

Jan. 1, 1929.

J. E. MUHLFELD ET AL

1,697,688

FURNACE

Filed Feb. 25, 1919

2 Sheets-Sheet 1

Fig. 1.

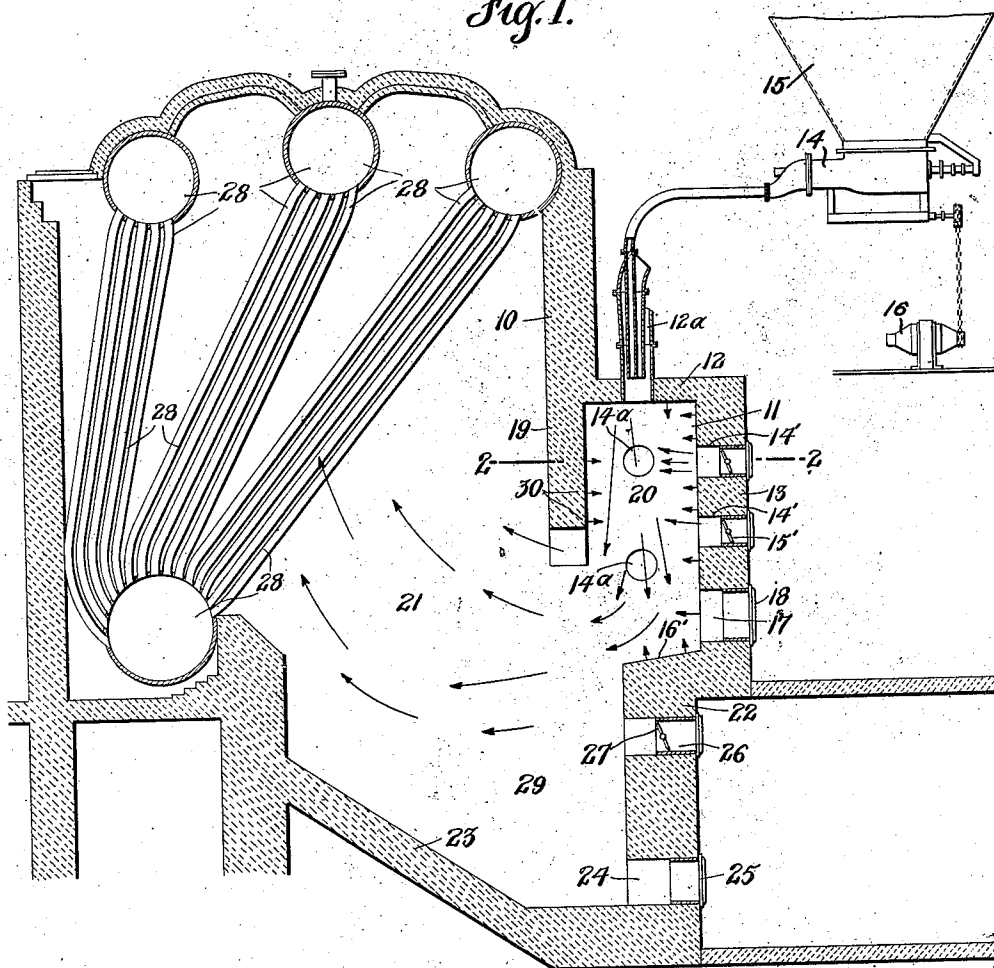
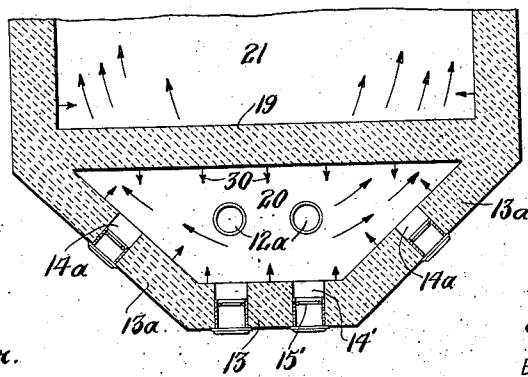


Fig. 2.



WITNESS

Gustav Benzlinger.

INVENTORS

John C. Muhlfeld
 Virginius J. Caracoste
 BY
 Cymmetress & Lechner
 ATTORNEYS

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2 Sheets-Sheet 2

Fig. 3.

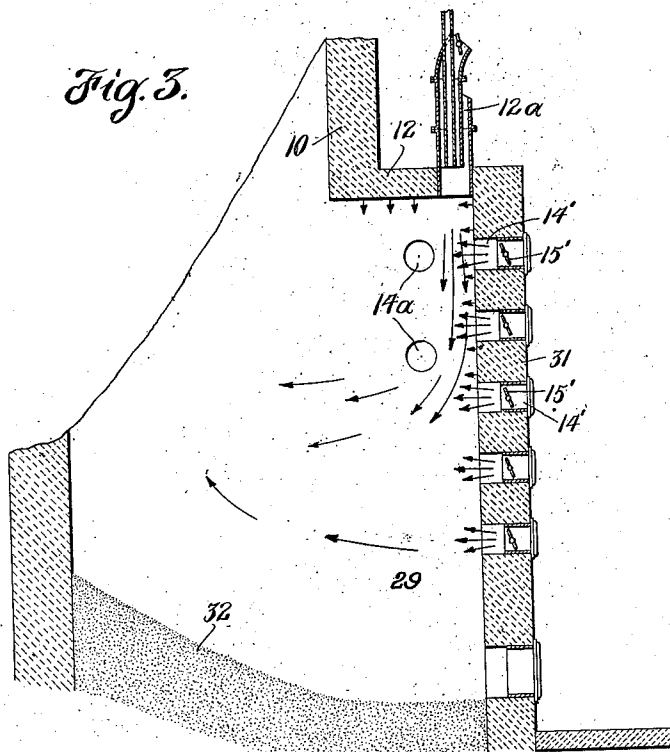
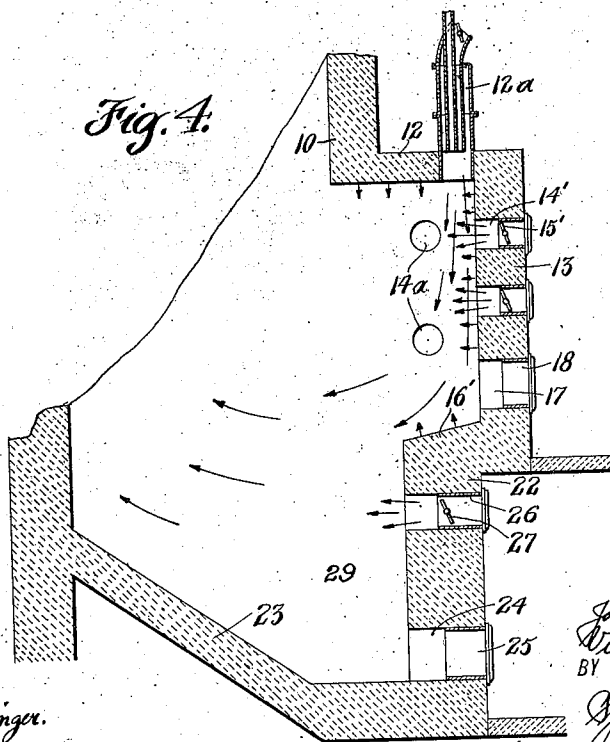


Fig. 4.



WITNESS:

Gustav Unglinger.

INVENTORS

John C. Muhlfeld
Virginius J. Karacristi

BY Symeatt & Lechner
ATTORNEYS

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1,697,688

UNITED STATES PATENT OFFICE.

JOHN E. MUHLFELD, OF SCARSDALE, AND VIRGINIUS Z. CARACRISTI, OF BRONXVILLE, NEW YORK, ASSIGNORS, BY MESNE ASSIGNMENTS, TO LOPULCO SYSTEMS, INC., OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

FURNACE.

Application filed February 25, 1919. Serial No. 279,155.

The present invention relates to improvements in furnaces, the present disclosed embodiment relating particularly to boiler furnaces in which pulverized fuel is burned.

5 It is an object of this invention to provide in a furnace increased radiating surfaces so disposed as to aid in the combustion, such radiating surfaces being perpendicular, preventing the accumulation of ash or other heat absorbing refuse thereon to render them at all times regenerative, and in this manner maintaining at all times a full efficiency of the radiating surfaces so as to aid in the combustion, permitting of the efficient burning of either low or high volatile fuels without rapid destruction of the refractories and other difficulties and also providing an increased flamework.

10 It is a further object to provide a furnace in which the feeding and mixing with air is arranged in consecutive steps, whereby a small proportion of the air necessary for combustion is induced into the furnace downwardly with the fuel and in line with the incoming fuel substantially in a perpendicular direction, and in which the additional air necessary for combustion is induced in the direction transverse to said first mentioned current, the resultant currents from the perpendicular and transverse currents, thereby insuring thorough mixing of air for combustion, so that the greatest efficiency in mixing is obtained. A further object is to create a structure which can be maintained in proper condition with facility and without interfering with the operation thereof.

15 A still further object is to provide preliminary and secondary combustion areas or zones into which combustion air may be independently directed, thereby improving the process of combustion and to provide a neutral zone of air, which is a poor heat conductor, below the combustion zones, which zone of air will cool the ash below substantial slag forming temperature.

20 One of the principal functions of the furnace is the provision of a construction whereby the combustion is completed at a point removed from the space provided for the deposit and removal of ash, so as to have an intervening non-conducting volume of air or air zone, between the space in which the combustion takes place and the ashes or floor on which the deposit of ash accumulates, so as

to maintain the temperature in said ash space 55 below the melting point of ash, thereby preventing the formation of slag.

With these and other objects in view an embodiment of our invention is shown in the accompanying drawing and this embodiment 60 will be hereinafter more fully described with reference thereto and the invention will be finally pointed out in the claims.

In the drawings,

Fig. 1 represents in vertical section a furnace of the boiler type embodying one form of our invention;

Fig. 2 is a transverse sectional view taken through the line 2—2 of Fig. 1;

Fig. 3 is a similar sectional view (with 70 parts broken away) showing a modified form; and

Fig. 4 is a fragmentary vertical section of a still further modified form.

Similar reference characters indicate corresponding parts throughout the several figures of the drawings.

Referring to Fig. 1 of the drawing, the furnace shown therein comprises a combustion chamber 10 having a forwardly projecting mixing chamber 11, in the top wall 12 of which there is disposed one or a plurality of fuel feed burners 12^a through which pulverized fuel mixed with air is fed by means of the apparatus 14 which receives the fuel from 85 the bin 15 and is operated through the motor 16. Any suitable number and arrangement of these burners may be provided depending upon the capacity of the furnace. In the perpendicular front wall 13 of the mixing 90 chamber there are provided a plurality of horizontally disposed auxiliary air feed pipes or openings 14^a provided with controlling dampers 15^a. Auxiliary air feed pipes or openings 14^a may also be located in the perpendicular side walls 13^a, which diverge from 95 the front wall to the parallel side walls so that incoming fuel and air flow in close contact therewith, these walls following the natural spread of the body of flame. Two such superimposed air feed pipes are shown in the drawing, but it will be understood that any number of these may be arranged along the length of the chamber.

100 The vertical feed burners 12^a are preferably of a type as disclosed in our co-pending application, Serial No. 215,428, filed February 5th, 1918, and opposed thereto and below

the auxiliary air feed pipes 14', there may be provided a laterally disposed target wall 16' inclined downwardly from an opening 17 provided with a door 18, this target wall deflecting the incoming fuel into the furnace. This target wall is, however, by no means a necessity to the operation of our furnace. A perpendicular baffle or partition wall 19 depends from the top wall 12 terminating at a point above the target wall 16', this wall separating the preliminary combustion area of the mixing chamber from the secondary combustion area respectively indicated at 20 and 21, an outlet space connecting the two areas being disposed between the corner formed by the target wall 16' and the vertical lower wall 22 and the lower end of the depending baffle wall 19.

Inclined upwardly from the lower end of the lower vertical wall 22, there is provided a guide wall 23 forming the floor of the secondary combustion area 21 and being substantially opposed to the direction of flow of the fuel emanating from the outlet space between the preliminary and the secondary combustion areas. At the lower end of the wall 22 there is provided an outlet 24 having a door 25 for the removal of ash.

A plurality of horizontally disposed auxiliary air feed pipes 26 having controlling dampers 27, may be provided in the lower wall 22 which admit air into the secondary combustion area.

The boiler 28 to be heated is arranged across the combustion chamber, this, however, being an arbitrary arrangement and other material or means to which heat is to be imparted may be suitably provided.

In operation the pulverized fuel enters the preliminary combustion area from the feed burners 12^a, these burners being such that these streams of mixed fuel and air are surrounded by streams of air and being directed into the preliminary combustion area, are subjected to radiant heat indicated by the arrows 30 from the perpendicular surface of the baffle 19 along which the fuel and flame flows and the perpendicular surface of the front wall 13 before it engages the target wall 16', which, during operation of the furnace, is incandescent. The heat radiating surfaces of the walls 19 and 13 being perpendicular prevent the accumulation of ash or other heat absorbing refuse. The transverse streams of air entering through the openings 14' tend to break up the surrounding layer of consumed gas permitting additional air to come into intimate contact with the partially consumed gas in the core of the flame causing complete combustion. The baffle wall 19, it will be seen, provides an increased radiating surface and flame-way along one side of which the fuel flows through the preliminary combustion area and along the other side of which it flows through the secondary combustion

area providing in each case perpendicular heat radiating surfaces.

Where the target wall 16' is used, the bricks of which it is composed, because of its intense heat and the impingement of the fuel thereon, burn out and otherwise become affected so that renewal becomes necessary. Heretofore renewal or repair of such parts necessitated the putting out of operation and complete cooling of the furnace. According to the present invention renewal of the target wall surface is permitted during operation of the furnace through the opening 17, this opening permitting insertion of the bricks by a suitable tool or the bricks may be thrown therein, thereby providing a new surface. The ash and other precipitated products of combustion slide along the inclined wall 23 to the outlet 24 where they may be removed.

The intervening distance between the target wall 16', and the space 29, being sufficient to decrease the temperature to a point below the melting point of ash, ash in a free state will be precipitated in such place, and such material is kept cleaned out of the furnace proper, the flame not impinging upon such non-combustible or non-radiating solids in view of the intervening air zone of poor heat conductivity. This intervening zone constitutes in effect an excess body of air which may be termed a neutral zone and it acts, among other things, to prevent material fusion of those products of combustion which precipitate so that they are prevented from forming a mass of slag in the lower portion of the furnace difficult of removal.

In applying pulverized fuel burning equipment to steam generating plants it is highly important to prevent "slagging" of the evaporating surfaces. If this is not prevented efficient steaming cannot be had because the slag forms an insulating coating, as it were, which does not permit the ready absorption of the heat. In our furnace slagging difficulties which have been so troublesome in this branch of the art are completely overcome. The flames do not carry along with them those products of combustion which fuse and form slag as they do in all previous furnaces with which we are familiar. These products are given a chance to precipitate because of the low velocity at which they are carried through the furnace, and because of the neutral zone of air through which they fall they do not fuse and form a solid mass of slag in the bottom of the furnace incapable of removal.

In Fig. 3 we have illustrated a modified form of construction in which the fuel feed burners 12^a have their outlets disposed adjacent and contiguous to the inner side of the front wall 31, which in this form extends uninterrupted to the base of the ash pit, in which the ashes 32 are precipitated, the said wall being provided at suitable points with auxiliary

iary air feed pipes or opening 14' having controlling dampers 15'.

The perpendicular baffle or partition 19 is dispensed with in the showing of this form, although it will be understood that it may, if desired, be used in connection therewith. The incoming fuel and air flows contactingly along the perpendicular wall in intimate relation with the radiating heat therefrom indicated by the arrows 30, the increased radiating surface greatly aiding combustion, the perpendicular disposition of the radiating surface preventing the accumulation of ash or other heat absorbing refuse.

In Fig. 4 a somewhat similar construction to that shown in Fig. 3 is shown, but in this form the target wall 16', is included in connection with the front wall 13 in a similar relation to the form shown in Fig. 1. It will be understood that in either of these forms shown in Figs. 3 and 4 a partition or baffle wall 19, such as shown in Fig. 1 may be included, and that this wall in any of the embodiments may be positioned at any desired distance from the front wall according to the degree of intimacy desired between the incoming fuel and air and the heat radiating surfaces.

We have illustrated and described a preferred and satisfactory embodiment of our invention but it is obvious that changes may be made therein within the spirit and scope thereof as defined in the appended claims.

We make no claim herein to the process of burning the pulverized fuel described, but have claimed the same in our copending application, Serial No. 321,976, filed September 5, 1919, which is a division hereof.

We claim:

1. A furnace for burning pulverized fuel having means for admitting the fuel substantially vertically downward, and an internal radiating wall in proximity to a wall of the furnace between which walls the burning fuel passes downward, said furnace being constructed to provide a cooling zone intermediate the zone at which combustion takes place and the ash deposit, said cooling zone acting to cool the ash precipitating therethrough sufficiently to prevent substantial fusion of the ash.

2. A furnace for burning pulverized fuel having means for admitting the fuel substantially vertically downward adjacent to a substantially vertical radiating wall thereof, said furnace being constructed to provide a cooling zone intermediate the zone at which combustion takes place and the ash deposit, said cooling zone acting to cool the ash precipitating therethrough sufficiently to prevent substantial fusion of the ash.

3. A furnace for burning pulverized fuel having an outlet in an upper part and having means for admitting the fuel in an upper part of the chamber in a substantially verti-

cally downward direction to one side of said outlet and adjacent an upright wall of the furnace whereby the fuel and flame stream takes a somewhat U-shaped course through the chamber, and having means for controllably admitting air for combustion at a plurality of successive levels below the level of fuel admission and opposite the fuel and flame stream.

4. A furnace for burning pulverized fuel having an outlet in an upper part and having means for admitting the fuel in an upper part of the chamber in a downward direction whereby the fuel and flame stream takes a somewhat U-shaped course through the chamber, and having means for controllably admitting air for combustion at a plurality of successive levels below the level of fuel admission and opposite the fuel and flame stream at three contiguous sides of the chamber.

5. A furnace for burning pulverized fuel having an outlet in an upper part and having means for admitting the fuel in an upper part of the chamber in a substantially vertically downward direction to one side of said outlet and adjacent an upright wall of the furnace whereby the fuel and flame stream takes a somewhat U-shaped course through the chamber, and having means for controllably admitting air for combustion at a plurality of successive levels below the level of fuel admission, said chamber having means for creating a cooling zone intermediate the zone of combustion and the place of ash deposit, which zone acts to cool the ash particles precipitating therethrough sufficiently to prevent substantial fusion of the ash.

6. A furnace for burning pulverized fuel having an outlet in an upper part and having means for admitting the fuel in an upper part in a substantially vertically downward direction to one side of said outlet and adjacent an upright wall of the furnace whereby the fuel and flame stream takes a somewhat U-shaped course through the chamber, a boiler subject to the outlet flow, and a wall in the chamber depending part-way down and located in a plane intermediate the point of fuel admission and said outlet.

7. A furnace for burning pulverized fuel having an outlet in an upper part, and means for introducing the fuel in a substantially vertically downward direction to one side of said outlet and adjacent an upright wall of the furnace whereby the fuel and flame stream takes a somewhat U-shaped course through the chamber, and having means for creating a cooling zone marginally of the zone of combustion for cooling refuse particles leaving the fuel and flame stream to pass through such zone, and boiler tubes exposed to the outlet flow.

8. A furnace for burning pulverized fuel having an outlet in an upper part, and means for introducing the fuel in a substantially vertically downward direction to one side of the outlet whereby the fuel and flame stream takes a somewhat U-shaped course through the chamber, and having means for creating a cooling zone marginally of the zone of combustion for cooling refuse particles leaving the fuel and flame stream to pass through such zone, and boiler tubes exposed to the outlet flow, and means for providing heat whereby complete combustion of the fuel is sustained.

In testimony that they claim the foregoing as their invention, they have signed their names hereunder.

JOHN E. MUHLFELD.
VIRGINIUS Z. CARACRISTI.