May 12, 1931. L. C. KOENIG 1,804,782

PRESSURE CONTROL IN FURNACES

Filed May 3, 1929

Fig. 1

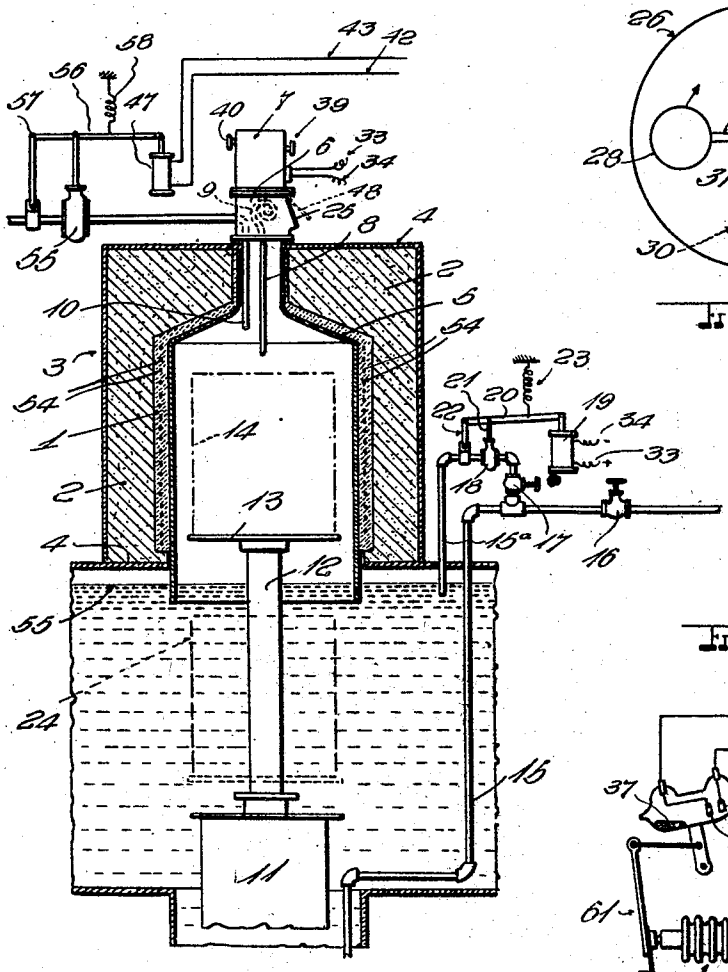


Fig. 2

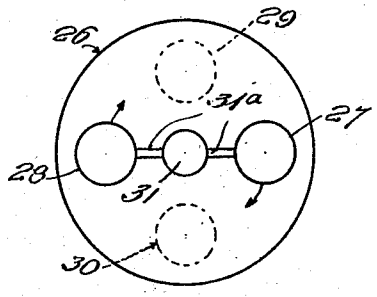


Fig. 3

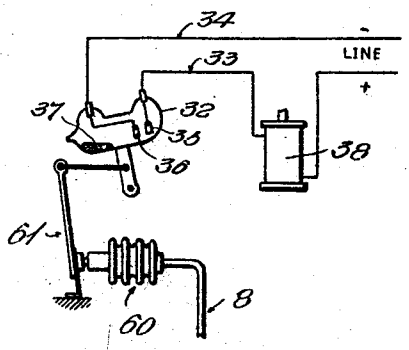
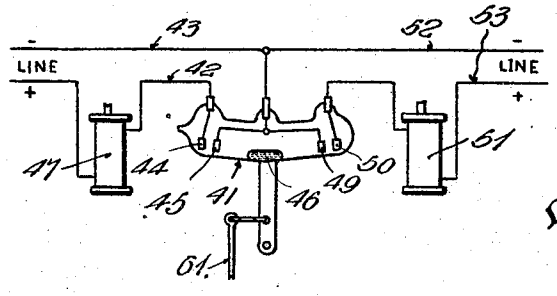


Fig. 4



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UNITED STATES PATENT OFFICE

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PRESSURE CONTROL IN FURNACES

Application filed May 3, 1929. Serial No. 360,188.

My invention relates broadly to heat treatment furnaces, and more particularly to a control system for heat treatment furnaces by which the operation of the furnace is governed by the pressure within the furnace chamber.

One of the objects of my invention is to provide means for controlling the speed of unloading a water-sealed retort furnace in accordance with the pressure in the retort.

Another object of my invention is to provide means for constantly maintaining a non-oxidizing atmosphere in the retort of a furnace.

Still another object of my invention is to provide means for preventing the collapse of the retort of a retort furnace due to a partial vacuum on the inside of the retort when unloading.

Other and further objects of my invention reside in the arrangement of control apparatus, as set forth in the specification hereinafter following by reference to the accompanying drawings in which:

Figure 1 shows a form of furnace embodying the principles of my invention, with the control system of my invention applied thereto; Fig. 2 illustrates a plan of mounting for the retort furnace employed in the system of my invention; Fig. 3 shows a wiring diagram of one form of control circuit employed in the system of my invention; and Fig. 4 illustrates a wiring diagram of another form of control circuit employed in my invention.

Referring to the drawings, reference character 1 indicates a furnace chamber formed by walls 2 such as a combination of fire brick and kieselguhr in laminated form enclosed in any suitable shell 3 having top and bottom heads 4. The chamber is heated by any suitable means, such as electrical heating elements 54.

Suspended in the furnace chamber 1 is a cylindrical type retort 5 made gas-tight and sealed at the bottom by any liquid such as water, the flow line being shown at 55.

At the top is a fitting 6 on top of which may be mounted a pressure or vacuum control switch 7. The switch 7 may be a bellows type diaphragm indicated generally at 60 operating a lever 61 which may tilt a mercury switch according to varying pressure within limits defined by adjusting screws 39 and 40. Attached to switch 7 is an open end tube 8 having the customary form of a pig-tail siphon 9.

Reference character 10 designates an inlet pipe through which any gas, such as steam, may enter retort 5. Pipe 10 may have manually operated valves along the length thereof or may have automatically operated valves therein, such as shown at 55. Reference character 11 represents any hoist, such as a hydraulic operated hoist, having plunger 12, on top of which is mounted a load platform 13 which may support a charge, such as indicated in broken line 14. Pipe line 15, through which any pressure exerting fluid may pass, is attached to cylinder 11 below the piston head (not shown), attached to plunger 12. Reference character 16 shows a valve controlling the flow of liquid through pipe 15. Reference character 17 indicates a by-pass valve in pipe line 15—*a*.

A gate valve is shown at 18 operated by vertical operating stem 21 pivotally attached to lever 20, which lever has a fulcrum point by means of pivotally mounted link 22. Reference character 19 shows a solenoid having electrical connections 33 and 34. Reference character 23 indicates a helical spring of the tension type holding lever 20 in an upward position until lever 20 is drawn down by electrically energized solenoid 19.

Figure 2 is a plan of a form of mounting for retort furnace, 26 being the outline of a tank, 27 and 28 being the location of re-

torts, and 31 is a hydraulic plunger to which is attached arms 31—*a*, supporting loading platforms, such as 13 of Figure 1. By any suitable mechanism the loading platforms and their supporting arms 31—*a*, together with the plunger 31, may be made to revolve in the direction shown by arrows to the unloading positions 29 and 30.

Figure 3 is a diagram of one form of the electrical circuits involved, 32 being a mercury switch attached to line circuit wires 33 and 34, terminating at one end in enclosed electrodes 35 and 36, the mercury in the switch being shown at 37. Reference character 32 of Fig. 3 corresponds to 7 of Fig. 1. Reference character 38 is a solenoid as indicated by 19 in Figure 1. The mercury switch in this figure is shown in the open circuit position.

Figure 4 shows a modified form of a mercury switch with electrical connections, operating through two solenoids 47 and 51, where solenoid 51 corresponds to solenoid 19 of Fig. 1, and solenoid 47 corresponds to solenoid 47 of Fig. 1. Mercury switch 41 corresponds to part of switch 7 of Fig. 1.

Furnaces of this type are used for the bright annealing of non-ferrous metals, such as copper, nickel, monel, nickel silver, etc., where oxidization may be prevented by annealing in a steam atmosphere. When a charge such as 14 is brought from its lowered position, shown by dotted outline 24, up into the retort, it carries with it considerable water, the introduction of which into the heated retort results in a considerable quantity of steam which is vented from the retort by means of flapper valve 25 subject to opening to position 48. This valve closes when excess of steam has been emitted. The weight of this flapper valve 25 can be made to resist any pressure, such as 2 to 4 oz. Charge 14 when in its lowered position 24 can be raised to its operating position in the retort by closing valve 17 and opening valve 16 which may apply pressure to cylinder 11. To unload, valve 16 is closed and valve 17 is opened. The flow of water under pressure through pipe 15—*a* is also controlled by the action of gate valve 18. The lowering of the heated charge into the water causes a considerable quantity of steam at atmospheric pressure, which is released into the retort at the atmospheric temperature of steam, or 212° F. This sudden chilling of the interior of the retort is imparted to the interior surface of the retort, while the external surface is kept expanded by the close proximity of the outside surface to the source of heat. The difference of expansion and contraction between the outer surface and the inner surface respectively causes sufficient strain in relatively thin metal retorts as to cause a collapse in the retort structure. This action has been of sufficient amount to cause the complete collapse of ¼″ boiler plate retort, 36″ in diameter, 6′ high above the water surface to the crown of the retort. To overcome this sudden cooling, steam at relatively high temperature may be admitted through pipe 10, through valve 55, controlled by solenoid 47. The admission of this steam may be controlled to such a rate as to overcome the chilling effect above cited.

When pressure steam is not admitted to the retort, the vacuum created by the lowering of the charge, as heretofore described, may cause an action on the diaphragm of vapor switch 7, tilting mercury switch therein, and closing the circuit through electrodes 35 and 36, energizing the solenoid 38 or 19, and thereby closing valve 18. This valve remains closed until the pressure in the retort again assumes normal, when the mercury switch again opens the circuit, thus completing one cycle.

The same switching mechanism and circuits applied to steam pipe 10 will result in similar action by controlling the flow of steam. The flow of steam, unless controlled, can be excessive, which would open valve 25 and waste steam thereby. I have shown a valve 55 in the steam pipe line 10 controlled by lever 56 pivoted at one end at 57 and controllable against the action of spring 58 at the other end by solenoid 47. The circuits which supply power to the solenoids 47 and 51 are shown at 42—43 and 52—53, respectively in Fig. 4.

In the control of both the steam line and the water line, a double point mercury switch is used as in Fig. 4. In Fig. 4 the mercury switch 46 is shown in a neutral position, as when the pressure in the tank is normal. Solenoid 47 controls the supply through the steam pipe valve 55 and solenoid 51 controls the supply through the water pipe valve 18. The too rapid exit of water discharged through pipe 15—*a* would create a vacuum and switch 7 would tilt mercury switch 41, when mercury 46 in the switch would close the circuit between electrodes 49 and 50, thereby energizing solenoid 51, thus closing gate valve 18 of the pipe line.

As heretofore described, flapper valve 25 may resist a low pressure, such as 4 oz. to 2 oz. pressure considered as normal. If live steam therefore is permitted to flow into the retort, any excess of steam would raise the pressure above normal. Pressure above normal would tilt mercury switch 41, closing the circuit through electrodes 44 and 45, thereby energizing 47, which would close a gate valve in the steam line. It will be understood that the live steam line may be closed manually by a valve when the charge is being raised into the retort, as

there is always then an excess of steam as heretofore outlined.

In the heat treatment furnace of my invention, a non-oxidizing atmosphere is obtained by preventing the inflow of free air. Heretofore, free air has been admitted to heat treatment furnaces resulting in heavy oxidization of the charge during the annealing process, unless a wasteful amount of steam is applied. In the system of my invention, the pressure within the heat treatment chamber and the non-oxidizing atmosphere in the retort may be retained accurately and automatically.

The control system of my invention is applicable to other forms of furnaces besides retorts, and it will be understood that modification in the structural arrangement of the parts of the control system may be made within the scope of the appended claims without departing from the spirit of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. In an annealing furnace of the water sealed retort type, means for automatically controlling the inflow of steam to said furnace in accordance with the pressure in said retort for maintaining a non-oxidizing atmosphere therein.

2. In an annealing furnace, a heat treatment chamber, means for conveying and removing a charge into and from said chamber, and means operated in timed relation to said aforementioned means for maintaining a non-oxidizing atmosphere in said chamber.

3. In an annealing furnace, means for conveying and removing a charge into and from said furnace, and means controlled by the pressure existent within the furnace for maintaining a non-oxidizing atmosphere in said furnace.

4. In an annealing furnace, means for introducing a charge into said furnace and removing said charge therefrom, and means operative under control of the pressure within said furnace for rendering the atmosphere within said chamber non-oxidizing and governing the rate of movement of the charge into or out of said furnace.

5. In an annealing furnace, a heat treatment chamber, means for introducing a charge into said furnace and removing said charge therefrom, pressure control means operative in accordance with the pressure within said furnace for regulating the pressure to which said charge is subjected, and maintaining a non-oxidizing atmosphere within said chamber throughout the period of heat treatment of said charge with respect to said furnace.

6. In an annealing furnace, a heat treatment chamber, means for introducing a charge into said furnace, pressure control means in said furnace, a multiplicity of solenoids, one of said solenoids being operated by said pressure control means and operating to control the movement of the charge with respect to said chamber, and another of said solenoids operating alternately with respect to the operation of said first mentioned solenoid for maintaining a non-oxidixing atmosphere within said chamber.

7. An annealing furnace comprising a heat treatment chamber, means for conveying a charge to and from said heat treatment chamber, electrical means for controlling the movement of said charge from said heat treatment chamber, and electrical means operative alternately with the operation of said first mentioned electrical means for maintaining a non-oxidizing atmosphere within said heat treatment chamber.

8. In an annealing furnace, a heat treatment chamber, means for conveying a charge to and from said chamber, electrical control means having a neutral position and opposing limited positions, means actuated by the pressure within said chamber for shifting said control means to either of said limiting positions for subjecting the charge within said chamber to a predetermined pressure, and maintaining a non-oxidizing atmosphere within said chamber.

9. An annealing furnace comprising a heat treatment chamber, means for conveying a charge to and from said chamber, electrical control means for governing the rate of removal of said charge from said chamber, and electrical control means for maintaining a non-oxidizing atmosphere in said chamber.

10. An annealing furnace comprising a heat treatment chamber, means for conveying a charge to and from said heat treatment chamber, a pressure supply line, a valve for automatically controlling the supply of pressure means in said pressure supply line for subjecting said charge to a predetermined pressure within said chamber and means for governing the operation of said valve according to the pressure within said chamber.

11. An annealing furnace comprising a heat treatment chamber, means for conveying a charge to and from said heat treatment chamber, a pressure supply line, a valve for automatically controlling the supply of pressure means in said pressure supply line for subjecting said charge to a predetermined pressure within said chamber, and means for electrically controlling the operation of said valve according to the pressure within said chamber for maintaining a non-oxidizing atmosphere within said chamber.

12. In an electric furnace, a heat treatment chamber, means for introducing and

removing a charge through a bath into or from said heat treatment chamber, automatic pressure control, means for governing the rate of movement of the charge from said heat treatment chamber through said bath, means controlled by the pressure within said heat treatment chamber for maintaining a non-oxidizing atmosphere within said chamber throughout successive processes of heat treatment.

In testimony whereof I affix my signature.

LEON C. KOENIG.