

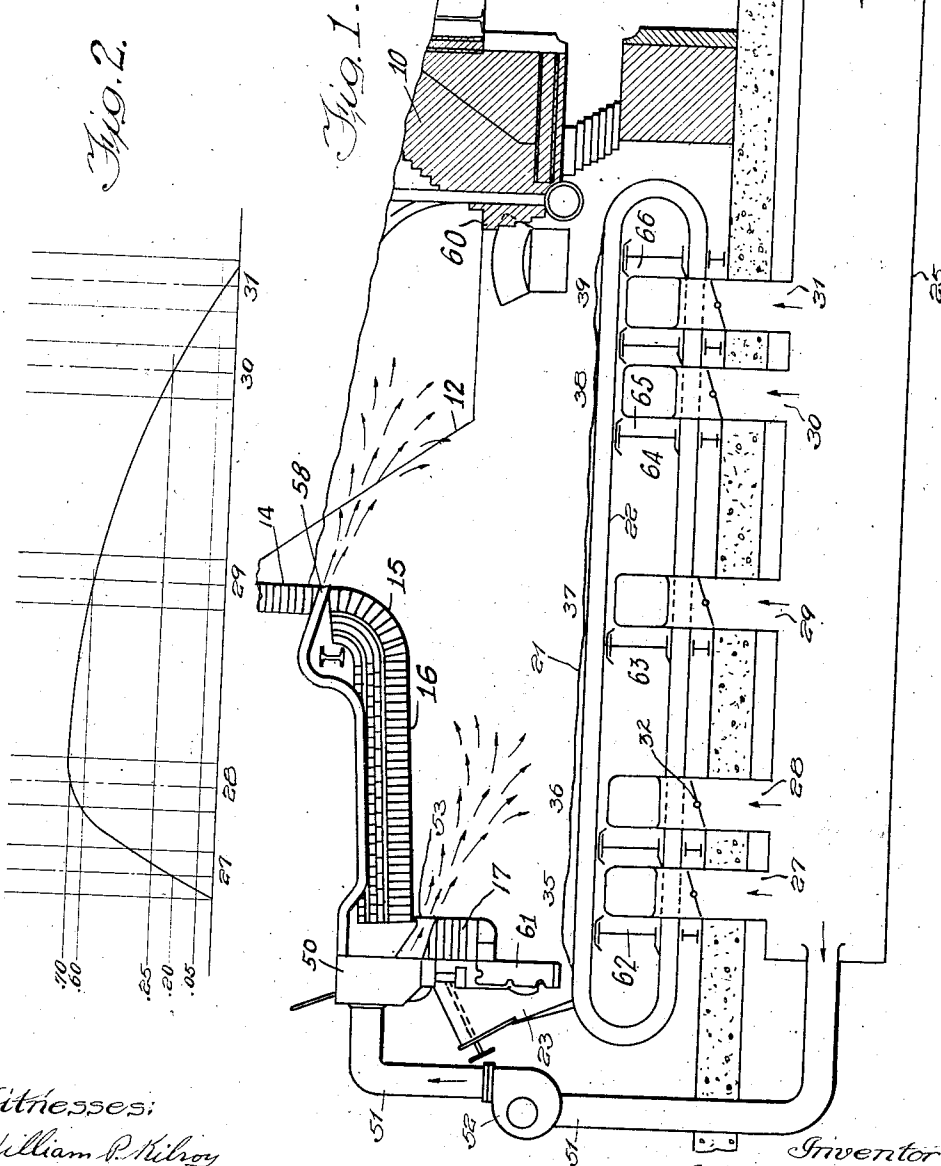
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FURNACE CONSTRUCTION

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UNITED STATES PATENT OFFICE.

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FURNACE CONSTRUCTION.

Application filed April 9, 1925. Serial No. 21,779.

This invention relates to furnace construction and more particularly provides an improvement upon the invention disclosed and claimed in our co-pending application, Serial No. 676,744, filed November 24, 1923 for furnace construction.

In that application we have disclosed a novel method of and means for improving combustion of fuel, particularly in connection with stoker fired furnaces employing fuel having considerable volatile matter by the use of a series of nozzles for delivering jets of air at relatively high velocity directed inwardly and downwardly within the furnace for the purpose of delivering the proper amount of over fire air into the bank of combustible gases rising from the fuel bed due to coking of the fuel.

We found in connection with our work with the device therein disclosed that in order to secure proper results, the relative proportions of over fire air to air through the fuel bed should be closely regulated and the velocity of the over fire air properly maintained. We found also that the air delivery through sections of the fuel bed should be regulated in a different manner from what would be necessary if over fire air were not employed. Heretofore it has been customary to depend to a large extent upon the excess of air delivered through the latter sections of the fuel bed where the fuel is reduced substantially to ash and refuse. But the air so delivered does not materially mix with nor, in fact, come close to the combustible gases from the coking of the fuel, and fine particles of fuel which may be carried in the draft, until they have passed a relatively great distance from the fuel bed, in some cases into the boiler tubes.

Since, according to our invention as disclosed in the aforesaid application, we can deliver the proper amount of air by our jet system and thoroughly mix it with the combustible gases and, in fact, mix all of the gases coming from the fire at or adjacent the region in which they are released, the proper proportioning of the air as among the various parts of the fuel bed and as between the through fire air and the over fire air, becomes a matter of prime importance.

According to the invention herein disclosed, we provide a common source of air delivery for delivering air at the proper rate to accord with the rate of fuel delivery,

and we connect the two air delivery devices, namely, the over fire air delivery device and the under fire air delivery device to this common source. The proper proportioning of over fire air and through fire air may be determined upon for a given grade or quality of fuel and a given character of fuel bed. Change in the rate of fuel being burned may require merely an increase in rate of air delivered from the common source.

For a different grade of fuel or thickness or character of fuel bed the relative pressures of air supplied to the over fire and under fire air delivery devices may have to be regulated to secure the proper proportioning of air over or through the fire.

We provide a series of separate air boxes under the fire fed from the common blower through control valves so that the relative proportioning of air as between the sections of the fire may be regulated and also by a common adjustment of these valves the relative delivery as between the over fire and through fire air may be controlled.

In addition, we provide as an optional feature a booster blower between the common source of air supply and the over fire nozzles, so that thereby the relative pressure may be varied and the velocity of the air delivered at the jets may always be maintained. We are aware that it is broadly old to admit air over the fire and through the fire from a common source, as shown for example, in the patent to Lishman, No. 477,376, June 21, 1892, but in all prior devices so far as we know where such common source of air supply was provided, no traveling bed of fuel has been maintained with the necessity for proportioning the air delivery in the respective sections of the fuel bed, and the necessity for maintaining a high velocity of the over fire air delivery means. The distribution means for distributing the air through the sections of the fuel bed affects at the same time the relative proportions of over fire and through fire air from the common source.

Now, in order to acquaint those skilled in the art with the manner of constructing and operating a device embodying our invention, we shall describe in connection with the accompanying drawing a specific embodiment of the same.

Figure 1 is a longitudinal vertical sec-

tion through the lower part of a furnace and stoker construction showing in somewhat diagrammatic form the air connections; and

Figure 2 is a diagram illustrating graphically the approximate conditions of pressure in terms of inches of water admitted into the separate chambers under the fuel bed.

The furnace with which I have elected to illustrate my invention is of substantially the same type as shown in my prior application above referred to, to which reference is here made for a more detailed description. The furnace includes a back wall 10 which has a forwardly projecting portion or arch 60 overhanging the discharge end of the grate and a front wall 14 below which there is formed a forwardly extending flat arch 16 joining the vertical wall 14 by a rounded knee 15, between which knee and the forward projection 60 on the rear wall there is formed a throat or narrow portion of a fire-box 11 which extends above the throat. The furnace may be divided into two portions each having a stoker therein as by means of the low wall 12. In this manner two stoker sections may be located under the same boiler, which is not shown.

The arch 16 is suspended from suitable supporting frame work and forms a suitable ignition arch above the forward part of the stoker 21, which stoker comprises a traveling chain grate 22. The front part of the arch 16 terminates in a front wall 17, which is formed of firebrick and which overlies the forward part of the fuel gate 61 by which the depth of fuel bed upon the chain grate 22 is determined. The entire interior of the furnace walls is lined with a suitable refractory, preferably firebrick, as is well understood by those skilled in the art.

Fuel is fed onto the grate 22 from a suitable hopper 23 which is supplied with fuel by a spout extending from an overhead hopper (not shown), as is well known to those skilled in the art.

Air is supplied to the fuel bed 24 on the chain grate 22 through a series of ducts 27, 28, 29, 30 and 31, each of which ducts has a suitable control valve 32 therein. These ducts extend from a wind box 25, into which air is delivered at a suitable pressure from a blower 26. The ducts 27 to 31, inclusive, deliver into chambers 62, 63, 64, 65 and 66, respectively, these chambers being formed under the grate 22, so that different pressures may be carried at different portions of the fuel bed, and so that the delivery of air to the respective sections of the fuel bed may suitably be controlled.

The fuel with which we have employed the construction herein shown comprises Illinois and Kentucky soft coal of screening size. This coal contains a relatively high percentage of volatile matter, analyses showing of the order of 39% volatile mat-

ter to 41% fixed carbon by weight on a dry basis.

According to our invention we provide at the forward part of the furnace, preferably adjacent the front wall 17, a plenum box or auxiliary wind box 50 from which a series of nozzles 53 project through the forward wall 17 immediately under the arch 16, these nozzles being directed inwardly and diagonally downwardly into the general zone of formation of a bank of combustible gases.

The plenum box is connected by a conduit 51 with the main wind box 25 so that the fan or blower 26 forms the common means for supplying air through the fire and above the fire.

We also provide a supplementary blower 52 in the conduit 51 so that the air in the plenum box 50 may be maintained at a suitable pressure to secure the desired velocity effect from the nozzles 53.

The nozzles 53 may be spaced at intervals across the width of the wall 17 so as to secure the desired effect of air delivery and the desired mixing effect within the furnace, as will be referred to later.

In operation, the coal entering under the gate 61 from the hopper 23 is ignited from the heat reflected from the arch 16 and the wall 17, and only a relatively small amount of air is delivered into the entering fuel from the chamber 62. As soon as the fuel is ignited it begins to give off combustible gasses because of the coking effect which occurs, this coking effect being most pronounced over the chamber 63, as indicated by reference numeral 36, and continuing in part over the chamber 64, as indicated by reference numeral 37. The main part of coking is accomplished by the time that the fuel emerges from under the arch 16 and it burns as a fixed carbon over the latter part of chamber 64, over chamber 65, and over chamber 66. The fuel is substantially reduced to ashes and refuse over the chamber 39, and it is discharged at the rear end of the traveling grate 22 into a suitable ash pit (not shown).

The plenum box 50 has connected thereto a set of secondary nozzles 58 which direct jets of air at relatively high velocity rearwardly and downwardly above the knee of the arch 15 to secure a thorough mixing of the gases and such air as is here delivered at the throat of the furnace. This discharge of air from the nozzles 58 at the point where the direction of gases tends to change in the throat of the furnace is particularly useful in connection with the combustion of fines, that is, small particles of solid matter which may be carried up in the draft. In addition, it serves to supply the necessary air for combustion of any gases which have not been consumed by contact with the over fire air delivered from the nozzles 53.

The spacing of the nozzles 58 transversely across the width of the furnace corresponds to the spacing of the nozzles 53, that is, about twenty inches apart, but obviously this may be varied and means is provided for shutting off the nozzles individually to secure the desired effect.

The air which is forced into the main wind box 25 by the blower 26 may be preheated, if desired, and since both the over fire air and the through fire air are supplied from the same common source by the blower 26, the same temperature of air is supplied at both points.

The nozzles 53 are of a shape which we have termed Venturi shape, that is, gradually decreasing to a narrow throat and then flaring outwardly to give the effect of a nozzle for injecting the air at high velocity. The nozzles 58 may be so shaped, but we have not found it necessary, to provide other than a straight cylindrical opening at this point.

In the furnace herein shown we have employed a blower at 26 which supplies the requisite delivery of air under normal burning conditions at approximately 1.25 inches of water.

For the fuel which we employ we find that it is necessary to admit about 15 to 20% of the total amount of air employed through the over fire nozzles to secure the best results. This figure naturally will vary with the character of the fuel employed.

When the blower is operating at a given speed its delivery is substantially constant, and we have found that the proportion of over fire and through fire air may be suitably maintained by means of the valves 32 which control also the distribution of air throughout the length of the fuel bed.

In Figure 2 we have shown, in the form of a graph, approximately the conditions of pressure prevailing in the various parts throughout the length of the fuel bed. Under normal running conditions the valve in duct 27 is set so as to deliver air at a pressure of substantially .20 inches of water, since the fuel entering here is substantially green and is ignited as it enters the furnace. In the next chamber 63 the pressure carried is substantially .70 inches of water, since it is in this region where the greater part of coking and consequent release of combustible gases occurs. The pressure in the chamber 64 is of the order of .60 inches of water. Some of the coking and burning of the fixed carbon occurs in this region of the fuel bed. The next chamber 65 carries air at a pressure of .25 inches of water, and the final chamber 66 carries air at only .05 inches of water. The flows through the various sections do not exactly correspond to these pressures, but it will be seen that the central part of the furnace in which combustion is

most rapid requires the greatest amount of air.

The setting of the valves 32 may be varied for a given delivery of air from the blower 26 to raise or lower the general level of pressures in the respective chambers, and thereby to vary the proportion of air delivered through the fire and over the fire.

The supplemental blower 52 furnishes means for maintaining the velocity at the nozzles 53 and 58 and this, in connection with the individual shut off means for these nozzles, permits of a regulation of the amount of air delivered and the velocity at which it is delivered to as close a degree as is necessary for practical operation.

We do not intend to be limited to the details shown or described.

We claim:—

1. In means for burning fuel, the combination of a furnace having means for maintaining a traveling fuel bed, means for delivering air up through the fuel bed to support combustion of the fuel in the bed, means for proportioning the air delivered through the respective sections of the fuel bed, means for projecting a stream of relatively high velocity air into the furnace above the fuel bed forwardly and diagonally downwardly into the combustible gases arising from the fuel bed to mix the same and secure substantially complete combustion, and common air supply means for both of aforesaid air delivery and air projecting means.

2. In means for burning fuel, the combination of a furnace having means for maintaining a traveling fuel bed, a main wind box, under fire air delivery means for delivering air from the main wind box up through the fuel bed for supporting combustion of the fuel in the bed, over fire air delivery means connected to the main wind box for projecting a stream of relatively high velocity air into the furnace above the fuel bed forwardly and diagonally downwardly into the combustible gases arising from the fuel bed to mix the same and secure their combustion, a blower delivering air under pressure into the main wind box, and valve means for controlling the proportions of air delivered through the fuel bed and above the fuel bed, respectively.

3. In means for burning fuel, the combination of a furnace having means for maintaining a traveling fuel bed, a main wind box, under fire air delivery means for delivering air from the main wind box up through the fuel bed for supporting combustion of the fuel in the fuel bed, an auxiliary wind box connected to the main wind box, over fire air delivery means for projecting air from the auxiliary wind box in a stream of relatively high velocity into the furnace above the fuel bed forwardly and diagonally downwardly into the combustible gases arising

ing from the fuel bed to mix the same and secure their combustion, a main blower for delivering under pressure all the air for both wind boxes, and a booster blower in the connection between the main and the auxiliary wind boxes for increasing the pressure of air delivered through the auxiliary wind box and its connected over fire air delivery means.

In witness whereof, we hereunto subscribe our names this 7th day of April, 1925. 10

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