 75 whose other terminal is connected to the exhaust pipe 44 electrically connected by bracket 73 to the shell electrode 76 of the spark plug. The switch 77 for controlling the primary circuit of the spark coil or transformer 75 is preferably interlocked with the switch which controls the fan motor 30 and/or the pump motor 60 to insure that whenever the furnace is in operation the gases issuing from it will be ignited.

It is to be understood my invention is not limited to the forms thereof specifically illustrated and described, but is coextensive in scope with the appended claims.

What I claim is:

1. A heat-treating furnace comprising a heating chamber, a retort in said heating chamber having a channel at its upper end for holding a body of fluidic sealing material, a second channel for holding a second body of fluidic sealing material disposed about said heating chamber, a floating seal member affording access to the interior of said retort and for closing the heating chamber space outside of the retort having flanges immersed in said bodies of sealing material, and a cover for said retort having a flange received by said second-named body of sealing material and removable for access to the interior of the retort while said sealing member is in place.

2. A heat-treating furnace comprising a heating chamber, a retort remaining within said chamber during loading, treatment, and unloading of the work, channel structure at the upper open end of said retort mounted for movement with respect thereto and containing fluidic sealing material, and cover structure for closing said furnace including a sealing flange received by said material to isolate the space within the retort from the heating chamber space outside the retort and extending therefrom to overlie said heating chamber space outside of the retort.

3. A heat-treating furnace comprising a heating chamber, a retort remaining within said chamber during loading, treatment, and unloading of the work, channel structure loosely supported from the upper open end of the retort and containing fluidic sealing material, and cover structure for closing the upper end of said retort having a sealing flange received by said material and extending beyond the flange to close the heating chamber space outside of the retort.

4. A heat-treating furnace comprising a heating chamber, a retort remaining within said chamber during loading, treatment, and unloading of the work, channel structure within said chamber at the upper open end of the retort and containing fluidic sealing material, and means for closing the upper ends of said chamber and said retort comprising cover structure having a sealing flange received by said material, extending outwardly to close the heating chamber outside of said retort, and having a central opening substantially corresponding with the open top of the retort, and a second cover structure movable to open or close the top of the retort while said first cover structure is in place.

5. A heat-treating furnace comprising a heating chamber, a cover for closing said heating chamber, a retort remaining in said chamber during loading, treatment, and unloading of the work, channel structure within said heating chamber loosely mounted at the open upper end of said retort and containing fluidic sealing material, and a sealing flange depending from said cover for reception by said material to complete isolation of said retort when said cover is in position to close said heating chamber.

6. A heat-treating furnace comprising a heating chamber, a retort remaining within said chamber during loading, unloading, and treatment of the work, channel structure at the upper open end of said retort disposed within said chamber and containing fluidic sealing material, cover structure for closing said chamber, means for isolating the retort atmosphere from the heating chamber space outside of the retort comprising a peripherally continuous flange received by the sealing material in said channel structure, and means carried by said cover structure for feeding treating agent through the cover structure within the periphery of said flange for discharge into the isolated treating chamber defined by said retort, said cover structure, and said flange.

7. A heat-treating furnace comprising a heating chamber, a retort remaining within said chamber during loading, unloading and treatment of the work, channel structure at the upper open end of the retort containing fluidic sealing material, cover structure for closing said chamber, structure including a flange received by said sealing material cooperative with said retort and said cover structure for defining an isolated treating chamber, and means for agitating the atmosphere within said treating chamber comprising fan structure within the retort.

8. A heat-treating furnace comprising a heating chamber open at its upper end, a channel in the base of said chamber containing fluidic sealing material, a fan rotatable above and adjacent said base within the periphery of said channel, a removable tubular retort open at both ends and

whose lower end is received by said channel for closure by the base of said chamber, a second channel containing fluidic sealing material at the upper end of said retort, and means for closing the upper ends of said chamber and said retort comprising a sealing flange received by said second channel and cover structure extending outwardly from said flange to cover the heating chamber space outside of said retort and inwardly from said flange to cover the open top of said retort.

9. A heat-treating furnace comprising a heating chamber open at its upper end, a channel in the bottom of said chamber containing fluidic sealing material, a fan rotatable above and adjacent said base within the channel outline, a removable tubular retort open at both ends and whose lower end is received by said channel for closure by the base of said chamber, a second channel containing fluidic sealing material at the upper end of said retort, and means for closing the upper ends of said chamber and said retort comprising cover structure overlying the heating chamber and retort therein and a sealing flange depending therefrom for reception by said second channel member to confine to the retort the atmosphere agitated by said fan.

10. A heat-treating furnace comprising a heating chamber open at its upper end, a channel in the bottom of said chamber containing fluidic sealing material, a fan rotatable above and adjacent said base within the channel outline, a tubular retort open at both ends and whose lower end is received by said channel for closure by the base of said chamber, a second channel containing fluidic sealing material at the upper end of said retort, and means for closing the upper ends of said chamber and said retort comprising cover structure overlying the heating chamber space outside of the retort having a sealing flange received by said second channel member, and a separate cover structure overlying the top of the retort and removable for loading or unloading thereof while said first cover structure is in place.

11. A heat-treating furnace comprising a heating chamber, a retort remaining in said chamber during loading, treatment, and unloading of the work, cover structure for closing said chamber and said retort therein, and means for isolating the interior of said retort from the heating chamber outside of the retort comprising a sealing member attached to the upper open end of said retort, a second sealing member attached to said cover structure, and an intermediate sealing member within the furnace free to move with respect to said first and second sealing members during continued co-action therewith to prevent leakage.

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