REFORMING OVEN FOR A SYNTHETIC GAS PRODUCTION PLANT

Fig. 3

Fig. 4

Fig. 5

Fig. 6
In a reforming oven for producing synthetic gas, wherein vertically disposed pipes are arranged in rows defining successive triangles two sides of each of which triangles are formed by the pipes and the third side of each triangle is constituted by a portion of a refractory heat-resisting side wall of the oven, the improved construction in which the rows of pipes are disposed in zigzag relationship between two walls. With such an arrangement any pipe (of the array of pipes) is exposed both to direct radiant heat and also to reflected heat and hence its heating is desirably homogeneous.

This invention relates to a reforming oven, designed for liquid, solid, or gaseous hydrocarbon catalytic reforming plants, which plants are intended for the production of various gases, such as ammonia, synthetic gaseous fuels, pure hydrogen, or again, for the production of gas of the household type, or having the same characteristics as natural gases.

In these types of ovens, the gases to be processed are forced to flow in fairly long circular pipes, thirty three feet long approximately, which must be evenly heated at their outer periphery, on at least part of their length. To attain this object, it has been proposed to design ovens, in which the flow pipes for gases to be processed are set up in layers, and a plurality of burners is provided for the heating of these pipes for flame projection in multiple directions. Apart from the fact that the latter solution is an expensive one, due to the fact of the number of burners to be used, it is defective from the point of view of the equal distribution of the radiated heat. Moreover, it will appear clearly that failure of one of the burners entails the stopping of the entire unit, and it is obvious that failure possibilities are all the greater from the fact that the number of burners is increased.

To palliate this disadvantage, it has been suggested to define, by means of rows of lines for the flow of gases to be processed, similar triangular shaped cells and to vertically arrange sets of burners in relation to the pipes opposite each cell, but at two separate levels, at least, the centerlines of which burners are so directed, and in such a manner, that the projecting flames do not directly intercept the walls of one of the pipes associated with each cell. According to this arrangement it has been possible to reduce the number of burners used, but the distribution of heat on the pipes was not always as regular as desirable.

This invention provides for a new type of oven, whose construction is more or less similar to that of the type of oven outlined above, and this invention is a sequel to the remarks stated by the applicant, according to which the regular distribution of heat to be radiated on the flow lines of the gas to be processed must be particularly taken care of, especially at the upper portion of the lines, that is, at the beginning of the path followed by the gases to be processed and on a length of from six to fifteen feet approximately, processing pipes which are close to thirty three feet long.

According to the invention, the reforming oven for a synthetic gas production plant is characterized in that pipes extend vertically for the flow of gases to be processed, in which pipes gases flow from top to bottom, the said pipes being arranged in such a way as to form successive triangles two sides of which are formed by the pipes and the third side by a portion of a heat-resisting side wall which is part of the oven, said oven comprising, adjacent to the upper and lower portions of the pipes, a roof and a floor, respectively, also made of refractory heat-resisting material the said roof supporting, in front of each triangle defined by the pipes, at least two burners projecting a heating flame vertically downwardly from the top toward the bottom, and extending substantially in a parallel direction in relation to the said pipes.

Various other characteristics of the invention will appear, moreover, from the following detailed description.

Different embodiments concerning the principles of the invention are illustrated in the appended drawings, and are given as preferential, but by no means restrictive, embodiments, as examples.

FIG. 1 is a vertical, sectional view, taken at the level of a processing pipe of a reforming oven illustrating an embodiment of the invention.

FIG. 2 is a perspective diagram showing a special embodiment of a reforming oven, according to the invention.

FIG. 3 is a cross sectional view, showing a special characteristic of the oven, according to FIG. 2.

FIG. 4 is a cross sectional view, similar to FIG. 3 showing yet another embodiment of the invention.

FIG. 5 is a cross sectional view, showing a further embodiment of the reforming oven, still according to the principles of the invention.

FIG. 6 is a modified cross sectional view, similar to FIG. 5.

FIG. 7 shows a fragmentary sectional view of a reforming oven for hydrocarbon catalytic processing, which oven comprises rows of pipes 1, supported by suspension means 2, which are in turn fixed to frame means 3. Ducts 4, provided at the upper end of the pipes 1, are intended to ensure the delivery of gases to be treated.

These ducts 4 are arranged above a roof 5 made of heat-resisting material and constituting one of the walls of the oven furnace 6. To allow for free expansion of pipes 1, heat resisting joints 7 are supported on the roof 5 in sealing relationship with the outside of the wall of each pipe 1.

At their lower ends, pipes 1 are choked to a smaller diameter 1a which choked ends are connected to a collecting means 8 for evacuation of processed gases. The lower portion of the oven furnace 6 is defined by an oven floor 9, composed of refractory material, which floor is plane and parallel to roof 5 so that pipes 1 extend through the interior of furnace 6 over an identical length. Floor 9 is not in direct contact with pipes 1, but on the contrary, is separated by passages 10, which define the fire resisting walls 11 and 12, which extend in a parallel direction to the rows of tubes 1.

The passages 10, whose width is generally comprised between two to three times the diameter of pipes 1, are closed at their lower ends by fire-resisting bars or plates 13 and are loaded with grains 14, also made out of refractory material and whose granulometry is carefully chosen so that the diameter of each grain can vary theoretically between 0.18 and 0.24, δ (delta) corresponding to the diameter of an imaginary circle, whose surface is equal to the internal annular section of passage 10 around pipe 1, diminished by the sectional area of this pipe.
Furnace 6 of the oven, located between roof 5 and floor 9 defines the area of the pipes which are to be heated by radiation, and passages 10—filled with refractory grating—define that area of the pipes in which heating of the latter is mainly carried out by convection.

According to the invention, the burners fitted for the heating of the pipes are located in roof 5, one of these burners being shown in FIG. 1, where it is defined by the numeral 15. The oven side wall, which connects roof 5 to floor 9, can be constructed in various ways according to its chosen architecture.

FIGS. 2-4 illustrate a circular section oven, in which the side wall is defined by the numeral 16 and is cylindrically shaped. Obviously, this wall is made out of heat resisting material and its internally directed side, of furnace 6, forms a reflective surface.

According FIGS. 2 to 4, two rows of pipes 1 are provided, these rows intersecting at right angles, so that the said pipes define, within cylindrical wall 16, four triangles I, II, III, IV, with their top angles adjacent to each other, one of the sides of each of which is of an arcuate shape defined by wall 16.

As can be seen in FIG. 2, each triangle I, II, III, IV is provided with two burners 15, 15a, and the centers of these burners are arranged parallel to the centerlines of pipes so that said burners project flames 17 axially, in a direction parallel to that of the pipes. According to another embodiment of the invention, burners 15 and 15a are located adjacent to wall 16, so that the latter furnishes two radiating areas, 16, 18a of substantially rectangular shape, and directed towards the pipes 1 to be heated.

Still another characteristic consists in arranging burners 15, 15a in each of the aforementioned triangles I to IV, so that they are located symmetrically about the bisectrix 19 (FIG. 3) of each of said triangles I to IV.

FIG. 4 shows a modification according to which a third burner 15b is located within each of the triangles I to IV. This third burner is located in bisectrix 19 and preferably at a point on the latter chosen so that straight imaginary lines passing through burner 15 to burner 15b, on the one hand, and burner 15a to burner 15b on the other, be in parallel with the corresponding side of the triangle formed by the pipes. In this manner, one obtains a very homogeneous heating of all the pipes in the furnace, with the use of only two or three burners for each triangle defined by the pipes and the corresponding wall of the furnace.

The above described characteristics of the invention can be used for other architectural shapes of the oven, namely for very high power ovens, generally of rectangular form, in which pipes 1 are arranged in a broken line between two side walls 16a and 16b to define, in the same manner as described above, successive triangles Ia, IIa, IIIa, . . . etc. This is illustrated in FIG. 5, in which have been indicated the locations of the two burners 15, 15a arranged in symmetrical relationship with the bisectrix 19 of the angle formed by two successive rows of pipes 1 of triangle Ia. Naturally, the same applies to the other triangles IIa, IIIa, . . . etc.

The hereabove described additional characteristic illustrated in FIG. 4, which consists in providing for a third burner 15b, is applicable also in the rectangular type of oven, as shown in FIG. 6, where one can see burner 15b located on bisectrix 19.

The invention is not limited to the embodiments shown and described in detail, as various modifications can be made without departing from the scope of the invention.

1 claim:

1. A reforming oven for a synthetic gas production plant in which pipes extend vertically for the flow of gases to be processed, in which pipes such gases flow from top to bottom, the said pipes being arranged in rows to define successive triangles, two sides of which are formed by the pipes and the third side by a portion of a refractory heat-resisting side wall which is part of the oven, comprising, adjacent to the upper and lower portions of the pipes, a roof and a floor respectively, also made of refractory heat-resisting material, the said roof supporting, in front of each triangle defined by the pipes, at least two burners projecting heating flames vertically downwardly from top toward the bottom, and extending in a direction parallel to the said pipes, said oven being characterized in that said third side of said successive triangles is constituted by two walls extending parallelly and between which said rows of pipes extend in a zigzag relation whereby one side of each triangle is common to an adjacent triangle and said burners symmetrically located with respect to said common side.

2. A reforming oven as set forth in claim 1 in which three burners are provided in each triangle one of which is located on the bisectrix of the angle delimited by two adjacent rows of pipes and the two other symmetrically with respect to said bisectrix at a distance thereof for which in each triangle two burners extend parallelly to the adjacent row of pipes whereby said burners in the oven of rectangular shape have a substantially uniform repartition.

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JAMES H. TAYMAN, Jr., Primary Examiner

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