Feb. 22, 1944. C. OTTO 2,342,214

BY-PRODUCT COKE OVEN PLANT

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Fig. 1.

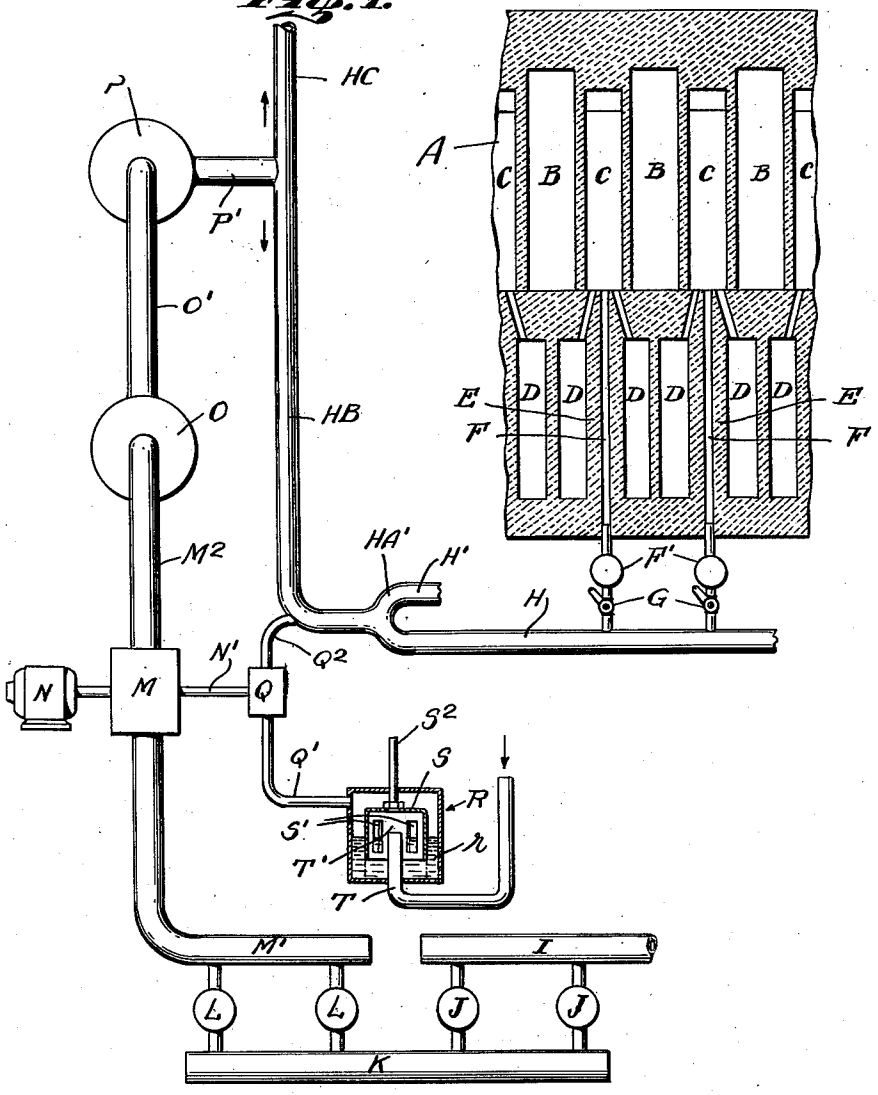
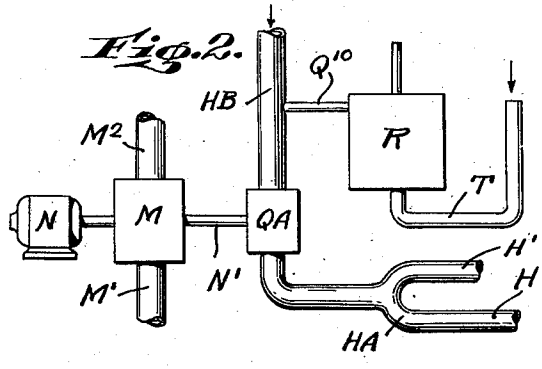


Fig. 2.



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BY-PRODUCT COKE OVEN PLANT

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4 Claims. (Cl. 202—151)

The present invention relates to by-product coke oven plants comprising coke ovens having supply passages extending through heated brickwork for the passage of distillation gas formed in the oven coking chambers into the oven combustion flues for use as oven heating fuel. Such coke ovens comprise all commercial forms of underfired regenerative ovens heated by the combustion of coke oven gas which is invariably supplied to the combustion flues of such ovens through channels which extend upward from the underside of the oven structure in regenerative division walls beneath the different oven heating walls.

The general object of the present invention is to provide a coke oven plant of the above mentioned kind, with improved means for mixing with the coke oven fuel gas, a portion of the air required for its combustion, prior to the passage of said gas into the said supply channels extending through heated brickwork. It has heretofore been discovered that air thus admixed with the coke oven fuel gas, prevents or minimizes objectionable carbon deposits in the hotter upper portions of the said channels, and contributes to improved combustion conditions in the heating flues to which the major portion of the air required for the combustion of the fuel gas is passed after being regeneratively preheated.

More specific objects of the present invention are to provide means for mixing air with coke oven fuel gas supplied to ovens of the type specified, which will avoid objectionable features inherent in arrangements heretofore proposed and including, in particular, an arrangement characterized by the provisions of a small continuously open bleed orifice in each of the individual gas supply pipes connected to the different uprising supply channels in the regenerator division walls.

Under normal operating conditions, a continuous air inflow through each of said bleed orifices is maintained by the suction transmitted through the heating flues and gas channels to said supply pipe. The use of such continuously open bleed orifices is open to the objection, however, that temporary increases in the pressure in the rich gas supply connections can be expected to cause an outflow of gas through the bleed orifices from time to time. Such gas outflow creates an explosion risk, and may pollute the atmosphere in the underfired coke ovens to such extent as to impair the working capacity and endanger the health of the oven attendants working in the basement.

A by-product plant embodying the present invention is characterized by its inclusion of a mixing fan or blower which is driven by the driving motor or other driving means for the plant gas exhauster, and which operates to draw air from the atmosphere and pass it into admixture with the coke oven gas used as oven fuel, prior to the delivery of the fuel gas to the distribution piping through which the fuel gas is supplied to the different uprising supply channels. The use of the same driving means for the mixing fan and exhauster insures that the fan will be in operation whenever the exhauster is in operation. In consequence, the mixing fan will maintain pressure conditions so long as the exhauster is in operation, normally effective to prevent the exhauster from creating backflow of coke oven fuel gas through said fan to the inlet through which the mixing fan draws the atmospheric air passed into admixture with the fuel gas.

Furthermore, when all of the air mixed with the fuel gas supplied to one or more coke oven batteries is supplied by a single mixing fan, it is a relatively simple and inexpensive matter to prevent, or to avoid injurious consequencies, as a result of backflow of coke oven gas through the air inlet to the mixing fan, under conditions tending to produce such backflow when both the exhauster and the fan are out of service. To that end, the air inlet to the mixing fan may be provided with a suitable non-return valve, or the inlet may be located at some point at which gas may be discharged into the atmosphere without explosion risk or other objectionable consequences.

By-product coke oven plants may vary greatly in the character and relative cost of their by-product recovery apparatus. For example, many by-product plants include apparatus for the recovery of free ammonia and benzol from the coke oven gas, but plants without benzol recovery apparatus are not uncommon, and some relatively inexpensive plants have neither benzol nor free ammonia recovery apparatus. In all by-product coke oven plants, however, an exhauster is necessary to move the gas formed in the coking chambers away from the latter and through suitable cooling and tar eliminating apparatus, and my invention is thus applicable for use in by-product coke oven plants of all forms including underfired regenerative coking ovens which are adapted to be heated by the combustion of coke oven gas made in said ovens.

In some cases, the air mixing fan driven by the exhauster driving means may be employed

solely to draw air from the atmosphere and discharge it into admixture with the coke oven fuel gas. In some cases, however, the air mixing fan may serve the double purpose of moving air into admixture with the oven fuel gas, and of moving or contributing to the movement of the fuel gas into the oven combustion flues, thereby reducing the duty or load imposed on the exhauster.

The various features of novelty which characterize my invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, however, its advantages, and specific objects attained with its use, reference should be had to the accompanying drawing and descriptive matter in which I have illustrated and described preferred embodiments of the invention.

Of the drawing:

Fig. 1 is a diagrammatic illustration of a portion of the by-product coke oven plant embodying a preferred form of the present invention; and

Fig. 2 is a diagrammatic view illustrating a modification of a portion of the apparatus shown in Fig. 1.

The regenerative underfired coke oven battery A shown in Fig. 1 is of conventional type, comprising horizontally elongated coking chambers B alternating with heating walls C including vertical combustion flues, and comprising regenerator chambers D and regenerator division walls below the coking chambers and heating walls, all of said chambers and walls extending transversely of the battery. The regenerator division walls E, directly beneath the heating walls C are each formed with uprising rich gas supply channels F, each of which is connected at its upper end to an individual vertical combustion flue in the superposed heating wall C.

All of the channels F in each wall E through which fuel gas passes at the same time, are customarily connected to a single horizontal distribution pipe or conduit F' extending parallel to the length of the wall E. In some ovens there is a single conduit F', but usually there are two such conduits for each heating wall. Said horizontal distribution conduits may be embedded in the lower portion of the coke oven masonry as disclosed in my Patent 21,933, reissued October 28, 1941, or they may be below said masonry as shown in Fig. 1. As shown, the different channels F' are connected through reversing valves G to a battery supply main H.

The by-product apparatus shown in Fig. 1, comprises primary gas coolers J receiving gas from a pipe I which may be, or is directly connected to, the usual collecting main receiving the distillation gases evolved in the different oven chambers B. The gas leaving the primary coolers J passes through a pipe K to tar precipitators L and thence to the inlet M' of the exhauster M. From the exhauster M, the gas passes through the exhauster outlet M^2 to a saturator O for the recovery from the gas of free ammonia in the form of sulphate of ammonia. The gas leaving the saturator O through its outlet O', passes to the inlet of the final gas cooler P which has its outlet P' connected by a pipe HB and manifold HA to the battery fuel supply main H. The outlet P' is also connected to a pipe HC which serves as a receiver for "surplus" gas not used as oven heating fuel gas.

As shown, the manifold HA is adapted to supply gas not only to the main H, but also to one or more other mains H', when the plant includes such other mains. In some cases, one of the mains H' may serve as a second longitudinal fuel gas supply main for the battery to which the main H pertains. Usually, however, each battery includes but a single longitudinal rich gas supply main, but it is quite common for a by-product plant to include two or more coke oven batteries, and to have all the distillation gases evolved in the different batteries moved through common by-product apparatus by a single exhauster. In such a plant, each of the mains H and H' shown in Fig. 1, may supply fuel gas to a different coke oven battery.

As previously indicated, while all by-product coke oven plants include some by-product apparatus and an exhauster M, the present invention is not concerned with the character of the by-product apparatus, but in the form shown in Fig. 1, applicant's invention is characterized by the use of the exhauster driving motor N to drive a small mixing fan or blower Q moving air into admixture with the coke oven fuel gas supplied to the main H. As shown in Fig. 1, the shaft N' of the motor N is extended to drive the impeller of the mixing fan or blower Q which draws in atmospheric air through its inlet Q', and deliver that air at suitably increased pressure through its outlet Q^2 which opens into the fuel gas supply pipe HB, thereby forming the desired mixture of air and gas to be supplied to the oven channels F.

The operation of the exhauster M and fan Q by the same motor N serves the practically important purposes of insuring an approximately constant air-gas ratio in the mixture supplied to the channels F, and of minimizing risk of the outflow of gas from the pipe HB through the fan Q which would tend to occur if the operation of the fan Q were interrupted while the exhauster M remained in operation. The use of a single motor to drive both the exhauster and the fan, contributes, also, to the relatively simple and inexpensive plant construction and operation.

To eliminate risk of outflow of gas from the pipe HB through the fan Q, which might otherwise occur as a result of gas backflow through the pipe HC at a time when the exhauster M and fan Q are both out of operation, I may provide a suitable non-return valve R through which the inlet Q' of the fan communicates with the atmosphere.

The non-return valve R, shown by way of example in Fig. 1, is of the hydraulic seal type, comprising a closed chamber partially filled with water *r* or other sealing liquid, and having an air space above the liquid and to which the inlet end of the pipe Q' is connected. In operation, air enters the air space in the valve R through a pipe T having its inlet end open to the atmosphere and having an outlet end within the device R and extending vertically up through the liquid *r* and having its open upper end above said liquid. A bell member S which may be of small weight or may have its weight partially counterbalanced when necessary, is mounted in the valve R with its body surrounding the air inlet T' and extending down into the liquid *r*. The bell S is formed with lateral windows S' so disposed as to be entirely submerged when the fan Q is out of operation and the bell is free to settle down under the action of gravity into its dotted line position in which its top engages

and is supported by the upper end of the air inlet pipe T. When the fan Q is in operation, its suction maintains a pressure in the air space of the valve R which is sufficiently below the pressure of the atmosphere to raise the bell and permit the passage of air from the pipe T through the windows S' into the pipe Q' and thence through the fan Q to the pipe HB. As shown, the bell S is provided with an axial stem A^2 extending upward through a passage in the top wall of the device R and guiding the bell S in its rising and falling movements.

In Fig. 2 I have illustrated a modification of the apparatus shown in Fig. 1, in which the air fan Q of Fig. 1 is replaced by an air and gas moving fan QA, which is driven by the exhaust motor N. The fan QA draws gas from the outlet P' of the final cooler P through the pipe HB, and delivers the gas after suitably increasing its pressure, to the oven heating system through the manifold HA, and draws air from the atmosphere into admixture with the gas moving through the pipe HB through the air inlet pipe Q^{10} connected to the pipe HB adjacent the connection of the latter to the inlet of the pump QA and connected at its other end to the atmosphere. As shown, the pipe Q^{10} communicates with the atmosphere through a non-return valve R.

The pressure in the pipe HB adjacent the air inlet Q^{10} of Fig. 2, must be slightly sub-atmospheric, and the pressure at which the gas is supplied to the main H should be appreciably higher than the pressure of the atmosphere, so that the fan QA supplies part of the total gas pumping energy and correspondingly reduces the pumping load on the exhauster M of Fig. 2. Such reduction in the pumping load on the exhauster M of Fig. 2 may be advantageous in some cases.

While in accordance with the provisions of the statutes, I have illustrated and described the best forms of embodiment of my invention now known to me, it will be apparent to those skilled in the art that changes may be made in the form of the apparatus disclosed without departing from the spirit of my invention, as set forth in the appended claims and that in some cases certain features of my invention may be used to advantage without a corresponding use of other features.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a by-product coke oven plant, the combination with a coke oven structure comprising coking chambers, heating flues and heated brick work formed with fuel gas supply channels communicating with said flues, conduit means communicating with said channels, gas cooling and by-product recovery apparatus, an exhauster moving distillation gas from said chambers through said apparatus and delivering it to said conduit means for passage into said channels, said conduit means having an inlet for the inflow of atmospheric air, a mixing fan moving atmospheric air through said inlet and into admixture with the gas passing from said apparatus to said channels through said conduit means and a common driving means for said exhauster and fan.

2. A combination as specified in claim 1 comprising a surplus gas receiver in communication with said conduit means between said apparatus and inlet, and non-return valve means preventing outflow of gas through said inlet.

3. A combination as specified in claim 1 in which said mixing fan is included in the portion of said conduit means between said inlet and channels and forms part of the path of flow of gas passing from said apparatus to said channels.

4. In a by-product coke oven plant, the combination with regenerative underfired coke ovens having coking chambers, heating walls with combustion flues therein, regenerative division walls respectively beneath said heating walls, and fuel gas supply channels extending upward through each regenerative division wall into communication with the combustion flues in the superposed heating wall, conduit means communicating with said channels, gas cooling and by-product recovery apparatus, an exhauster moving distillation gases from said chambers through said by-product apparatus and delivering it to said conduit means for passage into said channels, said conduit means having an inlet for the inflow of atmospheric air, a mixing fan moving atmospheric air through said inlet and into admixture with gas passing from said apparatus to said channels through said conduit means, and a common driving means for said exhauster and fan.

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