Nov. 25, 1930. A. E. NASH ET AL 1,782,829

HEAT TRANSFER SYSTEM

Filed Jan. 3, 1927

Fig. 1.

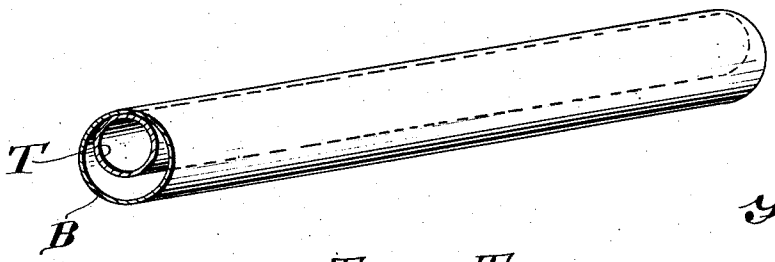


Fig. 2.

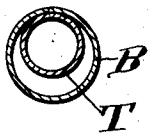


Fig. 4.

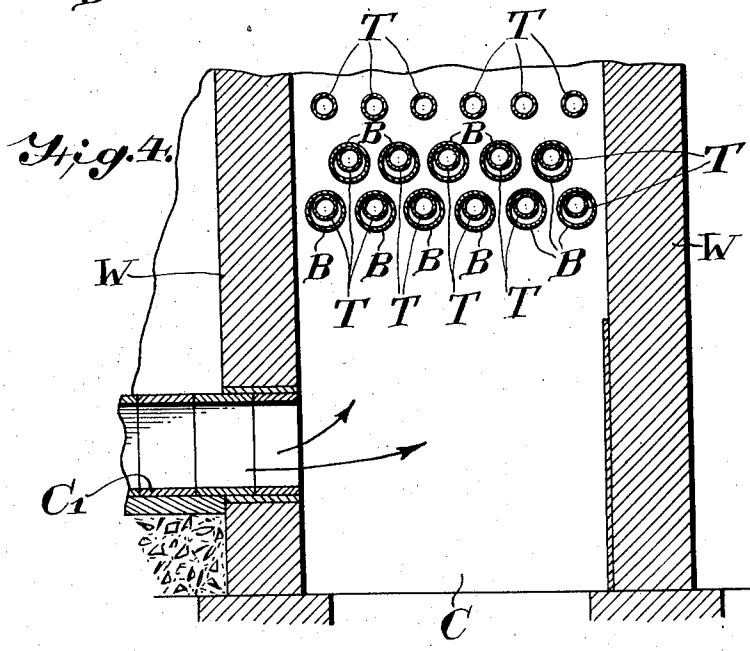


Fig. 3.

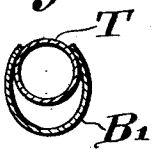


Fig. 5.

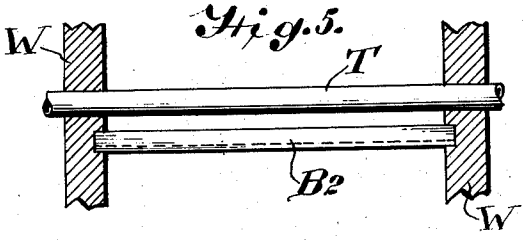


Fig. 8.

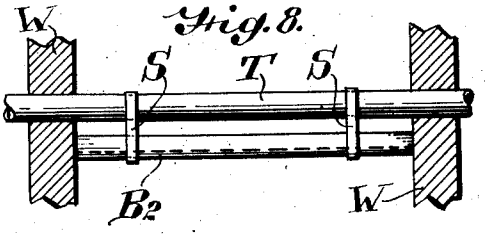


Fig. 6.

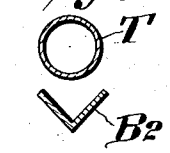
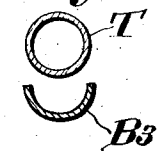


Fig. 7.



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UNITED STATES PATENT OFFICE

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HEAT-TRANSFER SYSTEM

Application filed January 3, 1927. Serial No. 158,549.

Our invention relates to the art of controlling the application of heat to a heat absorption structure and has particular reference to a method of and apparatus for diminishing the quantity of convection heat applied thereto without to a substantial extent interfering with the radiant heat application.

In accordance with our invention, suitable heat absorption structure traversed by fluid is disposed in the path of a hot medium, as hot gaseous products of combustion, and for decreasing the heat applied by convection from the hot medium to said structure there is utilized a member or baffle spaced, in part at least, therefrom and itself serving as a source of radiant heat.

Further in accordance with our invention, a vertical chamber whose lower wall structure is maintained at incandescence under the influence of hot gaseous products of combustion has disposed transversely thereof groups of tubes traversed by a fluid, as petroleum or a compound or product thereof and, for preventing undue temperature rise in those tubes and the therein-contained fluid subjected to radiant heat from the chamber wall structure and to convection heat from the hot gaseous products of combustion, there is utilized baffle structure itself heated to radiance and constituting a secondary source of radiation and which shields from said gaseous products the tubes last mentioned.

Our invention resides in the method and apparatus of the character hereinafter described and claimed.

For an understanding of our method and for an illustration of some of the forms our apparatus may take, reference is to be had to the accompanying drawing, in which:

Fig. 1 is a perspective view of tubular heat absorption structure having a tubular baffle associated therewith.

Fig. 2 is a transverse vertical sectional view of the structure shown in Fig. 1.

Fig. 3 is a vertical sectional view showing another form of baffle.

Fig. 4 is a vertical sectional view of a heating chamber containing tubular heat absorption structures some having baffles associated therewith.

Fig. 5 is a side elevational view, partly in vertical section, showing a heat absorption structure with another form of baffle associated therewith.

Fig. 6 is a transverse vertical sectional view of the structure shown in Fig. 5.

Fig. 7 is a transverse vertical sectional view corresponding generally with Fig. 6 showing another form of baffle.

Fig. 8 is an elevational view, partly in vertical section, showing another manner in which a baffle may be supported.

Referring to Fig. 4, there is illustrated a chamber C formed by the refractory walls W, W. Within the chamber C there is disposed a suitable heat absorption structure, for example, a bank of tubes T of iron, steel or other suitable material.

Opening into the bottom of chamber C is a combustion chamber C^1, which, in the example illustrated, conforms with the one shown in our U. S. Patent No. 1,591,431. It shall be understood, however, that chamber C^1 may be otherwise constructed as found suitable or desirable, for example, as disclosed in our co-pending application, Serial No. 151,307 filed Nov. 29, 1926.

Within the chamber C^1 is effected combustion of suitable fuel, ordinarily gas or oil, which, upon admission thereinto, passes, together with the air and gases, from left toward the right, Fig. 4, the hot gases or products of combustion passing into the bottom of the chamber C, then upwardly and around the tubes T and thence onwardly to any suitable destination, as, for example, a stack, not shown.

Heat radiating from the hot wall structure of the combustion chamber C^1 may be utilized for any desired purpose; for example, it may be transferred substantially exclusively as radiant heat to suitable heat absorption structure, not shown, in the manner illustrated and described in our aforesaid U. S. Patent No. 1,591,431.

The tubes T are disposed between opposite walls of the chamber C and may be connected in series or other suitable relation by

couplings or headers, preferably connected to the tubes externally to the chamber C.

Passing through the tubes T and subjected to temperature rise therein is any suitable fluid material, either gaseous or liquid, as steam to be superheated, or water for the generation of steam. Ordinarily, however, petroleum, or a component or a product thereof under suitable pressure, as superatmospheric pressure, is subjected to elevation of temperature while passing through the tubes T.

The hot gaseous products of combustion emerging from the combustion chamber C^1 pass, at relatively high velocity, between and around the tubes T and, when they are bare or unprotected, contact directly therewith, with resultant high rate of transfer of convection heat thereto. Usually, the gaseous products of combustion are at such elevated temperature that the walls W of chamber C, particularly the lower portions thereof, become incandescent and radiate heat to the tubes T, particularly the lower groups thereof. As a result, some of the tubes T and the material passing therethrough are subjected to excessive temperature rise by the combined action of radiant and convection heat, and this may result in deterioration of the tubes and damage to the material.

It is well understood that in order to transfer any substantial amount of heat by convection from hot gases to a heat absorption structure, the gases must be brought into contact therewith. Therefore, by deflecting or diverting substantially all of the gaseous products of combustion from those tubes T subjected to radiant heat, the heating effect upon the tube within the longitudinal extent of the secondary source of radiation and due to convection may be substantially entirely eliminated with the result that said tubes and the material passing therethrough are not unduly elevated in temperature. In so doing, however, the application of radiant heat to said tubes should not be substantially impeded.

To this end, there may be utilized structure which may assume any one of a variety of forms. For example, in Figs. 1, 2 and 4, the tubes T are each encompassed by a cylinder or baffle B of greater cross sectional area than a tube T, and preferably circular and of a length corresponding with that of the tube between opposite walls of the chamber C. Or, the baffle may assume a form such as is shown in Fig. 3, that is, one that is circumferentially discontinuous.

With constructions of the character illustrated in Figs. 1–4, the cylinders or baffle members are supported by the respective tubes. It is obvious, however, that the baffle members may be supported by opposite walls W of chamber C and in such relation that they do not contact with the tubes T.

In Figs. 5 and 6, a substantially V-shaped baffle B^2 is shown as supported in opposite walls W of the chamber C in suitable close relation beneath a tube T and so disposed with respect thereto that the hot gases as they travel upwardly are diverted or deflected to either side of the tube. A baffle utilizable as is the one illustrated in Figs. 5 and 6 may assume any one of a variety of forms, for example, as shown in Fig. 7, where the baffle B^3 is semi-circular in shape.

Instead of utilizing the walls W as a support for the baffle B^2, Fig. 5, such baffle or one of generally similar or equivalent shape may be supported by a tube T in the manner illustrated in Fig. 8, wherein the members or straps S encircle both the tube and the baffle to hold the latter in suitable position deflecting the hot gases to either side of the overlying tube.

A baffle of the character hereinbefore described under the influence of the heat from the gases and radiated by the incandescent walls W of chamber C in turn becomes incandescent and is a secondary source which radiates heat through the intervening space to the tube T with which said baffle is associated, the amount of radiant heat absorbed by the tube being changed slightly, if at all, due to the presence of said baffle. At the same time, the baffle deflects or diverts substantially all the hot gaseous products of combustion from said tube within the longitudinal extent of the secondary source of radiant heat with resultant decrease in the amount of convection heat transferred thereto. It follows, then, that those tubes T with which the baffle structure is associated, together with the material passing therethrough, are not subjected to undue temperature rise, since the amount of convection heat applied thereto is substantially diminished.

Only where the baffle structure is directly in contact with the tubes, as in Figs. 1–4, is heat transmitted thereto by conduction, and, due to the restricted areas of contact surface between the respective tubes and baffles, this type of heat transmission is insubstantial and inconsequential.

The baffles are preferably of such shape and so disposed within the chamber C as not to seriously impede the upward passage of the hot gaseous products of combustion. In other words, the passages for gases between the various tubes T should not, to any substantial extent, be occupied by the baffles or parts thereof.

Baffle structure of the character described herein may be formed by any suitable material, but preferably such as is chemically inert with respect to the gaseous products of combustion, of great resistance to oxidation at high temperature, and of high heat conductivity. For example, there may be util-

ized material as silicon carbide or the like, or and preferably a metal or alloy, as iron, steel, copper, nichrome and the chrome iron and nickel alloys.

It usually obtains that baffle structure of the character described herein attains such high temperature as to become incandescent or luminous. However, under some circumstances the baffle structure may not reach incandescence, while still radiating heat.

Those tubes T receiving small or inconsequential amounts of radiant heat, as those above the lowermost layers or tiers, Fig. 4, should not be equipped with baffle structure, for, otherwise said tubes and the therein contained material would not be heated to a sufficient degree, since the baffle structure would eliminate or reduce the application of convection heat without at the same time continuing the application of radiant heat.

What we claim is:

1. The combination with a heating chamber traversed by hot gaseous products of combustion and whose walls radiate heat derived from said products of combustion, of tubular heat absorption structure disposed in said chamber in the path of said hot products of combustion, and means for limiting the heat transfer to a tube comprising a secondary source of radiant heat disposed adjacent to but spaced from the tube and consisting of a baffle heated by radiation from said walls and by said products of combustion and substantially completely shielding said tube from said hot products of combustion.

2. The combination with a heating chamber traversed by hot gaseous products of combustion and whose walls radiate heat derived from said products of combustion, of tubular heat absorption structure disposed in said chamber in the path of said hot products of combustion, and means for limiting the heat transfer to a tube comprising a secondary source of radiant heat disposed adjacent to but spaced from the tube and consisting of a metallic baffle heated by radiation from said walls and by said products of combustion and substantially completely shielding said tube from said hot products of combustion.

3. The combination with a heating chamber traversed by hot gaseous products of combustion and whose walls radiate heat derived from said products of combustion, of a bank of fluid-containing tubes in said chamber and between which said products of combustion pass, and means for limiting the heat transfer to tubes comprising a secondary source of radiant heat for each of a plurality of said tubes disposed adjacent thereto but spaced therefrom and consisting of a baffle heated by radiation from said walls and by said products of combustion and substantially completely shielding the tube from said hot products of combustion, said baffles spaced from each other to permit passage of said hot products of combustion to other tubes convectively heated by them.

4. The combination with a heating chamber traversed by hot gaseous products of combustion and whose walls radiate heat derived from said products of combustion, of a bank of fluid-containing tubes in said chamber and between which said products of combustion pass, and means for limiting the heat transfer to tubes comprising a secondary source of radiant heat for each of a plurality of said tubes disposed adjacent thereto but spaced therefrom and consisting of a metallic baffle heated by said products of combustion and by radiation from said walls and substantially completely shielding the tube from said hot products of combustion, said baffles spaced from each other to permit passage of said hot products of combustion to other tubes convectively heated by them.

5. Petroleum treating apparatus comprising a heating chamber traversed by hot gaseous products of combustion and whose walls radiate heat derived from said products of combustion, of tubular heat absorption structure through which the petroleum is passed disposed in said chamber in the path of said hot products of combustion, and means for heating a tube and preventing excessive temperature rise thereof and of the contained petroleum comprising a secondary source of radiant heat disposed adjacent to but spaced from the tube and consisting of a baffle heated by radiation from said walls and by said products of combustion and substantially completely shielding said tube from said hot products of combustion.

6. Petroleum treating apparatus comprising a heating chamber traversed by hot gaseous products of combustion and whose walls radiate heat derived from said products of combustion, a bank of petroleum-conducting tubes in said chamber and between which said products of combustion pass, and a secondary source of radiant heat for each of a plurality of said tubes disposed adjacent thereto but spaced therefrom and consisting of a baffle heated by radiation from said walls and said products of combustion shielding the tube from said hot products of combustion, said baffles spaced from each other to permit passage of said hot products of combustion to other tubes convectively heated by them.

7. In the art of transferring heat to fluid contained in tubes in a zone in which there are hot gaseous products of combustion and in which there exists heat radiated from a primary source heated by said products of combustion, the method of diminishing the rate of application of heat to said fluid which comprises heating a tube directly and substantially solely by radiation from an adja-

cent secondary source heated by convection by the hot gaseous products of combustion and by heat radiated from said primary source, and by said secondary source substantially completely shielding the tube from absorption of heat directly from the hot gaseous products of combustion throughout substantially the entire longitudinal extent of the tube heated by said secondary source.

8. In the art of transferring heat to fluid contained in tubes in a zone in which there are hot gaseous products of combustion and in which there exists heat radiated from a primary source heated by said products of combustion, the method of diminishing the rate of application of heat to said fluid which comprises heating each of some of said tubes directly and substantially solely by radiation from an adjacent secondary source heated by convection by the hot gaseous products of combustion and by heat radiated from said primary source, by said secondary source substantially completely shielding each of said last named tubes from absorption of heat directly from the hot gaseous products of combustion throughout substantially the entire longitudinal extent of each of said last named tubes heated by said secondary source, and heating others of the tubes by convection by passing the hot gaseous products of combustion between and beyond said secondary sources.

9. In the art of transferring heat to petroleum contained in tubes in a zone in which there are hot gaseous products of combustion and in which there exists heat radiated from a primary source heated by said products of combustion, the method of preventing overheating of a tube and the petroleum which comprises heating a tube directly and substantially solely by radiation from an adjacent secondary source heated by convection by the hot gaseous products of combustion and by heat radiated from said primary source, and by said secondary source substantially completely shielding the tube from absorption of heat directly from the hot gaseous products of cumbustion throughout substantially the entire longitudinal extent of the tube heated by said secondary source.

10. In the art of transferring heat to petroleum contained in tubes in a zone in which there are hot gaseous products of combustion and in which there exists heat radiated from a primary source heated by said products of combustion, the method of preventing overheating the pertoleum and tubes which comprises heating each of some of said tubes directly and substantially solely by radiation from an adjacent secondary source heated by convection by the hot gaseous products of combustion and by heat radiated from said primary source, by said secondary source substantially completely shielding each of said last named tubes from absorption of heat directly from the hot gaseous products of combustion throughout substantially the entire longitudinal extent of each of said last named tubes heated by said secondary source, and heating others of the tubes by convection by passing the hot gaseous products of combustion between and beyond said secondary sources.

11. In a system of the character described, spaced walls for directing the flow of hot products of combustion between the same, heat-absorption units spaced with respect to each other and arranged to constitute jointly a group of such units extending across the path of flow of said products of combustion, the total area represented by the spaces between adjacent units being a relatively large portion of the entire area occupied by said group to permit free flow of said products of combustion through the spaces between the units of the group and in a direction transversely thereof, and means associated with said group operating to direct the flow of said products of combustion through said group by way of the spaces between said units out of intimate contact with the latter and operating to impart heat to said units by radiation.

12. In a system of the character described, spaced walls for directing the flow of hot products of combustion between the same, heat-absorption units spaced with respect to each other and arranged to constitute jointly a group of such units extending across the path of flow of said products of combustion, the total area represented by the spaces between adjacent units being a relatively large portion of the entire area occupied by said group to permit free flow of said products of combustion through the spaces between the units of the group and in a direction transversely thereof, means associated with said group operating to direct the flow of said products of combustion through said group by way of the spaces between said units out of intimate contact with the latter and operating to impart heat to said units by radiation, and a second group of heat-absorption units arranged to constitute jointly a second group similar to the first group, the second group arranged to require that the products of combustion pass between and into intimate contact with the units thereof subsequent to passages of such products through and beyond the first group.

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