

Aug. 13, 1935.

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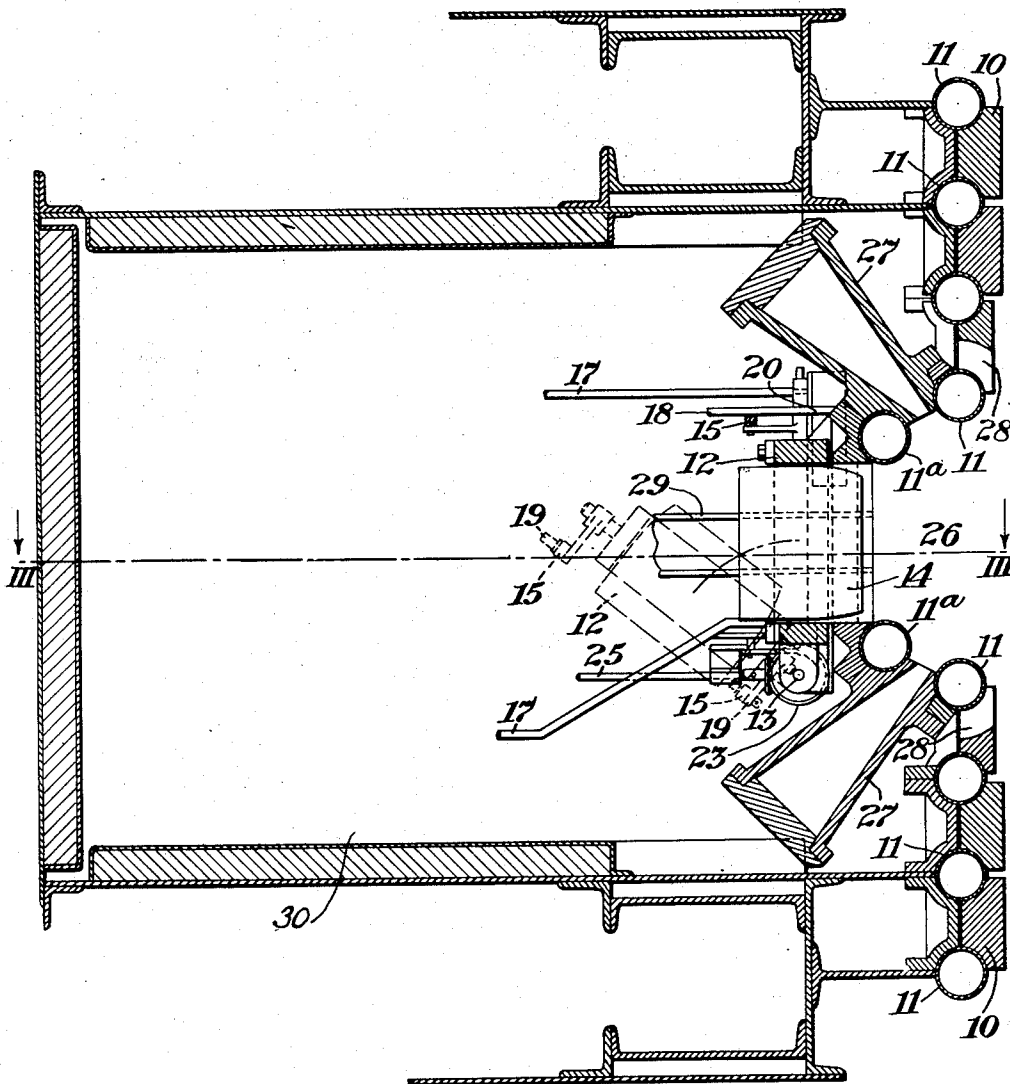
2,011,026

FURNACE

Filed Aug. 3, 1931

4 Sheets-Sheet 1

Fig. 1



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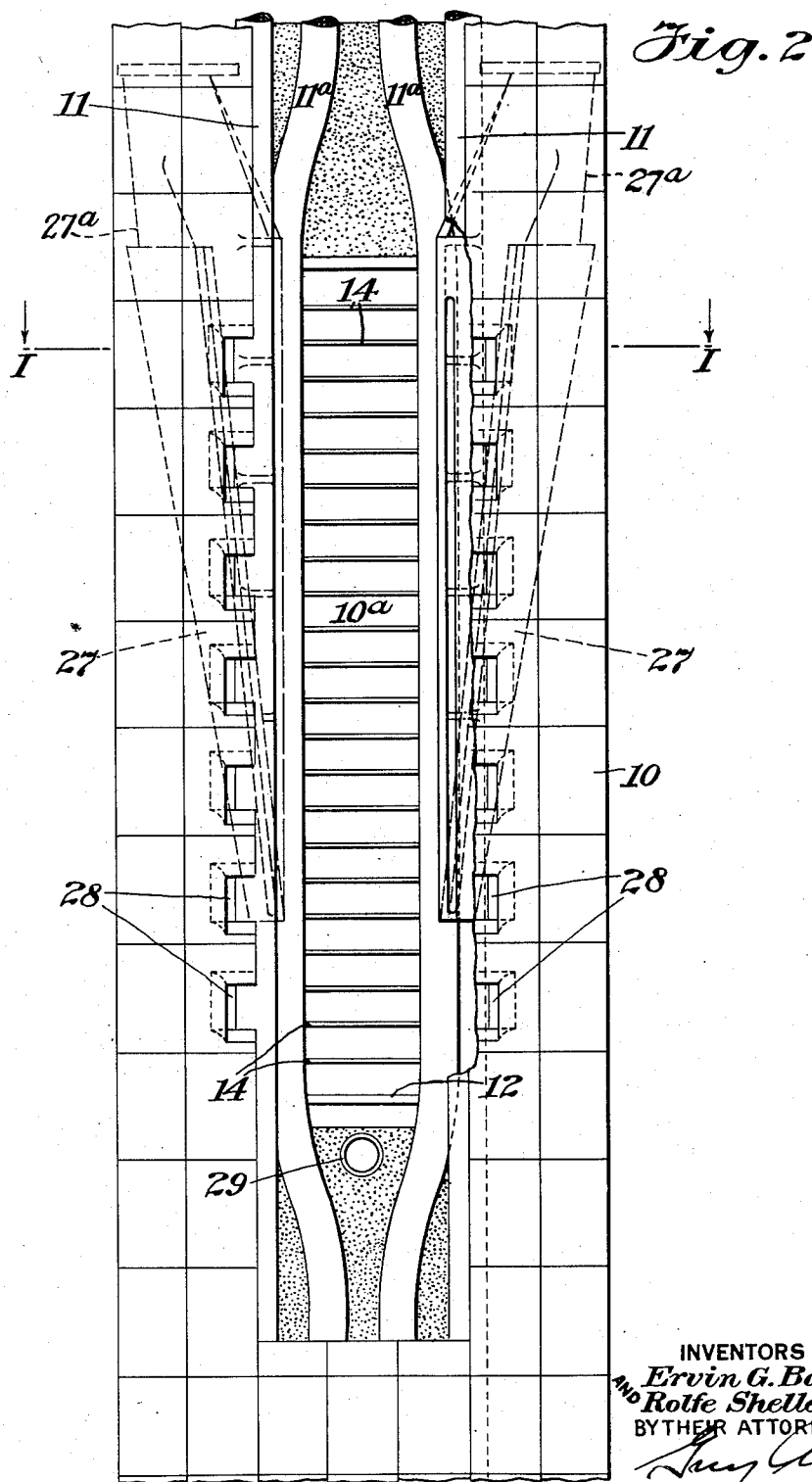
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2,011,026

FURNACE

Filed Aug. 3, 1931

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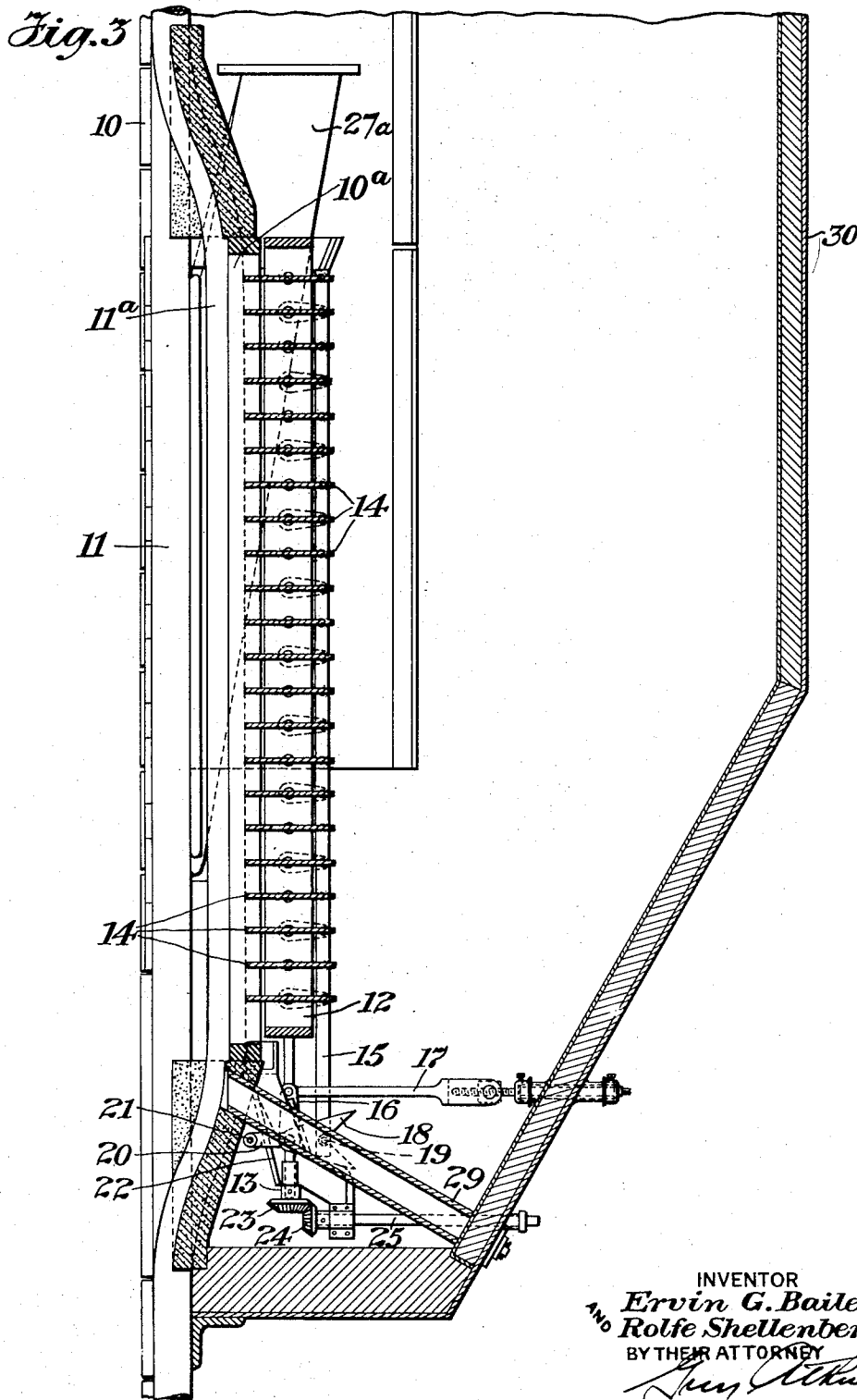
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2,011,026

FURNACE

Filed Aug. 3, 1931

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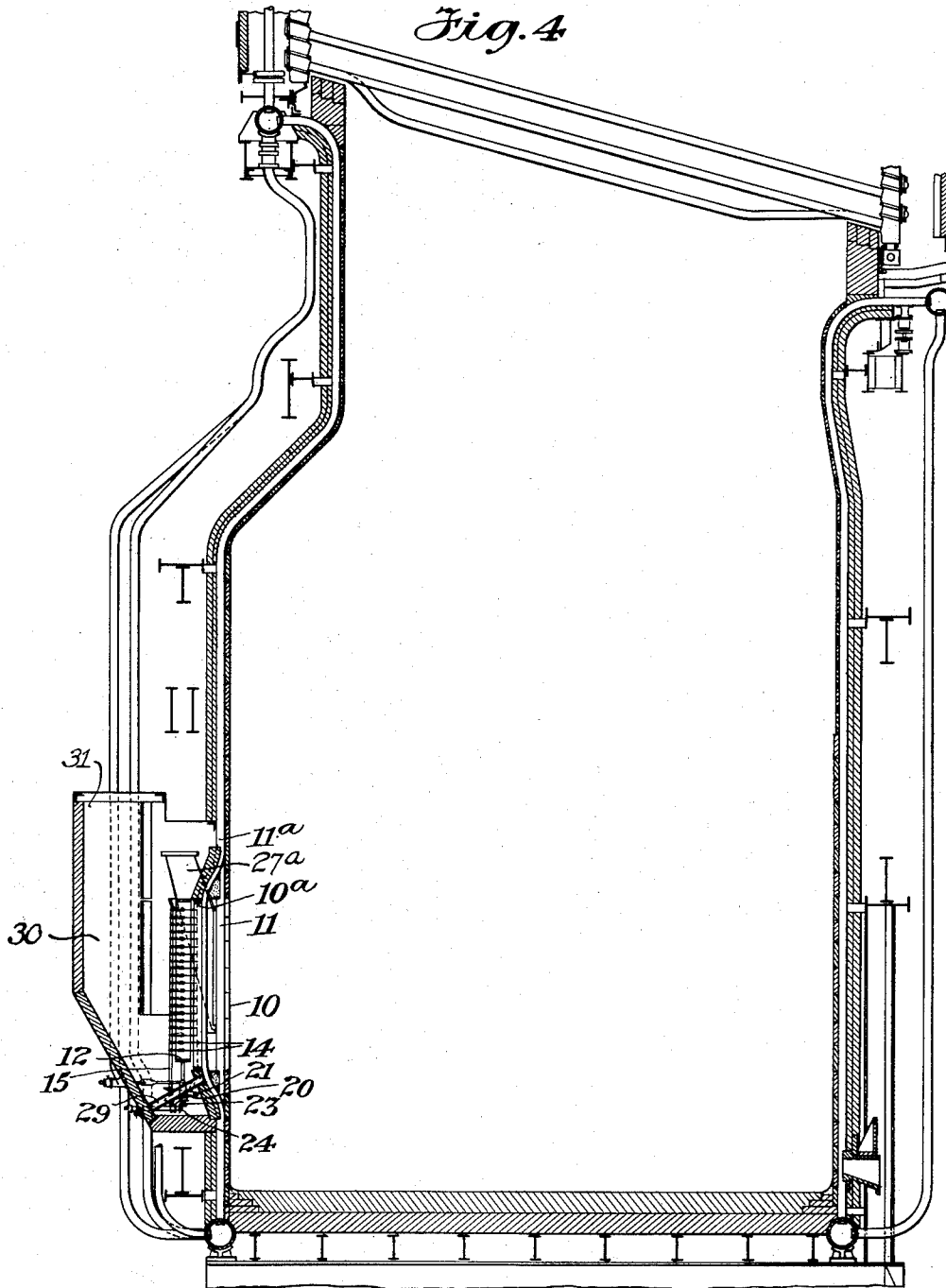
2,011,026

FURNACE

Filed Aug. 3, 1931

4 Sheets-Sheet 4

Fig. 4



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UNITED STATES PATENT OFFICE

2,011,026

FURNACE

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Application August 3, 1931, Serial No. 554,716

11 Claims. (Cl. 110—104)

Our invention relates to a furnace, and particularly a furnace adapted to burn fuel in fluid form, or in finely comminuted form carried by a fluid. The invention is especially useful in connection with a furnace in which pulverized coal is burned, although its use is not limited to such a furnace.

One object of the invention is to provide a construction by means of which the fuel in fluid form may be thoroughly mixed with air in order to permit rapid and thorough combustion. Another object is to provide an arrangement of primary air and fuel nozzles together with secondary air-ports which will give efficient combustion, and at the same time permit ready access for inspection and cleaning of the primary air and fuel nozzles. Another object is the provision of an apparatus wherein the fuel and air-ports will be cooled by association with cooling tubes in the furnace wall. A further object is the provision of a cooled recess in the furnace wall which will protect the ports from the full heat of the furnace. Other objects will appear upon consideration of this specification.

We have found that a most efficient nozzle and port arrangement may be provided, that thorough mixing may be brought about, and that protection may effectively be given the nozzles and ports by means of a construction, one form of which is illustrated in the accompanying drawings, wherein—

Figure 1 is a horizontal cross section of a part of a water cooled furnace wall embodying the invention, the section being taken on the line I—I of Fig. 2,

Fig. 2 is an elevation of the wall illustrated in Figure 1 viewed from within the furnace, with part of the furnace wall broken away,

Fig. 3 is a section on the line III—III of Figure 1, and

Fig. 4 is a vertical section through a boiler furnace constructed in accordance with the invention.

Some difficulty has been experienced in designing an effective form of nozzle and port arrangement for a furnace and in protecting the nozzles and ports opening into a furnace in which a high temperature is generated. Difficulty has also been experienced in securing a short intense flame and completing combustion of a fuel within a small furnace volume—for instance, entirely below the boiler tubes in a boiler furnace. In order to accomplish this last-named result, the stream of fuel must be subdivided or flattened in order that a large surface of the fuel may be

brought quickly in contact with secondary air supplied to the furnace, and combustion thus completed during a short length of travel by the fuel within the furnace.

In the embodiment of the invention illustrated by way of example in the drawings, there is shown a furnace wall 10 comprising water tubes 11 and a port 10^a for admitting or projecting air for combustion through the wall 10 into the furnace. The air port is formed between a pair of outwardly and laterally bent tubes 11^a, and as here shown, is defined by a rectangular frame attached to and cooled by the tubes 11^a.

A regulator is associated with the port 10^a and comprises, in the embodiment illustrated, a rim 12 and louvre dampers 14 pivoted in the rim. The rim 12 of the regulator is shielded by the port frame and by the tubes 11^a upon which the port frame is carried. Nozzles 27 which may be fuel nozzles, are provided on either side of the port 10^a and the regulator therein. The regulator with its louvre dampers 14 is associated with the port in such a way as to control the amount and direction of the air supply to the furnace.

Means are provided for removing the regulator from the furnace to give access thereto. As here shown, a pivot 13 is provided about which the rim 12 is adapted to swing outwardly away from the furnace wall carrying the louvre dampers 14 with it. Thus, easy access can be had through the port 10^a to the furnace and to associated nozzles (for instance the nozzles 27) for dislodging any deposit which may have coked on or adjacent the fuel nozzles, as well as for other purposes. In the past the problem of securing access to a furnace has been an exceedingly difficult one to solve. By pivoting the regulator, and affording access through the air-port, as here described, a very satisfactory solution is provided for this problem.

The louvre dampers 14 may be adjusted in any known or convenient manner. We prefer to adjust them by means of a pair of connecting rods 15, one of which is shown in Fig. 3. We also prefer to connect alternate dampers to each of these connecting rods so that by operating one connecting rod, alternate dampers may be moved, and by operating the other connecting rod the dampers not moved by the first may have their positions changed. By operating both connecting rods at the same time and in the same sense, it is possible to direct the fluid entering the furnace upwardly, downwardly or horizontally, and thereby to influence the flame direction toward or away from the floor of the furnace. By

allowing one set of dampers to stand in horizontal position, and by moving the other set into vertical position, the stream of secondary air may be substantially shut off. An intermediate position of the second set of dampers will reduce the amount of the air supply to the furnace.

Each connecting rod 15 is preferably operated by a bell crank lever 16, which may be actuated by a bar 17, capable of being moved longitudinally from without the furnace. In order that the regulator (that is to say, the rim 12 and the louvre dampers 14 pivoted therein) may be swung away from its active position, which has previously been described, the bell crank lever 16 has a fish-tail 18 thereon with a notch in extension of the V therein with which a pin 19 on the connecting rod engages when the nozzle is moved into place. Disengagement of the pin and fish-tail is effected as the rim 12 is swung outwardly away from the furnace. An arm 20 is provided on the bell crank lever extending in a direction opposite to that in which the fish-tail extends. A lug 21 is provided on this arm 20 which comes in contact with a stationary member 22 on the furnace wall and acts as a stop to prevent the fish-tail from swinging into a position wherein the pin 19 will not engage therewith.

By having two bell crank levers pivoted to the furnace, each provided with a fish-tail for engaging a pin 19 on one of the connecting rods 15, it is possible to operate both sets of dampers, as described above, and yet to swing the regulator into and out of operating position. The means here shown for swinging the regulator about its pivot 13 comprises a bevel wheel 23 on a vertical shaft, which acts as the pivot 13. A second bevel wheel 24 coacts with the first-named bevel wheel 23, and an operating shaft 25 carries the bevel wheel 24 and extends outside of the furnace.

As shown, the displacement of the tubes 11^a from the line of the furnace wall tubes 11 forms a recess 26 in the furnace wall into which the air port 10^a opens. A pair of fuel nozzles 27 also discharge through the recess 26 at opposite sides of the air port and between adjacent tubes 11 and 11^a, the ends of the nozzles contacting with and being cooled by the corresponding tubes 11 and 11^a.

The fuel nozzles 27 are disposed at an angle to the regulator and arranged to project streams of fluid fuel against the air stream projected into the furnace through the port 10^a, thereby to mix the several streams. Clearly the fuel nozzles may be fed from a single source or from separate sources through the conduits 27^a.

It will be seen that by means of the present construction, the stream of fuel, for instance, pulverized coal and carrying air, is projected into and across the stream of entering secondary air. A thorough mixing of the two streams is thereby accomplished and rapid combustion with a short flame results. It may also be remarked that the column of secondary air enters the furnace under lower pressure than do the jets of primary air and fuel, and the difference in velocity is conducive to better mixing. Furthermore, the flattened form of fuel nozzle illustrated causes a greater fuel surface to be exposed to the stream of secondary air.

Auxiliary air may be admitted to the furnace, if desired, through auxiliary air-ports 28, which are here shown as extending through the furnace wall 10 on opposite sides of the fuel nozzles 27 from the secondary air-port 10^a already described. Secondary air is supplied to the air ports 10^a and

28 from an air box 30, opposite side walls of which are connected to and extend outwardly from the wall 10 at the sides of the air ports 28 opposite the burner nozzles. The air box 30 receives a supply of air from a suitable source through an inlet 31 at the upper end thereof.

A pilot lighter may be provided in the form of a tube 29 for carrying a combustible into the furnace.

The invention provides simple and effective means for both cooling and protecting the ports and nozzles employed in connection with a furnace. Direct cooling of the nozzles and ports is accomplished by associating them with wall cooling tubes. Furthermore, the entrance of the fuel nozzles into the furnace is behind tubes 11, by which they are protected. Indirect cooling is accomplished by positioning the nozzles and ports within a water cooled recess in the furnace wall.

Although it has been indicated that the removable element is employed for admission of secondary air into the furnace, whereas the fixed nozzles have been referred to as primary air and coal nozzles, it must be evident that this condition might be reversed, the resulting construction still coming within the purview of the present invention. Furthermore, the shape and exact positioning and construction of the ports and nozzles specifically described, are not to be taken as limiting the invention. Still further, the fuel employed need not necessarily be pulverized coal, but may clearly be gas, vapor, oil or other fuel in fluid form. Obviously, other forms of the invention coming within the proper scope of the appended claims will suggest themselves to those skilled in the art in view of the detailed description given above. With this understanding—

We claim:

1. A furnace wall comprising water tubes, said wall having means forming a port therein between two of said tubes, and a regulator associated with the port in said wall for admitting a fluid through said wall, said regulator being associated with said tubes and cooled thereby, in combination with a pivot about which said regulator is adapted to swing outwardly away from said furnace wall.

2. A furnace wall comprising water tubes, said wall having means forming a port therein, and an air regulator associated with the port in said wall for admitting air through said wall, said regulator being associated with said tubes and cooled thereby, said regulator having louvre dampers pivoted therein, in combination with a pivot about which said regulator is adapted to swing away from the furnace wall to give access to the furnace, substantially as described.

3. A furnace wall comprising water tubes, certain of said tubes being displaced outwardly from the line of the furnace wall to form a recess in said wall, means forming a port for admitting air through said wall associated with and cooled by a plurality of said displaced tubes, and two fuel nozzles each associated with a displaced tube and cooled thereby, said fuel nozzles standing at an angle to each other on opposite sides of said port.

4. A furnace wall comprising water tubes, certain of said tubes being displaced outwardly from the line of the furnace wall to form a recess in said wall, means forming a port for admitting air through said wall associated with and cooled by a plurality of said displaced tubes, and two fuel nozzles each associated with a displaced tube and cooled thereby, said fuel nozzles standing at

an angle to each other on opposite sides of said port, in combination with auxiliary air-ports in said wall beyond said displaced tubes and adjacent said fuel nozzles.

5 5. A furnace wall comprising water tubes, certain of said tubes being displaced outwardly from the line of the furnace wall to form a recess in said wall, a regulator for admitting air through said wall associated with and cooled by
10 a plurality of said displaced tubes, and two fuel nozzles each associated with a displaced tube and cooled thereby, said fuel nozzles standing at an angle to each other and to said air regulator, in combination with a pivot for said air regulator
15 about which said air regulator is adapted to swing away from the furnace wall.

6. A furnace wall comprising water tubes, certain of said tubes being displaced outwardly from the line of the furnace wall to form a recess
20 in said wall, means forming a port for admitting air through said wall associated with and cooled by a plurality of said displaced tubes, and louvre dampers controlling the air supply through said port, in combination with a pivot about which
25 said air dampers are adapted to swing away from said furnace wall, and two fuel nozzles, each associated with a displaced tube and a tube which is not displaced and cooled by said tubes, said fuel nozzles standing on opposite sides of said
30 port and at an angle to each other.

7. In a furnace wall having a fuel burner opening formed therein, a pair of angularly arranged fuel burner nozzles arranged to discharge converging streams of fuel through said wall opening, means forming an air port between said
35 burner nozzles, dampers normally positioned in and controlling the passage of air through said port, and means for moving said dampers out of their operative position to permit access to the discharge ends of said burner nozzles through
40 said air port.

8. In a furnace wall having a fuel burner opening formed therein, a fuel burner nozzle arranged to discharge through said wall opening, means
45 forming an air port adjacent said burner nozzle, a series of pivoted dampers normally positioned

in and controlling the passage of air through said port, means for independently operating separate sets of alternate dampers, and means for moving said dampers out of their operative position to permit access to the discharge end of said
5 burner nozzle through said air port.

9. In a furnace wall having a series of horizontally spaced vertical cooling tubes positioned therein, means forming a vertically elongated air port opening to the furnace between two of said
10 wall tubes, a pair of fuel burner nozzles at opposite sides of said air port and having vertically elongated discharge ends positioned between different pairs of said wall tubes, said burner nozzles being relatively arranged to discharge converging
15 fuel streams toward the stream of air passing through said air port.

10. In a furnace wall having a series of spaced cooling tubes positioned therein, means forming an elongated air port opening to the furnace between two of said wall tubes, a pair of fuel burner
20 nozzles at opposite sides of said air port and having elongated discharge ends positioned between different pairs of said wall tubes, said burner nozzles being relatively arranged to discharge converging fuel streams toward the stream of air, and air ports at the opposite sides
25 of said burner nozzles from said central air port and arranged to direct streams of air into the furnace at the outer sides of said fuel streams.

11. In a furnace wall having a series of horizontally spaced vertical cooling tubes positioned therein, means forming a vertically elongated air port opening to the furnace between two of said
30 wall tubes, a pair of fuel burner nozzles at opposite sides of said air port and having vertically elongated discharge ends positioned between different pairs of said wall tubes, said burner nozzles being relatively arranged to discharge converging fuel streams, and a series of air ports
35 at the opposite sides of said burner nozzles from said central air port and arranged to direct streams of air into the furnace at the outer sides of said fuel streams.

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