This invention relates to open hearth furnaces and more particularly to means to automatically regulate the fuel input thereof to prevent burning of the refractory lining of the said furnace.

One of the objects of the present invention is to provide means to automatically regulate the fuel input in response to temperature conditions attained by the hottest point in the furnace. Another object is to provide means responsive to temperature conditions attained in the furnace to automatically regulate the fuel input to the furnace to prevent burning or melting of the refractory lining of the furnace. Other objects and advantages will appear as the invention is more fully disclosed.

An open hearth furnace is fired alternately from one end to the other. We have found that the hottest point in the furnace is located at the neck or knuckles at either end of the furnace close to the rear skewback. When the furnace is being fired in one direction the outgoing neck is the hottest point. When the direction of firing is reversed the opposite neck becomes the hottest point.

In co-pending application Serial No. 31,735, filed July 16, 1935, by Lewis Rumford II, entitled Method and means for determining and automatically regulating furnace temperatures, there is described and claimed a method and means for determining the temperature of furnaces by measuring the radiant energy emitted by the refractory lining thereof. Lewis Rumford, II, one of the applicants of the present invention, is the same Lewis Rumford, II, applicant of the above identified copending application.

In accordance with the invention of said co-pending application a radiation pyrometer device is sighted through an opening in a wall of the furnace upon the inner surface of another wall and a pressure of air or other suitable gas is blown through the opening into the interior of the furnace to prevent the escape of flame, dust and products of combustion through the opening which would interfere with the correct measurement of the radiant energy emitted by the inner wall surface.

When the furnace temperature is measured in the manner described in said co-pending application we have found that the temperature of the roof is lower than the temperature of the outgoing neck of the furnace. Consequently while the roof may be prevented from deleterious overheating the outgoing neck cannot be so protected. By regulating the fuel input in response to temperature conditions of the outgoing neck, however, the roof and other sections of the furnace thereby may be protected from overheating.

Accordingly, the present invention contemplates an improvement in the method of said co-pending application with respect to this feature and further with respect to fuel input regulation responsive to the temperature conditions of the outgoing neck of the furnace. Reference should be made to the accompanying drawing wherein—

Fig. 1 is a plan view of a typical open hearth furnace incorporating the present invention;

Fig. 2 is a cross-section along plane 2—2 of Fig. 1.

In the drawing the furnace is shown with back wall 1, front wall 2 and neck side walls 3 and 4 respectively which extend burners 5 and 6 respectively. Walls 7 and 8 are the rear skewbacks as they are known in the art. The hottest points in the furnace are points 9 and 10; point 9 when burner 6 is operating and point 10 when burner 5 is operating. Burners 5 and 6 are periodically operated to alternate the direction of firing.

In accordance with the present invention radiation pyrometer devices 11 and 12 are sighted through appropriate openings 13 and 14 in the back wall 1 upon points 9 and 10 respectively. The electric energy developed by said devices 11 and 12 is conducted by suitable electric connections to double throw switch 15 electrically connected to pyrometer controller mechanism 16. Circuit arrangement A schematically illustrates a circuit diagram of a relay device to operate double throw switch 15 to connect the pyrometer device 11 or 12 which is sighted on the outgoing neck 9 or 10. Switch 17 in circuit A may be located in any convenient manner on the furnace reversing mechanism so that upon reversing burners 5 and 6 switch 17 closes one or the other contacts 18 and 19 thus energizing the relay to throw double switch 15 to connect the particular device 11 or 12 which is sighted on the outgoing neck.

The electrical energy from either of pyrometer devices 11 or 12 passing into pyrometer controller 16 energizes a relay circuit B through switch arm 20 and adjustable contacts 21 and 22.

Thus energized relay switch 23 energizes reversible motor circuit C. Circuit C energizes reversible motor 24 opening and closing valve 25 in main fuel supply conduit 26 thereby increasing or decreasing the amount of fuel being supplied to burners 5 and 6. Hand operated valves 27 and 28 control the direction of fuel feed to burners 5 and 6 and one of these valves is closed when the
other is open. Switch 11 (circuit A) may be arranged in mechanical combination with valves 27 and 28 to be operated by the reversing of burners 5 and 6. Such a mechanical combination of an electrical switch with hand or motor operated valves heretofore has been devised and specifically forms no part of the present invention any more than do relay mechanisms 15 and 23 or reversible motor means 24.

In the practical application of the present invention contacts 21 and 22 are adjusted so that when the temperature of the inner surface of the outgoing neck of the furnace approximates 90°F. below its danger or melting point the relay switch 23 is thrown into circuit closing position energizing motor 24 to close off the fuel supply a certain maximum. When the temperature of said inner surface drops below a determined minimum relay switch 23 is again energized to close the other circuit to energize the motor 24 in a reverse direction to open valve 25 permitting an increase in the fuel supply to the furnace. These circuits are indicated by letters "H" and "L" respectively, letter "C" indicating the central or common ground circuit of the two.

In this manner the temperature of the furnace may be automatically regulated to be below a certain maximum determined by the temperature attained by the outgoing neck which is the hottest point in the furnace, and also regulated to be at all times above a certain minimum. The refractory lining of the entire furnace is thereby protected at all times from the deleterious effects of overheating.

Having broadly and specifically described the present invention it is apparent that many modifications and adaptations may be made therein without departing essentially from the same, and all such modifications and adaptations are contemplated as may fall within the scope of the accompanying claims.

What we claim is:
1. Apparatus for regulating the temperature in a furnace of the regenerative type, provided with means to alternately supply heat energy at opposite ends thereof, said apparatus including a pair of radiation sensitive devices adapted to convert radiant heat energy into electrical energy having an intensity bearing a known relation to the temperature inducing said heat energy, means to irradiate each of said devices by radiation emitted by a portion of the inner refractory lining of said furnace which during each alternate heating of the furnace is subjected to the maximum heating effects, means adapted to be actuated by the electrical energy thereby produced in said devices to lower and to increase the supply of heat energy to said furnace as the intensity of said electrical energy approximates maximum and minimum limits respectively, and means to automatically connect to said heat supply control means first and then the other of said devices in synchronism with the alternate supplying of heat energy at opposite ends of the said furnace.

2. Means for regulating the temperature of a furnace heated from opposite ends alternately at periodic intervals by the injection of fluid fuel and oxidizing gases into the said furnace, said means comprising a pair of radiation sensitive devices adapted to convert radiant heat energy into electrical energy having an intensity bearing a known relation to the temperature inducing said radiant heat energy, means to irradiate one of said devices with radiant heat energy emitted by a portion of the inner refractory surface of said furnace which during one period of heating of the furnace is subjected to the maximum heating effects, means to irradiate the other of said devices with radiant heat energy emitted by a portion of the inner refractory surface of the furnace which during the next succeeding period of heating is subjected to the maximum heating effects, means to supply fluid fuel to said furnace, means to direct the supply of fuel alternately to opposite ends of said furnace, means to reduce the amount of said fuel passing to said furnace a determined amount from a maximum, means to reverse said reducing means, and means energized by the electrical current generated in one of said devices during each heating period to actuate said decreasing means and said reversing means when the intensity of said electrical energy approximates determined maximum and minimum limits respectively representative of temperature limits desired in said furnace.

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