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TUBULAR RECUPERATOR FOR RETORT COKE OVENS.

APPLICATION FILED JAN. 7, 1910. RENEWED SEPT. 14, 1912.

1,120,147. Patented Dec. 8, 1914.

2 SHEETS—SHEET 1.

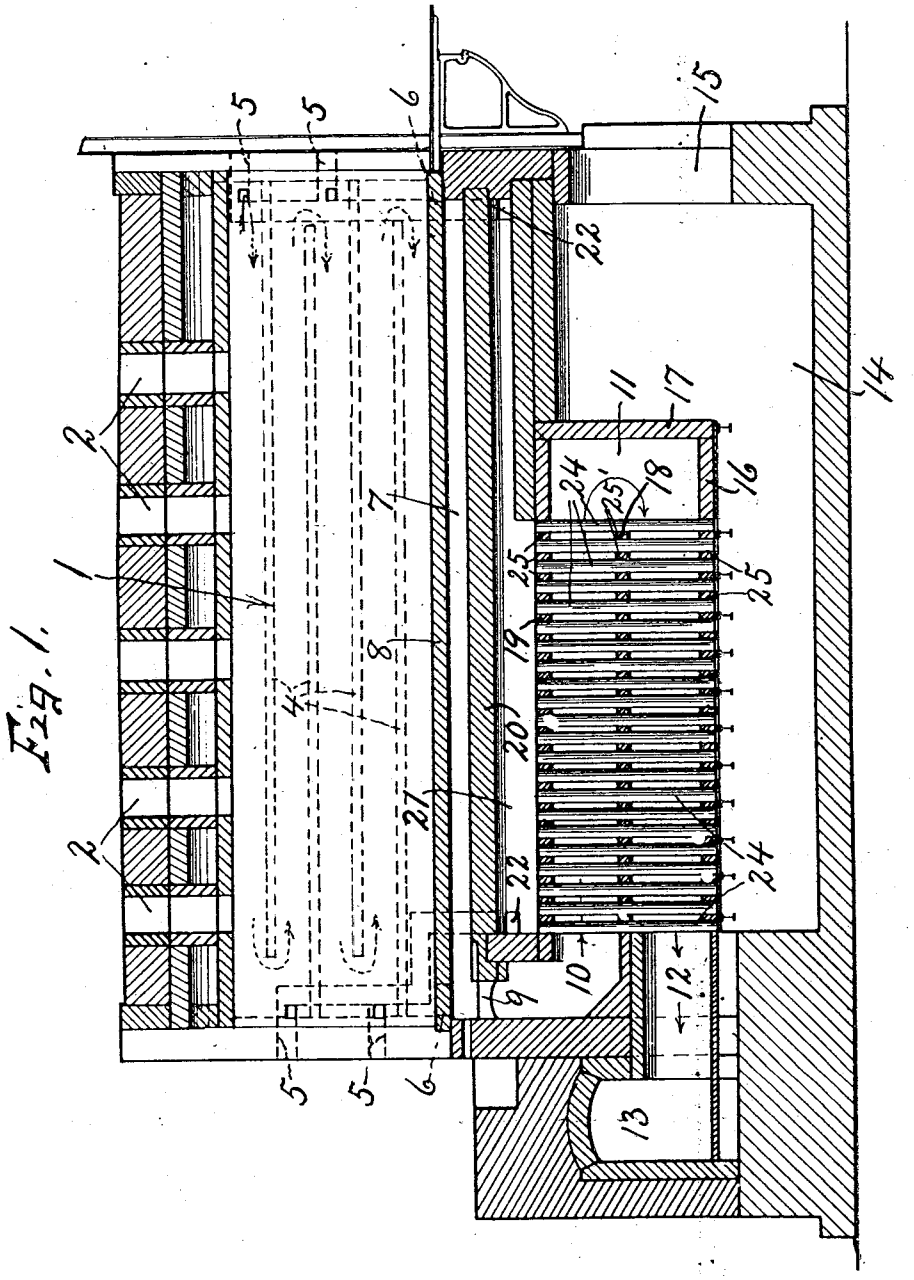

Fig. 1.

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2 SHEETS—SHEET 2

Fig. 2.

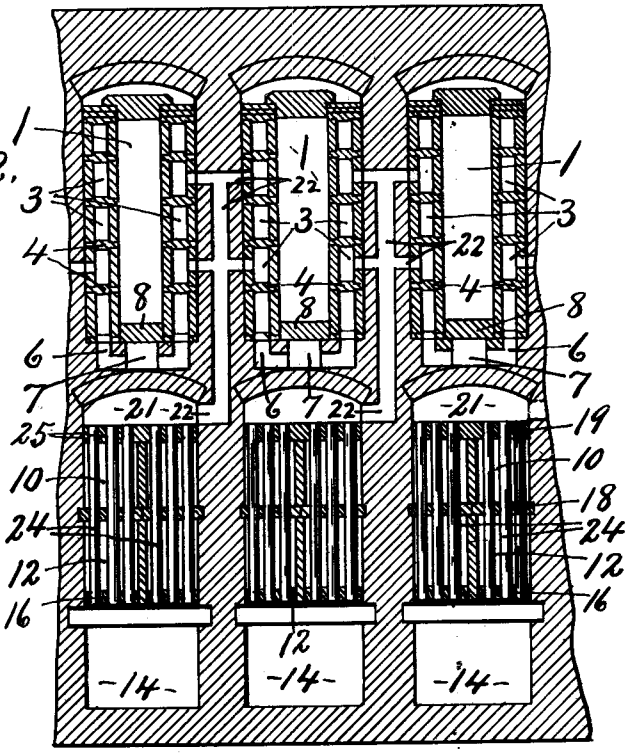


Fig. 3.

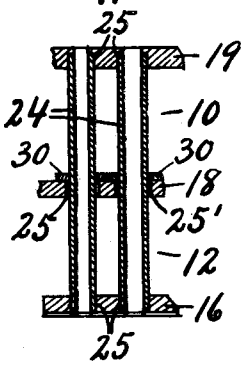


Fig. 4.

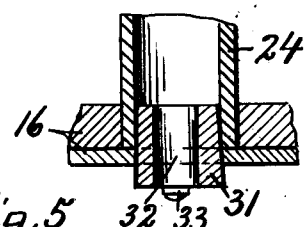


Fig. 5

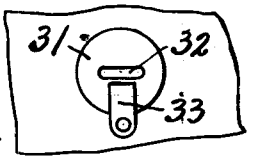
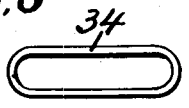


Fig. 6



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TUBULAR RECUPERATOR FOR RETORT COKE-OVENS.

1,120,147. Specification of Letters Patent. Patented Dec. 8, 1914.

Application filed January 7, 1910, Serial No. 536,807. Renewed September 14, 1912. Serial No. 720,422.

To all whom it may concern:

Be it known that I, CHARLES H. HUGHES, of Syracuse, in the county of Onondaga, in the State of New York, have invented new and useful Improvements in Tubular Recuperators for Retort Coke-Ovens, of which the following, taken in connection with the accompanying drawings, is a full, clear, and exact description.

This invention relates to certain improvements in retort coke ovens and refers more particularly to the construction of the heat interchangers for utilizing the waste heat of the products of combustion in heating the air and gas (or both air and gas) forming the combustible mixture.

It has been found that by heating the cold air or gas, or both, while in transit to the combustion chambers, the degree of combustion and temperature is materially increased thereby conserving the fuel and reducing the interval of time required for the conversion of coal into coke. Heretofore this preheating of the inflowing air or gas has been accomplished by causing the same to pass through heat interchangers composed of apertured bricks of suitable material laid in courses one upon the other, or side by side, in the path of the escaping products of combustion with their apertures more or less in registration with each other but in practice it has been found to be impracticable to lay these bricks in such manner as to produce and maintain perfect registration of these apertures or passages and it has been equally impossible to prevent more or less leakage through the joints of the several courses of bricks thereby destroying in a measure the very objects which it is sought to carry out and reducing the heating efficiency of the apparatus.

The primary object of my invention is to provide the heat interchangers with continuous air or gas tubes so as to establish more perfect continuity without leakage in the passage of such air or gas through the interchanger to the combustion chambers and through the heated products of combustion in such manner as to heat the combustible mixture to a greater degree of temperature than is possible under the existing systems. In other words I have sought to produce a greater conservation of fuel and at the same time to obtain a higher degree of combustion and temperature from a given quantity of fuel.

Other objects and uses relating to specific parts of the apparatus will be brought out in the following description.

In the drawings: Figure 1 is a longitudinal vertical sectional view of a retort coke oven embodying the various features of my invention, showing the heat interchanger as provided with vertical air tubes. Fig. 2 is a transverse sectional view through a series of the same ovens in block. Fig. 3 is an enlarged sectional view through two of the air conducting tubes, shown in Figs. 1 and 2. Fig. 4 is a still further enlarged sectional view of the lower end of one of the tubes and its supporting wall, showing one of the regulator plugs therein. Fig. 5 is an inverted plan of a portion of the same supporting wall and plug shown in Fig. 4 showing the retaining means for the plug. Fig. 6 is an end view of a modified form of tube elongated laterally.

These ovens are preferably built side by side in series or blocks having suitable retorts or coking ovens —1— into which the coal is introduced through inlet openings —2—, the ovens being separated and inclosed by hollow partitions or side walls forming combustion chambers —3— which are divided horizontally by staggered horizontal partitions —4— in such manner as to cause the combustible mixture to pass back and forth in tortuous paths from end to end of the ovens, the side walls and end walls of the ovens being extended downwardly some distance below the bottom of each oven to form a series of underlying chambers for the reception of suitable heat interchangers one for each oven. The fuel, such as gas, is admitted to opposite ends of combustion chambers —3— in the usual manner through suitable openings —5— shown by dotted lines in Fig. 1. The lower portions of the combustion chambers —3— of each oven are connected by passages —6— to a common chamber —7— underlying the chamber —1— and separated therefrom by a partition —8— which forms the bottom of the oven.

The chamber —7— is connected by a passage —9— to one end of a horizontal flue —10—, the opposite end of which is connected by a chamber —11— to a return flue —12— which leads to an outlet flue or chim-

ney —13— said flues being disposed one above the other in the underlying chamber beneath the corresponding oven and constitutes a part of the heat interchanger for said oven as will be hereinafter more fully described.

Underneath each oven and inclosed by the downwardly extended side and end walls thereof is an air chamber —14— having an inlet —15— opening to the atmosphere for supplying cold air to the chamber —14— which extends under the lower return flue —12— and is separated therefrom by a horizontal partition —16— and upright partition —17—, forming respectively the bottom of the return flue —12— and inner end of the chamber —11—. The flues —10— and —11— are substantially of the same size and are divided by a horizontal partition —18—, the upper side of the flue —10— being separated from the passage —7— by horizontal partitions —19— and —20— which are spaced apart one above the other to form an intervening air chamber —21— said chambers 21 being disposed in a substantially horizontal position directly under the chamber 7 and therefore directly under the corresponding oven. The opposite ends of the air chamber —21— are connected by air passages —22— to the inner ends of the fuel inlets —5—, portions of said passages —22— being shown by the dotted lines. The air chambers —14— and —21— are therefore located respectively below and above the flues —10— and —12— and are connected by a series of upright tubes —24—, preferably of fire clay or other heat resisting material and closely fitted in vertically alined apertures —25— in the partitions 16, 18 and 19. The air chambers, 14 and 21, are thus connected by substantially vertical, unidirectional, continuous tubes which traverse the hot gas passage, consisting as shown of the flues 10— 12—, and are therein surrounded by and exposed to the heating effect of the hot gases of combustion. By this means the heated air is caused to flow directly upward to its point of use by natural draft thus assuring a sufficient supply for the combustion of the gas and since the tubes are entirely surrounded by the hot products of combustion and are jointless a more efficient interchange of heat is effected than where the air and hot gases merely flow in contiguous passages and no loss is suffered through leakage. Heretofore it has not been practicable to employ such continuous air tubes in recuperators since all the forms of construction suggested have, in order to give sufficient heating surface, called for tubes of an impractical length or the tubes have been so located as to be inaccessible for repairs. In the construction above described, however, the recuperator can be extended to such a distance longitudinally as to bring its height down to a point where relatively short continuous tubes can be employed giving ample heating surface, and at the same time the tubes are easily accessible from the air chamber —14— through which they can be removed and new ones substituted in case of breakage. From the air chamber —21— the heated air passes upward through passages —22— to the inner ends of the fuel inlets, —5—. The fuel is ignited at these burner inlets and the products of combustion which is supported by the heated air pass through the combustion chambers —3— in tortuous paths into the chamber —7— and thence through the passage —9—, flue —10—, chamber —11— and return flue —12— to the chimney —13— thereby impinging against and practically enveloping the air tubes in such heated products to heat the air in transit from the chamber —14— to the burners, as previously stated.

The ends of the tubes —24— are connected by air and gas tight joints at —25— to the lower and upper partitions —16— and —19—, while their intermediate portions pass loosely through slightly enlarged apertures —25′— in the intermediate partition —18—, said apertures being closed at the top by packing rings or washers —30— which are closely fitted upon their respective tubes and effectively cover the openings —25′— to prevent leakage of the heated products of combustion or air therethrough, the object in enlarging the apertures —25′— through which the tubes pass is to allow for the expansion and contraction of the tubes without injury thereto.

In order that the amount of air admitted to the combustion chambers may be regulated, each tube is provided at its lower end with a removable plug —31— having an aperture —32— therein and held in place by a movable detent —33— adapted to be operated by hand to permit the removal of the plug and the reinsertion of another one having a different sized opening therein when necessary.

The gas tight joints of the upper partition 19 are in the form of annular seats for the tops of the flues while in the lower partition 16 a facing plate allows for the insertion and removal of the flues into said perforations and retains the same therein, while said plate is also provided with perforations therethrough alining with and substantially of the same diameters as the internal bores of said flues.

These tubes are preferably circular in cross section but any other suitable form may be used and in Fig. 6, I have shown a tube —34— as elongated laterally which will serve the same purpose.

It will be seen from the foregoing description that the main feature of my in-

vention lies in construction and relative location of the heat interchanger for heating a portion of the combustible mixture in transit to the combustible chamber by establishing continuity of flow of such portion of the mixture through the escaping heated products of combustion and providing means for the regulation of such flow and also providing means for the expansion and contraction of the conducting mediums without liability of leakage.

What I claim is:

1. A recuperator comprising lower, intermediate and upper partitions spaced apart and provided with vertically alining apertures therethrough, a series of vertical one-piece flues extending through said perforations, and spanning the intervening spaces between the said partitions, the space between the upper and intermediate partition being connected at one end to the corresponding space between the lower and intermediate partitions, the said apertures through said intermediate partition being of greater diameters than that of the flues passing therethrough, closely fitting washers upon said flues, said washers being closely seated upon said intermediate partition and adapted for sealing said flues therein, and devices upon the ends of said flues for reducing the openings therein.

2. A heat interchanger comprising lower, intermediate, and upper partitions spaced apart from each other and each provided with a series of vertically alining apertures therethrough, one-piece flues spaced apart and vertically-arranged in said apertures and extending continuously across the intervening spaces between the said partitions, the apertures through said intermediate partition being of greater diameter than those passing therethrough, closely fitting washers upon said flues, the said washers closely seated upon said intermediate partition and adapted for sealing said flues therein, internal annular shoulders provided in the perforations of the upper partition against which the upper ends of the flues are adapted to abut, a plate upon the lower face of the lower partition abutting the lower ends of the flues and provided with perforations therethrough alining with and of the same diameter as the bores of said flues.

3. In a heat interchanger for retort coke ovens the combination of an upper air chamber, a lower air chamber, a shallow, longitudinally extended waste gas passage located between said chambers and independent, continuous, unidirectional air-conveying tubes extending vertically across said passage and connecting said chambers and removable through said lower air chamber.

In witness whereof I have hereunto set my hand on this 31st day of December 1909.

CHARLES H. HUGHES.

Witnesses:

H. E. CHASE,

A. L. HUMPHREY.