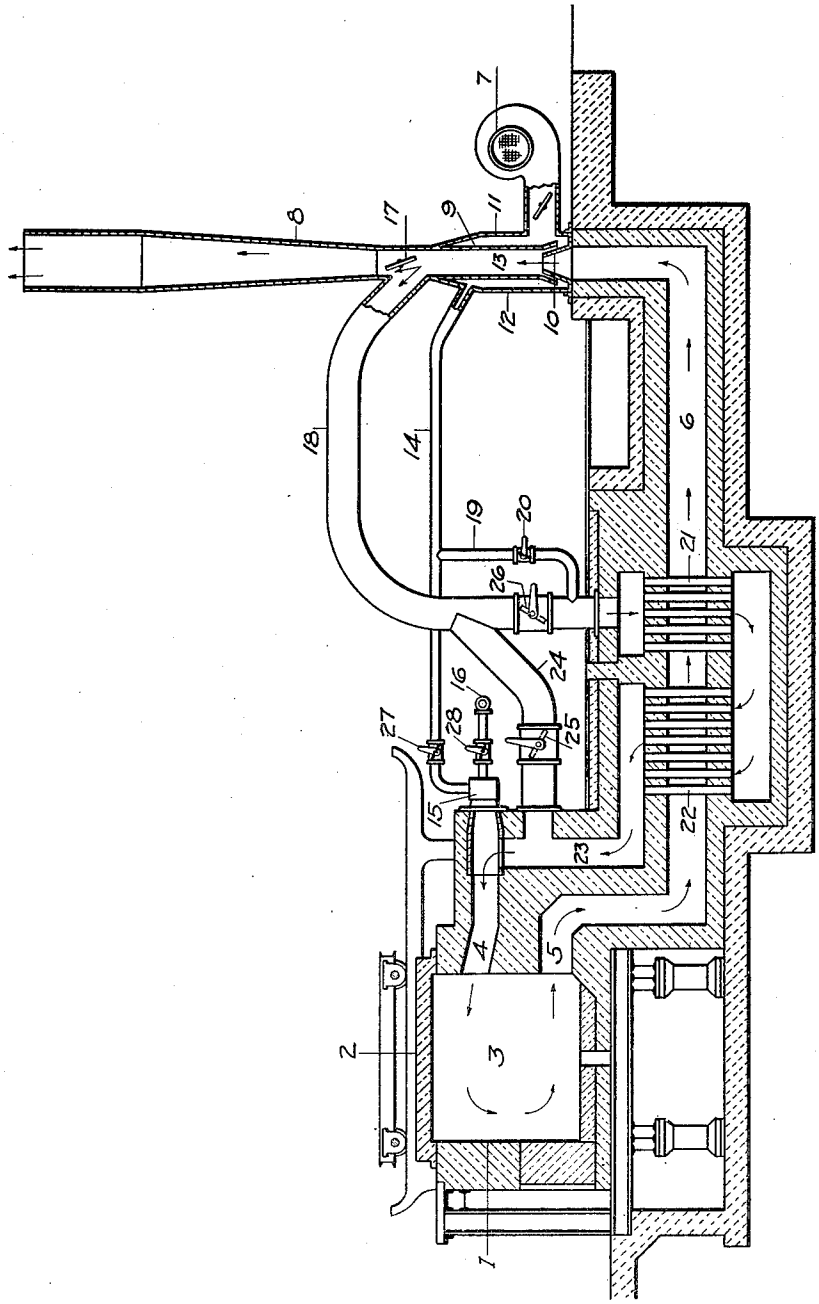
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COMBUSTION CONDITIONING SYSTEM FOR SOAKING PITS

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COMBUSTION CONDITIONING SYSTEM FOR SOAKING PITS

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The present invention relates to soaking pit furnaces, and more particularly to those of the one-way type. The invention preserves in the furnace proper all the advantages of space economy and low construction cost that are characteristic of this type of furnace, and it provides, in addition, a highly flexible system of controlling and conditioning the quantitative, the chemical, and the thermal properties of the flame in the furnace to suit the quality and character of the fuel used, and the results desired. Other and further objects and advantages of the invention will appear from the following detailed description thereof, taken in connection with the accompanying drawing, in which the single figure is a sectional view of a soaking pit furnace to which the invention is applied.

Referring to said drawing, the numeral 1 indicates a soaking pit of conventional form, having the usual removable cover 2 for the introduction of ingots to and their removal from the interior of heating chamber 3 of said furnace. One wall of the furnace provides an upper port 4 and a lower port 5, the former serving, as hereinafter described, for the introduction to chamber 3 of the combustible gases, and the latter serving for the off-take of the burned gases or products of combustion from said chamber 3, being connected for this purpose to a flue or passage 6 that conveys the waste furnace gases away from the furnace.

Said waste furnace gases are drawn through the outlet passage or flue 6 by the action of aspiration produced thereon by air under pressure, which is supplied in the present instance by a suitable blower 7. Said blower 7 is operatively associated with a discharge duct 8 of Venturi form, arranged to receive the waste gases from flue 6 and to discharge the same in part to the atmosphere. To this end, the lower end of the throat portion 9 of duct 8 is in telescopic spaced relation with a tubular member 10 at the terminal of flue 6, the arrangement being such that all of the outgoing gases are delivered within said throat portion 9. The air under pressure supplied by blower 7 is received in a chamber 11 that is formed by a casing 12 in surrounding relation to the parts 9 and 10, and the annular space 13 between said parts provides a restricted annular nozzle through which a portion of the air under pressure in chamber 11 is admitted, at relatively high velocity, to the throat portion 9, where it mixes with and entrains the waste gases coming from the furnace by way of the flue 6. In this manner, a portion of the air under pressure supplied by blower 7 procures the drafting of the furnace by aspiration of the products of combustion therefrom.

Another portion of the air supplied under pressure by the blower 7 is conveyed by a pipe 14, leading from the chamber 11, to a high temperature combustion burner 15 associated with the port or passage 4 and receiving a suitable fuel from a supply pipe 16. Such fuel, burning in the presence of air under pressure supplied by pipe 14, produces in the port or passage 4 and in the chamber 3 a flame which, by reason of the location of the off-take port 5 on the same side of chamber 3 as port 4, describes in said chamber a path of substantially hairpin form, as indicated by the arrows.

The temperature of such flame is dependent, to a considerable extent, on the character of the fuel supplied to the burner 15; it is well known that in the operation of various metallurgical furnaces, where the latter are fired with rich fuels, such as coke oven gas, natural gas, and the like, the flame temperatures sometime get so high as to be destructive of the furnace itself, or even of the materials or articles to be heated in said furnace. The present invention provides a novel arrangement for tempering such flame, to reduce, when desirable or necessary, its temperature, and for controlling, within close limits, its composition,—these results being effected by recirculation of a portion of the waste furnace gases in the following manner:—

As shown in the drawing, the duct 8 is equipped with a valve or damper 17, and inwardly of the same, said duct is provided with a lateral branch 18. The waste furnace gases from flue 6, in admixture with and entrained by the air under pressure delivered through nozzle 13, pass upwardly in part through duct 8 for discharge to the atmosphere, and in part are diverted into branch passage 18,—the volume of the so-diverted mixture being dependent upon the position of the valve or damper 17. This diverted current of air and waste gases in passage 18, supplemented or not as required, by additional air from chamber 11 (supplied from pipe 14 by a pipe 19 having a shut-off valve 20), is delivered through recuperator tubes 21 and 22 to a passage 23 that leads to the combustion intake port 4,—said mixture in its passage through the tubes 21 and 22 being heated, from the fact that such tubes extend across the flue 6 which carries off the waste furnace gases. Or, if desired, this diverted current of air and waste gases in passage 18 may be delivered, in whole or in part, direct to passage

23 and port 4, without undergoing heating in the recuperator tubes 21 and 22, through the medium of a by-pass 24, which is equipped, as shown, with a valve or damper 25. By suitable manipulation of this damper 25 and of a valve or damper 26 in passage 18, it is possible either to recuperatively heat the entire volume of the flame-tempering mixture delivered to port 4, or to secure the maximum tempering action by letting all the mixture go unheated through the by-pass 24; also, by various intermediate adjustments of the valves or dampers 25 and 26, so that a portion of the diverted mixture is heated while the remainder is left unheated, the temperature reached by the flame-tempering medium at the juncture of by-pass 24 with passage 23 may be varied over a wide range. A suitable valve 27 in the pipe 14 is provided, to regulate the volume of fresh air under pressure that is admitted to support the combustion of the fuel supply,—the latter being also suitably regulated, as by a valve 28.

The arrangement above set forth gives the greatest flexibility in the regulation, conditioning and tempering of the flame that emanates from burner 15 and that describes a path of substantially hairpin form in the chamber 3. Under conditions requiring heat of the utmost intensity in chamber 3, the burner 15 may be operated with an excess of fresh air from pipe 14, and with practically no tempering of its flame,—this last being secured by closing the valves 25 and 26 to prevent recirculation of the waste furnace gases. Without materially decreasing the fresh air supply, such intensely hot flame may be tempered, practically to any desired degree, great or small, by admitting to port 4 from passage 23 as much or as little of the mixture of air and inert gases as is needed to give the desired lowering of temperature in the chamber 3; and obviously, the whole or any part of the mixture so admitted may be preheated or not by passage through recuperator 21, 22, depending upon which course is most conducive to the production of the quantitative and chemical characteristics desired in any particular instance for the flame and hot gases contained in the chamber 3.

Under other conditions of operation, the supply of fresh air from pipe 14 to burner 15 may be materially curtailed, or even cut off entirely,—the combustion-supporting medium for the fuel being then constituted, in part or in whole, by the mixture of air and inert gas, preheated or not as desired, that is diverted through passages 18 and 23 to the burner port 4. This mode of operation produces a relatively low-temperature combustion even when a rich fuel is being used, on account of the material dilution of the combustion-supporting air with inert gases. It will thus be seen that the invention affords practically complete control over the volume and temperature of the flame and gases circulating through the chamber 3, as well as over the proportions of the several constituents thereof.

1. In a furnace of the class described, a heating chamber having an intake and an offtake, an air supply to said intake, to support combustion therein of the furnace's fuel supply, means for blowing air outwardly through a furnace exit passage to entrain the burned gases delivered through said offtake, a connection from said exit passage to said intake, permitting diversion to the latter of a portion of the mixture of air and burned gases, for tempering the flame produced by said combustion, means for procuring, selectively, the delivery of said diverted mixture to said intake either at the mixture temperature or at a higher temperature, resulting from preheating by the outgoing burned gases, and means for controlling the volume of air from said air supply to said intake and the volume of diverted mixture to said intake.

2. In a furnace of the class described, a heating chamber having an intake and an offtake, an air supply to said intake, to support combustion therein of the furnace's fuel supply, means for blowing air outwardly through a furnace exit passage to entrain the burned gases delivered through said offtake, a connection from said exit passage to said intake, permitting diversion to the latter of a portion of the mixture of air and burned gases, for tempering the flame produced by said combustion, means for heating said diverted mixture by the outgoing burned gases, means for causing said diverted mixture to bypass said heating means, and means for controlling the volume of air from said air supply to said intake and the volume of diverted mixture to said intake.

3. In a furnace of the class described, a heating chamber having an intake and an offtake, an air supply to said intake, to support combustion therein of the furnace's fuel supply, means for blowing air outwardly through a furnace exit passage to entrain the burned gases delivered through said offtake, a connection from said exit passage to said intake, permitting diversion to the latter of a portion of the mixture of air and burned gases, for tempering the flame produced by said combustion, and means for introducing air into said connection.

4. In a furnace of the class described, a heating chamber having an intake and an offtake, an air supply to said intake, to support combustion therein of the furnace's fuel supply, means for blowing air outwardly through a furnace exit passage to entrain the burned gases delivered through said offtake, a connection from said exit passage to said intake, permitting diversion to the latter of a portion of the mixture of air and burned gases, for tempering the flame produced by said combustion, and means for by-passing through said connection a portion of the combustion-supporting air supply.

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