

Dec. 15, 1936.

E. G. BAILEY

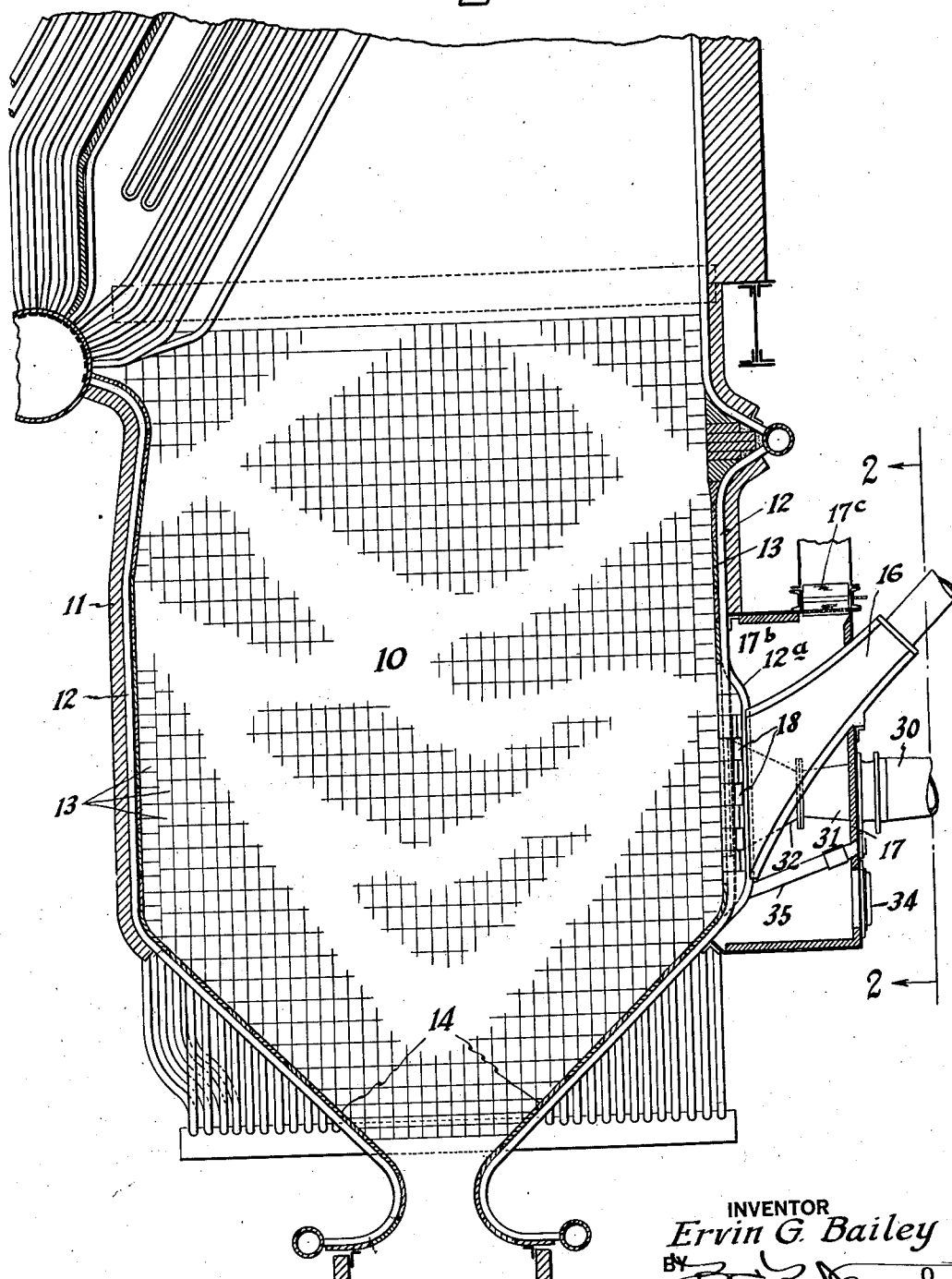
2,064,366

APPARATUS FOR BURNING PULVERIZED FUEL AND GAS

Filed June 21, 1932

3 Sheets-Sheet 1

Fig. 1



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Fig. 3

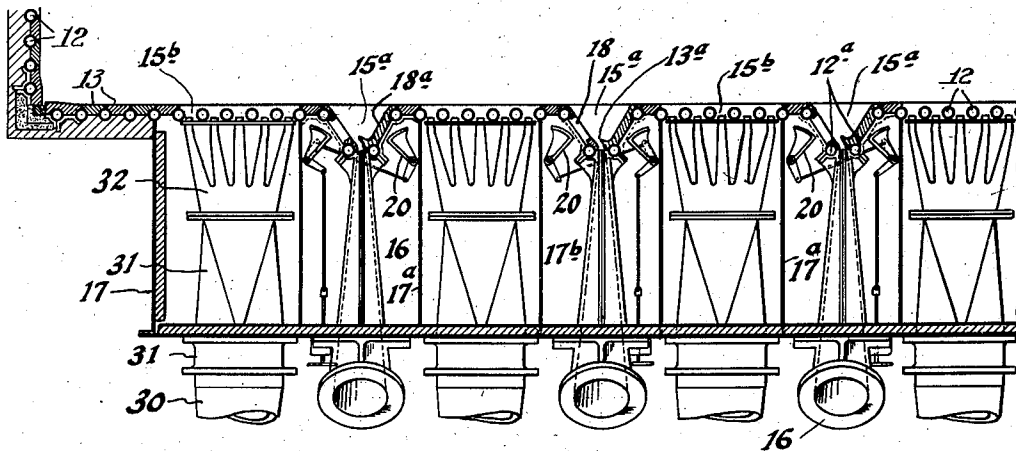
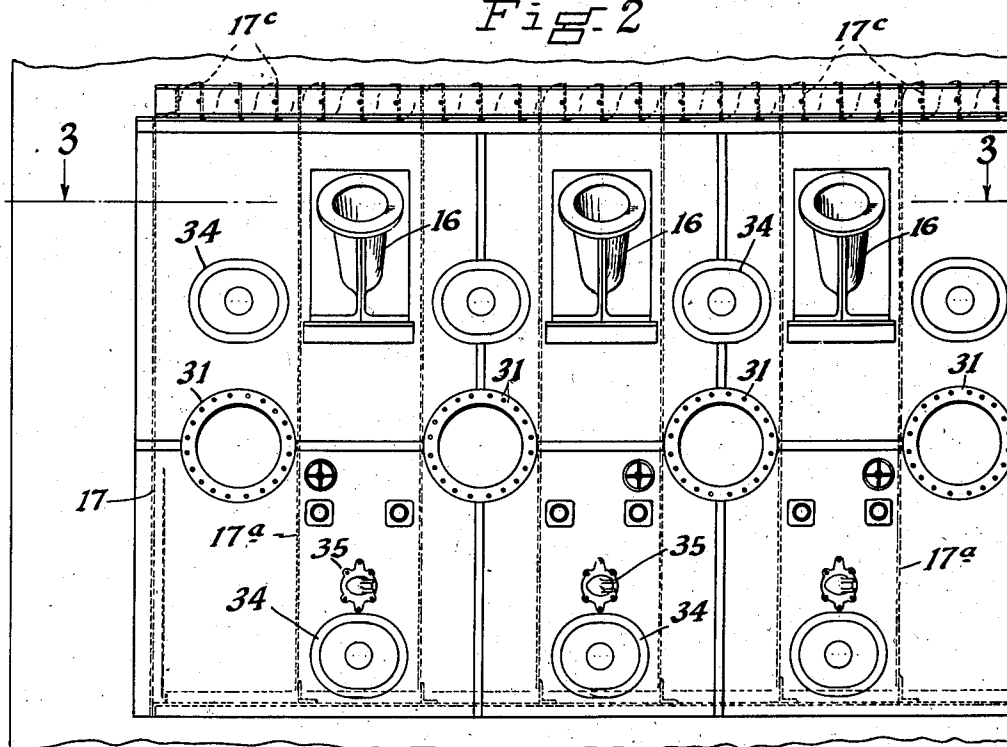


Fig. 2



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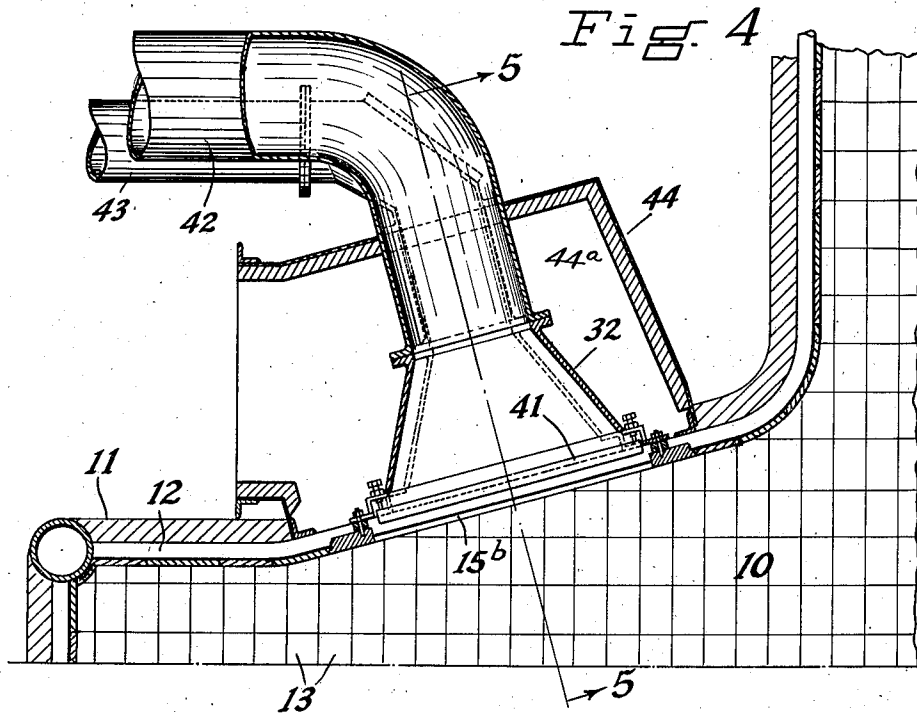
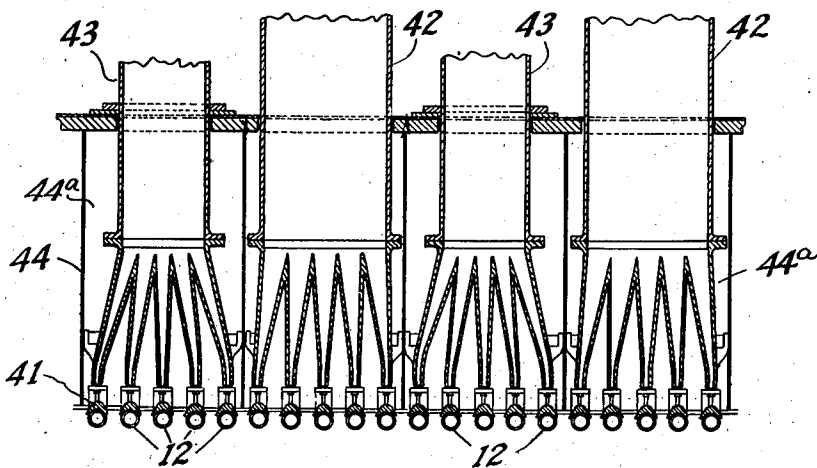


Fig. 5



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UNITED STATES PATENT OFFICE

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APPARATUS FOR BURNING PULVERIZED
FUEL AND GAS

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Application June 21, 1932, Serial No. 618,451

4 Claims. (Cl. 110—22)

The present invention relates to the construction and operation of furnaces adapted for the separate or simultaneous burning of a plurality of fuels in suspension therein.

5 In furnaces heretofore built or proposed for burning pulverized coal and/or blast furnace gas, for example, combustible mixtures of fuel and air have been projected into different portions of the furnace chamber either from the same or
10 opposite sides thereof, and in directions which create a substantial mixing of the fuels before or during combustion when simultaneously utilized. Separate burner ports and fuel burners are provided for the different fuels. The loca-
15 tion of the burner ports for the different fuels in different portions of the furnace structure usually results in a substantial difference in the length of flame travel in the furnace with a corresponding loss in combustion efficiency of one or
20 both fuels. Where the burner ports for the different fuels are so located that the streams of fuel and air are superposed in the furnace when the fuels are simultaneously fired, a loss in combustion efficiency results not only from the difference in lengths of flame travel in the furnace,
25 but also because of flotation of fuel particles in the upper stream by the lower stream out of the furnace before combustion thereof is effected. Where the burner ports for the different fuels
30 are superposed in a vertical wall of the furnace, it has been found when only one set of burner ports is utilized, that the portions of the idle burners exposed to the radiant heat of the furnace will deteriorate and be destroyed in a relatively short time.

35 The general object of my present invention is the provision of a high capacity furnace of the character described in which the burner ports and fuel burner means are constructed and arranged so as to fully utilize the available furnace
40 volume when the fuels are burned either simultaneously or separately. A further and more specific object is the provision of a fluid cooled furnace and fuel burner means adapted for the
45 firing of a plurality of fuels at high ratings and efficiencies.

50 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, its operating advantages and specific objects attained by its use, reference should be had to the accompanying
55 drawings and descriptive matter in which I have

illustrated and described preferred embodiments of my invention.

Of the drawings:

Fig. 1 is a sectional elevation illustrating a preferred embodiment of my invention;

Fig. 2 is a front elevation of the invention with parts omitted;

Fig. 3 is a section on the line 3—3 of Fig. 2;

Fig. 4 is a view similar to Fig. 1 illustrating a modification; and

Fig. 5 is a section on the line 5—5 of Fig. 4.

In the drawings I have illustrated a steam boiler unit comprising a furnace chamber 10 formed by vertical walls 11 lined with spaced water tubes 12 which in turn are covered by
15 blocks 13 of heat resistant material. Above the furnace is positioned a steam boiler of the Stirling type into the circulation system of which the wall tubes 12 are preferably connected. The lower
20 portions of the walls 11 are inclined and arranged to form fluid cooled hopper surfaces 14 receiving ash or residue.

The furnace illustrated is designed for the efficient burning of pulverized fuel and/or blast furnace gas at high capacities. The provisions
25 for this purpose include a series of burner ports arranged side-by-side in the front wall of the furnace, and at a level therein sufficiently above the ash hopper that the amount of heat to which the ash therein is subjected is not excessive. As
30 shown at Figs. 2 and 3, burner ports 15^a are arranged for the discharge therethrough of a combustible mixture of pulverized fuel and air, while alternate burner ports 15^b intermediate the ports 15^a are adapted for the discharge of
35 a combustible mixture of gaseous fuel and air. As indicated in Fig. 3, the series of burner ports extend substantially across the front wall of the furnace.

The fuel burner means associated with the burner ports 15^a are similar to those illustrated
40 in U. S. Patent No. 1,994,445, their specific construction forming no part of my present invention. As shown in Fig. 1, two of the tubes 12 are bent outwardly as indicated at 12^a to facilitate
45 installation of the burner. A vertically diverging and laterally tapering fuel burner nozzle 16 is positioned with its discharge end between the tube portions 12^a. A casing 17, supplied with air for combustion, extends across the front furnace wall and is divided by partitions 17^a into a
50 number of supply chambers 17^b, alternate ones of which surround the nozzles 16. Dampers 17^c permit independent regulation of the air supplies to the several chambers. The tube blocks 13 be-
55

tween the tube portions 12^a and adjacent straight tubes are spaced so as to leave staggered openings 18 at opposite sides of the tube portions 12^a, through which openings streams of air are discharged from the chambers 17^b. The blocks have extensions or lips 13^a to direct the discharge of the primary air and fuel from the end of the nozzle 16 in staggered streams in front of the block openings 18. The streams of secondary air impinge on the fuel streams and effect a thorough commingling of the fuel and air. Dampers 20 may be advantageously used to regulate the effective area of the secondary air discharge openings in accordance with variations in the supply of secondary air for the purpose of maintaining an air velocity sufficient to effect the desired mixing action.

The gaseous fluid fuel burner means associated with the ports 15^b, each comprises a supply conduit 30 connected to a burner nozzle 31 which terminates in a vertically diverging tip member 32 shaped to divide the entering fuel into a plurality of thin parallel streams and project them through corresponding spaces between the tubes 12 into the furnace. An air chamber 17^b, intermediate the air chambers for the pulverized fuel burners, surrounds each nozzle tip member and opens to the spaces between the discharge ends of the tip member and the wall tubes, whereby the streams of fuel issuing from the burner discharge openings scrub or are scrubbed by the surrounding streams of air, depending upon the relative velocities thereof, effecting the desired commingling of the fuel and air. Access doors 34 permit inspection of any of the burners without interrupting the operation of the remaining burners. Lighting ports 35 are arranged adjacent the access doors.

In lieu of either or both of the fuel burner constructions illustrated in Figs. 1-3, I may employ the fuel burner construction illustrated in Figs. 4 and 5. The fuel burner construction therein illustrated is generally similar in construction to the fluid fuel burner previously described, differing mainly by the location of the nozzle tip discharge slots adjacent to and in longitudinal arrangement with fuel dispersal members 41 carried on the outer sides of the tubes 12. In this construction, gaseous fuel is supplied through pipes 42, and pulverized fuel and primary air through conduits 43 arranged intermediate the pipes 42. Air for combustion is supplied to the intertube spaces from a casing 44 divided into separate chambers 44^a surrounding the nozzle tip members. In operation, the fuels are discharged through the slotted discharge openings of the tip members impacting on corresponding members 41 and spilling over into the intertube spaces, through which streams of air from the corresponding chambers 44^a are continuously passed. An intimate mixture of fuel and air from each burner is thereby effected before entrance to the furnace chamber. The fuel burner construction illustrated in Fig. 5 is adapted for use in the location shown in Fig. 1 or preferably in a vertical position in a horizontally inclined arched portion of the furnace as illustrated in Fig. 4.

The various fuel burner constructions illustrated are substantially similar in their capacity for efficient operation at high ratings, for effecting an intimate mixture of fuel and air in proportions suitable for short flame combustion, and for discharging a fuel and air mixture in a stream concentrated in substantially the same vertical

plane throughout its travel through the furnace chamber.

In the operation of the steam boiler illustrated in Fig. 1 with pulverized fuel and blast furnace gas, for example, the proportions in which the fuels are used will be primarily dependent upon their relative costs and availability. Ordinarily, the cheaper fuel will be utilized for the production of a major portion of the power requirements, and the more expensive fuel utilized when the supply of the cheaper fuel is insufficient. In this type of furnace, there may be considerable periods in which both fuels are simultaneously burned, and the present construction is particularly adapted for the maintenance of efficient combustion and desirable furnace conditions during such periods. The supplies of combustion air to the different burner air casings are regulated to deliver the amount necessary to secure a thorough mixing of the fuel and air before or adjacent the point of entry, and complete combustion of the fuel in the furnace. The pulverized fuel and air mixture will enter the furnace in a series of horizontally spaced substantially parallel streams, while the fluid fuel and air mixture will enter the furnace in streams intermediate the streams of the pulverized fuel and air mixture. Due to the construction and arrangement of the fuel burner provisions, little or no interference will occur in the furnace between adjacent streams, and each stream will undergo combustion substantially independently of the combustion conditions occurring in the neighboring streams. The air/fuel ratios and velocities of discharge of the streams of fuel are preferably regulated to initiate combustion at substantially the same distance from the points of entry into the furnace, whereby mixing of the products of combustion from one stream with unburned particles of fuel in a neighboring stream will be minimized. The side-by-side relation of the different fuel and air streams maintained in the furnace permits all of the streams to have the same length of travel in the furnace, providing a maximum utilization of the furnace volume for any given size furnace, and a reduction in size as compared to prior furnaces of this type and capacity.

The described arrangement of the fuel burners and burner ports is particularly advantageous when a portion of the series is not being utilized. When, for example, only the fluid fuel ports 15^b are in operation, the pulverized fuel burner means positioned therebetween will be adequately protected from radiant heat due to their location in what will be then the coolest portion of the furnace. Moreover, with the present arrangement, substantially the same furnace conditions will be present when the fuels are burned separately, obviating the necessity of providing for different conditions which occur when the burners are differently located as has been heretofore the practice, and minimizing wall maintenance problems.

I claim:

1. In apparatus having walls enclosing a furnace chamber, an elongated air box arranged externally along one of said walls, partitions dividing said box into a series of side-by-side compartments each having an air inlet opening therein, a row of fuel burner ports formed in said wall and providing communication between said compartments and said furnace chamber, means in spaced compartments for projecting a combustible mixture of a fuel and air through the correspond-

ing burner ports in separate streams traveling in substantially parallel flow paths throughout said furnace chamber, means in compartments intermediate said spaced compartments for projecting a combustible mixture of a second fuel and air through the corresponding burner ports in separate streams traveling in substantially parallel flow paths throughout said furnace chamber and intermediate and parallel to the streams of said first fuel and air mixture, and means for controlling the supply of air to each of said compartments.

2. In apparatus having walls enclosing a furnace chamber, an elongated air box arranged externally along one of said walls, partitions dividing said box into a series of side-by-side compartments each having an air inlet opening therein, a row of fuel burner ports formed in said wall and providing communication between said compartments and said furnace chamber, means in alternate compartments for projecting a combustible mixture of a fuel and air through alternate burner ports in separate streams traveling in substantially parallel flow paths throughout said furnace chamber, means in the intermediate compartments for projecting a combustible mixture of a second fuel and air through alternate burner ports in separate streams traveling in substantially parallel flow paths throughout said furnace chamber and intermediate and parallel to the streams of said first fuel and air mixture, and means for controlling the supply of air to each of said compartments.

3. In apparatus having walls enclosing a furnace chamber, an elongated air box arranged externally along one of said walls, partitions dividing said box into a series of side-by-side compartments each having an air inlet opening therein, a row of fuel burner ports formed in said wall and providing communication between said compartments and said furnace chamber, means

in alternate compartments for projecting a combustible mixture of pulverized fuel and air through alternate burner ports in separate streams traveling in substantially parallel flow paths throughout said furnace chamber, means in the intermediate compartments for projecting a combustible mixture of gaseous fuel and air through alternate burner ports in separate streams traveling in substantially parallel flow paths throughout said furnace chamber and intermediate and parallel to the streams of said pulverized fuel and air mixture, spaced cooling fluid tubes extending across the burner ports communicating with said intermediate compartments, and means for independently controlling the supply of air to each of said compartments.

4. In apparatus having walls enclosing a furnace chamber, spaced cooling fluid tubes lining said walls, an elongated air box externally mounted on one of said fluid cooled walls, partitions dividing said box into a series of side-by-side compartments each having an air inlet opening therein, a row of fuel burner ports formed in said wall and providing communication through the corresponding inter-tube spaces between said compartments and said furnace chamber, means in alternate compartments for projecting a combustible mixture of pulverized fuel and air through alternate burner ports in separate streams traveling in substantially parallel flow paths throughout said furnace chamber, means in the intermediate compartments for projecting a combustible mixture of gaseous fuel and air through alternate burner ports in separate streams traveling in substantially parallel flow paths throughout said furnace chamber and intermediate and parallel to the streams of said pulverized fuel and air mixture, and means for independently controlling the supply of air to each of said compartments.

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